



9th European Symposium on
**Paediatric
Cochlear
Implantation**
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Mr. Lech Kaczynski
President of the Republic of Poland

ABSTRACT BOOK

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9th European Symposium on
Paediatric
Cochlear
Implantation

WARSAW

POLAND



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Opening Lectures

Education and rehabilitation of children with cochlear implants: a multidisciplinary task

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KIDS, Royal School for the Deaf, Hasselt, Belgium; ONICI, Independent Information, Centre on Cochlear Implantation, Zonhoven, Belgium

It is the first time in the history of the European Symposia on Paediatric Cochlear Implantation, that the opening lecture is on the topic of 'Education and Rehabilitation'. This means that more and more professionals who are involved in cochlear implants (and especially the organisers of this conference) are aware of the importance of good rehabilitation and education for deaf children after they have received a cochlear implant. It is not just technology, surgery and fitting, but there is a lot of work to do after the implantation. Or as Sue Archbold (The Ear Foundation, UK) always says: "what surgeons start, educators have to finish". As a Belgian psychologist, working in the education of deaf children for more than 25 years, I am proud to say that Flanders, the Northern part of Belgium, was in 1998, the first region in Europe to implement a Universal Neonatal Hearing Screening (UNHS) programme combined with a further diagnostic and rehabilitation-guidance programme. Since that time a lot of literature has been published (especially by Yoshinaga-Itano, Missouri, USA) which shows us that UNHS is very important for the future development of these children. Children who have been screened early and fitted with hearing aids before the age of 6 months, reach a higher expressive and receptive language level, their speech is more intelligible, they have higher auditory capacities, fewer social-emotional problems, their parents have better attachment, they become better readers and more and more of these children are going to a mainstreamed educational setting. Following the implementation of UNHS and the earlier identification and diagnosis of deafness, cochlear implantation in the very early years of life has become a reality. In Belgium we have found that the median age of implantation has decreased from 41 months (1995-1999) to 18 months (2000-2008) and we all know that age of implantation has a big influence on the outcomes. But this also means that parents (and 95% are hearing) have to deal with decisions at a time when they are at their most vulnerable, and before they have any knowledge of the impact of deafness. At such a time, cochlear implantation may be seen as a quick 'fix', which will solve the hearing problem for ever. At this very young age, we often don't know if the child will have additional needs or not. That's why parents require up to date information about CI in order to make an informed decision. Available studies also indicate that, despite a high rate of spoken language achievement by many of these children, some do not acquire the skills for fluent use of speech for communication. We need to specifically analyse profiles of these children to see whether aspects of their intervention programmes need to be changed to give them better support. And, faced anew with admonitions that signing will interfere with learning to speak, we need to focus research on the perceptual as well as the sensory aspects of processing auditory and visual language. Although it is clear that children with cochlear implants need much exposure to spoken language in order to acquire it, it is equally obvious that early communication both with hearing as well as deaf infants and toddlers is gestural in form. Thus early multi-modal communication seems to be the most natural approach in the early years. What the role is of sign (language) at later ages is not yet clear. It can even be different from child to child and from age to age. So we need more objective studies on a larger number of children. Despite these difficulties, outcomes in the population of hearing impaired and deaf children have changed dramatically in countries where Universal Hearing Screening, digital hearing aids, cochlear implants and early multi-disciplinary support, are available. We see now that most of these children can acquire intelligible spoken language and choose spoken language as their main means of communication to access education, because they go to mainstream schools in larger proportions, and fewer to schools for the deaf. But there is also evidence that a number of successful CI users with intelligible spoken language are opting to go to a special school (oral) where they also use sign language for communication with their peers. These young people were not diagnosed through UNHS of course, but can communicate well orally. It seems that they are choosing to 'add in' sign and code switch depending on who they are communicating with; looking for their identity? Stimulating both ears to provide auditory information is a logical step in the treatment of bilateral profound hearing loss in order to provide the potential benefits of binaural hearing. This may be made possible through bilateral hearing stimulation by either bilateral acoustic hearing aids, combination of a unilaterally implanted CI and a hearing aid in the opposite ear (bimodal stimulation) or by two cochlear implants (bilateral electrical stimulation). There is a lot of research going on looking at the benefits of two cochlear implants; searching for the best way to fit children with two cochlear implants and how to monitor the effect of bilateral implantation. But little is known about how to train children's binaural hearing or is it developing automatically? Do we

know how we have to support and guide these children in daily practice, in auditory training, in the educational setting? At KIDS, Royal School for the Deaf in Hasselt-Belgium, we give bilateral implanted children a specialised auditory training and support. How we do this, will be explained during the presentation. Even the fact that a large group of these deaf children will be able to learn incidentally (Robbins, 2003) needs to be handled with caution. This can only be the case if the necessary prerequisites are met to allow this learning process to take place. Besides attention to the personal qualities of individual educators who are required to show the skill to anticipate and tune in to the changing communication modes of their child, one also needs to focus on the acoustic quality of the living environment. (Boothroyd, 2004). All this is a big change for the educational services. They have to adapt their way of working and they must ensure that their educational staff have the skills to meet the challenges: to be flexible, continually updated with the technology and changing expectations (ongoing professional training), to provide an environment which will utilise the useful hearing whilst meeting the linguistic and curricular needs of the children, to meet the psycho-social needs of this group as they grow through adolescence and to work with other professionals. The surgical intervention of cochlear implantation has also brought together the worlds of medicine and education, with implications that were not foreseen by surgeons and teachers or therapists. Sometimes, implants can work too well, so people think it is a hearing child, which needs the same education as other hearing children. Of course this is not the case. There are also children who do not do as well as predicted. It is likely that these children have other difficulties not identifiable prior to implantation and we also have to detect these additional problems as soon as possible, so we can give optimal support to the child and family as soon as possible. And we also have a growing group of young people with cochlear implants who, during adolescence, face many challenges. They may question the value of the implant system, the decision made by their parents, and need support during this time of transition to adulthood. So assessment and management of children with cochlear implants necessitates a multidisciplinary team; which includes surgeons, audiological scientists, teachers of the deaf, speech and language therapists, social workers, psychologists; but also deaf (CI) adults and other families of deaf children (with and without implants). Because 1/3 of the deaf population have additional needs, and as we implant younger and younger, we cannot know all these additional needs at the time of implantation, so we have to continue to assess and monitor these children in a multidisciplinary manner. Not only by looking at their auditory, speech, language and school curriculum development, but also by looking at their cognitive and social emotional development. It has been essential to develop outcome measures from implantation to ensure that information is available for parents, professionals and purchasers of the service. It is important that regular evaluation is carried out of children in order to: monitor the functioning of the device, monitor progress in early communication and language skills, determine whether there are no other learning difficulties present, provide information to parents, professionals and purchasers and to refine practice. We see that a lot of material is already available in English, but this is still lacking in other less common languages. Now and looking ahead, the challenge for deaf education is also to embrace the diversity of this population and then to appropriately address the specific needs of each child in his/her family in that specific country. The service should be delivered to meet each child's individual's needs, abilities, expectations and attitudes. This is particularly relevant with children whose home language is not 'English' or those who have additional needs (30-40%). With growing numbers of children being implanted, increasingly young and with increasing complexity, and growing numbers becoming teenagers with cochlear implants, there is still much to learn. We continue to consider the long-term outcomes in terms of reliability, attainments and employment prospects. So, there still remain, many challenges for the future.

Treatment of partial deafness

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Modern methods of augmentation of hearing in persons with different types of impairment are based upon newest scientific achievements and advanced technology. The basis for contemporary understanding of a particular hearing problem is defining a new disease entity named Partial Deafness (PD). It includes cases of hearing deficit observed at various frequencies. Diverse etiology, either congenital or acquired, makes this entity non-uniform in its nature. Nevertheless, in every patient diagnosed with partial deafness normal or near normal hearing exists at low and mid frequency range. Partial deafness has nowadays several indications for effective therapy. New strategy for partial deafness treatment (PDT) is a therapeutic answer for all possible variations of hearing impairment under this definition and reflects present knowledge and technical achievements from different centers. The goal of partial deafness treatment is to provide free communication with the outside world with the optimal solution for those with this kind of hearing deficit. Treatment of partial deafness includes four possible strategies: A. Acoustic stimulation (AS) with hearing aids; B. Electrical complement of usable existing hearing (EC)

with cochlear implants; C. Electric and acoustic stimulation (EAS) provided by hybrid devices: CI and HA; D. Electrical stimulation - (ES) for those with little residual hearing. The senior author presents new strategy for treatment of partial deafness developed based upon more than 2500 cochlear implantations over 18 years of experience, showing results of long time observations in particular modes of therapy.

Keynote Lectures

A02

Cochlear implant – a bridge over troubled water

Coninx F.

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The education of deaf children is a challenging task for parents as well as for professionals. Over centuries already, different educational approaches and methods were developed and implemented. Often this was discussed in a very controversial way, especially regarding the use of spoken and/or sign language. One author described it as “The two hundred years’ war in deaf education”. But even within one communication modality, for instance spoken language, different methods have been discussed: natural and conversational learning, structured learning in therapy, early use of writing, etc. When Cochlear Implants entered this field it was another element contributing to even more controversy and confrontation. This was especially obvious in the first one or two decades after the introduction of CI. However, CI seems to be building bridges now: it enables virtually all children to hear, not at a normal level but significantly more and better than without CI. By that, children have much better opportunities to develop speech and spoken language, literacy and communication. Cochlear Implant is building bridges between silence and sound, between deafness and hearing and - more and more - between deaf and hearing communities. Everyone involved in the multidisciplinary field of the education of young deaf children and cochlear implantation has to deal with these bridging issues, and stay aware of the past and present status of “the water being troubled”.

B10

Bilateral cochlear implantation, the start and the results after 16 years

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Useful bilateral cochlear implantation started 1996 when a pharmacist, who became completely deaf on both ears progressively, asked for an implant into his second ear because the first implanted ear was so much better than the second ear with only a conventional hearing aid. After intensive discussions in the team and informing the patient that a bilateral implantation had so far not led to better hearing the second ear was implanted. The patients hearing was more improved than optimistically hoped for. The pharmacist and his implanters were happy. This news spread fast and the positive effects of bilateral implantation could be confirmed with many patients and different surgeons and was internationally and later nationally accepted. Bilateral cochlear implantation proved beneficial especially in deaf borne children. An impressive speed of hearing and communication competence developed when the implantations were performed in the age of 1 and 2 years. These children, without multiple handicaps, could acquire a hearing like their age mates when they entered normal schools. But also adults with more than 40 years of postlingual deafness could regain near normal hearing abilities. The results were obtained with implants carrying an electrode of 30 mm length providing the possibility to excite low frequency neurons selectively. This is obviously an advantage. In a comparative study 193 implantees with different devices responded to a questionnaire to be answered anonymously asking for their communication electronics: hearing mainly with CI alone or with additional help like optical cues, FM-sets, amplifiers or other tools. In the two groups of the main CI-providers the percentage of bilaterals was similar. In one collective the CI alone was 62%, in the other 83%. The difference showed to be statistically significant. The intervals of confidence of 95% did not overlap. The 83% group was the one with the 30 mm electrode. In a comparative study 193 implantees with different devices responded to a questionnaire to be answered anonymously asking for their communication electronics: hearing mainly with CI alone or with additional help like optical cues, FM-sets, amplifiers or other tools. In the two groups of the main CI-providers the percentage of bilaterals was similar. In one collective the CI alone was 62%, in the other 83%. The difference showed to be statistically significant. The intervals of confidence of 95% did not overlap. The 83% group was the one with the 30 mm electrode.

C12

Implantable hearing aid for the mechanical stimulation of the inner ear – a future addition to cochlear implants?

Lenarz T.

Department of Otolaryngology Medical University of Hannover, Germany

Mechanical stimulation of the cochlear has been a subject since decades. Several devices have been developed and achieve this goal circumventing the middle ear partially or totally. Recent advances in technology and the increasing medical experience have shown that these active middle ear implants are able to provide a better sound quality and a special value in patients with chronic outer and middle ear disease. The direct stimulation of the inner ear at the round window and / or footplate offers new treatment possibilities for patients with severe to profound mixed hearing loss. Current research targets towards a more efficient direct mechanical stimulation of the cochlear using intracochlear approaches such as stimulation through the round or oval window. Future developments will also use optic stimulation of the cochlear for a more localized and frequency specific stimulation. Functional restoration of the cochlear amplifier is in the main focus of current experimental research. The combined electro-mechanical or electro-optical stimulation will allow a more focus in individualized treatment of inner ear disorders based on the pathophysiology of the hearing loss.

A08

Partial Deafness Cochlear Implantation (PDCI) and Electro-Acoustic Stimulation (EAS)

Wilson B.S. on behalf of the investigator teams

Co-Director, Duke Hearing Center, Duke University Medical Center, Durham, NC, USA Adjunct Professor, Dept. of Surgery, Duke University Medical Center, Durham, NC, USA, Chief Strategy Advisor, MED-EL Medical Electronics GmbH, Innsbruck, Austria, Overseas Expert, Marie Curie project, International Center of Hearing and Speech, Senior Fellow Emeritus, RTI International, Research Triangle Park, NC, USA

The purposes of this lecture are to 1. review briefly the experience to date with combined electric and acoustic stimulation of the auditory system, for patients with some residual, low-frequency hearing; 2. describe the further results that have been obtained with the combination for patients with higher levels of residual hearing at the low frequencies, termed “partial deafness cochlear implantation” and pioneered by the team in Warsaw; and 3. present new results on the relative benefits of cochlear implantation according to the level of remaining hearing. In broad terms, PDCI and combined EAS have produced large improvements in the speech reception abilities of the treated patients, compared with electrical stimulation alone or acoustic stimulation alone. The benefits are especially large for recognition of speech presented in competition with noise. Indeed, the immunity to noise interference provided by PDCI and combined EAS is remarkable. In addition, reception of musical sounds and identification of melodies are greatly improved with the inclusion of the acoustic stimulus. The relative benefits of cochlear implantation according to the level of remaining hearing were determined through a retrospective chart study of 170 patients culled from the archives of charts at the International Center of Hearing and Speech in Kajetany, Poland. The outcome measures included recognition of the Pruszewicz monosyllabic words presented in quiet and in competition with noise at the speech-to-noise ratio of +10dB, and the conditions included recognition of the words with the hearing aid only and with the cochlear implant plus the hearing aid (CI + HA). A surprising aspect of the results is that patients with high levels of residual hearing (PDCI levels) receive benefits from cochlear implantation (CI + HA) that are at least as great as the benefits received by patients with lower levels of residual hearing. In addition, the highest scores are obtained by the patients with PDCI levels of hearing. These findings are counter to the conventional wisdom that patients with such good residual hearing can be harmed by cochlear implantation and suggest that criteria for implant candidacy should be relaxed further so that many more patients can benefit from the procedure. In all, PDCI and combined EAS are highly effective treatments, and the benefits are especially large for patients with PDCI levels of residual hearing. Acknowledgment: Parts of this work were supported by the United States National Institutes of Health and by the Marie Curie Transfer of Knowledge (ToK) project for the Remediation of Hearing Loss, funded by the European Commission and coordinated by the International Center of Hearing and Speech, which serves as the host institution for this multi-center effort. Support for patient and investigator travel for some of the studies was generously provided by MED-EL GmbH of Innsbruck, Austria.

Introductory Lectures

D07

Central auditory mechanisms associated with cochlear implantation

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Cochlear implantation alters both auditory cortex electrophysiology and morphology. In this brief overview, auditory cortex changes as a result of auditory deprivation (profound hearing loss) and stimulation (electrical/acoustical) will be discussed. Comments on current evoked potential and functional imaging research relevant to implantation will be offered. Also discussed will be the long maturational course of the auditory cortex and how this may influence various measurements of hearing status with cochlear implants.

A07

Conservation of Hearing and Protection of Auditory Hair Cells against Trauma-Induced Losses by Local Dexamethasone Therapy: Molecular & Genetic Mechanisms

Van De Water T., Dinh Ch., Bas E., Haake S., Chen S., He J., Eshraghi A., Balkany T.

Cochlear Implant Research Program, University of Miami Ear Institute, Department of Otolaryngology, University of Miami Miller School of Medicine, Miami, USA

Dexamethasone (DXM) is a synthetic corticosteroid that protects both hearing and hair cells against trauma-induced loss in models of acoustic trauma, aminoglycoside ototoxicity, ischemia/reperfusion injury, and electrode insertion trauma (EIT)-induced hearing loss. The base formulation of DXM (DXMb) retains its otoprotective capability even after being incorporated into and bioreleased from a polymer. Guinea pig model of EIT-induced hearing loss. Organ of Corti explant model of TNF α -induced hair cells loss and DXMb otoprotection with inhibitors of cell signal molecules and RT2-PCR for gene expression. Local DXMb treatment of the cochleae of EIT-animals prevents loss of auditory brainstem response thresholds that occurs in untreated, EIT-animals and prevents EIT-induced loss of auditory hair cells. To explain this *in vivo* action of DXMb, organ of Corti explants challenged with tumor necrosis factor- α (TNF α) were treated with DXMb and with polymer-eluted DXMb to establish our *in vitro* model of otoprotection. Inhibitor treated explants demonstrate that DXMb treatment requires both Akt/PKB and NF κ B signaling for otoprotection of TNF α -challenged auditory hair cells. DXMb treatment of these explants showed up regulation of anti-apoptosis gene expression (i.e. Bcl-2, Bcl-xl) and down regulation of pro-apoptosis gene expression (i.e. Bax, TNFR-1). DXM-initiated up regulation of anti-apoptosis genes and down regulation of pro-apoptosis genes does not occur if NF κ B signaling is blocked. DXM and DXMb are both effective in preventing EIT-induced hearing loss in an animal model of cochlear implantation. Polymer eluted DXMb retains its otoprotective capability for both conservation of hearing and protection of trauma-injured auditory hair cells. DXM exerts its otoprotection against trauma-induced hearing and hair cells losses by activation of cell signal molecules (e.g. NF κ B) that alter the expression levels of anti- and pro- apoptosis genes to favor hair cells survival. Bioreleased DXMb is a good choice for conserving hearing during cochlear implantation of patients with residual hearing.

Free Papers / Oral Presentations

B09 – 254

Quality of life and improving cost – effectiveness in early cochlear implantation

Abdi S.

TUMS

This study provides evidence, based on speech perception, language skill and rehabilitation sessions, CI is a cost-effective health care intervention in profoundly hearing-impaired young children. The present study assesses an important issue concerning the use of CI in infants younger than one year old. We have compared hearing speech perception skills and rehabilitation sessions in children with prelingually hearing impairment subjected to CI before one year of age and at a later age. They were divided to two groups less than

1 year old and between 1-6 years old. Children are assessed pre-operatively, at first fitting and then at 1, 3, 6, 9, 12, 18, and 24 months post-fitting. 75 patients made our first cohort, with their ages at the time of implantation ranged from seven months to 57 months. After excluding those patients who did not complete the follow-up sessions, 26 CI children fewer than 12 months remained for the final analysis. Therefore we selected 26 prelingually deaf children implanted the age over than one year. CI in Children less than one year obtained better results than other group and it was statistical significant. When we tried to compare the habilitation session of children who had been undergone implantation before age of 12 months or after it, it was interesting to find out that there was significant difference in mean sessions between these two groups across 48 months follow-up. Mean of habilitation session in children less than 12 months was 30 ± 7 . 2 sessions and 224 ± 87 in children after age of 12 months. Early identification of hearing loss, CI and language intervention before age 1 are less costly and patients can reach normal levels in language acquisition. CI was a cost-effective intervention for the majority of subjects, including the group given implants before age one. CI was a cost-effective intervention for the majority of subjects, including the group given implants before age one.

C07 – 275

Clinical study of nursery rhymes and music perception in prelingual cochlear implanted children

Abdi S.

TUMS

Objective: Nursery rhymes are an indispensable part of the development and education of normal children, and have a crucial role in language and speech education for them. The same thing applies to prelingual deaf children, they need a through habilitation program, which in an ideal program should include all the auditory aspects of life. This is clinical study of teaching nursery rhymes to our cochlear implanted prelingual children who have musical habilitation programs. Materials & Method: We tried teaching rhymes to 65 CI children alongside the musical melody of them. A single music trainer both teaches the children how to play simple (like xylophone) or more sophisticated instruments (like setar, a traditional string instrument and Piano), and evaluates their ability in performing the melody and singing some usual nursery rhymes. Children were evaluated by open questioning using a score from 0 to 10. Results: By this time, there are 65 children who have received music training. The time in the music training ranges from 5 to 41 months. Considering all the evaluation results of their ability to sing nursery rhymes while they perform the background melody for those rhymes, the mean score was 6.25 and the median score was 8. Including the best score for each child, the mean increased to 8.14 and the median to 10. Conclusion: Their speech abilities, especially vocal tonality also have improved since those training programme, although measured in a subjective level. Using this combined method for teaching music and singing to children helps them in better engaging in vocal abilities like singing. Cochlear implanted children can successfully learn singing nursery rhymes, especially if they learn how to play the melody for each rhyme, using this combined method for teaching music and singing to children helps them in better engaging in vocal abilities like singing.

D04 – 175

Drawing shows the evaluation of emotion in children undergoing cochlear implantation; introduction a protocol and results of the pilot study

Abdi S., Tavakoli H.

TUMS

Children undergoing cochlear implantation are combated with great stress and Cochlear implantation is a major incident in the life of the deaf children that help them to minimize their stress. Few measures have been developed to evaluate the emotional changes in their life. We have developed a method to quantitatively evaluate the drawings of children undergoing cochlear implantation. In a longitudinal study, the drawings of the children with cochlear implants were compared with those of a deaf control group (drawn before implantation and on 1-, 3-, 6- and 12-month intervals). The drawings were scored by a child psychologist using the Standardized Measure for Evaluation of Emotions Reflected in Drawings developed by the Hearing Research Center, which incorporates factors such as use of red color, pressure of pencil, etc. 41 children undergoing cochlear implantation that were compared with 46 control subjects (age 3 to 14 years). The scores were compared across the two groups as well as the changes of scores through the study. The final analysis of the results is in progress and the results will be presented. Children undergoing cochlear implantation are facing with great stress and their drawings before implantation reflect their anxiety. Their new normal way of living. Help

them and minimize their anxiety as well. We emphasize on the importance of assessment of all aspects of changes happening in the life of a child with cochlear implant and we believe that children's drawing is a valuable source in this regard.

A04 – 024

Cochlear implants in patients identified by the Neonatal Hearing Screen: management and outcomes in the first year

Allen L., Davies S., Hanvey K., Harris N., John M., Maggs J., Pretorius A., Tyszkiewicz E., Whitehouse J.

Birmingham Children's Cochlear Implant Programme

The paper describes the first series of cochlear implant patients at Birmingham Children's Cochlear Implant Programme following neo-natal hearing screening, who have received implants at 14 months or less. Demographics of the patient group are described, as regards unilateral or bilateral implant, type of device, surgical complications, programming issues, equipment management issues, rehabilitation, and results to date. Outcomes at 6 months and 1 year of cochlear implant use are reported for those patients for whom they are available. Considerations specific to the management of this very young patient group are discussed. Areas for further reporting/research are identified. Early cochlear implant surgery is advantageous in terms of the outcomes observed. However, successful management of these patients requires attention to specific issues, and availability of trained and experienced staff.

A01 – 001

Assessment of auditory performance in young children with cochlear implants

Al-Muhaimeed H.

To assess the auditory performance of young children using a simple and valid test, the listening process profile (LiP) after cochlear implantation. In this prospective longitudinal study 21 children with age range from 3 years to 7 years 1 month were included. All the children were congenitally deaf. The listening process profile test was administered pre- and post-implantation to assess auditory performance. The listening progress profile test has been applied at 6, 12, 24 and 36 months intervals. It has been found that the test is sensitive and monitoring improvement and auditory performance at these intervals. The rapid made improvement is obvious at 1 year post implantation. It has been found that the listening progress profile (LiP) is valid to assess the changes in auditory performance of young children post implantation and it is a simple test that can be applied by the clinician and the family.

D06 – 195

European adult multi-centre HiRes 120 study – an update on 65 subjects

Ambrosch P.1, Aschendorff A.2, Boermans P.P.3, Boyle P.4, Buechner A.5, Cooper H.6, Eklof M.7, Fielden C.6, Filippo R.8, Frachet B.9, Freijid A.7, Frijns J.3, Gallego S.10, Helbig S.11, Jeffs E.12, Kienast B.4, Lenarz T.5, Lombaard S.13, Mancini P.8, Marco J.14, Meerton L.13, Meyer B.15, Morant A.14, Mueller-Deile J.1, Pickerill M.16, Sterkers O.17, Truy E.10, Vanat Z.16, Wesarg T.2

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A new sound coding strategy called HiRes 120 was commercially released by Advanced Bionics in 2006. This sound coding strategy gives Cochlear implant users access to virtual channels by steering current between two adjacent electrodes. To ensure safe use for children, a multi-centre adult study was first performed (N=101). The goals were to: 1) Investigate the efficacy of HiRes 120 vs. the previous generation HiRes coding strategy; 2) Determine the benefit of the Harmony sound processor compared to earlier processor models; 3) Identify variables to predict users who might benefit from HiRes 120. The multi-centre study consisted of several different protocol options evaluating the benefit of HiRes 120 with the Harmony or Platinum Sound Processor. Experienced users, as well as users with no previous Cochlear Implant experience, were evaluated. To date, results from 65 users are available. Performance results are significantly better with HiRes 120 (p=0.0204) compared to HiRes.

Subjective data show a significant improvement in the categories 'immunity to noise' (p=0.037) with HiRes 120. A significant benefit for HiRes 120 in music was reported for sound quality (p=0.048) and sound pleasantness (p=0.0196) compared to HiRes. The Harmony processor was rated highly, especially with respect to increased battery life. 86.4% of subjects preferred HiRes 120 when using the Harmony (N=22). Discussion: Due to the very encouraging results of this adult study, a paediatric is underway. In the adult study, a learning effect was seen with HiRes 120, so it will be interesting to evaluate the results over time in children, considering the different plasticity. The HiRes 120 strategy has proven to offer benefit in challenging, real life situation such as noisy environments or with music. The behind the ear Harmony processor is reliable, comfortable and has a substantial battery life improvement compared to the previous Auria processor.

D13 – 461

Outcomes in children receiving a custom-made common cavity electrode

Anderson I.

MED-EL

Common cavity is no longer considered a contra-indication for cochlear implantation. Previous reports suggest good outcomes in children with common cavities. However there have been issues with CSF gushers and a need for frequent re-programming due to migrating electrodes. This study documents the results of children who have been provided with a custom made electrode based on the MED-EL Short electrode. The developmental outcome of children was evaluated pre-operatively, and at various intervals post-operatively up to five years on perception of Ling's sounds and the CAP and SIR rating scales. All children show some improvement post-operatively. This development follows the normal pattern with detection showing the most rapid improvement. Both auditory perception and speech production skills improve gradually over time. Use of a custom-made electrode is a viable means of providing audition to children with a common cavity. Due to the nature of their cochleae, development takes place at a gradual rate, though all perform better than pre-operatively. It seems clear that children with fairly severe bony malformations of the cochlear can receive a cochlear implant, and that provision of a special electrode can provide stable programming and benefit.

A03 – 015

Cochlear implantation in children: beyond rehabilitation

Archbold S.

The Ear Foundation, Lenton, United Kingdom

Cochlear implantation surgery in children begins a life-long commitment to ensure the maximum benefit from the procedure. This involves not only clinic-based professionals but those who support the child in their local community, teachers and therapists, and of course their families. A great deal of thought has been given to rehabilitation in the cochlear implant clinic, but less to what happens to support the life-long use of the implant system for the child into adulthood. A survey of parents, users and professionals in Europe asked what they felt was needed after implantation, who should provide it and how it should be provided. A questionnaire was sent to parent, user and professional groups, containing both closed and open questions. The survey included the views of both implant centre and community based professionals. 311 returns were received, from 15 countries. 85% respondents felt that support following implantation was provided by cochlear implant centres, and a significant lack in provision for adults compared with that for children was revealed. Great concern about the long-term support of both children and adults was expressed. The major concern was the management of the technology and the links between implant centre and local professionals, with expertise seen as residing in the implant centres. Long-term day to day management of implant systems resides in the community, for both adults and children. With rapidly growing numbers of both adults and children being implanted, ensuring long-term benefit from cochlear implants depends upon systems which are useable by non-specialists, and expertise being transferred from implant centres to local professionals and to the user and families themselves.

A05 – 030

From diagnosis to implantation: parental experience

Archbold S., Wheeler A., Gregory S.

The Ear Foundation

Early implantation is more effective, and newborn hearing screening and early diagnosis makes earlier implantation more likely. However, there is a range of age at implantation across European countries, and some indications that early diagnosis, while it can be shown to have changed the age at hearing aid fitting in the UK, it has not affected the age at implantation as strongly as elsewhere. This study looked at ages at implantation, and ages at hearing aid fitting before and after the establishment of newborn hearing screening in the UK. The figures obtained were compared with the figures across other European countries. Parents of young deaf children with cochlear implants in the UK were surveyed by questionnaire and interview to investigate their path from diagnosis to implantation, looking at a range of factors which support and which impede the process: information, audiological assessment, access to services, financial, political or others that arise from interviews. In the UK, prior to new born hearing screening, the average age of hearing aid fitting was over two years; now it is three months of age. For age at implantation, we cannot show a similar effect of newborn hearing screening in the UK, as can be shown in other countries, eg Flanders. Up to date figures for age at implantation across Europe will be given. Parents' views on those factors which support and impede progress to implantation will be given. Age at implantation is the most significant factor in increasing the effectiveness of the process. New born hearing screening, with earlier access to diagnosis and fitting of hearing aids, should allow earlier access to implantation. The reasons given by parents as to why this cannot yet be shown in the UK will be discussed, and how they could be addressed.

B14 – 409

Reading abilities after cochlear implantation: the effect of age at implantation on outcomes at five and seven years after implantation

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The Ear Foundation

The reading skills of deaf children have typically been delayed and this delay has been found to increase with age. This study explored the reading ability of a large group of children who had received cochlear implants seven years earlier and investigated the relationship between reading ability and age at implantation. The reading ages of 105 children, who were implanted below the age of seven years and with onset of deafness below the age of three, were assessed five and seven years after implantation using the Edinburgh Reading Test. The difference between chronological age and reading age was used to give net reading age. Non-verbal intelligence was measured for a subset of 71 children, using Raven's Coloured Progressive Matrices and investigation of this subset looked at the association of non-verbal intelligence, age at implantation and reading ability, measured by net reading age. There was a strong negative correlation at both 5 and 7 years after implant between net reading score and age at implantation. Progress in reading at the 2 intervals were closely related. Those implanted at or before 42 months who had cognitive abilities within the normal range had age-appropriate reading both 5 and 7 years post implant. Those implanted after 42 months were delayed in reading abilities. Age at implantation was a significant factor in the development of reading skills in this group. With earlier implantation, and improved technology, the encouraging results in the group implanted below the age of 42 months give evidence of the positive influence of cochlear implantation on the development of reading skills in young deaf children.

B13 – 407

Management of cochlea implantation in patients with malformations

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The prevalence of ear malformations is estimated at around 20%. In most cases, these are minor anomalies without influence on surgery or probably on the outcome of rehabilitation. In case of complex malformation, there is a basic risk of electrode misplacement, injury of the facial nerve because of an abnormal nerve route. In these cases, careful preoperative diagnosis and surgical planning is necessary. We developed a phased schedule for patients

with malformation. In case of minor anomalies, the regular setting with monitoring of the facial nerve, intraoperative electrical evoked stapedius reflexes, intraoperative neural response telemetry and plain X-ray is sufficient. Larger malformations, such as cochlear hypoplasia, require intraoperative evaluation of anatomy and electrode position, ideally with intraoperative 3D volume tomography (VT) or computed tomography without navigation. Complex malformation like X-linked deafness, Charge syndrome or Gorlin-Cohen syndrome with the risk of unintended electrode insertion into the internal auditory canal or injury of the facial nerve or the carotid artery should be facilitated by using intraoperative 3D-VT-assisted navigation and intraoperative 3D-VT control of electrode position. Radiologically-assisted navigated surgery improves surgical quality, reduces the risk of further procedures and the risk of complications and is therefore valuable with regard to costs and time. This phased schedule enhances the precision of surgery and reduces the risk of improper electrode placement and additional surgery in malformations.

D11 – 359

Development of a paediatric audio-visual speech test in noise

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The importance of audio-visual speech integration in the communication of children with cochlear implants may sometimes be underestimated. There are not many tools available to assess lip-reading abilities. The objective was to develop a paediatric audio-visual speech test to evaluate the benefit obtained from adding lip-reading information to auditory signal. The materials from the existing McCormick and English as a Second Language toy tests were selected. The 26 words available were recorded from male and female children. Editing was performed to add competing noise to the speech signal. A display adaptor capable of using two screens simultaneously ("subject" screen allowing lip-reading and "clinician" control screen) was created and software prepared to use it. Pilot testing was performed on twelve paediatric cochlear implant users, first with lip-reading, then with auditory signal only. The video recordings provided acceptable quality. The preliminary version of the software platform is functional. Words are randomly presented to the subjects whose task is to indicate the corresponding picture or toy, or to repeat the word. Testing may be conducted in quiet or noise, with adaptive signal to noise ratio. The clinician can select lip-reading only, or lip-reading with audio or audio only. Controls are available for scoring and automatic report generation. Feedback was collected on how to improve the ergonomics of the interface. The results showed differences in scores obtained in the audio-visual condition compared to the auditory only condition, highlighting the benefits that might be obtained from adding lip-reading information to auditory signal. The feasibility of using recorded audio-visual material to assess lip-reading abilities was confirmed. The option to test in noise allows for a better representation of real-life conditions. The next steps will involve finalizing the interface and testing a larger group of children.

B03 – 067

Minimal invasive surgery for cochlear implantation in children; transcanal and modified transcanal technique

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The authors have shown a series of 75 implanted patients operated by minimal invasive surgery. There were 75 children with pre- or perilingual deafness aged from 17 months to 12 years. In four cases deafness was due to bacterial meningitis with incomplete ossification of cochlea. There was also two patients with severe cochlear hypoplasia in one side and cochlear agenesis on the opposite side. Remaining 73 patients have had fairly normal cochlear morphology. Preoperativ radiological assesment consisted of CT scan in vast majority of patients. In Cases with ear malformation and suspected ossification MSCT (multi slice CT scan) and MRI were performed in order to get finer details of ear anatomy. Primary surgery was performed in 74 patients. There has been one case of revision surgery due to device failure. That patient was operated abroad three years ago. Medel Combi 40 + was used in 19 patients and Medel Pulsar in remaining 56. Minimal invasive surgery, transcanal "Veria" technique was performed in 60 of the patients. Modified transcanal technique was performed in 15 of the patients. No perioperative or postoperative complications were met in this series. We found this techniques feasible for cochlear implantation both in children and adults. Comparative advantages are minimal drilling of the bone and preservation of mastoid structure which is extremely important for young children. This techniques enables safer access and better angle in performing cochleostomy in cases with normal anatomy as well as cochlear malformations or ossification of the basal turn.

Factors influencing the linguistic development in cochlear implanted children

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Objective: The purpose of this study was to examine prognostic factors of cochlear implantation and to evaluate the impact of early implantation on linguistic development in deaf children. **Study design:** Retrospective study **Setting:** Tertiary referral center **Patients:** Seventy-four prelingually deafened children implanted before the age of 5 years **Intervention:** Annual follow-up after cochlear implantation **Main outcome measures:** Speech perception, intelligibility, expressive and receptive language scores from age 3 to 8 years, were globally compared between four subgroups of children (implanted <2 yrs, 2-3 yrs, 3-4 yrs, and 4-5 yrs) (Kruskall-Wallis test, $p < 0.05$). Significant differences were further explored by intergroup comparisons (Student's t test, $p < 0.05$). **Stepwise logistic linear regression** ($p < 0.05$) was performed using the following variables: age at implantation; duration of CI use; preoperative hearing levels; age of hearing aid fitting and age at time of the evaluation. Between group comparisons displayed significant differences according to age at implantation. **Multivariate analysis** demonstrated the positive impact of early implantation on receptive language. Moreover, duration of CI use and pre-operative hearing levels were statistically correlated with performance on speech perception, intelligibility, expressive and receptive language. Age of hearing aid fitting was associated with speech intelligibility. Age at implantation, but also duration of CI, pre-operative hearing levels, and age of hearing aid fitting may each be useful in predicting linguistic success following cochlear implantation. This study was supported by Cochlear France.

B01 – 048

Is the ASSE (auditory speech sound evaluation) test a language-independent tool for pre- and postoperative evaluation of speech-discrimination and hearing development in cochlear implant patients?

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The ASSE® is an audiological evaluation tool based on speech sounds as stimuli and was developed by The Eargroup Antwerp. It consists of three levels: detection, discrimination and identification of phonemes and has proven to be a sufficient tool to measure supraliminal auditory capacities in the Flemish language for children 10 months and older and adults. It should also be suited for other mother tongues than Flemish. Aim of the study was to test whether the test is suitable for German patients and then in conclusion for different languages as well. To get a comparison to healthy subjects 20 normal hearing patients (10 children and 10 adults) got the whole test battery. Standard test protocol was developed, and children were additionally evaluated by video camera or second investigator. 50 candidates for cochlear implantation (children and adults) were tested before and 3, 6 and 9 months after implantation. Results were compared to results of OLSA, OLKISA, Freiburger hearing test, free field audiometry, BERA and electrocochleography. Preliminary results show, that especially the discrimination level is very suitable for evaluation of "hearing quality". The fact that "Flemic sounding" phonemes sound different from German language seems not to influence the test results and discrimination ability of patients. Especially in very young children the reaction on the phoneme-exchange is not always clear, so that repetition is necessary and often additional evaluation of reaction by second investigator. Test results are extremely helpful in fitting and also change of fitting parameters, so that the ASSE seems to be a suited tool for evaluation of speech discrimination and hearing development in cochlear implant patients.

D13 – 458

Modiolar Research Array – first temporal bone results

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Objective: To evaluate intracochlear placement and trauma following the insertion of a newly developed electrode array in human temporal bones. The new Modiolar Research Array (MRA) consists of a thin preformed intracochlear electrode array that is advanced through an external sheath. The sheath is removed following the complete insertion of the array. Dimensions of the array have been reduced to approx. 25% of a Contour Advance electrode

providing the possibilities of future soft-surgery insertions with preservation of residual hearing. We conducted a temporal bone study with insertion of the MRA electrode in 15 fresh frozen human temporal bones (TB). Insertions were performed via a cochleostomy approach (14 TB) and 1 round window approach in two sessions by 3 surgeons. TB's were then processed by 3D-volume tomography and histologic evaluation was performed by a cutting-grinding technique following standard procedures as described earlier by our group. The insertions were mainly easy to accomplish. Nevertheless, the mode of insertion needs training of the surgeon to allow an atraumatic insertion without the risk of a tip-foldover. Care had to be taken to perform a small cochleostomy, but with enough width to perform the insertion. In that respect the round window insertion does not seem to allow a reliable insertion as it demonstrated a major tip-foldover. If the insertion is completed in a technically correct way, the electrode position is perimodiolar, covering the basal turn without major trauma. With regard to 3D-volume tomography our results demonstrate an excellent visibility and evaluation of this thin electrode array in temporal bones. The newly developed MRA electrode is a promising development of a thin, atraumatic perimodiolar array that is combining the requirements for an optimized electrode position, yet reaching an insertion depth of the whole basal turn and with dimensions that allow for an atraumatic surgery.

B11 – 268

80 Swedish children with bilateral CI

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It is hypothesized that bilateral cochlear implantation in children improve hearing compared to a single cochlear implant (CI) in complicated listening tasks such as understanding speech in noise and improve the ability to localize sound. The purpose of the current study was to compare measures of speech understanding and sound localization among bilaterally implanted children using both CI's versus a single CI. Eighty children (ages 5-12 yrs) who were full-time users of bilateral cochlear implants (Bi-CI) since at least 6 months participated in the study. Subjects' speech understanding with Bi-CI, right CI and left CI were measured in quiet. The best ear was determined from the single CI tests; this ear (Best-CI) was used when testing speech understanding in noise and sound localization. The same tests were used with Bi-CI. Speech understanding in noise was measured using phonemically balanced words or a three digit test with speech presented in front of the child and speech-weighted uncorrelated noise presented from four loudspeakers surrounding the subject at ± 45 and ± 135 degrees. Sound localization was measured by presenting animal sounds (one low-frequency sound and one high-frequency sound) from five loudspeakers spanning a half-circle in the frontal plane (-90 to $+90$ degrees). The results show that a majority of the children benefit from two CI's in terms of better speech understanding in noise and better sound localization performance. Detailed results will be presented and discussed. Most children with bilateral CI performed better on measures of speech understanding in noise and sound localization when they used bilateral CI rather than unilateral. A few children demonstrated a deterioration of performance using Bi-CI compared to Best CI. Results from speech understanding and sound localization measures from a large population of children implanted with CI bilaterally will be presented and discussed.

B09 – 255

Cochlear implant: Can it be a way of improving quality of life among multihandicapped children and their families?

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The application of cochlear implant (CI) in multihandicapped children is controversial. We aimed to assess the quality of life among multihandicapped children and their families after cochlear implantation. Sixty two patients underwent CI surgery at Ondokuz Mayıs University School of Medicine Department of Otolaryngology since May 2006. Five multihandicapped children were included in this study. Seven-year-old patient 1 with pervasive developmental disorder (PDD), had used CI for 18 months. Seven-year-old patient 2 with cerebral palsy, had used CI for 20 months. Three-year-old patient 3 with mental motor retardation following meningitis, had used CI for 18 months. Thirteen-year-old patient 4 with mental retardation, had used CI for 3 months. Four-year-old patient 5 with PDD, auditory neuropathy (AN) and moderate hearing loss, had used CI for 7 months. Patients 1-4 had profound hearing loss. Pre and postoperative audiological evaluation results were recorded. A survey for evaluation of behavioral changes in children was conducted by a

questionnaire given to the families. Patients 1-4 had a mean pure tone average (PTA) of 37,5dB (min 30-max 50) and speech production was not observed among these four patients. No detectable PTA was obtained from patient 5. The survey revealed significant improvement in nonverbal communication skills and arousal in interest with the surrounding environment in patients 1-4. The application of CI in multihandicapped children is controversial. Despite the lack of speech production, the improvement in nonverbal communication skills and positive behavioral changes is promising for CI application in multihandicapped children. Lack of improvement in patient 5 can be explained by AN rather than PDD. Multihandicapped children should be given the chance of gaining hearing ability by CI regardless of speech production capability.

B04 – 077

Factors that influence early CI outcomes in prelingual deafness

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Cochlear implants have radically changed the auditory and linguistic outcomes of prelingual deafness. Deaf children can today achieve very high levels of auditory and language abilities with this implantable device. However, variability in cochlear implant performance can greatly vary across individuals, with still incomplete explanation of the reasons for good or less-good outcomes. Some implanted children demonstrate open set speech recognition even when communicating at the telephone, while others may not consistently discriminate speech sounds without the support of lipreading. The range of auditory performance can be large even among children with similar otologic history or the same cochlear implant device. The variability in cochlear implant outcome raises a number of questions concerning the management of cochlear implant recipients: what are the important elements in the cochlear implant selection process? What are the key factors in making predictions of cochlear implant results? How should we counsel families that are approaching cochlear implantation for their children? How to evaluate benefits of cochlear implantation in pediatric populations? These issues require careful consideration of individual variables that can influence quality and timing of developing auditory and language abilities of implanted children. We analysed a homogeneous group of 40 children affected by non syndromic prelingual deafness with no other disabling condition, with normal non verbal intelligence, all implanted with the same cochlear implant system. Their auditory capacities at 12 and 24 months of cochlear implant activation were assessed and classified using hierarchical rating scales (Categories of Auditory Performance, CAP). CAP results were compared with a number of individual factors that may be considered important for developing effective auditory abilities. The objective of the study was to identify and quantify the predictors of early cochlear implant outcomes in a homogeneous group of children with prelingual deafness, in an attempt to understand the relationship among early auditory performance and factors such as deafness cause, age at implantation, preimplant high frequency residual hearing, family involvement, use of a contralateral hearing aid. Our results, in accordance with universal findings, provide evidence that prelingually deaf children should receive implants as early as possible to facilitate auditory and speech perception skills development, and thus maximize the health gain from the intervention. However, age of implantation alone is not the best predictor of early implant performance. Most probably is the relation between some effective auditory experience (by means of residual high frequency, postnatal deafness, both linked with stimulating/tutorial family environment) together with the age at implantation that should be seen as the foundation of the ability to develop good early auditory skills, rather than considering these variables separately. This considerations are important in CI selection process and rehabilitative management.

D01 – 142

Improving CI clinic capacity, profitability and quality: early results from the application of Kaizen

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Introduction: Our objective present two year results from the gains in patient access, program profitability, and increased quality from the adaptation of a continuous improvement program. Materials and Methods: Using 5s and value stream mapping of CI patient flow, current and ideal future states of a tertiary medical center- based CI program were defined. This report focuses on data related to audiological services. All appointment types were consolidated into 5 main categories for analysis. 5-day process improvement workshops and 1-2 day Kaizen workshops were begun in 2003 targeted to optimize value-added (VA) patient care cycles while removing all non-value added (NVA) components in the various appointment types. Metrics used to calculate financial performance included all direct, indirect, fixed and variable costs.

VA versus NVA added time and the charges versus actual reimbursement. Patient satisfaction surveys were done prospectively to ascertain the impact of implemented changes on their perception of care availability and quality. Materials and Methods: Using 5s and value stream mapping of CI patient flow, current and ideal future states of a tertiary medical center-based CI program were defined. This report focuses on data related to audiological services. All appointment types were consolidated into 5 main categories for analysis. 5-day process improvement workshops and 1-2 day Kaizen workshops were begun in 2003 targeted to optimize value-added (VA) patient care cycles while removing all non-value added (NVA) components in the various appointment types. Metrics used to calculate financial performance included all direct, indirect, fixed and variable costs. VA versus NVA added time and the charges versus actual reimbursement. Patient satisfaction surveys were done prospectively to ascertain the impact of implemented changes on their perception of care availability and quality. Conclusion: The application of LEAN principles proved to be effective in improving patient access, significantly improved financial performance in CI care, while maintaining high patient satisfaction. This is one very effective methodology to address clinic capacity and profitability in growing CI centers world-wide.

A04 – 020

First words: Tracking children's early understanding and use of words with 'Living Language' (Preliminary study)

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This ongoing study aims to monitor receptive and expressive use of first words in the two years following implantation, using the First 100 Words checklist from the Living Language Starter Programme. 1. Understandably, parents and caregivers may be unsure about the timescale involved in their child learning to understand and use spoken language with their implant, and about how this process is expected to happen. An important additional objective is therefore to provide a 'framework' to help them to recognise and build on the earliest signs of progress. The checklist is completed with parents pre-implant and at 6, 12 and 24 months post-implant. I will report on the results of a prelingually deaf group of 13 children, all of whom were aged under 3 years at time of implant and who had no (obvious) significant additional needs. Five children used predominantly signed communication and eight were preverbal/oral. Four children had Punjabi as mother tongue at home. Children implanted under two years of age acquired receptive and expressive vocabulary fastest; later implanted children started to 'catch up' after 12 months and by 24 months post-implant their scores were only slightly lower than those of the youngest group. All children except one made a clear transition to speech as their primary mode of communication. Feedback from parents and nurseries is enthusiastic; discussion about the First 100 Words is proving to be a positive way of fostering joint working between home, local professionals and cochlear implant team. Future areas of study may include: - Transition from no formal communication/signed communication to spoken language. - Further investigation into acquisition of first words for children with English as a second language. Reference 1. Locke A. Living Language. Windsor: NFER Nelson; 1985.

A07 – 199

Mild hypothermia during cochlear implantation supports conservation of residual hearing – 12 months results

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Mild systemic hypothermia has been shown to reduce cortical brain damage after trauma as well as hearing loss caused by noise exposure. In addition, we have previously demonstrated that mild systemic hypothermia conserves auditory function following electrode insertion in a rat model of cochlear implantation. This prospective, single-subject repeated measures clinical trial was designed to test the safety and efficacy of mild hypothermia and conservation of residual hearing during cochlear implantation in selected severely to profoundly deafened adult human volunteers. During cochlear implantation core body temperature was lowered 30C to 34C for 30 minutes before, during and for 30 minutes after insertion of a cochlear implant electrode array. The main outcome measures were: 1) cooling-time profiles; 2) anesthetic recovery times; 3) blood loss; 4) post-operative infection rate; and 5) levels of residual hearing. Immittance, low frequency pure tone thresholds, speech awareness threshold and speech recognition (HINT sentences and CNC words) were tested pre-operative and at 1 month, 6 months and 1 year post-op. This report describes 12 month results of the first 13 subjects. Cooling within the desired parameters was possible in all subjects and there was no evidence of increased

anesthetic recovery time, blood loss or infection rate. Pure tone hearing was conserved within 20dB as measured at 1 month but tended to progress at 6 and 12 months. Mild hypothermia was safe in this selected cohort and may be effective in promoting conservation of residual hearing following cochlear implantation for the intervals tested. Additional follow-up is necessary to determine long term outcomes from this initial clinical study and a larger clinical trial will be necessary to demonstrate safety and efficacy.

C10 – 305

Cochlear implantation through neonatal hearing screening

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As a result of neonatal hearing screening programme, babies with different degrees of hearing loss are diagnosed. Screening programmes provide these babies with congenital severe to profound hearing loss with the access to cochlear implantation. We aimed to discuss the importance of systematic follow-up of “refer” babies in hearing screening programs. In Ondokuz Mayıs University Hospital 1934 babies were screened by neonatal hearing screening program. Year 2000 Position Statement: Principles and guidelines for early hearing detection and intervention programs prepared by Joint Committee on Infant Hearing were used for risk factors and to prepare hearing screening protocol. Four babies were confirmed to have profound sensorineural hearing loss and received bilateral hearing aids between 6-10 months (mean 7 months). These babies were followed up for at least six months for speech and hearing rehabilitation. The length of hearing aid use ranged from 7 to 17 months. All children received cochlear implants (CI) between the ages of 13-24 months (mean 19 months). Audiological findings and Infant-Toddler Meaningful Auditory Integration Scale outcomes were compared pre and postoperatively. All children had postoperative 30dB HL puretone threshold average scores and age-appropriate auditory perception skills. Early implantation is feasible and beneficial in children who are younger than 12 months. Neonatal hearing screening is the gold standard in identifying cochlear implant candidates within the first months of life. Neonatal hearing screening is a milestone in early diagnosis and rehabilitation of hearing loss. But, we believe the definition of success is not the number of babies who were diagnosed with hearing loss through neonatal screening but the number of babies who were enrolled in the rehabilitation programme with hearing aids or CI.

A08 – 211

Hearing preservation through round window approach in cochlear implantation

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Preservation of preoperative residual hearing levels is one of the important concern in cochlear implant surgery. Surgeons have been trying various strategies recently in order to minimize intracochlear trauma. Cochleostomy site is also important in avoidance of insertion-induced damage. In this study we present the results of hearing preservation in round window approach.

A10 – 217

Preservation of residual hearing with two different electrode arrays in cochlear implantation

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Minimizing intracochlear trauma and preserving residual hearing during cochlear implantation is one of the important concern recently. Surgical technique, site of implantation and type of electrode array are the important factors determining preservation of preoperative hearing levels. In this study we present the results of hearing preservation with two different electrode arrays in cochlear implantation.

C06 – 132

The influence of stimulation rate on speech perception using different coding strategies with the Nucleus “Freedom” system

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The new Nucleus “Freedom” cochlear implant system has – beside other new features – an increased stimulation rate. With this system it is possible to stimulate much faster than the usual 1200 pulses per second (pps) using an ACE strategy. 9 adult subjects were implanted with the Freedom device and were evaluated in their speech performance with different stimulation rates and coding strategies. For the evaluation the rates 500pps (A), 1200pps (B) and 3500pps (C) were chosen with each of the coding strategies ACE, CIS and MP3000. Test material consisted of a monosyllabic word test in quiet and an adaptive sentence test in noise. To avoid learning effects the subjects started with the study after 3 months of experience and followed an ABCCBA investigational sequence with 4 weeks of experience in between. Speech perception measures were taken after each sequence. At the end of each sequence the subjects were asked for their rate preference. Subjects dominantly chose lower to medium stimulation rates for preference: 7 subjects 500pps, 8 1200pps and only 2 3500pps for the ACE strategy with similar results for the other 2 strategies. The speech test results were in line with this finding showing only significantly poorer speech scores in noise for 3500pps but no statistical differences neither for the lower rates nor the coding strategies. These results suggest to program new cochlear implant recipients initially with a low to medium rate. This applies especially in the fitting of children.

A07 – 200

Vienna experience of Electric Acoustic Surgery (EAS)

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In 1999 Christoph v Ilberg introduced the Electro Acoustical Stimulation (EAS) as a combination of conventional hearing aid and cochlear implant on the same ear. Through a very soft and cautious insertion the clear evident residual hearing should be preserved. After successful EAS implantation cochlear implant and hearing aid are combined on the ipsilateral ear. In Vienna we performed since 1999 20 cochlear implantations in residual hearing patients, concerning the aspects of EAS. In the majority of patients we preserved residual hearing. Those successful EAS-patients use hearing aid and cochlear implant on the same ear effectively together. Over the years different electrode arrays from MED-EL company have been used. Beginning with standard electrodes in 1999, over Additionally to the EAS procedure itself, indication and wording has changed in the past decade, too. Actually implanted patients considered for an EAS procedure, are audiologically different from those implanted in 1999. different custom made devices onto the recent MED-EL Flex soft EAS Electrode array. Consequently the surgical procedure changed, from a cochleostomy procedure, towards a round window insertion nowadays or a special fenestration technique using stapedotomy instruments. Still today there is no so called standardised EAS surgical technique recognised. We show the development of electrode array and implant technique since 1999 and compare to the outcome of patients. We focus on the different “schools of EAS” (Frankfurt, Gstottner-Kiefer; Warszawa, Skarzynski; Vienna, Baumgartner) and our results in the short and long run from January 2000 until June 2008.

C12 – 416

Vibrant Soundbridge surgery in children

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Up to 2005 the Vibrant Soundbridge semi-implantable hearing aid was used in sensorineural hearing loss only in patients with good function of the ossicular chain. In 2005 Vittorio Colletti from Verona introduced a new technique – the Vibroplasty, where the FMT of the Vibrant Soundbridge is not longer placed on the long process of the incus. In this technique the FMT can be placed in the round window niche, or on remnants of the stapes, or on the oval window, or a fenestration like surgical procedure ! This allows opening the indication criteria to combined hearing loss and malformations. Since January 2006, 30 patients were implanted with the Vibroplasty technique in Vienna – seven patients were operated under local anaesthesia. Two patients were children. In these patients the implant was programmed immediately and the patients were tested with Freiburger numbers and monosyllables as well as music dur-

ing the operation. There was no complication, neither during operation nor in the postoperative time. All patients are very satisfied. Speech perception was assessed using Freiburger monosyllable tests and (OLSA) Oldenburger sentences in quiet and noise. Air- and bone conduction was controlled pre- and postoperative. Outcomes show an improvement in all speech perception scores over time. The Vibroplasty is a safe and efficient method for therapy of patients with combined and sensorineural hearing loss, especially in patients with otosclerosis or radical cavity or middle ear malformations. Vibroplasty procedure especially changes the future surgical concept of malformations in children.

D04 – 176

The influence of the side of implantation on spoken language development after cochlear implantation

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Recent studies on ear selection for CI in prelingually deafened children suggest an advantage for right ear implantation in speech perception and in monosyllabic word production. In hearing children a right-ear advantage develops due to stronger contralateral connections to the left language-dominant hemisphere. Maturation of the corpus callosum takes until the age of 4 years. This study examines whether this right-ear advantage in young CI-children also holds for higher-level language abilities. For this study all children unilaterally implanted before the age of 4 (13 right-sided, 9 left-sided) with at least three years of follow-up after implantation were selected that additionally met the following inclusion criteria: native spoken Dutch language environment, no multiple handicaps, no meningitis. Data on active vocabulary, language comprehension and mean length of utterance were collected at regular follow-up intervals at 12, 24 and 36 months. The number of participants in each group varied across intervals and across test measures. No significant advantage of right over left ear implantation at these post-operative intervals was found for the three language measures studied. As a group, however, the children did show a highly significant ($p < .001$) increase on all three language measures across the three time intervals. No advantage for language abilities was found for right ear cochlear implantation at 12, 24 and 36 months post-operatively. This absence of ear advantage may be due to the early stage of language development studied, i. e. up to 3-word utterances with no complex inflections or unstressed function words. As spoken language becomes more complex the recognition of morphological cues and non-stressed words may depend more on the perception of speech sound distinctions and may consequently show a right-ear advantage. Whether this will occur indeed remains to be explored.

B12 – 389

Auditory brain stem implants in NF-2 patients

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On the basis of the excellent results in CI patients, the 12 channel MED-EL device Combi 40 / 40+ was used and a special electrode for insertion into the lateral recess of the 4th ventricle for stimulation of the cochlear nucleus was developed. 34 NF-2 patients were included up to now. In 29 patients 32 ABI probes were implanted, 3 patients were operated twice, 2 due to probe dislocation, one due to implant failure. For several reasons 5 patients were not implanted. One of the implanted patients is a non user from the beginning, another patient experienced a deterioration of the disease and could not benefit from the implant any longer, before she used the device on a basic level. Until now, 7 patients were implanted with the new Pulsar 100 device and will be reported separately. In 3 patients contralateral hearing was present and 3 patients were implanted in Asia, they were not tested, or from the latter no detailed data exist. The others use the implant on a daily basis. All have tonotopy, sound discrimination and are able to perceive daily life and warning sounds. In the first 6 months period, the average increase of sentence lip reading ranges from 19. 4% without implant to 59. 6% with ABI (n=9). The average rate of Freiburg numbers in open set ABI only users was 40.1% (n=8), and 46% sentences (n=4). In those and ABI plus lip reading patients the rate was 58. 5% sentences (n=12) and 53. 3% numbers (n=9). In the 2 years period in lip reading plus ABI mode, sentence recognition was 67.5 (n=9) and numbers 81.3 (n=5). ABI only results were 42. 7% sentences (n=8) and 51.7 numbers (n=9). Both groups together scored 71.1% correct sentences (n=12) and 78. 5% numbers (n=11). More than 50% of the evaluated patients have open speech understanding at different performance levels. Three patients are able to use the telephone on a basic level. Complications attributed to ABI implantation are mainly CSF leakage, no neurological or other major complications occurred. ABI implantation, and the device used, is a reliable and safe method for hearing rehabilitation and restoration in NF-2 patients.

B12 – 393

Bilateral electrical stimulation of the cochlear nucleus – surgical and technical feasibility

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Restoration of hearing in patients with lesions of the cochlear nerve, especially in Neurofibromatosis 2, is since several years technically possible. The generally acknowledged method is the implantation of an auditory brainstem implant (ABI) via the retrosigmoid or translab approach. By this treatment patients may regain a useful hearing and in some cases an open speech understanding. However, there is still a big difference in performance compared to cochlear implant (CI) patients. They even show an increased hearing ability by bilateral stimulation of the cochlea. The surgical and technical feasibility of bilateral stimulation in ABI candidates was to be evaluated. Three patients with midline tumors in the posterior fossa were investigated intraoperatively. One suffered from NF-2, had a neurinoma in the right cerebello pontine angle and was planned to be implanted with an ABI. Prior a big meningioma at the craniocervical junction has to be resected. The others had a tumor in the area of the vermis cerebelli. All cases were operated in semi sitting position. After tumor resection two placing electrodes of the MED-EL ABI system were inserted via the fourth ventricle on the auditory tubercle. Stimulation parameter settings were identical with those used in ABI surgeries. The EABR signal was recorded between Cz and A1 (left ear lobe). Recordings were triggered at a rate of 13 Hz, 1000 responses were averaged. The electrode impedances for simultaneous stimulation were similar. In all cases it was safely possible to insert two placing electrodes into the fourth ventricle and on the auditory tubercle of each side. The suboccipital midline approach proved to be ideal for this attempt. Both cochlear nuclei could be identified and stimulated either singular or simultaneously. The morphology of the EABR recordings were similar to those identified in previous ABI implantations. With bilateral simultaneous stimulation an EABR signal could be recorded with increasing amplitude by higher stimulation currents. No significant difference in unilateral compared to bilateral stimulation mode in terms of latencies or amplitudes was recorded, but a tendency to higher amplitudes in bilateral mode. Bilateral simultaneous stimulation of the cochlear nuclei is technically possible and the midline suboccipital approach is appropriate for safe placement of the electrodes via the fourth ventricle to the area of the cochlear nuclei. The possible benefit for the patients in terms of hearing performance has still to be evaluated.

B13 – 405

Our approaches to the surgical stage of cochlear implantation in children and its features at obliteration of the cochlea

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Ukraine

Presently, the most promising method of treating sensorineural deafness is cochlear implantation. Cochlear implantation has been a standard treatment for children and adults for several years. In recent years, cochlear implant (CI) manufacturers have begun offering special electrodes designed to meet the needs of people with obliterated cochlea or other malformations. 48 patients with sensorineural deafness were implanted from 2006 onwards in the clinic of otorhinolaryngology of the Dnepropetrovsk State Medical Academy. Among these, 44 were children ranging in age from 1 to 10 years and four adults ranging in age from 18 to 36 years. Candidate selection was made based on the generally accepted criteria for cochlear implants (CIs). The cochlea was accessed through mastoidectomy and posterior tympanotomy. We used the MED-EL COMBI 40+ (44), PULSAR 3. and SONATA 1. devices. Telemetry and electrically evoked stapedius reflex were measured intraoperatively to verify correct positioning of the electrode in the cochlea and to determine most comfortable levels (MCLs) for first fit. The split electrode was used for three patients with obliteration of the cochlea subsequent to meningitis. Results of rehabilitation in patients with traditional CI depended on age of child and duration of deprivation. In an 18 year old patient who received a split electrode results of rehabilitation one year postoperatively were not markedly different from results in patients with a standard electrode. However, for the other two patients with a split electrode, testing one year postoperatively revealed that some of the channels were not functioning possibly because of poor mobility in the cochlea. For the child of 3,5 years old, five channels were switched off on the short electrode, and for another patient 3 channels were switched off. In these patients, the rehabilitation process is extended and gains, more modest compared to patients with more traditional CI use. The split electrode is an option to treat deafness subsequent to obliteration of the cochlea, but long term use of all inserted electrodes is a concern, as outcomes are sometimes not as favourable as outcomes with a standard electrode.

A06 – 046

Conversational language abilities development after implantation: a longitudinal study

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Most research conducted in the field of post-implant assessment have mainly focused on the restoration of perceptual abilities and the development of verbal language. Only few studies have assessed the impact of a cochlear implantation on children's overall development, particularly, on their conversational language abilities. Previous works on preverbal development stage revealed recurrent difficulties experienced by deaf children in acquiring knowledge on social norms and skills relative to speech activities. In children with profound bilateral deafness, a conventional hearing aid does not provide sufficient relevant information to acquire a satisfactory oral communication development. Our hypothesis is that access to oral perception will not only improve implanted children's social skills, but will also increase their rate of participation and their use of verbal language during interactions with a familiar adult (mother, father or caretaker). Their communication skills profile would resemble that of younger normal hearing children. Using conversational samples from a filmed video protocol at specific intervals within the span of two years, we monitored the development of communication skills in a group of 20 pre-lingually profound deaf children (mean age: 3.7 years). Results corroborated our hypothesis. They indicated that children using cochlear implants improved their overall performance in communication skills, quantitatively and qualitatively speaking, even during the first year post-implantation stage. children using cochlear implants improved their overall performance in communication skills, quantitatively and qualitatively speaking, even during the first year post-implantation stage.

A10 – 222

Evaluation of the cochlear micro morphology and the internal dimensions of the cochlear scalae with special reference to insertional trauma during cochlear implantation

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Cochlear implantation is a widely accepted treatment for deafness and high grade sensorineural hearing loss. Though the device and the implantation methods are continuously optimized, no atraumatic implantation can be achieved. Reduction of insertional trauma is important for the preservation of residual hearing and on the background of the enhanced indication for cochlear implantation. This study was performed to examine the intracochlear spaces and to correlate the micro-morphology of the cochlear ducts with frequent patterns of intracochlear insertional trauma. Histologic temporal bone series from the "Wittmaack temporal bone collection" (Hamburg, Germany) were examined. The specimens were digitized and the internal dimensions of the cochlear scalae were measured with computer software that was developed for this study. These data were evaluated in reference to the cochlear spiral that was reconstructed for every cochlea according to the "graphical cochlea reconstruction"-method. The Scala tympani decreases in height during the first half cochlear turn, reaches then a constant value until the middle of the third turn, increases slightly again and then decreases toward the apex. In the first cochlear turn, previous to the ascending part, the height drops by 300µm. In this region the intersegmental decrease of height significantly varies downward from a supposed linear intersegmental decrease ($p \leq 0,001$). The curve indicating the combined height of the Scala vestibuli and the Scala media shows an inverted shape. The localisation of the distinct decrease in height of the Scala tympani correlates with the localisation of frequent cochlear-electrode insertional trauma. From the literature it is known that the intracochlear trauma in this area very often is severe and that optimization of electrode shape and insertion methods may have no impact on it. The curved shape of the cochlear duct as well as the specific intracochlear micro-morphology and the interindividual differences show a complex multifactorial interrelationship that has impact on intracochlear insertional trauma and which may not be compensated until the development of actively navigated cochlear electrodes.

B08 – 247

Early Auditory Awareness Monitoring Scale – pilot study

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The aim of this study was to develop and pilot a questionnaire to monitor the gradual development of auditory awareness in very complex children. These children have profound deafness with combinations of significant physical impairment, visual impairment and learning difficulties. This group of children are unable to undertake the conventional listening skills assessments that normally monitor progress. The need for a monitoring tool, to facilitate gathering data on processor use and the development of auditory awareness, was identified. Parents and carers can observe and report the small, but important, changes in behaviours seen in response to sound over time after cochlear implantation. A questionnaire has been developed to give both quantitative and qualitative outcomes relating to complex children's responses to sound. The scoring is based on the Meaningful Auditory Integration Scale (Amy McConkey Robbins). It covers processor use and the subtle responses to environmental and speech sounds which may be observed in this group. The questionnaire has been used with the parents, carers and teachers of a group of ten complex children over an eighteen month period. The questionnaire enabled implant programme staff to quantify progress observed by carers. It reflected changes in responses to sound observed over time along with parents' and carers' perceptions of the benefits gained by children using their device. This questionnaire has proved useful in enabling parents to monitor the small signs of progress in their children and to give positive answers to many of the questions asked. We will continue to use this questionnaire on larger groups, over longer periods, before finalising the format.

B07 – 243

Cochlear implantation in temporal bone fractures patients

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CI in temporal bone fractures is difficult procedure due to ossicle displacement, disturbed middle ear anatomy and cochlear damage. 83 cochlear implantations were performed in the Ear microsurgery and otoneurosurgery department of Kiev Otolaryngology Institute. In 3 cases we had the patients with postlingual deafness after temporal bone fractures. In one case there was bilateral transversal fracture of temporal bone with cochlear damage without middle ear involvement. In two cases middle ear was damaged with ossicles displacement, facial nerve canal injuries, and one patient with whip head trauma had also posterior displacement of otic capsule. In this case the misplacement of active electrode in hypotympanum was happened. The reimplantation was performed two months later. Radical mastoidectomy approach with temporally posterior canal wall removal was used during reoperation to access the cochlear. Cochlear implantation in the patients with temporal bone fractures sometimes may be difficult procedure. CT scan is obligative diagnostic method to choice the adequate approach for cochleostomy.

A02 – 014

Use of Sign Language in pediatric cochlear implant users: whys and wherefores

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On the grounds of our experience relative to a group of 151 children, ranging from 18 months to 14 years of age, of whom 34 had associated handicaps, we attempted to resolve queries which rise over a delicate and still controversial pedagogical theme. 50 children with and without associated handicap were analyzed relative to speech perception and production use of sign language to determine: WHO? What are the characteristics of the children who can benefit from the use of coded signals: age at implant, associated disabilities, family surroundings. WHEN? Mismatch between chronological and linguistic age groups (delay) HOW? Elements that lead to the use of coded signs either bimodal or Sign language; teacher of the deaf WHY? To facilitate the appearance/stabilization/enrichment of comprehension both in spoken and written language; enable reading with meaning. Findings related to use of sign, either as Italian Sign Language (LIS) or codified sign, were often adopted as a support for integrated comprehension, especially for reading. Bimodal rehabilitation was applied regularly in children with associated disabilities, whereas in a small group of children it became necessary when schooling reached more demanding grades. Conclusions will be drawn separately for each single group of children under study.

D06 – 194

Long term evaluation of prelingually deaf subjects implanted during adolescence and adulthood

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The aim of the study was to investigate the use of the implant, listening skills and/or speech and sign production, level of education and employment, satisfaction and personal identification into either deaf or hearing person of adolescent and adult prelingual cochlear implantees. 9 adolescents implanted between 13 and 15 yrs of age and 9 pre-lingual adults implanted between the age of 25 and 40 were tested after an average of 10 years from cochlear implantation. Tests in use were: speech perception in quiet and noise and our standard production test battery, projective tests, structured interviews. Within these groups there was a great variability in findings, ranging from non-use to full use of the implant, and from giving up schooling to graduating from university. Greater degree of non-use was seen in the adolescent group. Findings were very individual, taking into account that the adolescent group was implanted with an older technology which implied a more complex management of the device itself (battery duration etc). Furthermore, expectation was one of the most important variables contributing towards a satisfactory use of the implant.

C06 – 133

Multi-channel AGC for the Harmony processor

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Advanced Bionics

The small electrical dynamic range of cochlear implant systems, typically 10 to 15dB, makes essential the use of compression to provide a reasonable acoustic dynamic range. While acoustic hearing aids routinely provide multiple channels of Automatic Gain Control (MCAGC), cochlear implant systems typically use only a single channel AGC. This work examines initial experiments with MCAGC for the Advanced Bionics' Harmony processor. Optimization of DSP code allowed up to four AGC channels to run in real-time on the standard clinical Harmony BTE sound processor hardware. An experimental interface was created whereby the number of AGC channels, cross-over frequencies, compression thresholds and dynamic parameters could be manipulated. All channels were capable of executing the Cambridge dual-time constant algorithm. Listening tests were conducted for real-life situations, primarily those where competing noise would obscure only part of the speech spectrum. Speech perception testing was conducted for a pilot group of five participants, all experienced adult Harmony users. Improvements in sound quality were reported for MCAGC compared to the standard clinical program for listening in competing noise, representing: a car, an aircraft, air-conditioning and an office dominated by PC fan noise. Speech perception testing using some of the competing noises listed above also showed improvements across the group. The parameter space available is vast and optimization has certainly not been achieved. While much work remains to be done, it appears clear that at least two MCAGC channels provide benefit to cochlear implant users in real-world listening situations. Chronic use of MCAGC programs will guide the parameter set for a larger trial.

C07 – 276

Programming the Advanced Bionics' system for enhanced music perception

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A reasonable understanding of speech in quiet, and in some noise, is common for the large majority of cochlear implant recipients. The perception of music for many however, is still disappointing. This work investigates programs created specifically to enhance music perception. A range of program parameters was selected which might impact music perception. Changes to parameters were made iteratively, one at a time, while listening to familiar pieces of music played from CD. Electrode contacts showing no pitch differentiation from their neighbours were removed. Different settings of input dynamic range (I) were evaluated, along with linear amplification or input Automatic Gain Control (AGC). Stimulation rate was manipulated based on the electrical dynamic range being measured for a series of stimulation rates. Frequency response was modified through the channel gain settings. These changes were systematically made for two musically trained participants. Both were bilaterally implanted, used the Harmony processor and attended several programming sessions. A questionnaire was used to capture responses. For music a larger I than the 60dB

default was found beneficial. However, increases beyond 70dB were deleterious. Removing the front-end AGC was useful where the participant controlled the music's presentation level. A lower stimulation rate than the clinical default (highest sequential rate) was preferred, indicated by a maximization of electrical dynamic range. Emphasis of both high and low parts of the spectrum was preferred, bringing out previously inaudible parts. Both participants used their music programs for music listening, but standard clinical programs for speech. It appears that the default program settings for music perception are not the same as those required for optimal speech understanding. Changes were required on an individual ear basis for these bilateral users. A set of music defaults may be suggested, but should be evaluated on a larger group before being formally recommended.

A04 – 021

Parent observation – an effective assessment method for early speech and language development?

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Parents have been shown to be reliable sources of information on their own child's development, though their assessments are subjective. Parent questionnaires are, therefore, a generally well accepted method of assessing the early development of infants and toddlers. Still, not many valid tools exist for assessing the increasing young population of children receiving hearing instruments. The LittlEARS Test Battery was developed to assess early auditory, speech and language development of infants and toddlers with normal hearing (NH) or hearing impairment. Three parts are included in the battery: the Auditory Questionnaire, the Diary and the Early Speech Production Questionnaire. The Questionnaire assesses reactions to sound stimuli in the home environment. The Diary supports parents and professionals working with young children with hearing impairment by providing a place for descriptive and guided observations. The Speech Production Questionnaire assessed the earliest speech production in young children. Our investigations into the reliability and usability of these tools are yielding good results. The LEAQ was evaluated internationally on 3309 children with NH and a group of children with CIs. The children implanted before the age of two experienced auditory skill development on par with their NH peers, allowing them to bridge the gap in age-appropriate skills very quickly. Preliminary results for the evaluation of the speech production questionnaire are presented. Discussion: Assessment tools based on parent observation are a reliable method to assess the early stages of development in infants and toddlers with hearing impairment. These assessment tools cover all early developmental stages related to hearing and speech and allow parents and professionals to see the results of their chosen interventions.

A11 – 225

Anatomical considerations of cochlear morphology and its implications for insertion trauma in cochlear implant surgery

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Insertion trauma in cochlear implant surgery is a feared surgical risk, potentially causing neural degeneration and altered performance of the implant. In literature insertion trauma is reported to occur at specific locations (at the base, at about 180° and in deep insertions over 400°). This has been ascribed to surgical technique and electrode design in relation to the size of the scala tympani. This study investigates whether there is an underlying anatomical substrate serving as a potential source for insertion trauma at these specific locations. Eight human temporal bones have been harvested and preserved in formaline. A SkyScan-1076 micro-CT scanner (Aartselaar, Belgium) was used for data collection. The 3 dimensional path of the cochlear spiral was determined by segmentation, skeletonization, distance mapping and wave propagation technique applied on the micro-CT images. The most likely positions along this path at which a cochlear implant might induce pressure on cochlear structures, such as the basilar membrane and the wall of the scala tympani, due to deviation of the cochlear duct from a smooth trajectory were estimated with linear regression. The cochlear lumen shows a non-continuous spiraling path. Certain similarities in the shape and pattern of the central luminal paths in 8 different bones, strongly suggest that these potential pressure points occur more frequently at certain specific points along the cochlear lumen. It turned out that potential pressure points during cochlear implantation exist at the basilar membrane in the region of 180-225° (12-14mm) and 725° (22-26mm)

and at the floor of the scala tympani around 0-90°, 225-270° and 405-450° ($p < 0.00001$). Our data favour the idea that the intrinsic 3-dimensional cochlear morphology contributes to the risk for insertion trauma during cochlear implantation at specific locations.

D13 – 462

Initial clinical outcomes with the Modiolar Research Array (MRA) cochlear implant

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The HEARing CRC

This first-time-in-humans clinical study evaluated the surgical procedure and clinical outcomes for five postlinguistically hearing-impaired adult subjects who were implanted with a prototype Modiolar Research Array (MRA). The MRA is a prototype full length, pre-curved, thin perimodiolar array that utilises an external polymeric member in contrast to an internal stilet, to keep the pre-curved electrode straight prior to insertion via a cochleostomy. Five postlinguistically hearing-impaired adult subjects referred from the University of Melbourne Cochlear Implant Clinic participated in the study. All subjects had pre-operative low frequency hearing thresholds sufficient to assess the degree of preservation of residual hearing following implantation. Mean unaided thresholds for each subject (averaged across frequencies from 125 Hz to 1000 Hz) ranged from 34 to 65dB HL. Pre-operative and post-operative clinical assessments included unaided air and bone conduction thresholds, speech perception measures in quiet and in noise, and subjective ratings in the form of the SSQ questionnaire. All surgeries were performed according to a strict surgical protocol and a surgical questionnaire was completed following each surgery to document technical aspects of the surgical procedure. Post-operative x-rays were analysed to assess electrode position. Speech perception outcomes and subjective performance ratings for all subjects improved as compared with those obtained pre-operatively. Results indicate that hearing preservation is achievable with the prototype full length MRA electrode as used in this study. Surgical feedback on electrode design and surgical usability of the MRA was positive, with no surgical complications arising in any of the five surgeries. Post-operative x-rays indicated good perimodiolar electrode positioning and good insertion depth. This paper describes early surgical feedback and clinical data following implantation of the prototype MRA cochlear implant. Additional surgical experience and data is currently being collected in a larger number of subjects in a multi-centre clinical feasibility study. Initial experience with the prototype MRA cochlear implant is positive. The electrode design provides the possibility of preserving pre-operative levels of residual hearing while allowing for full electrode insertion and peri-modiolar positioning.

B12 – 394

Auditory brainstem implant: A longitudinal study

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For patients with lesions somewhere along the acoustic nerve, auditory brainstem implantation (ABI) is the only viable therapy for restoration of hearing. One of the main reasons for bilateral lesions is neurofibromatosis type 2 (NF2). Due to the low incidence of NF2, the number of ABI patients is small compared to patients with CI. Also, ABI is a complex intervention that requires interdisciplinary cooperation and is thus performed at a small number of centers only. Objective of the ongoing study is to longitudinally evaluate audiological performance of ABI patients using a Medel Pulsar Implant. 16 German speaking patients were implanted with a MEDEL Pulsar ABI and longitudinally followed during the first year after implantation. Test dates were at first fitting and at one, three, six and twelve months after initial activation. As performance measures we used the SERT environmental sounds recognition test, the MTP test (12 words closed set), HSM sentences and a subjective questionnaire. Speech reception tests were performed with and without lip reading. Due to their general condition on the background of their underlying disease, patients exhibited a high loss rate in the number of tests, where early fatigue often limits the amount of tests they can perform. Two patients, both NF2 cases, had no acoustic percept whatsoever and became non-users. One patient could only detect environmental sounds and up to now did not develop any kind of speech understanding. Five patients achieved 100% word recognition in the MTP closed set test without lip reading. Eight patients achieved some level of open speech understanding, four of which surpassed 50% performance (HSM sentences without lip reading). These four are all NF2 cases. For thirteen users, the ABI provided significant benefit over lip reading alone. The four best performers in our cohort were NF2 patients, thus NF2 is not a contraindication for ABI. Given the nature of the underlying disease, two non-users out of sixteen seems to be an acceptable ratio, especially when the majority of the users enjoys significant benefit for speech understanding.

C05 – 127

Fine structure processing strategy: results of the multicentric German FSP study

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Traditionally, stimulation strategies for cochlear implants convey only the envelope of the channel-specific band filtered signal, while the phase information is discarded. However, the phase alone contains enough information for normal hearing subjects to understand speech. New CI processors implement strategies that deliver phase information in addition to the envelope by placing bursts of stimulation pulses at the zero-crossings of the band-filtered signal. These strategies are referred to as “fine structure processing (FSP) strategies”. The contribution of this additional information to hearing performance is investigated. 46 CI users were tested in a prospective, multicentric, randomized ABA study. Subjects had at least 6 months of listening experience with the CIS strategy. In a two interval study, subjects performed a number of listening tasks with CIS and FSP, where testing with FSP was done acutely after switch-over. After three months of listening experience with FSP, subjects returned for a second visit and were re-tested with both strategies. Subjective benefit was assessed through a questionnaire. Subjects exhibit statistically significant improvement with the FSP strategy as compared to CIS. For most tasks, the benefit exhibited on the second visit only. In a pitch scaling task, the subjects’ pitch range expanded significantly towards lower frequencies. The questionnaire showed substantial and statistically significant subjective benefit. The majority of subjects chose to continue using the FSP strategy after participation in the study. second visit re-testing of CIS yielded neither improvement nor deterioration with CIS. We therefore conclude that the additional three months of CI usage do not account for the gain in performance, but have to be attributed to additional information conveyed by FSP. The fact that the gain is statistically significant at the second visit only, suggests, that the additional information has to be learned and interpreted by the subjects.

B07 – 234

Cochlear implantation in Jervell & Lange-Nielsen syndrome a cautionary report

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Jervell and Lange-Nielsen syndrome (JLN) is a rare, autosomal recessive, cause of congenital sensorineural hearing loss (SNHL) and abnormal cardiac rhythm. Patients have a tendency for recurrent syncope episodes, cardiac arrhythmias and possibly sudden death. Diagnosis is based upon the identification of a prolonged QT interval on electrocardiogram, associated with congenital SNHL. Several reports over the last decade have described successful cochlear implantation in affected individuals. The objective of this report is to review our unit’s experience with cochlear implantation in JLN. We performed a retrospective case-note review of the 3 children with JLN implanted in our unit, identifying patient demographics, cardiological treatments, and complications. In addition, pre- and post-operative auditory and communication performance was analysed. Case 1 was a 2 year-old girl who was found to have a prolonged QT interval when investigated for recurrent syncope attacks in the period following cochlear implantation. Mutation of the KCNQ1 gene, compatible with JLN, was identified. Cases 2 and 3 were both 3 year-old boys with implantable cardioverter-defibrillators (ICDs), and already taking a beta-blocker, prior to cochlear implantation. Case 2 died 2 years after the original surgery from an acute event unrelated to his cochlear implant. Case 3 had uneventful initial surgery, but intractable chronic infection necessitated explantation 5 months later. The child died in the immediate post-operative period due to cardiac arrest. In cases of JLN, beta-blockade is the mainstay of cardiac treatment, with some patients requiring an ICD. Targeted screening of paediatric cochlear implant candidates with unexplained syncope attacks or convulsions has previously been advocated. Based upon our experience, we perform electrocardiograms on all children undergoing cochlear implantation, with cardiology review of any child suspected to have a prolonged QT interval. This report adds a cautionary note to the expanding literature concerning cochlear implantation in JLN syndrome.

Cochlear implantation and congenital inner ear anomalies

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Although rare, a proportion of children referred for cochlear implant assessment will have inner ear abnormalities on radiological evaluation. Such children present several potential problems, including pre-operative assessment and evaluation, surgical technique and intra-operative problems such as the cerebrospinal fluid (CSF) gusher. This study was designed to assess the outcome of cochlear implantation in children with congenital inner ear abnormalities. We performed a retrospective review of all children with inner ear anomalies who had undergone cochlear implantation. Cases were identified from our paediatric cochlear implant database. Cases of post-meningitic cochlear ossification were excluded from the study. A case-note review was performed identifying patient demographics, operative findings and surgical complications. In addition, pre- and post-operative auditory and communication performance was analysed. 22 children were identified for further analysis. Fourteen children had enlarged vestibular aqueduct (EVA) and 8 children had Mondini dysplasia, with both abnormalities found in 3 cases. The remaining children had other radiologically demonstrable inner ear abnormalities. There were 4 cases of CSF gusher, all in cases of EVA. There was one major post-operative complication in a patient who developed a flap haematoma with subsequent displacement of the receiver-stimulator package requiring surgical repositioning. The extent of insertion of electrode array achieved in differing anomalies was variable, as expected. Children with EVA alone were found to have particularly good outcome following implantation. Surgical technique in such cases will be discussed, along with the management of intra-operative complicating factors such as CSF gusher. This study highlights the importance of good pre-operative radiological imaging and collaboration with a suitably experienced radiologist. Although challenging, cochlear implantation in children with congenital abnormalities of the inner ear is a safe procedure with the potential for good audiological outcomes in selected cases.

Cochlear implantation in cytomegalovirus deafened children

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Congenital cytomegalovirus (CMV) infection is a recognised cause of severe/profound sensorineural hearing loss. Concerns have been raised concerning the audiological outcome following cochlear implantation in such cases, due to the possibility of associated neurodisability and learning difficulties. The hearing loss associated with congenital CMV infection may be progressive, and of delayed onset, with children often otherwise asymptomatic. The purpose of this study was to determine the outcome of cochlear implantation in these children, with the findings subsequently ensuring that realistic information is given to parents of CMV deafened children prior to implantation. All children deafened by CMV were identified for this retrospective study from our paediatric cochlear implant database. A case-note review was performed identifying presenting features, patient demographics, and surgical complications. Pre-operative imaging was also reviewed. In addition, pre- and post-operative auditory and communication performance was analysed. Twelve children were identified for further analysis. The age at implantation ranged from 25 months to 7 years 8 months. Outcomes within this group were found to vary widely in respect of functional communication, despite the majority achieving good access to speech. The diagnosis of CMV related SNHL is often difficult and affected children are often 'asymptomatic' at birth. Whilst SNHL may be the only sequela of congenital CMV infection, the diagnosis should be considered in children with a background of rash at birth, intra-uterine growth retardation, neurological deficit or microcephaly, or when there are characteristic features on MR imaging of the brain. Although outcomes may vary, cochlear implantation can provide useful improvement in auditory performance in children with congenital CMV infection.

Cochlear implantation in Donnai-Barrow syndrome

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Donnai-Barrow syndrome is a rare autosomal recessive disorder associated with severe sensorineural hearing loss (SNHL). Several ocular abnormalities have also been described in this syndrome, including hypertelorism, down-slanting palpebral fissures, myopia and retinal detachment. The condition is

also associated with diaphragmatic hernia, exomphalos, absent corpus callosum and developmental delay. We describe the first recorded case of cochlear implantation in this rare disorder. This case of Donnai-Barrow syndrome was identified from our paediatric cochlear implant database. A case-note review was performed identifying patient demographics, operative findings and surgical outcome. In addition, pre- and post-operative auditory and communication performance was analysed. The child initially received a right cochlear implant at 39 months of age, but unfortunately the device failed 4 years post-operatively. Subsequently, bilateral simultaneous cochlear implantation was performed. BKB scores were 98% for bilateral implant use when tested 2 years post-operatively. Individual testing revealed a score of 94% for the right ear alone, and 80% for the left. The child achieved a 100% score on sound localisation testing using 3 speakers. The severe SNHL found in Donnai-Barrow syndrome is compounded by the potential for progressive visual loss. Diagnosis is dependent upon the identification of the characteristic pattern of clinical features, in association with a distinctive form of low molecular weight proteinuria, and may be confirmed on genetic testing. Affected individuals should undergo urinary protein electrophoresis, ophthalmological assessment, auditory testing and neuroimaging. Donnai-Barrow syndrome is a rare cause of SNHL; to our knowledge this is the first report of cochlear implantation to rehabilitate hearing loss in this condition.

Cochlear implantation in unilateral deaf subjects

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Subjects with severe to profound sensory-neural hearing loss on one side but normal hearing on the other do not fall in the indication criteria for cochlear implantation (CI). However, many unilaterally deaf subjects are also afflicted with tinnitus. This study was initiated to assess the influence of a CI on tinnitus in individuals with severe to profound unilateral deafness having also ipsilateral tinnitus. In addition it was investigated whether the CI improves hearing in adverse listening situations when combined with the normal hearing side. Five subjects were enrolled in the study. In monthly visits, the speech processor program was optimized and the hearing performance as well as tinnitus were monitored. Three subjects achieved an open-set speech understanding using the CI only. However, the subjects' group performance was below that of average CI subjects' scores. Speech perception tests revealed a significant benefit with the CI in combination with the normal hearing side for certain situations, which were not the same for each subject. In three subjects the tinnitus was significantly suppressed while wearing the CI. The other two subjects showed a situation dependent benefit in terms of tinnitus reduction. Positive effects were found regarding the hearing situation as well as the stress induced by tinnitus. However, not all subjects benefit from the CI in the same way. The results indicate that cochlear implantation in subjects with unilateral severe to profound hearing loss and ipsilateral tinnitus may be beneficial in a case by case basis. Further work is required to define the appropriate indication criteria.

Clinical outcomes of European MP3000(TM) optimization study in Freedom(TM) recipients

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1. MHH Hannover-GE, 2. Nijmegen-NL, 3. Basel-CH, 4. Maastricht-BE, 5. Varese-IT, 6. Piacenza-IT, 7. Gent-BE, 8. Zurich-CH, 9. Barcelona-ES, 10. Southampton-UK, 11. Las Palmas-ES, 12. VU Amsterdam-NL, 13. Bobigny-FR, 14. Koln-GE, 15. Strasbourg-FR, 16. Berlin-GE, 17. AMC Amsterdam-NL, 18. Halberstadt-GE, 19. Erlangen-GE, 20. Pamplona-ES, 21. Naples-IT, 22. Padua-IT, 23. Paris-FR, 24. Valencia-ES, 25. Kiel-GE, 26. Marburg-GE, 27. Warsaw-PL, 28. Wilrijk-BE, 29. Rome-IT, 30. Bari-IT, 31. Angers-FR, 32. Regensburg-GE, 33. Poznan-PL, 34. Marseille-FR, 35. Montpellier-FR, 36. Antwerp-BE, 37. Freiburg-GE, 38. Cochlear-EU

MP3000 is a new sound coding concept making use of a compression algorithm based on psycho-acoustical masking and has been implemented on the Nucleus® Freedom cochlear implant system. The primary objectives of this study are to investigate the preference for, and the performance with MP3000 in comparison to the ACE(TM) coding strategy. The secondary ob-

jectives include optimization of MP3000 fitting parameters and comparison of battery life. A prospective, multi-centre study was conducted in 9 different European countries including a total of 37 cochlear implant centres recruiting 247 Freedom users with open set speech recognition of 12 years and older. At study entry MAP-T/C levels were optimized and then a range of maxima (NofM) and masking function slopes were tested to optimize the MP3000 MAP. Speech tests in Dutch, English, French, German, Polish, Italian and Spanish were performed for MP3000 and ACE according to an ABABA design to compensate for learning effects. Diaries were used to log battery life during the study. At the end of the study recipients had to complete comparative questionnaires and indicate preferred coding strategy. In the total study population and in the populations of the different language areas no significant differences in performance between MP3000 and ACE were observed. The number of recipients preferring MP3000 was not significantly different from the number of recipients preferring ACE. Median MAP T and C profiles increase is 6 and 7 CLs when converting an ACE into an MP3000 MAP. Most recipients preferred MP3000 with high NofM and narrow masking functions. A significant average battery life improvement of up 39% was found. MP3000 coding delivers speech perception performance equivalent to ACE coding strategy and is equally preferred as the ACE strategy by Freedom users used to the ACE strategy. Most recipients benefit from MP3000 by an improvement in battery life. Study sponsored by Cochlear AG, Basel.

C06 – 130

The use of the psychoacoustic masking based strategy MP3000 in newly implanted Cochlear Implant Subjects

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In normal-hearing listeners acoustic masking occurs depending on frequency, amplitude, and energy of specific signals. If the selection of stimulated channels in cochlear implant systems was based on psychoacoustic masking models, stimulation patterns would be more efficient by concentrating on perceptually relevant signal components and neglecting those that are usually not perceived by normal hearing listeners. MP3000 is a new strategy making use of a psychoacoustic masking model derived from normal hearing listeners. Data from the European cross-over study on MP3000 as well as MHH data showed equal performance between the conventional ACE and the new MP3000 strategy, while the battery operating time was significantly extended when using MP3000. Also, no group preference for either strategy could be found. To investigate, if the long experience with the conventional ACE strategy in the study group biased the subjects' decision for one particular strategy, a new study has been set up to evaluate the MP3000 strategy in a group of newly-implanted subjects without previous experience. All subjects received ACE as well as MP3000 during the initial fitting session and were instructed to use both strategies at home for at least one month continuously. Immediately after each one month period with either one strategy subjects filled out a questionnaire on sound quality, music perception and ease of listening. At the three months follow-up appointment, speech perception measures with both strategies were conducted. So far, 17 subjects have passed the 3 months appointment. Results from the HSM sentence test in quiet and in noise showed equal performance between the strategies. Group results in quiet were 62% correct for the MP3000 strategy and 61% correct for the ACE strategy. 10 subjects preferred MP3000, while only five subjects expressed a preference for ACE. Two subjects had no preference at all. MP3000 seems to be a viable alternative for ACE. Preliminary data from our first-fitting study show a trend towards MP3000, while speech perception is equally good. MP3000 also gives significantly longer battery life over the conventional ACE strategy.

A13 – 372

Quality of life measures for patients with bilateral cochlear implants

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It has been well established in literature that hearing difficulties can have an adverse effect on the quality of life of the individual. Cochlear implants can improve the patients' quality of life. To date, there have not been any published studies on the patients' views on how their life changed when they got two cochlear implants sequentially. The aim of this study is to investigate the quality of life in patients with bilateral cochlear implants. More specifically, to design and validate a questionnaire which measures their quality of life. This study sample consists of patients from the UK National Health Service who have received two implants sequentially. They were sent an open-ended questionnaire and interviewed. Their responses will be used to develop a close-ended questionnaire for the same purposes. This will be validated with

the help of more patients. Questions in the open-ended questionnaire aimed at prompting responses about the patients' view of how the second implant changed their lifestyle and comparing their present quality of life to when they only had one implant. The conceptualisation of the data emerged from the actual data itself. Categories from the qualitative data were identified. Interviews were then held with the same patients in order to further explore this area. The concepts that emerged were the foundations on which the first version of the close-ended questionnaire was developed. These concepts will be discussed in more detail. Better understanding of quality of life after receiving the second implant will aid professionals dealing with these patients in understanding what the practical limitations of these devices are and advising future patients accordingly. Quality of life is a difficult concept for the paediatric population to understand. Therefore this study was performed with adult patients. However, the concepts that were explored are transferrable to the paediatric population.

C09 – 294

Sound advice; A service for cochlear implant users

Cameron M.

The Ear Foundation

As cochlear implant centres strive to provide services for the ever growing numbers of cochlear implant patients, alternative ways of delivering services in the long-term are being considered, to maximise the benefit of the technology. Sound Advice is one of these. Sound Advice provides a range of services to increase the effectiveness of cochlear implantation: individual therapy sessions, formal assessments, group communication sessions, technical advice, time to talk and discuss issues particular to an individual or family, and group support sessions for implanted adults and families. The team consists of an audiologist, teacher of the deaf, speech therapist and educational psychologist all experienced in deafness and cochlear implantation. In a few months the team has seen 16 children and 30 adults aged 2 to 82 from throughout the UK. Referrals come from individuals, charities, education services and cochlear implant centres, and demand is greater than our capacity. Parents of implanted children and adults often have a range of questions which they would like to explore in confidence. Parents want to know how to support their child's progress with listening, language and speech development over the years, and help in choosing education services. Adults need specific support in coping with different listening environments, in developing communication strategies and value meeting other adults. All require advice on how to use the technology and accessories. Evaluations reveal the benefits of receiving individual advice and addressing individual issues in managing the technology. The take up and response to Sound Advice demonstrates the need for ongoing, impartial, up-to-date support and advice after implantation. It illustrates one way of meeting the increasing demand from cochlear implant users for long-term support, and in supporting cochlear implantation in managing growing numbers.

A07 – 201

The sound of stress-related hearing disorders

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Individual differences in neural and hormonal responses to stress may contribute to well-known individual differences in human vulnerability to hearing loss and tinnitus. At present, the biological determinants of individual susceptibility to hearing loss and tinnitus are unknown. Various stress response systems appear to be fundamental in dealing with a variety of different challenges. Whether particular stressors elicit pathology may depend on the particular system under investigation and its ability to adapt to the stress load imposed on that system. The goal of this presentation is to focus on major developments related to the biological mechanisms that underlie stress-related hearing loss and tinnitus and to review some of the new pharmacologic approaches to prevent and treat hearing loss and tinnitus. More specifically, the following issues will be discussed: a) to characterize the relationship between stress and hearing disorders, b) to review the biochemical signalling pathways underlying acute and chronic stress responses and their influence on the auditory system, c) to discuss sex-related differences on stress-related hearing disorders; and d) to give a survey over new pharmacological strategies that are used to protect against stress-related hearing disorders.

C15 – 431

Enhancing signal to noise levels for Cochlear Implant users in mainstream classes through active feedback technology

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Cochlear implants have transformed opportunities for children born, or becoming, deaf in their early years enabling many to proceed to mainstream schools. Nevertheless, even for a bilaterally implanted child, the school classroom presents many challenges: high levels of ambient noise, reverberation and competing speech from children working in other groups. This paper describes an approach to improving signal to noise levels through establishing a means for self-regulation of the noise levels. The Classroom monitor (CM) continuously monitors and records the loudness level in the room for the purpose of later analysis, and provides real-time feedback in the form of a modified traffic light system to aid self-regulation. Baseline measures were established using triangulation methods including the Student LIFE UK questionnaire, teacher observations (TEACHER TOOL) and a number of acoustic measures of the classrooms including signal to noise levels at the ear level of the cochlear implant users, LAeq, LA10 and LA90. The CM was installed in classrooms. Matched classrooms were used as controls with the CM in data collection mode only. Questionnaires were repeated following the testing phase. Acoustic data was obtained throughout the trial period and analysed according to classroom activities. Results will be presented for a four-week evaluation. The inclusion of cochlear implant users into mainstream schools is predicated on the assumption that the acoustic environment is appropriate for the particular child. It has been demonstrated that using a cochlear implants when the signal levels is poor creates a significant challenge to participation. The Classroom Monitor provides useful self monitoring feedback to improve listening conditions in classrooms and creates environments that are more suitable for children using cochlear implants. Understanding the listening challenges found in everyday life is an important driver of improved performance, listening comfort and quality of life for CI users.

D05 – 186

Performance differences in pre-lingual implanted children

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Evaluate hearing capacity and the development of production and understanding of oral language in pre-lingual deaf implanted children. Thirty-two non-syndromic children implanted at the University Hospital of Geneva between 1998 and 2007, with a mean period of implant use of 6 years (1 to 13 years), were included. All follow the same rehabilitation program. Evaluations were made with measures of hearing thresholds, phoneme identification, categories of auditory performance, rating of the intelligibility of speech, discrimination test. All the children have similar hearing thresholds but different oral language production. All the children have similar hearing thresholds, meaning that they receive through their implants equivalent hearing information. Nevertheless their development in oral communication varied. We discuss here relevant factors influencing the evolution in language acquisition.

D03 – 167

Protection of high and low frequencies from round window dexamethasone during hearing preservation – an experimental study

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Aim: To protect low frequency hearing during cochlear implantation. **Background:** In our previous experiments we have demonstrated that the application of dexamethasone to the round window can preserve high frequencies during hearing-preservation cochlear implantation in the guinea pig. This experimental model did not lead to significant low frequency hearing loss, so it has until now not been possible to determine whether low frequency preservation was possible with this approach. However, preservation of low frequencies is critical, as this is the range in which most patients have residual hearing. In these hearing-protection experiments a greater magnitude of low-frequency hearing loss was achieved by performing the cochleostomy and implantation in the second turn of scala tympani. **Methods:** Dexamethasone was adsorbed into Seprapack, and under anaesthesia of ketamine and xylazine applied to the round window of the guinea pig prior to cochlear implantation. The duration of pre-treatment and concentration of the drug were varied (2% w/v for 30, 60 and 120 minutes; 20% for 50 minutes, saline controls). Auditory sensitivity was determined

pre-operatively, and at regular intervals up to one month post-operatively, with pure-tone auditory brainstem response audiometry (2-32 kHz). Cochlear implantation was performed via a cochleostomy filled into the second turn of the cochlea, into which a miniature cochlear implant dummy electrode was inserted using soft-surgery techniques. **Results:** There was a flat hearing loss of approximately 30dB across the frequency range due to the surgery. There was significant protection of both high and low frequencies from the dexamethasone treatment. **Conclusions:** Provided that the steroid is applied to the round window for long enough, diffusion of dexamethasone can protect both high and low frequency hearing during cochlear implantation.

C06 – 131

The comparison of Mandarin speech identification and tone identification between ACE and CIS speech processing strategy

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There are only four patterns of tone in Mandarin and their perceptual cues are carried mostly in fundamental frequency of vocal folds, which are not coded by current speech strategies. The consequence is the poor tone perception. The purpose of this study was to investigate the effect of CIS and ACE on cochlear implant (CI) children's performance of mandarin speech and tone in quiet vs. noise. 1. **Subjects:** Participants were 10 children who have been using ACE from the switch on of their CI devices. 2. **Instruments:** (1)Tone identification: Four lists of monosyllable words, each containing 25 words of different tones (Wei, Cao, and Zeng, 2004). Scores were represented in percentage of correctness. (2)Speech identification: Three lists of picture identification, including vowels (16 items), consonants (21 items), and sentences (10 items) (Chen, 1999). The responses across of the three lists were summed and represented in percentage of correctness. 3. **Experimental Design:** Speech and tone perception tests were administered in quiet and noise (+5dB SNR) with ACE and CIS strategy, in two weeks apart. Speech strategy had no effect on speech perception either in quiet or in noise and it had no effect on tone perception in quiet. However, CIS provides significantly higher scores of tone perception in noise than ACE. Nevertheless 60% of the children preferred ACE than CIS. The possible reasons were that children were used to ACE strategy and the benefit of CIS strategy in noise might be too small to be noticed. The scores of speech perception, 74-89%, were higher than scores of tone perception, 56-75%; regardless of the mode of speech coding strategy and conditions, noise vs. quiet. There are only four patterns of tone in Mandarin, which is a lot less than the number of speech sounds. However, tone perception is worse than speech perception. Before we see more improvement in speech strategy to code acoustic characteristics of tone, it is worthwhile to try ACE for CI users who are used to be surrounding by noise.

A13 – 373

Language outcomes in school aged children following bilateral cochlear implantation

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The literature consistently reports the benefits of simultaneous and sequential bilateral cochlear implantation in children. The general consensus, however, is that sequential bilateral cochlear implantation may be less effective when the child is older than 7 and when there is a difference of 3 or more years between having the first and second ear implanted. Most of these results are based on cortical potentials, speech perception performance and localisation. Increased access to directionality and orientation with bilateral cochlear implantation was hypothesized to improve the pragmatic performance of school aged children. For example, improved localization in the playground was expected to enhance the child's ability to take turns. This study therefore aimed to investigate the impact of bilateral cochlear implantation on communication skills including pragmatic abilities. A phonology assessment was included in the test battery to determine whether there were any incidental improvements in children's communication that has not been reported to date. Five school aged children aged between 6-12 years received a sequential bilateral cochlear implant. The average time interval between the first and second cochlear implant was 4 years. The core subtests of the CELF IV were administered and the Diagnostic Evaluation of Articulation and Phonology prior to receiving their second cochlear implant. Children were retested 12 months following their bilateral cochlear implant. All children received an intensive period of weekly auditory verbal therapy immediately following their second cochlear implant for between 3-6 months. In addition these children also had speech perception testing for each ear separately

and binaural testing. During testing the audiologist rated the response time of the child according to the criteria used in the CELF IV. Results were analysed according to the child's speech and language age and chronological age. The child's previous speech and language scores were also used for within subject analysis. Single subjects showed improvements in some of the features measured in section 3 of the CELF IV, however these were not statistically significant. Trends observed in the analysis of results will be discussed. Speech perception results were not always significantly better following bilateral cochlear implantation, however the time and effort taken to respond to stimuli was rated as improved according to the ratings on these parameters. Although not all school aged children demonstrate significantly better scores on speech production, language or speech perception scores following sequential bilateral cochlear implantation the benefits in amount of effort and time taken to respond, and a the child's pragmatic abilities were identified. This is consistent with a reduction in the amount of effort required for these severe to profoundly deaf children to communicate than when using one cochlear implant in isolation.

B01 – 051

Early implantation in children with Auditory Neuropathy Spectrum Disorder (ANSD)

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Since the introduction of newborn infant screening 6 years ago, over 40 children have been implanted under the age of 12 months at the Sydney Cochlear Implant Centre. All children underwent preoperative electrophysiological testing which provided diagnostic for the presence or absence of the auditory neuropathy spectrum disorder. Ten of the children implanted were identified as being on the spectrum. This paper will highlight the progress of 5 children diagnosed with ANSD and 5 children who did not have any characteristics of the ANSD following cochlear implantation. Electrocochleography, transtympanic EABR, Acoustic ABR were used to perform differential diagnosis of the infants prior to cochlear implantation. Of the children who proceeded to cochlear implantation functional audiological evaluation, and speech and language measures were made prior to surgery and at 6 monthly intervals post operatively. All children received a single sided cochlear implant. Some children proceeded to have a bilateral cochlear implant with an increasing number having their second cochlear implant within the first year of cochlear implantation. Electrophysiological testing was performed during surgery, and a those children identified with ANSD were tested with cortical evoked potentials. All children were managed with auditory verbal therapy during their acute management at SCIC. Some of the children originally diagnosed with ANSD were able to make similar gains to their peers who had a severe to profound sensorineural loss with no evidence of ANSD. The performance of children varied amongst individuals, however group data shows that the on the whole children implanted under the age of 12 months showed patterns of speech and language development consistent with their hearing peers Early intervention with severe to profoundly deaf children with and without ANSD is consistent with speech and language development evidenced in hearing children. There is considerable variability in the outcomes of children receiving cochlear implants regardless of the diagnosis of ANSD.

B13 – 400

Outcomes of pediatric cochlear implantation in patients with inner ear malformation

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Cochlear implantation (CI) in patients with inner ear malformation (IEM) is not contraindicated any more if preoperative radiologic and electrophysiologic examinations are performed meticulously. The objectives of this study was to evaluate long-term outcome of CI in patients with IEM and to assess if there is any prognostic indicators in these patients. From 1992 to 2008, a total of 144 patients with IEM were operated on at 2 tertiary referral hospitals. Their medical records and temporal bone high-resolution CT images were reviewed retrospectively. Age-matched CI patients without any IEM were allocated as the control group. In a series of 144 consecutively investigated CI patients with IEM, the most common malformation was incomplete partition type II (IP2) with enlarged vestibular aqueduct (EVA) (36/144, 25.0%), followed by EVA alone (27/144, 18.8%). With regard to the warble tone thresholds, all the malformations except common cavity (CC) showed no statistically significant difference when compared with the control group. All the enrolled malformations groups showed gradual improvement in CAP scores, and the IP2, EVA, narrow internal auditory canal and vestibular malformation groups showed more than CAP 4 on average at 36 months after the implantation. The average

CAP scores of the IP1, CC and hypoplastic cochlea group were less than 4 at 36 months after the implantation, but these groups also showed gradual improvement of performance. Our analysis of the rehabilitation results revealed that most of the patients with IEM can benefit by CI. With the development in the preoperative evaluation methods and various types of custom-made electrodes for the patients with IEM, speech rehabilitation in these patients may become more successful.

B01 – 049

P1 latency and MMN in children with auditory dys-synchrony

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Auditory dys-synchrony is a hearing disorder characterized by poor speech discrimination disproportionate to the degree of hearing loss, abnormal or absent auditory brainstem response in the presence of normal otoacoustic emissions and cochlear microphonics, absent acoustic reflexes, absent efferent suppression of otoacoustic emissions, absent masking level difference. In this study we aim to explore the differences in cortical auditory evoked potential measures in patients with auditory dys-synchrony managed with either a cochlear implant or conventional hearing aids. 16 children who were diagnosed as having auditory dys-synchrony were included in the study. The age range of all the subjects was 1 year to 15 years. The age range at the time of implantation was 20 months to 46 months for the patients who received a cochlear implant. P1 and MMN cortical auditory potentials were measured in these children when their speech processor or hearing aids were on and off position. The relationship between speech perception scores and cortical evoked potentials will be presented. The differences in terms of speech perception, language development and the Cortical evoked auditory potential results between the patients with CI, with hearing aids will be discussed. Significant improvement is obtained in hearing, speech perception and language development in all patients with auditory dys-synchrony after cochlear implantation and hearing aid use in some patients. The objective data obtained through cortical potentials also indicates that cochlear implantation can be an option to overcome dys-synchronization and to provide a potentially successful method of habilitation.

B02 – 060

New fixation system in Nucleus Freedom Contour Advanced CI

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Small incision in cochlear implant surgery has improved cosmetic and post-operative morbidity. However it makes more difficult to securely fix the device in place. We describe a simple technique for implant receiver/stimulator fixation using miniplates and titanium screw. Our experience in Claros Clinic starts in November 2007. 68 patients underwent cochlear implantation over 14 months period using this technique. A 2 cm postauricular skin incision is done and after creating a bed for the receiver/stimulator unit in the skull, we use a modified miniplate with two screw for CI fixation. All plates are made of pure titanium. This proven biomaterial allows for low-profile, easy to contour plates, while maintaining optimal plate strength. The pediatric patients implanted with this system are between less than 1 year old and 18 years old. No complications have been observed. Successful secure fixation was obtained in all cases. - Prevention of receiver-stimulator movements in the bed over temporal bone. - Surgical techniques with this system vs other materials like classic stitches or bio-resorbable plating microfixation. From January 2009 we start to use a new system, LactoSorb®; (Copolymer of 82 L-lactic acid and 18 glycolic acid), the only clinically proven material that completely resorbs and is eliminated from the body within one year.

B07 – 236

Jervell Lange Nielsen Syndrome in cochlear implants

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Jervell Lange Nielsen Syndrome (JLNS) described by the first time in 1957 associates deep hereditary deafness and cardiological disorders, specially prolongation of the interval QT in the ECG. The clinical manifestations of syncope after physical effort or exhibition to intense noise, they can be mortal if they are not diagnosed and treated prematurely. This is a presentation of a 7 years old child affected of deep congenital bilateral sensorineural hearing loss with

cochlear implant at age 4. Both parents present deafness, there exists a family history of deafness and sudden death to early ages in both families. The latter result was discovered after presenting two episodes of perspiration, cutaneous pallor and sickliness after an effort that they yielded spontaneously and a last severed episode in rest that registered in the ECG an interval QT in the high limit inside the normality, that was the reason why he was submitted to more complete cardiological study, suspecting JLNS affection. The clinical evolution of the postimplant patient is satisfactory both in tonal level and audiometrical as like as level of acquisition of the language. The cardiological complete study was asymptomatic and the clinical evolution up to the current importance also. Nevertheless precaution has been advised before physical important efforts and is submitted to frequent cardiological reviews. JLNS is depending on the family genetic study. Though the JLNS is slightly frequent, due to the gravity pronostic is important to carry out an early diagnosis. The detailed family anamnesis of sudden death in child with deep deafness could be the most early clinical, easy and suggestive information for the diagnosis. Though the cardiological exploration doesn't show evident alteration at early time, it is important to avoid trigger situations of syncopate symptoms and to make a genetic family study that can be definitive in the early diagnosis.

D07 – 315

The role of low-frequency hearing in the acquisition of morphology

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Pitch-marked elements are more prominent in running speech than those that are unmarked. Particular morphemes, such as the indefinite article (a), occur more frequently in the presence of a pitch-marked noun. Children therefore acquire indefinite articles more easily than their definite counterparts (the). In previous work we have found that the grammar of cochlear-implanted children does not show the same preference for indefinite articles. These findings are assumed to result from their deficient perception of voice pitch. In order to test this hypothesis, different populations of deaf and hearing subjects have been tested on their perception of low-frequency hearing, in particular pitch-related morphology. 19 deaf adults, 19 deaf children (age range 5-15 years) wearing different types of hearing devices (CI, HA and bilateral CI+HA) and 30 hearing adults and 19 hearing children (age range 6,5-12 years) have been tested on 2 intonation tasks, in which pairs of mono- or bisyllabic words were to be discriminated on the basis of differences in pitch accent in a same/different paradigm (16 pairs of natural speech words and 16 pairs of words low-pass filtered at 500 Hz). Performance outcomes in discrimination were examined in terms of the type of hearing device and type of stimulation. The results confirm that CI-users perform significantly worse on intonation tasks than hearing controls. The simultaneous use of a HA in the opposite ear significantly improves their performance. CI-children have difficulties in hearing subtle changes in fundamental frequency. This is reflected in their poor performance on intonation tasks. Therefore, pitch-marked nouns are less easily perceived in incoming speech, resulting in a delay in the acquisition of indefinite articles. EAS is expected to improve low-frequency hearing and as such to have a beneficial effect on the acquisition of morphology.

B14 – 412

Reading abilities in deaf children: Respective and/or combined contribution of early age at implantation and exposition to Cued Speech?

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Background: Deaf children typically exhibit literacy difficulties (Chamberlain & Mayberry, 2000). The main reason is that phonological processing is critical in reading, even for deaf individuals. There is now a substantial body of evidence showing that different new aids such as Cochlear Implantation ("CI") and Cued Speech exposition ("CS", manual system aimed at resolving the ambiguity inherent in lipreading), can respectively improve speech perception (CI: Pisoni & Geers, 1998; Watson et al., 2006; CS: Charlier & Leybaert, 2000; Paire-Ficout et al., 2003) and reading abilities (CI: Archbold et al., 2008; Geers, 2003; CS: Colin et al., 2007; Leybaert & Lechat, 2001). These different studies showed that the age at implantation or exposition to CS is a significant factor

in the development of phonological and reading skills. Objective: The aim of this study was to observe the respective and/or combined contribution of CI and CS in the development of reading abilities. Participants: Two groups of French-speaking participants, profoundly deaf and hearing children from 7 to 10 years old, took part in the study; the group of deaf participants was split into four sub-groups on the basis of the age at implantation (earlier vs lately) and exposition to CS (earlier vs lately). All the participants preferred an oral communication mode and had no other significant handicapping conditions. The deaf children were recruited from different regular primary schools (from grade 2 to grade 5). Methods: This transversal study explored the performances of the deaf children in different phonological and reading (write word recognition and comprehension) tasks. The first results showed a positive effect of early exposition to CS in deaf children who had been early implanted in all tasks. These results suggest that the younger a child is implanted and exposed to CS, the more likely they are to be able to develop accurate phonological representations and efficient reading abilities.

C08 – 285

LittIEARS® Auditory Questionnaire

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With more children receiving cochlear implants during early infancy, there is a need for appropriate and validated assessments of auditory skills in the pre- and postoperative phase. The LittIEARS Auditory Questionnaire (LEAQ) was developed as a praxis tool to assess the auditory behaviour in children of 0-24 months of age. The LEAQ (Weichbold et al 2005) was designed to supply a picture of auditory behaviour and functioning for children in daily life conditions. The questionnaire contains 35 "yes/no" questions documenting the receptive, semantic, and expressive behaviours and milestones which normally constitute an infant or toddler's reactions to auditory stimuli in the natural environment. Normally, parents complete the questionnaire. The LEAQ score (total of "yes" responses) can be interpreted and evaluated in a within-subject monitoring way and/or compared to external reference data collected in groups of normal hearing children. LEAQ has been adapted/translated so far into 15 languages (Coninx et al). Age dependent norm values turn out to be largely language and culture independent. This not only confirms the validity and applicability of the originally German questionnaire but also allows cross-lingual and cross-cultural comparisons. Some case studies and group data of children with hearing aids and/or cochlear implants will be shown. Also, the use of LEAQ as a screening tool (second screening after NHS) will be presented, based on first data from n=3000 children from a German study. Weichbold V, Tsiakpini L, Coninx F, D'Haese P. (2005). Konstruktion eines Eltern-Fragebogens zur Entwicklung des auditiven Verhaltens von Kleinkindern bis zu zwei Jahren. [Development of a parent questionnaire for assessment of auditory behaviour of infants up to two years of age]. *Laryngo Rhino Otol* 84:328-334. F. Coninx, V. Weichbold, L. Tsiakpini et al. (2009). Validation of the LittIEARS® Auditory Questionnaire in children with normal hearing. Submitted for publication.

B08 – 245

Behavioral problems in children using a CI, a comparison between children with and without multiple handicaps

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The behavioural problems of children with CI were examined, in order to contribute to the discussion whether a CI decreases or increases social and emotional problems in deaf children. A distinction was made between children without and with additional handicaps (low cognition, neurological problems, diagnosed psychiatric disorders). Interactional processes between hearing impairment, additional handicaps, language problems and behavioural problems were analyzed. From 27 children with a CI, aged 1-8, the behavioral problems were assessed using the Child Behavior Checklist. Language comprehension and production were tested with the Reynell comprehension test and the Schlichting language production test. The assessments made in the selection phase of our CI program were used to make a distinction between children with and without additional handicaps. The children with CI and without additional handicaps did not show more behavioral problems than the children from the norm group of the CBCL. From the children with CI and additional handicaps, 33% had a clinical score on the Total Behavior Scale of the CBCL, 42% on the Externalizing Behavior Scale. These percentages differ significantly from the 10% found in the norm group. No correlation was found between language scores and behavioral problems, when controlled for 'with and without additional handicaps'. Children with a CI and without additional handicaps do not have more behavioral problems than hearing children, when aged 1 to 8 years.

The benefits of a CI on hearing and language appear to extent to their social and emotional development. In children with a CI, an additional handicap is more interrelated with behavioral problems than a language delay. The social en emotional development of young children with CI and without additional handicaps is age-appropriate. When discussing their rehabilitation programme, a distinction must be made between children with and without additional handicaps.

D14 – 466

Robotic cochleostomy – a porcine trial

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Protrusion of the drill tip through the endosteal membrane whilst performing a cochleostomy not only appears to be one of the main causes of a reduction in post operative hearing levels but has been suggested by Nadol to be one of the contributing factors for post operative meningitis. Our aim was to produce an autonomous drilling robot capable of performing a bony cochleostomy whilst minimizing the damage to the underlying cochlear endosteum. In this laboratory based study, a robotic drill was designed to measure the changes in force and torque experienced by the drill tip during the drilling process. This information is used to predict the point of breakthrough and stop the drill prior to damaging the underlying endosteal membrane. The robotic drill was used to perform cochleostomies on 20 porcine cochleas. After the robot had completed its task, an assessment was made of whether a successful bony cochleostomy had been performed, the integrity of endosteal membrane was then assessed. The autonomous surgical robotic drill successfully performed a bony cochleostomy and stopped without damaging the endosteal membrane in all 20 cases. The autonomous surgical robotic drill can perform a cochleostomy whilst minimizing the trauma to the endosteal membrane. The system allows information about the state of the drilling process to be derived using force and torque data from the drill tip. This information can be used to effectively predict drill breakthrough and implement a control strategy to minimize drill penetration beyond the far surface. Using this system in paediatric cochlear implantation would minimize the trauma sustained by the cochlea. The effect of the autonomous robotic drill on complications and residual hearing is subject to ongoing investigations.

A08 – 213

Spatial hearing and music perception abilities in subjects using a combination of electric and acoustic stimulation

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Recent advances in electrode technology and in surgical insertion techniques have resulted in the preservation of acoustic low-to-mid frequency hearing in many cochlear implant recipients. Recipients who have such hearing preservation are potentially able to make use of two hearing aids used in combination with a cochlear implant. The aim of this clinical study was to assess the benefit of use of the residual hearing in the implanted ear. Twelve adult subjects, implanted with either the Nucleus Contour Advance (or a research full-length electrode array) or the Hybrid-L24, participated in the study. Clinical testing was conducted to assess the benefit of using the ipsilateral hearing aid (i. e. comparing the 'combined' condition using two hearing aids and the cochlear implant with the 'bimodal' condition using only the contralateral hearing aid and the cochlear implant). All testing was conducted a minimum of three months after initial activation. Speech perception was evaluated in a range of speaker configurations to measure spatial hearing abilities. Localisation ability was measured using an 8-speaker array with a 180-degree span. Musical tests included pitch ranking of sung vowels, identification of stretched or compressed melodies and sound quality ratings. For most subjects benefits were observed in the combined condition as compared with the bimodal condition for tests of speech perception in noise, sound localisation, musical sound quality ratings and functional performance in real-world listening situations. No measurable improvement was observed on objective music tests. The use of residual acoustic hearing in the implanted ear provides the potential for significant improvement in clinical outcomes for cochlear implant recipients.

A12 – 371

The binaural implantation – a necessity instead of a choice: case report

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The restoration of hearing by bilateral cochlear implantation can be nowadays a choice sustained by the possibility of a better speech understanding, better hearing in noise and a better spatial localization. The Neurelec binaural implant, stimulating both ears with a single device, presents economical and surgical advantages. We report a special case of a young man with postlingually evolute profound hearing loss, who benefit of a binaural implant from neurological reasons. Before the surgery, we made the standard medical and audiological review. The MRI showed an asymmetry of the configuration of the brainstem on the left side, but the neurological exam was normal. The imaging results suggested a degenerative disease. The patient was implanted with a binaural cochlear system. We evaluated the results using some subjective and objective methods (electrically auditory brainstem response - EABR). The postoperative evolution was very good, with significant progresses in communication and in quality of life in short time. We did not identify differences between left ear and right ear regarding the tonal hearing and speech discrimination, but the latencies of EABR were longer on the left side. Knowing that degenerative diseases can contraindicate the cochlear implantation, despite the imaging results, in the absence of neurological symptomatology, we decided to implant the patient. Receiving a binaural implant, the possible effects of a degenerative neurological disease could be ameliorated and the patient has the chance to conserve the hearing at least on one ear. This patient could be at the limit of indication for a cochlear implant, but an unpredictable neurological disease shouldn't represent an absolute contraindication for a cochlear implantation. In one year after the implantation, no hearing degradation was noted and none neurological symptom. We considered the choice of a binaural implant by necessity for this patient the best possible solution.

B05 – 078

Revision surgery in paediatric cochlear implantation: our experience

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The aim of this study is to analyze the incidence and problems implied with revision cochlear implant (CI) surgery in children. A retrospective chart analysis of 7 cochlear implant revision surgeries performed on children at our Institution between 1994 and 2008 by the first author. The causes of reimplantation were classified as hard device failure, soft device failure, exposure/infection, magnet migration, electrode dislocation. 468 cochlear implants were performed during the study period including 7 revision procedures. 219 of them were children. The rate of revision surgery in the paediatric population in our population was 2.3% (5 out of 219 cases). The series include also 2 cases of revision surgery in which the first CI was done in other Institution. So the overall rate was 3.2%. Hard device failure occurred in 2 cases (28.6%); one patient had a traumatic device failure (14.3%). A traumatic magnet migration/dislodgment occurred in 1 child (14.3%). 2 cases of exposure/infection (28.6%) were observed. They were explanted for intractable infection leading to exposure of the device after several conservative treatment including antibiotic courses and surgical drainage of secretions. A bio film on surface of device was demonstrated in one of them and suspected in the other one. In 1 case (14.3%) the electrode was originally misplaced in an other institution. The array was found to penetrate the vestibule and the ampulla of the horizontal semicircular canal. All patients received small incision revision surgery. There were not intra-operative complications and postoperative course was normal. All cases had full insertion of the array. In 4 cases we used the same device, in other 2 a different one. Auditory performance after CI was equal or greater than preoperative one. Revision cochlear implant surgery is an infrequent occurrence. Full insertion was achieved in all cases. Good audiological results demonstrates that the surgical trauma is comparable to that of the primary procedure. Special attention is required to main surgical landmarks.

Comparison of bimodal and bilateral cochlear implant users

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Many cochlear implant users have difficulty with speech perception in noise, music appreciation, tone of voice recognition, and talker identification. These tasks rely on pitch perception, which is generally poor in cochlear implant users because of the speech processing algorithm. Amplitude envelope information is extracted from the incoming sound; the temporal fine structure, which is important for pitch perception, is mostly discarded. Bilateral cochlear implantation provides benefit in terms of localization and speech recognition in noise, but does not solve problems related to poor pitch discrimination. Benefit may also be obtained by using a hearing aid on the contralateral ear to the implant: bimodal hearing. Thirteen bimodal and thirteen bilateral cochlear implant users were compared on speech recognition with a competing talker, music perception, tone of voice recognition, and talker identification. In order to categorize the extent of residual hearing required for bimodal benefit, a unique cochlear implant subject with normal hearing in the contralateral ear was evaluated on speech recognition with a competing talker. Although there was no significant difference in group mean scores between the bimodal and bilateral cochlear implant users, examining data further showed a slight advantage for the bimodal users. Evaluation of the subject with normal hearing in the contralateral ear showed that the addition of low-frequency sound, even when unintelligible and limited to below 150 Hz, significantly improved cochlear implant speech recognition with a competing talker. This research suggests that bimodal stimulation offers equal or better performance than bilateral cochlear implantation on these four tasks in adults. Bimodal stimulation should be attempted before considering bilateral implantation. In the UK we may soon be able to offer two implants to all congenitally deaf children. We will share our centre's protocol to assess which children should use a bimodal configuration and which would benefit from two implants.

Nottingham Auditory Milestones: a profile to monitor the growth of active listening, understanding, auditory memory and sequencing in babies and young children in the first three years after receiving cochlear implants

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Nottingham Cochlear Implant Team

Following an audit, a need was identified for appropriate materials for our youngest client group to chart progress from the earliest days post implant, through to a sufficient understanding of spoken language to access learning by listening within a group situation. There was a requirement for a tool which was based on recognised developmental hierarchies to both monitor and set expectations. There was also a need to identify as early as possible those children who were not making the expected progress. Any new materials needed to link with existing assessments, used both within the team and wider community. It needed to be easy to administer by a range of professionals and based on observations of the functional use of audition via age appropriate, play and routine based activities to which families could readily relate. The profile consists of 5 milestone stages: 1-3months, 3-6months, 6-12months, 1-2 years and 2-3years. At each milestone there are 10 descriptors of target behaviours for the child, with accompanying examples of different ways in this skill could be demonstrated. The reliability of the profile has been examined retrospectively with a cohort of 25 children who had their operations under the age of 30 months and who are now at least 3 years post implant. Early results indicate that it is an effective tool. It can provide the basis for setting both short and long term targets and for raising expectations for rate of progress. The profile enables us to track the developing auditory skills of our children. It provides a tool for identifying those children whose progress plateaus and where further investigation is required.

Detection at birth of cochlear implant candidates

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This report investigates efficiency of screening newborns in early detection of permanent childhood hearing impairment (audiometrically defined as thresholds permanently above 40dB HL in the better ear, due to a sensorineural or

mixed hearing loss). In the framework of a multicenter screening programme supported by the national Health system, all neonates were eligible for a two-stage screening test using automated auditory brainstem responses (AABR). Two categories of newborns were distinguished: 1. those who needed to be transferred in a specialized unit due to health condition (around 4.5% of the whole population); and 2. those who were maintained in maternity ward for well-babies. The first part of results describes usual parameters employed in assessing the efficiency of any auditory screening programme in newborns: rates of coverage, refers, children effectively tested in the audiological center, and false-positives. Results were significantly different in transferred and non-transferred infants. The second part of the report concentrates on the hearing-impaired children born in our health district and followed-up for at least 2 years. Based on these criteria, 26 hearing-impaired children (born between March 2005 and March 2006) were identified. In this population of early identified children, one was lost from follow-up during the study period. Permanent profound hearing loss was identified in 10 of the 25 correctly followed-up children (40%). Among the 15 non-profoundly hearing-impaired children, one displayed a bilateral profound hearing impairment in the first months following discharge from neonatal intensive care unit, and then after progressively recovered her hearing (moderate hearing loss by 9 months of age). Among the 10 profoundly deaf children, 4 received a cochlear implant before 2 years of age. Early cochlear implantation after neonatal screening will be discussed in light of recent studies comparing language development as a function of implanting before or after one year of age.

Surgical aspects of cochlear implantation in children

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Inherited deafness or chronic sensory hearing loss is considered to be irreversible since cochlear hair cell damage is permanent in the mammalian inner ear. After adequate investigation of hearing impaired children, treatment is performed according to established medical guide lines usually starting with the fitting of conventional bone conductive hearing aids. Patients that suffer from a bilateral profound sensory hearing loss that is not sufficiently improved by powerful hearing aids are candidates for cochlear implantation (CI). If the hearing loss is caused by infectious diseases (i. e. meningitis), immediate implantation prior to cochlear ossification is recommended. Preoperative patient evaluation has to include audiological/paedaudiological testing, surgical, radiological and laboratory evaluation, as well as the psychological and social environment of the patient. Also, age and duration as well as a pre- or postlingual onset of deafness have to be considered. In particular in children, the auditory family environment is of great importance for the success of hearing rehabilitation. The presentation will emphasize on cochlear implant surgery in children and will discuss the different aspects such as the time of implantation, technique of implantation (posterior tympanotomy vs. transcanal, cochleostomy vs. round window etc.), choice of implant (complete vs. partial electrode insertion), surgical handling of the implant and uni- and bilateral implantation. To comment on the postoperative benefit in young children, three patients with different hearing experiences and different age at cochlear implantation will be presented. By regularly using the parents questionnaire "LittlEars" a progress of the auditory development could be seen already in early phases after cochlear implantation before a language acquisition has been started.

Changing candidature: do we know how to support these children and families in short and long term?

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Flanders, the North part of Belgium, was in 1998 one of the first regions in Europe to implement a universal early hearing-screening programme combined with a further diagnostic and rehabilitation guidance programme. Of the children identified through Universal Neonatal Hearing Screening (UNHS) programs approximately 10% of them have profound bilateral severe hearing losses above 90dB. Of this number, 35% have identified additional disabilities by the end of the first year of life. The mean age of implantation is 14 months. But some children are receiving their cochlear implants already at age 5-6 months, some (35%) will also have additional disabilities (but maybe we don't know it yet), some of them will wear two cochlear implants or a digital hearing aid at the opposite ear, etc. All these changes in candidature took place in the last decade. But have we also changed our support services for these young children and their families? Do we know how to support and educate these children not only now as babies, but also in the future as teenagers or

adolescents? All these changes are a big challenge for service centres and deaf education. They have to adapt their way of working. We must ensure that their professionals have the skills to meet the challenges: to be flexible, continually updated with the technology and changing expectations, to be trained in working with very young children and their families, to provide environment which will utilise the useful hearing while meeting the linguistic and curricular needs of the children, to meet the psycho-social needs of this group as they grow through adolescence and to work with other professionals.

A13 – 374

Performance of children after sequential bilateral cochlear implantation

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To compile the results of bilateral cochlear implantation in children Patients: 30 children provided with bilateral cochlear implants sequentially. All children received their second implant before the age of 8 years (range 2y;5m-8y;6m) and used their first cochlear implant for at least one year. In 2006/2007 a cohort of 30 children has been provided with a second implant sequentially. A prospective study protocol was followed involving speech recognition tests and localisation tests. Speech recognition tests were performed in quiet and in noise with the first implant, the second implant, and boT. After 6 months the speech recognition in noise of the children with two implants did not differ significantly between one implant and the bilateral condition. The performance of the second implant significantly lagged behind. However, already after 12 months of experience this difference disappeared. The best performance was reached with both implants after 12 months compared to the unilateral condition. In lateralisation tests approximately half of the children were able to differentiate stimuli offered at an angle of 60 degrees or more, and 25% of the children were even able to do this within 30 degrees. In a within subject comparison, for the majority of the children with one year, bilateral cochlear implantation is beneficial, with respect to speech recognition and localisation in comparison to the unilateral condition. In addition, most recent 24 month postop data of our bilateral program will be presented and addressed.

A07 – 202

Towards hearing regeneration: Cochlear cell types from inner ear stem cells

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In the mammalian auditory system, hearing impairment resulting from aging, ototoxic drugs, infections, overstimulation and genetic dispositions is irreversible. Underlying the permanence of acquired hearing loss is, in most cases, the incapacity of the inner ear to replace lost hair cells and their associated spiral ganglion cells. Despite this inability to regenerate lost hair cells, cells with high proliferative capacity can be isolated from various tissues of the neonatal mouse inner ear including the vestibular and cochlear sensory epithelia. A powerful technique for the isolation of stem cells from inner ear tissues is the sphere formation assay, which is derived from the neurosphere assay used to isolate multipotent and self-renewing stem cells from the central nervous system (Reynolds and Rietze, 2005). Here, we show that sphere-forming inner ear stem cells display a distinct capacity to divide in non-adherent culture conditions, which leads to the formation of clonal floating colonies, so-called spheres. We provide an in-depth characterization of the properties of these spheres and the distribution of stem cells in the different tissues of the mouse inner ear. We demonstrate that sphere-forming inner ear stem cells are self-renewing, the sphere cells express marker genes of the developing ear and nervous system, and that sphere-derived cells have the capacity to differentiate into a variety of different cell types, including hair and supporting cell-like cells as well as neuronal cell types. These data imply that inner ear stem cells are not only an excellent tool for in vitro developmental studies but they are also an important cell source for transplantation studies into damaged inner ears of animal models with the long-term objective of developing cell-based replacement therapies.

A06 – 037

The role of working memory in the language-learning process for children with a cochlear implant

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In some cases language acquisition by children with a cochlear implant (CI) is observed as being suboptimal. Recent models of cognitive psychology assume that the crucial factor involved may be a functional impairment of the working memory. In order to investigate whether there is a connection of this kind between various measures of working memory performance and the development of language skills, a correlative study was being conducted by the Heidelberg University of Education, involving a test group of 24 children who are CI recipients and a control group containing 24 normal-hearing children. Data were obtained from the two groups – which were matched on the basis of hearing age – using eliciting procedures and spontaneous speech samples. Initial evaluation of the results obtained using standardized testing methods show that accuracy in processing speech and language input of unknown content in the working memory is significantly lower in children with a CI than in the control group. However, no differences between the groups are evident with regard to memory capacity and the “working speed” of the rehearsal mechanism. It is the quality of processing that would appear to be the chief factor in the learning lag (relating to receptive language performance) that was observed in this study.

A05 – 031

Family focused intervention for young children with cochlear implants

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The rehabilitation of young children with severe to profound hearing disorders in Bulgaria started 35 years ago, successfully developing strategies and techniques for early intervention. At the beginning of cochlear implantation surgery and rehabilitation in Bulgaria (1999) the newborn hearing screening was not yet introduced and children under one were diagnosed accidentally. The youngsters were a very small population distributed all over the country, making it very hard to offer appropriate treatment and monitor the development of new listening skills. Families of eight (8) young children with cochlear implants (CI) were involved. Focused and control research groups were formed, equal in numbers. Post-operative rehabilitation based on systemic family guidance was in focus: Intervention included techniques developing auditory perception and following the hierarchy of listening skills. Auditory perception test was applied for evaluation. Family support included step by step training of parents for natural communication through listening. Feedback was provided by both parents and professionals via questionnaires evaluating parents' participation. The development of new listening skills of children in focused group was more successful and timesaving comparing to results of CI children in control group. It was found that family training was crucial for the development of new listening skills in CI children from the focused group. Receiving systemic guidance parents of CI children perform more confidently when interacting with children and use listening in all day routines. They acquire skills of high importance for the development both of non verbal and verbal communication of their CI children. Recently, in parallel with the Department of Logopedics at South West University, several rehabilitation settings in Bulgaria offer professional services to families with young CI children, accumulating experience and supporting many practitioners in CI early intervention.

A04 – 023

Do children who received a cochlear implant at age 2 attain language levels within normal limits after 2 to 6 years of use?

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Recent research reports have indicated substantial benefits of cochlear implantation at a very early age (Svirsky, Teoh & Neuburger, 2004; Tomblin et al., 2005; Connor et al., 2006). These encouraging results have led some researchers to suggest that implantation around age 2 would allow children to show near-normal language skills at age 6. 27 French-speaking children who received a cochlear implant (CI) between the age of 8 and 28 months were tested with standardized measures of receptive and expressive language achievement. Language levels attained by children with CIs were compared with those of the normative sample of same-age hearing peers for each measure. Analyses permitted examination of the relationships between functional use of a cochlear implant (MAIS and MUSS

scales) and development of the different language components. Non-parametric statistics were used to accommodate the small sample size. As a group, children with CI exhibited language levels within normal limits on all standardized language measures. However, examination of individual patterns revealed 4 different language profiles, ranging from language within normal limits to general language delay. In three of the four language profiles, comprehension of sentences was impaired. Correlational analyses showed that age at implantation was not associated with language achievement. Receiving a cochlear implant between the age of 1 and 2 does not ensure normal language levels at 5 years of age, or after up to 6 years of experience with the implant. Results of this study highlight the importance of the two levels of data analysis that allowed the validation of group results and the observation of language achievement profiles, thus providing a more accurate and complete description of language achievement in this group of children.

C03

Training for the practice of pediatric-educational audiology

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This congress on pediatric cochlear implantation is quite timely for considering further standards of training practitioners in the field of audiology, specifically in the area of pediatric-educational audiology. This presentation describes a new professional audiology training project at our university, funded by the US Department of Education, Office of Special Education. The project will support a group of academically talented graduate students already committed to this sector of service (i. e. following graduation). The project is to serve as a vehicle for developing not only an enhanced curriculum for “ped-ed” audiology but a platform to help bring more attention to the manpower need in this area and to bring greater discussion among professionals who embrace important areas of development from auditory processing to speech-language, and ultimately to reading literacy. This includes the classroom teacher, special educator, and speech-language-pathologist (orthophonist) but, we contend, should involve more substantially the audiologist. The overall rationale of the project considerably overlaps the combined issues of post-newborn-screening management of identified children with hearing loss and specific needs for CIs and other early-interventions. Then there are a large proportion of children with non-congenital (later-onset) hearing losses, as well as the ever-demanding problems of auditory processing disorders and their distinction from/involvement in dyslexia and other central disorders. Indeed, these are areas for which definitive diagnoses and treatments remain somewhat elusive. Given the success of CIs, we submit that the aforementioned areas may be becoming more formidable than those of treating profound deafness with CIs. Early intervention in the latter now would appear to support (for example) nearly normal, if not normal, literacy development, a goal seemingly out of reach not all that long ago. Consequently, educating practitioners well to address this broad and demanding subspecialty in the global health-care market presents a special challenge, namely when overlaid with variable models of hearing health-care delivery and socio-economic considerations. The purpose of this presentation is to highlight the relevant facts underlying the stated manpower needs and to encourage discussion of the relevant issues, if not possible solutions.

B02 – 059

Assessment of the surgical feasibility of the Digisonic SP cochlear implant in children

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The objectives of this study were to evaluate the surgical feasibility, the complications and reliability of the Digisonic SP (Neurelec, France). We concentrated data from 4 tertiary referral university hospitals (Algeria, France and Greece). 160 children were included. Their age at date of CI ranged from 13 months to 14 years old and the duration of the follow up ranged from 5 to 65 months. We analyzed the duration of surgery, the duration of general anaesthesia, the per- and post-operative complications related to surgery and/or to anaesthesiology, the number of unactive electrodes, the number of failures and the cumulative survival rate according to the ISO 5841-2:2000 norm over the follow-up time. This implant being optionally secured to the cortical bone by screws, we analyzed if any differences could be revealed between the two groups (screwed+ versus screwed-). The number of inserted then active electrodes was close to 100%. There were very few per-and post-operative complications related to the surgical implantation, and to the anesthesia. The

cumulative failure rate of the internal part was less than 3% over 60 months (before corrective action on the design in march 2006) and less than 0,35% over 34 months (following design modifications). The mean time of surgery was less than 60mn in 90% of the children. The main surgical differences between the 2 types of surgery (screwed/unscrewed) were the gain of time during the surgery procedure and the possibility of a reduced post-auricular incision. From these data we can deduce that the Digisonic SP cochlear implant can be placed relatively fast with few intra- and post-operative complications, even though the surgeon could encounter anomalies of the cochlea or of the facial nerve. The failure rate is low. We can conclude that surgery is safe and fast using this implant, and that reliability is high.

A07 – 203

Inhibition of JNK signal cascade conserves hearing against electrode insertion hearing loss

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Electrode insertion trauma-induced hearing loss involves activation of JNK cell death pathway. The neuroprotective action of SP-600125 was demonstrated on neuronal cell death in murine model of focal ischemia and reperfusion. Recent animal studies demonstrated also that D-JNKI-1 peptide protects against the ototoxic effect of aminogluco-side and noise induced hearing loss; Both of these molecules are inhibitors of JNK pathway that may be used to protect the residual hearing after cochlear implantation. In vitro study was performed to test the efficacy of SP600125 to prevent hair cell death in organ of Corti explants challenged with ototoxic level of TNF alpha. Explants were stained with fluorescein isothiocyanate-labeled phalloidin, and then IHC and OHC were counted per 415 um sections of explant basilar membrane. Guinea pigs were implanted to evaluate the efficacy of D-JNK-1 inhibitor to prevent electrode trauma induced hearing loss. ABR are measured before and after electrode insertion and drug delivery to measure the changes of hearing thresholds overtime. The TNF alpha group that received SP600125 after 16 h of culture had a total cell count average of 315.3 +/- 4.3. That was not significantly different than the untreated control group not exposed to TNF alpha (317.8 +/-4.4). The Guinea pig ears implanted have an immediate increased hearing threshold followed by a gradual loss of hearing the days after surgery. Once treated with DJNKI-1 there is no significant difference in hearing between the ear implanted and the contralateral not implanted ear. Inhibition of JNK cell death path may prevent hair cells death and hearing loss after electrode insertion trauma.

B13 – 403

Cochlear implantation in children with the inner ear abnormalities

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Cochlear implantation in deaf patients with abnormalities of temporal bone is associated with number of difficulties: atypical position of the facial nerve, changes of cochlea, probability of Gasher syndrome and insertion of the electrode array into the inner ear canal. The stimulation of the facial nerve and vestibular reactions are also possible. During 2005-2008 6 cochlear implantations in patients with inner ear abnormalities (age of 2-4 y. o.) were performed. In 4 cases sensorineural deafness was diagnosed in the age of 1 y. o. and in 2 cases – in the age of 3 y. o. One patient twice had meningitis in anamnesis – in the age of 9 and 23 months. Computerized tomography showed the following abnormalities: Mondini malformation in 4 cases (2 of them had obliteration of cochlea and semicircular canals on one side combined with the congenital ossicles abnormalities), dysplasia of the vestibulum with the wide vestibular aqueduct syndrome in one case and the stenosis of the inner ear canal in the other. In all cases the MRI-scan confirmed the presence of the liquid in cochlea. Cochlear implantation was performed with standard technique, including mastoidectomy, posterior tympanotomy and cochleostomy in the scala of tympani of the basal turn of cochlea. In 4 cases Nucleus CI24R(ST) cochlear implant was used, in 1 – Nucleus CI24M and in one case – Nucleus CI24RE(CA) implant. The registration of the electrically evoked stapedial muscle reflexes (ESRT) and the electrically evoked compound action potentials (neural response telemetry-NRT) was performed in all cases, except 2 patients: in one case it was necessary to close the cochleostomy due to Gasher syndrome and the registration of the ESRT wasn't performed, and in one case – NRT was registered only from the low frequency channels in the postoperative period. The electrode array was in close contact with the cochlear wall in all Mondini malformation cases and was in the basal turn of cochlea in case of dysplasia of the vestibulum, which was documented by the results of the postoperative X-Ray or CT. The facial nerve stimulation was

discovered in 2 cases, which was a reason of the uncomfortable sensations caused by the electrical stimulation. The follow-up results showed positive hearing and speech development in all patients.

D08 – 330

Correlation between radiological and embryological images of cochlear malformations

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Cochlear malformations are responsible of 20% of hearing losses. There are several classifications but the universally most accepted is Jackler's embryological classification. Nevertheless fewer observations have been performed over neural distribution. Several embryos and fetus, sized 5-18 mm, stained in haematoxylin-eosin were studied, focusing our interest in the development of neural and maturation of the inner ear structures. These images were also compared to HRCT images obtained from patients affected of diverse cochlear malformations. Great similarities between radiological and embryological images have been found the research on cochlear malformations is growing on steadily nowadays. The known difficulties for cochlear implant surgery have increased the interest in their diagnosis in order to improve and search new techniques to facilitate surgery and rehabilitation.

C02 – 103

SmartNRI study: results of the clinical phase

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Objective measures such as Neural Response Imaging (NRI) may sometimes be difficult to interpret, due to the presence of noise and stimulus artefact. An automatic statistical method (SmartNRITM) was developed for determining whether a real neural component is present and for more reliably obtaining thresholds. This algorithm was validated in a pilot study. A second phase looked at the clinical application by comparing behavioural fittings to SmartNRI-based programs. In the pilot phase, NRI measurements taken with the SoundWave™ fitting software were classified by experienced clinicians and by the auto-detection algorithm. The outcomes were compared to validate the automatic system. In the clinical phase, the SmartNRI principle was used within the Research Studies Platform - Objective Measures (RSPOM) to measure NRI. SoundWave measurements were also performed. Visual (1stNRI) and extrapolated (tNRI) thresholds were recorded. Programs were created based on the SmartNRI thresholds and compared to standard behavioural programs using speech tests and sound quality questionnaires. The auto-detection algorithm was validated, with an acceptable error rate (3.6%). At the time of writing eighteen subjects had been included in the clinical phase and a limited number of datasets were available. However, the results indicated that the time required to acquire NRI on four electrodes was approximately 15 minutes, compared to 30 minutes usually needed with SoundWave. The 1st-NRI and tNRI values were similar with RSPOM and SoundWave. No subject rejected the SmartNRI based program. More data on program comparison and questionnaires will be shown. The SmartNRI algorithm was verified and implemented within RSPOM. Preliminary clinical results show that SmartNRI records NRI thresholds faster than SoundWave and with similar reliability. More data are now necessary to confirm whether SmartNRI based programs are a suitable alternative to standard behavioural programs.

A10 – 216

The extension of cochlear implantation to patients with residual hearing. Why and how ?

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Many adult candidates for cochlear implantation falling within current indications which are based upon limited speech recognition with hearing aids have significant low-frequency residual hearing. "Hybrid" or "electro-acoustic" stimulation has been proposed which allows the combined benefits of electric and acoustic stimulation in the implanted ear. We discuss the benefits and risks of cochlear implantation in children who fit the "Hybrid/EAS" profile

with reference to outcomes obtained in groups of adult "borderline" patients. Retrospective analyses were performed upon data from 31 patients implanted with Nucleus 24 Contour Advance. 13/31 were classed as candidates for a "Hybrid" electrode according to recent clinical trial criteria. Additional data were obtained from adult patients implanted with a 16mm "Hybrid-L" electrode, and children implanted with Nucleus Standard and Contour electrodes. Pre-operatively "Hybrid" CI candidates had significantly better speech recognition in noise compared to the "Standard" CI candidates, with only a trend for better words scores in quiet. However, post-operatively there were no mean differences in performance between the two groups. Scores were noticeable poor for several cases in both Contour groups and the Hybrid-L group where there was evidence of childhood high-frequency hearing loss. Cochlear implantation with conventional or "long" electrodes, and Hybrid or "short" electrodes gave substantial benefit in all adult patients except where there was evidence of childhood or very long duration of high-frequency deafness. Implanting children with profound high-frequency hearing loss with/without low-frequency residual hearing at an early age would avoid a permanent communication handicap which cannot be resolved by cochlear implantation at a later date.

B07 – 237

Sudden deafness due to autoimmune disease: a possible indication for urgent CI

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Objective: To bring attention to a possible indication for urgent CI in sudden bilateral severe sensorineural hearing loss or deafness due to autoimmune inner ear diseases after failure of immunosuppressive therapy. Material and methods: Literature review and case study. Discussion: Primary autoimmune inner ear diseases or systemic autoimmune diseases can result in loss of hearing in days to weeks. These diseases can also induce fibrosis and consecutively ossification of the cochlea. This makes implantation of a cochlear implant difficult or even impossible. Prompt audiometric evaluation and evaluation by an internist is indicated. A MRI scan with gadolinium should be performed within days to evaluate the amount of fibrosis and ossification thusfar. Sometimes the hearing loss can be treated systemically with prednisolon or cyclofosfamide. If the hearing loss proves not to be reversible, a possible indication for urgent CI exists. We present a case and the CI NN protocol autoimmune inner ear diseases and CI with the methods of management and treatment for this category of patients. Conclusion: Sudden deafness due to autoimmune inner ear diseases needs to be managed promptly and can lead to an urgent CI.

C13 – 425

Vibroplasty in young children with aural atresia – clinical experience

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So far a soft band hearing aid is the only hearing rehabilitation method for bilateral atresia. At age >4 years a bone anchored hearing aid can be administered. Recently the applicability of the Vibrant Soundbridge (VSB) to atresia patients was shown. Here we present our experience of 10 adolescent cases and show a variation of the technique which allows extending the indication criteria to young children without jeopardizing the aesthetic outcome. On a six year old patient with bilateral atresia a posterior incision through all layers of the hair bearing scalp followed by a subperiosteal approach towards the atretic plate was performed. The soft tissue was carefully preserved. An anterior access through the bony atresia plate was illed. The floating mass transducer was coupled to the stapes. Audiometric testing was performed. The surgery did not affect the local tissue, which is essential for later ear reconstruction. Bone conduction thresholds were unchanged. Two month postoperatively the mean threshold with activated VSB in free field warble tone audiometry was 31dB HL. The functional gain was 38dB HL. Aided free field speech discrimination in quiet was 90% at 50dB, 100% at 65dB and 100% at 80dB. By circumventing the malformed middle ear and directly stimulating the cochlea, the VSB provides a new rehabilitation option. The initial results of our first toddler are accordant with the adolescent patients. The key issue in toddlers with aural atresia is to avoid damage as scarring or shearing of local tissue in respect of later ear reconstruction. The future aim is to apply the device to infants with bilateral atresia as an alternative to a bone conducting device. Further improvements of the external processor as well as in fitting are required in order to match the special needs of these patients.

D07 – 317

Simultaneous and Non-simultaneous dual electrode stimulation in cochlear implants: Evidence for two neural response modalities

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Psychophysical experiments with both simultaneous current steering and sequential stimulation of neighbouring contacts have proven the ability to elicit intermediate pitch percepts between electrode contacts with cochlear implants, at least at most comfortable levels (MCLs). Theoretically, this would give the patients access to more perceptual channels than physical contacts in the electrode array. This study examines the effects of simultaneous current steering and sequential stimulation on pitch and loudness. For both lateral wall and perimodiolar electrodes, simultaneous current steering as well as sequential stimulation was simulated in a computational model of the implanted human cochlea. From the neural response patterns both pitch and loudness of the percept were predicted. The latter predictions were validated with psychophysical loudness balancing experiments. Simultaneous current steering with adjacent electrode contacts in the basal end of the cochlea was generally able to produce a single, gradually shifting intermediate pitch percept. Current steering beyond the first cochlear turn, sequential stimulation, and current steering with non-adjacent electrode contacts, often produced two regions of excitation. In the case of sequential stimulation the total amount of current to reach MCL was raised, if the current was divided between the two contacts, both in the model and in the patients. There are two response modalities to dual electrode stimulation: a shifting, continuous excitation, which is the desired effect, and a jumping or split excitation with considerable variation in loudness. The first one most likely occurs in the basal turn, with adjacent contacts, stimulated simultaneously rather than sequentially.

A01 – 003

Understanding in everyday life situations; results from paediatric cochlear implant users

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A previous survey evaluated how well adult cochlear implant (CI) users cope with the listening challenges of everyday life situations. The goal of this ongoing survey is to evaluate the hearing abilities and use of accessories in paediatric CI users. The evaluation will be done subjectively via the Everyday Listening Questionnaire (ELQ) for children and teenagers. Currently 10 children and adolescents between the ages of 7 and 21 years have participated, with enrolment ongoing. It is aimed to present results from 30 subjects. All subjects used an implant system from Advanced Bionics, with any sound processor, independent of its generation. The participants had more than six months' experience with their CI. The questionnaire included a profile section first, and then covered 4 every listening topics: 1) the phone; 2) music; 3) at school or university; and 4) in other social environments. An additional mini-questionnaire included more detailed questions about the situation at school and whether a change of school type had occurred after implantation. The preliminary results show that most of the children and adolescents use their CI without any accessories. The hearing of music via MP3 player or HiFi system was rated as enjoyable without using any special program or accessory. One reason for the limited use of accessories may be the improvement of hearing in young people as a result of their early implantation. Further analysis comparing the results of early vs later implanted children/adolescents may give more insight into this topic. It was interesting to see the reasons why the accessories were not used by the children. These reasons may help us to develop more paediatric friendly accessories and can also influence the counselling.

C15 – 427

Evaluation of the built-in TCoil of the behind-the-ear Sound Processor Harmony

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The current behind-the-ear sound processor Harmony of Advanced Bionics offers a built-in TCoil to access external signal sources. In an acute test session four different conditions for using the telephone were tested: the built-in TCoil, the built-in microphone of the processor, the pinna microphone TMic as well as the external TCoil developed for the Auria BTE processor. In an acute test session the Freiburger monosyllables test was performed via telephone in the four different conditions. Additionally the subjects filled in a questionnaire concerning their telephone habits in everyday life. The study group consisted of 14 adult CI users with HiRes90K or CII implant systems with a mean age of 52 years (32 to 72 years) and a mean duration of deafness of 48 years (24 to 67 years). The significantly best result with 66.4% was achieved by the modular external TCoil. The other three conditions did not show any significant differences (between 53 and 55%). The majority preferred either the external TCoil or the TMic (35.7% of subjects for each). While the results of TMic and built-in TCoil were at least similar in this test in a quiet background, the TCoil would have an advantage during the use of the telephone in background noise. The TMic was preferred, because it is the standard option in everyday life for most users. The built-in TCoil gives a similar hearing quality as the TMic and is recommended for using the telephone in background noise. For CI users who regularly use an induction system the modular external TCoil should be considered.

C01 – 102

Measuring NRT for the fitting of cochlear implants

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Fitting infants and small children usually is more difficult than fitting adults because they can't give clear feedback about the loudness of the perceived tones. Even some adults have problems with this task. Measuring NRT threshold (TNRT) was widely used as a basis to create a first fitting map. Meanwhile software has developed to a degree where automatic NRT measurements are feasible even to inexperienced personnel. With an experience of about 4 years of using Cochlear Freedom we are retrospectively evaluating our clinical data to find out if TNRT values are an appropriate base for fitting subjects and if AutoNRT is a reliable tool to work with. More than 80 adults all implanted with a Nucleus Freedom cochlear implant were measured with AutoNRT on each of the 22 electrodes during the first week of initial fitting and at follow-up sessions. TNRT was estimated automatically with the CustomSoundEP software. Correlation coefficients regarding TNRT versus C-Level were estimated as well as mean values. So far results from 60 subjects have been analyzed. Mean correlation coefficient (TNRT value versus C-Level) is 0.70 ± 0.30 and does not vary from initial fitting to the aftercare appointment. The mean TNRT value is 164 ± 15 CL and is slightly increasing over the next 3.6 months to 166 ± 14 CL meanwhile the mean C-Levels are increasing from 154 ± 20 CL to 163 ± 22 CL. Some typical misinterpretations of AutoNRT will be discussed as well as possible ways how to identify these cases. Because the difference between TNRT and C-Levels goes up to ± 50 CL in individual subjects, an estimation of the overall loudness of the map should be carried out by conventional behavioural approaches. Since the TNRT profile matches the C-Level profile in a satisfactory manner, TNRT values are a good base for initial fittings of children. However, the absolute C-Levels are not reflected by a NRT measurement.

A13 – 375

Documenting progress with sequential, bilateral cochlear implants: Reported device use and performance milestones achieved by toddlers, children and young adults

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The aim was to document early progress of sequential, bilateral implant recipients in terms of reported device use and performance in daily life. Such important information aids understanding of the process of adapting to a 2nd implant and documents outcomes for a wider range of users than just those who participate in objective testing. Information was collected regarding

achievement of specific milestones by 40 participants who received a 2nd side implant (CI-2). In the first 12 to 24 months post-operative, information was collected via monthly telephone (or email, n=1) interviews with parents or via telephone or email interview with some older participants (n=3). Milestones related to bilateral implants (namely: full time bilateral implant use, demonstrated or stated preference for bilateral over unilateral, and superior daily listening performance with bilateral implants) and CI-2 implant alone (namely, being comfortable using CI-2 alone and similar daily listening performance using either implant alone). Results were divided into three groups. For the 13 participants implanted before 3.5 yrs, the majority achieved all milestones, and did so within 1-5months. For the 9 participants receiving CI-2 after 10yrs, the majority achieved all milestones except "similar listening with either CI"; though this group required more experience than the younger group, particularly for CI-2 alone milestones. For the 18 participants in the middle group (CI-2 received 3.5-10 yrs), results were generally poorer and more mixed. Participants who received CI-2 young made the fastest progress and achieved the most milestones. The middle group of participants demonstrated the most mixed results, and consistent device use was an issue. Participants aged >10yrs at CI-2 generally showed good progress, and may have benefited from high levels of internal motivation. Given some participants achieved none of the milestones, and progress varied across participants, implications for pre- and post-operative counseling will be discussed.

D07 – 320

Electrically evoked auditory brainstem response in cochlear implant users: waveform, parameter peculiarities, stimulus intensity dependence, gender, age variances

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Electrically evoked auditory brainstem responses, ABRs, in cochlear implant users have been compared with acoustically evoked ABRs in normally hearing subjects. The revealed similarities and differences were expected to clarify the mechanisms involved in their construction. The investigations covered 24 cochlear implant recipients and 18 age- and gender-matched normally hearing subjects. Electrically evoked ABRs in implant users and acoustically evoked ABRs in normally hearing individuals were registered under equivalent conditions. In contrast to acoustically evoked ABRs, electrically evoked ABRs lacked Waves IV, VI, and VII. As compared with acoustically evoked ABRs, electrically evoked ABRs owned shorter peak-latencies, shorter inter-peak intervals, and greater amplitudes. Conversely, with increase in stimulus level both similarly shortened in peak-latencies and grew in amplitudes. Also, both similarly exhibited lower thresholds, shorter peak-latencies, and greater amplitudes in females vs. males and similarly possessed lower thresholds and greater amplitudes in children vs. adults. In contrast to acoustically evoked ABRs, electrically evoked ABRs lacked Waves IV, VI, and VII. As compared with acoustically evoked ABRs, electrically evoked ABRs owned shorter peak-latencies, shorter inter-peak intervals, and greater amplitudes. Conversely, with increase in stimulus level both similarly shortened in peak-latencies and grew in amplitudes. Also, both similarly exhibited lower thresholds, shorter peak-latencies, and greater amplitudes in females vs. males and similarly possessed lower thresholds and greater amplitudes in children vs. adults. Selective component deficiency in electrically evoked ABRs argues the origin of successive response constituents in consecutive auditory structures. Intrinsic cochlear processes are suggested instead in their initiation. Parameter differences between electrically and acoustically evoked ABRs can similarly be attributed to the omission under electric stimulation of cochlear events, e. g. of inert traveling wave mechanisms, that being in action under acoustic stimulation. Similar intensity dependence and similar gender variances in electrically and acoustically evoked ABRs prove on the other hand that brainstem but not inner ear affairs are responsible for particular items. Similar maturational characteristics of both ABRs confirm that age differences are also mediated solely by extracochlear factors.

C07 – 278

Evaluation of music perception in adult users of HiRes® 120 and previous generations of Advanced Bionics® sound coding strategies

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In 2007 Advanced Bionics has launched the novel sound coding strategy HiRes 120. The strategy incorporates the concept of current steering and offers up to 120 stimulation sites using only 16 electrodes. Early clinical results showed improved speech understanding in noisy environments. Also the naturalness of speech and music and the sound quality overall were improved. Objective of

the evaluation is to observe if there is a difference in music perception, listening frequency, enjoyment and ability to differentiate special musical features, between the three main group of subjects using different generations of strategies: CIS/MPS/SAS; HiRes; HiRes 120. The evaluation is based on a questionnaire. Forty questions are divided into several sections: Individual sections will help collecting information on etiology, equipment used for listening to music, sound coding strategy, frequency of listening to music, musical activity, and enjoyment of music before becoming deaf and with the cochlear implant. Last section is assessing subject's ability to follow melodic and harmonic structure of music and to investigate its impact on emotions. In the pilot phase of the evaluation a group of twenty five normal hearing subjects were tested as control group. Preliminary results suggest that the normal hearing subjects are performing quite well (Average 8 on a scale 1-10) in majority of the tasks. There are few tasks as "identifying how many instruments are playing together" or "understanding words in new music", which appear to be more difficult for some subjects (4-6 on a scale 1-10). Based on the data obtained from normal hearing subjects, the evaluation seems to be appropriate to collect a large number of data within a short time frame. The results may help understanding how much cochlear implanted subjects do listen and enjoy music and if the advances in sound coding strategies are improving these abilities.

C07 – 279

Music listening software for cochlear implant users

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Music is a universal language that gives emotion. In contrast with our prejudice, it is reachable by any cochlear implant user. Nevertheless, it sometimes needs a little training. "Atmosphere musicale" is an interactive music discovery software, set out as a game, for hearing-impaired adults. Instead of testing, the main goal is listening to music samples of carefully graded difficulty with playing pleasure. The structure of the software is divided in five themes (mood in film soundtracks, instrument recognition, voice recognition, mother language recognition, and lyrics identification), each of them including numerous levels of complexity. The software user just needs to follow the questions that are not only made to help his understanding but also to entertain. (For instance, in the level one of the voice recognition section: "Try to imagine the way the singer looks, his age, his gender...") Answers can be glanced before listening, guessed or checked out at any time. All the uses are appropriate. Many bonuses are given to show the clips. Links to go further in music listening on the web are also provided. Very quickly users will find out that music can be reached and that they can recognize by themselves instruments, singers, lyrics... They will discover standards, classical music but also "trendy" music and will astonish their friends and family. The CD (software) can be taken home and used for an individual exploration of all aspects of music. Auditory rehabilitation thus appears not to be only synonymous of efforts and stress: it may also be a source of entertainment.

D07 – 321

Cortical Evoked Response Audiometry in CI users

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The measurement of Cortical Evoked Response Audiometry (CERA) determines the structural integrity and functionality of the auditory system. This objective method can be used even in patients with poor cooperation in behavioral assessment of hearing. The aim of this study was to compare CERA results in CI performers and in normal hearing age peers (with same auditory age) in order to have an objective validation technique of cochlear implantation's benefit. We evaluated 10 subjects – 5 MED-EL CI users (13 to 51 years of age) and 5 normal hearing age-matched subjects. All of them were submitted to behavioral assessment of hearing (free field speech audiometry) and electrophysiological evaluation of central auditory system (measurement of CERA). Comparison included presence versus absence of CERA and speech audiometry results in same subject (cross-validation of the methods), as well as differences in latencies and amplitude of CERA in the two chosen groups. We consider CERA a good objective tool for assessment and monitoring of the auditory benefit in CI users.

A06 – 040

Evolution of communication abilities after cochlear implantation in prelingually deaf children

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This study try to evaluate different factors on communication ability outcomes in cochlear implanted children. Communication abilities are studied using the validated APCEI-scale based on five components of the language: cochlear implant Acceptance, perceptive language Performance, Comprehension of the oral orders, Expressive language and speech Intelligibility. APCEI-scores were calculated every 6 months for the first 2 years, then yearly. The studied variables were: gender, social origin, preoperative residual hearing, age, aetiology of hearing loss, and associated disabilities. Communication ability scores increased with high socioeconomic level, presence of residual hearing, younger patients when no residual hearing, connexin mutation related deafness, and absence of associated disabilities. No significant difference has been noted between both sexes. Many different factors influence the evolution of communication abilities of cochlear implanted children. Investigating the cause of hearing loss, presence of associated disabilities and residual hearing before surgery, may help to predict outcome and plan appropriate care to those children with negative predictive factors.

A01 – 004

Auditory and language development after very early cochlear implantation

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This study evaluated auditory and language development of the youngest cochlear implant users in the Netherlands, infants of one and two years old. Their general reactions to auditory stimuli were measured as well as their understanding and use of early symbolic gestures and words. Participants were 25 infants of one and two years old. Their average age at initial stimulation was 13 months. Two norm-based parent questionnaires were used: LittLEARS and the McArthur-Bates Communicative Development Inventories (CDI). The LittLEARS Auditory Questionnaire is a parent questionnaire that evaluates all types of auditory behaviour which are observable as a reaction to acoustic stimuli. The MCDI (Dutch version by Zink & Lejaegere, 2002) consists of forms at which parents can mark the child's understanding or use of hundreds of early vocabulary items. The results showed that the level of auditory and language of the majority of the children in this young CI-group was lower than that of hearing typically developing children, but showed very rapid rates of development. In addition, 20% of these children with CI demonstrated excellent perceptual and vocabulary skills, performing within the normal range of hearing children. Importantly, early auditory perception and word production was always much better than expected on the basis of children's effective hearing age, except for the children who became deaf after meningitis. The findings demonstrate that early implantation promotes the development of auditory and language skills such that profoundly deaf toddlers achieve skills comparable to hearing age-matched peers. The norm-based tests mentioned here can be used effectively to study outcomes of very early cochlear implantation. The results provide objective and realistic expectations about auditory and language development of deaf infants following cochlear implantation. This project was funded by a grant (275-70-010) from the Netherlands Organisation for Scientific Research (NWO).

D08 – 324

Auditory Functional MR Imaging

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Knowledge about functional organization of auditory cortex is subject of study of many researchers. The tests indicate the existence of possibility of changes in cerebral activity depended of acoustic stimulation. According to present knowledge of functional magnetic resonance, it is important technique to evaluate the cerebral activity and very helpful to elucidate any doubts. The technique of functional magnetic resonance is non-invasive method,

that estimate the risk in neurosurgical and otolaryngological operations. It's also applied in researches of activity of cochlear nerve in deaf patients. The primary auditory area measures 1-4 cm³, and its position and extent are both asymmetric and highly variable in individuals. Functional magnetic resonance is useful for evaluate the activity of cortex. This method is based on BOLD (blood oxygenation level depended), it is connected with local changes in oxygenation of blood in cerebral vessels. Magnetic resonance is evaluating the range of activation of auditory cortex in deaf patients. It was also established that auditory areas are overlapping, when the sources of signal are coming from the many sides. The researchers revealed the fact that auditory cortex can be activate without the hearing stimulation. While listening the silence and using the imagination the blood flow through the cortex increases. The technique of functional magnetic resonance has many artifacts. Although the disturbances connected with a scanner, the changes in cerebral blood flow of deaf patients resulted from the signal were observed. It proves the possibility of reorganization of the auditory tract. It confirms the clinical usefulness of this method particularly to qualify the candidates for implant.

C11 – 308

Cochlear implantation in very young children. Surgical aspects

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As a result of newborn hearing screening, deaf children are being diagnosed early and the age of implantation has substantially decreased over recent years. In many centers, children are now implanted before the age of 1 year. The goal of this study was to describe the surgical aspects related to the young age, to investigate the safety of cochlear implantation in children who are younger than 18 months, and determine the best age for implantation. This retrospective study included 127 children implanted over the period from 1998 to 2008. 81 children were implanted after the age of 2 years, 36 before the age of 2 years and 10 before the age of 1 year. Before implantation, all children had at least a 3 months period of rehabilitation with conventional hearing aids. Perioperative and postoperative surgical aspects were compared between children under of 1 year and others. The surgical technique in very young children is described. In children under 1 year of age, the mastoid size was smaller than in other children, but was large enough for safe identification of surgical landmarks, and allowed a complete insertion of the electrode array in all cases. The very small incision technique was not used in young children, in order to allow a short duration surgery and a better bleeding control. Surgery was uneventful, and no immediate or delayed complications were encountered in very young children. Children were discharge home in average after 2.3 days after the surgical procedure (no difference between young children and others). This study didn't reveal additional risks for children implanted before the age of 1 year. Early implantation is feasible and beneficial in some children who are younger than 12 months with appropriate anesthetic and postoperative support, and if the diagnosis of severe or profound deafness is absolutely definite. We think the 3 months period of rehabilitation with conventional hearing aids is essential to state the diagnosis before implantation.

C04 – 112

Automatic and outcome-driven expert fitting: a new approach to program cochlear implants

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CI-fitting is a tedious job requiring specific skills and competences. Expert audiologists need to be familiar with the different implants, their fitting software and their electrical specifications. It is difficult to establish the validity and reliability of all the fitting procedures encountered. Routine fitting procedures use to be so laborious that no time is left for the in depth assessment of the performance, let alone for the feedback of such an assessment to modify the fitting. To overcome this issue, it is essential to automate the entire procedure and to turn it into a simple and quick expert driven and outcome based procedure. A software program Fox®; has been developed to assist the audiologist in programming cochlear implants. Fox®; is outcome even and expert based. The core is a feed-back engine to which both audiological results and existing MAP-parameters are fed and which delivers modifications to the MAP. The engine contains a set of mathematical algorithms called an "advice" and programmed by an expert fitter. Multiple advices are possible. Data can be entered manually or automatically. Fox®; is operational in the eargroup since June 2008. All CI-patients receive fully automatic switch-on fitting. All follow-up fittings are done with FOX®; based on audiological test results and the execution of the FOX®; advice. Immediate positive effects are seen on the audiogram, the speech audiogram, the AŞE discrimination task and the AŞE loudness increase test. The introduction of fully automatic and outcome even

expert software substantially reduces the fitting time and improves the fitting quality. It will standardize and systematize the fitting procedure, allowing highly improved process control and the systematic exploration of new fitting strategies. It will allow audiologists to allocate their time to the exploration of new fitting strategies and developing in-depth expertise.

B10 – 263

Implanting the second ear in congenitally deaf children: evidence to support the concept of a 'Critical Age'

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The results will be presented of a multi-centre study designed to provide evidence on whether, for a congenitally deaf child (implanted at an early age and having developed good speech perception and spoken language), there may be a 'Critical Age' after which a cochlear implant introduced into the second, contralateral ear (perhaps after failure of the original implant) can no longer provide hearing and speech perception. 12 paediatric cochlear implant programmes in the UK and Australia were approached to ascertain whether they had in their care children who had received sequential (not synchronous) bilateral cochlear implants. We asked for the following data on these children for each ear separately: Age of implantation; aetiology where known; speech perception scores, using their implants, for each ear separately. To extend the age upward, we used a second model: 4 subjects were included who had congenital Unilateral deafness, lost all hearing in their only hearing ear and received a cochlear implant in their congenitally deaf ear ('Unilateral' cases). 45 children were reported with complete data. 4 'Unilateral' subjects were also identified. 80% of those who received an implant in their second ear aged 3 to 13 years scored 79% or more on sentence tests in quiet. Of those receiving their second or 'unilateral' implant aged 15 years or more, one scored 30% and the rest approximately zero. Animal work suggests the presence of a 'critical age' for maturation of the spiral ganglion and cochlear nucleus in response to afferent input from the ipsilateral cochlear nerve. Individual case reports suggest that this may also apply to humans, although such a 'critical age' is likely to be later than the one that is well recognised as applying to the auditory cortex. If there is such a 'critical age', a child implanted successfully at an early age who then lost the use of their original unilateral implant later in life, and (perhaps because of severe infection) could not be given a replacement implant for the originally implanted ear, would not benefit from a contralateral implant after this age. Our evidence supports this idea, although the numbers are small and do not necessarily imply that implanting the second ear after the age of 13 years might not be successful in some cases. The study raises an important question for which more data should be collected. The study does, however, suggest that if a child is to receive bilateral implants, the second ear should be implanted as early as possible. The concept of a 'critical age' for the second ear in such cases will also apply to future developments in treatment of the peripheral auditory system such as neurotrophins and hair cell regeneration.

A02 – 009

Attitudes toward paediatric cochlear implantation in Slovakia

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Cochlear implantation is a standard clinical tool to manage prelingual deafness. Clinical interpretation of deafness gives rational arguments to provide cochlear implantation for deaf children. Clinically the deafness is interpreted as a disorder that should be eliminated or at least the sequels of deafness should be eliminated. On the other side of this problem there are representatives of the Deaf community. They do not accept clinical interpretation of deafness; they prefer cultural-anthropological approach. Several authors have evaluated opinion of paediatric cochlear implantation. There is no paper in the Slovak literature that would monitor this topic. Cochlear implantation goes beyond the clinical environment. It is necessary to evaluate opinion of cochlear implantation also among parents, teachers and representatives of the Deaf community. There were 5 different groups to evaluate their opinion of cochlear implantation: Members of the cochlear implant team, phoniaters, parents of the implanted children, teachers from the schools for deaf and hard of hearing and representatives of the Deaf community. Questionnaire with 21 items to evaluate opinion of cochlear implantation has been created for this research. The probands expressed their opinion in 5 points scale from agreement to disagreement with individual statements. Research on opinion of cochlear implantation has show a wide range of attitudes. The opposite position of clinical representative versus Deaf community representatives has been confirmed. In the Slovak Deaf community pronounced community opinion has been shown (unlike growing tolerance with cochlear implantation in the

Deaf community of some Western European countries). Members of the CI team and phoniaters show similar positive opinion of cochlear implantation. Parents of implanted children show clinical opinion. The widest spectrum of opinion has been shown in the teachers of deaf and hard of hearing.

B05 – 079

Reoperations after cochlear implant surgery in children

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The purpose of this study was to determine the incidence of revision cochlear implant surgery in children and to describe failure rates, causes of revision, surgical findings, and the impact of reoperations on audiologic performance. The present study includes 124 consecutive children undergoing cochlear implantation in a tertiary reference center between March 1996 and November 2008, with a mean age at implantation of 4.6 years, ranging from 10 months to 16 years. The mean duration of follow-up at the time of study was 7 years (0.1-12 yr). There were no major perioperative or major early postoperative complications. Fourteen children underwent 18 (14.5%) revision operations, with most being related to device failure (8 of 18 [44.4%]). Two of them had direct trauma to the ceramic package of the receiver. All patients had their second device placed in the same ear as their initial implant. In two (11.1%) cases 6 months and 14 months after surgery necrotic tissue over the receiver arose. In one of them two months after revision surgery flap infection required explantation and implantation of second device in the opposite ear. Two cases of incorrect electrode positioning required a revision operation for putting it in the correct place. A foreign body granuloma set onto the fixed tie of the receiver area above the implant in another two cases. The nylon suture-knot had to be removed. Eight and 11 months after the implantation in another two cases an onset of acute purulent mastoiditis occurred and the mastoid was consequently treated with additional operative and antibiotic treatments. One child had revision surgery after traumatic ear um perforation. Audiologic performances were stable or improved following reoperation in all patients. Reoperation in cochlear implant surgery is safe, technically feasible and allows continued auditory perception.

C08 – 287

Questionnaire-based assessment of communication development in children with cochlear implants

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In recent years the amount of cochlear implantations (CI) in young children increased constantly. Partly, this might be due to the assumption that early-implanted children achieve better and more natural communicative performance than late-implanted children. However, in German speaking countries this hypothesis has not yet been assessed using validated instruments. The present study aims at investigating possible differences in verbal communication ability between children who received their CI(s) before 2 years of age and children implanted at the age of 2 or older. The results have been analysed in the context of communication capacity of normal-hearing children and hearing impaired children wearing hearing aids. A sample of 64 parents of children with CIs answered the German version of the 23-item Functioning After Pediatric Cochlear Implantation (FAPCI) parental questionnaire (Lin et al, 2007). This inventory is suitable for assessing children aged 2 to 6 years. A global score was computed. The statistical reliability and the nomological validity of the instrument have been shown in a previous study (Grugel et al, HNO in press). Non-parametric statistical tests have been applied to the data in order to investigate differences. Subsequent to activation of the speech processor data revealed that early-implanted children did not reach the performance of late-implanted children. In contrast, assessment after three to four years of hearing with the CI showed that the former obtained significantly higher scores than the latter. A difference between both study groups could be seen corroborating the study hypothesis. After activation of the speech processor late-implanted children got better results as they are on a higher global developmental stage. Expectedly, when conducting a survey after some time of CI usage the early-implanted children reached higher scores than those implanted late. The data suggest early provision of CIs in order to allow for an adequate verbal-aural development. Literature: Lin FR, Ceh K, Bervinchak D (2007) Development of a communicative performance scale for pediatric cochlear implantation. *Ear Hear* 28(5): 703-712.

D11 – 360

Selecting appropriate language tests for pediatric cochlear implantees

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A detailed view of their language skills is necessary to optimize the language rehabilitation of hearing-impaired children. A selection has to be made from available oral language tests because of time and cost constraints. The aim of this study is to develop a flow chart for selecting appropriate language tests at every stage during the rehabilitation of Dutch pediatric cochlear implantees. In a consecutive cohort of 14 implanted children, aged 1;6 – 6;3 years and with cochlear implant use between 2 – 36 months, the spoken language skills were assessed using standardized tests, parent questionnaires and spontaneous speech analyses. Scores were expressed in language age equivalents and analyzed by means of frequency tables, scatter plots and Spearman correlation-coefficients. No test could be used in all children. Language age equivalents determined by using the Dutch MacArthur Vocabulary Checklists (N-CDI) – rather than chronological age or hearing age – allowed to predict which subsequent tests could be administered. Significant correlations were found between N-CDI scores, Reynell language comprehension scores and Mean Length of Utterance. These correlations differ from those found in normal hearing children. Comparing the results of this study with the published psychometric properties of the used language tests reveals that chronological age is not an optimal criterion for test selection. Results on N-CDI are a more robust indicator. However, precaution has to be made regarding the small sample studied. The study is continued to confirm the usefulness of this flow chart.

C12 – 419

Round window application of implantable hearing aids in radical cavities

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Electromagnetic middle ear implants which had been originally used in patients with high frequency hearing losses with normal middle ear conductive mechanism, recently were begun to be used on patients with defective or absent ossicles. Round window application of transducer of electromagnetic implant, first used by Colletti seems to be promising in such patients. In this study indications and a modified technique of round window attachment of an electromagnetic implant (Vibrant Sound Bridge) are presented, and results obtained on 7 patients are discussed. All patients had been implanted at Izmir Teaching and Research Hospital on 2007 – 2008. All cases were formerly operated in various centers because of cholesteatoma and all but one found to be free of residual or recurrent cholesteatoma during surgery. In all cases floating mass transducer has been applied onto the round window membrane in a perichonial envelope. Patients were switched on 4-6 weeks after surgery. Pre-op AC levels were between 65-85 db (median 69.3) and BC levels were between 10.1-60 db (median 33.7). SDS scores were between 46-95% (median 77.3) In all patients we have not seen any deterioration in these values after surgery. After switch on hearing thresholds with implant were elevated near to BC levels. SDS scores were considerably better in all patients (median 83) after surgery. Patients with radical cavities in both ears can benefit from electromagnetic middle ear implants. (VSB) Surgery needs some skill and when technical steps carefully applied, round window application of FMT seems not to be hazardous to the residual hearing of the patients. Hearing gains are better than conventional hearing aids. Satisfactory hearing results in selected cases with radical cavities in both ears can be obtained with electromagnetic middle ear implants.

B07 – 233

Cochlear implantation in neurobrucellosis

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Brucellosis is endemic in countries bordering the Mediterranean; humans are affected as secondary hosts by living together with the primary host animals such as goats and sheep. The most common route of transmission is ingestion of contaminated dairy products such as raw milk and mozzarella like fresh cheese. The aim of this presentation is to report the first successful cochlear implantation in a case of neurobrucellosis. A 32 years old male patient with a history of progressive gait disturbance due to spastic paraparesis and hearing loss was admitted for evaluation of his severe deafness. His disease had been

diagnosed 6 years before when he was referred to the neurology department with fever, malaise, loss of balance, difficulty in walking and bilateral hearing loss. The sequelae of spastic paraparesis and severe bilateral SNHL had affected his life in such a poor way that he was willing to regain the sense of hearing again desperately. The patient was considered a borderline candidate for CI and admitted for evaluation as accordingly. Despite inconclusive MRI and ABR results, positive promontory stimulation test result was considered as an indication for CI since it was thought that even a small hope of sound perception would be very helpful for the patient. He was implanted with a 24 channel Nucleus Contour Advance device via the transmastoid facial recess approach in a routine manner. Intra operative electrically evoked compound action potentials were successfully recorded for all electrodes by Neural response Telemetry (NRT) test. Postoperative plain radiographs confirmed the optimal perimodiolar placement of the electrode and the patient discharged uneventfully at the 3th postoperative day. He was fitted at the first postoperative month and was able to perceive sounds immediately. Six months postoperatively, hearing thresholds in free field testing environment were within normal levels (i. e. 30 to 40dB SPL) and monosyllabic word recognition score was 48% with audition only and increased to 66% in sentence testing. Monosyllabic word recognition score and sentence testing were found to be 56% and 70%, respectively at 18th months post fitting. This case represents the first successful cochlear implantation in neurobrucellosis. SNHL has long been considered as a frequent manifestation of neurobrucellosis; however, its rate in brucellosis was reported as none or very high among different studies. SNHL should be evaluated in all forms of brucellosis and screening laboratory tests may be considered for brucellosis in patients with bilateral SNHL in endemic areas. SNHL in neurobrucellosis is generally bilateral and mainly affects higher frequencies; prolonged exposure to bacteria, combined with an age of > 30 years may increase the risk. The indication for CI may be a challenging task in a large number of adult cases resulting from a variety of genetic and inflammatory conditions, and our case was an example of this statement. It can be concluded that a positive result obtained from promontorium stimulation test can be regarded as an indication of surviving spiral ganglion cell population in patients with profound SNHL due to neurobrucellosis and successful results can be expected after CI.

D06 – 198

The value of using the Profile of Actual Speech Skills (PASS) with implanted children with complex communication needs

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Objectives: There are many assessments available to monitor a child's progress post cochlear implantation. However, it can be difficult to measure the more subtle developmental stages of progress a child with complex needs may show at the speech production level. This study aims to illustrate how a video-based technique enables a therapist to record changes in a child's speech production before real words occur. PASS is used before implantation, at 6 months and 1 year post implantation, when a formal word-based assessment of speech production is not appropriate. A video sample is taken of the child interacting with a familiar adult. Their spontaneous early speech patterns are transcribed and classified using criterion-referenced descriptors. Two case studies of implanted children, one meningitic and one with global developmental delay will be discussed. The PASS outcomes obtained will be used to illustrate the changes observed in the speech production of both children. The results show that using PASS is a valuable and informative tool when working with children with complex needs. Discussion: The PASS allows observation of a child's interaction and speech production. This can then be used to monitor the child's progress over time. Conclusion: Experience of using PASS with very young or low verbal deaf children, suggests that it is a useful pre-cursor to standardised tests of speech production. The PASS outcomes enable the therapist to reassure parents and local support professionals that a child with complex needs is making progress. Changes at the speech production level may provide evidence that the child is making use of the auditory sensations provided by the cochlear implant.

A06 – 042

On the relation between early implantation and the acquisition of grammar

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Sufficient access to auditory information is a prerequisite for oral native language development. This is especially the case for grammatical elements, due to their acoustic non-salient nature. Mastery of the native language rule systems is at risk in hearing impaired children. Previous research has shown

that children with hearing aids (HA) have a delay in the acquisition of grammar. Improved sensory experience by means of a CI is expected to result in improved grammar performance. Here, we investigate the long-term benefits for early implanted children. Our study includes 76 hearing impaired children between 4 and 7 years (28 HA, 48 CI). A 50-utterance spontaneous speech sample was analysed according to a standardized test for language development. Measures involve mean length of utterance, the number of inflected verbs produced and a qualitative analysis of verbal morphology. Both hearing-impaired groups are able to overcome their initial language delay. They close the gap with their hearing peers on mean length of utterance and the number of inflected verbs produced. In this respect CI-children reach normality slightly earlier than HA-children. For CI-children the outcomes are partially predicted by age at implantation. The qualitative analysis of verbal morpheme production reveals that both clinical groups make significantly more errors as compared to their hearing peers. Between the age of 4 and 7, early implanted CI-children are faster-than-normal language learners. The observed errors in verbal morphology production may be related to the sub-optimal perception of particular morphemes. Despite variability, CI-children are able to partially catch up with their hearing peers on grammar development. However even at the age of 7 they show persisting difficulties with particular non-salient verbal morphemes. The best grammar performers are likely to be children who are implanted very early in life.

B13 – 401

Cochlear implantation in ossified cochlea

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Cochlear Implantation in an ossified cochlea is a challenge, even for experienced ear surgeons. Labyrinthitis ossificans is the pathological deposition of new bone within the cochlear and labyrinthine lumen. It occurs commonly after bacterial infection or inflammation of the otic capsule. Vascular disease or trauma may also lead to ossification. Severe cochlear ossification may occur in more than 20%, within weeks. We present 10 such cases of cochlear ossification needing different levels of cochlear drilling, to achieve different lengths of cochlear insertions of electrode array, with post-op results. Very good results were achieved with Transcanal approach for cochlear implantation. HRCT of the Temporal bone & 3D MRI of the cochlea are both needed for correct identification of the cochlear ossification. However the surgeon must realize that absence of radiological ossification signs is no guarantee of smooth cochlear insertion of the electrode array in cases of post meningitic cochlear implantation. Partial ossification can be negotiated by drilling the ossified zone of the scala. In case scala tympani insertion is not achievable insertion may be done in the scala vestibuli. In cases of extended ossification the promontory should be removed or the array placed in the second turn of the cochlea. Transcanal Technique has proved to be a better technique for cochlear Implantation giving better exposure of the Basal turn of the cochlea, for electrode insertion into the scala tympani, in an ossified cochlea.

A14 – 384

Speech perception in noise in children with bilateral cochlear implants

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Introduction: The aim of this study was to investigate speech perception in noise in children with bilateral cochlear implants. Methods: 24 children aged 5-10 year at testing, who received bilateral cochlear implants at the age of 0.9-8 years either simultaneously (2 children) or with a mean timegap of 1.2 years underwent speech perception testing. We used the Wuerzburger Kindertest in 3 different listening conditions (right only, left only, both implants). Speech was always presented from the front at 70dB SPL with noise coming either \pm 90 degrees from the side or the front with an SNR of 15dB. Results: Bilateral implant use ranged from 1.2 to 6.4 years (mean 3.7 years). In all noise conditions significant binaural benefit could be demonstrated. Average binaural summation was 13%, head shadow was 23% and squelch effect was 6%. No statistical significant difference between the performance of the first and the second implant could be found. The contribution of the second ear was largest, when noise was directed towards the tested ear. Within our subjects no influence of age at implantation, timegap or bilateral implant use was evident. Conclusion: Speech perception is significantly improved after bilateral cochlear implantation in children, especially in noisy conditions, thus leading to better listening and learning conditions.

C06 – 134

Performance of long-time Tempo+ users is improved after switching over to the OPUS2 speech processor

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Introduction: Although primarily designed to support the MED-EL I100 cochlear implant electronics, the new OPUS2 speech processor offers backwards compatibility for use with the C40+ CI-system. The aim of this investigation was to evaluate the speech perception of C40+ users with the OPUS2 vs. the Tempo+ processor. Method: So far 19 postlingually deafened adults implanted with C40+ systems between 1997 and 2003 have been switched over to the OPUS2 processor. Speech perception with the Tempo+ and OPUS2 was tested acutely and after 4 weeks. Performance was assessed with Freiburger monosyllables and HSM-sentences in quiet and in noise. Fitting occurred during regular clinical visits and no additional training was provided. Results: At the day of switch over, speech perception with the OPUS2 was significantly better for monosyllables in quiet and sentences in noise. Further improvement was observed after 4 weeks, when patients scored significantly higher with the OPUS2 compared to the Tempo+ in all tests. Within the trial period, no significant changes of performance with the Tempo+ processor were evident. Conclusion: Switching over to the OPUS2 improves speech perception with the C40+ implant in quiet and noise. Experienced Tempo+ users show significant benefit from the new technology without extra listening experience.

A05 – 035

Educating the educators: promoting good practise for professionals supporting young deaf babies

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“Small Talk” is a DVD based resource for families with deaf babies which aims to: 1. Impart key messages about the benefits of early playful talk 2. Make parents aware of how communication changes as the baby grows. 3. Give advice about the adaptations that are necessary to provide optimal communication opportunities for Deaf babies. We were interested in exploring different models of service delivery, in which local professionals could be given the resources to implement programmes to families, thus reducing the amount of support from specialist programmes. We felt that if successful, this model could be transferred to other aspects of rehabilitation, following cochlear implantation. Local support services were encouraged to host Small Talk days. The purpose of the day was to work with groups of parents to; 1 Build their confidence and to help them to relax into communication with their new deaf baby. 2. Give them the opportunity to meet with other families in similar situations to themselves 3. Use video footage, group discussions and child focussed activities to stress the benefits of early communication experiences. The local professionals were provided with resources including slides and teaching notes for future Small talk days 21 Small Talk events have been hosted. 96 parents and 76 professionals have been trained. Evaluation forms showed that 80% of the participants rated the session as excellent and 18% rated it as good. The families particularly valued how the information about early communication was applied directly during the children’s session. Providing workshops in localities has enabled us to communicate messages to more families than we would have using formal models. As cochlear implants become more prevalent, we must consider innovative ways of delivering rehabilitation; educating the local educators may be one of the ways to make this happen. Supported by Cochlear Europe.

B10 – 259

Bilateral cochlear implantation in children: outcome in 74 Bernese children

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The Swiss Social Security Insurance (Schweizerische Invalidenversicherung) approved bilateral cochlear implantation for profoundly deaf children and adolescents in November 2003 on request of the committee of audiology and experts in hearing aids of the Swiss Society of Otorhinolaryngology, Head and Neck Surgery. The committee applied the following arguments for his decision: the importance of bilateral cochlear stimulation on the development of the central auditory system; the likelihood of sensory deprivation of the auditory system in unilateral implanted subjects; the issue of implanting the better hearing ear; the achievement of directional hearing in bilateral implant-

ed subjects; better language comprehension in noisy environment in bilateral implanted subjects. A total of 74 children have been implanted bilaterally in the last 10 years in Bern. Our experience shows that children and adolescents are most likely to benefit significantly from bilateral cochlear implantation with regard to their professional training and social integration. Typical indications for performing bilateral implantation are bilateral profound congenital deafness or prelingual acquired deafness, no adequate reaction on auditory stimulation in best aided condition, suitable anatomical and surgical conditions in both ears, physical and psychological condition to benefit from two CI and the likelihood to develop open speech perception. Surgery is suitable as a one stage or sequential procedure. One stage surgery shows excellent results, although the operation time is increased and associated operative risks are slightly elevated. Two stage surgery should be performed within one year to minimize auditory deprivation of the later implanted ear.

D07 – 318

Linguistic assessment tools for the Digisonic®; Dual electric-acoustic speech processor

Heeren W., Vaerenberg B., Coene M., Daemers K., Govaerts P.J., Avram A.A., Cardinaletti A., De Ceulaer G., Del Bo L., Gillis S., Pascu A., Rooryck J., Schauwers K., Van Heuven V., Volpato F.

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Low frequency coding is suboptimal in CI electrical stimulation. Low frequencies, however, are essential in pitch perception, the primary acoustic cue to language prosody. In the developing child with a cochlear implant, it is therefore anticipated that language deficits may occur at the phonotactic, morpho-syntactic and pragmatic level. It is assumed that this deficit may be (partially) compensated by additional acoustical stimulation. A new module of the Auditory Speech Sound Evaluation test (AŞE®; Govaerts e. a. 2006) has been developed in order to assess the perception of language prosody by means of discrimination and identification tasks. Test sounds are synthetic, complex harmonic sounds and strings of three to six nonsense syllables mimicking natural sentence and word prosody. All stimulus sounds are available with and without high frequency content. Preliminary results show that CI-subjects perform slightly worse than hearing subjects as long as high frequency content is available, but significantly worse when this high frequency content is removed. Especially in the latter condition, additional acoustic stimulation (Digisonic®; Dual electric-acoustic processor) points in the direction of normalization of prosodic perception. Discussion. Additional acoustic stimulation of residual low-frequency hearing provides temporal fine structure that is not conveyed by current CI-processors. It is therefore anticipated that the Digisonic®; Dual processor will provide pitch details of speech necessary for prosodic perception. Conclusion. The spectral resolution of current CI-processors has been optimized for speech sound discrimination, providing only restricted information about voice pitch. Hybrid electric-acoustic stimulation will give access to low-frequency information in the speech signal. As such, it will enhance prosodic perception and thus also –indirectly– spoken language development of young deaf children. This research was funded by the European Commission (7th FP-SME "DUAL-PRO 222291" consortium).

A08 – 214

Preliminary results in EAS users: Outcomes with the Flexeas Electrode Array and DUET Audio Processor

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EAS is an emerging treatment for individuals with a ski-slope type hearing loss who gain minimal benefit from hearing aid amplification, yet still struggle within their everyday environment. Hearing preservation and sufficient use of preserved low frequency hearing have been challenges facing clinics over the past 10 years. This clinical trial aims to establish the benefits of providing a less traumatic electrode and a combined audio processor for users of EAS. Eighteen subjects were recruited into this clinical trial. All received the FLEXEAS electrode array. A strict surgical protocol was followed to ensure maximum hearing preservation. After two months of cochlear implant experience, users were fit with EAS using the DUET audio processor. Users were assessed at regular intervals up to 12 months post-EAS fitting. 12 subjects have completed the trial, while some are still in the early stages of fitting and assessment. All subjects show good hearing preservation and significant improvements in

speech score over time. This paper will present provisional data, as allowed by the analysis criteria of the clinical trial. The provision of less traumatic electrodes and the following of a strict surgical protocol seem – in comparison to results of earlier clinical trials – to ensure better hearing preservation. There is user preference for a combined electric and acoustic audio processor, which thereby provides greater acceptance and use of EAS.

A10 – 219

Evaluation of a new electrode for hearing preservation

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Low-frequency hearing preservation in cochlear implantation requires the use of an electrode carrier reaching 360° insertion angle, corresponding to an insertion depth of 20 mm measured from the round window (RW) membrane. Surgical procedure and properties of the electrode carrier mainly influence results after cochlear implantation. A new electrode (FLEXEAS 20) design for hearing preservation was to be evaluated histologically. The new electrode array consists of 12 channels distributed over 16.5 mm length, while the total insertion depth is 19.5 mm. Metallic wires within the array are zigzag shaped to increase the flexibility of the electrode. The diameter of the electrode increases from tip to base from 3 mm to 8 mm. Ten post mortem human temporal bones were implanted with the FLEXEAS 20 by the round window insertion method. The temporal bones with the electrode in situ were embedded, radiologically controlled and the undecalcified bone was sectioned. Macroscopic and histological investigations in terms of basal cochlear trauma were performed. All electrodes were positioned by minimal insertion forces in the scala tympani without deviation into the scala media or vestibuli. The RW approach did not result in significant trauma in any of the ten specimens. A 360° insertion could be exactly achieved in 7 out of 10 cases. Electrode trajectory immediately after the RW is in the centre of the scala tympani, then approaching the lateral wall. The properties of the new electrode recommend it for clinical application in cases of hearing preservation. Intracochlear trauma and insertion forces are kept minimal. RW insertion ensures entrance into the scala tympani and makes the introduction of all electrode contacts by 360° insertion possible.

B08 – 249

Cochlear implantation in syndromic children

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As the selection criteria for cochlear implantation evolve and screening for congenital sensorineural hearing loss (SNHL) improves, greater numbers of children with syndromic SNHL will become candidates for cochlear implantation. We present our unit's experience of cochlear implantation in this complex group of patients, with emphasis upon assessment, surgical factors and audiological outcome. All children with syndromic SNHL were identified for this retrospective study from our paediatric cochlear implant database. Only children with a confirmed syndrome were included, excluding those with isolated inner ear abnormalities. A case-note review was performed identifying patient demographics, operative findings and surgical complications. In addition, pre- and post-operative auditory and communication performance was analysed. Twenty-four children were identified for further analysis. Children with Waardenburg syndrome (n=10) constituted the largest patient group. Other cases included Usher syndrome (n=8), Jervell and Lange-Nielsen syndrome (n=3), CHARGE (n=2) and Stickler syndrome (n=1). As expected, there was a wide range of outcome in auditory and communication performance between different syndromes and within individual syndrome groups. Five patients in this study were considered to be 'non-users' or 'partial users'. Children with syndromic SNHL have a variety of other symptoms that can impact on their ability to achieve optimal cochlear implant performance. Visual impairment in particular can be a confounding factor to successful outcome. The most demanding aspect of cochlear implantation in children with genetic syndromes, who often have structurally normal inner ears, is the pre-operative assessment and post-operative rehabilitation. A cochlear implant team experienced in managing these issues, and in providing support to affected families, is vital to allow children to reach their maximum potential. Clinicians need to caution parents regarding expected outcome when implanting children with known genetic syndromes.

B08 – 253

Autistic spectrum disorder and cochlear implantation

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Autistic Spectrum Disorder (ASD) describes a group of conditions including autism, Asperger disorder and ‘pervasive developmental disorder-not otherwise specified’ (PDD-NOS). There are 3 main patterns of behaviour associated with ASD: impaired social interaction; poor communication skills; and rigid, repetitive patterns of unusual behaviour. Impaired development of language contributes to the communication difficulties. This study was undertaken to evaluate the assessment and outcome following cochlear implantation in this diverse and challenging group. In this retrospective study, all children with ASD were identified from our paediatric cochlear implant database. A case-note review was performed identifying patient demographics and outcome, including identification of ‘non-users’ and ‘partial-users’. Pre- and post-operative auditory and communication performance was analysed. Seven children with a diagnosis of ASD were identified for further analysis. In this study, all children had been diagnosed with ASD post-implantation. Auditory and communication performance and implant usage in individual cases will be discussed. Since the introduction of universal newborn hearing screening in the UK, we have seen a decrease in the age at implantation and consequently an increase in children subsequently diagnosed with ASD. An overview of our tertiary referral unit’s experience with children with ASD will be given. The communication difficulties characterizing these disorders make initial behavioural assessment of hearing impairment and post-operative programming difficult, potentially compromising outcome. The incidence of ‘non-use’ or ‘partial use’ should be discussed with the child’s family prior to performing cochlear implantation where a diagnosis of ASD is known or suspected. Children with Autistic Spectrum Disorder represent a challenging group of patients when considering cochlear implantation. However, cochlear implantation represents an effective method of hearing rehabilitation in appropriately selected children. When a diagnosis of ASD has been confirmed or is suspected, parents must be provided with appropriate support in order to develop realistic expectations concerning possible outcome.

C08 – 288

“Bionic Ear Rehabilitation Tools – BERT”

Herrmannova D.

Advanced Bionics company recently developed rehabilitation tools “BERT” to support • New centres starting with cochlear implants; • Specialists – teachers of the deaf and speech and language therapists in their daily work with the CI candidates and users. Parents and families of CI candidates and users; • Everyone interested to learn more about implants; • Range of materials about different CI topics are all packed in nice box easy to transport around. “BERT” will take you step by step through whole non-medical CI process with the child and will offer you support in each of these steps. The materials are structured from the basic topics to advanced for experienced specialists. “BERT” box contains: CD with presentations; • Brochures and articles to learn more about CI; • Assessment tools; • Rehabilitation materials for specialists and parents; • Special games and toys to be used during different sessions with CI users; • Accessories, gifts. The lecture will introduce this new rehabilitation equipment.

D05 – 187

Champions profile for evaluation of paediatric cochlear implant users with complex needs – European retrospective study

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Introduction – In the last years the inclusion criteria for cochlear implantation have been widened. The consensus is growing that additional disabilities are not a contraindication. Therefore more deaf children with complex needs receive cochlear implants. Following implantation, their unique combination of disabilities makes the potential of these children difficult to evaluate and progress difficult to monitor. Not all of the traditional outcomes, typically measuring speech perception or production, will be predictable, or indeed

applicable, but the experience of having a cochlear implant (CI) may bring exciting and significant life rewards. Objectives – This survey introduced the “Champions” profile to assess the influence of cochlear implantation on medical and audiological aspects, communication strategies, social and psychological aspects as well as quality of life. The objectives were to verify the profile and to determine the usefulness of data gathered for the potential management of complex needs children. Materials and methods – Children with complex needs from four European centres were evaluated using the ‘Champions’ scales. The data were analyzed to illustrate and compare the important outcomes for these children in terms of everyday life. Data collection is underway with a target of 52 data sets to be completed for analysis. Initial results point to the different development and benefits from CI for children with complex needs as well as quality of life. Results – The graphic presentation of the scales makes it easy to see the areas in which progress has been good and those areas in which the child will benefit from more intensive support. The Champions evaluation is unique in providing a unified system for recording the progress of paediatric CI users through a system that makes monitoring the child’s progress highly accessible. Conclusion – The outcomes present a meaningful measure, which relates to real world benefits with this complex group of children. Further details on the usefulness of the Champions profile will be presented and discussed.

D11 – 361

“Champions” Evaluation Scales for paediatric CI users with additional disabilities

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Many studies confirm that during the last two decades the population of children with complex needs has grown. In particular, a greatly increased number of very premature babies are now surviving through advanced medical care where this is available. However, up to 40% of very early born babies have significant and permanent disabilities. These frequently include difficulties in the areas of hearing, vision, kidney function and respiration. Society can now offer much to premature babies. Significant changes have taken place, and continue to take place, in the tools and technology to support them. One example is the Cochlear Implant (CI): this can benefit children who are profoundly deaf, including those with complex additional needs. Cochlear implants can bring benefits across a range of areas, including listening, the development of communication, psychosocial skills, and pre-academic and academic function. However, there are differences in the type of benefits cochlear implantation will bring to children who are deaf with complex additional needs and to those whose primary need is caused by deafness alone. Champions Evaluation Scales for Paediatric CI Users with Additional Disabilities was designed for multidisciplinary use. The scales track the progress of the child in different areas over time and can be used within CI programmes and in establishments working with CI users. The graphic presentation of the scales makes it easy to see the areas in which progress has been good and those areas in which the child will benefit from more intensive support. A major goal of Champions, therefore, is to help professionals in devising programmes for the child. Champions is unique in providing a unified system for recording the progress of CI users through a system that makes monitoring the child’s progress highly accessible. The authors wish to thank the many colleagues who offered their invaluable advice and support. Dagmar Herrmannova, Rob Phillips, Gerard O’Donoghue, Richard Ramsden Special thanks belong to Advanced Bionics Europe, the Ear Foundation (Nottingham, UK), and to the Royal School for the Deaf and Communication Disorders (Manchester, UK). These establishments made the publication of Champions possible.

C01 – 096

Error estimation in TECAP measurements

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Telemetric recorded electrically evoked compound action potentials (TECAP) are characterised by latency and amplitude of individual waves. Measurements of physical quantities are always connected with an error. The aim of this study is to determine error intervals of the TECAP threshold (T-TECAP). The influence of artefact suppression methods, number of averages and number of recordings at different intensities on the error of T-TECAP will be investigated. The recordings were made in patients using Medel Pulsar CI100. Stimulus intensities were in the range between T-TECAP and maximum acceptable loudness. There were always 200 sweeps collected with the artefact suppression methods Alternating Polarity, Forward Masking and Masked Response Extraction. All raw data were stored for further off-line analysis. The amplitude

growth functions were extrapolated: the T-TECAP. The error of the T-TECAP was estimated using bootstrap procedures. The NIP1 amplitudes were tested for normal distribution using the Shapiro-Wilk test. Results show a normal distribution usually for more than 80 averaged sweeps. In clinical ART use with numbers of averages from 25-50 sweeps normal distribution is not reached. The determination of error intervals for T-TECAP shows that for fixed number of averages the error of the T-TECAP is smallest using Alternating Polarity, followed by Forward Masking and Masked Response Extraction. Recordings near threshold lead to smaller error of the T-TECAP as suprathreshold measurements with large NIP1 amplitudes. The estimation of the error of the T-TECAP is possible using bootstrap. The error of the T-TECAP decreases with increasing number of averages, and is depending on the selected stimulus intensities. Choosing the number of averages it should be taken into account that using Forward Masking and Masked Response Extraction more than twice the number of averages are necessary than using alternating polarity.

C01 – 095

Variance of the AutoNRT Profile in Children – preliminary results of a multi-centric study

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Researchers and clinicians have been investigating possible prognostic factors for CI outcomes for several years. Pflingst et al (2004, 2005) found a correlation between across-site behavioral threshold variation and performance in CI recipients. Smoorenburg et al (2002) found that no significant difference in performance when subjects had their CI speech processors fitted according to behaviorally measured levels or based on the profile of the Electrically evoked Compound Action Potential (ECAP) measured via Neural Response Telemetry (NRT). Thus, a relationship may be found between the ECAP threshold measured via AutoNRT and performance. The goal of this study is to find out whether the variations in reaction of the auditory nerve along the electrode array can be used to predict performance of a Nucleus Cochlear Implant recipient. In the future this knowledge might help guide the rehabilitation plan. This study is a prospective, non-randomized multi-centre study in over Nucleus®; Freedom™ cochlear implant recipients. Variance of the AutoNRT profiles are investigated intra operatively and post operatively and compared with the findings on standard performance measures at 6 months and 12 months post initial fitting. AutoNRT profiles were obtained in over 46 pediatric and 39 adult intra operatively and post operatively up to at least 6 months post initial fitting. 10 children have reached the 12 month stage at the time of this abstract. Validated translations of the Profile of Actual Linguistic Skills (PALS), Infant Listening Profile (ILiP) into local languages were used to provide standardized performance measures in these young children. With such a young population, it is difficult to form any firm conclusions until all subjects completed the 12 month performance measurements. Nevertheless some interesting trends have been observed between the pediatric and adult subjects even at this 6 month stage and the possible clinical implications of these trends will be addressed.

C02 – 107

Evaluation of a novel, noninvasive, objective test of auditory nerve function in pediatric cochlear implant candidates

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Objective: To investigate, if the objective, noninvasive recording of the electrically evoked amplitude modulation following response (EAMFR) can be applied for the assessment of auditory nerve function prior to cochlear implant surgery by comparing the test results with the intraoperative neural response telemetry (NRT) results. **Prospective clinical study from 2005 to 2008. Setting:** Cochlear Implant Program at the Charite University Hospital (Berlin, Germany). 84 children, mean age 4.2 years (range 0.96-12.4 years) with severe to total bilateral labyrinthine hearing impairment were included. **EAMFR:** the following stimulation parameters were used: carrier frequency $f_C=500$ Hz, modulation frequency $f_M=80$ Hz, and modulation depth $M=90\%$. The objective thresholds of the EAMFR were correlated with the mean intraoperative electrically evoked compound action potential (ECAP) thresholds. The intraindividual left-right concordance of the EAMFR and ECAP thresholds was investigated in bilaterally implanted patients. The EAMFR-auditory nerve function test produced clear responses in all children examined. The mean EAMFR threshold of the group was 0.56 mA (SD=0.21 mA). The test of correlation between the EAMFR and NRT thresholds revealed a highly significant, positive correlation ($p<0.001$). In all bilaterally implanted children the ear with the lower preoperative EAMFR threshold was also the one with the lower

intraoperative mean ECAP threshold. Especially in children, in patients with vestibulocochlear malformation, dysplasia of the vestibulocochlear nerve, or in patients with long-term deafness there is an evident need for an objective, noninvasive and simple to perform test of auditory nerve function. Our results indicate, that the objective, noninvasive recording of EAMFR appears to be a useful diagnostic tool for the evaluation of the auditory nerve function in cochlear implant candidates.

A12 – 364

Importance of age and period of second cochlear implant for the benefit and functional outcome for children using sequential bilateral cochlear implants

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Patients with profound hearing loss or deafness got cochlea implants (CI) in Erfurt since more than 10 years. 151 patients were provided with cochlear implants. 32 patients received bilateral implantations, 25 of these were children. The age of first implantation differed from 8 months up to 10 years, on average 4,6 years. All children using bilateral implants have been sequentially operated in a period differing from 1 month to 10 years, on average 4,5 years. 200 patients, adults and children, including 27 bilateral implanted children, are rehabilitated in the Cochlear-Implant-Rehabilitationcenter of Thuringia. We report our experiences in the acceptance of the second CI and the special aspects of rehabilitation. The subjective experiences of speech therapists and parents were represented as well as the results of speech perception. The rehabilitation of children until 3 years with sequential bilateral CI proceeded without problems. The age of children at period of more than 1,5 – 2 years between the first and the second CI is very important for the acceptance. There are various problems at the age from 4 to 9 years. The reasons are high expectations and missing memories of the first activation of speech processor. We observed a high motivation for the rehabilitation of the second site in children elder than 10 years. In conclusion all children profit by the bilateral implantation. We show that especially after a large period the sequential bilateral rehabilitation requires a well-aimed rehabilitation. This specific requirement will be indicated. The undisputable advantages of a bilateral CI accommodation could be better utilized from both children and parents, if as we recommend the period between the implantations would amount from 1 to 3 months.

A14 – 385

Do young children and teenagers with bilateral implants gain a bilateral benefit when identifying sound sources located at 90° to the left or the right?

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The objective of this study was to determine if children and teenagers with bilateral cochlear implants (BiCIs) gain a bilateral benefit when identifying the location of sound sources at 90° left or right. Participants ($n=25$) were required to indicate the presenting loudspeaker when pink noise bursts were presented from 90° left or right. The test conditions were CI-1 (1st implant alone) and BiCI. The response method was VRA, pointing, or verbal, depending on subject capability. Results could be classified into three categories: 1) $n=10$ scored significantly above chance in BiCI but not CI-1 condition; i. e., demonstrated a bilateral benefit. 2) $n=7$ scored at chance in both conditions. 3) $n=8$ scored significantly above chance in both conditions. Only the ten Group 1 participants demonstrated a bilateral benefit. Nine of these participants were young at CI-2 ($\leq 3y1m$) and at testing ($\leq 5y3$), the tenth being slightly older at CI-2 ($3y10m$). The other groups were also relatively homogenous for age at CI-2 and at testing. Six of seven participants in Group 2 (chance level performance in both conditions) were older at CI-2 ($3y9m-6y1m$) and at testing ($4y3m-7y2m$). Seven of eight participants in Group 3 (above chance performance in both conditions) were older again at CI-2 ($\geq 6y3m$) and at testing ($\geq 8y3m$). In both conditions these participants tended to respond slowly and report quality differences between presentations from each loudspeaker. Given the groups were relatively homogenous for age at CI-2 and at testing, performance may be related to these factors. The results indicate greater potential for bilateral benefit when BiCIs are received early, i. e. before 3yrs. Group 3's performance suggests participants were not locating the source of the sound but using sound quality cues to discriminate between the loudspeakers. Caution is therefore required when interpreting the results of simple localisation tests, especially for older participants.

D07 – 319

Acoustic Change Complex in Cochlear Implant Subjects in comparison with psychoacoustic measures

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Objective measures are important in pediatric cochlear implantation. They are in particular useful for testing device integrity, proper electrode nerve coupling and neural functioning. The Acoustic Change Complex is an event related potential (ERP) which provides a measure of stimulus differentiation on a cortical level. Recently, it was shown that the ACC may be recorded in cochlear implant subjects with reasonable effort. Auditory evoked potentials were measured at eight channels on the scalp in twelve adult cochlear implant subjects provided with a nucleus freedom system with at least six months CI experience. Additionally, the ACC was recorded in response to subsequent stimulation on neighbouring electrodes at three different sites (basal, medial and apical). For each subject, the Nucleus CI Communicator toolbox (NIC) was used to test the psychoacoustical discrimination ability for the corresponding electrodes. In particular, the method proposed by Kwon and van den Honert (JASA 2006) was implemented. While the onset ERP (N1-P2-complex) was registered in 100% of the measurements, the ACC in response to switches between adjacent electrodes could be reliably recorded in 68% of the cases. No significant effect were observed regarding the intracochlear electrode location. Electrical artefacts by the implant were present in some cases but never on all scalp electrodes. Mean interpeak amplitudes of the ACC were 7,1 microvolts. Correlation between psychoacoustic measures and electrophysiologic measures was $r=0.75$. The ACC correlates significantly with psychoacoustical measures. However, the incidence of the ACC in this study was limited. It may be enhanced by optimization of the stimulation paradigm. The ACC may be used in for pediatric cochlear implantation since it provides important information on the discrimination ability on the level of auditory cortex.

A02 – 010

Bilingual and learning of a second tongue in children with cochlear implant

Huarte A., Martinez J., Martinez P., Perez B.

In the modern world due to geographic mobility and globalisation of the media we encounter more and more bilingual parents that would like to bring up their children in a bilingual environment. This raises the question: Is this possible when we talk about a deaf child with a cochlear implant? In addition to this, Is it possible for children with cochlear implants going to main stream school or integration schools to learn a second language? In this study we will try to answer these two questions. In our Clinic 38 patients are exposed to two different languages at the same time. This means the 13.6% of the children implanted in our Centre live in bilingual communities, and 10.5% have initiated their learning experience with both languages simultaneously. The evolution and learning experience of these children will be studied using auditory discrimination test, auditory questionnaires, and Language development scales. Children who start the second language at the age of 6 years need four more years to have a good auditory comprehension over 70% on sentences for this second language. Children implanted under the age of two obtain similar results on both languages in auditory comprehension of words and sentences. No statistical differences have been observed in these children when exposure of both languages has been similar. Children with cochlear implants are able to learn more than one language. In order to become bilingual, early implantation and early exposure of both languages is necessary.

A13 – 377

Results of sequential bilateral implantation in prelingual children

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In order to fully develop the central auditory system it is essential to properly stimulate the ascending auditory pathway. In the case of a profound bilateral hearing impairment, it is already known that cochlear implantation should be performed as early as possible, preferably before 2 years of age. The goal of this communication is to present our findings concerning an auditory critical period for a sequential implant procedure and study the benefits of such bilateral stimulation in children. Out of a population of 109 bilaterally implanted children, we have studied 38 children sequentially implanted with a

follow-up period of at least 4 years. Both were Cochlear brand implants, and they used a similar stimulation strategy for both ears. Mean age at the first implantation was 2.31 years (range 1-9 years) and at the second implantation 7.55 years (range 3-15 years). Open-set logaudiometric testing has been used in different conditions for auditory evaluation. The separate analysis of both ears shows that discrimination of disyllable words was significantly lower in the second implanted ears at 1, 2, 3 and 4 postoperative years. A negative correlation is found when the analysis compares discrimination level and the age at implantation of the first and second ear. Results show a significant binaural benefit with the use of both CI. These benefits were especially significant when the age at implantation for the first and second ear was below 5 years of age. For children considered for sequential implantation, a relatively early second implantation procedure is advisable. For children suffering from a congenital bilateral hearing loss that have received an early, unilateral stimulation by means of a cochlear implant, there is at least a 5 year window to receive a second implantation in the opposite ear.

D04 – 177

Mental health of hearing impaired adolescents with cochlear implants compared to normal hearing peers

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Our objective was, to provide first basic information on the mental health status of deaf adolescents with cochlear implants (CI) and its correlates. 32 adolescent CI-users (mean age: 15.0 years, range: 12.5-17.1 years, with a maximum age of 24 months at onset of deafness, with at least three years of cochlear implant use and with implantation in our clinic) and 212 normal hearing peers participated in the study (cross sectional). Mental health of the adolescents was assessed by the 'Strengths and Difficulties Questionnaire' (SDQ) by adolescents themselves, their parents and their teachers. The SDQ provides the Total Difficulty Score (TDS) and the Prosocial Behavior Score (PBS) as measures of mental health problems. The reading comprehension of the CI-users was evaluated by teachers ratings. The Total Difficulty Score (TDS) and the Prosocial Behavior Score (PBS) of CI-users did not differ significantly from the TDS and PBS of normal hearing peers. From the point of view of the teachers peer problems are more frequent among CI-users. In the study group (CI-users) the TDS ratings correlated negatively with audiological speech test results. The PBS ratings correlated with the skill level of the mothers, the competence in sign-language and special school education. Age at implantation and the duration of deafness did not correlate with the outcomes. The most important predictors of high SDQ-ratings among adolescents with CI are the competence in sign language and special school education. Persons with good audiological speech test results are less vulnerable for mental health disorders than persons with speech test results under average. Our findings suggest, that mental health of deaf adolescents with CI is comparable to that of normal hearing peers.

A12 – 365

Potential adaptation difficulties for children under 4 years receiving a second side implant

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Background: Over 40 children have received a second side sequential cochlear implant before 4 years of age at the Royal Victorian Eye & Ear Hospital's Cochlear Implant Clinic in Melbourne. The literature indicates that the majority of children in this age group gain significant benefit on objective measures and/or clear benefit in daily life, thus promoting the assumption that young children adapt easily to a second implant and progress quickly. However it is important not to overlook the children who have adaptation difficulties, as valuable insights can be gained leading to improvements for future children. Objective: To catalogue the adaptation difficulties of young children (<4yrs) when receiving a second sequential cochlear implant and discuss how changes to pre-operative counselling and post-operative management may help to avoid some of these problems. Information was obtained from parents, clinicians and clinical files regarding the compliance of the child in wearing the new device and the preferences of the child over time for either or both devices. 10% of children in this age group had significant difficulty adapting to the use of the 2nd implant. Children displayed a range of behaviours relating to adaptation problems from removing the coil to refusing the device completely. Many of these children have since gone on to be successful bilateral users, whilst one child remains a non-user of the 2nd implant after 2 years. The factors which may contribute to these difficulties for different subjects

will be discussed. Suggestions will be made on how this knowledge can feed into pre-operative selection and counselling and post-operative management to avoid early post-operative adaptation difficulties and long-term non-use of the second implant.

B09 – 256

Outpatient cochlear implantation in paediatric and adult patients: a prospective study of patient's well-being and (parental) satisfaction

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'Day surgery' or 'outpatient surgery' refers to the practice of admitting patients into the hospital on the day of surgery and discharge them on the same day after surgery. The last two decades, day surgery has become a high-quality, safe and cost-effective approach to otological surgical health care, not only in minor procedures but also in major ear surgery such as stapedectomy, mastoidectomy and labyrinthectomy, and recently also in cochlear implantation. In this prospective study we evaluated in a paediatric and in an adult group the patient's well-being and (parental) satisfaction following cochlear implantation in an outpatient setting. Twenty three children who received a second implant (sequentially bilateral) and twenty adults who received their first implant have been included in this study. All children had received their first implant in an inpatient procedure. Telephonic Interviews with the parents of the implanted children 1 day postoperative and written questionnaires 2 months postoperative were taken after implantation in day care. The adult patients received a written questionnaire within two months post operation. The medical chart of each patient was evaluated. To be selected for day care surgery, patients had to be healthy, older than 2 years and had to live within a one hour journey of our hospital. The questionnaires included closed questions related to the quality of care and information at the day of hospitalization and open questions related to the post operation situation. The questionnaires and telephonic reviews revealed that the majority of parents/patients were satisfied with cochlear implant surgery in an outpatient setting. The number of side effects and prolonged stay at the hospital was at an acceptable level. Cochlear implantation in day care is viable procedure in paediatric/adult patients when they are healthy and preoperatively well informed.

A01 – 005

Do parents and speech and language therapists report concordantly on children's auditory and spoken language milestones after cochlear implantation?

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High reliability of observational data is especially important in assessing outcomes of care and habilitation. The aim of this study was to compare the reports of children's parents and speech therapists on emergence of early auditory and spoken language skills after implantation. Data on 18 children's development were collected with questionnaires sent to the children's parents and speech therapists 6 months and 1, 2, 3, 4, and 5 years after implantation. All the children had a congenital or early acquired profound bilateral hearing impairment, and they had used their implant since the mean age of 3 years, 4 months (range 1 year, 7 months-8 years, 6 months). Eight children (44%) had comorbid problems, most often a specific language impairment or slight problems with motor development. Parental reports usually served as the earliest indicators of the child's development. However, the mean difference between the reports of parents and speech therapists was less than 2 months in eight (67%) of the 12 areas surveyed: recognition of 1) environmental sounds, 2) rhythm of music, 2) child's own name, 3) words, 4) sentences, and production of 1) vocalization, 2) onomatopoeic words, and 3) 1- to 2-syllable words. According to the Spearman's and Intraclass correlation coefficients, emergence of recognition of sentences (parental mean 11 months), and production of 3-syllable words (10 months), 2-word sentences (11 months), 3-word sentences (13 months), and word inflection (16 months) were statistically significantly similar as reported by parents and speech therapists. Direct language assessment is not always possible because of time constraints and co-operation problems with the child. Parental reports are feasible in follow-up after implantation when concordant with the observations and notes of speech therapists. Despite having been asked at lengthy intervals, the reports of parents and speech therapists were generally in agreement.

D03 – 169

Disposable drug delivery catheter for use in cochlear implantation: radiological study in cadaver temporal bones

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Acute drug delivery to the inner ear during cochlear implantation would be best achieved using a disposable catheter designed to enter up to 20 mm of scala tympani. A catheter approach to deliver drugs to the inner ear is even more compelling since in vitro experiments in a cochlear model demonstrate that an unknown quantity of drug delivered at the cochleostomy does not enter the scala during electrode insertion. A conical inner ear catheter was developed and tested in vitro and in situ. The catheter has the same outside dimensions and profile as one electrode used by a CI manufacturer. Regular marking indicate the insertion depth of the catheter. The catheter loaded with a marker solution was inserted in a scala tympani model at several insertion depth and fluid injected. Temporal bones were inserted with the catheter, prior to electrode insertion, through the round window and through a cochleostomy. 10 µL of an iodine solution was injected in the scala tympani at depth of 15 to 20 mm. Four multi slice CT sequences were performed, after catheter insertion, after injection of the small bolus, after removal of the catheter and after electrode insertion. In vitro the fluid injected does not travel past the tip of the catheter. Electrode insertion flushes the fluid out and does not carry the marker solution forward. Insertion of the catheter in human temporal bones was a unproblematic. No resistance was met. Insertions depths of 15 to 20 mm were easily achieved. Radiologically, the iodine injected stays in the scala tympani and there were no perforation of basilar membrane. Drug delivery during cochlear implantation requires the use of an intra cochlea catheter. A catheter if soft enough can be inserted without trauma to a distance of up to 20 mm.

D03 – 171

Combined insertion of intracochlear catheter and electrode array: evaluation of surgical trauma in cadaver temporal bones (an histological study)

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Objectives: To evaluate the insertion characteristics of a disposable catheter, designed to enter up to 20 mm of scala tympani. To evaluate histologically the risk of trauma to intracochlear when inserting the electrode array into the scala tympani injected with a contrast agent through the catheter. Fresh human temporal bones were inserted with the catheter, prior to electrode insertion, through the round window membrane and through a cochleostomy. 10 µL of an iodine solution was injected in the scala tympani at depth of 15 to 20 mm. The temporal bones inserted with two types of electrode array (Flex eas, Flex soft). Insertion depths were evaluated radiologically. The bones were fixed and embedded in methylmethacrylate in order to cut the undecalcified temporal bones parallel to the modiolus axis with the electrode array in place, each histological section was photographed to document the location and extent of trauma and the position of the electrode array relative to the walls of the cochlea. 20 mm insertion depth of the catheter could be achieved with a single stroke insertion. Injection of the contrast agent was achieved without any resistance. Minimal resistance was observed during insertion of the electrode array after the injection. Histologically, no specific damage to cochlea structures occurred. The electrode array was positioned into the scala tympani in all temporal bones with one exception. Insertion of the catheter through the round window membrane and cochleostomy were shown to be atraumatic with one exception. No intracochlear additional trauma intracochlear caused by the insertion of the electrode array after the injection of an iodine contrast product was demonstrated.

D08 – 331

Investigation of cochlear implant electrode positioning using Flat Detector Computed Tomography (FD-CT)

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The cochlear implants (CI) are used in increasingly younger patients. Parallel to this, there is a growing interest to minimize intracochlear trauma and to prevent all side effects after the implantation. To achieve this, increased atten-

tion must be paid to the optimal positioning of the cochlear electrode. It has been shown that speech performance is significantly better if the electrodes are placed in scala tympani (Aschendorff, Finley). Hence, correct placement of the electrode is crucial for the cortical development of the youngest CI patients. New and improved technology, such as flat-panel detector C-arm angiography system (Artis Zeego, Siemens Medical Solutions, Germany) with CT-like image reconstruction, makes it possible to visualize and study the electrode positioning within cochlea in greater detail. This technology is tested to evaluate electrode insertion techniques and to examine if it may replace the use of conventional intraoperative X-ray imaging. This pilot project will be followed by further studies with adult CI patients where objective measurements of CI performance will be correlated with electrode position. Test electrodes from Cochlear® MED-EL® and Advanced Bionics® were inserted in cadaver temporal bones with no anatomical malformations. One faulty insertion was carried out by placing the electrode into the scala vestibule for the reference purpose. Right after surgery a FD-CT scan was performed to visualize the electrode placement. Preliminary results show that there is a correlation between the insertion technique and possible intracochlear trauma. FD-CT scans help to visualize how the electrode is placed and therefore avoid negative effects and eventual complications. FD-CT scans may provide increased level of details about the electrode placement in the cochlea. This presentation will demonstrate advantages of this technology and will illustrate how it may be used. Currently the clinical implementation of FD-CT is being examined.

C09 – 293

The effect of training on the identification of emotions in speech by cochlear implant users

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CI recipients rely essentially on intensity cues to identify emotional affectation in speech. We hypothesised that a self-training program where intensity cues are removed would improve the use of frequency cues for the recognition of emotions in speech. Five neutral sentences spoken with the emotions “anger”, “joy”, “sadness” and “fear” and in a neutral tone were recorded with four voice actors. Semantically congruous sentences were also recorded for the self-training material. In all presentations the RMS amplitudes of the sentences were equalized. 18 adult cochlear implant users and 18 normally hearing adults were evaluated. CI subjects were tested twice in two sessions, with a training period of approximately one month between. Normally hearing subjects were tested twice in one single session. For the first session CI subjects scored on average 35% correct compared to 72% for the NH subjects. There were no significant differences between the first and second tests for both groups. The neutral tone and “anger” were best identified followed respectively by “joy”, “sadness” and “fear”. The mean score for CI subjects increased significantly to 41% after the self-training: Most improvement was seen for the identification of “fear”. Self-training can improve the perception of emotional affection in speech, particularly to enlarge the use of frequency cues. Focused training on specific listening tasks may give a benefit for cochlear implanted children.

A12 – 366

Critical period for bilateral cochlear implantation in children

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Over 60 patients (including 40 children) have received bilateral cochlear implants (CIBIL) at our department since 1997. The primary goal of this study was to evaluate the ability of bilaterally implanted congenitally deaf children to process binaural information and to document the development of the auditory skills after sequential implantations. The second aim was to evaluate the influence of the age at implantation and the time interval between the implantations on the extent of improvement in auditory performance after contralateral implantation. 10 children sequentially implanted with the Nucleus-Nucleus or the Laura-Nucleus CI combinations, have been chosen for this longitudinal study and followed for more than 3 years. Age at implantation of the 1st implant ranged from 15 to 129 months, and for the 2nd implant from 51 to 157 months. At pre-defined time intervals extensive audiological evaluation was performed and comprised the speech understanding tests (CVC monosyllabic words, NVA-list in quiet and at +10dB S/N speech noise), localization tests, binaural summation tests, detection of binaural beats and binaural masking level difference for tones. 1.) CIBIL children show normal behaviour on binaural summation tests and some of them perform very well on localization tests. 2.) No binaural beats nor binaural masking level differences could be demonstrated in CIBIL children. 3.) The average maximal

speech understanding results with the 2nd implant only, obtained at 3 months post-operatively, was 57% 3.) The 2nd CI achieved performance at a level comparable to the first one after approximately 18 months. 4.) Additional benefit in speech discrimination evaluated in the second year after bilateral (2nd) implantation (measured as the improvement in the maximal phonemic score with both implants relative to the best mono-aural condition) disappeared in children who received the 2nd implant after the age of 10 to 12 years. 1.) The only binaural cues that are effectively used by CIBIL children are the intensity cues. 2.) Contrary to what had been reported before, the results of speech understanding obtained with the 2nd CI do not differ significantly from the results obtained with the first one. The time needed for the 2nd CI to approach the results of the first one is approximately 18 months. 3.) In our group there seems to exist a critical period for obtaining additional benefits in speech understanding with bilateral implantations as compared to unilateral implantations. Children implanted with the 2nd CI after the age of 10 to 12 years tend to show no additional benefits in speech understanding.

A11 – 230

The evaluation of partial deafness patients by transiently evoked otoacoustic emissions

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Partial deafness is characterized by steep audiograms with normal thresholds up to 0.5 kHz and almost total deafness above. The aim of this study was to investigate if transiently evoked otoacoustic emissions (TEOAEs) could be used in evaluation of hearing of this group of patients and to check if tone burst stimuli can give any improvement in comparison with standard click stimuli. TEOAEs evoked by clicks and 0.5 kHz tone bursts were measured from two groups of subjects using ILO96 system by Otodynamics. The first was a group with partial deafness (10 subjects) and the second was a control group with normal hearing (20 subjects). Additionally, each subject was tested for the presence of spontaneous OAEs (SOAEs) using synchronized SOAE (SSOAE) technique provided by ILO96 equipment. The presence of OAE was evaluated by reproducibility parameter. It is defined as the correlation between two buffers of sub-averages of single responses. The reproducibility of responses to clicks for partial deafness was very low, meaning that these stimuli did not produced OAEs. On the other hand reproducibility for responses to 0.5 kHz bursts was only slightly lower than that of normal subjects. The 0.5 kHz tone burst OAE is more reliable than click evoked OAE in case of activity in low frequencies. However the reproducibility values for low frequency responses are significantly lower than for standard wideband click stimuli. Therefore the prolongation of measurement and/or lowering detection criteria should be considered. Nevertheless the 0.5 kHz tone burst OAE could be promising tool for detection of emissions in patients with deep high frequency hearing loss when click stimuli did not produced OAE.

B07 – 238

Cochlear implantation in children with Autism Spectrum Disorder

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Autism is a lifelong developmental disability. The characteristics of autism are generally divided into three main groups (difficulties with social communication, interaction and imagination), with a wide range in presentation and severity. Given the difficulties with communication and language, cochlear implantation is not always supported for children with Autism Spectrum Disorder (ASD). However, with early implantation (where, ASD may not yet been identified) and relaxation in candidacy criteria, the number of implanted children with ASD is growing. To date only a small number of studies have reviewed the progress of children with ASD when using a cochlear implant. The Nottingham Cochlear Implant Programme has implanted over 750 children and over 20 have a formal diagnosis of ASD. A range outcomes measures both pre and post implantation, along with other factors (age at implant, age of diagnosis of ASD, device use, communication mode and educational placement) have been reviewed. Results of this retrospective review along with possible early predictors for ASD will be discussed at the conference. The presence of ASD can be challenging when evaluating outcomes in children who receive cochlear implants. Children with ASD can benefit from cochlear implantation however, parents need support and appropriate counseling to ensure goals and expectations are realistic.

D03 – 168

Semi-chronic application of dexamethasone from the electrode

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MED-EL

An abundance of glucocorticoid receptors (GR) are present in the mammalian inner ear. The GR can be found in the spiral ligament, organ of Corti, spiral ganglion as well as in the vestibular sensory epithelium. There are indications that corticoid application to the inner ear reduces the inflammatory response, and minimize fibrous tissue growth around the electrode. Most importantly, the drug may improve the preservation of residual hearing after electrode insertion. MED-EL in collaboration with several Universities and institutes, are investigating 4 ways to bring dexamethasone and nanoparticles into the scala tympani with the cochlear implant electrode. The systems under feasibility study include: 1. An electrode combined with dexamethasone eluting silicone for the intra cochlea portion of the array 2. The inclusion of a drug delivery reservoir inside the electrode carrier (to be filled intra operatively with a liquid solution of dexamethasone) 3. Ultra thin coating of the electrode with a biodegradable polymer loaded with dexamethasone 4. Disposable drug delivery catheter for intra cochlea injection of dexamethasone in liquid form, prior to electrode insertion. The four systems described above allow a precise and defined amount of dexamethasone to be released in a defined location of the inner ear. The first 3 systems result in a semi chronic application of the drug lasting from a few weeks to several months (length of release controlled by the design goal), while the last system results in a precise bolus of up to 10 micro L, slowly injected preferably along the whole the basal turn (15 to 20 mm). Release curves and reproducibility of the systems under test will be presented. Silicone and dexamethasone can be homogeneously mixed. Elution of the drug in vitro is highly predictable and reproducible. Liquid protein solutions are better delivered through passive diffusion from a pre loaded reservoir. A disposable catheter can be used for a slow bolus delivery before electrode insertion.

B12 – 395

Auditory brainstem implants: Results over time

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Auditory performance and its evolution over time in patients with an auditory brainstem implant (ABI) will be evaluated. The stability of technical fitting parameters over time is analyzed. Between May 1996 and October 2008, 29 patients with neurofibromatosis type 2 and 6 non-tumor patients (ossified cochlear or hearing nerve aplasia) underwent implantation of an auditory brainstem implant in Hannover. 8 patients received the Nucleus 22 ABI, 7 the Clarion ABI and 20 patients the Nucleus 24 device. Auditory performance data were obtained at regular intervals after device activation, levels were adjusted and electrodes were checked for side-effects. Patients were seen at 3, 6 and 12 months after activation and later on once a year. Speech performance was tested with the standard test battery: vowels, Freiburger numbers and speech tracking. All tests were performed in audio-visual mode and if possible also in audio only mode. The fitting of the device was controlled: electrodes were checked for side-effects, levels were adjusted and the tonotopic ordering of electrodes was controlled. All data were analyzed over up to 12 years. The mean number of activated electrodes is stable over time ($9 \pm 3,5$ for Nucleus and $6 \pm 2,4$ for Clarion at 3 years after activation). Some electrodes had to be switched off because of side-effects but on the other hand electrodes could be activated, where the side-effects disappeared by and by. Mean charge for hearing level is stable over time (14,5 nC for the hearing level and 28,3 nC for the comfort level, both at 3 years after activation for patients with monopolar stimulation). Only for some patients a sudden increase was observed, but this could not be related to clinical observations. Speech test results in all conditions are slightly increasing over time. The learning phase for ABI is extended compared to CI. ABI is a safe and stable device for restoring auditory function in patients who can not benefit from a Cochlear implant.

A13 – 376

Loudness perception of patients with unilateral CI in comparison to normal hearing listeners using a modified scaling method

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To investigate the overall level of loudness perception of CI users in comparison to normal hearing listeners, 26 unilaterally implanted subjects (MED-EL C40+ with Tempo+ processor) and 26 normal hearing listeners performed loudness scaling tasks. Four different types of stimuli, two narrow band and two broad band signals (1 kHz pure tone, warble tone, CCITT speech spectrum noise and a speech signal of 1 s duration each) were presented at 13 different SPLs in 5dB steps from 30dB to 90dB. The stimuli were presented in free field condition in an anechoic chamber. Each stimulus type was offered 169 times. This main sequence of SPLs was selected such, that each was offered 13 times and each SPL preceded each possible other. An additional initial sequence of SPLs, unrecognized by the subject, preceded each main sequence to allow for possible adaptation. Loudness judgments were made on a 1 to 50 scale, which was subdivided into five main loudness categories. Responses had to be given within a time window of four seconds. Depending on the individual normal hearing listener, loudness judgments varied in overall level and variance. In group statistics, judgments were strictly monotonic increasing with SPL, where each step of 5dB was accompanied by a statistically significant increase in loudness judgment. Broad band stimuli were judged significantly louder than narrow band stimuli. A positive correlation of judgments both with the preceding SPL and the preceding judgment was found. The 26 CI users tested in the same setup exhibited surprisingly similar results except for overall loudness level, especially in the lower SPL region. Judgments were strictly monotonic increasing with SPL, broad band stimuli were significantly louder than narrow band stimuli and a positive correlation between judgment and preceding stimulus could be observed. Generally, stimuli were judged significantly quieter than by normal hearing listeners. To produce the same loudness perception as in normal hearing listeners, at speech loudness levels (60 to 70dB), approximately 5dB higher SPLs would be necessary. The difference in loudness perception can possibly be attributed to the monaural listening condition of the CI users vs. the binaural of the normal hearing subjects. However, in the course of repeated mapping sessions and by adjusting their clinical processors, experienced CI users effectively decide for themselves at which loudness level their CI system operates. Given the technical possibility, the question remains open, why CI users do not request adjustment. In a possible oral presentation/poster we will additionally present the results of 13 bilaterally implanted subjects.

A07 – 204

Elution of dexamethasone from a cochlear implant. Release profiles and efficacy evaluation

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Pharmacological treatment of the cochlea may be a keystone of future approaches in cochlear implantation. Corticosteroids are well established and previous studies suggest that they have protective properties in relation to surgical trauma. The objective of this study was to evaluate a novel system that delivers pure dexamethasone to the cochlea after implantation. 1: Rods of dexamethasone-eluting silicone were created with drug loading of a few percent. Release profiles were evaluated in artificial perilymph at regular intervals and the concentration of dexamethasone was measured using HPLC. 2: In a guinea pig model, in-vivo measurements of drug concentration were made using apical fluid sampling at selected intervals after implantation of dexamethasone-eluting electrodes. 3: In the same model, we performed insertion of eluting electrodes and control electrodes (n=18/group). Auditory thresholds were established using tone-burst BERA and Distortion Product Otoacoustic Emissions. 1: The release profiles show an initial peak, followed by release at a constant rate over 4 months and longer. Whereas the rate of release was primarily determined by the surface area in contact with the fluid, its duration was determined by the total load of substance. 2: In vivo measurements of drug concentration demonstrated a fast clearance, with no evidence of accumulation. 3: In the animal model, there was at 1 month a significantly lower threshold shift, at mid to high frequencies, after implantation with dexamethasone-eluting electrodes than in animals implanted with control electrodes. This difference was maintained for 24 weeks. Dexamethasone elution is feasible, with rate and duration of delivery highly reproducible and controlled by design. Animal model results suggest that the novel electrode

concept may be effective in reducing the risk of significant hearing loss after cochlear implantation in selected patient groups. Ongoing safety studies are now evaluating the effect of steroid elution on infection risk.

C12 – 417

Combined functional and esthetic reconstruction of the malformed ear – new applications of active middle ear implants

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Malformations of the ear require a twofold solution for their aesthetic as well as functional impairment. Outer ear reconstruction with autologous cartilage is a well established technique with convincing results, if it is performed by surgeons with extensive experience. Functional rehabilitation with conventional reconstructive surgery, however, was not able to restore sufficient hearing in many cases in our hands and in other reports. Therefore, a novel technique, using active middle ear implants, was developed. Application of active middle ear implants for the malformed middle ear in combination with reconstruction of the outer ear was evaluated in 15 patients. An active middle ear implant (Vibrant MED-EL Soundbridge) was implanted during the second step of outer ear reconstruction in most cases. The floating mass transducer (FMT) was coupled either to the incus, the stapes suprastructure, the footplate or the round window, according to individual anatomy. Pure tone audiometry as well as speech audiometry were measured pre- and postoperatively. In 14 out of 15 patients, a sufficient coupling of the FMT was achieved. Aided thresholds ranged between 20 and 30dB in the frequencies 0.5 – 4 kHz. In one patient, the FMT had to be transferred from the round window position to a footplate position to obtain sufficient coupling. No complications were observed. Integration into operative procedures for reconstruction of the outer ear was possible in all cases. Active middle ear implants offer new possibilities for functional reconstruction of the malformed ear in combination with reconstruction of the outer ear with the advantage of reliable and reproducible results.

B01 – 047

Different manifestations of auditory neuropathy

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Auditory neuropathy or dys-synchrony is an auditory disorder characterized by a range of auditory deficits, including elevated puretone thresholds, reduced speech recognition scores, absence of auditory brainstem responses and normal to at least partially normal evoked otoacoustic emissions and cochlear microphonics. With increased advocacy for early implantation (as young as six months of age) patients with auditory neuropathy may be considered for implantation at a very young age. This should be however approached with caution as a subset of patients presenting with a clinical picture of auditory neuropathy may present with reversible hearing loss. We are presenting eight patients diagnosed with auditory neuropathy within the first weeks of life. All of these patients have passed a newborn hearing screening however, following the onset of hyperbilirubinemia requiring exchange transfusion were diagnosed with severe to profound hearing loss based on auditory response brainstem testing. All patients presented with cochlear microphonics and normal to near normal evoked otoacoustic emissions. These patients were followed up with periodic auditory brainstem response, otoacoustic emission testing, and audiometry. All patients presented with either a complete or at least partial recovery of hearing and the auditory brainstem response re-appeared by approximately 12 months of age, and cochlear implantation was no longer an option. Some patients continued to exhibit some fluctuation in puretone thresholds that eventually stabilized to mild to moderate high frequency hearing loss which was effectively managed with conventional amplification. This presentation demonstrates that similar initial clinical result patterns may have different final outcomes: in particular when associated with hyperbilirubinemia, the typical auditory neuropathy tests result pattern may be reversible. The results of this study indicate the need for caution when early implantation is considered in patients presenting with signs and symptoms of auditory neuropathy.

B13 – 402

The predictive value of transtympanic, promontory EABR in congenital temporal bone malformations

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Pediatric implant candidates with congenital temporal bone malformations including narrow IAC may present with increasing current level requirements, and a subset may present with intermittent sound perception with a cochlear implant due to abnormal adaptation. We will be presenting our experience with transtympanic, promontory EABR and its predictive value in patients with a variety of temporal bone anomalies including those with narrow IAC. In addition to determining electrical stimulability, we have recently identified EABR indicators associated with abnormal adaptation to electrical stimulation. Data on 50 patients with congenital temporal bone anomalies including EABR amplitude, latency, and replicability and post-operative performance with a cochlear implant will be presented. EABR is obtained by delivering pulsatile electrical stimulation transtympanically to the promontory under general anesthesia. This allows the determination of pre-operative electric thresholds and the selection of an electrically stimutable ear for implantation. In patients with temporal bone anomalies, we also attempt to elicit each response 2-3 times at the same level in order to assess its stability as an indicator of rapid adaptation. Our results indicate that when classifying patients into incomplete partition, common cavity deformity, and narrow IAC, the latter present with the lowest wave V amplitudes and the highest thresholds. Sequential EABRs obtained from a subset of patients were characterized with a progressive reduction of wave V amplitude. Implanted patients with these response characteristics, exhibited intermittent benefit from their cochlear implant, with increasing current level requirements. The advantage of our technique is two fold: 1. It allows us to determine the presence or absence of cochlear nerve in cases where imaging studies may not identify a nerve thus providing the opportunity to implant some of these patients; 2. This technique allows us to determine level of benefit, by identifying patients likely to present with mapping problems due to abnormal adaptation.

B06 – 085

Excessive increase of the reference electrode impedance in CI patients due to the deep bone embedding

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Electrode impedance is a critical parameter for the proper function of a cochlear implant. In monopolar stimulation mode the impedances of all the active electrodes are measured in relation to the reference electrode by a sophisticated method implemented by the cochlear implant itself called telemetry. In case the reference electrode impedance is high, the functionality of all electrodes is affected. The reference electrode is placed on the bone surface of the temporal bone under the fascia temporalis. We present two cases of cochlear implant patients with excessively high impedance value of the reference electrode. The first case was a 2-year old girl congenitally deaf that received the first CI (MED-EL Pulsar) on the right ear in June 05 at the age of 10 months. The electrode impedances were progressively increasing and reached values between 9.29 to 13.40k Ω with the highest increase on the reference electrode to 4.24k Ω . We explored the reference electrode using a small incision of skin and temporal muscle over the electrode. We found the reference electrode buried deeply into the skull bone and we liberated it by removing the bone over the implant using a diamond burr and we placed it on the surface of the bone. The second case was a 15 year old girl with a history of premature birth, neonatal infection and dehydration. She received a CI (MED-EL Combi-40+) on the left ear in December 99. In 2008 she claimed of a progressively reduced hearing and in August 08 she went to the audiologist for a new fitting. The impedance values of the active electrodes were between 8.96 to 10.55k Ω but the impedance value of the reference electrode was 6.59k Ω . A successful fitting could not be achieved. Using the same technique we found the electrode buried deeply into the bone and we liberated it by removing the bone with a diamond burr. In the first case the impedances value of the active electrodes went reduced between 5.95 to 10.76k Ω and the value of the reference electrode to 0.89k Ω . In the second case the values of the active electrodes impedances were reduced between 2.89 to 6.0k Ω and the value of the reference electrode to 0.79k Ω . She had then a new fitting that was successful and satisfying. The reference electrode of a cochlear implant placed directly on the surface of the temporal bone may be buried by bone growing over the electrode especially in small children (bone remodeling). This may affect the proper function of the device and should be corrected. We propose: a) that the clinics evaluate all the implanted patients and b) modify the technique and place the reference electrode close to the device to be incorporated in the fibrous capsule.

D06 – 196

Psychiatric symptoms in parents with cochlear implanted children

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The aim of the study is to investigate psychiatric symptoms in parents with cochlear implanted children. 23 mothers and 21 fathers of 23 cochlear implanted children were evaluated separately employing SCL 90-R questionnaire (Symptom Check List 90-Revised Version). The SCL 90-R is a widely-used questionnaire for self-report of psychological distress and multiple aspects of psychopathology, as part of the evaluation of parents with cochlear implanted children. 30.43% of the mothers and 19.05% of the fathers showed severe psychiatric symptoms as reflected in the SCL 90-R. As mothers of cochlear implanted children are the primary caregiver, as expected their SCL 90-R results are more severe than those of fathers. The result of this study suggest that there is a need for psychosocial support for 30.43% of the mothers and 19.05% of the fathers of cochlear implanted children.

A01 – 002

Listening preference to child-directed speech compared to static and dynamic non-speech stimuli in hearing and hearing-impaired infants following cochlear implantation

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Listening preference to speech over non-speech stimuli helps infants to orient to those auditory signals in the environment which are essential for language acquisition. It allows for early tuning to the speech input and consequently for learning about the organization and properties of speech sounds and speech patterns of the language. The attention to speech stimuli can be tested by the preference procedure thought to reflect a stage where infants recognize familiar patterns based on representations stored in memory or on acoustic saliency. The goals of the study were: 1. to determine listening preference to speech over static and dynamic non-speech stimuli in normal-hearing (NH) and hearing-impaired infants with cochlear implants (CI), and 2. to investigate the effect of auditory experience on listening preference to speech in both NH and CI infants. A total of 64 infants, 43 NH aged 6 to 20 months, and 21 CI users aged 14 to 33 months participated in this study. Of these, 22 NH and 9 CI infants were tested on their listening preference to child directed speech (CDS) compared to white noise (WN) and the remainder were tested on their preference to CDS compared to reversed speech (RS) using the Central Fixation Preference Procedure. While NH and CI infants showed significant listening preference to speech vs. non-speech stimuli, they also showed interest for the RS. Preference to speech stimuli increased significantly with listening experience for all infants. For CIs, preference to speech stimuli was significantly correlated with gross auditory and preverbal production skills as measured by ITMAIS and PRISE tests, respectively. Our findings show that similar to NH, CI infants' preference to speech during the pre-linguistic stage reflects both a listening bias towards dynamic acoustic stimuli combined with a listening bias towards familiar recognized linguistic stimuli. This preference increases with auditory experience.

C02 – 104

The investigation of the cognitive function in cochlear implant users

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The cognitive components of auditory event-related potentials (mismatch negativity, N2b and P300) signify the brain's detection of acoustic change. These endogenous cortical responses reflects the neurophysiologic processes that underlie auditory discrimination. These potentials may be evoked by a number of physical differences in acoustic tone stimuli including pitch, intensity and duration, using passive condition to verify the mismatch negativity (MMN) component and using active condition to verify the other (N2b, P300) components. We recorded cognitive responses to study the central auditory processes in cochlear implant users (with Nucleus and MED-EL implants) and normal hearing subjects (as control group). Our investigations was performed with PEGAZUS EEGMP equipment. We used acoustic oddball paradigm under passive and active condition. The stimuli consisted

of 1000 Hz frequent, 2000 Hz and 1500 Hz deviant. The different stimuli were presented in pseudorandom order with a fixed interstimulus interval. The ERPs were recorded on 19 channels. In parallel speech recognition tests were performed in quiet and under different background noise conditions. The tests covered number, word, and sentence recognition tests. The results of these tests were compared with the parameters of auditory event-related potentials. The cognitive evoked potentials registered in cochlear implant recipients are similar to the waveform measured in normal hearing individuals to the same stimuli. The parameters of cognitive ERP components (MMN, N2b and P300) reflect to the tone and speech perception and the patient's performance with cochlear implant. This is a useful method for assessing the discriminability of stimulation patterns produced by cochlear implant, that may yield important information for developing rehabilitation programs for individual cochlear implant users.

D14 – 467

Experimental trial for robot-assisted laser cochleostomy

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Precise bone ablation is a key issue for minimal traumatic cochleostomy. In a laboratory setup we have already shown, that preserving boundary layers in a temporal bone model while laser ablation is possible by visual control using image processing techniques. To test OR feasibility we are evaluating a method for accurate positioning of the laser using robot assisted surgery. The experimental setup for robot-assisted laser cochleostomy consists of a Staubli-RX90CR robot, the prototype laser-system OsteoLas and an articulated mirror arm, which guides the laser beam to a 2D galvanometric scan head at the robots flange. The target point on the promontory and the diameter of the cochleostomy canal are defined by means of a three-dimensional surface model of a temporal bone specimen prepared with a posterior tympanotomy. This geometrical plan needs to be transferred into an ablation pattern of single laser pulse positions afterwards. Every bone piece ablated by a single laser pulse has a volume of 0.001mm^3 ; – thus up to 2000 pulses have to be packed into the complete cochleostomy canal. Additionally feasibility and reachability with the robot system is checked in the simulation. We build up a robotic system for laser based cochleostomies. A planning and simulation environment allows configuring essential steps of the cochleostomy preoperatively. An ablation pattern is generated automatically to obtain a smooth bony surface in order to detect the lining membrane of the inner ear. Afterwards the relative location of the robot to the target point is generated automatically. The specimen was registered using fiducials with a resulting FRE of 0.37mm. This experimental trial is a step towards OR feasible robot assisted laser based cochleostomy. For the first time laser ablation and robot assistance are combined in order to support the surgeon during the microsurgical part of cochlear implantation.

D04 – 174

Oral or sign language for a deaf child? The old dilemma – new psychological perspective

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The question which: oral and/or sign language is optimal or appropriate for a deaf child has its old tradition. Today, however, its substance was changed to how to support the development, including language development of the deaf child in its linguistic, psychological, educational and medical aspects. Unfortunately, there is a lack of satisfactory solutions. The majority of deaf children from hearing families does not gain high language competence neither in oral nor in sign language, which means that their level of language competence is often not only dramatically lower than that of their hearing peers raised in hearing families but also that of their deaf peers raised in deaf families (see: Glickman 2007, Glickman, Black 2006, Fellingner et al. 2005, Krakowiak 2003, Scheetz 2004, Kitson, Fry 1990). In the area of psychology there is a growing amount of research showing that it is the quality of the mother-child interaction and not the type of the language that determines the development of the high language competences (see Janjua, Woll & Kyle 2002). Presented research was conducted using the interpersonal approach (Stern 1985, 1995; Zalewska 1998), in which the verbal self is related to the quality of mother's relationship with her child. The investigated group included 41 hearing mothers of deaf adolescents aged 18-22 with different levels of competence in oral or/and sign language and 40 mothers of hearing adolescents. Research included quality methods (clinical interview 'Motherhood') and questionnaires: SPSS (Mac Phee, Benson, Bullock), Scale of Relationship with a Child (by Gacas), Questionnaire I-Others 1 and 2 (modification of Traits Questionnaire by Jarymowicz), TAS-20 (Taylor, Bagby, Parker). It turned out that the oral or sign language does not make a difference between hearing mothers of deaf

children in terms of investment, competence, satisfaction with motherhood and importance of motherhood, quality of relationship with a child, level of alexithymia or properties of self representation of mothers. The differences in self experiencing as the mother of a deaf child manifest when we take into account the differences in the level of limitation in oral and/or sign language command of deaf adolescents. Research project supported by grant from MNIšZW Nr 2PO5E 109 28.

C01 – 100

The influence of coding strategy on Electrical Stapedius Reflex Thresholds (ESRT)

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Postoperative electrical stapedius reflex thresholds (ESRT) show a good correlation to psychoacoustic loudness scaling. This is the main reason why ESRTs are used for cochlear implant fitting in children for the estimation of comfort levels (c-levels, m-levels, MCL). The application of this objective fitting procedure is particularly helpful in children who cannot provide reliable behavioural response. After introduction of new coding strategies it is of interest, if changes of ESRT are observed when different coding strategies are used. By means of a new setup, ESR measurements were performed in children and adults. Stimuli were generated by the standard fitting software. Repetitive stimulation with increasing and decreasing stimulation intensities was applied to elicit the reflex in the vicinity of reflex threshold. Reflex detection was performed by impedance audiometry of the ipsi- or contralateral ear using a fast response impedance meter. The two apical electrodes (channel 1 and channel 2) of the MED-EL implants Pulsar 100 or Sonata 100 were stimulated applying FSP and HDCIS coding strategy. The median of the recorded ESRT was calculated for each coding strategy and compared. The effect of coding strategy on ESRT was found to be different for each individual patient. Equal, higher and even lower ESRT values were observed for channels stimulated using the FSP strategy in comparison to HDCIS stimulation, although the overall charge delivered to the implant within one burst is always lower for FSP. ESRT values for different coding strategies can differ depending on the individual and the electrode stimulated. Therefore, when the coding strategy is changed during a fitting session, the comfort levels of the channels affected have to be checked again and readjusted accordingly.

C06 – 129

Improvement in speech understanding and user satisfaction after upgrading from the Medel Tempo+ to the Opus2 speech processor

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Recently, the Opus2 behind-the-ear speech processor (Medel Inc., Austria) for cochlear implants has superseded the older Tempo+ device. The most apparent differences between the two types of speech processors are an improved coding strategy (Fine structure processing, FSP), a remote control, an integrated telephone coil and a smaller housing. The aim of this study was to compare speech understanding and subjective assessments of users, who have been switched from the Tempo+ to the Opus2.23 CI users (15 children, ages 6-16, and 8 adults, ages 18-70) who have been fitted with the new Opus2 speech processor in the last 7 months participated in the study. All participants had used a Tempo+ processor for at least 2 years at the beginning of the study and were converted from the CIS+ coding strategy to the new FSP strategy. Understanding of German monosyllabic words and 2-digit-numbers at 60 and 80dB were compared before the processor upgrade and after 2 months of use of the Opus2. Furthermore, all participants were asked to fill in a questionnaire regarding their subjective assessment and their use of the new speech processor. On average, speech understanding improved by +5.4% for numbers and +10.4% for monosyllabic words with the new speech processor. However, the differences were not statistically significant (monosyllabic words: $p=0.06$). All participants preferred the new speech processor. Subjectively, size and speech understanding were regarded as superior. The remote control and the telephone coil were used by less than half of the participants on a regular basis. Our results show an overall benefit of the new Opus2 speech processor for the user, when compared to the older Tempo+. Besides a better subjective rating by the users, improved speech recognition scores in quiet were found in children and in adults.

C07 – 274

Perception of timbre and melody in speech and music in cochlear implant users

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The aims of study were: 1) comparison of perception of timbre and melody in speech and music in CI users; 2) the development of training procedure for the enhancement of melody and prosody perception in CI users. 30 pre- and post lingual patients with CI (Combi 40, Combi 40+, Opus II, MED-EL) participated in the study. The following abilities were tested and trained: recognition of speakers' voice (female, male, and F0-modification); perception of intonation patterns; perception of selected musical excerpts; identification of timbres of musical instruments and distinguishing of rhythm structure. Specially designed computer program for training/assessment and interview were used. CI users become able to recognize well rhythm, speakers' voice and timbres of musical instruments after special training and development of auditory processes. Musical timbres with narrow energy distribution (flute, cello) were better perceived than the timbres with wideband spectral distribution of sound energy (organ, orchestra). The recognition of fundamental frequency patterns both in speech (phrase intonation) and in music (pitch and melody estimation) was the most difficult task for CI-users. The results demonstrate a correlation between the perception of speech prosody and music by CI-patients. The individual scores were dependent on the age of deafness, duration of CI using, personal musical experience before hearing loss and after cochlear implantation, individual characteristics, CI model. Perceptual training and experience improve the tested abilities. Most post-lingual patients after about 2-3 weeks of rehabilitation are able to adequately estimate general features of music excerpts. The most uncertain estimation remains for the pitch and its changes. The analysis and recognition of prosodic characteristics of music and speech sounds are widely available and effective training procedures to improve perception skills of CI users. Latest CI models (Opus II) provide advanced possibility for development of melody in music and speech prosody.

D06 – 190

Four periods of auditory-speech rehabilitation in prelingually deaf cochlear implant children

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The aim of study was to analyze an auditory, language and speech development in prelingually deaf children after cochlear implantation. 97 prelingually deaf children implanted with CI (Combi 40, Combi 40+, Opus II, MED-EL) at the age from 14 months till 15 years participated in the study. Auditory-speech perception, speech and language development were assessed. There are four periods of auditory, language and speech development in prelingually deaf children after cochlear implantation. 1-st period - "initial period of listening skills development". Duration: 3-12 weeks. During this period CI processor must be tuned to provide the perception of all speech sounds, child becomes interested in listening of sounds and pronunciation of sounds. 2-nd period - "main period of development of central auditory processing". Duration: 6-18 months. At this period central auditory processing (detection, differentiation, recognition), auditory attention and memory, coordination between auditory perception and speech motor skills (articulation/voice) are developed. 3-rd period - "language period of development of speech perception and oral speech". Duration: > 5 years. At this period auditory-speech and oral speech development are based on development of language system (vocabulary and grammar). The level of speech/language development of child at the end of period responds the level of 6-7 years normal hearing child. 4-th period - period of development of understanding of complex text and fluent speech. Only part of prelingual children can achieve this stage of speech/language development. Most of them are children implanted before 3 years old without additional disorders. They also got intensive auditory-speech rehabilitation before and after surgery. The approach with 4 periods of auditory/language/speech development in prelingual CI children is useful for organization of rehabilitation program and prognosis of results at different periods of CI using.

A04 – 025

Evaluation of usefulness of LittleEARS diary with supplementary activities

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The LittleEARS Diary (Veekmans et al 2004) provides: information on early childhood milestones and auditory, speech and language development; questions to guide parental observations and ideas for activities. The Diary covers the first 28 weeks after device fitting. The aims of this study are to evaluate the usefulness of the diary and of newly created supplementary activities over which parent and child interact during a therapeutic session. 28 activities, contingent with the week's information and advice, suitable for children aged 1-2 years were designed. Parents of 6 children, newly implanted with MED-EL PULAR CI100 and fitted with OPUS 2 speech processors, average age 20 months, participated in 1 diary based, observational, parent guidance session per week. 3 experienced therapists participated, each supporting 2 families. At each session the relevant weeks information was gone through, diary questions were asked and then parent and child interacted over the associated activity. The therapist observed interaction then offered advice and encouragement. After 14 weeks both parents and therapists completed a questionnaire to gain feedback about the program. Parents reported: they had become keener observers of child behaviour; they were more knowledgeable and confident; they repeated activities done in sessions at home and that knowing about developmental 'norms' encouraged them to work with their CI child so they would 'catch up'. Therapists reported: access to information on milestones helped them to know what child behaviour to expect; having questions, information, age appropriate activities and materials ready, lead to well planned, comprehensive sessions and that information collected provided a useful record on which to build rehabilitation goals and inform about progress. The diary, with supplementary activities is a useful aid to therapists inexperienced with working with very young children and could help to maintain quality of rehabilitation across centers.

C07 – 280

Music for young CI users

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A music program was developed for young CI users because of scarcity of such programs, positive effects of musicality training and current interest in effect of fine structure processing (FSP) on music perception. The program 'packet' contains information for parents and teachers, evaluation tools and lesson plans. Instruments were obtained. A variety of music, rhythmic chants, songs, rhymes and musical stories were chosen. Computer screens, picture materials and lesson plans were prepared. A pamphlet for parents with a questionnaire to promote and evaluate musicality in very young children and a hierarchical scale to evaluate musical progress were designed. The scale evaluates child ability to: sing; recognize songs, melody and timbre and move to music. This program was implemented at Ilkses Rehabilitation Center, Gaziantep, Turkey. 19 PULAR CI100 users, fitted with OPUS 2 speech processors implementing FSP, participated with parents in 1 group and 1 individual music session per week for 1 year. Children were divided into 2 groups, A and B. At start of project age ranged from 19 -44 months and length of device use from 0 to 15 months. Sessions were conducted by non-specialist teachers, mostly using recorded music. Lessons included: listening to music; singing; experimenting with percussion and musical instruments; beating rhythms and moving appropriately to music. Children were scored 5 times on scale at 3 monthly intervals. Children in Group A and B, respectively, had an average total score of 9% and 18% at start of program increasing to 47% and 71% after 1 year of training. Implementation and evaluation of program meant necessary adaptations could be made to final product. Neither group reached ceiling score indicating the program is applicable to children of varying ages and ability. Increase in scores over time demonstrates effectiveness of training and CI user's ability to perceive music.

D04 – 172

Visualization of speech an multisensory support for hearing with the use of Cued Speech

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The first condition of language acquisition and ability to speak is to differ precisely all the elementary parts of the phrase itself (syllables and phonemes), in a quickly produced stream of speech. Hearing impairment does not diminish the child's in-born language abilities. However, severe neural and sensual hearing impairment obstructs the child's access to the key according to which the meaning of the words has been coded. A child with such an impairment, in spite of the natural ability to differentiate the elements of the stream of speech, in practice experiences aphonemy or disphonemy - he/she cannot differentiate the phonemes he/she hears in such a precise way so as to assign them the language value. A deaf child does not learn language and speech spontaneously, in everyday conversations, but he/she has to struggle for learning each particular word and learn consciously how to control his/her own speech. It is difficult for him/her to create a rich inner language and in consequence he/she experiences social, educational and communicative difficulties, and what is more, it is difficult for her/him to learn to read and write. Because of the reasons mentioned above it is important to find a method that enables to fight the aphonemy and disphonemy and which makes it possible to communicate freely and spontaneously in everyday family life and in educational settings. Cued Speech is an example of such a method.

C05 – 126

Expansion of the perceived pitch range with fine structure stimulation

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Upon exposure to fine structure stimulation cochlear implantees typically report hearing sounds as being lower in pitch. The present study quantitatively explores this difference and shows that fine structure stimulation expands the perceived pitch range. To date six experienced cochlear implant subjects participated in the research. The speech coding strategies under investigation were a ten-channel implementation of Continuous Interleaved Sampling (CIS) and a fine structure strategy (FS) with identical filter banks. The stimuli were 500 msec long harmonic tones with a spectral roll-off of 9dB per octave, presented via the direct input of the speech processor. For every run of the experiment, a combination of fundamental frequency and coding strategy was chosen as a reference stimulus, which was always presented first. The second stimulus combined the other coding strategy and randomly selected fundamental frequencies, and the subject had to indicate which stimulus was higher in pitch. Thus, psychometric functions for pitch perception were sampled and the point of subjective equivalence (PSE) for the two coding strategies was estimated by fitting a logistic function to the data. The procedure was performed for reference stimuli with fundamental frequencies of 161, 287, 455 and 811 Hz. At 161 Hz in five of the six subjects FS sounded lower in pitch than did CIS, whereas at 287 Hz FS sounded lower in all six subjects. The average pitch shift was three semitones (one minor third) at the two lowest frequencies tested and one semitone at 455 Hz. At 811 Hz no pitch difference was found, which was to be expected since the stimulation patterns for CIS and FS are nearly identical for signal frequencies above the fine structure limit. The results indicate that fine structure stimulation does expand the range of perceivable pitches as compared to standard CIS.

C04 – 119

Real Life Fitting in speech therapy: results of practical application

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During rehabilitation of CI-patients, the normal noise-free fitting situation is not comparable to hearing in everyday life, and most patients do not profit from the sound preprocessing strategies (SPSTR) Smart Sound (Beam TM, ADRO TM and Whisper TM) in an optimal way. Real life fitting (RLF), an audiovisual system, as well as a new therapeutic setting, might optimize the quality of life of CI patients essentially. Until now, 14 patients have been assigned to two groups (A and B). Both groups were asked to fill in a questionnaire of their actual state of changing speech processor programs in every day life. Furthermore, both

groups received a defined alignment of the programming slot position (P1-P4) with one main position or SPSTR, respectively. The patients were informed about the function of SPSTR with standardized instructions. Additionally, by means of RLF, hearing impressions with different SPSTR were compared from Group A. Group B only received the standardized instructions. Both groups were asked to fill in "hearing diaries" at home with questions concerning the use of the programs for two weeks. Finally both groups had to evaluate their experiences via questionnaire during their second rehabilitation stay. Changing the therapeutic setting was of essential help for most patients, modifying their user behaviour significantly, thus allowing a new quality of hearing. According to our study, RLF is a useful instrument for most patients to represent hearing in everyday life. In order to use Smart Sound in an optimal way, it is necessary to change the therapeutic setting in CI rehabilitation.

B02 – 057

Some implementations of surgical techniques for cochlear implantats

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Since the middle of 1999 till this moment 280 patients have been implanted with a cochlear implant in the ENT department by the Medical University of Sofia. The implants were Nucleus and MED-EL CI. The conventional technique for cochlear implantation is via a mastoidectomy and posterior tympanotomy. We use a transmastoid approach and a suprameatal approach, posterior tympanotomy. By same patients we applied our own modification paracanal approach to the middle ear. This variation on the basic techniques are dictated by the shape of the device. After a skin incision is made we form two flaps – superficial (skin) and deep (muscularis and periostalis), the last of which is connected on wide basis. By these manipulations a. occipitalis is kept intact. The intracochlear prosthesis may be introduced via a transmastoid approach through the facial recess or a transcanal approach through the posterior epitympanic space. The level of danger of sacrificing n. facialis is immensely decreasing, shortening of the surgical and anaesthaesical time is achieved; decrease in the level of bone destruction in comparison to tympanotomy posterior, optimal electrode placement as near as possible to the spiral ganglion cells. The surgical trauma and postoperative edema was decreased and allowed programming of the implant in a shorter period of time.

A06 – 044

Predictive value of early language levels on long term developmental trajectories in early and late implanted children

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The objective is to determine the long term influence of age at implantation on developmental trajectories of audition, language and educational attainment. Follow-up data of 29 children, with normal cognition and learning potential, have been studied retrospectively. Two groups were classified according to age at implantation; Group I:<30 months. Group II:>30. Speech perception is expressed in open-set phoneme scores. Receptive and expressive language is quantified by Reynell age-equivalent language-scores. Educational attainment is determined with a national evaluation procedure. Non-parametric analyses were performed to contrast the auditory and language scores of the groups. The auditory and language group averages diverged remarkably. Long term language abilities of group I were within 1 sd of the hearing norm. In group II the average auditory and language scores were significantly poorer. However, there was a clear dichotomy in language-scores. When the language-age after 12 months of implant use was less than half of the chronological-age, subsequent developmental rates remained below 0.5. In contrast, children who performed above the 0.5 level after 12 months, reached rates above 1 at each following interval. Children with language rates above 0.5 were all in mainstream education. In early implanted children the development of vocabulary shows a steady increase over time, with only a small delay. Interestingly, the development of more complex morpho-syntactical structures shows a comparable smooth progression. However, the language level that is achieved after the first year of implant use is a strong indication for the long term outcomes in spoken language and education. Notwithstanding the large inter-individual variation that is often reported in literature, language acquisition within the first year after implantation is highly predictive for long term language and educational outcomes.

B08 – 251

Communicative intention as predictor for benefit of CI in multi-handicapped children

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The main objective is to evaluate the long term effects of cochlear implantation in multi-handicapped children with cochlear implants and to determine the characteristics of good and poor performers. In this prospective study a heterogeneous group of 18 children with complex needs has been thoroughly evaluated, pre-, 6, 12 until 24 months post-implantation. Age at implantation ranges from 1;1 to 11;2 years. The complex needs include cognitive disabilities (PIQ), learning and/or language disabilities, autistic spectrum disorders, blindness and physical/motor problems. Auditory abilities (MAIS, ASSE), early communicative behavior (TAIT, observation list) and language development (Reynell, NNST) are assessed, non-parametric analyses were performed. The average level of auditory awareness at 24 months is limited to detection and early discrimination. There was a large variation, ranging from absence of reactions, to in some cases the attachment of meaning to sound signals. The spoken and signed supported communicative development also showed large variability. Interestingly, relatively good performance at 24 months was only obtained by a group of children characterized by higher pre-implant spoken communication levels. Children who did not reach this level showed no development in communication. This dichotomy between good and poor performers was even more significant in sign supported communicative development. No correlation between auditory awareness and communicative development was found. Formal language as assessed with the Reynell remained extremely limited. The level of pre-implant communicative intention of children appears an important prerequisite for the use of auditory information within communication. However, most children showed some improved auditory awareness. In children with a wide range and degree of complex needs, some auditory awareness emerged. However, the most relevant predictor of auditory benefit in interaction is communicative intention.

D13 – 453

Modiolar Research Array – First Freiburg human implantation

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The major interest for new developments in cochlear implant surgery is a reliable atraumatic electrode insertion into the scala tympani. With the new modiolar research array (MRA) an intracochlear electrode is available that combines the advantages of a perimodiolar electrode position with considerably smaller dimensions than former electrodes. The insertion is accomplished by a sheath that straightens the electrode prior and during insertion and is removed after insertion. We describe the intraoperative surgical procedure and intra- and postoperative results following the first human implantation in adults at the University of Freiburg. The study was approved by Ethic's committee of the University of Freiburg. For reliable insertion a temporal bone training is necessary to provide a successful human implantation. Surgical steps for implantation as well as postoperative results in 3D-volume tomography will be provided. The comparison of radiologic and histologic results of our temporal bone study served as a baseline for evaluation of insertion results in patients. With the new MRA electrode an atraumatic intracochlear insertion can be performed. This is most important for preservation of residual hearing. The dimensions of the electrode as well as the insertion mode via an out of the sheath procedure needs an experienced surgeon. With regard to outcome long term observation is necessary. From the surgical point of view the development of an insertion tool is of interest to facilitate the insertion procedure.

A02 – 011

Phonological processing in deafness predict cochlear implant outcome

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Cochlear implantation (CI) works well in general but the individual outcome is not fully accounted by the data routinely available to the clinician, and therefore remains largely unpredictable. The aim of this phonological fMRI study was to delineate neurofunctional factors that can provide individual prognosis for CI. Eight post-lingual deaf adults candidate for CI were asked to perform a rhyming written task. They were compared to 8 controls, matched

in age and handedness. Performances during the task were recorded. The patients were implanted and their speech recognition scores at 6 months were collected. These data were then correlated to neuro-anatomic images before CI (SPM5 and non-parametric tests). While clinical data offered only prognosis trends, functional data showed two predictive patterns: poor performers pathologically involved the right supramarginal gyrus while good performers overactivated visual regions, and by-passed regions involved in high-level semantic processing. These patterns revealed cognitive strategies that emphasised either on-line input processing (the good one), or global pattern recognition (the bad one). These findings suggest that, if carefully targeted by specific behavioural explorations, cognitive strategies might fruitfully inform cochlear implant indication and orientate post-CI rehabilitation.

A06 – 039

The impact of a cochlear implantation on children's conversational language abilities

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Majority of studies have underlined the relevance of a cochlear implant in providing sufficient auditory information to attain a satisfactory oral communication development. But only a few studies have examined its impact on children's conversational language abilities. Furthermore, fewer are those that emphasize the improvement of children's social skills, rate of participation and use of verbal language during the first six months after implantation. Over the last few years, the age of implantation gets younger. In many centres around the world, the age norms of an early implantation seem to be earlier than the age of two (critical period for spoken language development). Thus, it is pertinent to study the latter's impact on the acquisition of social rules and skills relative to speech activities. Our hypothesis is that cochlear implantation before the age of two will permit a nearly normal speech acquisition. Consequently, the profile of young children implanted at an early age comes close to that of younger normal hearing children and differs from that of deaf children with conventional hearing aids. To analyze the language development of very young implanted children, we have used conversational samples from a filmed video protocol at specific intervals within the span of one year. We have monitored the development of communication skills in a group of 8 pre-lingually profound deaf children implanted before two years old (mean age: 1.5 years). Twelve months after implantation, the profile of the implanted children's group was compared to that of their normal hearing peers group within the same play interaction session with a parent. The results corroborated our hypothesis. Children implanted before the age of two increased their initiative productions and their vocal turn-takings. In the same way, their assertive productions were more numerous during the follow-up sessions. The implanted children of our sample presented the same profile as that of their normal hearing peers in regards to initiative productions and turn-takings. However, some differences appear among the groups. Deaf children seem to produce less information demands than their hearing peers. Another observation is the wide dispersal inter-individual differences present within the deaf group.

A12 – 368

Sequential bilateral implantation: only positive results?

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During our project with sequential bilateral implanted children we encountered more problems during the rehabilitation process than with monaural implanted children. Other presentations about bilateral implantation mainly present (positive) results of speech intelligibility or directional hearing. However, for counseling it is necessary that disadvantages and difficulties are known as well. In this project 30 children participated. The children received their second implant at a maximal age of eight years. The time between first and second implantation ranged from one to seven years. All participants developed well with their first implant. In this study we compared the problems met during the rehabilitation process of the second implant with that of the first implant. Because age of implantation could have influenced the results, the rehabilitation process of the second implant is also compared with that of an age matched group who receive their first implant. After a year more children do not like to wear their second implant than their first implant. Seventeen percent of the children showed moderate problems with wearing their second implant where none of the children had these problems with their first implant. The number of slight problems was for both implant about the same (20%). The poor sound experience via the second CI seems to be more responsible for these results than the worse speech intelligibility via the second CI. In this presentation attention will also be directed towards strategies to overcome the problems and predicting factors for these problems. Some sequential implanted children experience more disadvantages than advantages

from their second implant and dislike to wear their second implant. Parents and older children have to be warned that the quality of the sound via the second implant may be disappointing. A reward system can help to remove the resistance against the second CI.

A07 – 205

Pharmacological interference of inflammatory processes in the inner ear by local perfusion of TNF α blockers

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Hearing and vestibular function can be influenced by inflammatory process, in particular by autoimmune mechanisms. In 1979, McCabe reported 18 cases of patients with progressive bilateral hearing loss responding to corticosteroids and/or cyclophosphamide. An animal model of immune mediated labyrinthitis induced by immunization of with keyhole limpet hemocyanin (KLH), demonstrated the rapid accumulation of inflammatory cells in the inner ear [Chen et al., 1998]. The infiltrated cells contain large numbers of TNF α producing cells. TNF α is a pro-inflammatory cytokine that play a central role in inflammatory processes and is secreted by activated macrophages, monocytes, T cells, B cells and fibroblasts. TNF α induces the infiltration of immunocompetent cells into the tissues and amplifies the immune response. In addition, TNF α is directly toxic for the neurosensory structures of the inner ear. Several new drugs have been developed that interfere with the TNF α signaling pathway. TNF α inhibitors are effective in the treatment of an animal model of immune mediated labyrinthitis [Wang et al., 2003]. We tested whether a local administration of Infliximab could stabilize or improve hearing of patients suffering from an autoimmune inner ear disease dependant from a systemic administration of corticosteroids. Local administration of TNF α blocker allowed the tapering of methylprednisolone without loss of hearing function in 4/5 steroid dependant patients. Four additional patients were treated only with anti TNF α perfusion to the round window membrane without concomitant systemic administration of methylprednisolone. In 3 out of these 4 patients, the pure tone average (PTA) improved 22.6 ± 15.7 dB, resulting in hearing recovery comparable to treatment with systemic methylprednisolone. The 7 responding patients showed a significant reduction of recurrence of hearing loss to 0.028 ± 0.072 episodes per month over the 4.3 ± 2.4 months of the post treatment period as compared to 0.84 ± 0.4 recurrences per week seen in the pretreatment period. Conclusions: The results of this pilot trial demonstrate that in patients with AIED, once weekly transtympanic delivery of the TNF α blocker infliximab for 4 weeks allowed the tapering of steroids, resulted in hearing improvement and reduced disease relapses. These preliminary efficacy and safety results appear encouraging enough to warrant further follow-up and studies for better determination of the potential clinical utility of local administration of InfliximabTM not only for autoimmune hearing loss but for inflammatory mediated deafness in which TNF α that can occur after ischemia or trauma of the inner ear. These pharmacological approach might be applied for cochlear implantation.

C10 – 300

Hearing Screening in Germany: a long way from law to implementation

Lehnhardt M.

Prof. Ernst Lehnhardt Foundation

By 1st January 2009 the law for mandatory neonatal hearing screening came into effect in Germany. This was the result of nearly 10 years of lobbying by ENT doctors, audiologists and pressure groups. The implementation is the responsibility of the 16 individual German provinces. Critical voices already predict that this is one major obstacle to a smooth and nationwide realisation of this project. Another counter-productive factor are opponents who believe that neonatal screening for risk babies only should be the way to go forward. Based on interviews with key opinion leaders in the field of ENT, I will present the current situation in various German provinces. A preliminary analysis seems to indicate that the major issues will be: availability of appropriate medical equipment (OAE, AABR), sufficiently trained personnel, lack of central data collection and administration and, most importantly, counseling of and follow-up with parents. The result will be that not all newborn babies will be tested, that we will have false negative and false positive cases and that babies, identified with a hearing problem, will not be adequately treated in a timely fashion. Looking at other countries where neonatal hearing screening has already been routine for many years, i. e. Austria, the Flemish part of Belgium, and Poland, suitable strategies for successful implantation of the new law in Germany will be proposed and discussed. Economic considerations and cost benefit aspects will be considered.

B12 – 396

Auditory brainstem implant in NF2 patients results of 12 years systematic follow up in Hannover

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Deaf patients who do not have an intact auditory nerve cannot benefit from a cochlear implant. A central auditory prosthesis that bypasses the damaged nerve and stimulates directly certain parts of the central auditory pathway may restore hearing to these patients. At present there are three types of central auditory prosthesis (CAP) available for clinical use in patients with neural deafness: 1- Auditory brainstem implant (ABI) based on surface stimulation of the cochlear Nucleus, 2- Penetrating auditory brainstem implant (PABI) based on deep stimulation of the cochlear nucleus and 3- Auditory midbrain implant (AMI) based on deep stimulation of the inferior colliculus in the auditory midbrain. In this study we focus on the results of hearing restoration with ABI. In our study we concentrate on the long-term results of hearing restoration with ABI in 29 patients with neurofibromatosis type 2 (NF2) who have been implanted and followed since 1996 in Hannover. The results of 4 standard hearing tests (consonants, vowels, numbers and speech-tracking test) over a period of 12 years will be presented and the prognostic role of certain pre-operative factors like duration of deafness and tumor size on the hearing outcome with ABI (in NF2 patients) will be discussed. We also evaluate the role of the number of active ABI electrodes on the hearing outcome of the NF2 patients. Generally the results of the 4 hearing tests performed in audi-visual mode (AV mode) stabilize after one year and remain stable over the following years, although the results of the same tests in the auditory alone mode continue to improve very slowly over years. Regarding the prognostic role of the preoperative factors on the performance of the NF2-ABI patients; tumor size and duration of deafness did not play a significant role on the performance. Regarding the importance of the number of active ABI electrodes on the hearing, only patients with less than 6 active electrodes had significantly worse results compared to the patients who had more than 6 active electrodes, above this limit the number of the active electrodes did not make a significant difference in the performance with ABI in NF2 patients. Tumor size and duration of deafness do not have a significant prognostic value on the results of hearing restoration with ABI in NF2 patients.

A07 – 206

Hearing protection during cochlear implantation using atraumatic and drug eluting electrode

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Hearing preservation during cochlear implantation is becoming more and more an important issue. The electroacoustic stimulation provides additional benefit. In order to achieve the scores special electrode developments are under investigation. Nanoparticle coated electrodes are under development that will elute dexamethasone after implantation to protect residual hearing and prevent connective tissue growth. In addition these electrodes have special mechanical properties to minimize insertion trauma. In vitro experiments as well as in vivo experiments in guinea pigs show that the drug eluting effect is substantial to increase the rate and percentage of hearing preservation significantly. Clinical data so far show a high probability of hearing preservation provided that a special surgical technique of insertion into the cochlear is used. Recent research and clinical data show the basics of principal concepts of hearing preservation during cochlear implantation. Both experimental as well as clinical data support the idea of atraumatic insertion and local drug delivery.

B04 – 071

Round window insertion study of a prototype perimodiolar array

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Cochlear implants (CI) are the treatment of choice for individuals with severe-to-profound hearing loss. As more and more patients still have some residual hearing, electrodes are needed, which minimise insertion trauma, preserve delicate cochlear structures and therefore preserve residual hearing. The aim of this study was to assess the suitability for round window insertion of a prototype, small diameter, pre-curved perimodiolar array. The Modiolar Research Array (MRA) utilises an external polymeric sheath rather than a stylet allowing for a significant reduction in electrode dimensions compared to the Contour

Advance. In this study 12 human temporal bones were used for the insertion of MRA prototypes via the round window. Temporal bones were prepared as for normal CI insertion. The bony overhang was removed from the round window (RW), a small incision opened the RW and a sheath with the preloaded electrode was inserted. The electrodes were inserted through the sheath. After removal of the sheath, the electrode leads were fixed in a prepared groove in the mastoid. Temporal bones were fixed, x-rayed and embedded. Evaluation of the electrode position and possible trauma was done using grinding techniques and photo documentation. Insertion through the RW was possible. With the first set of prototypes, removal of the sheath was challenging, however subsequent design iterations resulted in improvements with sheath removal. All together we had 3 basilar membrane perforations, whereas 8 of the insertions did not cause any trauma. Insertion depths were between 280 and 450 degrees. Two electrodes causing basilar membrane perforation resulted in a tip foldover and insertion depth was about 100 degree. Although insertion of the MRA via the round window is feasible, the diameter of the external sheath is not yet optimised for round window insertion. We expect insertion dynamics and intra-cochlear trauma to improve with further optimisation of the MRA for round window insertion.

D13 – 454

Application of a precision 3-D force measurement system in development of the Advanced Bionics' minimal trauma electrode array

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While the locations likely to show cochlear trauma during electrode array insertion have been well reported, the actual forces imposed onto the cochlea are still quite poorly understood. This work used a state-of-the-art force measurement system (FMS) able to resolve mN forces in three dimensions. The goal was to correlate human temporal bone insertion measurements performed on the FMS with micro CT analysis of the implanted bones. A video camera was synchronized such that movement of the proximal electrode array could be reviewed with the corresponding FMS values. Additionally, an audio feedback signal was used where pitch was modulated by a pre-set range of forces. Ten human temporal bones were implanted using prototype electrode designs. Variables studied included: differential stiffness, lateral and perimodiolar location and length. Insertions were made via a cochleostomy of less than 1 mm diameter illed anterior and inferior to the round window. Insertions were made both free hand and with the assistance of an insertion tool. Micro CT analysis showed some buckling of the lateral lying designs in the basal turn. This behaviour was associated with peaks in the FMS records beyond 100 mN. The peri-modiolar arrays tended to show a smoother insertion profile. Audio feedback was found to be very useful and could play a valuable role in development and training on minimal trauma surgical approaches. Even in this initial experiment, the FMS has shown itself to be an invaluable tool for understanding the complex forces associated with cochlear implantation.

B05 – 080

Reimplantation – a rationale to upgrade cochlear implant systems in patients? Risks and benefits

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Cochlear Implantation is as well as in adults as in children an experienced and well-established therapy in cases of bilateral profound hearing impairment. As a consequence of the Newborn Hearing Screening (NHS) even more younger children will be implanted. Therefore we have to answer the question whether a reimplantation is possible and which outcome do we have to expect. At the ENT-clinic (MHH) in Hannover more than 4000 patients were implanted up to 2008. Because of implant failures, skin lesions, cholesteatomas and other medical complications reimplantations was necessary in 92 patients from 1985 until 2005. The analyses is based on the product used in the first implantation and after the reimplantation, on the outcome with the CI up the time to reimplantation and the development with the implant 2 years after re-fitting. We could find that patients experiencing an upgrade with the reimplantation increase their speech understanding about 14%. Reimplantation with the same product generation could not benefit with an increase of performance. An ongoing additional study analyses the results of electrode insertion with the reimplantation. These results will also be demonstrated and discussed. In conclusion reimplantation is possible in experienced surgical hands because an optimal reinsertion is difficult to perform. An upgrade in cases without medical indications for reimplantations should be discussed carefully – also under medical-ethically aspects.

B08 – 248

CI in deaf multi-handicapped children: specificity of the management

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Causes of deafness have changed progressively from meningitis to CMV related infections and premature deliveries. This changes have triggered an evolution in the practice of readaptation. Professionals are more and more confronted with the management of multi-handicapped deaf children. 20% of the 50 children followed up by the early childhood education team of the Comprene et Parler Center, are suffering from associated handicaps. This abstract is a case report on the evolution of 2 deaf children with a CHARGE synom; implanted at 11 and 26 months. Both of them had an auditory nerve(VIII) hypoplasia, retinal colobomas, psychomotor retardation and various functional impairments. 4 inter-related areas of work were defined: settings, speech therapy, partnership with the parents and specialized inter-team's collaboration. Results were evaluated 24 months after implantation. The CAP and the skills and limits observed in the support, facilitation and communication development were the basis of the assessment. A short video will illustrate this. The pitfalls encountered in the follow-up of these very handicapped children will be detailed: technical issues, difficulties in behavioral analyses due to multiple sensorial impairments, impact of fontional disorders on the quality of live... The specificity of the follow-up performed by readaptation professionals will also be discussed: project adaptation according to fluctuating needs, integration of new knowledge into clinical practice, listening and support the parents who progressively discover the limits of their child's skills and must face the radical change of the family balance, manage the cultural vision of the handicap. CCI: 3 parameters are to be considered as priorities in the follow-up of multi-handicapped children with a CI: -importance of a functional "global" diagnosis -interdisciplinary team approach -adjustment to the child and his parents'live style.

C10 – 301

Therapy, rehabilitation and genetics as issues in very young deaf children: the experience of newborn hearing screening programme in Campania

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The importance of an early detection of hearing impairments in childhood is a well known issue. Communication skills, neuropsychological and social developments in deaf children are, indeed, notably influenced by the time of the diagnosis. The UNHS programme in Campania (Southern Italy), covering almost all the 60,000 children born in the region per year since 2005, aims to establish an effective diagnostic protocol (clinical and genetic assessments), set up a rehabilitation/therapy strategy and carry out a follow-up tracking for the neonats found as deaf. From the end of year 2005 about 150,000 children were included in the UNHS in Campania. Its progressive implementation has brought to detect about 200 deaf newborn with an average of age at diagnosis of ca 3 months. All subjects underwent ABR, ASSR, TOAE and clinic evaluation. A genetic assessment has been performed in the most of the patients as well as in their families whether advisable. The fitting of hearing aids and cochlear implants as well as a periodic tracking of audiologic and verbal communications skills of all the patients are provided by the Programme. The rate of congenital hearing disorders in Campania is 1.2%. About the 50% have been defined as genetic. The 100% of nonsyndromic genetic deafness are due to mutations of connexin 26. About 30% of neonats detected as deaf have undergone cochlear implantation. The big majority of the patients showed very good performance in their communication abilities according to the age of diagnosis and clinical features. The conventional audiologic protocol seems to get a remarkable benefit from a DNA assesment in order to achieve an as earlier as possible detection of congenital deafness. Moreover attempts to correlate phenotypes and genotype the hearing impaired subjects have been conducted in order to better define the medical interventions and thus the clinical outcomes. So far the Programme is implementing on. Both conclusions and results may vary at the date of discussion.

A06 – 041

Correlation between cognitive abilities and language level in cochlear implanted children

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Early cochlear implantation (CI) dramatically improves language development in deaf children, but there is a great inter-individual variability in results. Among numerous factors, cognitive abilities, such as verbal and visuo-spatial reasoning, memory and attention, might influence language level in cochlear-implanted children. The aim of this study was to determine whether language level after several years of cochlear implant use was correlated with the cognitive functions explored by the Wechsler Intelligence Scale for Children, 4th edition (WISC-IV). 17 congenitally-deaf children, with no associated deficits, who were implanted before 4 years of age and followed for at least 4 years, were included in this study. They underwent both language tests (exploring comprehension and expression) and WISC-IV. As age at implantation and post-CI time largely differed between children, the language level was considered as a ratio between language age assessed by tests and cochlear implant use duration. Language level was significantly correlated not only with Verbal Comprehension Index (VCI), but also with visuo-spatial perceptual reasoning index (PRI) and working memory index. A large difference between PRI and VCI, which suggests a severe language disorder, was also linked to a low expression level. When children were separated into 3 groups according to language level, a significant difference between groups was also observed for the Processing Speed Index. These results are in agreement with previous works suggesting that slow language development might be due in some cochlear implantees to cognitive disorders, such as Specific Language Impairment. Yet they must be taken with caution, as language and cognitive results to tests might be biased by tiredness, anxiety or limited oral language understanding. It is also impossible to determine whether cognitive results were the cause or the consequence of language level. But the cognitive factors must not be underestimated when potential CI benefits are explained to parents.

B08 – 244

More about cochlear implantation in children with CHARGE syndrome

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Three years ago we presented a case-study about two cochlear-implanted and two hearing-aided children with CHARGE association. It showed a wide range of language development: three children developed oral communication, with a moderate delay compared to other rehabilitated hearing-impaired children, but one child still had no use of oral language 3 year after CI. The present paper aims to have a larger overview and a longer follow-up of CI results in CHARGE syndrome. Five boys with CHARGE association and profound hearing impairment received a cochlear implant in our department. Age at implantation ranged from 2.5 to 6.2 years, and follow-up from 1 to 6 years. Surgical and rehabilitation aspects (fitting parameters, perception, communication mode, comprehension and expression) were studied. Despite anatomical particularities, effective electric stimulation was obtained in four children, leading to a significant development of oral communication. Yet soft failures (one of them after a mild head trauma) led to implant inner part replacement in two cases. The fifth child, who had more severe associated deficits than the other ones (major feeding troubles, low visual acuity and developmental delay) does not use his implant anymore. This study confirms the ability of most children with CHARGE syndrome and profound hearing impairment to develop oral language thanks to CI. Language development in cochlear-implantees with CHARGE association seems to mostly depend on the severity and extension of associated troubles: reaction to sounds with hearing aids and interest for global communication before CI may be good prognosis factors.

C04 – 116

Freefield audiometry during cochlear implant speech processor fitting in children

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It is very important to make a correct speech program during fitting session. Sometimes there is no way to forecast how good child will hear after fitting. Conventional methods of checking with sounding toys usually can give only approximate estimate. Ten children (5 boys and 5 girls) at age from 3 to 5 years implanted with Nucleus 24 system (Cochlear) about one year ago were investigated. Control group consisted of similar 10 children. All patients had ESPrint3G speech processors. In experimental group we use Custom Sound 2.0 software for fitting. Audiologic measures had performed with ORBITER 922-2 (Madsen) and Martin Audio speakers for freefield audiometry. Playing with child with toys and simultaneously stimulating through Custom Sound at first we found out thresholds and made a speech program. Then we switched to "Life mode" and started to produce narrow-band noises (freefield) with audiometer continuing to play with child. Thereby we get an audiogram of implanted child during fitting and able to make adequate changes to speech program. Control group had conventional fitting. Results were estimated after 3 months by questioning parents and pedagogical testing of child. Statistically significant differences in rehabilitation progress between groups were obtained. Parent of children of experimental group were more satisfied with results of fitting. Testing also demonstrated that children of experimental group had better results. Using freefield audiometry during fitting of speech processor helps to create appropriate program for improving results of rehabilitation. Making a program for speech processor we shouldn't strive to get an audiogram better than first degree of hearing loss for except perception of disturbing background noises. We continuing our investigation for receive long-term results.

C06 – 136

SPAN: Improved current steering on the Advanced Bionics CII and HiRes90K systems

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Advanced Bionics Corporation

The use of simultaneous current steering, to address neural populations between physical electrode array contacts, has been demonstrated; initially psychologically and more recently in the clinical HiRes 120 sound coding strategy. This work examined an enhanced method of delivering current steering. Two situations were compared where electrode contacts were deliberately deactivated at intervals along the electrode array. In the "gap" condition discrete regions of current steering were applied, the deactivated electrode producing a gap. In the "span" condition current steering was altered to bridge the gap, including the region of cochlea ignored in the gap condition. A group of 14 experienced adult users of the Advanced Bionics' CII or HiRes90K implants undertook speech perception tests for both the gap and span conditions. For different tests zero, one, two and three electrode contacts were deactivated. With no electrode contacts deactivated span and gap produced very similar results. The span condition produced superior results to gap for missing electrode contacts. Even with a group of three consecutive contacts disabled, it was possible to span this region using current steering. Generally a sound quality preference was expressed for the span condition. Being able to bridge across deactivated electrode contacts using current steering means that areas of the cochlea which might not have been stimulated previously may now be addressed. One obvious application of span is to overcome the clinical situation where contacts have had to be deactivated through, a fault, or for some sound quality or non-auditory stimulation reason. The initial results are encouraging and imply that span could readily replace the clinical default application of HiRes120 which uses the gap approach. The span technique may be further extended to create stimulation patterns which better match the neural survival of an individual's cochlea.

C15 – 428

Single microphone noise reduction on the Advanced Bionics Harmony processor

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Hearing in noisy real-life listening situations is almost always found highly challenging by cochlear implant users. This work set out to automatically remove noise from the microphone signal and examine the sound quality

and speech perception consequences of doing this. A single microphone noise reduction algorithm was developed. Sound was analyzed on a channel by channel basis for stationary behaviour which could be assumed to be of a non-speech origin. Those channels which had more stationary content were allocated lower gains in order to emphasise the channels assumed to contain primarily speech. A group of 20 experienced users of the Harmony processor participated in listening trials, including speech understanding in competing noise. Different analysis times, gain reductions and gain adjustment times were studied. While the evaluation of new coding algorithms tends to produce responses of approval, indifference and disapproval, typically in equal measure, results from this work found a 100% approval response rate for at least one parameter setting of noise reduction. Typical situations where benefit was reported were: iving in a car, in a cafeteria or in a shopping mall. Improvements in speech understanding of as much as 30% were found. Participants typically showed optimal improvement for different amounts of noise reduction. This suggests that, clinically, parameters may need to be selected on an individual basis. Sound quality reports reinforced this. Some subjects reported larger amounts of gain reduction left the microphone "dead". The 100% approval for noise reduction is highly encouraging, particularly since both sound quality and speech perception have been positively impacted. Further work is required to select a clinically appropriate set of parameters.

A05 – 033

Special branch supporting cochlear implanted children with complex needs together with their families

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Nottingham Cochlear Implant Programme

Children with severe and complex physical, sensory and learning difficulties are receiving cochlear implants. The outcomes for this group of children may be different to the normal one of spoken language, as for many of these children spoken language is beyond their reach. There are few social opportunities for this group, and parents sometimes feel; marginalised from other cochlear implant families whose children's attainments are much higher, isolated as so few complex children have been implanted and despondent as their children's achievements with their cochlear implants are not valued or recognised by anyone except themselves. The Nottingham Cochlear Implant Programme together with the Ear Foundation and Advanced Bionics have established a new group aimed at these children called 'Special Branch'. The group was established in response to the needs of patients implanted by the Nottingham Programme and requests from their parents. The aims of the group are to encourage interaction and communication through music, for complex children and their families to meet together to share experiences and to enable families to access support and advice from professionals. Families completed a questionnaire to evaluate their views on activities, opportunities to participate and benefits of these sessions. All families rated the group as excellent or good, stressing the benefits to the children, themselves and siblings. All families requested further sessions, valuing the musical activities combined with informal opportunities to socialise. Valuable outcomes have been indentified from the questionnaire and these will be used to facilitate future planning. We hope to extend this opportunity to more children and their families.

A08 – 215

Preliminary results of DUET 1 to DUET 2 upgrade

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Objectives – To show sound quality and speech perception outcomes as well as subjective satisfaction with the new DUET 2™ as compared to the DUET™. Materials and Methods – 10 adults, who had minimum of 12 months of DUET™ experience were fit and tested with the DUET 2™. After 1 month the tests were repeated and the DUET 2™ user questionnaire was used to assess the subjects satisfaction with the design, wearing comfort, functionality and flexibility of the DUET 2™. The patients were tested using the AAST (Adaptive Auditory Speech Test) and monosyllabic word test in quiet and in noise at each. The patients also completed visual analogue scales questioning satisfaction, and device preference, when listening to speech and to a pop song. Results – Subjects reported a better satisfaction with the DUET 2™ as compared to the DUET™. Speech perception outcomes with the DUET 2™ was comparable to the DUET™. Conclusions – DUET 2™ can provide additional advantages over DUET™ to patients with partial deafness after cochlear implantation.

A11 – 227

Electric-acoustic ABR in cochlear implant subjects: possible use of application

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Introduction: Electrically evoked auditory brainstem response (ABR) is a widely used method in cochlear implants which is used either in the fitting process of the cochlear implant processors or for investigational purposes. The goal of the following study was to find if simultaneous electric-acoustic ABR is feasible in cochlear implant subjects. **Materials and Methods:** For the first time we were able to record electric-acoustic ABR in a subject implanted with a cochlear implant. The subject was implanted with the Medel Pulsar ci100 with the medium electrode array. The electrode of the length of 20mm was inserted via round window during Partial Deafness Cochlear Implantation (PDCI). **Results:** Wave III and wave V were easily recognized either for electrical or acoustical part of the stimulation. The acoustically evoked part of the recordings was increasing with the increasing amplitude of the acoustic stimuli. Similar effect was observed for electrically evoked part of the recordings when electrical stimuli increased. The latency between the electrically evoked Wave V and the acoustically evoked wave III were approximately 2.0ms. **Conclusions:** The measurement has possible application to access the control during the fitting of the hearing system, i. e. setting an optimal stimulation pattern. A further investigation is needed.

C06 – 137

Speech perception and subjective benefit in pediatric C40+ users after the upgrade to Fine Structure Processing (FSP)

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Objectives -This study aimed to assess objective and subjective performance of children with long-term experience with the C40+ cochlear implant system utilising the CIS+ coding strategy, who have now received an upgrade to the OPUS 2 using FSP. **Design** - 60 children, who had more than 3. 5 years device experience with the TEMPO+ speech processor using CIS+ coding, were upgraded to the OPUS 2 audio processor and were fit and tested with the HDCIS strategy (Interval I). After 3 months, they were fit with the FSP coding strategy (Interval II) and tested with all strategies (FSP, HDCIS, CIS+). After a further 3 months, they were further assessed on all three strategies and chose their take-home strategy (Interval III). The children were tested using the AAST (Adaptive Auditory Speech Test) in quiet and in noise at each test interval. The children also completed visual analogue scales questioning satisfaction, and coding strategy preference, when listening to speech and to a pop song. **Results:** Across all three strategies at Intervals II and III, results for speech in quiet showed significance for interval and strategy. Results for speech in noise showed significance for strategy and post-hoc analysis showed statistical significance for CIS versus FSP and CIS versus HDCIS. In broad terms, satisfaction when listening to speech and music was higher with FSP than with CIS+ across all tested intervals. Similarly, at Interval III, FSP showed best results when directly compared to CIS+ using speech and music. **Conclusions:** The FSP strategy can provide significant objective and subjective advantages to pediatric users of the C40+ cochlear implant.

B05 – 081

Medical and surgical complications in paediatric cochlear implantation

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Objectives: To report complications of cochlear implantation (CI) in children and to assess their risk factors. **Design and settings:** Retrospective study from 1990 to 2008. Mean follow-up 5.6 years. Tertiary academic center. **Patients and methods:** 447 patients with first CI. Mean age at implantation: 5 years (0.7- 20). Complications were classified into early (0-8 days after surgery) and delayed (>8 days) and into major (requiring new surgery and/or new admittance or prolonged stay) and minor. Spontaneous internal devices failures were excluded. **Results:** Major complications (24 cases) consisted in severe cutaneous infections/hematoma (15), magnet displacement (3), meningitis (2), cholesteatoma (2), unexplained fever 1. and electrode malposition (1). Minor complications (21 cases) consisted in dizziness (10), cutaneous problems

(5), otitis media (4), facial palsy 1. and CSF leak (1). Delayed complications (2.2 years; 0.1-8.4) were observed as late as 8 years after CI. Rates of major/minor and of early/delayed complications were 5.4%/4.7%, and 3.8%/6.3%, respectively for a total rate of 10.1%. Reimplantation was therefore necessary in 13 cases (2.9%). Traumatism to the mastoid area (n=14) and inner ear malformations (n=40) were highly correlated to major delayed complications (p<0.001) and early minor complications (p<0.001), respectively. Young age at implantation (< 2 years, n=41) was not correlated with any type of complication. **Conclusions:** Complications of CI in children (dominated by traumatism) are not rare and may be delayed for a large part. Inner ear malformations should prompt for specific preventive management. Young age at CI appears to be safe.

B08 – 246

Cochlear implant in children with associated disabilities

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Enlargement of the indications for cochlear implant (CI) in children have raised the problem of managing profound deaf children with other disabilities. Those disabilities can be of anatomic, ophthalmologic, motor, cognitive or psychiatric origin. Among 433 children implanted between 1990 and 2007, 75% of our population of our patient had genetic assessment leading to the aetiology 85% of the cases. The mean age at CI was 4.9 years (9m-18y) and the mean follow up was 5.5 years (1-16 years). The associated disabilities were classified in anatomic, neurological, psychiatric, behavioral and linguistic. Results were based on the MAIS, the closed and open set words (CSW and OSW), oral production obtained every year until 5 years follow up. Concerning the aetiologies, we found 51.5% genetic, 8.5% Neonatal disease, 7.6% meningitis, 25.2% unknown. In this population at initial 6% had anatomic, 5% psychiatric problems 23% neurological and 63% non specific compartmental difficulties. Results on perceptive skills were seen in closed and open set words at 3 and 5 years, and the oral production was very limited or inexistent. Nevertheless for all there quality of life improved and the children wore their CI everyday. The limits of the indications are not clear in those difficult cases and counselling the parents remains challenging. Meticulous pre operative assessment is required, with neurological and if needed psychiatric advices. The use of objective measurements during the fitting and particular educational programs must be planned before surgery.

B06 – 086

Otitis media in children with cochlear implants – a long term prospective study

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To report the current results of an on going prospective study aimed at assessing the short and the long term risk for otitis media (OM) after cochlear implantation. Of 164 children referred for cochlear implantation during the study period (November 1998-February 2008), implanted under the age of 7 years and were compliant for complete medical follow up, 99 were classified as OM-prone (Group A) and 65 as non-OM-prone (group B). Group A patients were managed according to a structured protocol aimed at pre-implantation control of OM. Post-implantation follow-up ranged from 6 to 114 months (average 48.2 months). Mean age at referral was significantly lower in the OM-prone group as compared to the non-otitis media group (21.7months and 34.2months respectively); mean age at implantation was significantly lower in the OM-prone group as compared to the non-OM group (31.2months and 40.7months respectively). Post implantation, 47% of the OM-prone children developed episodes of OM. In more than half of them it was an isolated episode of AOM, but in 23% of them (11 children) the post-CI OM proved to be recurrent and therapeutically challenging. Three subjects developed acute mastoiditis without intracranial complications. All OM and mastoiditis episodes were controlled conservatively. The group of challenging cases did not differ from the OM-prone children who did not prove to be OM-challenging in regards to age at referral, age at CI and average number of ventilation tube insertions prior to CI. Early referral led to early implantation, even in children susceptible to OM. The incidence of OM decreased after implantation in both groups, but was still significantly higher in the OM-prone group. Meanwhile, prior to CI it is not possible to predict the cases that become therapeutically challenging at a later stage. The presentation will also present the odds ratio to develop isolated episode of OM after implantation, the period of time during which it is possible to develop it and the odds ratio to become an OM challenging subject.

B11 – 265

Bilateral sequential cochlear implantation in children

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The aim of the study was to evaluate the amount of added benefit from sequential contra-lateral implantation in unilateral implanted children who underwent contra-lateral implantation several years after the first CI. 7 children who underwent sequential CI between 2006 and 2008 were included in the study. Mean age at first CI was 4.1 years (range: 1yr -12yrs). Mean age at second CI was 11.3 years (range: 8yrs - 14yrs). The mean interval between implantations was 7.3 years (SD 4.0). Mean duration of experience with both implants was 11.7 months (range: 3 months - 36 months). The contra-lateral implantation was performed after excluding the possibility of a technological failure of the first implant. The reasons for the contra-lateral implantation (bilateral implantation is not covered by the health insurance companies in Israel) were primary unsatisfactory benefit from the first implantation or unexplained deterioration in auditory performance with the first CI. That means that the decision for a contra-lateral implantation was in a way a 'forced' decision. Performance with the first implant and with the two implants was compared using monosyllable word recognition test (HAB) in quiet, open set sentence recognition test (simple sentences test or CID sentences, according to the child's language abilities) in quiet and with background noise (S/N +10dB). All children had significant added benefit from the second implantation. Mean word recognition score with both implants was 71% as compared to 44% with the first CI (P=0.018). Mean sentences recognition score in quiet with both implants was 78% as compared to 60% with the first CI (P=0.028) and mean sentences recognition in noise with both implants was 58% as compared to 26% with the first CI (P=0.028). Benefit from contra-lateral implantation was demonstrated in the present study despite the long interval between the first and second implantation and the relatively late age at contra-lateral implantation. This finding raises the possibility that the window of opportunity for beneficial sequential contra-lateral implantation is longer than hypothesized so far.

D08 – 332

Results of the PET tomography in functional examination of the brain of the patients after cochlear implantation

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In the paper the images of the functional reaction of cerebral cortex to the acoustic stimuli in the pre- and postlingually deaf patients after cochlear implantation were analyzed. Criteria of the including into research were age above 15 yo and under age of 50 with no concomitant neurologic deficits. 9 patients after speech processor hook-up and following 12 months of rehabilitation were examined. Different than in hearing subjects with normal pattern of functional organization, in the examined group of patients with pre- and post-lingual deafness the same pattern of activation was obtained (elevated level of metabolism in the right cerebral hemisphere with an advantage of frontal lobe, Brodmann Area no. 44, 45, 47 and 38) After 12 months regions responsible for receiving and processing of visual and spatial stimuli joined the group of areas undergoing activation during sound perception, whereas the activity of the structures connected with audible speech perception was decreased. The activation of the structures connected with speech perception was markedly increased in cases of postlingual deafness. In this matter the results of PET examination correlated with the results of auditory perception after 12 months of rehabilitation. The research confirm the importance of rehabilitation in the development of auditory perception in patients after cochlear implantation. Further research and observations would allow to explain the development of activation of respective areas of cerebral cortex following the improvement of speech perception in implanted patients.

A01 – 006

Testing auditory skills in children CI users: Is phonemic discrimination related to acoustic variables only?

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Discrimination is - in all Erber's categories - the one that is less influenced by cognitive abilities required to perform closed and open set recognition tasks and is the first ability to be developed by the deaf child after cochlear implantation. The ability to discriminate phonemes is considered to be basically language independent and their perception is less dependent upon a learning process. Starting from this assumption, the authors correlated discrimination outcomes with speech perception (open set) and cognitive skills in a group of children cochlear implantees. Children ranging from 2,5 to 12 yrs of age, implanted with different models of Advanced bionics implants, were tested making use of our standard speech perception test battery, Auditory Speech Sound Evaluation (ASE) tests for discrimination and identification of phonemes in quiet and in noise, non verbal IQ, attention span. Children had different implant use and age at implantation and were either CIS, SAS or HiResolution and HiResolution 120 users Phonemic discrimination evaluated in quiet and in noise was mainly correlated to acoustic and implant variables, such as PTA threshold and sound coding strategy in use. A good correlation was found between discrimination scores obtained with live voice and with recorded material. Nevertheless, cognitive abilities such as the attention span and comprehension influenced children's abilities to perform formal tests in a soundproofed room, whilst it was still possible to carry out live voice testing. The increased resolution which characterizes modern strategies strongly contributes to discrimination skills. Discrimination and identification in noise are consistent with reports of improved perception under everyday listening situations.

B06 – 087

Follow-up of cochlear implant use in patients who developed bacterial meningitis following cochlear implantation

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The present study is a long-term follow-up of speech perception outcomes and cochlear implant use in three cases of meningitis that occurred after cochlear implantation. Three children were under study; one was affected by enlarged vestibular aqueduct, the second by Mondini malformation, the third had normal anatomy. Children were implanted with different models of Clarion devices, two of them with positioners, and developed meningitis after 8, 12 months and 6 years post implantation. Recognition and comprehension were assessed via the Italian adaptation of the GASP (TAP) test, and phonetically balanced bi-syllabic words in open-set. The most comfortable electrical level were measured through SCLIN 2000®; and SoundWave®; programming software. Axial coronal and oblique multiplanar reconstructions of the cochlea were obtained with High Resolution computed tomography. As a consequence of meningitis, the child with a normal cochlea and the other with an enlarged vestibular aqueduct both developed cochlear ossification, resulting in increased M-levels and worsening of hearing outcomes up to the non-use of implant for the first child. Cochlear ossification was localized to the implanted ear only. The child with Mondini malformation developed facial nerve stimulation, that spontaneously regressed after a year, and temporarily reduced implant benefits. Controlateral implantation was successfully performed in the first two patients, who regained hearing performance to the same level they were used to before meningitis. Planned follow-up with high resolution computed tomography and evaluation of M-levels are useful prognostic tools in the management of these patients, whilst controlateral implantation still remains an option.

B07 – 239

Cochlear implantation in children with thin auditory nerves and performance

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Dr Manoj's ENT Super Specialty Institute and Research Center

Cochlear implantation in children with thin auditory nerves are challenging in case selection, evaluation and habilitation. This study evaluates a group of ten children with thin auditory nerves implanted in this center and evaluates their performance scores. A group of ten children in one of India's busiest cochlear implant clinics are studied for pre op evaluation, parent counseling, expectations, surgical challenges and post operative performance. Results of these children are tabulated according to the abnormality, age and performance.

Children with thin auditory nerves are poor performers in general when compared with other deaf implanted children with “normal” nerves. However, with adequate preop evaluation, counseling and habilitation encouraging results are obtained in these patients. All work in this study was done at. Dr Manoj’s ENT Super Specialty Institute and Research Center.

D08 – 328

Surgical correlation of CT temporal bone in cochlear implant surgery

Manikoth M.

Dr Manoj’s ENT Super Specialty Institute and Research Center

Cochlear Implant surgery has evolved now from a surgical procedure done in only a few centers to a fairly commonly done surgical procedure in most busy ENT Hospitals worldwide. With a greater number of Surgeons performing surgery, there is real need for accurate and thorough assessment of CT temporal bone for planning and performing surgery. Thin section temporal bone HRCT images are used to measure the posterior canal wall, the direction of the basal turn, the dimensions of the facial recess and thereby a formula is derived to predict the surgical difficulty in cochlear implantation. This may help surgeons in new cochlear implant centers to be more vigilant and help achieve best insertions in most cases. Manoj’s ENT Super Specialty Institute and Research Center in one of India’s busiest cochlear implant Clinics and with these measurements done pre operatively, surgical difficulty was predicted and an attempt to correlate them was made. This new measurement technique should help every surgeon to accurately plan surgery, including the approach, type of implant to be used and generally predict the index of difficulty in various ears. All work regarding this was done at. Dr Manoj’s ENT Super Specialty Institute and Research Center, Calicut. Kerala, India.

B02 – 055

Use of a Micromanipulator to approach the Cochlea atraumatically

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The possibility of preserving residual hearing during the cochlear implant surgery opens new horizons to treat cochlea-originated sensorineural hearing loss. It is necessary to develop new techniques and surgical tools to expose the membranous labyrinth undamaged. This is necessary to use current or yet-to-come electrode arrays, directly deliver drugs, take samples or apply cell therapy. This communication’s goal is to present the development and use of a micromanipulator. A micro drilling system is adapted on to the MM. This equipment has been developed by a team of Universidad de Navarra. Besides, the efficacy of the micromanipulator has been studied to preserve the membranous labyrinth structures after drilling the promontory in front of the round window. This has been studied on 17 temporal (TB). Out of 17 procedures, 10 were performed by a seasoned surgeon and 7 by a beginner surgeon. 88.2% of TB preserved the cochlear endosteum intact. The percentage was slightly higher with an expert surgeon (90%) than with a beginner surgeon (86%). In any case, the provoked continuity solution affected a small portion of the cochleostomy area. 75% of TB totally preserved the spiral ligament. As for the remaining 25%, only very small areas of erosion were observed. Percentages of spiral ligament preservation were higher with the beginner surgeon (80%) than with the expert surgeon (71%). No direct injuries were made on the stria vascularis, the lamina spiralis or the basilar membrane in any of the cases. The average time to assemble the MM in the surgical field and perform the cochleostomy was 21.1 minutes. The study that has been carried out shows how useful the micromanipulator is to perform an atraumatic cochlear surgery.

B04 – 075

Auditory brainstem implants on children with malformations in the cochlear nerve: working protocol and results

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Auditory Brainstem Implants (ABI) have usually been indicated for patients suffering from type II neurofibromatosis with a bilateral affection of the acoustic nerves. These systems have recently started to be indicated for hearing losses non originated by a tumor: Complete ossifications of both cochleas, avulsions of the VIII pars, cochlear agenesis and hypoplasias or aplasias of cochlear nerves. The current number of implantations performed on these cases is still reduced, as well as the follow up period. Thereby the interest of communicating experiences related to this treatment. Selection and follow up protocols have been created and adapted to the evaluation of non tumoral ABI patients. This protocol has been designed as a multicenter collaboration. It gathers informa-

tion about hearing, language, image, stimulation parameters and complications for each phase of the program: selection, surgery and follow-up/rehabilitation. To date, there are 4 children-ages between 13 months and 8 years old-with an ABI. They all had congenital profound sensorineural hearing loss, originated by a bilateral aplasia-hypoplasia of the cochlear nerves. Through suboccipital approach, the posterior fosa was reached, where the aplasia of the cochlear nerve was evident. The surface of the cochlear nuclei was identified on the lateral recess. The ABI was placed. The correct placing of the ABI was checked during the operation with electrical ABR. Number of activated electrodes ranged between 14 and 20. Stimulation on these electrodes was exempt from non desirable auditory responses, and in a few days, satisfactory levels of sound detection and discrimination were obtained. Results obtained between 6 and 24 months of follow up after ABI activation will be presented at the congress. Preliminary auditory results are satisfactory. No relevant complications were observed.

D08 – 326

Relationship between radiological and audiological findings before and after cochlear implantation in children with cochlear nerve deficiency

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Cochlear malformations have been reported to occur in approximately 20% of children with congenital sensorineural deafness. Amongst these malformations, cochlear nerve deficiency is not uncommon. Preoperative CT scan and MRI of the petrous bone are essential to determine the feasibility of cochlear implantation; the functionality of the hearing nerve is assessed by auditory brainstem response and behavioral audiometry. The aim of this presentation is to examine the relationship between imaging features and pre/postoperative hearing evaluation. 4 children who have received a cochlear implant despite a radiological assessment showing a cochlear deficiency predicting a bad outcome, have been studied. 1 child with a very severe and 1 with a severe CHARGE Association presented a cochlear nerve dysplasia type I according to Casselman classification: 1 trigonocephalic child had a type IIa dysplasia; 1 child with isolated deafness had a type IIa dysplasia Their postoperative evolution will be presented with a follow up of 2 to 3 years. All 4 children obtained benefit of the CI: the child with a very severe CHARGE association implanted at 11 months obtained a CAP score of 2 after 2 years; the trigonocephalic child implanted at 34 months obtained a CAP score of 4 after 2 years; the child with a severe CHARGE association implanted at 27 months obtained a CAP score of 4-5 after 2 years; the child without associated handicap implanted at 22 months obtained a CAP score of 5-6 after 3 years. This presentation highlights the poor or the lack of correlation between radiological and audiological assessments in some deaf children with cochlear nerve deficiency. There is still a need to evaluate the specificity and sensitivity of these assessments in order to counsel the best therapeutic choice and to predict its issue.

A07 – 207

Evaluation of reservoir-based drug delivery for cochlear implantation

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This study evaluates the feasibility of delivering a drug passively from a reservoir in a cochlear implant electrode. The concept (for human implantation) involves the passive diffusion of a drug from a 10µl reservoir built within the electrode itself. The reservoir would allow the drug to diffuse through micro channels built within the silicone of the electrode carrier. Loading of the drug into the reservoir would take place intra operatively. The potential advantages of this system include control of dosage, uniformity of spatial delivery, a generic delivery device loadable by the surgeon, and little change in electrode properties. A simplified device was created scaled down to the dimensions of a Guinea pig cochlea – a tube filled with 4.5µl of Fortecortin (an injectable preparation of dexamethasone), open at one end. The release of drug over time was evaluated with high performance liquid chromatography (HPLC) analysis at 37 degrees. The practicalities of device filling and implantation were evaluated in bench tests and in a Guinea pig model. The safety of the first prototype device (in combination with (a) saline and (b) Fortecortin) was

evaluated through observation of hearing loss for 90 days after implantation. Finally, six tubes were explanted, and examined for the presence of tissue growth and invasion by common infective species of bacteria. Tubes filled with saline demonstrated threshold shifts of less than 10dB over 90 days. Shifts of up to 30dB were demonstrated with Fortecortin filled tubes. No evidence of bacterial ingress was found in these devices. Design modifications improved the ease of filling. In conclusion, the reservoir device appears feasible, however further development work and assessment is needed, including a toxicity evaluation of Fortecortin. The same design principle might also be developed for drugs incorporated into a biocompatible gel.

D09 – 333

Clinical/genetic overlapping factors in a group of connexin caused hearing impaired children

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Mutations in the connexin 26/30 gene (GJB2) are common in Caucasian populations and account for nearly 50% of Autosomal recessive non-syndromic hearing loss. Connexin-related impaired children can demonstrate significant improvement in speech perception and skills of expression after implantation. Clinical and/or genetic additional etiologic factors may be present in single cases and may interfere with the child's overall outcome. In this study, a total of 78 implanted children with mutations in connexin 26 were chosen. As per the results in the selection and evaluation for candidacy for implantation, all cases appeared free from additional disabilities. A retrospective analysis of genotypes, labyrinth bone development, brain anatomy and of speech perception outcomes was carried out. Among connexin-related impaired children, some uncommon genetic mutations and/or anatomical characteristics were found. Nowadays, these anomalous conditions appear to be of little relevance in terms of speech perception outcome. In fact, all children examined achieved open set speech perception scores after few months of implant use. Cochlear implantation can be successfully performed in case of connexin-related hearing impairment associated with genetic or anatomical anomalies. However, on evaluating the etiological factors causing hearing impairment, the co-occurrence of minor genetic/anatomical manifestations, even in cases with connexin mutations should be considered.

D05 – 188

Aural rehabilitation through cochlear implant: audiological, language, speech and voice assessment

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Since the beginning of the pediatric cochlear implantation program, in 1992, 314 children have been implanted, 5 of them bilateral, in Centro Hospitalar de Coimbra. The etiology was for the most part congenital (63% of cases) and meningitis (7,8% of cases). The age of implantation was less than 3 years in 73% of children. 55,9% of the implanted individuals are males and 44,1% are females. 85% were implanted in the right ear and 15% in the left ear. In this work, the authors have evaluated the tonal and vocal functional gain, discrimination tests adapted to the age of the individuals, auditory comprehension, speech and language in 142 children with more than 5 years of implantation. The evaluation was composed of auditory perception, language development and speech production tests. The monosyllables, numbers and sentences discrimination tests (Portuguese European Language tests) were presented in free field with recorded lists using SFS software through the audiometer at 65dB SPL. The scales CAP and SIR, portuguese test that evaluates language development (Compreensão de Estruturas Complexas) speech production (Teste de Articulação Verbal), vocal characteristics (Grelha de Avaliação das Características Vocais – GACV) and a vowel discrimination test were also used. 142 individuals were evaluated with the monosyllables discrimination test; 78,1% achieved 50% discrimination; 41,5% achieved 70%; regarding phonemic discrimination mean of 76,25 is achieved, median 81,40 and standard deviation 17,87. 142 individuals were evaluated with the numbers discrimination test; 96,5% achieved 50% discrimination; 90% achieved 70%, regarding phonemic discrimination mean of 93 is achieved, median 98,85 and standard deviation 13,97. 142 individuals were evaluated with the sentences discrimination test; 76% achieved 50% discrimination; 51,9% achieved 70% discrimination. 133 individuals were evaluated with the vowel discrimination test; the results were an average of 97,42%, and standard deviations of 11,04. 190 individuals were evaluated with the SIR scale; 13,2% were scored on level 3, 16,8% on level 4 and 58,9% on level 5. 127 individuals were evaluated with the CAP scale; 28,3% were scored on level 4, 30,7% on level 5, 17,3% on level 6 and 22% on level 7. 209 individuals were evaluated with the GACV scale; 4,3% were scored on level 3, 34% on

level 4 and 58,4% on level 5. Complex sentences comprehension test (Teste de Compreensão de Estruturas Complexas) (n=100) the results were an average of 61,67%, and standard deviations of 26,5. Speech production test (Teste de Articulação Verbal) (N=171) the results were an average of 77,6%, and standard deviations of 20,85. The results express a good performance in speech intelligibility, with a good articulation level and a good voice quality, according to the results published by other international cochlear implant center. Despite these numbers, inferior results were verified in language development tests. These results may be justified by inadequate pedagogic programs.

C04 – 115

Objective methods for cochlear implant fitting

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Early the detection and treatment of congenital hearing loss provide children with greater opportunity to reach their fullest potential, but in all type of hearing aids, the fitting process is more difficult to the young. The objective is to understand the variability across implanted persons and to determine possible ways of improving the fitting process in young children using ECAP and cochleo-palpebral reflex. There were tested 44 normal hearing ears and 10 cochlear implanted ears. A model of how rate of stimulation affects loudness and cochleo-palpebral reflex is presented, suggestions are made based on the model for additional information that may improve the fitting of cochlear implant. The study explores the theoretical relation between the psychophysically measured current levels required for sound processor fitting in cochlear implants, the objectively measured compound action potential threshold (as measured by Electric Compound Action Potential – ECAP) and the cochleo-palpebral reflex. It is a developing study that may prove useful in future cochlear implant fitting in young children.

C10 – 302

Neonatal hearing screening using OAE – first step in our community

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Each and every year approximately 200 children are born with profound hearing loss in Romania. Diagnosis and treatment are often delayed until ages of 2 or 3 years, so the child is deprived of auditory stimulus in the first months of life when it is critical for the development of speech and language skills. The aim of this paper is to identify strengths, weaknesses and gaps in the screening test we have used and to compare the benefits and harms of universal newborn hearing screening with those of high risk newborn selective screening. From the beginning of 2008 we assessed hearing in 5480 newborns in two birth centers in our area. All infants were screened with OAE. No additional testing was done with infants who pass the OAE, but those who failed were screened again using OAE. The infants who failed the second assessment were referred for diagnostic testing with Auditory Steady State Response (ASSR). Universal newborn hearing screening improves identification of newborns with hearing loss. Using this method we have found 6 children with profound deafness. The open question remains: Does this screening reduce or eliminate the gap between deaf and hearing children?

B04 – 070

Paediatric cochlear implantation in France: medical and social implications

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This study aimed to assess the functional outcomes, to evaluate the incidence of complications and device failures and to analyze the social consequences of implantation. A multicenter (21 reference centers) prospective study of 217 implanted children included in a one year period was carried out. All patients were followed-up for four years after surgery. Speech perception and production were evaluated, medical and technical complications were listed and the scholarization mode and social assistance to the families were reviewed. 65% of the children were found to develop a structured language. The major complication rate was 0,9%. 64% of patients were concerned by dysfunctions of the external part of the implant. 70% of the children attended regular schools. This prospective study gives an overview of paediatric cochlear implantation in France. It enables the identification of targets to achieve in the technological field and in social assistance to families.

A05 – 034

Sounding Board – the website for cochlear implant users and those who support them

Mather J.

The Ear Foundation

During the last 15 years children with cochlear implants have arrived in schools and in mainstream classes bringing a whole new area of technology to use and understand. Reviews of users, parents and professionals have repeatedly shown the need for the technology to be managed well in the classroom and the need for basic, user-friendly information and updates on the latest research and ideas. 'Sounding Board' is a new website launched in 2008 by The Ear Foundation to address this need. The website has three aspects: A wide range of resources and information on cochlear implants; including clear, simple downloadable instructions on how the main processors work, how to trouble shoot them and how to link them to the most commonly used radio aid systems. A forum enabling users to ask questions on any matter relating to cochlear implantation. Sounding Board for Teens giving teenagers the opportunity to read about implanted peers and young adults and ask their own questions in a 'Problem Page' format. Advanced Bionics, Cochlear and MED-EL are all represented on the site and where relevant, there are page specific links to the manufacturers' sites. In the first 8 months, the site had over 4,500 unique visitors from 62 different countries and the number of visitors is growing each month. Enquiries cover a wide range of topics from bilateral implantation to scuba diving. The site has received much positive feedback. Sounding Board is making an important contribution to the rehabilitation and education of users by providing easily accessible information to a wide range of people. The site was initially aimed at people working in education, but has attracted a large number of implanted adults and also parents of deaf children. Supported by Advanced Bionics.

C02 – 105

Advances in Integrity Testing for Nucleus implants

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Any implant failure is a major event for the recipient and for the parents of young recipients. Cochlear has a track record of exceptional device reliability that shows continuous improvement over design generations. Current Cumulative Survival percentages for the Nucleus Freedom implant are 99.46% in adults and 99.28% in children after 4 years of implant use. In case of a suspected failure objective testing is used to investigate if the implant is no longer functioning according to specification. The Nucleus 'Crystal' Integrity Test System allows stimulating the implant with a known pulse pattern. The recorded surface potential representations are used to confirm that there is no intermittent or unspecified output from the implant and that all electrodes are functioning appropriately. Novel, telemetry based tests have been explored, avoiding the need for external test equipment and the use of surface potential electrodes. Several test paradigms have been developed, using the impedance and neural response telemetry capabilities of the Nucleus Freedom implant, to gain diagnostic information on device integrity. In addition to detect short or open circuit electrodes, telemetry based implant testing is able to provide diagnostic information on electrode anomalies and detect extra-cochlear current flow. Furthermore, information on the properties of the tissue around the electrode array (e. g. ossification) can be obtained. Advanced, telemetry based implant testing provides useful diagnostic information without the need for surface potential recordings. The new algorithms show potential to improve implant testing capabilities of future clinical software.

A04 – 026

Early intervention and assessment of speech and language development in young children with cochlear implants

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In German speaking countries the number of children with hearing loss identified early and provided with hearing instrument or cochlear implants (CIs) is on the rise. Observations revealed that some of the children saw very nice improvements in auditory development. Nevertheless, we noted that not all children were testable due to the difficulty of the tests and that speech and language assessment tools for this particular group of young children with CI are urgently needed. Method: In Wuerzburg 89 children were implanted prior to 24 months of age (23 of 89 before 12 months of age). Recently observations of the speech and language development of 28 children receiving therapy at the

Rehabilitation Centre Wuerzburg, were recorded. In our retrospective study we compared the available testing methods to the need of individual children. Results from several standard German speech and language and cognitive tests (ELFRA, AWST-R, SETK, TROG-D, SON-R 2 ½ - 7) are presented. Nearly all of the children had speech and language results, which were similar to normal hearing peers', although some individual differences between the CI group and standardized scores were found. Our observations confirmed that some of these tests are too difficult or inappropriate for this group of early implanted children. Discussion: In everyday therapy it is not always possible to fulfil the needs of the youngest patients. This can occur for a variety of reasons which should be considered in intervention and in selecting assessment materials for this young group. Standardized speech development test that are used with normal hearing children can only used for some of the early implanted children. Children that can be tested show in most of the cases a speech development that is comparable to that of normal hearing children.

A06 – 043

The user's perspective: long-term functional communication skills after cochlear implantation

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For the user, the most important outcome from cochlear implantation is effective communication in everyday situations, but their views are rarely reported. This study explores the users' perceptions of their long-term functional communication skills by a group of deaf children and young people with cochlear implants. The views of one hundred and ten children and young people with ten or more years of implant use were obtained using the Pragmatics Profile of Everyday Communication Skills. This profile covers four areas: communicative function, response to communication, interaction and conversation, contextual variation. The majority of the group had developed good use of spoken language for most communicative functions and situations. However, about half the subjects reported difficulties responding to verbal humour, non literal language and subtle language ambiguities. They also found it difficult to deal with group conversations, background noise, and with changing contexts. The reasons given will be discussed. Although these long-term cochlear implant users were largely good performers in terms of speech perception and production, half reported difficulties in terms of everyday communication skills, even after ten or more years of implant use. The implications of the study are the continued needs of cochlear implant users for long-term support and the development of communication strategy programmes into adulthood.

D07 – 314

Meta-Analysis of Development of Language and Literacy in Children with Cochlear Implants: A Comparison of Outcomes in Implanted vs. Non-Implanted Children

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There is clear evidence to show that early implantation of cochlear implants provides for improved outcomes in the child receiving the cochlear implant. However, the literature on other intervention techniques and approaches is scarce and oftentimes has small sample sizes. Meta-analysis is a statistical technique that permits the combining of several reports of treatment efficacy into a summary of preponderance of treatment effects across a larger segment. Results of this analysis show that children with cochlear implants do significantly better than other forms of intervention; however, there is a strong relationship between age of implant and pre- versus post-linguistic abilities and amount of rehabilitation immediately following implant. This is true across language, literacy, and social skills. There does not appear to be a difference across nationalities.

B06 – 088

Dutch Cochlear Implant Group (CION) consensus protocol on postmeningitis hearing evaluation and treatment

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One of the devastating sequelae of bacterial meningitis is profound hearing loss or even deafness. Although cochlear implantation is able to restore (some) hearing abilities, obliteration with fibrosis or calcification of the cochlea in the

post meningitis period is limiting the success rate of an implantation. Still in 25-30% of the children hearing is not tested or severe loss is detected late (1,2). A national audiological post meningitis follow up protocol has to increase the chances of an early detection and possible intervention when profound hearing loss occurs. In the Netherlands the cochlear implant centers are located in the 8 academic otorhinolaryngology and audiology departments of the Netherlands. All centers are gathered in the Dutch Cochlear Implant Group (CI-ON, Cochlear Implant Overleg Nederland). Based on prior publications (3,4) a proposed protocol was sent to all implant centers in the Netherlands and asked to review and agree on. In cases with 30dB hearing loss or more imaging and cochlear implant team consultation is recommended as these patients are more likely to develop progressive hearing loss or cochlear obliteration. The Cochlear Implant Centers agreed on the need for, and use of the proposed protocol. Further use of this protocol in all hospitals and all audiological centers treating meningitis patients is aimed for. The Dutch Cochlear Implant Group (CI-ON) has agreed upon a protocolised follow up and treatment after bacterial meningitis in order to increase the chances of an early detection and possible (bilateral) cochlear implantation when severe or progressive hearing loss should occur. References: 1. Koomen et al., *Pediatrics* 2003;112(5):1049-53 2. Riordan et al., *Br J Audiol* 1993;27(6):375-7 3. Merkus et al., *Ned Tijdschr Geneesk* 2007;151(22):1209-13 4. Peek et al., *Ned Tijdschr Geneesk* 2007;151(40):2239-40.

B03 – 068

Suprameatal approach for cochlear implantation in children: our experience with 320 cases

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Objective: To demonstrate the advantages of the Suprameatal approach (SMA) in pediatric cochlear implant surgery. A review of the 320 pediatric cochlear implantations performed using the SMA between 1999 and 2008 in our department. The SMA involves entering the middle ear by means of retroauricular tympanotomy. A six o'clock vertical incision is made in the meatal skin, and a tympano-meatal flap is elevated to expose the middle ear cavity. The 1-2 mm long groove is then illed in the middle ear wall postero-superior to the chorda tympani nerve and lateral to the body of the incus. The visualization of the incus body serves as a target for drilling and prevents injury to the facial nerve which is located medially to the incus. After drilling of the cochleostomy and of the suprameatal tunnel, the electrodes are passed through the suprameatal tunnel and groove underneath to the chorda tympani and lateral to the incus into the cochleostomy. Following implant-related complications required explanation with subsequent reimplantation: device failure (5.6%), foreign body reaction (0.6%), allergy to implant (0.3%), and protrusion of the positioner (0.3%). Post-traumatically displaced magnet was reinserted in 3 (0.9%) children. All the vestibular (5.3%) and wound (3.1%) problems were considered as being patient-related and resolved spontaneously or were managed conservatively. There were no surgery-related complications, such as facial nerve palsy, electrode misplacement and damage to the chorda tympani among the children implanted with the SMA. In addition, there were no cases of mastoiditis or superbiosteal abscess since this non-mastoidectomy technique is in use for cochlear implantation in our department. The Suprameatal approach shortens the duration of the cochlear implant surgery and allows decreasing the rate of surgery-related complications owing the wide exposure of the middle ear and promontory during cochleostomy drilling and electrode insertion.

A02 – 012

Phonetic boost by bimodal stimulation in CI children

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Patients with one cochlear implant could experience difficulties in discrimination of low frequency sounds if there is concurrent noise. Bimodal stimulation using hearing aid in contralateral ear significantly improves listening in CI recipients especially in noise as well as localization of the sound source. The aim of this study was to investigate phonological differences in CI recipients using bimodal stimulation as compared to cochlear implant alone. Thirty cochlear implanted children aged 4 to 14 which have been using cochlear implant for more than one year were tested by Ling 6 test and standard phonetic test for Serbian language with and without hearing aid in contralateral ear. None of them have been using hearing aid on the other ear on regular basis. All of the patients in this study have shown considerably better results in listening to isolated sounds in Ling 6 test or monosyllables and non-words with bimodal stimulation as compared to CI alone. Significant differences

have been observed in differentiating of m and n, b and p, d and t, especially in initial and final position. If using CI alone, children usually use the context rather than phonetic discrimination to understand the certain word. Listening in bimodal situation has been useful for all of the children regardless of age or listening experience. Phonetic discrimination boost in CI recipients is achieved when using hearing aid in contralateral ear. It is especially true for low frequency sounds. Due to few spiral ganglion fibers in cochlear apex discrimination of low frequency sounds through CI alone is sometimes insufficient. Low frequency amplification through contralateral hearing aid could be extremely useful for speech understanding and intelligibility especially in background noise.

C11 – 306

Cochlear Implantation in Infants

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The purpose of this study is to evaluate the benefits of cochlear implantation in infancy and compare them to those obtained in children implanted at a slightly older age. A new measurement tool, the Visual Habituation (VH) Procedure, has been used to document early skills and the results are compared to those obtained in normal-hearing infants. In the VH Procedure, the infants are first habituated to several trials of a repeating speech sound presented simultaneously with a visual display. After the infants have habituated to several trials, a novel auditory stimulus is presented with the same visual display. An increase in looking time to the visual display when the novel auditory stimulus presented is taken as evidence that the infant is able to detect the difference in speech stimuli. We will also describe the surgical modifications developed to implant infants as young as six months. Early implantation can be safely applied and has the potential to minimize language delays and allow age-equivalent performance on standardized measures. The Visual Habituation Procedure is a useful tool for documenting progress in implanted infants.

C15 – 430

Speech recognition in noise by children using cochlear implants with FM systems

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The use of frequency-modulated (FM) systems with cochlear implants has steadily increased as the FM technology has become more integrated with the cochlear implant speech processor. Although noise-reduction technology is incorporated into cochlear implants, this technology cannot compensate for the reduction in the speech signal that occurs as the distance from the speaker is increased. The use of FM systems with cochlear implants is most often addressed in educational environments in which the noise level may interfere with learning new information. In the present study participated 16 subjects with ages ranging from 5 to 14 years old, 7 of them with unilateral cochlear implant and 9 with hearing-aids. Seven of them had bilateral hearing-aid fittings and the rest had unilateral hearing-aid fittings. Recognition of Frequently and Infrequently used words was examined in four acoustic conditions: with and without the FM system switched on; with and without background noise. Testing was carried out in the hearing-impaired children's classrooms. Significantly better speech recognition scores were obtained with the FM system than without FM system and in quiet than in noisy condition. Frequently used words were more easily recognized than infrequently used words. A significant interaction were found between wearing or not the FM system and lexical frequency and the presence or not of background noise. The main benefit of the FM system is obtained for infrequently used words and noisy background conditions. Speech tests in noisy environments are a useful way to establish a selection criterion for FM-user candidates and verify the benefits of the FM system. FM system advantage can be established from the substests for infrequently used words in quiet and noisy environments. The recognition of words in noisy and quiet conditions allows us to establish a highly-accurate selection criterion and identify those subjects that can benefit from the FM systems.

Prelinguistic development of deaf children implanted before 24 months old

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This study aims to examine the impact of family implication and, in general, the social and educational background, on language and communicative development of children implanted before 24 months of age. We also aim to explore the agreement between different data types (parental questionnaires and spontaneous speech samples). Participants are Spanish children: 1) 12 neurosensorial bilateral prelingually profoundly deaf since birth; 2) CI: 6 bilateral; 6 unilateral; 3) age at CI fitting between 12-24 months old. Several data sets were obtained pre-CI and every 1.5 months during one year: 1) Parental questionnaires: perception (LittlEars-Medel) & MacArthur Communicative inventory (Maldonado et al., 2003); Symbolic Play (adapted from McCune, 1995 play scale) & Family implication (adapted from Moeller, 2001); 2) Semi-structured samples of adult-child interactions are videotaped and transcribed according to CHAT norms (MacWhinney, 2000) to encode gestures, symbolic play, vocalizations and words. Research in progress. First results show that: 1) there seems to be a relationship between family implication and the rate of development; 2) In families with lower educational levels, there is a tendency to over or underestimate children skills (i. e. there are more discrepancies between parental questionnaires and videotapes). Preliminary results suggest that family implication may have an important effect on rate of development. However, further research is needed to determine when and why this effect occurs. If confirmed, the fact that parents with lower education tend to over- or underestimate the language and communicative skills of their children should be taken into consideration by language therapists. This project has received a grant J. A. Spain (P7-SEJ- 03119).

Mastoiditis in cochlear implanted children

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Mastoiditis with subperiosteal abscess is a dangerous complication in cochlear implanted children. The risks of receiver infection, intracochlear/ intracranial extension, and the device damage during surgical drainage, are major possible complications. The objective was to study the incidence and management of mastoiditis in children after cochlear implantation. A retrospective study was conducted on 248 cochlear implanted children between 1991 and 2008 in our department. Posterior tympanotomy approach for cochlear implantation was used in all cases. Mastoiditis with subperiosteal abscess developed in 3 children (1,2%). All cases had previous history of OMS, and 1 case was treated with adenoidectomy and ventilation tube before cochlear implantation. The mean age at implantation was 32.3 months of age. The complication ranged between 1-9 months post CI surgery (mean: 6 months). The diagnosis was based in clinical signs and radiological study. All cases were incised and ained with a retroauricular approach and in 2 cases a ventilation tube was inserted. Intravenous ceftriaxone was administered for 7-10 days, followed by oral cefuroxime axetilo. The implants were preserved in all cases. The incidence of mastoiditis increase in the group in CI children in relation to normal children population and in our opinion could be in relation with the surgical approach that could facilitates the extension of the infection Early treatment with intravenous antibiotics in OMA and subperiosteal retroauricular drainage must be performed in cases of mastoiditis in cochlear implanted children for infection control.

Speaker and melody discrimination in bilaterally implanted school-aged children

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Bilateral cochlear implants (CI) are recognized as the standard of care for severe to profoundly hearing impaired children. The purpose of this study was to demonstrate that music perception and speaker discrimination abilities of school-aged children with bilateral cochlear implants can be examined with tests originally developed for adult CI users. Melody and speaker discrimi-

nation were tested in 10 children (age 8 to 13 years) who were sequentially implanted with MED-EL cochlear implants. Data were also obtained from an age-matched group of 10 normal hearing children and from postlingually deafened adult CI users. Melody discrimination was evaluated using a subset of the Mu. S. I. C test (MED-EL GmbH, Innsbruck, Austria). Here we tested the subject's ability to detect small melodic differences between short phrases with the same rhythmic pattern. Speaker discrimination was evaluated with the OLLO speaker discrimination test (Muehler et al. ORL 2009; 71:14-20) by presenting pairs of logatoms, spoken either by the same speaker or by two different speakers. Both the melody and speaker discrimination tests were designed as "same-different" tests. All 10 children scored significantly above chance level on both tests. On average, children performed not significantly worse than the adult CI users. As compared to the normal hearing children, perception scores of children with CI were remarkably high in both tests. More detailed analysis of the speaker discrimination data revealed a significant effect of speaker's gender. The MED-EL Mu. S. I. C test and the OLLO speaker discrimination test are very well suited for the assessment of music perception and speaker discrimination abilities of school-aged children with bilateral cochlear implants.

Cochlear implants in unilateral deaf patients?

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Unilateral deaf patients complain about the loss of binaural hearing abilities, resulting in a deterioration in speech understanding in noisy environments and in a missing ability to localize sounds. A remarkable improvement of binaural hearing abilities is known for more than a decade now from bilateral cochlear implantation. In an attempt to at least partly restore binaural hearing in single sided deaf patients, we started to implant selected unilateral deaf patients. At the time of writing, 5 subjects have been implanted. To evaluate the benefit of bilateral implantation, a series of studies has been conducted to provide a broad image on binaural hearing abilities in unilateral deaf patients. All patients implanted so far with a CI did not benefit from other options (i. e. bone anchored hearing aid, CROSS-HA) tested prior to implantation. They wear the implant in daily life conditions. Speech understanding in difficult, noisy situations is improved. Directional hearing is restored to variable degree. No major surgical complications have been observed. From our results we conclude that cochlear implantation in unilateral deaf patients provides a significant benefit in speech understanding in noise. Unilateral deaf patients using a CI in addition to their normal ear seem to benefit from restored spatial hearing. Performance increases over time.

Complete cochlear coverage: Stimulation over two cochlea turns – a prospective long-term study

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Cochlear Implant systems use an array of intracochlear electrodes placed along the basilar membrane, in order to match the frequency of the input signal to the frequency-position function of the cochlea. It is generally agreed that the stimulation of the complete basal turn is essential for speech perception, but the questions of whether electrode contacts should be placed in the second turn and how far electrodes should extend apically remain unanswered. We address these questions with a prospective study in new implanted subjects that receive their first CI. All subjects are implanted with MED-EL standard electrodes (31.5 mm length, full insertion). Study design: The study follows a prospective three-interval preference design. At initial processor activation, new implanted subjects are fitted with two different 8-channel maps: 1. 8 contacts spread along the entire electrode length ("spread-8"); and 2. the 8 most basal contacts ("basal-8"). Subjects are instructed to switch between both maps every two days and to use both maps for an equal amount of time. After 6 weeks, speech perception is tested with both maps. Subjects then keep their preferred 8-channel map and additionally receive a "full-12-" map for the next interval. After 6 weeks of using both maps, the preferred 8-channel map is tested against "full-12". In the last interval, the best map is tested against a 10 channel map. Tests include several speech tests, a sound quality evaluation, and a questionnaire. In general, our data show a benefit of stimulation in the 2nd turn for all subjects. Our data also indicate some individual variability regarding the extent of the useful stimulation range; in some cases requiring individual fitting as to the number of active channels in the 2nd turn.

D13 – 455

New trends with cochlear implant electrodes

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Maximizing the chances of hearing preservation during cochlear implant surgery for EAS (electric and acoustic stimulation) candidates requires an atraumatic electrode array. Insertion length should be limited to reach the 1000 Hz region, equivalent to about 360 degrees insertion angle on the lateral wall. In order to reduce trauma and increase the chance of hearing preservation, the cochlear implant manufacturers offer lateral wall electrodes: from ABC a "Thin Lateral" and a HELIX II electrode has been reported, from Cochlear Ltd. the Hybrid S and Hybrid S and from MED-EL the FLEX EAS Electrode. Different prototypes are in testing. According to literature, pre shaped electrodes such as Contour Advance or HELIX increase the risk of hearing loss and are not designed for consistent hearing preservation due to the large number of reported direct scala vestibuli insertions and deviations from scala tympani to scala vestibuli. Lateral wall electrodes are preferred for hearing preservation, probably because they are assumed to be less traumatic than pre shaped electrodes, specially if they are flexible. Looking at the electrode itself, a key feature to give an electrode the desired flexibility is zigzagging the platinum iridium wires inside the electrode carrier. A collection of straight wires increases the rigidity and more than doubles the insertion force of the electrode compared to an array with wires in zigzag form. Slightly reducing the diameter of the metallic wire reduces insertion forces, but not as much as wiggling the wire into zig zag shape. A lateral wall electrode with zig zag wires allows for hearing preservation when desired and gives specific flexible characteristics to the array to facilitate deep insertion in standard cases.

C02 – 106

Clinical spread of excitation measurements

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The longitudinal spread of neural excitation that results from the electrical stimulation of the cochlea via a cochlear implant can be measured by telemetric recorded electrically evoked compound action potentials (TECAP) using the forward masking technique. By this method the probe position is fixed, while the masker position is varied across the electrode array. The amplitude of the response to the partially masked probe provides a measure of the amount of masking, which is dependent on the extent of overlap of the excitation regions of the masker and of the probe. Since the paper by Cohen et al. in 2003 this spread of excitation (SOE) measurement using TECAP is a well established procedure. It has been implemented in Cochlear's clinical programming system (Custom Sound EP) and in Advanced Bionics research platform (RSPOM). The clinical value of SOE measurements is on one side the differential diagnostic in electrode arrays with shorts and conspicuous electrode impedances. On the other side it can be useful in describing the interaction between intracochlear electrodes. By this SOE measurements can be of special interest in modern speech coding strategies, which lean on psychoacoustic masking. And the method could be of prognostic value for speech intelligibility with the cochlear implant. SOE measurements were performed in 25 Nucleus 24 users for apical, medial and basal probe electrodes using at least three different stimulation levels, that each evoked clear TECAPs. The measurements were repeated within up to 4 months. The course of the excitation profiles was categorised and the influence of the stimulus intensity on the width of the profile investigated. Finally the calculated profile width of profiles with extrapolated maximal amplitude of 100µV was correlated with speech test results in quiet and in noise. The course of the SOE profiles is stable over time and with different stimulation intensities. Possibly the well known variability of the profile's width of the stimulus intensity can be overcome by normalising the width to the width of a profile with maximal amplitude of 100µV. The results of SOE measurements are very useful to support the decision whether electrodes with suspicious impedances should be used in speech processor maps.

C08 – 289

Clinical outcomes of cochlear implant in pre-linguistic Italian adolescents

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The aim of this study is to investigate the benefits of late cochlear implantation in pre-linguistic hearing loss adolescents. A retrospective study was undertaken of 42 deaf adolescents, who underwent implantation in our Cochlear Implant Programme. The mean age at surgery was of 14.8 years old. All subjects used the hearing aid daily. All of them used oral language as primary communication mode. We analyzed the results of speech perception to examine pre- and post- implant improvement. All subjects improved significantly their open-set words scores after cochlear implantation. 30% of them had open-set word score equal or greater than 80%. 40.6% of patient's score after 1 year ranged from 0% to 45%. This group of subjects is characterized by large variability of results. Many factors influenced the clinical outcome: previous residual hearing, the age of first hearing aid fitting, the rehabilitation programme. In this group of patients the cochlear implant benefits appeared in more long period of follow-up in confront of the other groups of patients.

C08 – 292

Production Infant Scale Evaluation in very early cochlear implant

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The primary aim of this study is to compare normative data on pre-lexical language development during the first year of life to the data of early cochlear implant users by means of the Production Infant Scale Evaluation (PRISE). Secondly the usefulness of this questionnaire was assessed in this particular clinical context. In a previous research the PRISE questionnaires were submitted to parents of 200 normal hearing children aged from 3 to 12 months. These normative data were compared to those of two small groups: 10 children implanted under the first year of life (7-12 months) and of 10 children implanted between 12 and 24 months at our institution. The questionnaire were administered prior and 3, 6 and 12 months after implantation. All of them had not co-morbidity and received an oral rehabilitation programme. In both groups we observed a progressive increase of the score with time. When checked for differences the PRISE mean rank scores show a significant difference between the 2 groups after 3, 6 and 12 months of the implantation. Children implanted under 1 year reached maximum score at a 'Normal' chronological age. Children implanted between 1 and 2 years reached the maximum score at a chronological age of 32 months. The results support the hypothesis that an early appropriated auditory stimulation improves the spoken language development. The questionnaire is useful in the daily practice to investigate the preverbal production.

D07 – 316

Gap Detection in Individuals with Cochlear Implants

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The auditory ability to perceive gaps in a white noise stimulus has been shown to be important hearing process from several perspectives. In this study, gap detection was measured in adult subjects with cochlear implants, a matched control group, and a young, normal hearing group. The cochlear implant group revealed longer gap thresholds and greater variability than the other two groups. Comments on these findings and how they relate to speech recognition scores will be offered as well as possible auditory mechanisms that may compromise temporal resolution in implanted individuals.

C12 – 418

Nijmegen Results With BAHA Application of a Bone-anchored Hearing Aid in Children: Simplified Surgical Technique

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A retrospective analysis was performed to evaluate the clinical outcome of percutaneous bone-anchored hearing aid (BAHA) application in children with the outcome measures of fixture loss and skin reactions. An analysis was done of 93 of the 101 children, 16 years of age or younger who underwent the simplified Nijmegen surgical technique between January 1994 and July 2007. Twenty-one of 129 fixtures (16.3%) were lost or removed. In 12 cases, osseointegration failed. The majority of the failures (86%) occurred within 1 year after surgery. No differences were found between three age groups, or between fixture lengths (seven 3-mm implants versus fourteen 4-mm implants). BAHA fixtures in children were less stable than in adults. In 8 cases, Holgers grade 4 skin reactions were noted at an average (\pm SD) of 5.5 months after surgery, ie, significantly sooner than the milder reactions ($P = 0.001$). In 28 cases (22%), skin reactions of Holgers grade 2 to 4 were observed. Revision surgery to reduce subcutaneous scar tissue was necessary in 22 implants (17%). Fixture loss was more frequent in children than in adults. The age of the child and the length of the fixture did not appear to influence fixture stability.

D01 – 139

The Dutch Quality standards for cochlear implantation

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The Dutch national cochlear implant group, CI-ON, was founded in 2004. CI-ON was recognized as a subdivision of the national society of Otorhinolaryngology and Head and Neck Surgery. Since its commence, CI-ON has functioned as a platform to exchange experience on cochlear implantation (CI) between centers. More-over, several task groups have been formed to tackle problems like developing consensus on indications for CI, brainstem implants and the management of specific subgroups of patients for CI. Three important milestones have been reached so far: a guideline for the treatment of prelingual deaf children (2005), consensus on the treatment of children with hearing loss after meningitis (2007), and ultimately the quality standards for cochlear implantation in the Netherlands (2008). Quality standards for cochlear implantation in The Netherlands are present, in the Netherlands 7 centers perform cochlear implantation in adults and children. In the past, a ministerial licence was awarded to the centers for cochlear implantation. However, as the Dutch government has been moving towards decentralization of health care policy in the last decade, in the future the provision of cochlear implantation will be a question of negotiation between health care provisionists and existing CI-teams and teams who wish to embark on cochlear implantation. Therefore, CI-ON has committed itself to formulate a quality standard for cochlear implantation. The current standard is applicable to adults and children, as it defines the basic prerequisites for a team to provide this sort of specialised care and defines the additional needs for the care for children. The quality standards consists of two parts; the first part describes the trajectory of care, the team's (minimal) composition and the team's relation to internal and external disciplines or organizations. The second part sets the standard with respect to the so called indicators. These indicators refer to the minimal members of a CI-team, the minimal number of patients treated per year and various other requirements to be fulfilled by a CI-team. Of enormous importance has been the fact that the quality standards were made up by the existing CI-teams, patient organizations (OPCI) and the National Board of Family Support (LBG) combined. The quality standard for CI has now been accepted as an official standard by the Dutch National Society of Otorhinolaryngology. It has been presented to the main health care providers in the Netherlands and has been viewed upon as a decisive document usefull in negotiations with hospitals who wish to provide this care. Furthermore, the competent authorities in the Netherlands have confirmed that this document is of great importance to monitor quality of care in cochlear implantation.

D05 – 183

Outcome of paediatric cochlear implantation according to the different aetio-pathogenesis of deafness

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Cochlear implantation is a standard clinical tool to manage prelingual deafness in children. Different factors may influence the functional outcome of cochlear implantation. Authors evaluate different aetio-pathogenetic patterns and their influence on functional outcome of cochlear implantation. A series of 120 children after cochlear implantation is evaluated. Three groups according to the different aetio-pathogenesis of deafness have been created. The first group were the children with clear aetiology of deafness (prenatal, perinatal or postnatal factors as HSV of mother, meningitis etc.) In the second group children with approved GJB2 gene mutation have been included. The third group were the children with unknown reason for their prelingual deafness. All the children were evaluated at least one year after using cochlear implant. Tone audiometry, spontaneous speech production, speech understanding using LIP profile, closed set tests (EARS), CAP and HOSR. In the tone audiometry the best results were shown for children with approved GJB2 gene mutation, then children with different known aetiology and then the children with unknown aetiology. Similar results were reached in the other tests. Since the final evaluation of the results is not completed yet the statistical analysis will be presented during the congress presentation. The aetiology of the prelingual deafness should be proved in the highest available numbers. All the tests that may increase the successfulness of diagnosis should be provided. Confirmed aetio-pathogenesis of deafness may contribute to the functional outcome prognosis after CI.

D11 – 354

The German Oldenburg Children Sentence Test (OIKiSa)-a new speech audiometry tool for quiet and noise for preschool and school children

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So far there was a lack of German speech audiometry tests applicable in quiet and noise with appropriate accuracy. Moreover, the established speech audiometry for children (Gottinger Kindersprachverständnistest, Mainzer Kindersprachtest) examined perception of single words only. At the University of Oldenburg and at the Hearing Center Oldenburg recently the Oldenburg Children Sentence Test (Oldenburger Kinder-Satztest, OIKiSa) has been developed which is an adaptation of the Oldenburg Sentence Test (OISa). Pseudo sentences composed from three words each are used as speech material. So more words can be tested in the same time than with tests using single words which results in a steeper discrimination function and an increased sensitivity. So far, the OIKiSa has been validated for speech in noise only and only with school children. However, to use it for children with profound hearing loss and/or reduced German language abilities as a diagnostic and therapeutic tool, in particular in CI-candidates, a validation and standardization also in quiet and for younger ages was necessary, first for normal hearing children. The OIKiSa was validated in quiet with 266 children aged 4, 5, 6, 7, 8, 9, and 10 years. The age-dependent discrimination thresholds (L50) and the slopes of the discrimination functions were evaluated. We calculated age-dependent normative curves and obtained steep discrimination functions indicating a high test sensitivity. The test-lists are homogeneous. No further serial effects (learning effects) were observed after a training with two training-lists of seven sentences each, and six test-lists (maximum number of applied test-lists here) could be completed without fatigue. A high inter-rater correlation of 0.85 indicated a good reliability; the objectivity was only moderate ($r = 0.63$, however, the mean difference was only 0.37dB. The test-validation in quiet together with the high validity of the test in noise (Wagener & Kollmeier 2005) indicates the high value of this speech audiometric test for German-speaking children aged between 4 and 10 years. To improve the objectivity of the test, standardized test instruction and performance are necessary. At current, we validate the OIKiSa with hearing impaired children. Reference: Wagener KC, Kollmeier B (2005) Evaluation des Oldenburger Satztests mit Kindern und Oldenburger Kinder-Satztest. *Z Audiol* 44, 134-143.

Evaluation of patients with Digisonic cochlear implants

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Authors analyzed different aspects of cochlear implantation with Digisonic CI's. Material comprises a series of 100 consecutive cochlear implantation performed since 2002. Retrospective analysis includes functional results of speech perception, and results in term of reliability. Different groups of patients were evaluated: children and adults according onset and duration of deafness: prelingual, postlingual, postlingual with sudden onset, postlingual-progressive. Results were evaluated based on Ling and instruments sounds, monosyllabic words (open-sets) multisyllabic words (open-sets), sentences and text. In 98% of cases full insertion of the electrode array were achieved. In 46 cases the insertion needed to make some additional manoeuvres. Residual hearing were preserved in more than 50% of cases. Best results were obtained in a group of adults with a short lasting deafness. Average results, in performed tests, in the best group of patient were consecutively as follows: 85,4%; 73,7%; 81,3%; 91,9%; 79,6%; 81,9%. In a group of children results were significantly lower than in adults. In a whole group 98% of patients use cochlear implant every day and 4% use it only part time. There were 4 reoperation due to break down of the implants and one reoperation due to unexpected malfunctioning of more than 10 electrodes. Three patients were implanted with binaural systems. In every case, bilateral stimulation were better when compared with unilateral one. There were one case of auditory neuropathy with tremendous improvement in speech intelligibility after implantation. Authors pointed out that implanted systems were safe and useful in different clinical conditions. Low percentage of break down systems and high percentage of every day CI users means that this system is reliable and efficient.

New method of minimally invasive approach for cochlear implantation with no drilling of bony bed

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Authors described their own surgical methods based on minimal skin incision, no drilling of bony bed for internal processor, fixation with one suture to the bone and facial nerve localization. There were three groups of patients distinguished in this study. In the first group (28 cases) bigger incision allowed to classic fixation with bony bed and sutures. There were no routine localization of the facial nerve. In the second group (41 cases) no bed and no fixation were performed. In the third group (181 patients) no bed for internal processor, but one suture stabilizing the implant to the bone in the axis of the electrode array, were performed. In both last groups facial nerve was localized in the mastoid before posterior tympanotomy. Time of operation, stabilization of implants and complication were evaluated retrospectively. Average time of operation (skin to skin) differed significantly between groups – 105 min. in the first group, 76 min. in the second group and 49 min. in the last group. In cases with no fixation, one migration of the implants occurred. No others migration were stated. In the long term study no migration of implants were observed. In the last analysis concerned value of direct facial nerve localization we stated that the average time of surgery (antromastoidectomy posterior tympanotomy, opening of the cochlea) were equal to 55 min. (first group), 34 min. (second group) and 29 min. (third group). Time of surgery with facial nerve localization were significantly shorter than in the first group. Minimal skin incision, no bed drilling for internal processor and facial nerve localization are the most important technical elements for safe and fast surgery. This type of procedure can be dedicated for small children. It is to consider that the shape of internal processor don't need to have a part for bony bed.

Evaluation of HiRes®; 120 Sound Processing in Children

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HiRes® with Fidelity 120 (HiRes 120) is based on the current steering principle: current is delivered simultaneously to adjacent electrodes, targeting neural populations located between the physical contacts to elicit intermediate pitch percepts. HiRes 120 is routinely fitted on adult users; the number of paediatric users continuously increases too. The objective was to evaluate outcomes of

switching children from HiRes to HiRes 120. Fittings were managed with the clinical software, SoundWave™ 1.4. Two groups were evaluated: – Group 1: subjects switched from HiRes/Auria®; to HiRes 120/Harmony®;. They tried HiRes and HiRes 120 for at least one month, and completed a questionnaire. – Group 2: younger children switched over on the Platinum Sound™ Processor (PSP). The APCEI profile was used to monitor changes. Questions were asked to the parents at subsequent fitting sessions. Group 1: the conversion to HiRes 120 was uneventful. All children preferred HiRes 120 immediately. Satisfaction was evaluated on a scale from 1 (very unsatisfied) to 10 (very satisfied). Auria/HiRes scored 7.88 and Harmony/HiRes 120 scored 8.63. All questionnaires reported better speech understanding. The battery lasted 13 hours with the PowerCel™ Slim. Suggestions for improvement included a smaller case and a more robust connection between processor and headpiece. Group 2: the conversion was straightforward too. Despite their being too young to give immediate feedback, the subjects accepted the change immediately. Parents reported positive outcomes. Paediatric conversion from HiRes to HiRes 120 was easy to achieve. Encouraging comments on improved sound perception were reported. The battery life with Harmony/HiRes 120 was enough for a full day. HiRes 120 appears a suitable fitting option for children. Long-term follow-up, including speech tests, is now necessary to monitor the rate of progress, especially in young children.

Speech recognition technology in CI rehabilitation

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eHealth is a topic that is gaining increasing interest throughout all sectors of health care, driven by a constant drive towards greater efficiencies and quality, and by the fact that patients desire a more active, prominent role in their therapeutic care. IT and computer technologies can support this evolution in a structured way. A good example can be found in cochlear implant care, children and adults could benefit in the development of their auditory and language development skills by more intense therapy. However, there are relatively few experienced speech and language therapists, available at local support centers. If children/adults could perform auditory training exercises on the computer, at home or in school, the care could be intensified in a playful manner, while at the same time keeping the cost acceptable. Over the last decades speech and language computer technologies have evolved to a mature stage with many successful products, such as automatic speech recognition software. In the HATCI project, a software tool that allows cochlear implant users to practice and to develop their listening and speech production skills has been designed. The HATCI is interactive and provides text, sound and video samples. The auditory training sessions are based on 'speech tracking'. First, it presents phrases using an audio or/and a video stream. After each phrase, the user repeats the sentence and HATCI captures the voice. An automatic speech recognizer is used to evaluate his/her hearing and speech production abilities. The software has been evaluated with adult listeners and will be tested with CI children during the first quarter of 2009. Speech computer technologies are a promising method to support hearing and speech training in cochlear implant users. The HATCI project is financially supported by the Stevin program of the Dutch Language Union.

Performance with the OPUS 2 speech processor in a roving-level speech test

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Introduction and objectives: As performance with cochlear implants improves, and as the expectations of cochlear implant users increase, it becomes increasingly important to assess performance under more realistic and challenging conditions than in state-of-the-art speech tests. Based on the results of a study [Haumann et al., 2008] by the Medical University of Hannover, we performed speech tests aiming at testing speech at variable presentation levels. Materials and methods: 10 subjects were tested using a modified version of the Oldenburg sentence test where speech was presented at three levels (50 dB, 65 dB, 80 dB) and the noise level was adaptively varied to obtain speech reception threshold. In one test, the three levels were interleaved so that level varied from sentence to sentence, and in additional tests, each level was tested individually. Results: Results show a significant effect of the roving level method on test outcomes. Discussion: Results can be explained by taking both subject factors as well as cochlear implant design aspects into account. Conclusion: Improved test methods can provide new insights into subject performance with, and design aspects of, a cochlear implant system.

Star2 Validation Working Group: Cochlear Implant users' everyday-life performance assessed in clinical practice

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The STAR2 (Sentence Test with Adaptive Randomised Roving levels) aims to make an assessment of speech perception that more closely relates to real life listening situations than the fixed level tests traditionally conducted. Sentences are each delivered by either a male or a female speaker, at one of three different presentation levels, with adaptively varying background noise. The presentation order is randomized, for both the level and the speaker, such that subjects cannot optimize their processor controls as for fixed level tests. This aspect of the STAR2 design better mimics group conversations and more fully challenges sound processor functionality, such as the Automatic Gain Control (AGC) system which is not usually exercised in conventional tests. The objective is to conduct a validation process for STAR2. STAR2 data are collected from adult CI users in a number of centres across Europe, using STAR2 in their clinical routine. Lists of 30 sentences are delivered from a loudspeaker placed one metre in front of the participant. Global analysis will investigate: normative data, list equivalence, learning effects, test-retest variation. STAR2 scores will also be compared with other routine clinical tests as well as with other measures of everyday-life performance. Pilot data on 18 normal hearing individuals found low inter-subject variability with mean Speech Reception Thresholds (SRTs) of -7.9 dB and -9.24 dB for the male and female speakers respectively (Nunn, 2008). Preliminary results obtained in the same study from hearing impaired subjects and CI users showed a reverse pattern with better SRTs for the male speaker, most likely due to the faster delivery rate of the female voice. These observations as well as those from other studies using STAR2 to investigate front end processing are very encouraging on the usefulness of the methodology behind STAR2 for experimental designs as well as for clinical application.

Assessment of benefit after bilateral cochlear implantation in children

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Numerous studies have shown that after bilateral cochlear implantation patient receives additional channels of information what makes sound localization possible and improves speech understanding in noise conditions. Most of those studies concerned adult patients. The aim of this work is to show the results of bilaterally implanted children in the Institute of Physiology and Pathology of Hearing. 10 children aged from 2,5 to 7 years implanted in simultaneous or sequential procedure with the same type of implant in both ears are included in the study. For benefits assessment AAST (Adaptive Auditory Speech Test) in quiet and in noise was used in unilateral and bilateral conditions. Average speech reception threshold in the group was 18% better in quiet and 56% better in noise for bilateral conditions. Improvement in speech understanding especially in complex sound environment in bilateral conditions was observed.

Translation of the LittEARS questionnaire into Polish

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Introduction: Professionals involved in cross-cultural assessment acknowledged the methodological challenges which they must have faced when translating and adapting questionnaires developed for a specific linguistic and cultural group. International medical studies have demonstrated that a simple forward-translation of a questionnaire does not ensure data accuracy. The aim of this study is to get the evidence of the quality of the translated version of the LittEARS questionnaire. Method: The back-translation design was used to translate the LittEARS as the most recommended by the International Test Commission for test and questionnaire adaptation. The main steps when applying this design were: 1) direct translation from English (source language) into Polish (target language); 2) back translation of Polish version into English; and 3), comparison of the two versions in "the source language" to adjudicate

the target version for each item of the questionnaire. The evaluation of translated version was performed by applying an expert-appraisal method. The experts were asked to compare both English and Polish versions of each item and to assess to what extent both versions measure the very same auditory behavior. The experts' rates were analyzed. Results: As a result of the statistical analysis, 8 items were reviewed, two of which had the lowest median value (Median = 3), and six had the second lowest value of median of the expert assessment (Median = 4). The experts made additional comments and suggestions for 5 items. Taking into account the results of the expert appraisal method, the final translated Polish version of the LittEARS questionnaire was produced. Conclusions: Adaptation of the LittEARS questionnaire according to the International Test Commission Guidelines allows to avoid serious errors in translation process. Application of an expert appraisal methods guarantee linguistic equivalence of the translated version and the best professional quality of the adaptation.

Validation results of the Polish version of the LittEARS questionnaire

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Introduction: There is a growing need for instruments to appropriately monitor auditory behavior in very young children. This need is more evident since the benefits of early detection and intervention in children with different types of hearing loss have been documented in various studies. One of such instruments is the LittEARS questionnaire developed to assess auditory behavior of infants up to two years of age. The application of an assessment instrument without being concerned about its psychometric properties for the new linguistic or cultural group is considered "bad practice". There is substantial evidence that a good translation process does not guarantee that the questionnaire score will be reliable and valid in a second language or culture. The aim of this study is to evaluate the psychometric properties of the Polish version of the questionnaire. Method: 310 parents of children with normal hearing aged between 0.47 and 24.00 months were assessed using the Polish version of the LittEARS. The mean age of children was 16.46 months. 138 girls and 172 boys participated in the study. Results: Corrected item-total correlations ranged from 0.14 to 0.84. The Cronbach's alpha coefficient was 0.95, indicating that the measurements were highly reliable. The linear correlation between total scores and age was 0.90 ($p < .001$). The regression analysis conducted to obtain normative data showed that 83% of the variance in the total scores can be explained by age. Conclusions: The results of psychometric analyses support the use of the Polish version of the LittEARS questionnaire as a sensitive and reliable tool to assess the development of auditory behavior in Polish children between 0 and 24 months of age.

Meeting the challenges of paediatric cochlear implantation

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Advances in cochlear implant (CI) technology continue to transform the lives of profoundly deaf adults and children. Speech perception capabilities of unilaterally implanted individuals, especially in quiet, have shown considerable gains over the past 10-15 years. However, most unilateral recipients find their performance considerably degraded in noise or in multi-talker situations. In their pursuit of the development of spoken language, congenitally implanted children place considerable demands on a cochlear implant system; classrooms are typically noisy so that the effort of listening with one partially hearing ear can at times prove overwhelming. In addition, the inability of unilaterally implanted individuals to localise sound places them at a considerable disadvantage in everyday listening situations and may put them at risk if unable to orient to a warning sound. Assuming auditory deprivation plays an important part in the capacity to integrate spatial hearing in the nervous system, how time-dependent is the development of spatial hearing in man? Are bilateral implants best provided simultaneously or can the interval between CI 1 and CI 2 be staggered and, if so, by how much? How safe is bilateral CI and what additional risks does it impose? As some implant recipients retain limited residual hearing in the non-implanted ear, in what circumstances should such residual hearing be exploited by an acoustical hearing aid rather than by a second CI? And if 2 CIs are indeed better than one, how best can the incremental benefit of a second CI be measured. In addition, questions of effectiveness and cost-effectiveness need to be addressed. The UK's National Institute of Health and Clinical Excellence has just recommended bilateral

simultaneous implantation in young children and the implications of this for service delivery will be discussed. Thus, bilateral CI, once perceived as a technological curiosity, now appears set to present clinicians and commissioners with challenging questions of service delivery as the evidence base in their favour gains momentum.

A03 – 019

Cochlear implantation services' – change is overdue

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Contemporary models of delivering cochlear implantation services have not changed over the past 20 years. At present, most programmes are funded almost exclusively from health-care budgets and are usually located in the departments of otolaryngology of large tertiary referral hospitals. Such a model has served the field well, delivering excellent quality of care and ensuring the safe delivery of what was a novel service. With well over 100,000 implanted individuals around the world, the time may now be right to critically appraise how services are best delivered in the 21st century, drawing from the extensive experience that now exists in the field. Can the service be better delivered using other models? Can much of this service now be better delivered in the community, closer to where patients live? Hospital-based services are, of their nature, expensive requiring a costly infrastructure to deliver them. Some aspects of the process, in particular the surgery, will always be hospital based; and for young infants, the special services of a dedicated paediatric service may be required. However, outside of this, the assessment, programming and tuning can probably be better done in dedicated facilities away from the acute hospital. Besides, hospital environments strike fear into many adults and children, who if given a choice, would opt to be cared for in less daunting facilities; indeed many performance-based testing, especially in children, is much better undertaken in more informal surroundings. The current prevalence of hospital-acquired infections adds to the unattractiveness of hospitals for many. Besides, most implanted deaf children are not ill so why should we require of them to attend hospital? Furthermore, hospital-based services would seem superfluous and inappropriate in the follow-up and routine maintenance of patients in the years after their implantation. A reappraisal is now needed of just what services can be responsibility devolved to organisations outside the hospital sector. In particular, the implications such changes will have on local services and the consequent training needs will need to be evaluated. Above all, the collection of long-term outcomes data based on the real lives of implantees, their achievements and difficulties, will be facilitated. And if long-term outcomes are important, what core outcomes should be collected to benchmark services and quality-assure them? It is likely that by configuring services around families in the community, the service will be more cost-effective and more acceptable to patients.

B04 – 073

Bilateral cochlear implantation in children; what have we learned?

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The benefit of unilateral early cochlear implantation (CI) in congenitally deaf children is well documented and generally accepted. Evidence is also accumulating that a second, contralateral CI can generate added benefit in children with congenital, bilateral profound hearing loss. However, there are some issues related to bilateral CI that remain to be solved. 1/ How does the benefit of a second CI compare to the benefit of a contralateral conventional hearing aid in cases with contralateral residual hearing? 2/ Is there a critical age or time window for the second CI? In which cases can we wait to implant the second ear without jeopardizing its added benefit? 3/ How well can we evaluate the potential of residual contralateral hearing for successful hearing aid fitting in a prelingual child? 4/ Does the sequentially implanted second ear deliver results comparable to the first ear? If so, does it depend on the age at implantation? 5/ Does bilateral implantation allow for real binaural hearing? 6/ How do these questions reflect on the choice between simultaneous versus sequential bilateral implantation? The outcome of a retrospective study we performed on a cohort of congenitally deaf children, who received their first and second implants at various ages, sheds some light on the above mentioned questions. Our preliminary conclusions are the following: 1/ The outcome of unilateral cochlear implantation is inversely related to the age at implantation: the younger, the better. 2/ The congenitally deaf child should receive the first implant before age 1.5 to give the best results. There is thus a critical time window for fitting the first implant, 3/ There is also a critical time window for the development of binaural processing. In bilaterally profoundly deaf children, the second implantation seems to give little or no added benefit for speech discrimination in

quiet and noise after the age of 12.4/ The second implant reaches a mean level of performance compared to the first implant 18 months after fitting. 5/ The second implant offers cues for binaural hearing based only on ILD (interaural level differences), but seems to offer no cues for binaural hearing based on ITD (interaural time differences). Therefore, we offer early bilateral CI only to children with bilateral profound hearing loss. In children with contralateral residual hearing which seems to offer some potential for conventional hearing aid fitting, we wait until we can evaluate the child in terms of binaural hearing before making the decision to implant the second ear.

C05 – 122

Comparison of pediatric CI user performance with CIS+, FSP and HDCIS coding strategies acutely and after trial in quiet and noise

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Fine structure processing (FSP) was designed to add temporal (rate) cues to envelope cues in continuous interleaved sampling (CIS+). The aim of this study is to compare performance of paediatric CI users with CIS+, FSP and HDCIS coding strategies acutely and after trial in noise and in quiet. 10 pre-lingual (average age 67 months) MED-EL PULSARCI100, TEMPO+ speech processor users (average length of CIS+ use 15 months) were upgraded to the OPUS 2 speech processor implementing FSP and HDCIS. Closed set speech perception tests were administered in quiet and noise (+10 SNR) prior to upgrade, acutely after and after a 2 week trial with FSP or HDCIS. Users' strategies were then changed and testing was repeated acutely and after 2 weeks. After 6-8 months, testing was repeated with trialled strategy and acutely with non-trialled strategy. Pairwise comparisons were made on CIS+, acute FSP, acute HDCIS and trialled for 2 weeks FSP and HDCIS data. Paired-samples t-tests were performed on data collected 6-8 months later. There is a definite trend for scores with trialled FSP and HDCIS to be higher than scores with trialled CIS+. Scores with trialled HDCIS tend to be higher than scores with acute HDCIS but there is little difference between trialled and acute FSP scores. CIS+ scores tend to be better than scores with acute HDCIS but worse than with acute FSP. After 6-8 months there is a tendency towards significance for trialled FSP to be better than acute HDCIS and acute FSP to be better than trialled HDCIS. Trends are similar for testing in quiet and noise. A coding strategy comparison would be better conducted on a larger number of adult, post-lingual patients to remove limitations of small sample size and variables introduced by children. FSP as implemented in the OPUS 2 leads to user performance equal to or better than performance with CIS+.

A03 – 018

Beyond rehabilitation: Changing education' what is needed in education for long-term support

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The need for long-term educational services for children with cochlear implants has been widely acknowledged (e. q. Nevins & Chute, 1996). In early school years, focus is placed on equipment maintenance and classroom activities for developing auditory/spoken language (Chute & Nevins, 2006). In later school years, focus is shifted rather than waived out since many CI children face difficulties due to advanced language curricula, interchanging instructors and classroom noise (Archbold, 2005). Finally, the need for diverse supporting services is capitalized for those CI children who attend schools for the Deaf since auditory/spoken language exposure is scarce. The scope of our pilot program was to pivot a dual change in the educational system for students with CI in Greece by a) enhancing students' skills for audition of spoken language and b) training school professionals in ways of conforming instruction and in interdisciplinary collaboration. Twenty-one children and 44 school professionals participated in the program which recruited 9 diverse educational settings. The program was a team-based approach and entailed four components: a) continuous education seminars for school professionals and parents b) one-to-one student assessments in hearing, audition, speech and language c) generation of IEPs and supervised implementation and d) production of educational material. The students' progress was assessed via direct follow-up assessments. Feedback from school professionals was gathered via pre- and post-questionnaires and formal forums. 17/21 children with cochlear implants benefitted from the pilot program regardless of their educational placement. In addition, gathered data from school professionals allowed for a documentation of knowledge and skills that were acquired and ones that needed a future focus. A realm of conclusions is addressed, including the diverse needs of educational settings and CI students, the need for constant equipment monitoring and for creating and preserving an inter-disciplinary focus.

B13 – 399

Effects of cochlear implantation on hearing and speech development of children with bony labyrinth abnormalities

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Cochlear implantation is a remedy for severe to profound deafness in selected cases. Patients with bony cochlear malformations are known to have less neural elements than the patients without malformations. In this study effect of cochlear implantation on hearing, speech and language development of children with cochlear bony malformations have been investigated and results have been compared with the values of patients without bony abnormalities. 22 patients with various abnormalities have been retrospectively analyzed. There were 4 common cavity, 5 incomplete partition type I, 12 incomplete partition type II and 1 hypoplastic cochlea. Evaluation of hearing and speech developments of these patients have compared with 37 age matched implantees with no bony labyrinth abnormality. Hearing levels in incomplete partition type I patients were found to be similar with age matched controls, but were lower in other groups. Apart from hypoplastic cochlea patient in all groups LIP and GASP scores were eventually reached to control group patients. Time span for reaching same levels were not statistically different for incomplete partition type II patients, but for other groups a longer time was necessary reach similar scores. Bony labyrinth malformations are not a contraindication to cochlear implantation. Even if surgery may be problematic and necessitates considerable skill and experience in some cases results are promising. Although a longer time may be necessary to reach comparable levels, patients with bony labyrinth abnormalities can benefit from implantation as much as patients with no abnormalities.

B14 – 410

Effect of cochlear implantation on voice development in prelingual implantees

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Voices of the deaf children are considerably different from normal children. Rehabilitation of deafness either with a hearing aid or a cochlear implant may improve the voices of children. In this study effects of cochlear implantation on voice parameters of prelingually deafened children is investigated. This study has been conducted on 45 patients implanted at Izmir Teaching and Research Hospital CI Center. Patients were aged between 25-76 months during implantation. Patients were divided four groups according to ages and duration of device usages. Group A1 consisted of 22 patients under 4 years of age who were used their implants less than 5 years. In Group A2 there were 10 patients younger than 4 years and used implants more than 5 years. Eight Group B1 Patients were older than 4 years during implantation and used their devices less than 5 years and 5 Group B2 patients were also implanted at older than age 4 years and used their implants more than 5 years. All patients were prelingually deafened and have not any other abnormalities or bony cochlear malformations. 25 healthy children aged between 50-68 months were also included in the research as a control group. Voice records of all patients were obtained 36-85 months after implantation and also voices of control group subjects were recorded. During the research F0, F1 and F2 formants of /a/, /e/, /i/, /o/ and /u/ vowels were evaluated. Nine months after first investigation a second voice analysis have been conducted on all subjects. Fundamental frequencies, F1 and F2 of some vowels have been normalised in group A1, other voice have been normalised by longer device usage as seen in group A2 patients. On the other hand F0, F1 and F2 values have never reached normal values in group A1 patients, but some parameters have normalised or reached to near normal values after more than 5 years in some vowels. Cochlear implantation have positive effects on voice parameters especially in young implantees with long term usage. As the outcome is different for each vowel one should evaluate not only /a/ vowel but also /e/, /i/, /o/ and /u/ vowels in order to follow up voice development and benefit from cochlear implantation. Voice analysis may be a valuable objective tool to prove the benefit from cochlear implantation. This may be specifically appropriate in follow up of small children and possibly mentally retarded children.

D04 – 173

Early learning of reading as a stimulation of language system development of a child after cochlear implantation

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The perception of sound of speech through Cochlear Implant is not sufficient to understand speech in the way of hearing. Deaf patients need much more than just to be introduced to the world of sound. They must learn how to associate particular sound with its meaning. Hearing child builds the structure of phonemes in his environment due to continuous aural contact and due to his own realization. Mental perceptual proficiency and realization by not hearing person must be formed through special interactions. Listening to his own realization is the most important exercise for a deaf child. It can be achieved through reading, which let child imitate sound, listen to and perceive kinesthetic and sensory transformations. Reading is carried using simultaneous and sequent method by Jagoda Cieszyńska. This method takes advantage constructed strategies for simplification of processes of forming systematic proficiency. It builds strategies also practicing remaining proficiency of language communication. There are following steps in learning how to read: 1) from opened syllable to the first word, 2) from first words to many components speech, 3) from many components speech to a minimum of lexical stock. Deaf child acquires phonological system in the course of learning how to repeat, understand (indicate) and independently read the syllable. Semantic system is being learnt by child through repeating, understanding (indication) and reading of word (expression) and calling of objects, features and phenomena. Syntactic system is being learnt by child through reading of text and independent construction of the same. Method of early learning of reading is based on texts created during conversation with a child. Deaf child acquires phonological system in the course of learning how to repeat, understand (indicate) and independently read the syllable. Semantic system is being learnt by child through repeating, understanding (indication) and reading of word (expression) and calling of objects, features and phenomena. Syntactic system is being learnt by child through reading of text and independent construction of the same. Method of early learning of reading is based on texts created during conversation with a child.

C07 – 281

Music benefits with HiRes 120 sound processing

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Today's cochlear implant users expect not only high levels of speech understanding in noise, but also a reasonable representation of music. HiRes 120 sound processing uses current steering to improve representation of pitch, thereby offering increased spectral resolution and the potential for enhanced music listening to Harmony implant recipients. This study assessed music perception and enjoyment in HiRes 120 users. A group of 41 adult HiRes 120 users were evaluated with a battery of subjective and objective music tests at six US study sites. Questionnaires assessed musical enjoyment, quality ratings for musical passages, and real-world listening. Objective tasks included the AMICI (Spitzer et al, 2008), which required listeners to identify musical instruments, styles, and pieces, and the UW-CAMP (Nimmons et al, 2008), which evaluated the ability to discriminate/identify pitch, timbre, and melody. Music results were compared to speech perception scores and demographic variables. The median rating for music enjoyment was 7 (1 = not at all, 10 = enjoyed very much). For AMICI instrument identification, 25 participants scored 70% or more (chance = 10%). Eleven subjects scored 70% on the AMICI musical pieces open-set task, which was highly correlated with BKB-SIN scores ($r = 0.68, p < 0.0001$). On the UW-CAMP test, 13 participants discriminated 2 semitones or better, 23 scored 45% or better on timbre (instrument) identification (chance = 12%), and 19 scored better than chance (20%) on the melody test. Music enjoyment was not correlated with either AMICI or UW-CAMP scores. HiRes 120 music enjoyment ratings are notably higher than those reported by Mirza et al (2003) for users of previous generation technology on the same scale. These results are very encouraging, suggesting that HiRes 120 can offer improved music listening benefits to Harmony implant recipients.

B05 – 082

Revision cochlear implant surgery in children

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The number of CI surgeries are increasing nowadays, as the cumulative number of operations and number of new CI centers increases. The aim of the present study was to evaluate the reasons of revision surgeries and share our experience in managing revision cases. At the Izmir Bozyaka Education and Research Hospital, CI Center 862 implantations have been performed since 1998. Retrospective case review was our study design. Thirty six revision cases have been encountered. Device failures are the most frequently encountered category in children followed by suspected device malfunction. Surgical complications constitute another group and five families requested for upgrade. As the cumulative number of CI operations are growing, the incidence of revision cases increases. The knowledge of the different surgical modifications in various occasions during revision CI surgery is an important issue. Our experience in revision cases will be presented with a short video clip will be presented.

C08 – 284

Developing and adapting subjective questionnaires: lessons that we can learn from a multidisciplinary perspective

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In recent years, there has been a growing interest in developing and adapting questionnaires which provide subjective measurements for a broad set of variables related to cochlear implantation field. This interest has been reflected in the appearance and growth of articles, research projects, communications, etc. Questionnaires can be developed or adapted for a wide range of purposes and for very diverse populations in terms of linguistic and cultural backgrounds. Regardless the specific purpose and population, the quality of the subjective measurements depend on to what extent the questionnaire respond to the Best Practices agreed by professionals from different fields involved in adapting and producing subjective questionnaires. This presentation will focus on principal recommendations and guidelines developed by international public and private organisations (e. g., International Test Commission, European Federation of Psychologist's Associations, American Psychological Association, etc.), that can be useful to improve the quality of subjective measurements in the field of cochlear implantation. The contents of this presentation will intend to stimulate discussions among participants on their experiences developing or adapting subjective questionnaires. Finally, future trends in the field will be pointed out.

D04 – 178

Numerical intelligence, Verbal competence and Intelligence in preschool children with cochlear implant: our findings in a clinical sample

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This study is aimed to the individuation of the non verbal cognitive profile characteristics, and other cognitive variables, linked to the development of numerical intelligence (NI) in deaf children early treated with cochlear implant (CI). More specifically, we go on in explaining the hypothesis about functional autonomy of numerical knowledge respect both to verbal development and to non-verbal intellectual level, according to a neuropsychological approach, in such conditions of hardly impaired language acquisition. Eighteen children aged from 4 to 6 years (pre-school) who underwent cochlear implantation between 2006 and 2008 in the regional Hospital of Treviso-Padova University were selected. A protocol composed by Leiter-R, BIN 4-6 and a whole logopaedics battery was administered to a sample of children with congenital deafness and normal intelligence. Regarding cognitive status we could observe some difficulties about ability of Fluid reasoning; specifically for Numerical Intelligence, the competence was globally lower than in normal children and there were only two significant discrepancies: one regards the ability of "Writing numbers" - that it is higher, in our sample -, the other regards the performance "Number comparison", which involves mental operations of a more specifically conceptual and strategic quantity comparison. Furthermore we observed that, differently from what happens in language development in which the time of remedial is significant, there was no correlation between the variables "Length of time" from cochlear implantation and "numerical Intelligence" data. We suppose that an effective autonomy of numerical

competence respect to linguistic-verbal competence development exist and that some selective insufficiencies about semantic skills in numerical knowledge in deaf children can be present: in this case, the focus is concerning the quantity comparison inside semantic system, through the representation of Arabic code.

C07 – 273

Frequency band reallocation to electrodes: a possible way to improve melody recognition by children with cochlear implants

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Both child and adult cochlear implant (CI) users experience remarkable difficulties in music perception because of poor understanding of melody pitch patterning. One important reason for this is the misalignment between the processor's frequency allocation to electrodes and the subjective pitch percepts elicited by stimulation of the same electrodes. Recently, we have demonstrated that melody recognition by adult CI patients with residual hearing can be improved by a fitting procedure reducing misalignment through frequency band reallocation to electrodes according to the results of a matching test between acoustic and electric stimuli. This study assesses the results of this same procedure in child star patients with CIs and sufficient residual hearing. 5 implanted children (7-12 years) with residual hearing were asked to match acoustic percepts generated by pure tone stimulation of the ear with residuals to the electric pitch elicited by CI electrode stimulation. Thus, the degree of frequency map misalignment could be estimated, which enabled misalignment correction through frequency redistribution to the matched electrodes. Familiar melody recognition was assessed before and one month after the fitting. All patients had some degree of misalignment, and one month after correction showed melody recognition improvement. Patients' speech recognition abilities were unchanged, and they seemed pleased with their new maps. The results of this experiments show that music understanding in CI children is probably impaired by frequency map misalignment as it happens with adults. The correction of this condition through frequency reallocation to electrodes can be a useful tool to improve melody recognition in CI children. Although limited in its use on account of the difficulty administrating the pitch matching and the melody recognition test to children, the procedure is worth trying in the growing number of child star CI patients who attend everyday musical activities.

D14 – 469

Home Rehabilitation Clinic – as a form of support for parents of implanted children

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Diagnosis of hearing impairment and the choice of a method of treatment initiate the process of rehabilitation of the deaf and hearing impaired children. Rehabilitation is conducted as individual or group therapy in different units. However, the true therapists are parents or caretakers. They realize the stages of rehabilitation program step by step in everyday activities. Usually they are not properly prepared to such a role. To meet their needs, we have started to prepare a set of materials to help them plan and conduct a lot of activities. As the effect we have worked out a set of Home Rehabilitation Clinic (HRC) materials which so far includes 12 CD. CD from 1-2 cover theoretical materials and the next CD from 3-12 include practical exercises. Home Rehabilitation Clinic facilitates access to knowledge and valuable opinions of various specialists and equips parents and patients with ready tools adapted to the needs of different age groups. Popularity and success of the set of rehabilitation materials among our patients and the constantly growing group of implanted patients encourages us to develop new elements of the HRC.

C09 – 295

The Listening Cube: a three dimensional auditory training program

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Due to restriction of conventional hearing aids in the past, auditory training was limited. Since the development of CI and other devices, hearing impaired children can do much more with their residual hearing. Therefore, auditory training becomes ever more important. The Listening Cube offers a practical guide to auditory training. The Listening Cube is developed at KIDS, Royal

School for the Deaf in Belgium. It is an auditory training program that consists of 3 dimensions: the level of auditory training, training material and listening conditions. Auditory training can be done at the levels of detection, discrimination, identification or interpretation. A wide variety of sounds can be used as training material: environmental sounds or music, but also speech sounds and language. The same applies for listening conditions: a closed set or open set task; with or without lip-reading; with or without background noise; in life voice or by using external technical devices such as DVD or telephone. By making different combinations between the 3 dimensions, we can create an infinity of exercises adapted to each person's possibilities. There are several advantages to the Listening Cube. First of all, it presents itself as a guide, not a fixed program. You can determine yourself the order of the different components. Second, there are no limits, only possibilities. Third, no matter what language, type of hearing loss, age or extra handicap is involved, it is universal in use. The Listening Cube is useful to any kind of patient, whether using a unilateral or a bilateral device. Rehabilitation and especially auditory training is essential after cochlear implantation. The Listening Cube is a useful guide which helps you to be creative and flexible in designing auditory training exercises.

C07 – 272

Measuring aspects of music perception in children with Cochlear Implants (CIs): Methodological considerations and test design

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Psychological approaches to musical development in pre-school and primary school children with normal hearing have revealed the areas of primary interest for research in the domain, including singing, aesthetic appreciation, rhythmic and melodic development, and the acquisition of harmony and tonality. Recent advances of hearing implant technology and research have led to enhanced music perception by the CI patient population thus providing the opportunity for an improved musical enjoyment. Most important, in the cases of children who grow up with CIs, enhanced perception of music is a major concern, because early engagement to music-related activities or appropriately structured music training, besides the apparent influence on child's musical development, is likely to affect positively sub-skills related to language and literacy development, as well. Aims The lack of a broadly adopted, systematic screening of strengths and weaknesses of music perception and appreciation in children CI recipients is more than evident, since it is frequently reported in the literature that determination of the musical activities which are most satisfying to them are usually based on a trial and error procedure. The aim of the present work is to describe a test-design framework within which research-informed decisions can be taken regarding the particular behaviours and response methodologies to be assessed by music tests for CI children populations. Methodological approach The proposed framework integrates methodologies from a) Traditional psychoacoustical testing procedures, b) widely known musical aptitude tests, c) our prior research on the assessment of music skills in children with various types of learning disabilities, especially dyslexia, and d) computer-based assessment of music skills. Illustrative prototypical testing environments for the assessment of fundamental aspects of musical rhythm and pitch perception are also presented.

B04 – 076

Technology and signal processing in the future

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While the technology of cochlear implants is constantly progressing to improve reliability and ease of use of the devices, the fundamental principles behind speech processing have not really changed in the 10 last years. All present cochlear implants systems use some kind of band pass filtering to extract temporal envelope fluctuations in the various frequency bands, and then transmit this information via relatively high-rate pulsatile stimulation of tonotopically arranged intracochlear electrodes. Such systems are successful in that they allow most of their users to understand speech without lipreading in favorable listening conditions. However, strong limitations are also evident. Understanding of speech in noisy environments is quite poor, as well as the perception of melody information in musical sounds. It is now quite evident that these limitations are both due to the lack of sufficient spectral resolution provided via present multichannel systems. I will use acoustic simulations of cochlear implants to let you hear the effect of spectral resolution on performance. How can we further improve performance of cochlear implants

in the future? Do we need to fundamentally change signal processing? If we cannot improve spectral resolution, we need to find new signal processing strategies that allow transmitting (at least in part) fine structure information. Some interesting attempts in that direction have been made. However, another solution would be to keep present signal processing and to improve spectral resolution by astically diminish the distance between stimulating electrodes and surving auditory nerve fibers and concomitantly increase the number of electrode. Attempts to reach this goal are either surgically extremely complex or biologically not yet well mastered, but might well pay off with a jump in performance, to reach levels close to normal unilateral hearing.

A12 – 363

Contribution of a contralateral microphone to the performance of cochlear implant paediatric users

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Unilaterally implanted users experience difficulties similar to those encountered by unilaterally deaf subjects: stereophony loss, difficulties in hearing in noisy environment, head shadow phenomenon. In order to alleviate these difficulties, unilaterally implanted subjects may apply for bilateral implantation or for the use of a conventional hearing aid on the contralateral ear. Another option, which might be considered, is to position a Contralateral Routine Of Signals (CROS) system on the opposite ear and to connect it to the Cochlear Implant (CI). The aim of this study was to evaluate whether the use of a CI in combination with a CROS system elicits binaural benefits in paediatric users of the HiResolution® Bionic Ear system. All children use a Harmony®; sound processor from Advanced Bionics®; on the implanted ear. The contralateral ear is equipped with the CROSLink system from Phonak. Performance in speech perception, localization and communication are assessed comparing CI with CROSLink system versus CI alone. Each condition is tested with different positions of speech with respect to noise and at different Signal to Noise Ratios (SNR). Data collection is ongoing, the aim being to recruit ten subjects in total. Preliminary results suggest improvements in sound quality, loudness perception and localization when the CI is combined to the CROSLink system. Children who tried this configuration immediately accepted it and used it all day. This study data show that CROS systems, such as the CROSLink may be considered as a valuable option to improve performance of unilaterally implanted children. Further data are now required to confirm and quantify the benefits of the CROSLink system.

C02 – 108

Comfortable loudness of bandnoises and stapedia reflex thresholds in implanted adults with postlingual deafness

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The most difficult task is fitting of prelingual patients. Levels of reflex thresholds are not always final MCLs. In order to find MCL it is necessary to touch threshold of discomfort. We have undertaken attempt to estimate comfort loudness of bandnoises. Purpose of our study: How to find real MCL? We divided speech spectrum in accordance with width of channel bands. SPL of every band was 100dBs. We used sum of 3 adjacent bands. Patient increased intensity of these sums from 40dBs up to SPL estimated as MCL. The same three bands sums were used for stapedia reflex threshold measurements. 7 experienced postlingual patients participated in our study. They used their comfortable program of Tempo (MED-EL). All participants subjectively estimated intensity in range of 103-107dB SPL as MCLs. If we tested patient at own more loud, than comfortable program, patient established MCL at SPL less than 105dB. Levels of reflex thresholds were in range of 75-90dB. There is a good closeness of individual results. It means that 105dBs SPL may be used as intensity level of discomfort threshold. Levels of reflexes were lower than MCL. This is evidence that threshold levels of reflex are not MCLs. Our experienced patients say that the estimation of comfortable loudness on separate channels is a more difficult procedure than estimation of loudness of bandnoise stimuli. We suppose that the estimation of MCL by bandnoise sounds will give more simple and natural results for fitting. Best method of fitting is subjective behavioural method. We continue this work and we check up such method of loudness estimation for fitting of prelingual children.

D06 – 191

Factors determining successful cochlear implantation

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The outcome of cochlear implantation (CI) depends on many factors determining success of its separate stages. The first stage of this system is to select and prepare candidates for the operation, the second stage – the surgery itself, and the third stage – postoperative programme of hearing and speech rehabilitation. CI has been performed in 94 patients (81 children, 13 adults), the youngest one being 2, and the eldest – 62 y. o. There were 77 children having lost the hearing in prelingual period and 4 with late hearing loss. The duration of deafness among children with late hearing loss and in adults ranged from 1 to 5 years. MED-EL Combi 40+ implants have been following the operation and postoperative rehabilitation programme, all patients recovered hearing in the operated ear. All adults with late hearing loss returned to their previous occupation. 19 children do well at secondary schools, 4 at a specialized school for subjects with impaired hearing, 57 can hear and speak without using gestures (being trained by a surdologist), 1 can hear but prefers dactylic speech (went to the kindergarten for deaf children). CI results have been demonstrated to depend on the following factors: available hearing experience by the time of operation, the patient's age, and the deafness duration, surdological and family rehabilitation. The dynamics of hearing and speech recovery was more successful in the following groups of patients: having at least minimal hearing experience in the past; deaf-aid users and those with remaining hearing; aged less than 3 yo (prelingual deafness); those with deafness duration not exceeding 5 years; those having chosen family rehabilitation under the supervision of a specialist. The CI success is thought to be due to the screening diagnostics of impaired hearing in infants with their subsequent preparation for CI and implementation of postoperative rehabilitation programme.

C05 – 128

Comparison of speech recognition results of patients using Opus speech processor vs Tempo+ processor

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The CIS+ strategy is the coding strategy used in the C40+/ PULSARCI100 cochlear implant system. It is a variant of the Continuous Interleaved Sampling (CIS) strategy, which was first published and is comprehensively described by Wilson et al. (1991) (24). In contrast to CIS, it uses the Hilbert transformation for the envelope extraction and offers a wider input frequency range. In contrast the new OPUS speech processor uses FS1 with a basic fine structure strategy closely following CIS+. The only difference is that up to five low-frequency channels can be configured to temporally code the fine structure using Channel-Specific Sampling Sequences (CSSS) as described in Zierhofer, 2001 (26). Methods: So far more than 300 Patients were implanted with a MED-EL Implant at the CCIC Tuebingen. Based on the new speech processing strategy, children as well as adults with the old speech processor have been offered the opportunity to switch to the new speech processor unit. In order to evaluate the benefit of the new strategy, free field audiometry with and without background noise was done in each individual with the CIS speech processor and the FSP speech processor. In total 16 children and 15 adults have been analyzed so far in detail. Results: Overall there is a tendency for better performance with the FSP speech processor system. This tendency is significant in free field testing with background noise. 15 of 16 Children have improved speech recognition in background noise vs. sound proof condition (Age range 7 to 11). In adults (n=13), the performance with the FSP system is already more significant without noise than in children without noise. Summary: The new FSP strategy improves the speech recognition in children particularly in the situation of background noise. This effect has also been seen in adults, however adults seem to profit already significantly in case of sound proof condition.

C11 – 312

Cochlear implantation in infants deafened by congenital cytomegalovirus

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MS

Congenital cytomegalovirus (cCMV) infection is nowadays the leading cause of non-genetic congenital hearing loss in infants. Ten percent of infected fetuses are symptomatic at birth, 90% of these infants will develop significant neurologic sequelae including hearing deficits in 30%-65% of patients. Five

to seventeen percent of clinically asymptomatic children may develop late sequelae including sensorineural hearing loss (SNHL). Cochlear implantation is of value in the setting of CMV-associated SNHL although the outcome is less predictive. Case series indicate benefit with good speech and language development. Eight implanted children with cCMV-related deafness underwent audiological assessment including otoscopic examination, tympanometry, auditory brainstem responses and behavioral pure tone audiometry. Test protocol was selected according to the developmental age of the child. A retrospective review of the pediatric cochlear implant database of the Ghent University Hospital was performed and eight patients with cCMV-related hearing loss were identified. Besides audiological assessment, additional disorders and sequelae will be documented. Outcomes of these children will be discussed. Eight children with congenital cytomegalovirus received a cochlear implant. A wide range of outcomes is seen within this population, possibly because additional problems are common.

C07 – 277

The impact of musical training on implanted deaf children

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Research with aphasic adults and normally hearing children has shown a potential role for melody and rhythm training for the improvement of the perception and segmentation of speech. We therefore introduced sessions of musical training into the habilitation of a group of cochlear implanted deaf children and studied its short term impact. Sixty-five severely to profoundly deaf children from two centres, with no other handicap were studied prospectively. Children were aged between 4 to 10 years with a minimum of 18 months post-op experience. A treatment and control group were randomly selected; in the treatment group 33 received additional musical training, in the control group 32 continued a standard course of habilitation. The main measure was the intelligibility of the children's speech (PBK). Secondly, phoneme discrimination, rhythm following, voice recognition, melody recognition, timbre and pitch discrimination. Further, in the child's speech fundamental frequency was studied; average/mode, range, and variability, completed sentences and use of pauses. Measures were made before starting the training (T0), at 6 months and at 12 months. The improvement in score on the PBK was significantly greater for the treatment group with musical training than the control group ($p < 0.05$). Additionally, prosody was more greatly improved in the treatment group; mode of voice pitch ($p = 0.0002$), pitch range ($p < 0.05$), and pitch variation ($p < 0.05$). Musical training can improve the vocal expression and speech of cochlear implanted deaf children. Of course it was a true pleasure to run musical training sessions with these children, for both parents and professionals alike.

D14 – 465

Auditory Nerve Implant (ANI) – results of acute cat experiments

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Intraneural electrical stimulation of the auditory nerve promises activation of the hearing system with higher frequency specificity, greater dynamic range and lower thresholds than with cochlear implant stimulation. The aim of this project is the development of a new prosthesis for intraneural stimulation of the auditory nerve (Auditory Nerve Implant – ANI) in humans. Acute experiments were conducted in anesthetized cats. After transbullar exposure of the cochlea, the modiolus was exposed (modiolostomy) by an extended round-window-cochleostomy. Subsequently various penetrating multisite electrode prototypes were inserted into the modiolar part of the auditory nerve. After craniotomy and a supratentorial access, the activation of the hearing system to auditory nerve stimulation was monitored with penetrating electrode arrays (multi-site silicon "Michigan" probe, 32 site single shank, $400\mu\text{m}^2$ iridium sites) in the central nucleus of the inferior colliculus (ICC). A reproducible and safe surgical access to the modiolus was developed in cats (as well as in human temporal bones in a parallel study). Also a robust ICC recording setup for the electrophysiological evaluation of auditory nerve stimulation has been established. Through stimulation of different sites using various penetrating intramodiolar multisite arrays, activation of specific frequency layers of the ICC was observed and effective activation was achieved for low stimulation thresholds ($< 10\mu\text{A}$). Direct intramodiolar electrical stimulation of the hearing system appears to be an encouraging new approach for an auditory prosthesis, in which frequency specificity with low thresholds is possible. Future animal experiments will show the feasibility of chronic implantation and stimulation with a newly developed Hannover ANI prototype array.

A10 – 218

Factor analysis of hearing preservation after cochlear implantation

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Objective: Recent studies showed different range of a residual hearing preservation after cochlear implantation. The objectives of this study were to identify factors that explain a variety of hearing preservation. **Study design:** This was a retrospective study. Data of 500 CI patients, implanted in the Institute of Physiology and Pathology of Hearing, was analysed. Variables such as gender, age and duration of deafness, etiology, degree of hearing loss, surgical technique (cochleostomy/round window), type of electrode were identified and factor analysis was used. **Results:** Two factors: a surgical technique and a age influenced the hearing preservation to the large extend. **Conclusion:** It is possible to preserve hearing in the majority of cases using the appropriate surgical approach and electrode design.

B11 – 266

Results of BAHA system application in single sided sensorineural deafness in children

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Single side deafness means permanent profound hearing loss in one ear. Unilateral hearing significantly reduces localization skills and hearing sensitivity for signals presented to the deaf ear and hinders hearing in noise creating communication handicap in many situations. One of possible therapeutic solutions for patients with single sided deafness is application of BAHA system on the deaf side. This technology provides effective sound transmission by bypassing skin and subcutaneous tissue and allowing vibrations to pass directly into the inner ear. The aim of this study is to evaluate the benefits of Baha in children with single sided deafness (SSD). 15 children, not younger than 5 years of age, with SSD were included to the study. SSD was defined as a hearing threshold AC better than or equal to 20dB HL (measured at 0.5, 1, 2, 3 kHz) on the good ear and worse than 90dB BC (bone conduction) on the bad ear. Speech discrimination in noise was evaluated for three signal/noise level configurations: signal level 50dB, SNR 0 and signal level 65dB, SNR 0dB and SNR+5dB in two spatial orientations - signal to the deaf ear/noise to the good ear and signal to good ear/noise to the deaf ear. Testing was performed in three conditions: unaided and two aided - with conventional Cros and Baha system. Results for speech in noise show significant differences for condition ($p<10^{-3}$), signal/noise level configuration ($p<10^{-6}$) and spatial orientation ($p<10^{-6}$). Achieved results indicate the potential benefit for BAHA in single-sided deafness.

D14 – 464

Preservation of low frequency hearing after cochlear implantation in behavioral and objective measurements

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High frequency hearing loss in many cases is characterized by normal or slightly elevated thresholds in the low frequency band with nearly total deafness in higher frequencies. We proposed to name this kind of hearing loss "partial deafness" The proposed therapeutic approach consists in combining electric stimulation of the same basal part of the cochlea with acoustic stimulation of the apical part. Combined electric and acoustic stimulation (EAS) requires preservation of the residual hearing following placement of a cochlear implant. The aim of the study was to assess preservation of low frequency hearing using behavioral and objective methods. Pure tone audiometry and standard ABR procedure using as a stimulus tone burst with a gaussian envelope and the frequency 500 Hz were performed in a group of partially deafened patients one month before and one month after cochlear implantation. The individual thresholds differences were calculated for frequency 500 Hz for AT and ABR procedure. The high correlation between pre- and post operative thresholds differences at 500 Hz measured by means of ABR and pure tone audiometry was stated. ABR measurement of 500 Hz thresholds looks very promising for assessment of low frequency hearing preservation after cochlear implantation.

B14 – 413

Production of high frequency consonants by children and young adults

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The high frequency consonants [s, sh, t, ch, and j] perform many important grammatical functions in English and other European languages. Analyses of these consonants, however, have tended to focus on production by adult male speakers and have ignored potential age and gender factors. This study looks at production of these consonants by a group of child and young adult speakers. Subjects include both normal hearing and cochlear implant users. Subjects were recorded producing a short poem in which the target consonants [s, sh, ch, j] occur in a [Ci] context. The average spectrum of each consonant was calculated and the spectral peak identified. The lowest and highest points in the spectrum -12dB below the peak were also identified. The results showed a pronounced age and gender effect, with many of the female subjects having peaks for [s] that were more than one octave above that reported for adult males. Differences were also found between the normal hearing subjects and those wearing cochlear implants. The significance of these results for testing and training procedures, and for selection of the frequency response of cochlear implants will be discussed. The results indicate that the high frequency consonants produced by children and adults differ markedly from those produced by adult males.

C09 – 296

Approaches to training for young adults with cochlear implants: A case study

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Many young adults with hearing loss receive cochlear implants in their teenage years or later. Training for this unique group of subjects should emphasize the development of speech communication skills via audition only and auditory-visually. This presentation will focus on training provided to a 27 year old male who received his first implant (right ear) at age 11 years, and the second (left ear) at age 26 years. Training was provided twice weekly for a period of six months. Materials used included: the KTH Tracking Procedure presented via lipreading only (L) and lipreading plus cochlear implants (LCI), TeenTrax, a modified form of Speech Tracking presented via audition only, Everyday Sentence Lists presented via audition only, and Closed Set Sentence Lists presented via audition only. The results obtained show a steady increase in the subject's ability to understand speech via audition only over the course of the training period. There was a significant difference between the subject's Speech Tracking scores presented L and LCI indicating that he was able to successfully integrate the visual and auditory signals. The results show the value of a systematic program focusing on the use of CIs for auditory only and auditory-visual speech perception. Context-based materials resulted in enhanced performance, and their importance in training will be discussed. The subject's ratings of the various training activities will also be presented and discussed. The results show the value of training for young adults with CIs.

D09 – 337

Treatment of hearing impairment in BOFS – very rare genetic disorder

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Genetic background and characteristic symptoms of a child with the Branchio-Oculo-Facial (BOF) syndrome were outlined. This autosomal dominant syndrome is very rare, since the 1980s only about 50 cases were reported in the literature. Diagnostic protocol and treatment strategies for this complex lesion were presented and discussed. The child was diagnosed with bilateral hearing impairment after evaluation with TEOAE screening test at birth. The final diagnosis of profound hearing impairment with no responses down to the 100dB level was definitely established after ABR was done in our Institute when the child was six months old. Cochlear implantation was performed at the age of 12 months; baby was implanted in the right ear. There were no adverse incidents and no problems with electrode insertion during surgery. Results of treatment and auditory rehabilitation in our Cochlear Implant Center after 12 months were presented. Due to the rarity and multiplicity of

symptoms in the presented case a standard therapy has not been established yet. However, it is of crucial importance to focus on hearing improvement despite a complex bilateral congenital malformation of the head and neck. Cochlear implantation is beneficial to children with BOFS providing hearing at the level of social communication.

D13 – 459

New electrode design for preservation of residual hearing in EAS and PDCI – results of temporal bone study

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Success in conservation of residual hearing after cochlear implantation with the round window technique benefits patients who previously were not considered for conventional cochlear implantation. Technological developments, especially in the design of an electrode array play a key role in minimising trauma to the cochlea during the optimized surgical procedure. Recent improvements in both hardware and software enabled a combined electric and acoustic stimulation of patients who have residual low-frequency hearing and poor speech recognition even with the best-fitted digital hearing aids. The Nucleus® Straight Research Array has been designed and developed as a collaboration project between The Institute of Physiology and Pathology in Warsaw/Kajetany and Cochlear Ltd. with objective of minimising trauma to the cochlea with round window insertion. Twenty-two fresh or thawed fresh-frozen human temporal bones were prepared and inserted with the SRA electrode with a standard round window technique used for cochlear implantation by one otosurgeon. Additional 4 temporal bones were inserted with a Standard Straight electrode using the same surgical technique. All insertions were performed in the scala tympani of the cochlea. Evaluation of insertion depth and position of the electrode array inside the cochlea showed little or no evidence of significant intra-cochlear trauma in the vast majority of implanted bones inserted with the SRA, which demonstrates its superiority over the Standard Straight electrode when it comes to insertion characteristics. Handling of the electrode carrier was reported as very satisfactory which is evident from low resistance to insertion being apparent in the majority of cases. Proven safety of repeated atraumatic insertions makes this new design suitable for clinical trial to be part of The Hybrid Sound Processor Investigational Device (Hybrid SPID) that has been developed to be used with any Nucleus CI24R or CI24RE series cochlear implant in order to produce electrical stimulation of the cochlea in the conventional way and in addition acoustic stimulation like a conventional hearing aid.

A11 – 224

Fitting of the hearing system affects EAS performance

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Introduction: Previous experiments showed that both electric and acoustic parameters in EAS differ from electric or acoustic stimulation only. The goal was to develop a fitting paradigm for EAS with the new DUET Hearing System. Materials and Methods: Twenty four EAS users with at least 12 months of experiences with their cochlear implants (CI) and 1 month with their hearing aids (HA) participated. Speech tests and subject's opinions were investigated and evaluated for each parameter change. Subjects were tested in conditions HA only; HA + CI only, CI only (contralateral non-implanted ear plugged) and best aided condition (contralateral ear unplugged or plus contralateral HA). Results: Several programming parameters such as low frequency slope, compression, AGC threshold and electric and acoustic frequency ranges play an important role in the fitting of EAS. A single parameter change in the condition CI only or HA + CI only may change speech test results performed in quiet or noise up to 35% of correct words with the mean change up to 17% or correct words. For the optimized fitting parameters subjects performed best in the condition best aided and HA+CI only. Optimizes fitting parameters and paradigm will be proposed. Conclusions: The results show a strong benefit of ipsilaterally (implanted side) preserved hearing and an additional benefit of the contralateral hearing for the group of PDCI subjects. Optimized programming has a strong effect on speech test performance and quality of hearing in EAS.

D09 – 334

Molecular analysis among group of Polish CI patients

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Hearing loss is the most common sensory defect in humans, affecting about 1-4 in 1000 newborns. About 60% of hearing impairment in children and about 50% in adults can be attributed to a genetic defect. Up to 50% of all patients with autosomal recessive non-syndromic prelingual deafness in different populations have mutations in the gene encoding gap-junction protein, connexin 26 (Cx26, GJB2). Mutation 35 delG constitutes more than half of all pathogenic Cx26 mutations. GJB6 gene with big deletion (Δ D13S1830) is the second most common genetic cause of non-syndromic hearing loss. According to the preliminary functional analysis, pathologic changes (caused by mutations of GJB2 and GJB6 genes) did not comprise spiral ganglion cells, which are crucial for the results of cochlear implantation. The aim of our study was to estimate the prevalence of mutations of the GJB2 and GJB6 genes among patients with cochlear implants (CI). Methods: We have analyzed 348 consecutive patients diagnosed with congenital hearing loss who received CI. Search for mutations was performed by ASSP multiplex PCR test, PCR-RFLP and direct sequencing. Results: Pathogenic mutations were found in 192 cases (55,2%). There were 149 patients homozygous for 35 delG mutations, 24 patients compound heterozygotes (35 delG/IVS1+1 G/A, 35 delG/314del14, 35 delG/167delT, 35 delG/delAA333, 35 delG/44A/C, 35 delG/55G/C, two patient with a deletion in GJB6 gene, and 17 patients in whom we have found only one 35 delG mutation. In conclusion: mutations in GJB2 and GJB6 gene are the main cause of hearing loss among patients with congenital hearing loss and CI. All detected mutations are the mutations that inactivate the protein.

D11 – 355

Validation of CSS (Cotulbea, Stefanescu, Stanciu) Sentence Test in Romanian language

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CSS (Cotulbea, Ștefanescu and Stanciu) is the Romanian Sentence Test developed to evaluate speech understanding in cochlear implant(CI) users. The test is an adaptation of the German Hochmair-Schulz-Moser (HSM) test and it consists of 30 lists of 20 everyday sentences. For the purposes of evaluating speech in noise, noise with a speech shaped spectrum was recorded along with the spoken lists. The CSS test is available on CD and it consists of 30 lists of 20 sentences, 3 to 8 words each (total= 106 words), plus 3 exercise lists, each with 10 sentences. 10 CDs were recorded with different signal to noise ratios (SNRs) ranging from: +3, up to -9. To assess the difficulty of the lists, 30 adult subjects with normal hearing were tested. The 30 lists of 20 sentences were presented with 6 different SNRs:+1, -1, -3, -5, -7, -9 (5 lists The lists presented in random order were used with every SNR. The percentage of correct answers (correctly repeated words) decreased as a function of increased noise levels. The 50% understanding level was found to be at an SNR of -4. With an SNR of +1 the average percent correct was 92,23%, while an SNR of -9 yielded an average percent correct of 10,56%The test is relevant for the evaluation of adult CI users' speech understanding in everyday life. Also, it can be used with varying degrees of difficulty, due to the different SNRs. Comparison between the German HSM test and the Romanian CSS sentence test.

B08 – 250

Application of cochlear implants in treatment of deafness in patients with the Oculo-Auriculo-Vertebral Dysplasia (Goldenhar) Syndrome

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The hearing impairment in patients with OAVD is mostly of conductive type. It is caused by the existence of congenital malformations of the external and/or middle ear. Bilateral profound sensori-neural hearing loss is a rare condition in these patients. In our Clinic this type of hearing loss was confirmed in two of eleven children with diagnosed OAVD. Two children with diagnosed OAVD were treated with cochlear implants for profound bilateral hearing loss. One of them had bilateral congenital facial deformities, more intense on the

right side and coexisting deformation of the upper extremity: polydactyly with syndactyly. Computed tomography revealed normal internal ear structures on both sides. We used Medel Pulsar 100 device for implantation. The second child had unilateral clinical features of OAVD. Computed tomography showed internal ear malformation in form of cochlear hypoplasia and ossification of the round window. In this case we used Nucleus Freedom device. In both cases we used the facial recess approach with cochleostomy. The operations were performed without any early or late complications. The wound healing was normal. First fitting of the speech processor was approximately 3 weeks after surgery. Preliminary results from our Rehabilitation Center are encouraging considering the fact that profound congenital malformations as well as some degree of mental retardation, are present. After first fitting free field audiometry in two presented cases showed responses at the level of 50dB and 40dB, respectively. We point out that cochlear implants can be used in treatment of deafness even in cases of advanced congenital malformations of the head. Rehabilitation of these patients must be more intense and takes longer than in other cases of profound hearing loss.

B06 – 090

Dizziness after cochlear implantation

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Cochlear implantation has become a safe and effective method for the auditory rehabilitation of the profoundly hearing impaired although it carries the potential risk for vestibular system insult or stimulation with resultant dysfunction. Incidence of disequilibrium and vertigo after cochlear implantation ranges from 13% to 74% in the literature. The aim of study was to determine the prevalence, symptom characteristics, and potential risk factors for vestibular symptoms after unilateral cochlear implantation. A retrospective study included adult patients who had answered the questionnaire about postoperative vestibular symptoms after cochlear implantation in our center for a period of years 1994-2008. Preoperative dizziness, age at implantation, and age at onset of hearing loss were also recorded. Patients with dizziness were considered case subjects, whereas those without vestibular symptoms were considered case controls. Unilateral cochlear implantation rarely results in significant effects on the vestibular system. Delayed dizziness was not related to immediate surgical intervention but could result from chronic changes occurring in the inner ear. We also present a case of BPPV after cochlear implantation. Three different mechanisms are proposed for the occurrence of BPPV in patients with CI. The findings should be considered in counseling patients about cochlear implantation.

B01 – 050

Role of different factors in the CI outcome

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Cochlear implantation gives standard outcome in the defined condition. Some patients do not reach expected results despite the fact that surgery, fitting, rehabilitation is done according to the international standards. The goal of this paper is to identify some factors that may influence the outcome of cochlear implantation. Patients that have at least one year experience with cochlear implant were included to this study. There were 43 children. Following tests and evaluations were done: Pure Tone Audiometry (PTA), Speech Audiometry (free field with and without background noise), monosyllable tests, number tests, level of communication with CI evaluated according CAP standards. We evaluated speech and hearing rehabilitation in the pre-implantation period, after implantation, educational environment, family condition and support. There were 51 patients implanted in the period from April, 2005 to May, 2009. The inclusion criteria one year experience with the CI fulfilled 43 patients. The average PTA was at the level of 30-40 DB on 125 – 6000 HZ, average speech audiometry, average monosyllable tests demonstrated 60-70% of discrimination. From the whole series 18 patients have not reached the expected level of speech and language development. There are several factors that may influence the outcome of cochlear implantation even in best given conditions (cochlear implant, anatomy of the cochlea and cochlear nerve, surgery, rehabilitation). One of the most influential factors in our series seems to be the family support and special care during the educational process. These patients are the subject of the further investigation and the detailed results will be presented in the congress presentation.

C13 – 424

Management of conductive hearing loss in aural atresia with VibrantSoundbridge implantation

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There is a dynamic development in the management of aural atresia in recent years. The surgery has been shifted to school age, many surgeons do not recommend unilateral aural atresia for surgery anymore, and there are anaplastologic techniques to manage the aesthetic problem of microtia. Recently implantable active middle ear implant has appeared to manage the conductive hearing loss. First experience with VibrantSoundbridge implantation in 6 patients with bilateral aural atresia is presented. Four patients with bilateral aural atresia and two patients with soft premyringic atresia are presented. All patients had had experience with conventional hearing aid. There was no previous surgery for aural atresia prior to VibrantSoundbridge implantation. The CT scan showed well differentiation of the ossicular chain in 3 cases and absent stapes in one case, normal cochlea and internal acoustic meatus. Patients with soft premyringic atresia had normal CT picture of the middle ear. Five patients were implanted via mastoidectomy and posterior tympanotomy with the transducer fixed to incus. In one patient with bilateral aural atresia round window FMT placement has been applied. All patients reached excellent functional result in the first fitting (4 weeks after the surgery). The air conduction ranged between 10 to 30dB. There was no complication of the surgery with the primary healing of the wound. Implantation of the active middle ear implant may become a method of choice to manage the conductive hearing loss in aural atresia. Together with anaplastologic management of the deformed pinna it gives excellent functional and aesthetic results in the management of aural atresia.

C01 – 101

Revisiting the correlation of intraoperative EABR and NRT results with psychophysical measures in the Freedom series cochlear implant

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Early cochlear implant research has tried to use electrophysiological measures to predict the psychophysical measures with the cochlear implant. Previous studies with earlier technology have failed to show significant correlation between these measures. With the introduction of the Freedom series cochlear implant, SCIC readdressed the data analysis of the results obtained intraoperatively with the psychophysical measures at the time of initial activation of the device and at regular intervals during the first 12 months of activation. Electrophysiological measures of NRT and EABR were performed on over 400 Freedom devices. Approximately 200 of these devices were implanted in adults, with nearly half receiving straight arrays and half receiving contour devices. In children, a greater proportion received the straight array than in adults however there was a sufficient number of children receiving contour advanced devices to enable statistical analysis of data. Adult data has been separated from paediatric data to isolate the impact of mapping methodology. Paediatric data has been further divided into five groups, children switched on and mapped using Behavioural Observation Audiometry, Visual Response Orientation Audiometry, play audiometry, adult response type or unreliable responses. This was to determine the impact of audiological technique on the psychophysical measurements made and the electrophysiological measures obtained during surgery. The complete electrophysiological battery of results could be measured on approximately 250 recipients, Measurements revealed consistent profiles of fitting that were device specific across adults ie a different profile for the straight vs contour array. The impact of the methodology of mapping for the children was evident with those mapped with BOA and children with unreliable responses showing far more conservative setting of threshold and comfort levels in the first mapping sessions that children fit using VROA and play audiometry. Data suggests that the fitting of the Freedom device for both adults and children could follow the map profile defined from intraoperative electrophysiological testing, and that for mid and apical channels there is a reasonable correlation between comfort level and the electrophysiological measures.

A11 – 226

Bilateral EAS: A comparison of partial and deep electrode insertion, a longitudinal case study

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In electric acoustic stimulation (EAS), an electrode array is partially inserted into the cochlea. Deep insertion is not recommended because there would be a higher risk of damaging the inner ear and losing residual acoustic hearing. A patient with bilateral severe, sloping, high-frequency hearing loss was implanted bilaterally for EAS with a partial insertion of the electrode array in the cochlea on the right side; 39 months later a deep insertion of an electrode array was performed contralaterally. The aims were to assess whether low-frequency hearing can be preserved after deep electrode insertion, and to assess the added benefit of bilateral EAS compared to monaural EAS. A comparison was also made between EAS using partial and deep electrode insertion in terms of hearing preservation and speech reception results. Hearing thresholds and speech reception outcomes in quiet and in noise were measured preoperatively and up to 48 months postoperatively. The benefit of EAS in daily life was assessed with the APHAB questionnaire. Benefits of bilateral EAS were calculated from speech reception thresholds measured using the LINT speech material. Speech was always presented from the front. Noise was either presented from the front, from the left side, or from the right side. Each condition was measured for unilateral and bilateral implant use. Deep insertion of the electrode array resulted in hearing preservation and significant speech recognition in this particular case. Both EAS devices provided more than 80% speech reception in noise at 10dB SNR. Bilateral EAS was beneficial for speech reception in noise compared to unilateral EAS. A head shadow effect of 3.4dB, binaural squelch effect of 1.2dB and binaural summation effect of 0.5dB were measured. Hearing preservation is possible after cochlear implantation using a long electrode array (30mm) that is fully inserted into the cochlea. Bilateral EAS was successfully implemented in this patient providing better speech reception in noise compared to monaural EAS.

A05 – 032

Emotional expression in children after cochlear implantation

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Introduction: For most parents, the primary motivation for getting a cochlear implant for their child is to help their child to talk, to understand speech and participate in the family and social life. There are numerous studies demonstrate positive effects of cochlear implants on speech perception, speech production of prelingually deaf children. Changes in these areas are closely connected to the changes in emotional, social and cognitive aspects of a child development. **Aim:** The purpose of the study was to analyze parents' subjective opinion about the changes in a child's social-emotional development after cochlear implantation. **Material and method:** A total of 30 children, aged ranged from two to six, were included in the data analysis. All children were prelingually deaf, grown up in the hearing family, with no additional disabilities. In every cases emotional and behavior problems were observe. The questionnaire consisted of nine open-ended questions and was fulfilled by the children parents. **Results:** Parents answered the questions in their own words, without any specific suggestions from the questionnaire proposed for the authors for the purpose of current study. **Conclusion:** The finding reflects the systematic change in the children behavior.

A11 – 228

Subjective benefit after partial deafness cochlear implantation

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Objective: However, subjective benefit after cochlear implantation among non PDCI users (with profound hearing loss) has been assessed with a range of methodologies; it has never been assessed specifically in the PDCI (Partial Deafness Cochlear Implantation) group. The main purpose of the questionnaire was to allow parents of children with partial deafness to freely describe their perceptions of children experiences in wearing cochlear implants. Open-ended questions were seen as the most appropriate format which enables parents to express complex attitudes and experiences associated with partial deaf children wearing a cochlear implant. **Material and methods:** The tested

group consisted of 20 PDCI children implanted in the Institute of Physiology and Pathology of Hearing in Warsaw. All subjects from the group were cochlear implant users for at least two years. The experience with CI varied from 2 to 6 years, mean experience 3.51 years. The questionnaire consists of 12 open-ended questions and was fulfilled by the children parents. Parents were asked to answer the questions in their own words, without any specific suggestions from the questionnaire proposed by the authors. **Results:** The most common issues raised by parents was developing communication abilities connected with general increase of children confidence. **Conclusions:** Current research revealed a substantial benefit after cochlear implantation in the group of children with partial deafness who previously had not been considered for implantation.

D11 – 356

Logatome discrimination in CI users: development of a new subjective test compared to the mismatch negativity

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We report a recently developed logatome discrimination test for cochlear implant (CI), based on a multi-lingual speech database, the Oldenburg Logatome Corpus, which has been originally recorded for the comparison of human and automatic speech recognition. The logatome discrimination is based on the presentation of 100 logatome pairs with balanced representations of the conditions 'vowel replacement' and 'consonant replacement'. 11 adult normal hearing listeners and eight adult CI users - good and bad performers - were included in the study and completed the test after their speech intelligibility abilities were evaluated with an established sentence test in noise. Further, the discrimination abilities were measured electrophysiologically by recording the mismatch negativity (MMN) as component of auditory event related potentials. The results show a clear MMN response only for the normal hearing and the good CI performers, correlating with the logatome discrimination abilities. Here, higher discrimination rates for the vowel replacement than for the consonant replacement condition were found. We conclude that the logatome discrimination test is well suited to monitor the speech perception skills of CI users. Due to its large amount of different spoken logatomes, the Oldenburg Logatome Corpus appears as powerful basis to develop further speech perception tests for CI users.

C11 – 310

Microphone / processor and coil retention in young babies and children – what are our options?

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The skills of all the professionals involved in paediatric rehabilitation pale into insignificance if the baby or child has difficulty wearing and retaining the microphone / processor and transmitter coil. Typically this is seen in the very young when head movement can easily dislodge the external parts. Similarly, with children who have special needs. Review of the various methods of assisting the retention and wearing of microphones / processors and coils in babies and young children. To a certain degree the manufactures have risen to this challenge. The basic principles have been to reduce the weight worn on the ear by having a separate power pack or having a body worn processor and power source. Technically processors can be held in place with ear moulds and silicon tubing around the pinna in the form of a 'Huggy' With those tactics exhausted various forms of adhesives and doubled sided tape can help the BTE systems. Parents have also come up with some novel ideas such as fixing the processor on to head bands with Velcro™. Whilst there are more options for retaining a microphone close to the ear retention of the coil is still an issue. Increasing magnetic strengths should be done with caution because of potential risk of thinning and damage to the skin. It is important to be able to share ideas and develop and modify the equipment.

D01 – 141

UK Appraisal of Clinical and Cost-effectiveness of Cochlear Implantation by NICE

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In 2006 NICE (National Institute of Clinical Excellence) commissioned PenTag (Exeter) to review “the clinical and cost-effectiveness of cochlear implants for children and adults with severe to profound sensorineural hearing loss. “This was applied to unilateral and bilateral implantation. Clinical experts were interviewed in November 2007 and shortly after the first Appraisal Consultation Document (ACD) recommended: - Unilateral CI’s for “children and adults with severe to profound deafness who did not receive adequate benefit from acoustic hearing aids” - Bilateral CI’s for - prelingual children; adults and children who are registered as blind and those who are at risk of ossification of the cochlea. An appeal was lodged and unusually a second ACD was issued in March 2008. Whilst unilateral implants were still recommended there was a reversal in NICE’s stance on bilateral surgery only supporting; Children and adults who are blind, and those with signs of bilateral cochlear ossification. As no new information had been submitted NICE was flooded with appeals. The Final Appraisal Determination (FAD) was released in August recommending - Unilateral CI for “people with severe to profound deafness who do not receive adequate benefit from acoustic hearing aids” - Simultaneous bilateral cochlear implantation for o Children o Adults who are blind or who have other disabilities requiring increased reliance on auditory stimulation. Within the UK NHS cost effectiveness is based on treatments of a QALY being less than &#pound;30K. Calculations of the appraisal were based on improvements in HRQL (Health-related Quality of Life) and discounts for the second implant. Sequential surgery was not recommended. However, for those within the above criteria should have the option of an additional contralateral implant only if it is considered to provide benefit by the responsible clinician after appropriate informed discussions. Whilst unilateral implantation has been accepted for many years units will need to carefully plan for the potential implications. We can learn from colleagues abroad. We also need to assess more robust methods of measuring outcomes so that we can show that adults will also benefit for bilateral implants. We are not expecting any changes to the FAD which will be published later in January 2009. Any issues will be discussed.

A06 – 045

Expressive spoken language development in deaf children with cochlear implants who are beginning formal education

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Children in the UK start school at age 4, and many children with cochlear implants (CIs) are entering mainstream schools with at most 3 years of hearing experience. This population shows good progress in many areas of speech and language development. This paper assesses the expressive spoken grammar skills of young deaf children 3 years after cochlear implantation, compares them with those achieved by normally hearing 3 year old children and considers possible determinants of the outcome. The spoken language grammar of 45 deaf children implanted under 3 years old was assessed three years after implantation, using the South Tyneside Assessment of Syntactic Structures (STASS) based on the Language Assessment and Remediation Screening Procedure (LARSP). After three years of CI use, 58% of these children were at or above the expressive spoken grammar level of normally hearing three year olds; 42% were below this level. Aetiology of deafness, age at implantation, educational placement, mode of communication, and presence of additional disorders did not have a statistically significant effect ($p \rightarrow 0.05$) on the outcome. While just over half of the group had acquired spoken language grammar equivalent to or above that of a normally hearing three year old, others had not attained this level after three years of CI use. Spoken language grammar therefore remains delayed for many of the children in this group. All the children were attending school with four to six year old hearing children whose language skills are likely to be in the normal range. We need to ensure that educational programmes for deaf children with implants address their linguistic delay, in order that they can participate fully in all aspects of school life.

D06 – 197

Which co-occurring difficulties, common to many CMV-deaf children are having the greatest impact on long-term learning and language outcomes following cochlear implantation?

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It is widely accepted that the proportion of profoundly deaf children who have another difficulty is around 30%, and that those who are deafened by meningitis can have additional difficulties likely to affect progress in learning and language development. However there are very few studies describing the co-occurring difficulties in CMV-deaf children. The Nottingham Cochlear Implant Program has implanted 34 children with confirmed CMV deafness. This audit looked at the incidence and type of co-occurring difficulties experienced by the CMV-deaf children pre- and post-implant and looked at which ones affected long-term learning and language attainments. The modified Children’s Implant Profile, the Bawtry BCS Database and parental interviews were used to confirm the presence and type of co-occurring difficulties experienced by CMV-deaf children pre-and post-implant. The teacher rating questionnaire completed annually provided information regarding the child’s educational placement and mode of communication over time. Concerns were raised on ChIP for over 90% of the CMV-deaf children during the assessment phase pre-implant and over 75% were recorded as having at least one additional difficulty likely to affect progress in spoken language development on BCS. Furthermore, 32% had three or more additional difficulties. Despite good speech perception abilities, a higher proportion of CMV deaf children require specialised educational placements and a total communication approach, compared to non-CMV deaf children. Those difficulties impacting significantly on long-term progress post-implant for this population related to Sensory Integration, attention and behaviour, motor speech production and cognition. Professionals supporting CMV-deaf children in education should be aware that CMV is usually a syndrome of difficulties, and that following cochlear implantation, problems other than deafness can have a greater impact on long-term learning and language outcomes.

C04 – 118

Use of Telemedicine in the remote programming of cochlear implants

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Tele-Medicine is the application of new communication technologies to improve or allow citizens the access to health activities beside of difficult geographical conditions. The use of this resource in a Cochlear Implant (CI) program was contemplated to allow the remote control of the fitting station via internet to satisfy the needs of users and clinicians. The objectives of the current study were assess the technical viability, risks and difficulties of the Remote Programming System (RPS); and evaluate the benefits for the user comparing the Standard on-site CI programming versus the Remote CI programming. A randomized prospective study has been designed with the appropriate controls comparing RPS to the standard on-site CI programming. Study subjects were implanted adults with a HiRes 90K®; CI with post-lingual onset of profound deafness and 4 to 12 weeks of device use. Subjects underwent two daily CI programming sessions either Remote or Standard, in 4 programming days separated by three months intervals. A total of 12 Remote and 12 Standard sessions were completed. Performance tests were conducted on subjects after three months of use of either remote or standard programs. Control of the local computer from the remote one was done successfully and remote programming sessions were achieved completely and without incidents. A very small delay was noticed that did not affect the ease of the fitting. The oral and video communication was qualified as of high quality. Safety was proven checking emergency stops in different conditions. Remote and standard program parameters were compared showing no significant difference between both groups. The performance evaluated on subjects that had been using either Standard or Remote programs for three months, showed no significant difference. Remote Programming seems to be a viable, safe, user-friendly and cost-effective procedure to fit CI patients. Once the feasibility and safety of the RPS is demonstrated, the current model of CI service could change. This technique opens the possibility for main centres to program CI devices remotely, thus reducing the need for local medical support, and to provide remote CI support to secondary centres.

B04 – 074

Surgical risks. Implications for hearing preservation in cochlear implanted children

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The global analysis when selecting the option of a surgical treatment, by using a cochlear implant in a deaf child, must be considered under the perspective of the risk / benefit evaluation. A “soft” surgery protocol has been defined including 1-1.2mm cochleostomy inferior to the round-window, and also the possibility to make a Round window insertion in order to preserve inner ear structures. The type and depth of electrode array insertion is also crucial for the result and hearing preservation. The advantages of using a “soft” surgical approach including a posterior tympanotomy wide enough to exposure of the middle ear and promontory, less drilling, reduced surgical time and anesthetic risk is presented. The surgical technique, pitfalls, complications and hearing outcomes are described. After more than 15 years of cochlear implants, in children in our center the benefits has been shown effectively (school settings, language development...) so it is important to evaluate also the risk that must be considered by using this surgical technique and to evaluate the minimum risk when performing this technique.

B06 – 091

Infections in cochlear implantation in children. Importance of the biofilms and slime producing bacteria

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The aim of this study is to evaluate the different complications we have found in a population of 450 cochlear implanted children, of infectious origin. We present a retrospective study, in children implanted in a period of 10 years. A complete clinical history was obtained. General ENT exploration was performed, obtaining samples for Microbiology study from the infection. A detailed history was obtained, related to cochlear implant surgery (Cochlear implant device, surgical trauma...) Clinical specimens were placed and inoculated to several growth media. The detection and identification of bacteria was done by common systems. Patterns of resistance and susceptibility of bacteria were tested by both dilution methods. For this period different infectious related complications were found: otitis media, mastoiditis, retroauricular infection, and wound infection or flap infection. In eight cases a surgical procedure was performed and in three of them a reimplantation was performed. No cases of meningitis were found. We analyse the actual status of the heptavalent vaccine against Streptococcus pneumoniae in cochlear implanted children, in the incidence of eradication in pharyngeal carriers of the bacteria, and the incidence of recurrent otitis media in this population. This study was supported by the FUNCIS grant 0045/06.

A08 – 212

Ganglion and “Denite” populations in EAS ears

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EAS technique combines electric and acoustic stimulation in the same ear and utilizes both low frequency acoustic hearing and electric stimulation of preserved neurons. We present data of ganglion cell and dendrite populations in ears from normal individuals and those suffered from adult-onset hereditary progressive hearing loss with various residual low tone hearing. Some of these were potential candidates for EAS surgery. The data may give us information about the neuro-anatomic situation in EAS ears. Denites and ganglion cells were calculated and audio-cytochleograms constructed. The temporal bones were from the collection at the House Ear Institute in Los Angeles, USA. Normal human anatomy, based on surgical specimens, is presented. IHCs and OHCs, supporting cells, ganglion cells and denites were preserved in the apical region. In the mid-frequency region, around 1 kHz, the OC with inner and outer hair cells were often conserved while in the lower basal turn, representing frequencies above 3 kHz, OC was atrophic and replaced by thin cells. Despite loss of hair cells and lamina fibers ganglion cells were present even after 28 years duration of deafness. Conditions with profound SNHL with preserved low tone hearing may have several causes and the pathology may vary accordingly. In our patients with progressive adult-onset SNHL (amalgamated into “presbycusis”) neurons were conserved even after long duration of deafness. These spiral ganglion cells may be excellent targets for electric stimulation using EAS technique.

C08 – 291

Teenage Questionnaire to assess the ways in which this population makes functional use of the cochlear implant in a wide variety of everyday listening situations with particular emphasis on the ability to access available technology

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Nottingham Cochlear Implant Programme

Paediatric cochlear implants within the Nottingham Programme have been available for almost 20 years. We now support around 250 adults and children over the age of eleven. As a result, we needed to update the information collected on this population to reflect functional use of hearing in the wider context. At the beginning of 2008, the current questionnaire was revised and subsequently used with 74 teenagers, all in full time education. Length of implant use varied between 18 months and 14 years and 72% received their first implant at over 3 years of age. Questions covered a range of topics including issues of personal identity, communication modes and preferences, use of assistive listening devices, enjoyment of music, telephone use and the ability to access a variety of technology based entertainment such as TV and games consoles. 88% of the young people are wearing their processors all their waking hours, and just under 65% have speech as their preferred mode of communication. 65% are using the telephone to some extent and the majority enjoy music and technology alongside their peers. Some limitations were identified. For example, the vast majority still require TV subtitles, effective telephone use is sporadic and informal listening situations continue to present challenges. The majority of the young people are able to access technology to varying degrees although problems remain in the most challenging listening situations. There was a clear difference in functional benefit and identity issues linked to age at the time of the initial operation.

C10 – 303

TECAP assessments in very young cochlear implanted children coming from newborn hearing screening programme. How much are reliable and correlated with impedance levels?

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The research of objective measurements in cochlear implantation represent a remarkable topic for a better definition of the fitting strategy of this important medical device. Notably, in implanted children the introduction of the TECAP has helped the clinician in predicting the stimulation levels to fit. The aim of this work aims to verify how telemetry may result reliable in very young implanted children and define both the advantages and limits in clinical tracking. TECAP measurements have been performed in about 30 implanted children. The telemetric sessions have been conducted intraoperatively as well as at the first fitting. Periodical fitting and data taking have been moreover carried out at 3,7,15,30,60,90 days after the first fitting and periodically every 3 months as defined by the protocol. Comparisons with impedance level and profile have been moreover set up. The first results may confirm the importance of TECAP definitions while on the other hand show how difficult could be, in certain cases, to conduct the measurements both due the low compliance rate of the children at the first fitting sessions and sometimes the loss of reliability of the software to detect the comfortable threshold levels. Moreover a correlation between TECAP levels and impedance levels has resulted especially in first period after the first fitting as well as be predictable for audiologic performance of implanted children included in the study. So far, objective measurements in cochlear implant recipients have notably helped clinicians to increase the reliability and the rapidity of the device fitting. Nevertheless, we retain that in very young implanted children TECAP level have still to be confirmed by behavioral both audiometry and visual assessment in order to identify an adequate threshold level fitting. Data and results are under definition to date. Discussion may vary according to novel researches and clinical assessments.

C07 – 282

Developing musical perception through a music education program for teenagers with cochlear implants

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The purpose of this study was to assess outcomes in relation to development of musical perception within teenagers, aged 13-18 years, with cochlear implants who had been involved in a group educational music program. Outcomes were analysed in relation to musical perception, speech and language and musical skills. Sessions were recorded and assessed using UK national curriculum measures and AEB standards. New training techniques and protocols were developed by the Mary Hare School for the Deaf, UK in order to develop better musical perception for teenagers with cochlear implants. 25 teenagers were assessed using baseline national curriculum measures at specific ages. Outcomes were analysed after participation in the music group educational program. Video recordings were made and analysed. The new assessment techniques and protocol will be presented and the first results for the music groups. Both individual and group results will be shown in terms of the new protocol and the development of musical perception. Outcomes in musical attainment will be shown based on UK National Curriculum standards. Teenagers with cochlear implants who consistently participated in the group music educational program showed significant development in terms of musical perception. Results from the group were comparable to normally hearing teenagers based on National curriculum results for the UK.

B06 – 092

Complication in paediatric cochlear implantation

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Pediatric cochlear implant surgery was first practiced in Cuba in September 2000. Until June 2008 138 consecutive procedures were performed. The aim of this study is to assess early and late postoperative complications, device failures after cochlear implantations and discuss their treatments. A tertiary referral center conducted a retrospective study of all cochlear implantation in children. Patients were follow-up by the same surgical team. All complications and treatments were reviewed with a maximum follow-up of 8 years. The overall rate of complications was 7.2% (n=10). Device failure related 2.9% (n=4) leading to revision surgery and new device implantation. Early complications were 2.2% (n=3), 2 surgical wound abscess and 1 flap seroma. All patients recovered after proper drainage and antibiotics regimen; 2.2% (n=3) suffer from late complications: 1 extrusion with receiver relocation, 1 severe infection treated with a revision and explantation surgery and a sequential contra lateral implantation; 1 mastoiditis solved with medical treatment. No meningitis was observed in patients after implantation. After proper treatment all children are using their implants. This procedure has low morbidity rate, but not exempted from complications. It demands an experienced team to enable the child's recovery and if possible preserve the implanted device.

C11 – 307

Cochlear implantation in children under age one year

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Cochlear Implantation for the rehabilitation of severe to profound hearing loss is performed with increasing frequency in children under the age of one year. Outcomes data that verifies efficacy is emerging. Young children receiving Cochlear Implants do however present unique medical/surgical considerations. The NYU CI Center patient registry revealed that 55 patients under the age of one received cochlear implants. A retrospective review of etiology of deafness, age at implantation, surgical or medical complications and outcomes, and speech perception/auditory performance outcomes was performed. All children implanted under the age of one received significant benefit and are performing near or at levels comparable to normal hearing children. Medical and surgical issues were analyzed and will be discussed. No significant complications were noted. Implanting under the age of one year is efficacious, safe and should be considered in children with severe to profound sensorineural hearing loss.

C11 – 309

Cochlear implantation in the very young child: long term safety and efficacy

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Newborn hearing screening coupled with improved diagnostic tools allowing for more definitive diagnosis of profound sensorineural hearing loss has led to implantation in children under 13 months of age. Initial studies established the safety and efficacy of the procedures in the short term if attention is paid to a variety of medical and surgical issues. The purpose of this study is to demonstrate that cochlear implantation in children under age one is safe and efficacious following an extended period of cochlear implant use. 50 children with confirmed severe to profound sensorineural hearing loss received cochlear implants and have been followed at our institution for a period of 1 to 8 years. 4 children underwent simultaneous bilateral implantation. The outcome measures recorded were the medical and surgical aspects and age appropriate phoneme, word and sentence recognition tests. All children had full electrode insertions. One child experienced a scalp flap breakdown 10 months after implantation. One child had a post operative CSF leak that was repaired and one child had a device failure. All three required reimplantation. The 5 minor complications included magnet area irritation and minor cellulitis. Magnet rest and oral antibiotics resolved the minor complications. Children without cognitive issues all are developing age appropriate auditory and linguistic skills. Cochlear implantation in child <12 months of age is safe and efficacious over an extended period of time.

D13 – 460

Insertion dynamics and force evaluation of a prototype perimodiolar electrode array

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Objective: To evaluate the insertion dynamics and intra-cochlea forces produced by a prototype, small diameter, pre-curved Modiolar Research Array (MRA). Study Design: Prospective analysis using a series of analytical techniques. Methods: The prototype electrode array utilizes an external polymeric straightening member rather than internal stylet to hold the electrode straight prior to insertion through a cochleostomy. A technique similar to the Advanced Off Stylet technique is then used to complete insertion of the pre-curved electrode array. A number of physical and analytical techniques are employed to evaluate insertion dynamics and insertion safety. These include electrode interaction in human temporal bones under fluoroscopy, histology of embedded human temporal bones, measurement of perilymph displacement during insertion, and mechanical insertion and removal forces. All studies are conducted in fixed cadaveric temporal bones. Results with the prototype MRA electrode are compared to previous studies conducted with the Contour Advance electrode array. Results: Insertion of the MRA under fluoroscopy generally resulted in a reliable and less traumatic insertion than with the Contour Advance electrode. Histology of implanted human temporal bones demonstrated good perimodiolar positioning within the scala tympani and no evidence of trauma. No hyaloid forces were detected when measured from the superior semicircular canal ampulla. The MRA also demonstrated a reduction in intracochlear contact forces. Conclusion: The significantly reduced diameter and volume of the MRA electrode, combined with a more flexible pre-curved perimodiolar design and atraumatic insertion technique contributed to improved mechanical interaction with the intracochlear structures. The evaluation techniques used, and results of this study indicate suitability of the MRA electrode for use in human clinical trial. In addition, the insertion dynamics and reduced intra-cochlear electrode volume of the MRA may provide potential benefit as a full depth perimodiolar hybrid electrode.

C12 – 422

Vibrant MED-EL middle ear implant: our experience in child

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The Vibrant MED-EL middle ear implant (VSB) was first used in adults for mild to severe sensorineural hearing loss. In 2007, the indications were extended to mixed and conductive hearing losses. More recently, the VSB has been proposed for children in a limited number of cases in Europe. The goal

of this presentation is to share our experience of a 9 year-old boy presenting a congenital bilateral mixed hearing loss (type 2) who underwent the implantation of a Vibrant MED-EL. The patient had bilateral external auditory canal stenosis associated with a fusion of incus and malleus. A conventional hearing aid was unsuccessfully worn during 7 years due to eczema. Aided thresholds were around 45dB SPL. Oral language was poor, leading to the use of combined lip reading and gestures. The indication as well as the surgical procedure were completely understood and approved by the parents and the patient. During the surgery, priority was given to fixation of the FMT on the long process of the incus, and so, in a first step, this process and the malleus had to be cleared. The implant was activated 15 days postoperatively with no modification of the cochlear function and the result was immediate (video). At a 3 month-follow-up, results show mean aided thresholds at 30dB SPL for tonal audiometry and 100% at 50dB SPL for speech in quiet. This first French experience demonstrates the ability to use the Vibrant MED-EL middle ear implant for rehabilitation of children presenting a bilateral ossicular malformation.

C02 – 109

What has to be done when no NRT response are obtained during operation?

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NRT is used to assess the nerve stimulation through the cochlear implant. It also provides an help for the fittings, particularly in the case of very young children. We had the case of one 18 month aged girl with profound hearing loss. CT scan showed a type I incomplete partition of both inner ear. MRI confirmed the presence of a cochlear nerve in the internal auditory canal. Cochlear implantation was decided and performed with a straight electrode on the right ear. No NRT was obtained during implantation. Electrode placement was checked with XRays. A CT scan was in discussion but behavioral responses were obtained during fittings. NRT can miss during inner ear malformations' implantation due to a lack of neuronal maturation or a poor neuronal population. The good location of the electrode has to be checked. If good, fittings have to be continued until a behavioral response is obtained.

A13 – 378

Bimodal hearing versus unilateral and bilateral cochlear implantation in adults. New insights into the value of acoustic hearing

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Bimodal fitting means that the patient has a cochlear implant (CI) on one side (electric hearing) and a hearing aid (HA) on the opposite side (acoustic hearing). We compared the results of the simultaneous bilateral group with the hearing performance of the bimodal fitted group. In our study, 25 adult patients who had been bimodal fitted have been monitored for one year after the first fitting in speech understanding in quiet and noise (Freiburger Monosyllables Word test, HSM sentence in quiet and noise), and in the directional hearing (in a circle of 12 loudspeakers). All tests were carried out in a free-field room in all conditions: HA only, CI only and with bimodal supply. The results were compared to 20 bilaterally supplied patients. Bimodal fitting turned out to be superior to unilateral cochlear implantation in quiet (monosyllables: 70.8% vs. 51.7%) and in noise (S0N0: HSM+10dB) which is shown by a statistical significant difference between CI only and bimodal condition after 3 and 6 months respectively ($p=0,001$ and $p=0,004$). Compared to the simultaneous bilateral group, after one year you can merely see differences in emphasis after one year in speech understanding in quiet in the bimodal supplied group (monosyllables: 62.3% vs. 70.8%, HSM: 87.9% vs. 95%). There are no statistical significant differences. In regard to speech understanding in noise, after one year you can see a better speech understanding in the bimodal group (HSM S0N0+10dB: 41.1% vs. 64.3%) was noticed again. There is no statistical significant difference. It is obvious that a supply of the other ear with a hearing aid is more than important. A bimodal supply is better than a unilateral supply. In the first year the results show that a bimodal supply has almost similar even slightly better results than the bilateral supply, particularly in noise.

B02 – 061

Combined technique to avoid cochlear implant complications

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The most frequent mayor complications in cochlear implant surgery are those related to the scalp and the erosion of the tympanic frame. To avoid these complications making the surgery safer we have designed some modifications to the technique. Posterior Tympanotomy: During the drilling, in cases of wide openings, with osteolysis and post superior wall reabsorption, pressure of the electrodes, tympanic frame descent, with a sac or cholesteatoma formation, it can be exposed the electrode to the tympanum. This takes relevance because most surgeons try to drill far from the facial nerve, especially with small mastoids and with large electrodes. With this new technique we make a cochlear implant roof, with a bone table over the electrode to avoid the tympanic frame descent reinforcing this frame. avoid device infections and reinforce its fixing, we dissect the temporal muscle on a vertical plane, rounding over the device, covering it like a fan, suturing the muscle to the periosteum. This technique gives the muscle more irrigation. The scalp must be done with a firm consistency to avoid its debridement. The suture of the scalp is made with 3-0 Dexon between its borders to the periosteum border. The objective is to expand and reinforce the area that covers the implant avoiding a possible extrusion of the device. In second place if there is a middle ear infection, it is very well irrigated helping the reaching of antibiotics preventing the device infection. On third place this technique isolates the device from the skin sutures and gives enough irrigation for the skin nutrition. These modifications to the cochlear implant surgery technique don't extend long the surgery times and they can avoid this important and severe long term complications like the electrodes extrusion to the external ear canal or the device extrusion due to infections or skin injury.

D09 – 335

Mutational analysis of the mitochondrial 12S rRNA and tRNASer(UCN) genes in Polish patients with aminoglycoside-induced hearing loss

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Mutations in mitochondrial 12S rRNA and tRNASer(UCN) genes, have been reported as associated with aminoglycoside-induced hearing loss. We have recruited 87 patients with hearing impairment after aminoglycoside exposure. The 12S DNA samples from subjects treated with aminoglycoside, but with no ototoxic effect, were used as a control group. Prior to mutational analysis of 12S rRNA and tRNASer(UCN) genes, the samples were tested to exclude deafness-associated mutations in GJB2 and GJB6 genes. Finally, in 70 patients mutational screening for entire 12S rRNA and tRNASer(UCN) genes was performed by a direct sequencing. The sequence analysis of 12S rRNA gene resulted in an identification of known pathological mutation A1555G with the frequency of 5,7% (4/70) and two novel mtDNA variants: T669C (2/70, 2,8%) and G988A (1/70, 1,4%), potentially associated with aminoglycoside-induced hearing impairment. 12S rRNA secondary structure analysis and its prediction were analyzed to determine the putative pathogenicity of T669C and G988A nucleotide changes. We have found, that C at position 669 as well as A at position 988 alter the 12S rRNA secondary structure leading to more complicated organization of 12S rRNA compared to the wild-type. Mutational screening of the tRNASer(UCN) revealed two different pathological nucleotide changes, including G7444A (1/70, 1,4%) and A7445G (1/70, 1,4%). Our findings demonstrate that pathological mutations in tRNASer(UCN) gene appear to be less frequent than in 12S rRNA. The A1555G substitution is the main genetically determined cause of aminoglycoside-induced hearing loss in Polish patients. The novel 12S rRNA variants C669T and G988 A may be involved in aminoglycoside ototoxicity.

B05 – 083

Reference electrode revision procedure – PULSARCI100 Cochlear Implant

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CI users with high electrode impedance, voltage and ground path impedance values require high charge levels to perceive electrical signals as loud. High

charge levels require wide pulse widths which slow down processing rate, adversely affecting speech perception. Increasing electrode impedance, voltage and ground path impedance values may be due to migration of the reference electrode or bone covering the reference electrode contact. 2 CI users with progressively increasing electrode impedance, voltage and ground path impedance values whose speech processor programs were compromised underwent a revision procedure. Under general anesthetic the reference electrode was exposed and bone was carefully removed from the reference electrode contact. The reference electrode was repositioned under the periosteum of the temporal squama. The intra cochlear electrode array was not interfered with. Intra-operative telemetry measurements were performed. After healing of the incision these two CI user's speech processors were re-programmed. Both before and after the revision procedure, maximum comfort levels MCL's were set at electrically elicited stapedius reflex threshold (ESRT) levels. After revision Patient 1's ground path (GP) impedance value dropped from 3.19 to 1.04 k. ohms and average required charge dropped from 34.72 to 23.85qu. Processing rate increased from 913 to 1183pps and number of active electrodes from 10 to 12. Patient 2's GP value dropped from 4.66 to 1.49 k. ohms and average required charge dropped from 19.846 to 14.69qu. Processing rate increased from 798 to 958pps and number of active electrodes from 10 to 12. In situations where fitting parameters are less than optimum due to migration or surrounding of the reference electrode contact with bone, careful replacement of the reference electrode may result in decreased electrode impedances, voltages and GP values enabling faster processing rates and use of more active electrodes.

B09 – 257

Supporting pupils with cochlear implants in secondary school

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The Ear Foundation, UK

Children with cochlear implants are increasingly educated in mainstream schools. However at secondary age a significant number, in the UK, are moving to specialist provision. This study was set up to explore the experience of deaf pupils with implants in secondary school. Part one of the study sought the views of TODs by post and on line which was followed up by ten telephone interviews using a semi structured questionnaire. Part two of the study interviewed five families, with six children, attending mainstream secondary provision and telephone interviews with parents of four children attending specialist provision. A number of issues were raised by pupils, parents and TODs including language levels of the young people; school acoustics; teaching style; speech intelligibility masking true language levels; level of support; quality of support; understanding of language levels for all teaching staff; knowledge of cochlear implantation and its implications and involvement of pupils in decision about their support. There appears to be a need for a greater awareness and understanding of the needs of pupils with implants in mainstream secondary school and that the current mainstream educational provision is not always flexible enough to meet the needs of young people with cochlear implants in order to maximise benefit over time as their needs change.

B14 – 414

Counselling skills for Audiologists, Teachers of the Deaf, Speech and Language therapists: A training need

Salter J.

The Ear Foundation, UK

With the implementation of NHSPs, audiologists, teachers of the deaf and speech and language therapists are increasingly working with families coming to terms with a diagnosis of deafness in their new born child. Consequently the professionals are finding themselves dealing with difficult emotional situations they feel ill equipped to cope with. The Ear Foundation has received many requests to provide training courses and resources to address this need. In response The Ear Foundation has developed a programme of courses that includes two one day courses "Introduction to Counselling skills" and "Sharpening your Counselling Skills" and a six week course "Counselling for Audiologists: Listening with a "Third Ear". These are supported by three DVD based resources. "Luterman Lore" and "Parent to Parent" with David Luterman are designed for those working with families of newly diagnosed deaf children and provide material to provoke thought and discussion. "Counselling for Audiologists: Listening with a "Third Ear", also developed with TOD and SLT in mind, provides a set of counselling strategies designed to support families. To date The Ear Foundation has trained 110 delegates including approximately 60 audiologists, 35 TODs and 15 SLTs. A further eleven days are planned and it is estimated that over 200 delegates will attend. Course feedback has been very positive with the majority of respondents considering the course content excellent. Many comments indicated that the course is

likely to lead to significant changes in practice. The rapid change in technologies and service provision for deaf children and their families are transforming the role of all the professionals that work with them and many professionals feel inadequately prepared to support them. These courses and resources are beginning to address this significant training need.

D07 – 322

Using partial-bipolar stimulation to generate a pitch sensation lower than that produced by stimulation of the most apical electrode in cochlear implants

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Simultaneous dual-electrode current steering generates intermediate pitch precepts between two physical contacts, has been well reported and is the basis of the clinical HiRes120 strategy. This work examines the ability to current steer using partial-bipolar stimulation (pBP) to produce a pitch sensation lower than that produced by monopolar stimulation of the most apical intracochlear electrode contact, an approach postulated by Blake Wilson at RTI. In pBP, current I is delivered to the primary electrode, while current $I \cdot \sigma$ is delivered anti-phase to the neighboring basal electrode. Current $I \cdot \sigma$ flows between the primary electrode and the extra-cochlear return electrode. For pBP the amount of compensation (σ) ranges between 0 and 1: MP $\sigma=0$; BP $\sigma=1$. Psychophysical pitch perception experiments were conducted for a group of 16 experienced adult Advanced Bionics' CII or HiRes90K users. Pairs of loudness balanced stimuli were presented: one being pBP, the other single electrode monopolar stimulation. Participants were required to indicate the highest pitch stimulus. Results were variable in degree, but consistently confirmed pBP to generate a pitch sensation lower than that produced by monopolar stimulation at the most apical electrode. Experiments in the middle of the array revealed that some subjects matched the pBP pitch to that produced by monopolar stimulation of one or two electrodes more apical (around 2.2 mm). Informal listening, largely to music given the acute experiment, confirmed that use of the asymmetrical tripole at the apex produced a pitch sensation obviously lower than that of the clinical program. These results confirm, in a reasonable population, the theory of being able to stimulate neurones beyond the insertion depth of an electrode array. Applications might include: compensation for partial insertions, pitch matching of bilaterally implanted arrays, or delivery of low pitches in a shallow insertion minimally traumatic electrode array design.

D04 – 179

The effect of IQ on spoken language and speech perception development in children with impaired hearing

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Intelligence (IQ) has long been reported as a predictive factor in language development of preschool children with impaired hearing, but is not highly predictive of language or academic outcomes for school-aged children. This paper examines the effect of IQ on the rate of language development of preschool and school-aged children, the interaction between IQ and degree of hearing loss, and the effect of IQ on speech perception performance. The difference between cognitive and language quotients over time is also examined. 62 children participated in this study, 21 of whom had a CI. Two standardised measures were administered annually to each child to assess their development in vocabulary, receptive and expressive language. Speech perception was assessed using a monosyllabic word test and a sentence test. Non-verbal intelligence was assessed once using standardised tests. Language results are expressed as age-equivalent scores, in which a child's performance is equated to the average score of a normally hearing child of the same age. IQ was positively correlated with language performance. Speech perception scores on the CNC word test did not plateau until children had a language ability equivalent to that of a normally-hearing 7-year-old. Once the effect of language was accounted for, neither IQ or PTA had a significant effect on speech perception results. Language: IQ significantly affected language learning, which was also affected by degree of hearing loss, and whether children were at preschool or primary school. Throughout preschool and primary school, there was an LQ/IQ difference that would not usually be found in children with normal hearing. Children developed language at a faster rate in preschool than in primary school. Perception: CIs significantly affected speech perception performance, but not language outcomes. Further, once the effect of language was removed, IQ and degree of hearing loss did not affect speech perception scores.

A frequency-place map for electrical stimulation in cochlear implants

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Recent studies by Vermeire et al. (2008), Dorman et al. (2006) and Boex et al. (2006) have determined frequency-place maps for the electrically stimulated cochlea from unilateral CI subjects with contralateral hearing. While Boex et al. and Dorman et al. found an approximate one-octave downshift of the electrical frequency-place map with respect to Greenwood's frequency-position map of the Organ of Corti (OC), mean data from Vermeire et al. corresponded to Greenwood. In this ongoing study, 6 MED-EL recipients from the study by Vermeire et al. have been re-evaluated so far with a methodology different from the original mixed acoustic-electric scaling procedure. After loudness balancing, electric pitch percepts from unmodulated trains of biphasic pulses (1500 pulses per second, 50 μ s/phase) were pitch-matched to contralateral acoustic pure tones. Matched acoustic frequencies were evaluated as a function of electrode insertion angles. Electrode placement and insertion angles were determined from high-resolution CT scans of the subjects' temporal bones (Xu et al., 2000). Electrodes at insertion angles ranging from 640° to about 40° were matched to frequencies ranging from 180 Hz to 8.4 kHz. In the data available at the time of writing, the mean frequency-place function is about one octave below Greenwood's map in the basal turn, deviating by a lesser amount and coming close to Greenwood's function for more deeply inserted electrodes. With increasing duration of a lack of normal auditory input from the OC in the implanted ear, targets of electrical stimulation may shift from progressively deteriorating peripheral denites in close proximity to the OC to more centrally located spiral ganglion cell bodies. The different findings compared to Vermeire et al. may either result from this shift over time in neural structures responding to electrical stimulation or from the difference in methodology.

Clinical experience and comparison of alternative forms of Vibrant Soundbridge coupling

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With regard to middle ear implants the supply with the implantable hearing system Vibrant Soundbridge (VSB) represents the most experienced system in clinical practice with an era of more than 10 years up to now. Initially the VSB system was developed for patients with pure sensorineural hearing loss. In the meantime the alternative forms of coupling of the FMT broadened the indication field to patients with combined hearing loss. 20 cases with alternative coupling of the VSB were analysed comparatively with regard to functional gain and gain reserve (Kuppler-measurement). In addition to a mean functional gain (0.5, 1, 2, 3, 4) of 15.8dB +/- 10.8dB (SD), there is a mean gain reserve of 16.2dB +/- 9.6dB (SD). We observed no significant difference in functional gain between round window coupling of the FMT and coupling directly to the stapes. Beside the classic coupling of the VSB to the incus diverse alternative forms of coupling the FMT have been established and have expanded the indication for the system. A sufficient functional gain and gain reserve can be achieved with different forms of coupling.

Bilateral cochlear implantation in children with Noonan syndrome – features of diagnostic and therapy

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Objective: To display the aspects of diagnostic and therapy in children with Noonan syndrome and severe bilateral sensorineural hearing loss. In a case report we depict two children (female, 2 and 4 years old) with Noonan syndrome who underwent bilateral cochlear implantation in our department. Both girls presented with a general developmental disorder and a complete lack of language acquisition. Additionally multiple malformations of the cardio-vascular system (Pulmonary valve stenosis, patent ductus arteriosus, atrial septal defect

and patent foramen ovale) were detected. In the older child a coagulation disorder was conspicuous. In the younger child, recurrent respiratory tract infections complicated the course of diagnostic and therapy. In both children, a mutation was detected in the PTPN11 gene, which confirmed the diagnosis of Noonan syndrome. Audiologic diagnostic showed a behavioural reaction only to very loud sounds (> 80dB) and a bilateral threshold level of 90 and 100dB, respectively, recording auditory brainstem responses in both children. The radiographic findings (CT and MRI) of the petrous bone were normal. After optimisation of coagulation in the older girl and treatment of the respiratory infections in the younger girl, both children sequentially underwent bilateral cochlear implantation successfully. Noonan syndrome has increasingly moved into focus due to the recent establishment of genetic markers that can confirm the diagnosis. If a child is diagnosed with the syndrome, particular attention should be given to possible hearing disorders. In cases with severe sensorineural hearing loss, no difference should be made in determining cochlear implant candidacy in comparison to children with non-syndrome-related hearing disorders. Interdisciplinary preparation and consideration of the syndrome-related characteristics, as is possible in specialized centers, allow a successful cochlear implant operation and rehabilitation in children with Noonan syndrome.

Cochlear implants as drug delivery systems

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Cochlear Implants (CI) are now widely accepted as treatment for the deaf. In order to further improve the outcome with a CI, the interface between electrode and nerve cells has to be improved. During deafness, spiral ganglion cells (SGC) start to degenerate, but the number of SGC is considered to be among the factors defining the effectiveness of cochlear implants. Furthermore, after cochlear implantation, fibrous tissue grows around the electrode array which can be observed as increase in impedance after implantation. Currently, attempts are made to achieve both, reduction of fibrous tissue growth and enhancement of spiral ganglion cell survival or even regeneration of the neural structures by local drug delivery. The local drug delivery is either fluid based or non-fluid based. Research in fluid based drug delivery is concentrated on growth factor or steroid depots connected to the cochlear implant. Non-fluid based drug delivery is focused on drug release (proteins, steroids, nanoparticles, metal particles) from CI surface structures (small cavities, polymer coatings) or from drug producing cells attached to the CI surface. The results of various studies concerning local drug delivery in the inner ear are very promising. Fluid based application of exogenous growth factors and steroids was demonstrated to fulfil the expectations of SGC protection and fibrous tissue decrease in vitro and in vivo. Nanoparticles and metal particles, incorporated in surface polymers, as well as cell delivered drug treatment show very promising results in vitro. Non-fluid based drug delivery systems are on the way, but fluid-based drug delivery works today. The different drug delivery strategies provide various possibilities to enhance spiral ganglion cell survival and inhibit fibrous tissue growth. Therefore these strategies will help to increase the benefit of the cochlear implants.

Middle ear implantation with Vibrant Soundbridge in children with aural atresia

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Four cases of middle ear implantation (MEI) with Vibrant Soundbridge (VSB, Vibrant MED-EL, Austria) in 3 children, (one case was bilaterally implanted in two stages, #1) between May 2006 and June 2008. Average age at implantation was 11.5 years (7.5-15 years). The etiology was bilateral external auditory canal (EAC) atresia in 1 case (patient #1), bilateral microtia in 1 case (#2), and a unilateral EAC and pinna atresia (microtia) in 1 case (#3). There was a conductive preoperative hearing loss in 3 ears (#1right, #1left and #2) and a mixed hearing loss in 1 ear (#3). The mean air conduction (AC) (mean 0.5, 1, 2, and 4 kHz) was 68.75dB HL and mean bone conduction (BC) 15dB HL. All patients underwent a preoperative high resolution CT scan. One patient (#3) had a preoperative MRI. The 2 patients with microtia (#2 and #3) had earlier multiple-step pinna reconstruction but no EAC reconstruction. For the 4 ears, surgery of MEI consisted in a retroauricular approach using a facial nerve monitoring and posterior tympanotomy. In 3 ears (#1right, #1left and #3), the floating mass transducer (FMT) was crimped to the long process of the incus and in case #2 to the stapes head after uncudo-stapedial separation because of incudo-malleal blockage. First audiograms and fitting session were performed 3 weeks postoperatively. The follow-up ranged from 1 month (#1left) to 26 months. Speech comprehension scores in quiet for disyllabic

words were calculated at 65dB SPL. No statistical analysis was performed given the small number of cases. All ears, except case #2 (incudo-malleal blockage), had hypermobile ossicular chains. The mean aided AC was of 35dB (40dB at low and 20dB at high frequencies). The audiogram was performed in free field for the 2 cases of bilateral EAC atresia (#1right, #1left and #2), and with a head phone, the contralateral ear being masked, for the case of unilateral EAC atresia (#3). Mean functional gain between aided VSB and unaided was 33.75dB. Speech comprehension score was 100%, 75%, 100%, 80% for cases #1right, #1left, #2 and #3, respectively. Complications: There was no surgical complication in. A minor ossicular chain malformation was discovered intra-operatively in 2 cases (#2, #3). In case (#1) the tympanic portion of the facial nerve was dehiscens. In case #3 (unilateral microtia), there was a postoperative sensorineural hearing loss in the frequency range 1 kHz to 4 kHz. In the remaining 3 cases, no change in BC thresholds was observed. The benefit of the VSB in the case #1left is limited and a surgical revision is scheduled soon. The preliminary results obtained in pediatric MEI with the VSB system in selected cases with EAC atresia demonstrate good functional results.

B02 – 062

Resorbable system for cochlear implant fixation

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The question, if the cochlear implant device should be fixed or not intraoperatively, is under discussion. A crucial step during successful cochlear implantation involves stable fixation of the receiver-stimulator portion of the cochlear implant against the skull. This is important because device migration can predispose to infection, extrusion, the need for revision surgery and for operations with minimal incision. Secure fixation also allows the device to follow the contour of the skull, minimizing irritation and trauma to the overlying skin flap. A variety of methods are currently used to secure the device. The most common approach involves drilling holes outside of the wall and passing a resorbable suture over the receiver-stimulator. Alternative methods to enhance efficiency of device stabilization use polypropylene mesh (PDLA Resorb-X) or preshaped resorbable meshes (e. g. SonicWeld Rx, KLS Martin Group, Germany). The pins are anchored in the bone by ultrasonic energy. After successful clinical application in 4 cases with a follow-up period of 2 years with no wound healing problems we performed a randomised, prospective, controlled study. This on-going study will assess the characteristics of SonicWeld Rx as means of an alternative fixation method (stitches) for cochlear implants (PULSAR ci100, SONATA TI100, MedEl Company). Furthermore it will be assessed how long it takes the surgeon to fix the receiver. Up to now we enrolled 15 cases in this investigation. The results will be discussed in relations to type of implants, time consumption, implant fixations. Our alternative method are provided an opportunity reducing the time to first fitting of speech-processor.

A04 – 027

Early auditory and lexical development in children with cochlear implants compared to a normal hearing group

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The aim of this longitudinal study was to document the auditory and lexical development of children provided with a cochlear implant (CI) very early compared to children with normal hearing (NH). 10 children, 5 with NH (aged between 4-5 months) and 5 with hearing impairment (ranging in age from 75-1.4 years), participated in the study. All children from the deaf group received hearing instruments before a CI and now use bilateral CIs. Parents completed questionnaires (LittEARS, ELFRA-1, ELFRA-2, FRAKIS) pertaining to hearing, speech and language development of the children. Questionnaires were analyzed according to total scores and chronological and hearing ages. The children from both groups showed individual patterns of auditory development. Some children with CI made slower progress while others reached scores equivalent to NH peers by 24 months of chronological age. Speech development results revealed that children with CIs experience delays in expressive vocabulary development compared with NH peers, though receptive vocabulary appears to be more on target with normal development. Some children in the CI group were able to catch up to NH peers, making gains in speech development that were consistent with what would be expected for their chronological age. These results indicate that early implantation and therapeutic intervention are necessary for children with sensorineural hearing loss to have the ability to catch up with NH peers. Further research is needed to explore effects of parental factors as well as clinical and therapeutical methods.

B01 – 052

Performance after cochlear implantation in children with auditory neuropathy

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Auditory neuropathy is a group of disorders typically characterized by sensorineural hearing loss in the presence of otoacoustic emissions. As individuals with auditory neuropathy typically have degradation of speech recognition disproportionate to the degree of sensorineural hearing loss, conventional amplification is often of marginal benefit. The inner hair cells, the inner hair cell-cochlear nerve junction, and the cochlear nerve are possible sites of auditory dysfunction. Risk factors for auditory neuropathy include hypoxia, hyperbilirubinemia, and genetic predisposition. An animal model of auditory neuropathy has been developed. There has been reluctance to consider cochlear implantation in children with auditory neuropathy due to the possibility of limited benefit. The purpose of this exploratory study was to evaluate audiologic performance after cochlear implantation in children with auditory neuropathy. In this observational cohort study, children with clinical evidence of auditory neuropathy undergoing cochlear implantation at the University of Ottawa Auditory Implant Program were evaluated. All patients did not receive significant benefit from a prior trial of conventional amplification. Magnetic resonance imaging was performed to ensure the presence of a structurally normal cochlear nerve. Age appropriate audiologic outcomes of children with auditory neuropathy were compared to children undergoing cochlear implantation for sensorineural hearing loss due to other etiologies. Seventeen children with auditory neuropathy underwent cochlear implantation. The mean age at implantation was 3.29 years (range 1-12 years). Two children underwent bilateral implantation. Three children had a complex developmental history. Performance in children with auditory neuropathy was similar to children with sensorineural hearing loss due to other etiologies undergoing cochlear implantation. Cochlear implantation should be considered in children with auditory neuropathy who derive minimal benefit from hearing aids and have evidence of a structurally normal cochlear nerve on magnetic resonance. The findings of this exploratory analysis should be confirmed by a multicenter study or meta-analysis.

A11 – 229

Simulation of an eas implant with a hybrid vocoder

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Electrode arrays designed for EAS are shorter than standard ones but the number of electrodes on the array does not change. Consequently, the electrodes are closer to each other and this might imply more interactions between electrodes. The aim of our study is to evaluate if a coding strategy should be more appropriate than others for EAS. If the results show that speech recognition is independent of coding strategy, we suggest, for EAS, to use a coding strategy which minimizes electrode interactions. 15 normal-hearing listeners were tested with the French FOURNIER's lists of dissyllabic words. Several coding strategies were implemented, depending on the overlap between acoustic and electrical region (with or without overlap), the speed (250, 500 or 1000 pulses per second) and the number of maxima extracted (2/10, 4/10, 6/10 and 10/10). The tests were performed in quiet and in cocktail-party noise with a S/N of +6, 0 and -6dB. Results show that speech understanding is better without overlap than with an overlap between acoustic and electrical stimulation. They also show that the recognition increases with the number of maxima stimulated. Finally for EAS, we did not find a significant effect of speed, unlike the classical cochlear implant. For EAS, it would be advisable to use a CIS strategy (without maxima extraction) at a slow rate of stimulation and without frequent overlap between acoustic and electrical stimulation. The outcomes of this simulation may be helpful for fitting EAS implants.

C15 – 429

Improving central auditory processing in children with cochlear implants – challenges and new possibilities

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Good auditory processing abilities are one of the important factors in restoring functional hearing after cochlear implantation. In majority of children implanted early enough to avoid hearing deprivation development of higher

auditory processes occurs naturally. In those implanted after prolonged period of auditory deprivation there is necessity to intensify restoring of auditory functions by intensive rehabilitation. We present the battery of central auditory tests which can be used in diagnosing of auditory processing abilities and also in monitoring the effectiveness of the rehabilitation. The advantage of computer controlled adaptive tests is that they allow to provide information about the auditory processing abilities and simultaneously by measuring the reaction times and false alarm rate allow to monitor the "quality" of this measure.

B07 – 232

Apical cochleostomy in basal turn ossification: clinical results and experimental data

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Ossification of the basal turn of the cochlea is a common finding following meningitis. Cochlear implantation is a challenge in such a situation and therefore the approach with cochleostomy at the apical turn and reverse insertion of the electrode from apex towards the base has been developed. In such a situation, the speech processor programming has to reflect the reverse electrode insertion. The first part of the study consisted of a retrospective clinical study assessing outcome, hearing performance and radiological findings in 8 ears of seven patients with basal turn ossification and apical cochleostomy. In three bilaterally implanted patients with apical cochleostomy on one side, the opposite ear was implanted using a conventional basal turn implantation. The outcome was compared across the two ears in these three patients. The second part of the study consisted of an experimental apical cochleostomy and electrode insertion in 4 autopsy-derived temporal bones. The aim was to find the optimum location to perform the apical cochleostomy and to track the intracochlear electrode course using high-resolution microtomography and 3D reconstruction. At the long-term follow-up investigation, the average free-field hearing threshold in the ears with the apical cochleostomy was 46 ± 6 dB PTA ($n=8$). The average scores in the bisyllabic number test assessed at 60 and 80 dB SPL were $66 \pm 32\%$ and $71 \pm 33\%$, respectively. In the monosyllabic word test assessed at 60 and 80 dB, the scores were $31 \pm 26\%$ and $26 \pm 20\%$, respectively. In the three patients with bilateral implants and different insertion techniques across the ears (basal vs. apical), the hearing threshold and speech perception outcomes were comparable without statistically significant difference across the two ears. Radiological follow-up revealed, that in 7 ears a true apical cochleostomy was performed with a reverse, descending course of the intracochlear electrode towards the base. One patient had a medial turn cochleostomy, with an ascending electrode course towards the apex. The experimental part of the study revealed that in three cases a true apical cochleostomy had been performed and in one case, the medial turn instead of the apical turn has been implanted, again with ascending course. The apical cochleostomy is an easy-to perform and efficient alternative approach in case of basal turn ossification of the cochlea. A postoperative, high-resolution computed tomography is mandatory to visualize the intracochlear course of the inserted electrode in order to program the processor accordingly.

B12 – 390

Surgical Results of ABI in prelingually deaf children with severe inner ear malformations

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Cochlear implantation is contraindicated in labyrinthine aplasia, cochlear aplasia and cochlear nerve aplasia. The aim of our study is to present the surgical results of 14 children where auditory brainstem implantation (ABI) was performed to restore hearing. This study was conducted at the departments of Otolaryngology and Neurosurgery at Hacettepe University Ankara, Turkey. Between July 2006 and November 2009, 14 prelingual (30-56 months of age) deaf children with severe cochlear malformations had ABI. These patients had radiological contraindications to standard cochlear implant surgery. Four patients had labyrinthine aplasia, two patients had cochlear aplasia, two patients had cochlear aperture aplasia. The remaining six patients had cochlear nerve aplasia. All patients underwent retrosigmoid approach for the placement of ABI into the lateral recess. Successful brainstem implantations were carried out in all patients with retrosigmoid approach. One patient had rhinorrhea in the second postoperative day, and subsequent exploration revealed a cerebro-

spinal fluid fistula which was repaired successfully. No other complication was observed in this patient population. All patients showed benefit after using their ABI. Our results show that auditory brainstem implantation surgery is possible in prelingual children with very little complications. Audiological and rehabilitation results will be reported separately in this meeting but, preliminary data demonstrated that, ABI is an effective way of restoring hearing in patients with absent cochlea and cochlear nerve.

B13 – 404

Cochlear implantation in inner ear malformations

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Surgery in inner ear malformations presents a challenge to the implanting surgeon. The aim of this presentation is to report the surgical findings in 76 patients with various inner ear malformations. Inner ear anomalies were classified according to Sennaroglu and Saatci classification. Between November 1997- January 2009, 76 patients with various inner ear malformations underwent cochlear implantation. There were 23 patients with incomplete partition (IP) type I, 22 patients with IP-II, one patient with IP-III, 18 patients with large vestibular aqueduct, 5 patients with common cavity, 3 patients with cochlear hypoplasia, 3 patients with vestibular dilatation and one patient with narrow internal auditory canal. Standard transmastoid facial recess approach was used in 69 patients. In 5 patients with common cavity deformity the electrode was inserted by transmastoid labyrinthotomy approach. In two patients transcanal approach had to be used because of abnormal location of the facial nerve in the facial recess. CSF gusher was encountered in 22 patients. It was found that CSF gusher was more profuse in patients with IP-I and IP-III, than in IP-II and slightly larger cochleostomy is better to prevent CSF oozing around the cochleostomy. It is very important to have a universally accepted classification of inner ear malformation. Facial nerve abnormalities and cerebrospinal gusher in inner ear malformations, make this surgery more challenging than the standard cochlear implantation. Facial nerve monitoring must be used in all cases. Surgeon must be ready to modify the surgical approach during surgery according to findings. Audiological and rehabilitation outcome results will be given separately.

B14 – 415

Development of articulation skills in children with cochlear implant

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Over the past two decades, the benefits of cochlear implant use on speech perception and production have been well documented. The aim of the study was to investigate the development of articulation skills of children with CI. For this purpose, 14 children between 2 to 10 years of age with CI was administered the standardized articulation test named AAT (Ankara Articulation Test). In order to evaluate the development of articulation skills, AAT was conducted on each CI user child at the first and the third years of CI implantation. The test group was selected among those congenitally hearing impaired children who had been used hearing aids bilaterally before one and a half years of age and receive intervention after fitting hearing aids. The test group was categorized into two subgroups; first subgroup was consisted of the children implanted before 3 years (18-36 months) of age and the second subgroup was consisted of the children implanted after 3 years (37-72 months) of age. For these two subgroups, inter-group and intra-group evaluations of development were performed (for the articulation skills in the 1st and 3rd years of implantation). Wilcoxon and Mann-Whitney U non-parametric tests were used for statistical evaluation. The results of the study showed that significant development of the articulation skills in the 1st and 3rd years evaluations in the subgroup implanted before 3 years of age. But for the subgroup implanted after 3 years of age, the difference between the evaluations seems to be insignificant. These results emphasize the importance of the early application of cochlear implantation in the development of articulation skills in profoundly impaired children.

B07 – 240

Congenital profound hearing loss: management of hypoplastic and aplastic vestibulocochlear nerves

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Cochlear implantation has evolved to become an established intervention in selected children with severe to profound deafness. As implant programmes have grown, an increasing number of children with congenital deafness have been identified with aplastic or hypoplastic cochlear nerves. These children pose a significant management challenge. The aims of this study are: firstly, to assess the incidence of hypoplastic and aplastic vestibulocochlear nerves in the UK, secondly to quantify the abnormality radiologically, and thirdly to review the management and outcomes in this population. Postal survey of all paediatric cochlear implant units in the UK, registered with the British Cochlear Implant Group. Data on audiological assessment, management, and postoperative outcomes were collected. All imaging was reviewed by a single consultant radiologist, and measurement of the internal auditory meatus and 8th nerve was standardized. The caseload of children with congenital deafness and significant abnormalities of the auditory nerve across cochlear implant programmes is small, and variable. The approach to managing these children ranges from no specific intervention, cochlear implantation and auditory brainstem implantation. The benefit of cochlear implantation in this group is likely to be significantly restricted. In specific cases it may be appropriate to offer cochlear implantation, but careful counseling regarding likely outcomes is essential. Auditory brainstem implants hold some promise for future management of these patients. The findings of this national survey will lay the foundation of a collective approach in defining best practice in this particular group of children.

A10 – 221

Does deep insertion damage residual hearing? – a report

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Preservation of residual hearing is important in the light of changing selection criteria and more & more young children with residual hearing undergoing implantation. Deep insertion of electrodes, as offered by MED-EL standard electrodes, is thought to give extensive cochlear coverage thereby ensuring better matching to the natural tonotopicity of the cochlea. While some studies suggest that long electrode array can damage the lateral wall of the cochlea thereby destroying residual hearing if any, there are also reports indicating that the length of electrode insertion is not related to outcome of residual hearing preserved. The present study is aimed at determining whether residual hearing is preserved in MED-EL implants with standard electrode array & whether any co-relation exists between insertion depth angle & post operative hearing threshold levels. Retrospective study of 7 children (5-16 years) fitted with MED-EL implants (standard electrode array). Residual hearing assessed 2-6 months post switch-on. X-Ray skull was carried out to assess the position of electrode array. The cochlear view was used to evaluate the depth & angle of insertion. Graphical analyses & descriptive measures such as pure tone averages & median calculations were employed to compare pre with post operative hearing levels. X-Ray skull showed complete electrode insertion was obtained in 5 of the 7 subjects with angle of insertion ranging from 530-720 degrees. Residual hearing preserved in all but one case within 10 db of pre-operative hearing levels. The subject with 25 db shift in hearing threshold levels had partial insertion & least angle of insertion (320 degrees). MED-EL standard electrodes when used in conjunction with soft surgery can maintain residual hearing. Also insertion depth of electrodes does not appear to have an influence on residual hearing. The impact of time on the results need to be ascertained as hearing loss at some later stage has been reported to occur. The results give a certain degree of optimism especially when we are lowering the bar of candidacy in recommending implantation.

C02 – 110

Remote intraoperative monitoring during cochlear implant surgery is feasible and efficient

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Intraoperative testing of cochlear implant devices, establishment of electrical threshold for acoustic reflex, and recording neural responses to electrical stimulation has traditionally required the presence of a cochlear implant audiologist in the operating room. The goal of this study was to determine the

feasibility of remote testing to improve time efficiency and cost. A standard PC with TridiaVNC software and either Cochlear Corporation, Advanced Bionics Corporation, or MED-EL corporation mapping software was configured to perform remote testing. The time required to perform onsite or remote testing was measured. With the availability of the laptop and internet access, there were no geographic restrictions as to the site of remote testing. Remote testing was time efficient requiring 9 minutes of audiologist's time compared to 93 minutes when the audiologist had to travel to the operating room. Remote testing of the cochlear implant device and patient's response to electrical stimulation is technically feasible. It is timesaving, practical and cost efficient.

A12 – 367

European multi-centre paediatric bilateral study: benefits of bilateral cochlear implantation with HiRes 120

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Since the majority of cochlear implant users are provided with a single device, there is little information available to date on the benefits of bilateral cochlear implantation in children, particularly to produce strong quality evidence on the advantages over unilateral implantation. This study aims to determine the benefits that bilaterally implanted children receive from HiRes 120 in comparison to a unilaterally implanted control group. The main focus is to evaluate speech perception and sound localisation. Congenitally deaf children with profound bilateral hearing loss, aged between 18 months and 4 years, are included in the study and randomly assigned to either unilateral or bilateral implantation. In total, 48 subjects, 24 per condition, will be enrolled across the three participating centres. They are implanted with Advanced Bionics' HiRes 90K implants and using HarmonyTM or PlatinumTM Sound Processors with the HiRes Fidelity 120TM coding strategy. The assessments take place before implantation followed by sessions at 3, 6, 12, 18, 24, 36, 48 and 60 months post-switch-on. All subjects are tested on speech detection, discrimination and identification (in quiet and in noise) and on sound localization. They are also assessed via parental questionnaires and via clinical observation scales on speech production and communication. Subject recruitment is ongoing. So far, data has been collected for eleven subjects, five unilaterals and six bilaterals with similar demographic data across the two groups. Data from pre-implantation to the 12-months session are currently available for a subset of assessments. According to the preliminary data obtained from scales and questionnaires, subjects with two implants seem to perform better than those with one, especially after six months of implant use. The results suggest a general tendency towards the benefits of bilateral implantation but more subjects and long term data including speech test results are now necessary to confirm these preliminary observations.

B10 – 264

Perception of supra-segmental features by binaural – bimodal (unilateral CI and contra-lateral HA) adults

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Introduction: Cochlear implant (CI) users have difficulties in utilizing pitch cues due to the limited access to pitch encoding provided by the electrical hearing of CI technology. Indeed their perception of supra-segmental features (intonation, syllables stress and word emphasis) is suboptimal and they mainly rely on intensity and duration to perceive these cues. Study hypothesis: Addition of some salient pitch information in low frequencies via acoustic hearing to the electrical hearing of CI users might improve their ability to percept supra-segmental features. Objective: The purpose of this study was to evaluate the contribution of hearing aid (HA) usage to the perception of supra-segmental features in adults who use unilateral CI and contra-lateral HA. Subjects: 23 adults were included in this study. 14 participants had congenital hearing loss (pre-lingual) and 9 developed their hearing loss post-lingually. Mean duration of experience with the CI was 3.2 years (SD = 25.9 months), range: 7months – 7years. All participants continued to use the HA in the non-implanted ear after implantation for at least 75% of waking hours. Mean duration of bimodal experience (unilateral CI and contra-lateral HA) was 3.2 years (SD = 25.9 months), range: 7months – 7years. Design: Perception of supra-segmental features was assessed by using three tests. Perception of intonation test assessed the ability to identify a statement and a yes/no question. Perception of word emphasis test assessed the ability to identify the position of the emphasis word in sentences containing three mono-syllable

words with different word position emphasis in each sentence; Perception of word syllable stress test assessed the ability to identify initial syllable stress and final syllable stress using bi-syllabic, meaningful, minimal, familiar pairs differing in their stress pattern. All tests were administrated in two listening conditions, CI alone and CI+ HA. The order of test stimuli and listening conditions were randomized among participants and were presented at a normal conversational level (70dB SPL) through a tape recorder. Results: Scores were significantly higher in the bimodal (CI + HA) condition as compared to scores in CI alone condition in all three tests (intonation, word emphasis and syllable stress): 75%, 71.9% and 64.5% respectively in CI+HA listening condition as compared to 55%, 63.61%, 54.67% in CI alone condition. In the CI alone condition there were more errors in the perception of questions in comparison to statements. In the CI+HA condition there were significantly less errors in the perception of questions, and thus no difference between errors in questions and statements. In both conditions there were more errors in the perception of a final stress as opposed to an initial stress. There were no significant differences between the errors in the perception of word emphasis in different locations, in both conditions. Conclusions: This study found significant advantage for perception of all tested supra-segmental features in the bimodal listening condition (CI+HA) as compared to electric hearing only. The advantage is likely to be the result of the better low-frequencies acoustic hearing provided by the HA in the bimodal listening condition. The most significant contribution of bimodality was in the perception of intonation, probably because perception of intonation is based mainly on changes in fundamental frequency along the utterance.

D13 – 457

Repair issues associated with cochlear implants

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The purpose was to examine, over a period of four years post implantation, the numbers and types of cochlear implant problems requiring repair. The charts of all children who received cochlear implants at a specialty eye and ear institute between 1994 and 2002 were retrospectively reviewed. Twenty children were implanted with the body style and fifteen children wore the ear-level style at implantation or after experience with the body style. For the body style, during the first year post implantation, the median number of implant problems requiring repair was 4.00. The repair issues largely involved the implant's external components; the cords, coil, and external magnet were the components most frequently affected. During the fourth year post implantation, the median number of implant problems requiring repair was 4.00. The repair issues involved only the external components. The speech processor was the component most frequently affected. For the ear-level style, during the first year post implantation, the median number of implant problems requiring repair was 2.00. The repair issues involved only the external components of the implant; the median number of repair problems was 0 for each component. During the fourth year post implantation, the median number of implant problems requiring repair was 1.00. The speech processor was the component most frequently affected. Over time, the mean number of implant problems requiring repair remained relatively constant for the body style but decreased for the ear-level style. The fewer ear-level problems and their decrease over time may partially reflect the higher age at fitting with the ear-level than body style and the fact that the wearers of the ear-level style had prior experience with the body style. Parents whose children are being evaluated for cochlear implants should be counseled regarding the typical numbers and types of cochlear implant repair problems over time.

B03 – 064

Inroads towards a robotically inserted CI electrode development

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During the last decade, medical robotics proved its efficacy in extending the capabilities of surgeons through seamless coupling of information with intra-operative action. Using robotic assistance, surgeons were able to successfully overcome the constraints of Minimally Invasive Surgery (MIS) for applications such as abdominal laparoscopic surgery, cardiac surgery, and prostatectomy. Despite these successes, the current robotic systems fail overcome the challenges of surgeries on challenging anatomies such as the inner ear. Cochlear Implant surgery restores partial hearing to patients suffering from severe sensorineural hearing loss by direct electro-stimulation of the auditory nerve. The design of current electrodes and insertion tools, the anatomy of the cochlea, the blind access into the cochlea, and the proximity to the auditory nerve affect the success of this surgery. These limitations currently result in a high rate

of traumatic electrode array insertions. Patients with partial hearing, but who can not benefit from external hearing aids, are not considered candidates for this surgery as a result of this high rate of trauma. To solve these problems, we resort to robot-assisted electrode array insertion. The speaker will present the teams ongoing research on under-actuated robots for cochlear implant surgery while highlighting both the expected clinical impact and the theoretical research problems. The talk will present a modeling framework for the problem of optimal insertion of a flexible under-actuated robot into an anatomical cavity. The specific application for cochlear implant surgery and preliminary results for optimal electrode array design will be presented. Problems of insertion force feedback will also be discussed together with statistical characterization of the proper friction models to be used for electrode-array insertion force feedback. This device and technique results in reduction of intra-cochlear trauma. Robotically inserted novel cochlear implant electrodes achieved consistent positioning within the cochlea with minimized insertion force and trauma. The concept and electrode are scalable to a 1 to 1 model.

A06 – 038

New Technology for Hearing Stimulation Employing the SPS-S Method

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The system outlined here, namely the Compact Audio Therapy Unit (CATU) can process any audio signal inside a very compact device working in real time, employing advanced digital filtration, signal keying, manipulating playback rate, various spectral modifications of the signal, repeating phrases and others. It was designed to provide a platform for the therapy with the Skarzynski's Method of the Aural Perception Stimulation (SPS-S). The design for wearability allows one to use the device effectively in normal everyday life conditions, e.g. outdoors. The compact and versatile processing device can potentially open a new era in patients and trainees mobility¹. The device consists of: small internal digital sound recorder/player, tiny audio signal processing unit programmable from a PC through a USB port, a pair of earphones and a bone conduction phone. Despite the advanced functionality being offered, the technology employed in the CATU device makes it possible to keep its dimensions no bigger than a walkman player. Any audio signal can be processed by the small device CATU, employing its internal tiny processors representing high end of modern digital technology. Based on logical programming the signal can be transmitted to the left or to the right ear using earphones after the ear has been previously alerted by osseous conduction employing a bone conduction phone. The principal hearing conditioning procedure consists in band-pass filtering of audio signal and sending its adequately filtered version to the left or to the right subject's ear depending on the estimated loudness of the signal upon alerting the ear by osseous conduction. Another set of signal processing methods employ some new ideas of how to improve the wrong lateralization in some patients using specially designed stereo sound. The application of a very compact and relatively powerful signal processors in the CATU device opens also an opportunity to apply the device in stuttering and Tinnitus patients therapy and in many other tasks through storing, repeating or modifying signals in the auditory feedback loop, formed by the electro-acoustical path consisting in: microphone, real-time digital signal processors and acoustic transducers. Optionally, a variety of hitherto applied therapy and training methods could be implemented in the tiny device as procedures working in real-time, such as proper lateralization restoring, acoustic ambience conditioning, re-education of the voice, storing the last phrase spoken - through the detection of vocal cords relaxing or speech intensity, student's progress in a dialogue monitoring by measuring the deviation of the student's current speech from his original speech template and many others. 1. The technology is patent pending within the PCT application No. P 387631 entitled: "A portable audio device, a system and a way of exercising aural acuity" co-authored by H. Skarzynski & A. Czyzewski.

B01 – 054

Cochlear implantation in cases of congenital malformation of the cochlea known as a common cavity

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Aim: Analysis and assessment of the possibility to apply cochlear implants in patients with congenital malformation of the cochlea called as common cavity was the objective of this research. Authors present experience of the Institute within surgical aspects and postoperative rehabilitation of patients with common cavity. Up to this day cochlear implantation is considered to be the best and most effective method of treatment of children with bilateral profound hearing loss as well as children with congenital malformations of the

cochlea. Most of the clinics do not take effort to operate these difficult cases because of uncertain results of stimulation of the auditory nerve, and high risk of intraoperative complications. Material and method: from numerous cases of congenital malformations of the inner ear surgically treated at the International Center of Hearing and Speech of the Institute of Physiology and Pathology of Hearing we have chosen 3 patients with rare pathologies called common cavity. Diagnostics and selection of patients was conducted by the team of experienced specialists. Assessment of radiological and audiological data, electrostimulation of the auditory nerves confirmed the possibility of stimulation using cochlear implants. In all cases operations were performed as a standard procedure – anterior tympanotomy approach combined with transmeatal approach. During implantations the operator used M type electrode (MED-EL) in 2 cases and S electrode (MED-EL) in one case. During the postoperative period computer tomography was performed. Results: in all cases the postoperative period was stable and without complications. Speech processor was fitted 12-14 days after operation. Stable electric stimulation of the nerve was confirmed and audiological results and sound reactions were comparable to the results obtained in implanted children with normal anatomy of the inner ear. Conclusions: obtained results present successful rehabilitation of children with congenital malformation of the ear known as the common cavity with use of the cochlear implant. Thus this method may be recommended as a method of choice applying appropriate surgical technique, assuming the operator's experience, proper selection of the device and choice of electric stimulation type.

A10 – 220

Clinical outcomes with the new SRA cochlear implant electrode designed for preservation of residual hearing

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Introduction: There are an increasing number of patients with residual hearing who have been successfully rehabilitated with cochlear implants. They benefit from either electrical complement to their hearing in the contra-lateral ear or more recently combined electrical and acoustical stimulation in the implanted ear. In the latter the choice of surgical approach, surgical expertise and the development of new electrode carriers for hearing preservation is vital. The Nucleus® Straight Research Array has been designed and developed as a collaboration project between the Institute of Physiology and Pathology in Warsaw/Kajetany and Cochlear Ltd. with objective of minimizing trauma to the cochlea with round window insertion. The overall length of the prototype electrode carrier, measuring 25 mm, with 22 contacts over 20 mm length and its physical properties were proven in temporal bone studies to be less traumatic to intra-cochlear structures compared to an older design. Material and method: Fifteen adults with significant residual hearing in low frequencies were included in the study. All patients were unilaterally implanted with the Nucleus CI24RE device carrying the SRA electrode with a standard round window technique used for cochlear implantation by one otologic surgeon. All patients were programmed with the use of Freedom Hybrid sound processors. Pure tone hearing thresholds were measured pre-operatively, and postoperatively at: 1-2, 3, 6 and 9 months to evaluate the level of hearing preservation. HRCT scans were taken to measure depth of electrode insertion for each patient.

B03 – 066

Surgical procedure in PDCI – difficult cases

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Surgical experience, as well as better hardware and software used in cochlear implants have brought about incremental improvements in speech understanding. Boundaries for cochlear implant candidacy have been expanded and the new patients demand an optimized solution for their type of hearing impairment. This includes children who are diagnosed with usable remaining hearing. The level of hearing impairment reflected in the number of active ganglion cell populations in the apical part of the cochlea can be a predictive factor in the mode of future rehabilitation. Preservation of residual hearing during a minimally invasive cochlear implant surgery verifies preoperative assumptions, showing the level of functional hearing preservation for true benefit in patients. In our experience in treatment of patients with residual hearing the round window approach was the preferred, most often used passage to the cochlea. It is the most physiological and least traumatic method of electrode array insertion assuring optimal and direct stimulation of the organ of hearing. In the majority of cases the round window niche could be well visualized through the slightly widened posterior tympanotomy. The round window

needed some preparations in most cases, but the final result was not difficult to obtain and an intact membrane could be clearly visible. We encountered situations where the round window niche could not be visualized well enough to ensure proper insertion of the electrode at an optimal right angle. It needed to be prepared with a transmeatal approach due to obstruction of the view posed by the posterior tympanotomy approach. In three cases cochleostomy was applied as an alternative approach. Results obtained in children treated according to partial deafness cochlear implantation methodology were presented and discussed. Modifications of our standard procedure and application of technology available in modern otosurgery assure proper insertion of the electrode array through the round window membrane for preservation of low frequency hearing. In our opinion, the round window approach is an advantageous and technically simple procedure providing good landmarks for the surgeon, thus allowing for confidence that the electrode carrier is correctly inserted in the scala tympani.

B12 – 391

Bilateral electric stimulation from auditory brainstem implants in a patient with neurofibromatosis type II (NF2)

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Background: Rapid development of the electronic hearing prosthesis allowed for introduction of auditory brainstem implants (ABI) in patients with neurofibromatosis type II (NF2). Case report: A bilateral electric stimulation from auditory brainstem implants (ABIs) was applied in the case of a young man. Conclusion: Results from the presented case support further applications of bilateral electric stimulation from ABIs for people with NF2.

D11 – 357

A new digit-triplet test for measuring the ability to understand speech in noise in cochlear implant users

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Evaluation of speech perception in cochlear implant users with standard speech tests (using monosyllables in quiet) has several limitations. First, sensitivity to subtle differences in performance is low, because performance on standard speech tests may be close to perfect for cochlear implant users. Second, there is a poor relationship between test results and daily-life situations. To avoid these disadvantages, a speech-in-noise could be used. The standard Dutch speech-in-noise test uses sentences and is thus not suitable for use in children (because of the high demand on linguistic skills) and in subjects with severe hearing losses. Aim of the present study was to develop a new closed-set speech-in-noise test for measuring the ability to understand speech in noise expressed in signal-to-noise ratio. The test should be suitable for a broad range of hearing losses and a broad population including children and cochlear implant users. We constructed 120 unique digit-triplets from the digits zero to nine and masking noise with a spectrum equal to the average digit spectrum. In a validation study the new digit-triplet test was compared to the standard speech-in-noise test that uses sentences (gold standard). To avoid effects of linguistic skills, we included only normal hearing adults subjects and simulated several types of hearing loss. The digit-triplet test shows a high correlation with the sentence speech-in-noise test. The measurement error is small and a learning effect is observed only in the first test-list. Preliminary results with the new test in cochlear implant users show reliable results for subjects as young as ten years. The digit-triplet test is a speech-in-noise test that can be used also for children and adults with cochlear implants. It measures the ability to understand speech-in-noise with very limited demand on linguistic skills.

B04 – 072

Long term speech perception, perceptual processing & auditory memory and spoken language in early implanted children without and with mild degrees of complex needs

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The aim is to assess long term auditory and linguistic development in early implanted children. Inclusion of children later diagnosed with complex needs (CN) let to the aim to identify differences in developmental trajectories in

children with (CN group) and without (D) complex needs. Speech perception, perceptual-processing & auditory-memory and spoken language acquisition of 21 children implanted before 30 months of age, are evaluated until 5 years post implant. Perception is quantified with an open set phoneme recognition test. Processing and memory are assessed with a standardized psycho-diagnostic instrument. Receptive and expressive language are tested with the Reynell-test. Non-parametric analyses are carried out to compare the performance of the CN and D group and to assess improvement over time for both groups. Speech perception showed no differences between the D and CN group. Tasks that require linguistic skills, however, showed a significant lower performance for the CN group. The D group showed a swift progression of language. Average performance was at a level within 1 sd of the hearing norm and 80% of the children are mainstreamed. In the CN group 70% performed more than 2 sd below the hearing norm. Ci's enable the D group to develop spoken language based on audition within the average or low average range of hearing children. In the CN group auditory speech perception skills reached a similar level as in the D group, their spoken language skills, however, remained at a significant poorer level. Audition apparently is not the most limiting factor in the CN group. Early implantation offers deaf children the opportunity for relatively good linguistic and academic achievements, however, mild degrees of complex needs are often difficult to diagnose at this early age and hinder linguistic development, while audition is good.

B12 – 397

First combined auditory brainstem and cochlear implantation (ABCI) using a double array device

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Today in some cases of NF2 (after tumor removal), auditory neuropathy and auditory nerve hypoplasia, it can not be predicted with absolute certainty which implant, a CI or an ABI, would give the best postoperative functional outcome. Indeed no test is available by which one may verify the function of the remaining auditory nerves fibres. Therefore we have applied the new concept of a dual implantation of an ABI and CI, called ABCI. A double array device was custom-made by the Cochlear LTD company for this application. A Nucleus 24 was foreseen with a split electrode presenting a 90 mm Hybrid-L electrode for the cochlea and a 115mm lead as the ABI-electrode. Ten channels were assigned to the CI and another ten channels to the ABI. The first patient has been implanted in November 2008. He presented with a 1 cm IC growing vestibular schwannoma and bilateral profound sensorineural hearing loss with ongoing degradation. Via an extended translabyrinthine approach the tumor was removed, with anatomical preservation of the cochlear nerve, and the ABI electrode was inserted in the lateral recess of the 4th ventricle. Then the cochlear electrode was inserted. At the third fitting at two months CI stimulation to thresholds around 40dB were achieved, and first auditory sensations were induced by brainstem stimulation. The six month functional results will be presented. In the light of the preliminary results in a first case, the authors believe that the concept of this dual implantation "ABCI" might be promising in selected cases. This could potentially be helpful in NF2 patients with still small tumors where auditory fibers can be preserved during tumor removal. Its use could also be extended to non-tumor indications (VIII hypoplasia, neuropathy, cochlear otosclerosis). The simultaneous electrode insertion would avoid patient's disappointment, unnecessary reoperations and morbidity. It would also allow new pathways of stimulation (cross-electrode stimulation).

A04 – 028

Assessment of early auditory skills in young implanted children using the LittlEARS Auditory Questionnaire (LEAQ)

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An aim of implanting young children is to access them to sound so that auditory development, a pre-requisite for linguistic development, can occur. The LEAQ (Kuhn-Inacker et al 2003) reflects age-dependent milestones of preverbal auditory behaviour for hearing children examining response to sound and vocal-verbal productions. The aim of this prospective study is to document auditory development of implanted children and compare it with that of hearing children using the LEAQ. 20 children implanted with MED-EL PULAR CI100 before 36 months were evaluated on LEAQ at first device fitting and 3 monthly intervals till 12 months of hearing age. All children had at least 9 active electrodes. The same therapist filled in the LEAQ with parents at the set intervals. Mean age at first fit was 25 months (range 12-34 months). Correlation between

age at first fit and LEAQ score was examined. All children showed an increase in LEAQ scores overtime. There was statistically significant improvement from 3 to 6, 6 to 9 and 9 to 12 months, when scores at each interval were combined ($p < 0.001$). Scores varied at 12 months from 37% to 100% – mean 66% (66% is the expected value for hearing children age 12 months). At 12 months hearing age 10 children scored higher than the expected value for hearing children, 7 scored within the expected range and 3 scored below the minimal expected value. No significant correlation could be found between age at 1st fit and LEAQ scores. 2 of 3 children with low LEAQ scores had developmental delay as measured on Bayley scale. 1 child had poor hearing with functioning CI and was implanted on contralateral ear 15 months into project. This study demonstrates that implantation of children under 36 months generally leads to auditory performance similar to that of hearing children.

A13 – 379

Electrically-evoked auditory brainstem responses in children with sequential bilateral cochlear implants

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Evaluation of neural plasticity in 30 children (mean age 5y3m) after sequential bilateral cochlear implantation with a mean time interval between the first and second implantation of 42 months. The electrically-evoked auditory brainstem response (EABR) was measured at both implanted sides intraoperatively and 6 and 12 months after the first switch on. The electrophysiological responses, obtained from both sides (newly implanted side versus experienced side), were compared within the subject over time with respect to EABR latencies of wave III, wave V and interwave latency III-V. Even after 12 months of bilateral implant experience wave V and interwave III-V latencies were significantly prolonged at the newly implanted side compared to the experienced side. However, delayed wave V latencies in the newly implanted ear diminishes significantly over time. The maturational pattern on the newly implanted side was assessed by comparing EABRs between both implanted sides over time. As can be concluded from the prolonged latencies for the second implant of both wave V and interwave III-V, children with sequential bilateral cochlear implants show a delayed neural conduction in the rostral part of the auditory brainstem on the second implanted side up till 12 months of bilateral implant experience. Whether the newly implanted side will mature within normal limits and whether sound of both sides will converge at the level of the auditory brainstem is still unknown. To learn more about maturation of the auditory brainstem after sequential bilateral cochlear implantation, long term data is desired. Since this research is still running, the most recent 24 month data of the whole population will be presented.

A14 – 382

Direct intracochlear EACRs reflect auditory cortical plasticity even after relatively long intervals of sequential implantation

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This project is focused on auditory plasticity of the central auditory pathways in a group of 30 children (range 2y;5m-8y;6m) after sequential bilateral cochlear implantation with relatively long time intervals between surgical interventions. Electrically-evoked auditory cortical responses (EACRs) were obtained at 6, 12 and 24 months after the first switch-on. In contrast to previous studies (Sharma et al., 2005; Bauer et al., 2006), we used direct electrostimulation of intracochlear electrodes evoking very clear cortical responses. The responses, obtained from both sides (i. e. firstly-implanted 'CI1' versus secondly-implanted 'CI2'), were compared within and between subjects. Obligatory P1 responses, N1-P2 complexes, and N2 were observed and analysed over time. Data was compared with (E)ACR data from other cortical maturational studies, as well as with additional normative data of acoustically-evoked ACRs with respect to maturational morphology changes. 6 and 12 months data revealed significant interaural differences, i. e. P1 showed significantly prolonged latencies in CI2 compared to CI1, the latter following the maturational pattern of that of normal hearing children. With respect to later potentials in general, data showed that CI2 revealed prolonged latencies compared to CI1; however, neural conduction times improved after 12 months CI use in both ears, although no interaural differences were found for later potential N2. Besides a constitutional maturational effect, a learning effect underlies auditory plasticity: our present data show that regarding CI2, P1 is still prolonged after 12 months, but – despite the relatively

long time between the second intervention (mean: 42 months) – is still catching up in the long term. Previous studies have mainly described auditory plasticity in children with relatively short interval between surgeries (± 1 year). Our data showed that even children, who received their second implant relatively late, still catch up with first implanted ear. In addition, most recent 24 month postop data of our bilateral program will be presented and addressed.

D06 – 192

Ten years of cochlear implantation in Bulgaria

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The purpose of the present summary is intended to present the results from National Program for Cochlear implantation in our clinique. The aim is to performe the problems and results in cochlear implanted children with Med - El and Nucleus cochlear implants. The authors shared their experience and difficulties with 280 patients for the last 10 year /1999-2009/. The children were 1-18 years old pre-lingually deaf and same post lingually adults. The results are reported on every three months for two years by special speech and behaviour tests, free field audiometry. The conclusions showed improvement of lip-reading, hearing and better understanding of speech. The children developed earlier and efficiently their neurophysiological social life. The results by deaf born patients between 10 and 18 years, who had a very good rehabilitation before the operation, are very promising in audiological and not so far so good in linguistic aspect. This study suggests that significant benefit can be obtained with the use of hearing aids in the nonoperated ear in combination with CI. The children with multiple handicap achieve progress only in audiological aspect, but there is no linguistic improvement. Cochlear implantation is a method of choice for deaf children as early as possible. These data indicate a significant advantage in language learning, when CI is undertaken below the age of three years. Cochlear implant program and center was organized in ENT Clinic, Medical University, Sofia, Bulgaria.

B03 – 065

Minimal invasive cochlear implantation in pediatric patients

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Minimal invasive approaches have been described for cochlear implantation in adults. However, the number of reports about minimal invasive approaches for the pediatric population is sparse. We describe our pediatric cochlear implantation and incision techniques for different devices. Among 60 cochlear implantations performed between February 2007 and February 2009, there were 21 pediatric cochlear implantations with MED-EL and Cochlear devices. In our technique, standard posterior tympanotomy and cochleostomy were performed after 4- to 5-cm minimal invasive incisions in the postauricular region. In ten consecutive cases, suture fixations were not used for the implant receiver nor its electrode. There were 9 girls and 12 boys with a mean age of 4,8 years. The mean follow-up duration was 9.3 months. In both groups no flap necrosis, hematoma or infection, nor implant migration, extrusion or breakdown were encountered. Main principles of cochlear implant approaches are adequate exposure, cosmesis, rapid healing, and no extrusion of the package. Despite our short follow-up period no additional suturing seems necessary as we have not encountered implant migration or electrode displacement or breakdown. Minimal invasive cochlear implantation can be performed using small incisions without suture fixation of the receiver and its electrode.

A07 – 208

Patterns of hearing loss after hearing preservation cochlear implantation and potential protective agents

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Hearing preservation techniques are being applied to a progressively wider population of implant candidates including pediatric patients. Recent experience with this technique has shown that there are several different patterns of hearing loss that may be seen when performing this type of surgery. Acute losses are most likely due to intra-operative trauma and involve severe tissue damage and necrosis. Delayed losses may be related to induction of inflammatory pathways and result in induction of apoptosis (programmed cell death). A third category of loss are the patients that loose hearing in their implanted ear months to years after initial implantation. It is assumed that this loss is related to the presence of

the implant since the contralateral hearing ear is not affected. Currently rodent models can help us understand the acute and subacute injury process. If no overwhelming injury during the implantation process occurs, subacute injury and induction of apoptosis may be controlled with anti inflammatory agents or a variety of anti apoptotic agents. Three month old mice were treated with boluses of artificial perilymph into the scala tympani or with implantation of a platinum wire. Hearing was followed over time. Outcomes measures included immunohistochemistry and RNA extraction and array analysis. There was an upregulation of pro apoptotic and inflammatory regulators. Damage related to these molecules could be decreased through treatment with anti apoptotic agents and TNF alpha inhibitors. Evidence from mouse models clearly implicated TNF alpha signaling as a key component in this process. Currently in human implantation we are limited to the use of steroids as otoprotective agents in cochlear implantation. There are however a variety of therapeutic agents that are able to interrupt TNF alpha signaling that have the potential for application in cochlear implantation. Introducing these agents into the clinic could significantly enhance the safety profile of hearing preservation implantation.

B01 – 053

Paediatric cochlear implantation criteria based on speech reception in noise

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This study describes a method of determining candidature for cochlear implantation of hearing impaired children on the basis of a sentence test in noise. The use of a sentence test in noise is inferior to the typically used single word tests in quiet because sentences in noise are a more realistic representation of real life communication situations. Candidature will be determined on the basis of critical speech reception performance, which will be obtained by a specific proportion of either 95%, 90% or 75% of early bilateral or unilateral cochlear implanted children with no additional handicap (age 8.2 - 15.4 years), at a signal-to-noise ratio (SNR) of 0dB SNR and at the speech reception threshold (SRT). To increase reliability a full discrimination function was measured for each child. Speech and noise were presented both from the frontal direction (S0N0). Mean speech reception in noise for bilateral implanted children at 0dB SNR was 59.1% (SD 19.9%) and 44.5% (SD 16.5%) for unilateral implanted children. The SRT was -1.25dB (SD 1.63dB) for bilateral implanted children and -0.51dB (SD 1.12dB) for unilateral implanted children. The calculated CI indication thresholds: bilateral implantation: proportion: 95% critical speech reception at 0dB SNR: <35.8%; SNR >1.43dB proportion: 90% critical speech reception at 0dB SNR: <42.0%; SNR >0.84dB proportion: 75% critical speech reception at 0dB SNR: <52.4%; SNR >0.65dB unilateral implantation: proportion: 95% critical speech reception at 0dB SNR: <34.5%; SNR >1.33dB proportion: 90% critical speech reception at 0dB SNR: <39.3%; SNR >0.93dB proportion: 75% critical speech reception at 0dB SNR: <47.3%; SNR >0.25dB. The measurement of individual discrimination function of speech reception in noise provides reliable information for the selection of bilateral or unilateral CI indication criteria.

D01 – 143

Cochlear implants as a paediatric day surgery service

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Our aim in this pilot study was to describe the day surgery service which we provide, and to demonstrate that it is possible to provide a day case facility for paediatric patients undergoing cochlear implantation. A retrospective review of notes of all paediatric patients undergoing cochlear implantation as a day case procedure at a central London teaching facility in a twelve month period. The parents were also contacted directly by telephone and asked about their day surgery experience. 23 paediatric patients underwent cochlear implantation surgery, planned as a day case procedure. 2 sets of patient notes were missing, but of the remaining 21 patients only 2 were admitted overnight post operatively. 1/21 (4.8%) suffered pain post operatively, 5/21 (24%) suffered nausea & vomiting, and only 1 patient was compromised with vertigo (4.8%) whilst still in hospital. The patients had few complaints once at home. The majority of parents were happy to take their child home. There are many benefits of early discharge in paediatric care. The possible problems are that parents feel a level of anxiety following a major procedure, or an incidence of a post operative complication. However if potential problems are dealt with i. e. parents are given appropriate advice, measures are taken to minimise nausea and vomiting and the facilities for an overnight admission are in place - then cochlear implantation as a day surgery service is an excellent advance. An interesting review of our service.

A08 – 210

Uni – and bilateral Hybrid stimulation: Indications and results. A prospective study of 22 cases

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The aim of this prospective study was to evaluate the indications, the effective conservation of residual hearing, and the functional results in case of electroacoustic stimulation (EAS) with CochlearR devices. From 2003 to 2008, 20 patients (21 to 70 years) have been implanted, on one (n=18) or two sides (n=2, interval of at least one year between the two procedures) with a Cochlear device: NucleusR 24 Contour advance perimodiolar electrode array device (13 patients, 15 ears) and NucleusR Hybrid L (7 patients with unilateral implant, 5 with round window insertion and 2 with cochleostomy). Indications were candidacy for cochlear implantation with substantial preoperative residual hearing: thresholds ≤ 60 dB HL at both 250 and 500 Hz. Specific "soft" surgical procedures were observed in all cases. Postoperative evaluation included pure tone hearing threshold levels and speech recognition, in quiet and noise conditions, with dissyllabic words and sentences. In the group of 15 ears with NucleusR 24 Advanced, residual hearing conservation was observed in 12 cases (80%), and ipsilateral acoustic stimulation was used in 7 cases (58%); total hearing loss was observed in 3 cases. The two patients with bilateral implant had a residual hearing preservation in both ears, but used acoustic stimulation only in one; a high level of understanding in quiet and noise situations was observed. Among the 7 patients with NucleusR Hybrid L, 6 patients (86%) had a functional residual hearing, and all used. The preservation of the residual hearing has been clearly increased by the decrease of the electrode diameter and its insertion through the round window. Bimodal stimulation improves speech intelligibility in noise, and bilateral implantation could be proposed in active population.

C05 – 121

Assessing masking release in cochlear implant users: comparison between HiRes™ and HiRes120™ coding strategies

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The goal of this clinical trial is to assess the ability of newly implanted adults to listen in noise, when using the two coding strategies HiRes and HiRes120 on the Harmony™ processor. The extension HiRes120 aims to increase the transmission of fine-grain spectral information using a strategy based upon current steering. The protocol is a cross-over design where half of the listeners is fit with HiRes for three months and then HiRes120 for three months, then HiRes for next two months and then HiRes120 for the last two months. The other half of the subjects is fit with the two strategies in the opposite order. Consonant identification and phonetic feature reception is measured in free field, in quiet and in the presence of a stationary unmodulated or a spectrally-modulated noise masker. In each experimental condition, the noise masker is added to each speech utterance at a fixed signal-to-noise ratio: SRT (which is the SNR leading to 45% correct responses in stationary noise). Performance is the amount of Masking Release (MR), defined as the change in consonant identification performance in modulated versus unmodulated noise. Twenty subjects participated into this clinical trial. We will show results comparing both strategies. Intermediate analysis shows several patient profiles: those performing better with HiRes120, those who do better with HiRes, and those who do equal. Interestingly enough, some subjects do have substantial MR, phenomenon which had not been observed with older generation coding strategies. This ability may explain why some subjects prefer one or another strategy in everyday listening situations. Understanding the individual determinants of preference and improvement is a crucial step for providing fitting guidelines for children, now being proposed both HiRes and HiRes120. Such a trial shows the advantage of having the choice between the two strategies, making it possible to optimize fittings individually.

D08 – 325

PET study of temporal voice activations in patients with cochlear and brainstem implants

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A selective human temporal voice brain area (TVA) has been described with functional MRI using passive listening to Voice and Non-Voice stimuli (Belin, Nature, 2000). The activation of this area has been studied in patients with uni-

lateral and bilateral cochlear implant (CI), and unilateral auditory brainstem implant (ABI) in order to analyze implant benefit, using a well-standardized positron emission tomography (PET H2O15O) paradigm adapted from previous fMRI studies. A PET H2O15O study was performed in 4 groups of adults: 1) 6 normal-hearing control subjects; 2) 12 postlingually deaf patients with a unilateral CI experience > 2 years (intelligibility score for monosyllabic words $> 80\%$: "GOOD group", n=6; intelligibility $< 20\%$: "POOR group", n=6); 3) 11 postlingually deaf patients with a bilateral CI experience > 2 years; 4) 7 auditory brainstem implant (ABI) users with an intelligibility score $< 20\%$. Regional cerebral blood flow (rCBF) was measured by PET during 3 conditions: silence, listening to voice and to non voice stimuli. The variations of rCBF were analyzed by statistical parametric mapping (spm99) at $p < 0.001$. In patients with a unilateral CI and compared to nonvoice, the voice stimuli induced bilateral activation of the TVA along the superior temporal sulcus (STS) in the control and the "GOOD group", but were not detected in the "POOR group". In patients bilaterally implanted, bilateral stimulation induced bilateral TVA rCBF increase compared to a unilateral stimulation by CI, especially in nonvoice stimulation. The patterns of activation with 2 CI were closer of normal hearing patients, compared to unilateral CI stimulation. In patients with ABI, no activation in the STS was found as in patients with POOR results with a CI. These results suggest that PET is an adequate method to explore CI and ABI benefits and that implant effectiveness appeared to be linked to the patency of the neural auditory pathway and to TVA activation.

A14 – 388

Perception of prosody in children fitted bimodally with a cochlear implant and a hearing aid

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Cochlear implants are largely unable to encode voice pitch information, which hampers the perception of some prosodic cues, such as intonation. This study investigated whether combining electrical and acoustic information improved the perception of prosody in children with a cochlear implant on one side and a hearing aid on the other ("bimodal fitting"). Fourteen children with normal hearing and 19 children fitted bimodally participated in two experiments. The first experiment assessed the just detectable difference in F0, using a bisyllabic utterance with an artificially manipulated pitch accent. The second experiment assessed the children's ability to distinguish between questions and affirmations in Dutch words, using artificial manipulation of F0. In each experiment, performance of the implanted children was significantly better when the hearing aid was added. However, even with a hearing aid, the implanted group needed more exaggerated F0 excursions to perceive a pitch accent and to identify a question, compared to the subjects with normal hearing. These results confirm the assumption that using a hearing aid in the unimplanted ear provides additional low-frequency periodicity information. The results of this study showed that bimodal fitting significantly improved the perception of prosody.

C13 – 426

Vibrant Soundbridge in children with aural atresia

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Congenital malformations of the external and middle ear are relatively frequent anomalies, having an incidence of one to five cases in 20.000 live births. Twenty-five percent of congenital middle ear anomalies occur in conjunction with inherited syndromes. Most of these patients have a pure conductive or a mixed hearing loss with a major conductive component as the inner ear function is well preserved. Children with aural atresia are nowadays fitted with bone conducting hearing aids or, as an alternative, with the bone anchored hearing aid (BAHA). The surgical technique with round or oval window placement of the floating mass transducer (FMT) recently described in adults, makes the Vibrant Soundbridge implantable device (VSB) a feasible alternative for patients with aural atresia and ossicular anomalies. We have successfully used this technique in two children. Subjects: One 11 years old female affected by Crouzon Syndrome had a bilateral conductive hearing loss with mean pure-tone air-conduction hearing impairment PTA4 (0.5-4kHz) of 52.5dBHL on the right and 58.75dBHL on the left ear; mean air-bone gap was 30dBHL and 41.25dBHL respectively. Speech recognition threshold (SRT50) was 77.5dBHL on the right and 90dBHL on the left side (Gottinger Kindertest). One 16 years old male with bilateral aural atresia had conductive hearing loss with mean pure-tone air-conduction hearing impairment PTA4 (0.5-4kHz) of 60dBHL on the right ear and a mixed hearing loss on the left with PTA4 (0.5-4kHz) of 50dBHL; mean air-bone gap was 38.75dBHL and 25dBHL respectively. Speech recognition threshold (SRT50)

was 80dBHL on the right and 67.5dBHL on the left side (Italian bisyllabic words). Both patients experienced poor benefit from traditional bone conduction amplification and, to some extent, discomfort with the appliance. Methods: Surgery was performed on the right ear in both cases. The FMT was positioned directly in contact with the round window membrane for the girl affected by Crouzon Syndrome whereas, for the adolescent with bilateral aural atresia the FMT was placed onto the footplate after removal of malformed ossicular chain and stapes suprastructure. Subjects underwent a comprehensive audiological assessment under head-phones and in open-field pre- and post-operative. Results: Three months postoperatively, the 11y old girl showed mean PTA4 of 41.25dB SPL with speech recognition at 65dB SPL of 70% and speech recognition threshold (SRT50%) for monosyllabic words of 60dB SPL; the 16y old adolescent showed mean PTA4 of 37.5dB SPL, speech recognition at 65dB SPL of 100% and speech recognition threshold (SRT50%) for bisyllabic words of 40dB SPL. One year postoperatively, both subjects showed a slight further improvement. The girl with PTA4 of 36.25dB SPL, speech recognition at 65dB SPL of 80% and speech recognition threshold (SRT50%) for monosyllabic words of 55dB SPL; the guy with PTA4 of 32.5dB SPL, speech recognition at 65dB SPL of 100% and speech recognition threshold (SRT50%) for bisyllabic words of 37.5dB SPL. Complications: The safety of the surgical procedure was attested by bone conduction that showed no worsening post-operatively. No major complications were observed. A delayed minor wound infection was solved by incision, drainage and antibiotics. Conclusions: The encouraging results achieved in these two young patients allow to consider the VSB as an option for severe congenital conductive or mixed hearing loss in children and adolescents. However, the options of hearing aid and BAHA versus surgical correction with VSB should be accurately evaluated with the patient's family who should be well aware of risks and possible complications. MRI contraindication should not be forgotten.

A02 – 013

Teenagers with cochlear implant in upper secondary school in Norway

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The project aims to make a model for tailor made education and rehabilitation for teenagers with cochlea implant. In Norway there are only about 50 pupils with cochlea implant in upper secondary school, aged 16 – 20. They are implanted at different ages. It is a complex group with differences when it comes to mode of communication, school placement and educational outcome. In the first part of the project 7 pupils were interviewed with focus on situation in school and how they look upon themselves. Based on this information, the second part of the project aims to develop a program for this special age group to meet their needs based on empowerment. Representatives from this group of implanted young people will contribute. We want to find out more about what need of support they have. From our experience so far we see the need of an individual approach for support and tailor made education in school and also programs to develop social competence. The teacher's role is crucial in this. We are interested in developing material to guide and inform the teachers. Our approach is an inter disciplinary approach to meet the complex needs of this age group. Teachers of the deaf, speech therapists and physiotherapists need to cooperate to help the young adults have optimal achievements in education and life in general. What strategies do they need to learn to use technical devices, develop self-confidence and succeed in communication? And what can teachers do to give them access to the curriculum in school? An important part of the project will be to arrange weekends where teenagers with cochlea implants can meet role models and professionals and together reflect on their own situation and what kind of support they need, where to ask and how to get help. In this project we cooperate with the hospital in Norway that do the surgery for CI in children and young adults. The project will be concluded in June 2009.

C10 – 304

An influence of Polish Universal Neonatal Hearing Screening Program on an early cochlear implantation

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Owing to the initiative of the Polish citizens and support of the Great Orchestra of Christmas Charity Foundation – a charitable organization, the National Universal Neonatal Hearing Screening program in Poland was introduced. The program began at the end of 2002. The program has already examined about 2 million babies. Due to this Program, hearing disorders in babies are detected much earlier, which allows the qualification of young babies with pre- and perilingual deafness to undergo cochlear implant treatment. The aim: The aim of this

study was to analyze how hearing screening has and is having an influence on early cochlear implantation for children with pre- and perilingual deafness. From a population of 568 CI users, we selected the study group which consisted of 363 children, implanted in the Department of Otolaryngology of Poznan University of Medical Science between 1995 and June 2008. Children were divided into two groups: pre and post introduction of screening program. Medical histories of implanted children were analyzed and statistical tests were used in this study. The average age of implanted children is falling, the analysis shows that it has fallen from an average of 6.6 years to 5 years. The number of implanted children below the age of 2 has increased by 13 fold. The hearing screening program has an enormous influence on early cochlear implantation of children.

B10 – 262

Bilateral versus unilateral implantation in young children

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Bilateral implantation is increasingly common, but evidence of efficacy is still sought, particularly in very young children, unable to carry out formal testing. We wished to investigate whether the provision of binaural hearing through implantation facilitated the development of early communication skills, which take place in less than ideal acoustic environments. TAIT video analysis, shown to be robust, measures pre-verbal skills which develop before understanding and use of spoken language. The percentage of non-looking vocal turns 12 months after implantation has been found to correlate with later development of speech perception and intelligibility. We compared 26 children bilaterally implanted under 3 with a matched group of 26 implanted unilaterally. The children were from five European centres; all children had a hearing loss of 110dB or more; none had significant additional cognitive difficulties. Before implantation, none of the children in either group used non-looking vocal turns. At the 12 month interval, following implantation, all children have developed the use of non-looking vocal turns. Results to date indicate that there is a difference between the two groups in terms of non-looking vocal turns in favour of the bilateral group and it seems likely that this will be significant. The final results will be available for the conference. This study is showing that children with bilateral implants before the age of three have increased ability to develop the essential skill of using non-looking vocal turns, when compared with those unilaterally implanted.

A01 – 007

The effect of age at implantation on speech perception performance in quiet and in degraded listening conditions

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Current studies have shown better speech perception in children with cochlear implants (CI) as age at implantation was decreased. These findings were based mainly on studies that were conducted in optimal listening conditions. The purpose of the present study was to examine the effect of age at implantation on speech perception in degraded listening conditions in children with CI and to compare their performance to normal hearing (NH) children. Participants included 20 NH children and 44 children with CI who were grouped by their age at implantation: between 11-18 months (n=18), between 19-25 months (n=15) and between 29-40 months (n=11). All CI children used their device for at least three years. Speech stimuli included monosyllabic words and children's everyday sentences presented in quiet and two-syllables words presented in quiet, white noise (SNR of + 9dB for the implanted children and in -3,-6 and -9dB for the NH), and at speeded rate (60% and 70% compression). The results showed that for undistorted speech, perception of monosyllabic words of the youngest implanted CI group was better than the older implanted CI groups and similar to NH peers. For distorted speech (noise and compression), performance decreased as age at implantation increased. The performance of the implanted groups, however, was significantly poorer than NH children. While these findings support the importance of early implantation for the development of speech perception abilities, they also suggest that the limitations of children with CI can not be compensated solely by early implantation. These limitations may be attributed to the children's impaired auditory system, the implant device and/or the inaccessibility (or use) of multiple cues for speech recognition. These results also emphasize the importance of using FM systems with cochlear implants.

B02 – 058

Our experience with a modified SMA method for CI in children

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The classic CI implantation method in children is the large mastoidectomy with posterior tympanotomy. Kronenburg et al introduced a innovative approach called Suprameatal approach (SMA). We applied this new approach in deaf children who were candidates for a cochlear implant. This presentation reports on our experience. In 24 children the SMA was applied. The youngest patient was 6 months (bilateral implantation). The oldest in this serie was 4.3 years. In 16 cases bilateral implantation was performed. In 11 cases simultaneous bilateral implantation with the SMA was performed. In all cases the Cochlear Freedom implant was used. The suprameatal approach could be applied in all cases studied. There were no complications in all surgeries performed with the SMA. The average time of bilateral SMA CI implantation was 2:35. The SMA method with some modifications can be applies safely in cochlear implantation in children and has the same results as the implantation with the classic approach For the safety of the facial nerve we prefer the SMA method for cochlear implantation in children.

D01 – 140

Internationally designed recommendations on newborn hearing screening and follow-up programs

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The principles of all programs are based on their justification, assessment of screening performance and the prevalence and impact of newborn diseases and disorders. The recommendations for the national NHS programs have to consider the information on screening systems currently used in each country, current screening methods, result interpretation, personnel/equipment requirements for newborn hearing screening, system performance and future technological options. Special attention must be drawn to screening programs for the developing countries and the development of protocols for rural/community based screening. Screening from an economic viewpoint is influenced by measures of benefit, necessity of efficacy, economic parameters, global effect on local family unit, local community, region, nation, world. The ethics of screening and communicating with parents is very important component of the program. It includes parent perspectives, their empathetic understanding, involvements into the screening and diagnostic process. All NHS programs have to be followed by paediatrician's assessment and preferably by newborn metabolic and genetic screening. Integrated health care and data systems have valuable impact on screening success. The follow-up strategies must be considered as an integral part of each NHS program. To improve the effectiveness of the follow-up the development of standardized algorithms for follow-up testing and monitoring of follow-up results is recommended. The final stage of screening is early intervention. Only screening with consequences makes sense. These recommendations will provide the entire collection of screening programs routinely delivered to newborns and will prescribe direction for future endeavors in this area.

D13 – 456

Electrode resistance changes during the first year of rehabilitation

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Electrode resistance in the CI electrode array has the limiting effect on stimulation current level as well as on the current spread in cochlea. In addition changes in resistance could reflect the processes in the cochlea after implantation. The data obtained in the course of one year of rehabilitation of 100 patients using Nucleus CI24 Freedom system were included in the study. Resistance was measured on each inserted electrode both during the surgery and through one year of rehabilitation. The decrease in resistance during the rehabilitation was most frequently obtained. The resistance was increased after the surgery and was remaining high before the switch-on of the speech processor and then had double decrease. This fact is usually interpreted as a recovery from trauma and inflammatory processes.

B07 – 241

Tinnitus Suppression by Electrical Stimulation. Study of 118 Patients with Different Types of Cochlear Implants

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Realistic chances for hearing preservation after cochlear implantation re-introduce electrical stimulation as a potential treatment option for intractable tinnitus. The aim of this study was to evaluate the efficacy of electrical stimulation for tinnitus suppression in patients implanted with different types of cochlear implants. Results of the follow-up of the first tinnitus patient treated with the Hybrid-L device will also be shown. This has been a retrospective, questionnaire-based study comprising 118 cochlear implant recipients older than 16 years and with at least 6 months experience of using the Nucleus, CII, HiRes90k and LAURA devices. The responder rate was 93%. The questionnaires evaluated the presence, the type and subjective loudness of tinnitus before and after cochlear implantation. Tinnitus complaints post implantation were evaluated also relative to the status of the speech processor (switched on or off) and the epidemiological, medical and the fitting data of the patients. Within the study population 65% of the patients had pre-operative tinnitus complaints (65% bilateral tinnitus, 35% unilateral). 20% of the patients were completely relieved from tinnitus merely by the implantation itself. Electrical stimulation suppressed tinnitus completely in 34% patients. Additional 16% of the patients reported subjective decrease of tinnitus loudness. No significant correlations were found between the post-operative tinnitus suppression and the epidemiological data or the stimulation strategies used by the patients. Electrical stimulation with cochlear implants is effective for tinnitus suppression in approximately 70% of the patients.

C04 – 120

Negative correlation between the behavioural T/C levels and the electrode impedances in patients with Nucleus Freedom cochlear implants

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It has been observed that patients with upper respiratory infections (URI) may experience perceptual changes during stimulation with their cochlear implants. Patients complain specifically of variations in the subjective loudness. During the fitting-sessions we often found decreased behavioural T- and C-levels and increased electrical impedances (examples of such cases will be presented). Based on these observations we undertook a systematic study on the relation between the T/C levels and the electrode impedances in Nucleus Freedom patients. The data were collected retrospectively from 68 consecutive patients implanted with the Nucleus Freedom cochlear implant. The electrode impedances were measured for all 22 electrode array contacts intra-operatively and post-operatively at each of the fitting sessions. The impedance and the behavioural T/C-levels data from the 1st and the 5th fitting session (respectively at 1 and 3 months post-operatively) have been compared and correlated with each other. The average increase in the T levels between the 1st and the 5th fitting session was 10CL. The C-levels increased by 36CL. There was no correlation found between the T/C-levels and the electrode impedances at the first fitting, yet at the 5th fitting session, where the behavioural T/C-levels normally reach their plateau values and stabilize, significant negative correlations have been found. There is a significant negative correlation between the behavioural T/C levels and the electrode impedances. This might explain the perceptual changes in patients with temporarily increased impedances of the electrode contacts as often found in URI. The exact mechanism of impedance increase in URI remains unclear, yet this phenomenon must be remembered of, especially in paediatric, non-cooperative patients.

B06 – 093

Reflexive epilepsy – a rare complication of cochlear implantation in a child with bilateral congenital deafness

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This paper reports on reflexive epilepsy – a rare yet noteworthy complication of cochlear implantation in a patient with bilateral congenital deafness. Case study in a tertiary otologic referral centre. This paediatric patient presented at our department at age 1 month for otologic evaluation after repeated failure on neonatal hearing screening. ENT and audiologic examination revealed bilateral deafness of unknown aetiology with no reproducible ABR responses

on both sides. A trial period with hearing aids confirmed absence of any serviceable hearing. The general health of the child was normal. She received the first cochlear implant at age of 9 months. Surgery and the postoperative period were uneventful. One day after the first fitting session (4 weeks after the surgery) she suffered from an episode characterised by involuntary eye movements, vomiting, and a loss of consciousness. These episodes reoccurred on several occasions, every time related to a new fitting session or changes in the stimulation parameters. EEG revealed no significant abnormalities, yet prolactin concentration in the serum was significantly increased following the episodes. Extensive diagnostics by paediatric neurologists led to a diagnosis of a very rare form of reflexive epilepsy induced by auditory stimulation. The electrical stimulation via cochlear implant was continued and the symptoms spontaneously subsided in the course of several months. When the patient received the second (bilateral) implant at the age of 21 months, she again showed identical symptoms, but less intense. These too disappeared in the following weeks. The most recent audiological evaluation at age 30 months showed perfect results of bilateral cochlear implantation with symmetrical free field thresholds at 35dB HL and 100% discrimination of Dutch phonemes. Auditory stimulation through cochlear implants can trigger episodes of reflexive epilepsy in patients with congenital deafness. These epileptic attacks will spontaneously disappear over time.

A07 – 209

Hearing preservation in long-term implanted guinea pigs can be achieved by local intracochlear infusion of corticosteroids

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The insertion of an intracochlear electrode in a partially intact cochlea of EAS patients may cause immediate mechanical damage as well as subsequent loss of residual hearing due to secondary processes (inflammation, apoptosis). Permanently implanted devices lead to enhanced tissue growth around the electrode and inside the cochlea due to a foreign body reaction, which might also deteriorate hearing. The suppression of secondary processes have been achieved by various drugs targeting mechanisms leading to hearing loss in animal studies (i. g. apoptotic inhibitors, antioxidants). In humans so far only glucocorticosteroids have been used to treat hearing loss of various origins (e. g. SNHL). Therefore it was obvious to test their efficacy in preventing post-implantation hearing loss. Three groups of guinea pigs were implanted with guinea pig electrodes (MED-EL). Either triamcinolone, dexamethasone or artificial perilymph (AP) was infused directly through a cochleostomy prior to implantation. The respective other ears were treated likewise omitting implantation and served as additional pharmacological controls. Click-evoked and frequency-specific compound action potential (CAP) audiograms were recorded. Hearing thresholds were measured before and after ug/AP application during the following 3 months. Threshold shifts were determined with respect to the pre-surgery CAP-thresholds for each individual ear. Finally, cochleae were cut longitudinally and Azan-stained. Area of tissue drilling the Scala tympani at the surgery site was measured in relation to the area left free. Hearing loss was most pronounced in implanted ears treated with AP. CAP-audiograms revealed lower threshold shifts at all frequency ranges for steroid-treated animals. No correlation between mean threshold shift and extent of tissue growth was found regardless of the treatment. Furthermore, acute glucocorticosteroid treatment did not suppress long-term tissue growth within the Scala tympani. The results indicate that the two steroids reduced implantation-induced hearing loss even after an acute application. They did not however suppress tissue growth significantly compared to AP-treatment.

D06 – 193

Hearing rehabilitation among children with sensorial hearing loss

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During the last six years in the Otolaryngology children Department were carried out 73 operations among children from 1 to 15 years old. For the cochlear prosthetic were used 12 channel cochlear implant MED-EI among 53 patients, and in 12 cases grafted prosthetic appliance by "Nucleus" company. In 30-40 days after operation the thresholds of perception amounted to 25-33dB and have been preserving during the half of the year. Then they have been coming down to 10-20dB, attested about the development of hearing attention. To estimate hearing responses of speech used Evolution tests of Auditory Responses of Speech. Prelingual hearing defeated children until 3 years old who have been

operated, after 1.5-2 years have been achieving 100 per cent of speech development as a normal hearing child. Prelingual hearing defeated patients 3. 5 – 4 years old who had the experience of wearing hearing aids and success rehabilitation before operation, in 2-2.5 years after cochlear implant grafting, reduced the level hearing approximated to the physiological normal level. Cochlear implantation among prelingual hearing defeated patients from 5 years old was carried out under the conditions of wearing hearing aids and the presence of functional speech. They had been achieving the level of 50 per cent legibility of speech material after 4-5 years (difference between physiological and hearing age). The patients who had defeated from meningial infections and soon were operated, have been reducing 50 per cent of hearing perception and 20 per cent legibility in a month. The positive dynamic was observing among postlingual defeated patients (insignificant period of hearing deprivation). In a 6 month they had 100 per cent legibility of the words, transferred through the microphone, 50 per cent during the telephone talking, and in a year – 100 per cent legibility of new material. Especial group contained the patients in the age of 9-15. Their indices were lower than the younger children had. They had 100 per cent legibility of non speech material but 10-15% legibility of speech. Also we should mark phoniatric psychological problems (misunderstanding of speech, pubertal problems). Received results acknowledge the high effectiveness of cochlear implantation in rehabilitation the children with sensorineural hearing loss.

C04 – 117

Special cases of fitting procedure

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During the fitting process it is the most important to determine the exact electrical threshold and comfort levels, which assumes a series of psychophysical measurements to be taken. The intensity at which just a hearing sensation is evoked (threshold level) and the intensity that causes a bearable loudness (the comfort level) must carefully be determined on each electrode. The speech processor will then transform the external sound stimuli – with the use of the appropriate speech coding strategy – to this dynamical range. In several special cases the determination of the electrical comfort levels is impossible. Frequently the maximum level of the electric stimulation is not sufficient to cause a normal hearing level. In other cases the stimulation of facial nerve or other non-auditory effects impede obtaining the appropriate hearing sensation. Using behind the ear speech processor the optimal power consumption and avoiding out of compliance values are very important. But we can solve these problem with the optimisation of the different stimulation parameters. The authors show these procedure in their patients. Having the above in mind we must say that the regular programming of the device is very important.

B12 – 398

Severe cochlear ossification: cochlear or brainstem implant?

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Several insertion techniques were reported for cochlear implant (CI) surgery in case of post-meningitis bilateral complete ossification. First, the electrode can be placed into the inferior segment tunnel. Alternatively, scala vestibuli can be explored by extending the cochleostomy superiorly. If scala vestibuli is also obstructed, the only way to achieve a complete electrode insertion is to drill an open trough around the modiolus, after a radical mastoidectomy is performed, and the external auditory canal and the Eustachian tube are closed (drill-out technique). Some special array (double, short) are designed to facilitate electrodes insertion in special cases. Finally in the last years some Authors have proposed to use auditory brainstem implant (ABI) instead of CI in bilateral complete ossification. In our study we compare the post-operative performance of patients with total bilateral obliteration, after cochlear or brainstem implantation. Between January 2004 and July 2008, 7 patients with post-meningitis bilateral cochlear ossification underwent implantation: 5 with a CI and 2 with an ABI. Age at implantation ranged from 17 to 64 years (mean 40 years). Mean post-operative follow-up was 9 months (range 4 ÷ 42 months). Among the five cases with cochlear implantation one patient was implanted through the scala vestibuli and four with a drill-out technique. The two ABIs were implanted through a retrosigmoid approach: intraoperative eABR was used to validate the electrode-array positioning. At the last follow-up, four out of five patients with the cochlear implant didn't show any word or sentence recognition in open set. Conversely, 6 months after the first fitting, the two patients with ABI scored 30 and 40% respectively in open-set sentence recognition. When auditory recognition was tested in association with lip-reading, they showed a greater improvement of communication skills. In conclusion, patients with bilateral cochlear obliteration secondary to meningitis and treated with ABI can achieve significant enhancement in communication skills and a substantial improvement their quality of life.

B13 – 408

Speech perception outcomes and neuroradiological findings in implanted children with inner ear and brain abnormalities

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Cochlear implants can be successfully performed even in cases of inner ear malformation and or brain anomalies. However, in many cases, speech perception outcomes improve slowly after implantation, compared to hearing impaired cases without anatomical anomalies. The aim of this study was to discuss the results of cochlear implantation in deaf children with ear and brain abnormalities and the outcomes in children with added disabilities. Ear and brain neuroradiological findings of 289 cochlear-implanted children were retrospectively reviewed. In all cases, CT of the petrous bone and MRI of the inner ear and the posterior fossa and/or the whole brain were performed. A retrospective study was done to assess speech perception and the overall outcomes. Out of the 271 patients, 180 showed completely normal findings or unimportant abnormalities. Among the ear abnormalities, we found 17 cases of bilateral labyrinthine ossification, 35 inner ear malformations, 13 large vestibular aqueducts. In few cases, a stenosis of the inner ear canal was found. Concerning the brain anomalies, 35 patients showed “dysmyelinating” areas or delayed myelination. Seventeen had post-meningo-encephalitic lesions. We found the following anomalies: cortical dysplasia, callosal hypoplasia, cerebellar vermis hypoplasia, cerebellar hemispheres hypoplasia and cerebellar tonsils ectopia. Finally, we found 6 arachnoid cysts of the posterior fossa. All implanted patients are full time users and achieve at least discrimination abilities. Out of the 289 patients, only 180 showed completely normal findings or little abnormalities. In pre-operative protocol, we suggest the study of not only the ear and petrous mastoid structures, but also the brain. In fact, whole brain MRI can also demonstrate anomalies in children without neurological signs or symptoms and can explain the wide variation of performance across individual cochlear implant users.

A12 – 362

The Digisonic SP Binaural implant: surgical technique and results

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The author presents a new technique for the rehabilitation of profoundly deaf adult patients by cochlear electrical stimulation. Usually, one ear is implanted. Bilateral cochlear implantation experiences have been reported by the literature recently. The Digisonic SP Binaural is a 24 channels cochlear implant with two electrodes array. The first array is introduced in the ipsi-lateral cochlea with 12 electrodes. The longer second electrodes array is running under the galea for the stimulation of the contro-lateral ear with 12 electrodes. Only One speech processor Digi SP does the signal processing. In addition, a contro-lateral microphone is connected on the auxiliary input of the processor to give bilateral perception. Protocol: 1/ Free field tonal audiometry: left ear (LE), right ear (RE), both ears (R&LE) Audiometry with monosyllabic word lists. 2/ Free field Speech audiometry in silence: -LE, RE, L&RE -at 60, 70dB SPL -SRT measurement 3/Free field speech audiometry noise: -LE, RE, L&RE -white noise at 60dB SPL -Speech at 50,60, 70dB SPL -SRT measurement -Head shadow effect -Squelch effect 4/Stereo audiometry with white noise at 65dB SPL - 5 Loud speakers -Localisation of sound sources (reliability, bias) The author will present the surgical procedure. Results on 7 patients will be given on various measurements with the Digisonic SP BinauralThe Digisonic SP Binaural is a safe, reliable and an efficient solution for the binaural rehabilitation.

D06 – 189

Multi-centric evaluation of the Digisonic SP CI. Comparison with the Digisonic Convex

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The objective of the study is to compare the outcomes of two series of patients implanted with two different CI systems: Digisonic SP and Digisonic Convex. The study includes 110 implanted adults: 61 with Digisonic SP and 49 with Digisonic Convex. Results on speech intelligibility in various situation will be presented: -words in open list -sentences with/without lip reading The tests have been done before implantation and after implantation at: 3, 6, 12 and 24 months. For each system and each tests: -statistical descriptions are given -variation of the scores with time are studied. The outcomes of the two population will be presented. Discussion points: is the score test link to the system use? Is the time of evaluation link to the score? Is there an interaction between system effects and time test?

C10 – 298

Worldwide hearing impairment – A need for action

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Two-thirds of people suffering from hearing impairment worldwide live in developing countries. It is estimated that 50% of this hearing loss can be prevented. In developing countries, funding for prevention, early detection, and rehabilitative programs is severely limited, and agencies must compete against priorities to treat life-threatening, pandemic diseases. Social attitudes, local customs, and cultural bias are factors in the delays in diagnosis that are often observed. The purpose of this review is to gain an understanding of the prevalence of hearing impairment in the developing world and to focus attention on the growing need for both prevention and effective treatment programs. Data were compiled from a review of the literature on the global impacts of hearing impairment and recent published reports on the prevalence and etiology of hearing impairment in developing nations. Hearing impairment and deafness are global issues that affect over 200 million people worldwide. The high prevalence of hearing impairment in the developing world is due to a variety of factors, including lack of widespread comprehensive immunization programs and other medical care, and inadequate funds for intervention once hearing impairment is identified. The status of future funding for hearing health in these countries will depend on the help of global health organizations, and country-specific government and non-government organizations (NGOs). Solutions differ, depending on income level, current problems and the status of current prevention and treatment programs We have developed a suggested set of priorities for addressing problems related to hearing impairment, based on country income level and available resources. Current status of development of a low cost but effective cochlear implant will also be addressed.

B08 – 252

Outcomes and experiences in cochlear implantation of children with profound and multiple learning difficulties on the Nottingham Cochlear Implant Programme

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Increasing numbers of children with complex needs are presenting for assessment for cochlear implantation. On the Nottingham programme, nearly 40% of our implanted children have at least one additional need, and we have implanted over 25 children who were diagnosed with Profound and Multiple Learning Difficulties at the time of decision to implant. In addition to very severe learning disabilities, these children have other significant difficulties, such as physical disabilities, sensory impairment or one or more severe medical conditions. These children present particular challenges, including establishment of candidature, medical needs at surgery at beyond, programming of the systems and lifelong support. An audit of the outcomes of cochlear implantation in this patient group will be presented, together with discussion surrounding the decision to implant, the subsequent resources required to

manage and support them, and the parents' perspective on the impact of implantation on the child and family. A case study will also be presented. Results of the audit will be presented. Cochlear implantation in children with profound and multiple learning disabilities can be shown to improve quality of life of the children and their families.

B11 – 269

The development of the Spatial Hearing Questionnaire

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A new questionnaire called the Spatial Hearing Questionnaire was developed which focused on realistic listening situations in the sound field. The questionnaire, composed of 24 items, is scored from 0-100 and contains items related to sound source localization, understanding of speech in quiet as well as in presence of spatially separated noise, music listening, and understanding of voices of children and adults. Data were obtained on the Spatial Hearing Questionnaire from a diverse group of adults with bilateral (CI+CI) and unilateral cochlear implants (CI) and cochlear implant plus hearing aids (CI+HA). Speech perception and localization abilities were measured, and the Speech, Spatial and Other Qualities (SSQ) questionnaire was completed to evaluate validity of the questionnaire. Psychometric tests were done to test the reliability and factor structure of the Spatial Hearing Questionnaire. Results showed high internal consistency reliability (Cronbach's $\alpha=0.98$) and good construct validity (correlations between the Spatial Hearing Questionnaire and other test measures, including the SSQ, were significant). A preliminary factor analysis revealed scores loaded on three factors, representing the following conditions: localization, understanding of speech in noise/music and understanding of speech in quiet. Most of the questionnaire items (12/24) loaded onto the first factor which represents the subscale related to sound source localization. Additionally, the Spatial Hearing Questionnaire scores from patients with CI+HA and CI indicated poorer performance as compared to those with CI+CI, a finding broadly consistent with perception tests. The Spatial Hearing Questionnaire is a reliable and valid questionnaire measuring spatial hearing abilities and is likely a valuable tool for clinicians and researchers. A web version of the Spatial Hearing Questionnaire is available and will be presented.

A12 – 370

Sequential bilateral cochlear implantation in children

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The first cochlear implants in children in Norway were done in 1988. All Norwegian children have their implants from the Oslo University Hospital (Rikshospitalet) in Oslo. Up until 2004, unilateral implantation was the standard treatment for deaf children in Norway. In 2004 it was decided to give bilateral implants as the standard treatment. The unilateral implanted children were then all offered a second implant, with no limits regarding the time gap between 1st and 2nd implantation. We wanted to evaluate the outcome of the treatment with a 2nd CI when stimulating an ear that had not been processing sound for several years. A study was set up to evaluate the effect the 2nd CI as compared with the first regarding speech perception. The scientific questions were: 1. Will a 2nd implant give speech perception equal to the speech perception of the 1st implanted ear? 2. Is there a correlation between the speech perception and the time interval between the two implantations? 3. Will the child achieve better listening skills using bilateral hearing compared to unilateral hearing? Subjects: 82 prelingually deaf children (42 boys, 40 girls) receiving bilateral cochlear implants in two stages. Method: Quantitative correlation analysis and interrupted time series design using Rikshospitalets Speech Perception Categories (Wie et al 2007), presented with scatter plots and bar charts using the SPSS program (Statistical Package for the Social Sciences). Results: The study showed that sequentially operated children, who got their first implant below the age of 5, developed open set speech perception skills on the 2nd implanted ear even after an interval of 12 years between the two surgeries. The results indicate that the benefit of the second implant was reduced if the time interval between the two implantations exceeded five years. One year post surgery, children who had less than five years between the two surgeries had significant better speech perception scores compared to those with a longer time interval between surgeries ($t=2,377$ (68) $p = .002$). Testing binaural use of hearing showed that one year post implantation, 84% of the children had a better total function of hearing using both implants, and that a non-optimal functioning 2nd implant did not disturb the speech perception of a well functioning 1st implant. On the contrary, a 2nd CI seems to be of support for the total speech perception. The study will be continued.

B05 – 084

Electrode migration – word of caution

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Cochlear implant electrode migration is a rare occurrence. Movement of only a few electrodes may not compromise performance but multiple electrode migration may require reoperation and reinsertion of the electrode array. Not every case of electrode migration requires reimplantation. Electrode migration is of concern in implanting children due to future skull growth. The author will be presenting a case report of a patient with electrode migration with emphasis on the clinical presentation and management. This will be followed by a review of literature of this underrecognised complication of cochlear implantation. Early detection and intervention of this complication gives optimal results. As we implant more and more children clinicians need to be aware of this complication and its possible effects on the outcomes and management of the same.

D08 – 329

New age imaging for a CI patient – how far can we go?

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Objective – To improve visualization of bony and membranous labyrinth using submillimetre multidetector high resolution CT and new high field M. R. sequences. Material and Methods – HRCT temporal bone performed on a 64 slice MDCT scanner and MRI of brain with special reference on temporal bone performed on 1.5 Tesla MR scanner using surface coil technology. Use of surface coil technology and new sequences (IVE) provide excellent demonstration of the fluid in the membranous labyrinth. High resolution contrast achieved between CSF and cranial nerves using new sequences provides invaluable information. Conclusion – HRCT of temporal bone performed on the new submillimetre MDCT scanners provide exquisite detail of the bony labyrinth and IAC. Isotropic multiplanar reconstructions along any required anatomical plane/structure is essential for complete evaluation.

B11 – 270

Five-year follow-up of children with bilateral cochlear implantation

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A multi-centre study was started to investigate the additional audiological benefits of a second cochlear implant in a group of 35 bilaterally implanted children, in whom the second implant was performed at the age between 2 and 12 years. Pure tone audiometry, speech recognition in quiet and noise (+10 and +5 dB SNR) and quality of life benefits were assessed by means of several tests, questionnaires and scales. Testing was done in bilateral (CI1&2) and both unilateral listening conditions (first CI = CI1, second CI = CI2). Assessments took place one, three and five years after the contralateral implantation. As different auditory tests were used, the children were categorized by their age at the second implantation: younger or older than 6 years. An improvement in PTA could be observed in both unilateral and bilateral condition in both age groups, however median results were better in the group of younger children. After only one year of second implant use, the CI2 thresholds were no longer significantly different from the CI1 thresholds. The speech recognition in quiet and noise were, for almost all children, superior in the bilateral condition and all scales and questionnaires indicated a higher result for all children, but the average increase tended to be larger for the younger children. The results show further increasing benefit of bilateral use during the 5 year period. Also, almost all children communicated orally, attended mainstream schools, experienced several bilateral benefits and were intelligible to all listeners after 5 years of bilateral implant use. The present results show that after five years of bilateral implant use all children achieve high levels of performance even when they were implanted at ages over 6 years.

C01 – 098

Intra-operative paediatric experience with the Research Studies Platform for Objective Measures

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Evoked compound action potential measurements, also called neural response imaging (NRI) with the HiResolution®Bionic Ear®system, provide insight into the peripheral auditory nerve response. Several NRI paradigms are of interest: amplitude growth, spread of excitation, selectivity, recovery time or adaptation measurements. The SoundWave™ fitting software only gives access to amplitude growth. So far the only possibility to measure alternative NRI paradigms was to use research software. The new CE-approved Research Studies Platform – Objective Measures (RSPOM) gives access to all NRI recording paradigms through user friendly software. Significant amounts of data have already been collected in adult CI users, but the paediatric experience is still limited. The objective was to evaluate the use of RSPOM during paediatric cochlear implant (CI) surgery. Three NRI paradigms were investigated: amplitude growth, spread of excitation and recovery. RSPOM version 1.2 was used, together with standard CI fitting hardware. Measurements were typically taken on apical, middle, and basal parts of the electrode array. The time required to perform the recordings was monitored. Intra-operative measurements were taken on ten children. There were no difficulties in setting up the system intra-operatively. All parameters were set-up in advance of the surgery within RSPOM, therefore limiting the intra-operative measurement time to a minimum. On average, thirty minutes were needed to perform recordings with all three paradigms. The quality of the measurements was good although a limited number of averages was used. Intra-operative paediatric measurements with RSPOM are a straightforward procedure. The time required to perform three recording paradigms was comparable to the time needed with SoundWave for one paradigm only, which improves intra-operative efficiency. The next steps will involve comparison with CI program parameters and performance, to evaluate how intra-operative measurements may be interpreted in clinical routine.

C01 – 097

Are eCAP metrics useful towards optimizing speech understanding performance?

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At the heart of fitting a CI program is the question how to optimally tune the program parameters towards his/her individual auditory nerve. Choices include setting stimulation levels, electrode activation and rate. Awareness of individual differences in how the peripheral auditory nerve responds to changes in stimulation intensity, place and rate seems therefore beneficial. These aspects can be studied with eCAP techniques, available for all major CI systems (NRI, NRT, ART) in the form of amplitude growth functions (AGF), spread of excitation functions (SOE) and recovery time functions (RTF). The SOE width is an indicator for the spatial overlap in neural excitation between electrode channels, whereas recovery time is an indicator for the temporal response of the auditory nerve. In this study we investigate the usefulness of these neural metrics in a clinical setting by comparing them to speech understanding performance. A neural profile, consisting of AGF, SOE and RTF functions at three places along the electrode, was taken in a group of 9 experienced users, all wearing an Advanced Bionics' device, using the RSPOM 1.2 electrophysiology software. From these functions three numbers were derived as indicators for the peripheral neural response: Tnri threshold, SOE width and recovery time constant. In addition the speech understanding scores (in quiet, in noise and at low presentation levels) were collected during normal audiological follow-up. The results show substantial variability of the neural metrics. Moreover their correlations are relatively low, indicating that tNRI, SOE width and recovery time form +/- independent aspects of the auditory nerve response. Combined into one global eCAP quality indicator, the correlation with a global speech understanding indicator is surprisingly high. A wider use of eCAP measures of an individual user towards optimizing the sound program seems promising, especially in pediatric or complex cases.

C02 – 111

Gaining insight in the electrode trajectory from electrical spread measurements

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Objective measures are often used as a quality metric in the operating theatre. E. g. successful eCAP capture implies that the device is placed well and the auditory nerve is responding to electrical stimulation. Here we present a similar tool that estimates an electrode trajectory based on electrical properties only. This technique is useful to detect anomalies during a normal implantation, e. g. a flipped electrode tip, or for abnormal anatomies, e. g. ossification. Electrical field imaging is an objective measure whereby each electrode is stimulated and the intracochlear voltages are recorded along the electrode. It was already shown that when measured accurately, these electrical spread measurements are unique to each subject, reflecting differences in electrode placement, tissue properties, and intracochlear current flow. We extended this method by converting potential differences into electrical distances, and deriving a planar map representing the electrode contacts in 2D, whereby their respective distances reflect the electrical similarity between the electrode contacts. The pilot validation study investigated normal insertions, a case of a flipped tip and ossification cases. For the normal case the electrical fields are monotonously exponentially decaying. The corresponding 2D map is an arc where all the contacts are spaced at approximately equal distance. In case of a flipped electrode, the fold over is also reflected in the 2D map. For ossification cases the 2D map shows increased electrical distances between the contacts in the ossified region as from an electrical point of view these contacts are more separated. Given the large electrical potentials, electrical field measurements are quick and easy compared to neural responses. From these measurements the proposed technique calculates a 2D map. A initial validation study demonstrated success in detecting electrode anomalies and ossification. Therefore it is a promising tool for intra-operative monitoring and potentially towards fitting.

A11 – 231

Is synergy detectable after one year of electroacoustic stimulation (EAS)?

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To investigate if synergy is detectable after one year of electroacoustic stimulation (EAS). 10 adult patients with residual hearing in the low frequencies and an aided monosyllable phoneme score of maximally 50% were included in a prospective study and implanted in the worst hearing ear with a special thin and short electrode up to 17 mm insertion depth. Residual hearing was preserved within 15dB at follow up of 6 months. To determine synergy in electroacoustic stimulation, an integration enhancement score was calculated for word recognition in quiet and sentence recognition in noise. Speech perception scores at 65dB SPL with EAS are at the average higher than postoperative scores with only acoustic stimulation or only electric stimulation. Synergy (positive integration enhancement) is demonstrated in half of the patients. At the meeting, the results after one year of implantation will be showed. Results vary considerable between patients. Possibly, adaptation to basal electrical stimulation and subsequent integration between electric and acoustic stimulation follows a time course in many patients that is longer than for cochlear implantation in deaf patients. With EAS there is a better speech understanding than with just acoustic stimulation, but after 6 months, synergy is not found in all patients. Follow-up data after 1 year will be presented.

C06 – 138

Fine Structure Processing versus CIS: Objective and subjective evaluation

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Recently, a new speech coding strategy named 'fine structure processing' (FSP) has been launched (Zierhofer, 2001). In contrast to CIS (Wilson et al, 1991), which only transfers information of the envelope of a signal, this new pro-

cessing strategy also represents the signal's fine structure component. The representation of fine structure is supposed to improve the perception of music and speech in noise by delivering subtle pitch and timing differences of sound to the user. In this study, a group of 33 subjects, implanted with the MED-EL PULSARCI100 system, have been upgraded from a TEMPO+ to an OPUS 2 speech processor. The total group consisted of 22 subjects using between 1 and 3 FSP channels in the low frequency range [FSP group] and 11 subjects using CIS channels for the whole extended frequency range [CIS group]. Patients were tested with TEMPO+ just before upgrade and after 12 months of OPUS2 use. Performance with OPUS 2 was tested at upgrade, and after 1, 3, 6 and 12 months. A sentence in noise test (LIST) was performed at each test interval. Additionally, a SSQ questionnaire was assessed. The FSP group shows an initial deterioration in SNR of 3.3 dB at the acute switch-over interval, but a significant improvement over time ($p < 0.001$) with a final benefit of 6.52 dB after 12 mo of FSP use. The CIS group only shows a slight deterioration in SNR (0.82 dB) at the acute switch-over, but afterwards do not improve significantly over time. The results of the SSQ questionnaire shows a significant improvement over time on the Spatial subscore ($p = 0.007$) in the FSP group; this cannot be seen in the CIS group. The results show that the fine structure coding strategy in the OPUS 2 speech processor can be beneficial.

B14 – 411

The role of language factors in reading comprehension in children with CI

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The objective of the study is to explore the positive effect of two major language components, decoding and vocabulary, on reading comprehension in deaf children with cochlear implants. Reading comprehension in a group of 50 children and adolescents with cochlear implants is evaluated with a standardized test for hearing children. The variables language comprehension (RDLS), decoding skills and auditory open set monosyllable recognition are evaluated. The relation between auditory speech perception and the language components and reading comprehension is analysed with regression analyses. Based on these analyses a model of relations is constructed. Structured Equation Modelling is used to test the hypotheses. There was no direct relation between speech perception and reading comprehension. Remarkably also no association between auditory speech perception skills and decoding was present. There was a strong relation between auditory speech perception and receptive vocabulary and also a strong relation between receptive vocabulary and reading comprehension. SEM analyses confirmed that the relatively high level of reading comprehension of deaf children with cochlear implants can for a large part be attributed to the development of receptive vocabulary that, on its turn, is associated with improved auditory speech perception abilities. The important role of spoken receptive vocabulary in reading comprehension is confirmed in children with implants. The lack of a relation with decoding skills may be influenced by the use of test that can be performed with decoding skills that do not require access to phonology. Our findings indicate that the better reading comprehension of deaf children after cochlear implantation is a result of the higher accessibility of spoken language through the use of a cochlear implant.

A04 – 029

Supporting young deaf children with cochlear implants and their families: suggestions and tips for parents and professionals

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In most countries, the age of cochlear implantation is decreasing enormously. This is especially true for those countries that use a Universal Hearing Screening program. In Flanders (Belgium), the average age of implantation now is 14 months. Cochlear implants at 8 to 10 months of age are not exceptional anymore. Parents have a lot of questions concerning their deaf child in the early years of their development. They want to know how to support their child, especially in the early auditory, speech and language development. Therefore, a multidisciplinary team of field experts has written a booklet for parents and staff working with young deaf children with cochlear implants. The booklet consists of 6 chapters: update on cochlear implants, preverbal communication, auditory development, speech and language development, social emotional development and going to (mainstream or special) school. Each topic provides information on the development of hearing children, deaf children and deaf children with cochlear implants. Readers will find suggestions and tips in order

to stimulate a certain area in the development of the child. Parents as well as professionals find this booklet – especially the suggestions and tips – very useful. The presentation will focus on some practical suggestions to support the early auditory, speech and language development of young deaf children with cochlear implants. The booklet “Supporting young deaf children with Cochlear Implants and their families: suggestions and tips for parents and professionals” proved very useful in supporting families with young deaf children. For that reason, MED-EL supported us with the translation of the booklet to other languages. At this moment, there is already a version in Dutch and English, but it will soon be available in French, German and Spanish.

A13 – 381

Specific complications in bilateral cochlear implantation

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The aim of this retrospective study was to investigate the occurrence of vestibular receptor deficiency, postoperative vertigo and taste disturbance after bilateral cochlear implantation. 20 patients (11y - 58 y) implanted between 1999 and 2007 with a period between first and second implantation between 1 y and 7 y were included. The patient's pre- and postoperative vertigo and vestibular receptor function was tested by a questionnaire (Dizzines Handicap Inventory, DHI), caloric irrigation (vestibulo-ocular reflex, VOR) for the function of the lateral semicircular canal (SCC) and by vestibular evoked myogenic potential (VEMP) recordings for saccular function. Taste was evaluated by a questionnaire and pre- and postoperative testing. Comparison of pre- and postoperative VOR and VEMP showed in 4 cases a disappearance of VEMP potential on one side. VOR disappeared in one case. DHI evaluation showed in 5 patients an increase of the score indicating a increased dysbalance. 3 patients disclaimed a persisting disturbance of taste although the specific testing was regular. Although a bilateral loss of vestibular receptor function and taste are rare complications the critical discussion of the risk has to be involved in the process of preoperative evaluation for bilateral cochlear implantation.

C12 – 421

Indication criteria for supply with the Vibrant Soundbridge System for patients with combined hearing loss

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The implantable hearing device Vibrant Soundbridge (VSB) is due to more than ten years of clinical experience one of the most mature active middle ear implants. Initially it was developed for patients with a pure sensorineural hearing loss especially in the high frequencies. Due to alternative coupling methods of the floating mass transducer the indication has been widened. Now also patients with a combined hearing loss can profit from this active middle ear system. We report on our database-study for detection of the prevalence of candidates for an alternative coupling of the VSB with a combined hearing loss. We introduce the database of the ENT-Department of the University of Heidelberg as well as the database of the ENT-Department of the Unfallkrankenhaus Berlin with together more than 44 000 enclosed patients as well as an analysis regarding the above mentioned question. With the database-analysis we found out that <5% of the enclosed patients are candidates for a supply with the alternative coupling of the VSB. We report on those candidates in detail. The amount of candidates for an alternative coupling of the VSB is limited. But the patients that are candidates are exactly those who could not be supplied with any hearing device sufficiently so far.

C01 – 099

ESRT, ART and MCL correlations in experienced paediatric cochlear implant users

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Introduction: The use of electrically evoked stapedius reflex thresholds (eSRT) and electrically evoked compound action potential (eCAP) threshold have been suggested as a useful means for creating a cochlear implant speech processor programme. Multiple studies have shown there are some correlations between eSRT and (eCAP) programmes and programmes created through behavioural testing. This study assessed the viability of using eSRT eCAP threshold to create speech processor programmes in children with Medel Opus II speech processor. Methods: Fifteen children and 15 adults implanted with Medel Pulsar system with Opus II speech processor participated in the

study. eSRT and ART was measured in both groups and MCL only in adult group. Subjective judgment of MCL was performed using a loudness scaling procedure beginning at “first hearing” and ending at “uncomfortably loud.” Results: eSRT vs MCL shows better correlation for apical, medial or basal electrode than ART vs. MCL for adults population. There is no significant difference in means for ART and eSRT obtained for children and adults for apical, medial or basal electrodes. Conclusions: Although eSRT is a better predictor for MCL values, both measurements: eSRT and eCAP can be useful tool to assist with map creation for children. Some of the research reported were supported by Marie Curie Host Fellowships for Transfer of Knowledge; Remediation of Hearing Loss; Nr. 042387.

B06 – 094

The effect of reduced cochlear implant electrodes on performance

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To examine speech perception outcomes as related to a reduction in the number of functional electrodes post-implantation, and to determine the effect of electrode reduction on subsequent device failure. 15 out of 1520 (1%) of children and adults with full insertions of the Advanced Bionics, MED-EL, and Nucleus devices were subjects. Patients were included in the study if all electrodes were functional at initial stimulation but the number of electrodes in use was subsequently reduced for cause at follow-up programming sessions. Subject exclusion criteria included partial and split array electrode insertions. Post-implantation age appropriate open set speech perception tests at the phoneme, word and sentence levels in quiet and noise obtained with a full complement of functional electrodes were performed and the results were compared to the scores obtained following the deactivation of 1 or more electrodes from the user program. Electrode deactivation was also correlated with device failure. The results of this study indicate that deactivation of cochlear implant electrodes is relatively uncommon and while the deactivation does not have a direct influence on speech performance outcomes, the loss of five or more electrodes did suggest impending device failure. Despite the fact that deactivation of electrodes did not directly influence speech perception outcomes, those patients with electrode deactivation and accompanying decline in speech perception scores should also be considered at risk for device failure.

B11 – 271

Initial and sequential bilateral cochlear implantation in the adolescent population

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Advances in technology and patient characteristics have led to an increase in implantation in congenitally/prelingually deaf adolescents who were previously considered poorer candidates. In addition, many children implanted unilaterally at a younger age began seeking second-side implantation as adolescents. The purpose of this study was to examine the outcomes and variables affecting initial and sequential bilateral implantation in the adolescent population. 80 initial implantations (Group 1) and 30 bilateral sequential implantations (Group 2) were performed on congenitally/prelingually deaf adolescents ages 10-17 years old. The main outcome measures were open-set speech recognition tests at the phoneme, word and sentence levels in quiet and noise. On average, results in first-side implanted and sequentially implanted adolescents revealed significant improvement in the implanted ear despite age at implantation, length of deafness or time between implantations (Group 2); however, a wide range of performance was noted. Factors affecting performance included implant technology, mode of communication at time of implantation and residual hearing. Cochlear implantation leads to improved speech perception in the adolescent population although numerous factors affect ultimate outcome and issues regarding motivation are more prevalent in this population than young children or adults. Appropriate counseling regarding prognostic indicators of performance is critical to continued and successful use in this population.

C04 – 113

Remote fitting of cochlear implant system

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The fitting procedure of the cochlear implant system introduced in the International Center of Hearing and Speech requires frequent visits of the patient and repetitive fitting sessions. Long travels, high cost, limited reliability of

tests results caused by travel weariness are disadvantages that should be solved to improve the quality of service for cochlear implant users. New method of remote fitting of cochlear implant system was developed and introduced in the International Center of Hearing and Speech. The aim of this paper is to present the technology and setups used in remote fitting and to assess the usefulness of this method in clinical practice based on results of the study performed in 2007 and 2008. Four computers with proper software and symmetric SDL Internet connection are used: one pair is used for videoconference connection, second pair is used for fitting itself. The specialist, using remote desktop application, takes control over distant computer, where the patient's speech processor is connected, and performs fitting and electrical hearing tests. Support specialist on the patient's site helps with the communication process and is responsible for connecting and disconnecting of the speech processor to the interface. Questionnaires for patients, support and fitting specialist were used to assess the usefulness, time effectiveness and overall performance of this method. Also the risk connected with connection breakdowns, slow-downs etc was assessed. Proposed remote fitting method is a good alternative for standard follow up and emergency visits. It can be used to improve the quality of fittings and rehabilitation of implanted patients. Based on the study results and few years' experiences, remote cochlear implant system fitting is a very useful and safe technology, appreciated both by patients and specialists. It was introduced into clinical practice between subsidiaries of the Institute of Physiology and Pathology of Hearing.

D04 – 180

Cognitive skills and reading ability in children with CI

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Children with CI have a different course of development of basic academic skills such as language- and reading skills, compared both with children with normal hearing and children with severe hearing impairment or deafness who have not been implanted. Increased knowledge about the cognitive development in children with CI is necessary in order to adjust their situation in various settings. In the present study, working memory capacity, lexical access and phonological skills were examined in 19 children with CI (age 5;7-13;4) attending grades 0-6 in the Swedish school system. Their performance was studied in relation to demographic factors and compared with 56 children with normal hearing. The children were further tested on reading ability. The cognitive tests were taken from a computer-based test battery (the SIPS), with auditory-, text- and picture-based presentation of information. The reading tests were presented in paper versions. The findings indicate that children with CI had general (i. e. simultaneous storage and processing) and visuospatial working memory capacities equivalent to the hearing children. They had lower performance levels on most of the other cognitive tests and the differences were particularly prominent in tasks that required phonological working memory and tasks that required extensive phonological processing. Seventy-five percent of the children with CI had a performance level in reading comprehension that was comparable to hearing children. Complex working memory was predictive of reading comprehension. Children with CI are good readers despite poorer phonological skills. The difficulties with phonological WM will be discussed with respect to phonological processing and development of reading ability.

A13 – 380

Speech perception in noise and directional hearing of bilateral cochlear implanted children*

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A highly developed auditory system is a compulsory condition for the development of speech perception as well as speech production. The ability of directional hearing is indispensable for the spatial orientation and allows focussing on a single sound source in background noise. This alleviates the verbal auditory communication and contributes to a considerable minimized effort of hearing. Deaf children in particular need an optimal auditory input for reaching best possible preconditions for the development of speech/language abilities. People with bilateral cochlear implantation benefit from binaural sound processing by head shadow and squelch as well as by summation to localize a sound source. This study aims on the investigation of directional hearing abilities and speech perception in noise of children with bilateral cochlear implants (CIs). 30 children of different age groups with bilateral cochlear implantation and an age matched group of 30 children with unilateral cochlear implantation participated in the study. The recently

developed Oldenburg Children Sentence Test (OIKiSa) was applied in noise to examine speech perception. Speech was presented at the side of the ear with higher hearing loss, masking noise was presented at the other side. Furthermore localization in the horizontal plane was tested with CCITT noise and 6 loudspeakers (0, 45, 90, 180, 270, 315 degree). In the speech perception experiment we measured the SNR for understanding 50% of the presented words. In bilateral condition the median of this SNR is lower than in unilateral condition. Preliminary tests revealed promising improvements in the localization abilities of bilateral implanted children compared to unilateral CI patients. Children with profound hearing loss on both ears could benefit from a second CI. In everyday live conversation is less stressful and potential dangers like traffic can be localized more precisely.

*This study has been supported by MED-EL.

D14 – 468

Optoacoustic stimulation of the auditory system: “Photons may substitute electrons in restoring hearing”

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Traditionally, electrical neural stimulation has been used to bypass the non-functional peripheral sensory organ, the cochlea, to reasonably restore some auditory function. However, the aided hearing performance is dramatically reduced in noisy environments in part, due to the lack of localized sensorineural activation across different frequency regions with these devices. Laser light, as a source of energy, can be focused in a controlled manner, thus may be a promising technology for cochlear activation. We sought to assess if 532 nm laser could be used to consistently activate the cochlea. The laser parameters were selected to induce an optoacoustic effect as the energy transfer mechanism to the inner ear. Click evoked auditory brainstem responses (AABRs) were recorded preoperatively in ketamine-anesthetized guinea pigs to confirm normal hearing. The bulla and then the cochlea were exposed. Optically evoked ABRs (OABR) were recorded in response to laser stimulation with a 50-nm optical fiber (532 nm, 10 ns pulses, 10pulses/s; Nd:YAG-laser) at the round window(RW) directed towards the basilar membrane (BM). OABRs similar in morphology to acoustically evoked ABRs, were obtained for stimulation through the RW with energy levels between 1.7-23 µJ/pulse. The OABRs increased with increasing energy level reaching a saturation level around 13-15 µJ/pulse. Furthermore the responses remained consistent across stimulation over time, including stimulation at 13 µJ/pulse for over 30 minutes, indicating minimal or no damage within the cochlea to type of laser stimulation. These findings suggest that laser light stimulation has the potential for a new type of auditory prosthesis that can achieve the activation of the cochlea without any apparent functional damage. Further studies are needed to investigate the effects of optical stimulation of lower frequency cochlear regions and how to safely elicit frequency-specific auditory activation with multiple fibers positioned within the cochlea.

C04 – 114

Remote fitting and measurement in Nucleus cochlear implant recipients

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Remote fitting and measurement of cochlear implant recipients can potentially save the working time of audiological professionals who provide intra-operative support and post-operative service to cochlear implant recipients, and reduce the travel of recipients. A study was conducted to confirm if available video-conferencing technology and remote-control software are suitable for remote measurement and fitting, and to investigate the feasibility of remotely-controlled intra-operative measurements and post-operative fittings of recipients with Nucleus cochlear implants. Intra-operative measurements were conducted in 20 recipients where the audiologist controlling the measurement software was not in the operating theatre. Post-operative fittings were conducted in two fitting sessions in 20 other recipients. In one session the audiologist and recipient were in the same room; in the other session they were in different rooms. Audio and video signals were transmitted via internet-based video-conferencing technology. The fitting software and equipment were controlled remotely via the same internet link. All active participants completed questionnaires. A bandwidth of 512 kBit/s is suitable for remote fitting, where remote control, bidirectional video and audio are used. It is feasible to have two video monitors on each side. However video is not required for intra-operative measurements. For the audiologist, remote intra-operative

measurement seems to be time-efficient but remote fitting requires some more time than local fitting. On group average, there are no differences between T levels and C levels, respectively, obtained with local fitting or remote fitting. Available technology can support remote measurement and fitting of Nucleus cochlear implant recipients.

A03 – 016

Changing communication after cochlear implantation

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Cochlear implantation is now a well established procedure for profoundly deaf children providing access to speech through hearing for many of them. Much attention has focussed on which communication mode to adopt with this group of children but very little work has looked at the choices that parents make before and after cochlear implantation. The three-part study used outcome measures, written questionnaires and in depth interviews to examine the way cochlear implantation impacts on communication choices and the experiences of families on one major cochlear implant programme in the UK. The study found that parents choose the most effective way of communicating with their child but retain as their goal, the development of oral communication skills. For many this is a journey in which different approaches are utilised at various stages in the child's development and in later years, the use of sign language may re-emerge alongside oral communication as a second language. Cochlear implants have widened choice for many children and their families, giving access to spoken language but without compromising their deaf identity. This research has been published in two papers: Watson, LM, Archbold, SM, Nikolopoulos TP. (2006) Children's communication mode five years after cochlear implantation: changes over time according to age at implant. *Cochlear Implants International* 7 2. 77-91
Watson, LM, Hardie, T, Archbold, SM, Wheeler, A. (2007) Parent's Views on Changing Communication After Cochlear Implantation. *Journal of Deaf Studies and Deaf Education*.

B09 – 258

Young people with cochlear implants: issues, outcomes and perspectives

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This presentation outlines the results of two studies which investigate the views of teenagers who had received cochlear implants. They were asked about their perspectives on issues such as communication, identity and education. This is balanced against the views of their parents and the teachers of the deaf working with them. Semi-structured questionnaires were used in an interview format with the young people with cochlear implants, their parents and teachers. The results of the interviews were analysed using Nvivo software to elicit themes and identify trends. The young people in these studies were positive about cochlear implants but also realistic. They have a flexible attitude towards communication and identity. Young people feel that cochlear implants help them in the classroom but that support is not always matched to their needs. Teachers express concerns about over-expectations. Funded by the National Deaf Children's Society and Royal National Institute for the Deaf in the UK respectively.

D05 – 184

The Development of a Protocol to Identify Poor Performers following Cochlear Implantation

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A protocol was written to assist in the identification of poor performers in the first two years post cochlear implantation. This was inspired by 'Tracking Auditory Progress in CI Kids', written by Amy McConkey Robbins. (Advanced Bionics, Clinical Red Flags for slow progress in children with cochlear implants.) Two pro formas were designed which incorporated bench marks for auditory and linguistic development during the first two years post implant, for babies and toddlers (to age 18 months) and for young children (aged 18 months to 4 years) respectively. These were trialled by rehabilitation staff at the Royal National Throat Nose and Ear Hospital. The outcome of the trial will be outlined, with regard to the degree of success in identifying poor performers at an early stage. The issues which arise from this will be discussed. The outcome of this study will inform future work in identifying poor performers and putting into place appropriate intervention strategies. With acknowledgement to Amy McConkey Robbins and Advanced Bionics.

A05 – 036

Health care in Turkish families with a deaf child with cochlear implant (CI)

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The care for deaf children and their parents from ethnic minorities is not always optimal in the Netherlands. The care is usually tuned to the needs of the native population. Besides, some parents from ethnic minorities do not know how the care system in the Netherlands is organized and have expectations that are not met. The objective of this study was to investigate how the care for Turkish families with a child with a CI can be optimized. Desires and expectations concerning care were assessed in eleven parents and ten family counsellors using structured interviews. The parents were all born in Turkey and have a deaf child with a CI. For seven of these eleven parents the language development of the children was followed as well in this research. The findings of this research show that Turkish parents have little confidence in the Dutch care system; this is shown by the fact that all parents consulted a Turkish doctor for a second opinion. Furthermore, Turkish children receive their CI late compared to native Dutch children. Also, Turkish parents have different needs than the current care system offers, such as the need for practical support (e. g. the availability of a babysitter, assistance with financial issues). By contrast, family counsellors think autonomy of the parents and guidance through the grief process are more important aspects. This study showed that parents as well as family counsellors experience problems in the care for Turkish children with a CI. The confidence in the Dutch care system of Turkish parents should be improved in order to improve the care for their children. Professionals need to take into account that these parents have different needs and expectations. Cultural differences and language problems should be taken into account in the care for these children.

D04 – 181

Difficulties in psychological assessment of deaf children after cochlear implantation

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The aim of the study was to assess cognitive and psychological development of deaf children after cochlear implantation. Children represented in the study show the dynamics of psychomotor development of children who gained audiological simulation and systematical rehabilitation. Another goal was to identify factors related to children scores in different psychological tests. The assessment was made during the child's qualification before the operation and later when the speech processor was being fitted. Variables such as children's age, type of deafness (prelingual vs postlingual), length of CI usage, speech rehabilitation intensity and structure of children's family was taken into account. Children implanted in Otolaryngology Clinic of Public Central Teaching Hospital in Warsaw were surveyed with authors' questionnaire and standardized tests such as WISC-R, Brunet-Lezine Scale, Raven's Standard Progressive Matrices, Leiter P-93 Test and Dziecica Skala Rozwojowa (Child's Development Scale). The research showed importance of individually-fitted rehabilitation programs, focused not only on hearing and speech improvement but also on child's overall cognitive development. Children, who at first scored poorly systematically gained new skills improving their performance in psychological tests. The results give evidence to the role of good overall cognitive assessment in planning effective rehabilitation programs for deaf children. That kind of assessment allows to track down children in risk of future educational difficulties. Further researches in this field including development of deaf children specific diagnostic methods are necessary.

D09 – 336

Deafening strategy and its impact on apoptosis genes activation in the inner ear

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Induction of the apoptosis in the hair cells of the inner ear results in exclusive hair cells loss whereas necrosis may cause the necrotic factors release and injury/destruction of the surrounding cells – such as supporting cells or pluripotent cells in the Organ of Corti. Prevalence of either cell death pathways may influence the results of regeneration experiments conducted

on deaf animal models obtained with different deafening protocols. The aim of this study was to investigate the apoptosis gene activation in the “short” and “long” deafening protocol, in order to assess apoptosis/necrosis ratio after aminoglycosides treatment. Three groups of Balb/c mice were prepared. Group one – mice deafened with Kanamycin 900mg/kg administered twice a day for 14 day, group two – mice deafened with single dose of Kanamycin 900mg/kg followed by single dose of Ethacrynic Acid 60mg/kg, group three – controls. Hearing loss was evaluated one week after discontinuing the drugs, with ABR measurements. Subsequently, cells from the cochlea of one ear were collected and immersed in RNA-later® solution, the other ear was immersed in 10% formaldehyde prepared for immune staining. RNA was extracted using SuperScript™ III Cellsdirect cDNA Synthesis System kit® (Invitrogen). Additionally, for comparative evaluation of RNA quality tissue from liver and lung was obtained. Expression of 86 apoptosis genes was analyzed with RT-PCR SYBR® Green and RT® Profiler™ PCR Array kit (SuperArray). ABR recording conducted on tested animals revealed in the group one hearing loss of 100dB in 11 out of 15 mice, 80dB in 4 out of 15 mice. The “short” deafening protocol resulted in 5 mice with 100dB hearing loss and only 1 mouse with 80dB hearing loss. None of the protocols enabled to obtain a 100% of deaf animals. The results of expression are currently analyzed and will be presented during the session. Our results have to be considered as preliminary, further testing is required. The study was supported by Ministry of Science and Higher Education Grant 2PO5C 061 28.

B02 – 063

Inserting cochlear implant electrodes without surgical tools: technique and results

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Cochlear tissue damage during cochlear implantation surgery results from excessive forces applied during electrode insertion with surgical tools. This study details the use of an improved insertion technique (“tunnel with 3 points technique”) designed to reduce trauma using strictly manual insertion. 350 profoundly deaf subjects consecutively implanted between 2007 and 2008 in a tertiary care medical center in Russia were retrospectively studied. All were implanted with a free fitting lateral wall array with an intracochlear length of more than 30 mm via a standard mastoidectomy and posterior tympanotomy approach. Using the tunnel with 3 points technique, the electrode is inserted through a 2+ mm tunnel filled from the mastoid cortex to the mastoid cavity. The electrode must have at least 3 points of support during insertion: the tunnel itself, the edge of the posterior tympanotomy, and the cochleostomy external aperture. Intraoperative or postoperative radiological verification of electrode position and safety was performed for all cases. Full electrode insertion was achieved using the tunnel with 3 points technique in 348 of 350 subjects. Two cases resulted in one and two extracochlear electrodes. In 90% of cases, strictly manual insertion was possible. In more difficult cases, a simple tool was used for only the last few millimeters of insertion. Mostly manual insertion is feasible for lateral wall free fitting electrode arrays inserted up to 30 mm with the tunnel with 3 points technique. The electrode array follows a straight path from the skull surface to the cochleostomy. No surgical tools are necessary for most electrode insertions.

C07 – 283

Family oriented musical activities for cochlear implanted children: speech and musical perception results of two year follow-up

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The purpose of this study is to determine whether children can gain benefit from training on pitch and music perception. Our main goal was to prepare a tool for training pitch and music perception and evaluating musical attitude in children, to determine whether pitch and music perception improve more rapidly with training and to assess the impact of training on speech perception. A family centered habilitation program based on musical training is developed. 9 newly implanted children whom were switched on in HiRes and trained from the outset and 9 children using HiRes strategy who did not receive training both undergo assessments to determine pitch and music perception skills and speech perception assessments. The speech perception test battery contains a comprehensive range of age appropriate tasks covering detection, discrimination, identification, recognition and comprehension abilities. Musical training program was based on a take-home electric keyboard which is used for listening to different pairs of notes. For this test,

three octaves and one extra note at the high end of the keyboard were used. Children were expected to discriminate a pair of notes. Assessments of speech perception at pre-implant, 3-,6-,9-,12-,24-months post switch-on. Also parents were given the 'Musical Stages Questionnaire' which covers some of the key areas of musical development. Children who were involved in music study demonstrated significant familiarity in both determining pitch differences. Statistically significant relation between music training and speech perception was observed at music group compared with the non trained group particularly at the rate of being linguistically/developmentally ready to carry out a formal closed set and modified open set speech perception evaluation. Until the end of twelve months the results on the musical stages profile were similar for both groups except in the area of exposure to music where the musically trained children find themselves in a richer music environment than the cochlear implanted children ($p < 0.05$). However by the end of 24 months music group showed marked improvement in all developmental areas of musical perception ($p < 0.05$). Music training program helps appreciation of music and speech perception after cochlear implantation in children. While, effects of the musical training program on daily listening attitudes and social aspects such as closer parent-child relationship were significantly observed future training programs should strive to improve satisfaction with music listening and its effect on speech perception. Music is joyful and must be experienced that way before it can be used as therapy. It can be said that this musical training program makes the children familiar with another aspect of hearing and, meanwhile, uses the opportunity to enhance the rehabilitation process. By exploring future training programs and programming strategies may strive to improve satisfaction with music listening and its effect on speech perception. By exploring future training programs and programming strategies may strive to improve satisfaction with music listening and its effect on speech perception.

D05 – 185

Ways of optimization the development of the addressed speech understanding

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Our attention was concentrated on the features of forming the addressed speech understanding of preschool age children due to the fact that they used cochlear implant. Experimental groups of children with cochlear implant were conventionally divided into sub-groups, taking into account age of these children, state of speech before conducting the implantation, and also their level of hearing perception. The experiment was based on the method of using not only traditional tests but also specially developed group of tests which were grounded on the peculiarities of Slavonic languages such as affectivity, difference in laying stresses and polysemy of words. Tasks were directed to - ability to understand unvocal means of communication, -development of understanding intonational in means of speech, -forming an intellectual sense of integrity and plenitude of vocal utterance, -development of the lexicogrammatical level in speech understanding. Children with cochlear implants considerably take the lead over their coevals with SA in development of hearing perception. However, it should be mentioned about disabilities in process of addressed speech understanding which is caused by lack of phonetics-phonemic hearing formation. Disabilities in sound differentiation results in difficulties of recognition the meaning of the word. Post-operating program of rehabilitation must include the correction of auditory perception violations and development of phonemic and inflection hearing, with the purpose of adequate recognition of words and improvement of addressed speech understanding.

A10 – 223

Interference with cochlear mechanics as a postulated mechanism for systematic loss of residual hearing following cochlear implantation

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Preservation of residual hearing after cochlear implantation (CI) would allow ipsilateral electro-acoustic stimulation with its important advantages such as improved hearing in noise and better musical perception. Systematic loss of residual hearing after implantation (ranging from 10-90% for all current CI systems with full electrode insertion depth) is one of the major factors limiting further expansion of the indications for CI's and their application in patients with more residual hearing. Numerous mechanisms for post-implantation hearing loss have been postulated such as perforation of the basilar membrane, noise trauma, oxidative stress and inflammation, infection,

compromised blood supply, etc. The authors postulate yet another possible mechanism for systematic loss of residual hearing after cochlear implantation: the mechanical distortion of the basilar membrane movement. 1.) HiFocus®; and Contour®; electrodes have been inserted in human cadaveric cochleas under direct visual control of the insertion process through the exposed basilar membrane. 2.) Repeated ABR measurements have been performed during cochlear implantation with a Nucleus 24R Contour®; in a patient with residual hearing. 3.) Micro-CT scanning of the human cochleas. 1.) Electrode insertion tests showed that with full (i. e. >4000) electrode insertions two important phenomena could be observed: significant lifting of the basilar membrane occurring at approximately 180 and wedging of the electrode tip in the latero-superior aspect of the scala tympani. 2.) Intraoperative ABR registration showed clear ABR traces as long as 5 or more electrode contacts remained still outside the cochlea. From the moment of full, approx. 400, insertion no reproducible ABR traces could be recorded anymore. 3.) Micro-CT evaluation showed particular anatomic features that explain the behaviour of the electrode at 400 insertion depT. Results of this study support the hypothesis that the systematic loss of residual hearing in CI patients can be due to mechanical distortion of the basilar membrane movement.

D08 – 327

Safety of Magnetic Resonance Imaging in Patients with Nucleus 24 Cochlear Implants

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Magnetic Resonance Imaging (MRI) has in recent years become one of the most important diagnostic procedures in medical practice and it is highly probable that most people would need MRI during their lifetime. Therefore with cochlear implants (CI) applied already in infants, or in patients after removal of acoustic neuroma, the MRI safety of CI's becomes very important. The aim of this study was to evaluate the compatibility of the implantable part of the Nucleus R24 CI system with the 0.2T, 1.5T and 3.0T MRI devices. The interactions between the MRI magnetic and Radio Frequency (RF) fields and the Nucleus R24 implants were measured at field strengths of 0.2T, 1.5T and 3.0T with both the magnet removed and the magnet in place. Results show that at each of the tested field strengths, with the magnet removed, all interactions are within the acceptance criteria of internationally recognized standards for active implantable devices. With the magnet left in place at each of these field strengths the results show that at 0.2T there is no risk of the magnet becoming dislodged or demagnetized. At 1.5T, the increased torque results in greater displacement of the implant magnet, however the use of a simple compression bandage wrapped around the implant site was shown to safely retain the magnet, and demagnetization was measured at <10%. At 3.0T the torque produced is too severe to safely retain the magnet, and demagnetization was measured at >90%. In each case the image artifact is approximately 60% greater with the magnet in place compared to the magnet removed. Nucleus 24 Implants have the option of either leaving the magnet in place for MRI scans at field strengths of 0.2T (without conditions) and 1.5T (with the use of a simple compression bandage) or alternatively removing the magnet to reduce the artifact size. At 3.0T however removal of the magnet will be required to ensure safety.

C15 – 432

A clinical protocol for verification of optimum settings of FM systems in children with cochlear implants

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Children with Cochlear Implants (CIs) can receive significant benefit in speech recognition through the use of an FM system in the educational setting. However, there are numerous settings as well as equipment arrangements that may be selected for a particular child. Therefore, a clinical protocol is needed for verification of performance to determine the optimum settings and arrangement. Evaluation through informal listening checks or electroacoustic measures as conventionally done with Hearing Aids are not possible with CIs. Optimal connections and setting must be ensured by systematic speech recognition measures. This study shows a verification protocol of the benefit of FM systems connected with the Cochlear SPrint processor. Speech recognition is measured in the sound field by live voice with the CI speech processor alone and combined with the FM receiver. Speech perception scores were obtained in quiet and in background noise with portable equipment of speakers in

the children's classroom. Benefit of the FM System was established through identification of words and sentences with different lexical and grammatical difficulties. This protocol may be used to behaviourally verify the benefit received when coupling FM systems to CIs.

D11 – 358

A computer-based, wordfree phoneme identification test Teetahtoo – adaptation into Polish

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Introduction: The auditory processing of different phonemes is an important listening skill, which is usually acquired already in early childhood. Early detection and intervention of hearing disorders as well as advanced technology of hearing-systems like digital hearing-aids and cochlear implants improved the auditory capabilities of hearing impaired children, so that the achievement of skills like auditory discrimination and identification of phonemes became realistic objectives in the therapy of hearing-impaired children. **Material and methods:** In order to diagnose a child's ability to discriminate and identify different phonemes a new test: Teetahtoo was developed by Frans Coninx. The test material contains only consonant-vowel syllables (like tee – tah – too), that means it is not dependent on the proband's lexicon. In order to avoid inferences with articulation problems, the test evaluates only decoding skills; the proband doesn't have to repeat the test stimulus. The test contains six subtests: In two sets, the consonant is always the same, but the vowel changes (large vs. small contrasts), in four sets the variation is in the consonants while the vowel remain constant (large contrasts vs. small contrasts on different phoneme categories). **Results:** In order to collect age-based norm data for the polish version of Teetahtoo, till now approx. 40 normal hearing children in the age from 4 to 7 years and 20 normal hearing adults between 20 and 30 years were tested with Teetahtoo. No pre-selection criteria were defined, but whole group was defined as norm. As expected, the performance increases with age, but also 4 years old children are able to be tested. **Conclusion:** The collection of the age-based norm data will be completed during the next months. Furthermore, we plan the validation of the test with hearing-impaired persons with different degrees of hearing loss and different types of hearing-systems. Some of the research reported were supported by Marie Curie Host Fellowships for Transfer of Knowledge; Remediation of Hearing Loss; Nr. 042387.

A01 – 008

Application of Visual Analog Scale for satisfaction and preference assessment in cochlear implanted children

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Introduction: The aim of the current study was to assess a feasibility of VAS application for satisfaction and preference assessment in cochlear implanted children. **Method:** Visual Analogue Scales (VAS) were completed by children to note satisfaction of three coding strategies (CIS, HDCIS, FSP) of Opus II speech processor, as well as comparisons between coding strategies. These VAS were completed for both speech and music. The VAS scale for satisfaction required the child to mark on a 20 cm scale whether the strategy was "bad", "average" (mediocre) or "good", with smiley faces to assist the child in their decision making. Children rated the strategies in the following order: FSP – music, HDCIS – music, CIS – music, CIS – speech, HDCIS – speech, and FSP – speech. **Results:** Satisfaction when listening to speech and music was statistically significant higher with FSP than with CIS+. Similarly, FSP showed preference when directly compared to CIS+ using speech and music. **Conclusions:** The application of VSA can revise the subjective preference of particular coding strategy application in pediatric population.

Short Oral Presentations

D10 – 340

A new Auditory Brainstem Response (ABR) Protocol for newborns and infants

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TUMS

Measuring hearing abilities of newborns and infants has been a source of much enthusiasms and research. One of the main tools for this screening program has been Auditory Brainstem Response (ABR) measurement. Here we have introduced a new protocol for this measurement which differs from traditional ones. We have used our method of ABR on a Bio-logic' Evoked Potential (EP) system for detecting ABR. We have used a new setting which enables us to better find ABR waves. We have tested our new protocol in 17 newborns and infants and have found that while this measurement had an efficacy of 100% in finding problematic children. This finding shows measurement had an efficacy of 100% in finding problematic children, it was also very successful in depicting waves I, III, and V latencies. This new setting for measuring ABR is a simple, reliable, and valid tool for examination of hearing pathway in newborns and infants. This new setting for measuring ABR is a simple, reliable, and valid tool for examination of hearing pathway in newborns and infants.

D02 – 163

Device choice feedback from pediatric and adult cochlear implant recipients

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This investigation is being undertaken to determine the reasoning behind recipients' choice of device. In Nottingham we have been offering pediatric recipients the choice of 2 systems since August 2005: Advanced Bionics and Cochlear. We have implanted 183 children in total since then, 89 selected Advanced Bionics and 94 selected Cochlear. We have been offering adults the 2 systems since the programme started in 1989 but have only collected data about their choice of device since August 2005. We have implanted in total 73 adults with Advanced Bionics and 24 with Cochlear since August 2005. A device choice de-brief is undertaken by the audiologists with an unbiased explanation of each of the devices and the workings of the speech processor. A comparison and rehabilitation booklet, with factual and practical information, are given to the recipients to support them to make an informed choice. They are asked to fill out a final "device choice" form, and list their reasons for choosing a particular device. On this form we have listed four main reasons which recipients may have taken into consideration when making their choice. These include: appearance, practicality, technology & other. They can tick one or multiple reasons, and are also asked to make comments. For both the adult and pediatric group we found that most recipients chose the device on practicality and appearance. Some recipients did not complete the form fully, although many made valid comments on each of the components mentioned above. The results show that a high percentage of recipients will chose their device on everyday life situations i.e. practicality and appearance. The information collected is used to further improve how we inform future candidates and the useful comments from recipients are also passed on to the companies.

D02 – 144

Life circumstances for children with hearing impairment – comparison between cochlear implants and hearing aids

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This study compares the life situation for children with cochlear implants with the situation for children using hearing aids. Use of cochlear implants and hearing aids in their daily life, attitudes to own hearing loss and to own aids as well as thoughts about other persons' attitudes will be explored. A cross-sectional explorative study was performed. All children with implants in four different age groups (6, 9, 12 and 15 years respectively) and a sample of 55 of the children using hearing aids in same age groups were invited. In the cochlear implant group non-users (N=5) and children having multi-impairment (N=7) were excluded. In the group with hearing aids, multi-impaired (N=28) and non-Swedish-speaking (N=9) were excluded. A specific questionnaire was

composed for the study. The subjects answered the questionnaires in the presence of a skilled interviewer. For the statistical analyses SPSS was used. All data were gathered. A total of 36 children with cochlear implant and 38 children with hearing aid answered the questionnaires. Characteristics of participants in the four age groups and of their school situation will be presented. Comparisons regarding use of aids and regarding attitudes to one-self and thoughts of other's attitudes will be made. Children's own perspectives on cochlear implants and on hearing aids are obtained. Use of hearing device differs between the two groups. Own attitudes and thoughts about other's attitudes seem in this preliminary stage of analysis to differ more between age-groups than between treatment groups. It was noticed that children/adolescents with cochlear implant needed more clarification from the interviewer than children with hearing aids. Conceptual translations and re-wording of questions were necessary in all age groups.

D12 – 436

Auditory brainstem implant in prelingually deaf children. Is it growth or plasticity?

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Auditory Brainstem Implant (ABI) has been applied in children who are born deaf due to cochlear nerve aplasia or with severe degree of inner ear dysplasia and for whom a cochlear implant is not an option. ABI electrodes have been placed in Cochlear Nucleus that is so close to some important Cranial Nerves and electrical stimulation of Cochlear Nucleus has some risk of side effects. Fitting of ABI is also so important to decide which electrodes have effective auditory stimulation and which electrodes have side effects that must be closed. We have no much more information about effects of long term electrical stimulation on cochlear nucleus in children. ABI was applied in 14 children (2-5 years old) with cochlear nerve aplasia and cochlear malformations. 13 Nucleus ABI-24 and 1 Medel Pulsar CI 100 ABI were used. Intraoperative EABR measurements were done in all children. Initial stimulation was carried out 6-8 weeks after the implantation in intensive care unit. The electrodes that caused side effects and nonauditory sensations were closed. The children that have been implanted with ABIs, were followed up every two weeks during the first three months. Fitting parameters and stimulation parameters were observed and found some changing. Numbers of open electrodes were increased and some electrodes that had nonauditory sensations were found to have auditory sensation. The numbers of electrodes had side effects were decreased during the following. The results of ABIs in prelingual children show the good improvements in auditory plasticity and language development. especially changing some fitting parameters cause some extra improvement in children. Auditory sensations have been happened in lateral electrodes were thought the growth of cochlear nucleus after the stimulation. Careful surgery, intraoperative EABR measurement, fitting and rehabilitation will rise the benefit of ABIs in children.

D10 – 342

Clinical application of the Spread of Excitation function in cochlear implant recipients

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One of the main and important goals in the modern cochlear implantation is the increasing the potential benefit of the method by the development of more effective ways to stimulate the surviving auditory fibers of the CI user. The aim of this study was to examine the Spread of Excitation (SE) with the Neural Response Telemetry (NRT) for Nucleus 24 CI wearers and to investigate the effect of modiolar placement on the stimulation thresholds and profiles, to test whether perimodiolar electrode placement does indeed result in the hypothesized reduced SE and to evaluate its usefulness as a clinical tool. 45 Nucleus CI24 patients were included in this study (15 CI24M, 15 CI24R(CS) Contour and 15 CI24RE(CA) Freedom implant wearers). NRT was performed intraoperatively. A frequency-selective curve was obtained by plotting the NRT amplitude as a function of masker electrode number, which may be interpreted as reflecting the SE through the cochlea. SE was recorded at all the electrodes with measurable neural responses. Statistical analysis of our data showed that the perimodiolar electrode placement resulted in a significant reduction in the width of SE curve. The results obtained suggest that the width of the NRT SE curves was significantly reduced in patients with perimodiolar electrode compared with the patients with conventional straight electrode array. It was also shown that modiolar location caused the reduction of NRT thresholds. At the same time it did not affect the slope of the NRT input-output function. SE provides a quick, objective measure of channel interaction. Our results suggest

that perimodiolar placement of the electrode array significantly reduces the thresholds and SE widths, which improves the selectivity of neuronal stimulation and can be used as an objective clinical tool for better prediction of the auditory performance after cochlear implantation.

D10 – 347

Clinical evaluation of the speech processor fitting based on AutoNRT

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Based on the recent tending of the drop down of the age of implantation and increase the number of difficult to program implant recipients, it is extremely important to facilitate the ECAP-based fitting procedure. The Nucleus Freedom System offers an automatic algorithm (AutoNRT) for the measurement of the ECAP thresholds. With the introduction of the Nucleus Freedom implant with new techniques of measurements and higher rates of stimulation, it is necessary to establish the relationship between the NRT thresholds and the behavioral thresholds at these rates and to evaluate the usability of AutoNRT for speech processor fitting. The aim of this study was to evaluate the correlation between intra-operative NRT measurements (thresholds and profile) and the behavioral MAP parameters (T- and C- levels and profile) in pediatric users. 16 patients implanted with the Nucleus Freedom system who were able to set psychophysically reliable T- and C- levels, were included in the study. Behavioral levels were measured at the first fitting and 3, 6 and 12 months after the switch-on. The mean difference and correlations between the intraoperative NRT data and behavioral measures (T and C levels, EAP thresholds as a percentage of the map dynamic range) will be presented. The intraoperative ECAP thresholds, when combined with a limited amount of behavioral data, may therefore be used for the prediction of the behavioral levels and MAP profile with a useful degree of accuracy for the fitting of small children and uncooperative patients.

D10 – 338

Recovery functions and spread of excitation recorded with a new Advanced Bionics objective measure software

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The new objective measures software "Research Studies Platform - Objective Measures" (RSPOM) implements various neural response imaging (NRI) measurements that can record auditory nerve reactions in response to changes in amplitude, site of excitation and temporal stimulation patterns. Compared to the clinical software Soundwave, RSPOM implements more stimulation modes, has a wider range of parameters available and has more extensive analysis possibilities. This study was initiated to gain further insight into the refractory properties of the auditory nerve and relate it to demographical and performance data. Fifteen adult cochlear implant users, all wearing a CII or HR90K device, participated in this study. Five NRI paradigms were evaluated: amplitude growth functions with different artifact reduction methods, spread of excitation measurements with changing masker or recording side and recovery functions. These measurements were repeated for 3 cochlear positions: apical, mid-cochlear and basal. Of special interest was to compare the two artifact reduction algorithms with respect to characteristics of the recovery functions, such as shape and steepness. Results were correlated with demographical and performance data. The recovery from refraction could be measured in the majority of subjects. Both methods resulted in a logarithmic curve for longer inter-pulse intervals. However, at very short inter-pulse intervals the recovery functions showed a non-monotonic behavior at least for some subjects. The non-monotonic behavior for very short inter-pulse intervals is an interesting phenomenon that needs further investigation. As it may occur with both artifact reduction paradigms and reproduces findings with the Nucleus RP8 system, method or hardware related artefacts can be excluded. Results with respect to demographics and performance will be presented and discussed at the conference.

D12 – 437

Cochlear implant in inner ear malformations

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The Cochlear Implant Group in Rovereto (GRIC) has implanted over 500 patients in the last 17 years. Sixty four had some inner ear malformation and were implanted, provided that some neural interface was present. Other cases

did not show reliable cochlear nerve supply or agenesis of the inner ear and were refused. The authors present their series of 64 patients, according to the main classification in the literature, concerning imaging, surgical technique, mapping and outcome. This group of patients is contrasted with a group of patients with inner ear malformation not suitable for cochlear implant. Gross malformation as common cavity and severe cochlear hypoplasia show lower outcome scores, as well as cochlear nerve hypoplasia. IPI I and IPI III show high risk of intraoperative gusher and require proper surgical intervention such as obliteration of the middle ear. Malformation of the posterior labyrinth neither affect results, nor surgical technique. Malformed patients are more likely to develop facial nerve twitching and show more difficult mapping, compared to their "normal anatomy" peers. Malformation of the inner ear needs proper classification, imaging and surgical technique and is likely to obtain proper auditory stimulation if proper neural interface is granted. Imaging assessment and classification is crucial to surgical planning and prognosis.

D02 – 146

Auditory and language abilities in children implanted before three years old: outcomes with different devices

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The objective of the research was to compare auditory and language skills in children using different models of cochlear implant (CI) devices. The study evaluated 40 children with pre-lingual sensory neural hearing loss who had received the cochlear implant (CI) before three years old. Subjects were divided in four groups, considering the CI device model: group 1 – children using CI PulsarCI100 device from MED-EL; group 2 – children using CI HiResolution 90K device from Advanced Bionics; group 3 – children using CI SonataTI100 device from MED-EL and group 4 – children using CI Freedom device from Cochlear Corporation. The procedure included: auditory and language abilities evaluation, using the Portuguese version of IT-MAIS and MUSS Scales. Procedures were conducted before the surgery and after three, six and nine months of cochlear implant use. The preliminary results showed a rapid improvement in the auditory abilities in the first six months of CI use for all groups. Regarding auditory skills, the performance obtained in the IT MAIS Scale after six months of CI use was 81,2% for group 1; 76,3% for group 2; 81,2% for group 3 and 77,5% for the fourth group. Children using SonataTI100 device (third group) showed the best improvement percentage on auditory skills (40%) comparing six months versus three months of CI use. Regarding language skills, the performance obtained in the MUSS Scale after six months of CI use was 33% for group 1; 30% for group 2; 21,8% for group 3 and 31,8% for the fourth group. Children using Freedom device (fourth group) showed the best improvement percentage on language skills (20%) comparing six months versus three months of CI use. Children with different models of cochlear implant systems demonstrated a continuous improvement in the auditory and language skills. Further investigation is under way.

D02 – 148

Language and hearing development in Dutch-speaking children with a cochlear implant

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Throughout the past decade, age of cochlear implantation in infants has decreased markedly due to general neonatal hearing screening in Flanders and the Netherlands. It is well known that early intervention is beneficial for the language and hearing development of hearing-impaired children. However, it is unclear what can be expected from implanted children regarding their language and hearing development, to what extent they differentiate from normal-hearing peers and which parameters mainly cause variability in performance. Since September 2008, an international research project has been launched, aimed at determining milestones in hearing, speech and language in a large group of Flemish and Dutch children with a cochlear implant. The results may guide hearing rehabilitation and education of hearing-impaired children. In a retrospective study, predictors will be determined based on existing data on language and hearing development in implanted children up to 12 years of age. Currently, a protocol is set up by reviewing recent literature and including available data of different CI-centers. First data are evaluated in a pilot study in one Flemish CI-center. Due to different procedures in each of the centers the retrospective study includes data on a variety of tests, collected at different intervals after implantation. The database includes 1. etiology and patient related data, 2. hearing, and 3. language test scores. Currently, no

standard follow-up protocol exists for implanted children in Flanders or in the Netherlands. An efficient protocol could enhance between-center information exchange and research possibilities. Findings of the retrospective study will be used to set up a protocol for a prospective study in which additional information on hearing and language development will be gathered in a standardized manner at the different locations. New tests will be developed and a more extensive test procedure will be implemented in order to enable the derivation of milestones in hearing, speech and language development in implanted Dutch-speaking children.

D12 – 439

Tinnitus in children with normal hearing in the material of the Institute of Physiology and Pathology of Hearing

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Tinnitus is a problem touching not only adults but also children. Although it accompanies numerous diseases in this age group, it is still being overlooked in the world's literature. The aim of this work was analysis of the material of 143 patients remaining under care of the Institute of Physiology and Pathology of Hearing, ages from 5 to 18, all of them with normal hearing and tinnitus. The analysis included aetiological factors, applied therapy and its efficacy. Only 33.6% of children reported tinnitus spontaneously, others did so during the interview. Constant tinnitus was present in 59.4% cases. Among the presumed risk factors count in 24.4% the emotional stress, in 20.5% infections of upper respiratory ways, in 10.9% exposure to noise and in 3.2% drug abuse. In 28.2% the apparent cause has not been ascertained. The tinnitus was perceived as disturbing mostly in silence before falling asleep and as hampering concentration and learning.

D12 – 441

Cochlear implant reimplantation

Brademann G., Mueller-Deile J.

Rising figures of cochlear implantations lead to the occurrence of a small, but unavoidable rate of device failures and complications, necessitating a cochlear reimplantation. The extent of success of such CI revision operations has been analyzed. The clinical data of cochlear implant operations performed between 1988 and 2008 in the Department of Otorhinolaryngology, Head and Neck Surgery at University of Kiel, Germany have been examined in this paper. There were overall 578 cochlear implantations up to 2008, with 21 cochlear reimplantations. In a retrospective study, the causes for such a revision operation were documented. The audiometric results before and after the CI reimplantations were compared. Furthermore, the intracochlear positions of the CI electrode arrays before and after the CI reimplantations were inspected. Typical reasons for a CI reimplantation were CI device failure by an increased humidity due to a leaking device, fracture of the housing and/or ICU due to a knock on the head, CI-array dislocation and refractory middle ear infection. 13 Children and 6 adults underwent a CI reimplantation, some of them more than once. All reimplantations were successful with proper depth of the electrode arrays. In comparison, the results of the speech intelligibility with the new CI were comparable to or even significantly better than the former CI. In Children, there was no decrement or stagnation of the audio-verbal development. Technical CI-failures should be prevented by the CI-manufacturers. A cochlear implant centre has to be able to detect CI-defects and complications, minimize them using standards and to resolve eventual problems immediately. Conclusions: A high quality initial cochlear implant operation is crucial to all revision operations. The good results in speech intelligibility, some with a CI-upgrade, in children and adults after a cochlear implant reimplantation contribute towards giving a patient confidence that there will be a good outcome after a reimplantation.

D12 – 443

Cochlear implantation in day care surgery – experiences in Oslo, Norway

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Patients are traditionally hospitalized when undergoing cochlear implantation (CI). Since the first CI was performed in 1986 at the National Hospital in Oslo, Norway, the time spent in hospital has decreased from 14 to 2 days. Restrictions in available operation theaters and ward beds in 2008 led to longer queues for CI patients. As a possible solution, CI was performed in the day care surgery unit on patients who otherwise fulfilled criteria for

that. To our knowledge, there are few reports of CI performed as day care. Questionnaire on patients' experiences during the perioperative phase to the first 30 patients who had CI in day care surgery and 20 patients who were hospitalized for CI during the same period. Questionnaire and interviews on caregivers' experiences. Postoperative vertigo, tinnitus, infections and other complications were registered. An economical analysis on differences in costs per patient was performed. Follow-up time was 1 - 6 months. Patients in day care were generally very satisfied with the procedures and with the pre- and perioperative information. They reported no more complications than the hospitalized patients. Caregiver's experienced a more effective logistics and more satisfied patients in day care as compared to hospitalization. There ranked day care patient's general condition and mood the day after surgery higher. The calculated reduction in costs per patient for CI performed in day care surgery was approximately 2500 EUR. In our hands, day care surgery has proven effective, safe and economically beneficial when performing CI on patients who otherwise fulfill criteria for day care surgery. The procedure is suitable for day care because it is well defined with respect to predictable time consumption, standardized surgical procedure and mostly low anesthesiologic risks. The need for precise coordination and planning is stressed. Extensive information to the patient on what procedures and experiences to expect is crucial.

D12 - 445

Major complications of unilateral and bilateral pediatric cochlear implantation

Cervera-Paz F.J., Valdivieso A., Manrique M.

The surveillance and investigation of causes of complications in a pediatric cochlear implant (CI) program is of outstanding interest. Upgrading technology, advances in surgical techniques, optimization of treatment modalities, or emerging problems in the follow-up (such as meningitis) may change some of the previously used methods for management of the profoundly hearing-impaired child. The series of 280 children implanted in the University of Navarra CI program from 1991 to 2008 is analyzed. We have reviewed our database and patient's chart to account for all major complications requiring revision surgery, or explantation-reimplantation. Children ages range from 0 to 14 years (mean 5). Sex ratio was almost 1:1. This study involved 174 children unilaterally implanted, 87 were bilaterally and sequentially implanted, and 19 were bilaterally and simultaneously implanted. Mean age at first surgery was 4.6 years old. An endaural incision was performed in 182 of cases and extended retroauricular in the remaining. The CI used was a Nucleus device in 98% of patients, with different CI technology upgraded. No mortality, meningitis or facial palsies were registered in the series. Only in 3 patients a major surgery-related complication occurred. In all children it was a long-term flap-related complication, and all of them were unilaterally implanted. Seven children developed a hard failure of the CI, requiring a explantation-reimplantation procedure. Four of them were children implanted unilaterally, and 3 were children implanted bilaterally and sequentially. Hard failures did not seem to have relation with device age. Regardless of children's age, surgery-related complication rate is very low in our pediatric CI program showing that cochlear implantation is a safe procedure. The most common cause of revision surgery continues to be device failure.

D12 - 447

An audit of medical, surgical and audiological complications of the first 300 paediatric cochlear implant patients in Birmingham - A learning curve

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The Birmingham paediatric cochlear implant programme has been running since 1992. A successful outcome from cochlear implantation requires appropriate decision making at many stages; from identification of the appropriate candidate, through managing the patients and parent's expectations, to competently performing the surgery and tailoring the rehabilitation process to the needs of the patient and parents. The aim of this study was to analyze whether the ongoing experience of the implantation team, both audiological and surgical, has had any impact on patient outcomes. The first three hundred consecutive paediatric patients undergoing cochlear implantation were identified using the cochlear implant database at Birmingham Children's Hospital. These patients were implanted between 1992 and 2007 and all have had a minimum of 18 months of follow up. The patients' outcomes and complications were analyzed in century cohorts. The current status of their device was recorded on this database and the patients' paper records were reviewed. The average age of implantation has fallen progressively across the series, from an average of 6.7 and 7.2 years (mean and mode) in the first 100

to 4.1 and 2.3 years (mean and mode) in the most recent 100. The non-user rate was 11% in the first hundred patients and 2% for the subsequent 200 patients. 6% of the first hundred patients' needed to be explanted compared to 3.5% (7 patients) in the following 200 patients. Of the later, 5 patients have been successfully re-implanted and are functioning well. The complications, both major and minor, have gradually reduced over the series. As the experience of the Birmingham paediatric cochlear implantation team has grown, the programme is implanting younger patients, with a greater surgical and audiological success rate. Whilst cochlear implantation has become a routine procedure for the rehabilitation of profoundly deaf children, there is a definite learning curve both in audiological assessment and rehabilitation, and operative success.

D10 - 349

The influence of increasing the IIDR in pediatric cochlear implant recipients

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This study was undertaken to investigate the influence of increasing the Instantaneous Input Dynamic Range in a heterogeneous group of pediatric Nucleus 24 recipients, when upgraded from the Esprit 3G to the Freedom processor. This was an acute study with repeated measurements, using sound field aided assessments and the BKB sentence repetition test at a conversational level (60dB(A)) and soft speech level (50dB(A)) in quiet, and in noise at the child's most challenging SNR. A custom-made questionnaire was completed in the acute phase and repeated after 3 months for follow up. Testing was initially carried out with the children's current 3G processor using a 30dB IIDR and repeated after converting their map for use with the Freedom processor, using a 50dB IIDR (25 -75dB SPL). No other changes were made to their map settings. Although data collection is still ongoing, a slight improvement was seen in sound field measures, particularly for 0.5 kHz. At this time no significant changes were seen for speech understanding in quiet and noise. Follow up questionnaires are still being collected and the results will be discussed on the poster. An increase in IIDR appeared to have some advantages for detecting soft sounds; however, a clear advantage was not seen in speech understanding. This might be due to a large number of recipients being unable to perform confidently in more challenging SNR's, which could show a larger benefit of increasing the IIDR. As the measurements were done acutely, an advantage might also appear after a period of acclimatization. A further study will investigate the IIDR using a more challenging test with roving speech levels in a group of children, able to perform on such a test.

D12 - 452

Combined technique to avoid cochlear implant complications

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The most frequent mayor complications in cochlear implant surgery are those related to the scalp and the erosion of the tympanic frame. To avoid these complications making the surgery safer we have designed some modifications to the technique. Posterior Tympanotomy: During the drilling, in cases of wide openings, with osteolysis and post superior wall reabsorption, pressure of the electrodes, tympanic frame descent, with a sac or cholesteatoma formation, it can be exposed the electrode to the tympanum. This takes relevance because most surgeons try to ill far from the facial nerve, especially with small mastoids and with large electrodes. With this new technique we make a cochlear implant roof, with a bone table over the electrode to avoid the tympanic frame descent reinforcing this frame. To avoid device infections and reinforce its fixing, we dissect the temporal muscle on a vertical plane, rounding over the device, covering it like a fan, suturing the muscle to the periosteum. This technique gives the muscle more irrigation. The scalp must be done with a firm consistence to avoid its debridement. The suture of the scalp is made with 3-0 Dexon between its borders to the periosteum border. As result of expanding and reinforcing the area that covers the implant we avoid a possible extrusion of the device. In second place if there is a middle ear infection, it is very well irrigated helping the reaching of antibiotics preventing the device infection. On third place this technique isolates the device from the skin sutures and gives enough irrigation for the skin nutrition Reinforcing the tympanic frame avoids its descent and possible electrode extrusion to the external ear canal. These modifications to the cochlear implant surgery technique can avoid these important and severe long term complications like electrodes extrusion to the external ear canal or the device extrusion due to infections or skin injury. These modifications to the cochlear implant surgery technique don't extend long the surgery times and are an easy method to be performed by any surgeon.

D12 – 448

CI particularities in a case with Fallopian apeduct dehiscence

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Case: 51 year-old woman with sequential bilateral sudden hearing loss, right peripheral facial palsy and rheumatoid arthritis became deaf in a 3 month period, with rapid deterioration of speech. She received a CI in her left ear (SONATA TI 100). During surgery, the surgeon had to deal with a complete dehiscence of the facial nerve in its mastoidian segment. Intraoperatively measurements revealed facial nerve stimulation simultaneous with the electrical stimulation of the cochlear nerve during stapedius reflex test, even at very low stimulation levels (8 qu). Solid bone-pate covering of the facial nerve during surgery and later than usual activation of the CI intended to offer appropriate results for the patient. Activation and first fitting sessions were performed at low current levels in order to avoid unpleasant facial stimulations during CI performance. Unusual anatomic conditions can be overcome with appropriate management of the cochlear implantation process.

D02 – 150

Word recognition of deaf infants after cochlear implantation

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This study aimed to evaluate the benefits of cochlear implantation in infancy in terms of the development of language skills. An important early linguistic skill is word learning. In order to learn words, infants must develop perceptual skills that allow them to recognize words in the continuous speech stream. These perceptual skills were tested in deaf infants with cochlear implants (CI). Participants were 20 infants of one and two years old. Their average age at initial stimulation was 13 months. The procedure used was the head-turn preference paradigm. The infants listened to target words and sentences with and without the target word. Their visual attention for these auditory stimuli was measured. The results show that, after 6 months of CI use, deaf infants listened longer to sentences with familiarized target words. This means that they were able to detect words in fluent speech even after only a brief period of exposure. However, individual differences, as mentioned in speech perception outcomes of older children with CI, were also present in this young group of CI-users. Surprisingly, almost all infants demonstrated a strong preference for the classical music that was presented in a pre- and post test trial. The findings demonstrate that deaf infants with CI are able to detect words in fluent speech, just like hearing infants are. Their early word segmentation skills are expected to have a positive impact on other aspects of spoken language development, such as learning of novel words. This project was funded by a grant (275-70-010) from the Netherlands Organisation for Scientific Research (NWO).

D10 – 339

Otoacoustic emission in diabetes patients with hearing loss

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Otoacoustic emission(OAE) is an important diagnostic method for inner ear cells research. OAE reflects active micromechanical process, which takes place in outer cells of Cortis organ. The aim of our article was the recognizing of diagnostic meaning of OAE in patients with hearing loss and diabetes. The present study included the following steps - anamnesis, audiometry, impedansometry, otoacoustic emission. 65 diabetes patients, who had no complains about the hearing loss and 30 healthy volunteers of the appropriate age and sex, were observed. The age of patients was from 25 to 58 years. As the patients aged over 60 were excluded because otoacoustic emission even in norm can be registered in only 35-55% of cases. Thresholds of perception with tone audiometry in all patients were in the range of 20dB. The results showed that at a frequency of 1000 Hz for the majority of the surveyed patients with diabetes, the average interval between the curves of noise and otoacoustic emission was close to normal, while at frequencies of 6000, 8000, and 10000 Hz observed changes in the ratio at 57% of patients, which we believe is related to the earlier violations of basal parts of cochlear, which are not detected by other methods. Studies have shown the presence of early hidden changes in auditory functions of diabetes patients that are not clinically apparent. Performing them the otoacoustic emission gives the possibility to diagnose the changes in early stage to carry out curative measures to prevent the development of hearing disorders.

D02 – 152

Speech perception and language development in early implanted deaf children with and without associated disabilities

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The aim of the study is to asses speech and language development in 28 children (younger than 26 months of age) with (dis+) and without (dis-) associated disabilities who underwent cochlear implantation between January 2000 and May 2006 in the Regional Hospital of Treviso- Padova University. These young patients were divided into two groups according to the presence or absence of associated-disabilities: the first group was composed by 18 children, the second by 10 children. Each patient was hearing aided with power devices at list for 5 months before surgery. They all underwent speech therapy before surgery. Auditory threshold (aided and unaided), perceptive skills and communicative-verbal skills were studied preoperatively. The tests used to evaluate speech perception for Italian language (P.Ca.P., T.I.P.I. 1 and T.I.P.I. 2) derived from the tests produced for English language (ESP, WIPI, NU-CHIPS). Preoperative data were compared with data obtained after cochlear implantation. Children were always evaluated at 3-6-12 and 24 months after the activation of the device. In children without associated disabilities the passage from the most elementary perceptive skills of the preoperative stage to the superior stages, is already visible 3 months after activation; the evaluation of the communicative abilities shows a slower evolution, but, after a 24 months follow up, an improvement of the morphosyntactic score with the development of the main grammatical rules and the production of simple propositions are present. Regarding children with associated disabilities we have to wait two years to see a significant improvement of speech perception skills, while the evolution of morphosyntactic skills remains at the presyntactic level with the production of single word sequences. The results of our study confirm, as expected, the advantages of cochlear implantation in prelingual deaf children regarding the functional hearing gain, especially at acute frequencies (2000-4000Hz) in both groups.

D02 – 166

Recognising additional disabilities in children implanted under two years

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The presence of additional disabilities is known to impact on rate of progress post implant. This retrospective study reviewed data on children implanted under two years to determine whether additional disabilities were recognised pre or post implant and the impact these disabilities had on progress. The group comprised 30 children implanted under two years with at least one year implant use. The Children's Implant Profile (CHIP) was used to identify concerns pre implant. Medical and speech language therapy reports were reviewed to ascertain diagnoses post implant. Outcomes were assessed using the Meaningful Auditory Integration Scale (MAIS) and Categories of Auditory Performance (CAP). Twenty children showed no evidence of disability pre or post implant. Ten children were diagnosed with a disability by one year post implant. Concern had been expressed on the CHIP for four of this group. No concern pre implant had been expressed for the other six children. At one year post implant outcome measures showed lower rates of progress for the children with disabilities than for the group with no disability. In this study 60% of additional disabilities were not recognised pre implant. None of the speech and language disorders and only one of the three cases of Autistic Spectrum Disorder had been diagnosed. Developmental delay was most likely to be diagnosed pre implant. It is difficult to diagnose some additional disabilities in children implanted under two years. Diagnosis can often be delayed in deaf children. Recognizing additional disabilities is important to guide parents regarding outcomes. Current assessments pre implant may not be sensitive to identifying additional disabilities. Outcomes at one year may highlight the presence of additional disabilities and prompt further investigation by the implant team and/or referral to other agencies, and renewed expectations counseling.

D10 – 346

Auditory evoked potentials after cochlear implantation

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It has been suggested that auditory evoked potentials (AEPs) provide valuable information about the adaptation and cortical re-organisation of the auditory system in response to CI stimulation. AEPs may, therefore, be of predictive value with regard to the outcome of the CI treatment. However, the analysis of AEPs in CI users is complicated by the huge electrical artefact caused by the CI and the perfect phase-locking between the CI artefact and the AEPs. Following on from our successful case study that reported high quality EEG data and AEPs from a single CI user (Debener et al., 2008), an on-going project is underway to study neural correlates of auditory rehabilitation following cochlear implantation in adults. To date, high density EEG recordings from up to 68 channels have been obtained from 17 CI users. All received their implant between 3 months and 6 years prior to taking part in the study. Inspection of the data revealed that acoustic stimulation produced an artefact that was evident in every single trial and visible in several EEG channels. Independent component analysis (ICA) successfully separated CI-related artefacts from AEPs in 13 out of 17 of the CI users. Butterfly plots, showing data from all channels, and associated topographies of the resulting AEPs illustrated that component N1 could be clearly identified and was consistent across all channels. Preliminary analysis of the N1 peak latency at electrode Cz showed this to be significantly delayed in CI users (mean = 127 + 17 ms) compared to a group of normally hearing participants (mean = 100 + 8 ms, $p < .01$). In contrast, N1 peak amplitude at Cz for the CI users (mean = -2.5 + 1.2 μ V) did not differ significantly from the normal group (mean = -3.5 + 1.3 μ V, $p > .05$). Further analysis will aim to correlate these amplitude and latency measures to known CI outcome predictors, such as duration of deafness prior to implantation, and other clinical measures of performance, such as BKB speech tests. These preliminary findings suggest that the latency of the N1 may reflect adaptation of the auditory cortex to the artificial input provided by a cochlear implant. The data are part of an on-going project and future analysis will include single subject source localization and analysis of regional source waveforms. References: Debener S., Hine J., Bleeck S & Eyles J. 2008. Source localization of auditory evoked potentials after cochlear implantation. *Psychophysiology*, 45, 20-4.

D10 – 350

Using multi-channel Auditory steady state response to predict hearing level in high risk group infants

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The purpose of this study is to evaluate whether multi-channel auditory steady state response (ASSR) is capable to estimate hearing thresholds in high risk group infants. This is a retrospective study, conducted at tertiary referral centers. Infants born during Jan, 2004 to Dec. 2006 and met the criteria of risk factors for congenital hearing loss were enrolled. Multi-channel auditory steady state response was used to obtain ASSR thresholds before the age of 12 months. After these children grew up, conditioned play audiometry was used to obtain pure tone audiogram (PTA) between the ages of 22 to 40 months old. The correlation between ASSR and pure tone audiogram thresholds was compared. 287 high risk group infants were enrolled. 216 infants fulfilled both examinations. The correlation coefficient (r) of ASSR and pure tone thresholds were 0.88, 0.94, 0.94 and 0.97 at 500, 1000, 2000 and 4000 Hz, respectively. The strength of the relationship between ASSR and pure tone thresholds increased with increasing degree of hearing loss and increasing frequency. Multi-channel ASSR was a reliable and convenient audiometric assessment tool in high risk group infants. It provided information for early hearing habilitation.

D02 – 165

Language patterns in older children with a severe hearing loss and hearing aids: spontaneous language analysis as a baseline before cochlear implantation

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Some children with a severe hearing loss show a marked speech- and language development using conventional hearing aids. When those children are avid communicators, they are often able to communicate in an efficient way through spoken language. Limited skills in speech perception or progression of the hearing loss can be a reason to consider cochlear implantation when they get older (> about 9 years). At this age it is important to obtain a detailed and differentiated description of the spoken language as a baseline for specific rehabilitation. Two children with a severe congenital hearing loss received a cochlear implant mid-April 2008. Both presented themselves as being proficient in communication through spoken language, although their linguistic skills were not at the same level as their hearing peers. Prior to implantation, we made a recording of their spontaneous language which was analyzed by using the STAP method (Van den Dungen en Verbeek, 1999). An analysis of spontaneous language was used to obtain an accurate description of the specific aspects of language which had been affected by the hearing loss. We preferred using this method over regular tests for different aspects of language because the information obtained by means of an analysis of spontaneous language gives a more realistic reflection of linguistic capacities in spoken language. The language of both children appeared to be severely impaired in specific qualitative aspects. Morfosyntactic impairment was most prominent, but in semantic and pragmatic skills both children showed an inadequate acquisition as well. An analysis of spontaneous language in older children with a severe hearing loss prior to cochlear implantation results in detailed directives for linguistic rehabilitation with an improved auditory input. This analysis is recommended when considering implantation in older children.

D02 – 154

Children with cochlear implant in conversation with hearing peers

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The purpose of this study is to explore conversational skills in Swedish children with CI. We believe that the ability to take part in everyday conversation is the ultimate measure of a child's language and communicative competence. The material consists of recordings of interaction in a referential communication task designed to reassemble a problem-solving in task in school. The conversations were transcribed and analyzed with focus on requests for clarification. Thirteen participants with CI, aged 11;9-19;1 participated. All attended mainstream education. They were individually matched regarding age and gender to a control group of hearing children. Each child with CI and each hearing child chose a hearing conversational partner of the same age to act as a conversational partner in the referential communication task. All participants took an active part in the interaction as cooperative and responsible conversational partners. The children with CI used significantly more requests for clarification than the hearing children. All children used predominantly specific rather than nonspecific requests for clarification. The children with CI used a significantly higher proportion of questions that required yes/no answers. The findings differ slightly from what has been found for other clinical populations. One explanation might be the structure of the task. Another might be that the children with CI, due to their hearing impairment, are aware of their shortcomings and therefore more used to and comfortable asking for clarifying information. The children with CI in mainstream education seem to prefer a strategy keeping them "on the safe side". They use a request whenever something is not understood or heard and they also take control of the conversation by seeking simple yes/no answers.

D02 – 158

How well can deaf children with a CI (2.5 to 5 years old) explain other people's thoughts and predict their behaviour?

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Receiving a CI could enable deaf children to overhear conversations and learn about people's motives for behaviour. This might help in acquiring a Theory of Mind (ToM); the notion that other people can have -and act according

to- beliefs and desires different from your own. A functional ToM is essential because it guides our responses in social interactions and aids in forming and retaining meaningful relationships. Although parents' reports on children's social development after CI implantation are positive, the only study to date that examined CI children's ToM capacities showed a delay compared to a hearing control group (Peterson, 2004). However, Peterson's subjects were implanted between 2 and 5 years of age, while currently most children receive their CI between the ages of 1 and 3. Therefore, we compare ToM development in 2.5 to 5-year-old CI children who received their implant at an early age to a matched hearing control group. Several tasks measuring ToM capacities were developed and validated in a pilot study among 50 hearing children (Mage = 44,44 months, sd=8,85). E.g., children were asked to predict a protagonist's behaviour according to his desire (adapted from Rieffe, Meerum Terwogt, Kooops, Stegge & Oomen, 2000), predict where a protagonist would search for an object according to his false belief (adapted from Wimmer & Perner, 1983), and explain their own changed belief (adapted from Hughes, Lecce & Wilson, 2007). Stories and questions were short and were supported by drawings. Predicting behaviour based on false beliefs is more difficult than predicting behaviour based on desires or explaining the own changed belief (30%, 83% and 69% correct answers respectively). The data suggest a developmental pattern. These tasks are currently being administered to CI children. In this presentation, performances of both groups are compared and differences in developmental patterns are examined.

D12 – 434

Electrostimulation in rehabilitation patients with tinnitus

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Tinnitus is acoustical sensation in one or two ears, which arises in the result of absence of an acoustic impulse in the environment. 17% of our population suffers of this disease. Despite the fact that there are a lot of methods of treatment of this pathology. The results of its treatment remain insufficient. The purpose of work is to estimate results of treatment of the patients suffering sensorineural deafness in a combination to subjective ear noise. During the period 2004 - 2008 in clinic of the Grodno State Medical University was cured 206 patients with subjective ear noise and sensorineural deafness using the electrostimulation method. Among the patients there were 112 (54,4%) of men and 94 (45,6%) of women. Their age was from 16 to 70 years. The duration of tinnitus was from 1 month to 38 years. The electrostimulation was held with the help of "Amplipuls-4", which is modified with intracochlear electrode. The procedure lasted 15 min. The course of treatment lasted for 10 procedures. The results: 33 (16%) patients with tinnitus disappeared completely after the treatment. The positive effect was reached with 61 (29,6%) patients. Insignificant noise was kept, but didn't disturb them. 99 (48,1%) person - tinnitus decreased slightly, but the weight of noise sensation decreased also. In 13 (6,3%) of cases the intensity of noise didn't changed, the sensation of the noise was still continued to disturb patients. The general positive result was noted in 45,6% of patients. So, the usage of electrostimulation has allowed to achieve the good result in treatment of patients with tinnitus and sensorineural deafness. The method and its technique are safe and effective.

D12 – 451

ABI in non-NF2 children: A case report

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So far 19 Scandinavian patients have been treated with Auditory Brainstem Implant (ABI) in Uppsala, Sweden. This includes 3 children. Here we present preoperative investigations and the preliminary postoperative results of a two year old boy with Goldenhaars syndrome. Thorough audiological tests showed total deafness of both ears. MRI showed absence of auditory nerves and aberrant course of the facial nerve. The boy was then operated with the translabyrinthine technique. In order to verify total absence of auditory nerve function a cochlear implant was first inserted and ABR/NRT performed. No responses were elicited and the CI extracted and the translabyrinthine approach used to reach the cerebellopontine angle with atypical topography. The ABI (Cochlear Inc.) was placed and peroperative control showed good responses over the entire electrode array. The results of audio-vestibular and MRI tests will be shown and discussed as well as the preliminary auditory results immediately after ABI switch-on.

D02 – 162

Speech recognition performance in children who underwent cochlear reimplantation in the contralateral ear

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A growing number of children experience problems with their cochlear implant (CI) leading to the removal of the internal device. Mainly because of medical reasons (e.g. ossification, chronic ear infections), a new CI cannot be placed in the same ear (Cote et al., 2007). Therefore, they receive a CI in the contralateral ear, although expected speech perception benefits remain uncertain. Retrospective case review. Eight patients previously received a CI between the age of 2 and 5. After 4-10 years of use, these children had to be reimplanted for failure of the internal device or medical problems. Various factors prevented revision implantation in the same ear. Revision implantation was carried out successfully for all cases. Following reimplantation, some children demonstrated a significant deterioration in performance whereas others demonstrated similar hearing abilities early on. Within 3 months after reimplantation, all participants had achieved at least similar levels of speech perception compared to the performance achieved with the first implant. Three of the 8 participants exceeded the levels attained with the first implant. The technology used did not seem to have a major impact on the benefits. Results suggest that reimplantation in the contralateral ear allowed all children to achieve speech perception levels at least equal to those obtained with their first implant, even though the contralateral ear had not been stimulated for years. This retrospective study provides evidence of maintained speech perception benefits after cochlear reimplantation in the contralateral ear. However, counseling before reimplantation remains important to well inform the patient about the possible loss in speech performance immediately after reimplantation. Future research should investigate on longer durations of deafness in the contralateral ear.

D02 – 160

Communication ways of implanted children attending different schools

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Speech perception on auditory way by an deaf child has big influence on his psychophysical development. Early implantation produces better rehabilitation results and speech competency. Goal of this paper was to proof that implantation age, rehabilitation and school type selection plays a large role on way of communication of implanted child. 123 children age seven to thirteen participated in the study. They were divided into 3 groups depending on the age of implantation. Forty four children implanted before 4 y.o.a. Fifty eight children implanted between 4 and 7 y.o.a. Twenty one children implanted later than 7 y.o.a. Authors used survey results conducted among school teachers supplemented with logopedic examination. In logopedic examination authors investigated 4 different planes: speech understanding, naming, repeating and articulation. About 70% of children attending mass-schools achieved good results on each investigated plane. In integration schools average result were about 5-10% lower; special schools for deaf children allowed only about 40% of children to achieve good speech competence. In conclusion authors stated: 1. Implantation age has a large impact on speech development in lexical, semantic and syntactic planes. 2. Level of speech competence influences choice of school type for further education 3. Depending on child didactic and upbringing environment (hearing or deaf people), it shows communication ways characteristic for particular community 4. Early implanted children (before 4 y.o.a.) attending mass schools are showing complex communicational behaviors and achieving better outcomes in logopedic tests.

D02 – 157

Speech perception improvement in children with cochlear implant

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The aim of this study was to assess speech perception of improvement in children with cochlear implant. fourteen children (9 males and 5 females) with mean age 5.5 years implanted in Amir Alam hospital from August, 2004 to October, 2006 were studied. Auditory training sessions was performed in 10 to 43 sessions. All patients have evaluated every 3 months. Third evaluation has been done only for 4 patients. The average of the total score of the first evaluation was 43.21%, of the second was 63.76%, and of the third evaluation was

78%. All children obtained complete score for sound awareness from the first evaluation. In environmental sounds discrimination 71.3%, 84.36%, and 100% children completely answered to questions for three evaluations, respectively. For speech sounds discrimination, 34.7% of theirs in first, 57.04% of patients for second, and 85% of theirs in third evaluation obtained complete score, and for auditory memory, fully responded 21% for first, 57.12% for second, and 83% for third evaluation. In the skill of story rephrase and comprehension also did not answered to questions any children, but for second and third evaluations respectively 12.83% and 12.83% of children obtained complete score. There were statistically significant differences between the first and the second evaluation ($p=0.002$). It seems sound awareness ability is achieved rapidly. To access to other abilities for speech and environmental sound discrimination broader training is needed. Speech comprehension, the last and in fact the most important ability is not accessible for communication with this rehabilitation period. A challenge for future research is to determine the relationship between the perception and rehabilitation period. The parents should be noticed to have more cooperation to continue the rehabilitation process.

D02 – 164

Aural rehabilitation through cochlear implant: Audiological, language, speech and voice assessment

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Since the beginning of the pediatric cochlear implantation program, in 1992, 314 children have been implanted, 5 of them bilateral, in Centro Hospitalar de Coimbra. The etiology was for the most part congenital (63% of cases) and meningitis (7,8% of cases). The age of implantation was less than 3 years in 73% of children. 55,9% of the implanted individuals are males and 44,1% are females. 85% were implanted in the right ear and 15% in the left ear. In this work, the authors have evaluated the tonal and vocal functional gain, discrimination tests adapted to the age of the individuals, auditory comprehension, speech and language in 142 children with more than 5 years of implantation. The evaluation was composed of auditory perception, language development and speech production tests. The monosyllables, numbers and sentences discrimination tests (Portuguese European Language tests) were presented in free field with recorded lists using SFS software through the audiometer at 65dB SPL. The scales CAP and SIR, portuguese test that evaluates language development (Compreensao de Estruturas Complexas) speech production (Teste de Articulação Verbal), vocal characteristics (Grelha de Avaliação das Características Vocais - GACV) and a vowel discrimination test were also used. 142 individuals were evaluated with the monosyllables discrimination test; 78,1% achieved 50% discrimination; 41,5% achieved 70%; regarding phonemic discrimination mean of 76,25 is achieved, median 81,40 and standard deviation 17,87. 142 individuals were evaluated with the numbers discrimination test; 96,5% achieved 50% discrimination; 90% achieved 70%, regarding phonemic discrimination mean of 93 is achieved, median 98,85 and standard deviation 13,97. 142 individuals were evaluated with the sentences discrimination test; 76% achieved 50% discrimination; 51,9% achieved 70% discrimination. 133 individuals were evaluated with the vowel discrimination test; the results were an average of 97,42%, and standard deviations of 11,04. 190 individuals were evaluated with the SIR scale; 13,2% were scored on level 3,16,8% on level 4 and 58,9% on level 5. 127 individuals were evaluated with the CAP scale; 28,3% were scored on level 4, 30,7% on level 5, 17,3% on level 6 and 22% on level 7. 209 individuals were evaluated with the GACV scale; 4,3% were scored on level 3,34% on level 4 and 58,4% on level 5. Complex sentences comprehension test (Teste de Compreensao de Estruturas Complexas) ($n=100$) the results were an average of 61,67%, and standard deviations of 26,5. Speech production test (Teste de Articulação Verbal) ($N=171$) the results were an average of 77,6%, and standard deviations of 20,85. The results express a good performance in speech intelligibility, with a good articulation level and a good voice quality, according to the results published by other international cochlear implant center. Despite these numbers, inferior results were verified in language development tests. These results may be justified by inadequate pedagogic programs.

D12 – 450

Auditory outcomes and difficulties in fitting implanted children with additional disabilities

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Retrospective study on cochlear implantation in children with multiple disabilities. Introduction of Newborn Hearing Screening Program in Poland

and innovations in neonatology care led to increase the number of detected cases of deaf children with additional handicaps. Their additional disabilities make difficulties in fitting and evaluating their potential outcomes. Group of 30 children with additional disabilities implanted in Medical University of Warsaw was evaluated using auditory measures and Quality of life profile. In this group were children with psychophysical developmental delays because of mental retardation, autism, cerebral palsy, prolonged stay in NICU, prolonged mechanical ventilation, prematurity. Results in this group of children differ and are related to medical factors. Because of these factors programming implanted children with additional disabilities is more difficult and their performance is worse than in only deaf children. Estimation of THR and MCL levels took more time. In these group often we did not have NRT or NRI measurements, helping in prediction of their thresholds. It happened more often that children took off their speech processors. All children showed improved auditory detection following implantation. Some of them differentiated instruments sounds, detected and discriminated LING sounds. In few cases they identified primary words. Quality of life profile indicated that parents reported benefits from cochlear implants. Benefits of patients with additional disabilities suggest that their benefits from cochlear implants should be estimated in a different way than to only deaf children. These results would not be satisfied in only deaf children, but are quite important in everyday life of handicap patients; let them to communicate with surroundings in small arrange.

D12 – 433

CI explantation and reimplantation in children. Causes, methods and results

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Major complications requiring CI explantation have special relevance in children because the biggest diagnosis difficulties and the importance of hearing deprivation in the speech development on early ages. Retrospective study in a tertiary referral center. The total explantation cases are 29 (about 6% of patients), 22 cases with CI failure and 7 for medical problems. The CI used was different models of Nucleus and Medel. Eight of them were children between 1 and 16 year old when the reimplantation was performed. The interval between the CI implantation and the explantation varies between 17 months to 6 years. The most frequent reason for revision surgery was device failure (7 children). The interval from implantation is from 2 months to 6 years. The final study of the explanted device was electrode problems in 6 cases, hermeticity failure in 1 and no evidence of problem in 1 (soft failure). The other three cases presented CI related infection. Two of them the infection was next to the receiver (staphylococcus, the clinic was pain and swelling; other presents a temporal bone necrosis around the cochlea. The explantation was performed leaving the intracochlear electrode with reimplantation after 2 months. No infection has been observed in ceramic CI. The clinic was sudden hearing loss (1 case) progressive (4 cases) intermittent hearing decrement (2 cases) and performance decrement (1 case). The tests in vivo were normal in 3 cases but the device study show diverse failures. The most common reason for reimplantation is the CI failure, but the integrity test of CI are no reliable in all cases and the diagnosis can be delayed. The most frequent infection is in silicone CI receiver devices and can be related with contamination during the surgery. Two stages surgery in same ear is possible, leaving a intracochlear electrode at first stage.

D10 – 352

Follow up report on device reliability

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Uncompromised functionality of cochlear implants throughout their intended lifetime is of utmost importance for cochlear implant recipients. Any incident reducing the performance of cochlear implant systems or requiring surgical intervention - no matter whether it is device related or due to medical or surgical root cause - represents a dramatic and difficult situation for each patient. Therefore it is essential to have clear and transparent information about the overall field performance of implantable devices. In many countries, clinicians as well as manufacturers have to report device failures and incidents reducing the performance to the competent authorities of the government, following local laws. Manufacturers reports of device reliability have been and are performed based on ISO standard 5841-2:2000 throughout the last years. This standard originally targeted on reliability reporting of pacemakers and was adopted by the cochlear implant industry. The authors present own data and extended device related reliability reporting by additional cumulative survival rates, which also include medical and surgical incidents resulting in

explanation. These additional numbers allow a precise and comparable assessment of global field performance of cochlear implants and thus complete the currently available device related CSR published by cochlear implant manufacturers. Cochlear implant revisions should be analyzed as detailed as possible to achieve progress for our patients. The proposed reporting procedure provides a complete picture of CI field performance. With its complete transparency this approach provides valuable information for patients and clinicians in the process of selecting the cochlear implant solution best matching individual expectations. Data show that cochlear implantation is a safe and reliable procedure.

D10 – 353

Comparison of postoperative automated and manual Neural Response Telemetry in children implanted with the Freedom electrode

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The Neural Response Telemetry (NRT) measurement provides an objective means of assessing auditory nerve condition and facilitates the fitting procedure. The objective of this study was to compare neural responses obtained previous to the initial tune-up, using the Custom Sound EP2.0, between the automatic and the manual way, in children implanted with the Freedom electrode. 20 implanted children were evaluated with NRT post-operative in electrodes 20, 15, 10, 5 using the automated and manual way. The total amount of electrodes measured was compared and values found in each way will be presented. The t-NRT post-operative values in all the electrodes studied, using the automated modality was similar to the manual values, and in media automatic values are higher. T-NRT evaluated by an audiologist and by the software showed good accordance, so auto NRT seems to be a valuable instrument. The auto NRT values provide a basis to fit the speech processor. This is very important in children and adults who are not able to give sufficient feedback. This automatic mode should be considered a time efficient tool of the Custom Sound EP2.0 for the Freedom electrode and results are comparable with human experts' results. It is also clear the t-NRT measures reflect peripheral mechanism and not central processes. More children and adults should be evaluated intra and post-operatively, to have more information of the t-NRT values in both modalities: automated and manual.

D02 – 156

Creation of complications of implanted children's speech perception and demonstration of their solution to normal hearing persons

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There are the parallels between speech perception of implanted patients and speech perception after comb filtration by normal hearing persons. Due to this fact there is possibility to train inexperienced subjects to perceive spectrally deprived speech and to explain the complexities of implanted children's acoustical perception to their relatives. We used comb filtered speech (3 spectral bands of 50 Hz width in range of 200-6250 Hz). Order of presentation : 1. Measurement of transformed words' intelligibility (1-st test). 2. Training by informing parents which word they would hear. 3. Measurement of the same words' intelligibility (2-nd test). 4. Measurement of the new words' intelligibility (control). Mean result of the 1-st test is 17% of words (range was 0-33%). While presenting words with the preliminary familiarization of which word would be presented, it turned out, that words became more clear recognized ones. Mean 2-nd test result was 57% (range was 40-75%). Control test result was 52%. Different individual results of the first test are a clear illustration of differences between implanted patients. The high result of the control test clearly proves to the parents that it is possible to improve their children's speech perception through training. The result of training is the equalization of abilities to perceive impoverished speech. Owing to differences between normal hearing subjects in understanding spectrally deprived speech, an audiologist can explain different abilities of CI-patients to understand speech. Parents' own comparison of speech quality, impressions during training and control testing is a demonstration of CI-patients' own solution to their problems. The implanted children's mothers highly appreciated the demonstration and recommended to all mothers to take part in such assessments. Up to date more than 90 subjects had been investigated.

D02 – 145

Early speech and language development of young Finnish deaf born children during the first two years of using a cochlear implant

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Wide international agreement exists that the age while receiving a cochlear implant has important implications on the probability to reach close to normal levels of spoken language abilities. The younger the recipient is, the higher the probability. Therefore, the age of children receiving a cochlear implant has decreased also in Finland. The aim of this prospective longitudinal work is to assess the development of early speech and language abilities of young Finnish cochlear implanted children. This has not yet been studied systematically. There is also a shortage of normative data on the early auditory development of Finnish children with normal hearing. To fill this gap, normative data were collected using the LittlEARS Auditory Questionnaire 1. adapted into Finnish. All subjects have received cochlear implants under the age of two years and have no additional handicaps. This is a national study and the possibility to take part in it is offered to all families of deaf-born Finnish children who meet the criteria. The data collection will continue until the end of 2010. The data will be analyzed both statistically and qualitatively and compared to normative values of Finnish children with normal hearing. Speech and language assessments are undertaken six times during the 2-year follow-up and they consist of seven different assessment tools including e.g. Reynell Developmental Language Scales III 2. and Categories of Auditory Performance (3,4). Also a video recording will be carried out at the end of the follow-up to analyse children's conversational abilities in detail. Comprehensive background information is gathered including information of the amount of speech and language therapy received and this information will be taken into account in the analysis. Preliminary data on the on-going work with Finnish cochlear implanted children are presented and discussed together with the final results on Finnish children with normal hearing. 1. Kühn-Inacker, H., Weichbold, V., Tsiakpini L., Coninx, F. & D'Haese, P. (2003) LittlEARS Auditory Questionnaire, manual. Innsbruck: MED-EL. 2. Reynell Developmental Language Scales III, Third edition Manual 1997. Finnish adaptation, Psykologien kustannus Oy, Helsinki. 3. Archbold, S., Lutman, M.E. & Marshall D.H. (1995) Categories of auditory performance. *Annals of Otology, Rhinology & Laryngology* 104 (suppl. 166), 312-314. (4) Archbold, S., Lutman, M.E. & Nikolopoulos, T. (1998) Categories of auditory performance: inter-user reliability. *British journal of audiology* 32, 7-12.

D02 – 159

Evaluation of speech intelligibility of children with cochlear implant

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Cochlear implantation is an effective treatment for hearing impaired children who gain little or no benefit from hearing aids. The development of intelligible spoken language is an ultimate outcome measured for pediatric cochlear implantation and also an index for the further development of language and speech abilities. Speech intelligibility is a measure of the extent to which listeners receive the verbal information that speakers intend to present. SI is not only as an effectiveness evaluator for speech development, but also reflects most fluctuate conditions of daily communication status through how much the listener understands what the subject is saying. The aim of the study evaluate the relationship between speech intelligibility and duration of implants use. The effects of the age at implantation will be evaluated.....cochlear-implanted children with their ages ranging from...to...years (mean = ... S.D. = ...) participated in this study. Their age at the time of implantation ranged from... to... years (mean = ..., S.D. = ...), the post-implantation period ranged from... to... years. Speech intelligibility will be represented with the speech intelligibility ratings (SIR) and the correct percentage of dictation. The relationships between speech intelligibility, age at implantation and duration of implant will be evaluated by linear regression analysis. Average of speech intelligibility of subjects, correlation with age and duration of cochlear implant will be presented. The results of study will be discussed.

D12 – 435

Neural distribution of hearing structures in inner ear malformations and the need of further cochlear implant stimulation strategies

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The aim of the study are to present the cochlear neural distribution on diverse congenital malformed inner ears and to introduce the possibility of cochlear implant stimulation throughout temporal elements. 16 patients suffering diverse cochlear malformations have been implanted in our Otolaryngology Service in the last 10 years. An embryological descriptive study based on the neural distribution was performed in order to assess the neural distribution on congenital inner ear malformations. Also, the cochlear implant fitting results and speech discrimination outcomes are presented. The morphology of inner ear malformations reflects the diverse embryological development stages of the inner ear. The more severe the malformation is, the less distribution and maturation of the neural structures inside the cochlea. Also, the more severe the malformation the higher electrical thresholds, the higher electrical charges needed to stimulate the hearing structures and the worst speech discrimination results. Major malformations (common cavities and hypoplasias) showed poor speech discrimination outcomes. Eventhough higher charges are available with actual cochlear implant devices, the poor speech discrimination outcomes reflect the deficient distribution and maturation strategies based on pitch distribution and so we believe that stimulation strategies should take advantage of temporary elements that may perceive these patients.

D02 – 147

Canonical babbling of children with normal hearing and children with cochlear implants

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The onset of canonical babbling has been shown to be a very important milestone in children who are typically developing. Our aim was to document the precanonical and canonical vocalisations of children receiving cochlear implants (CIs) at a very young age and compare these with the vocal development of children with normal hearing. 10 children participated in this longitudinal study: 5 with NH (aged 4 to 5 months) and 5 with sensorineural hearing loss (aged 9 months to 1.4 years). The second group received hearing instruments before CIs; all in this group are now bilateral CI users. We video- and audio-taped the preverbal utterances of both groups during semi-structured play sessions occurring every four weeks for one year. We analysed all utterances according to Ertmer's (2001, 2002) "Three-level classification system". All children passed through a pre-canonical stage with vocalisations like /b/, /mba/, and /da/, before canonical babbling began. The onset of canonical babbling occurred in the CI group between 13-16 months of chronological age (CA). In the NH group, canonical babbling began at 4-9 months of CA. The CI group's vocal development was not qualitatively or quantitatively different from the NH group's, except for the fact that it occurred at a later CA. Future, more in-depth analyses of canonical babbling in children with CI may reveal whether it has the same prognostic relevance for these children as it has been shown to have in children with typical development patterns. Scientific and clinical evidence in this field could help parents and professionals to identify crucial developmental levels and to support children in acquiring speech skills.

D10 – 341

A filtered speech test to better evaluate EAS candidacy

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EAS is a new solution for treatment of partial deafness. But actually some patients, despite hearing preservation, may not greatly improve their speech understanding with EAS compared to CI alone. The aim of this study is to evaluate, for each patient with high-frequency hearing loss, the intelligibility provided by residual low-frequencies, in order to assess if a patient is a good candidate for EAS or if, on the contrary, bimodal stimulation will not provide enough benefit. The French FOURNIER's lists of dissyllabic words were used in this study. They were low-pass filtered at several cut-off frequencies every 1/2 -octave (2000; 1414; 1000; 707; 500; 353; 250 Hz). We performed speech audiometry tests on 20 normal-hearing listeners with unfiltered and filtered

lists, in order to establish a normalized model of "speech intelligibility depending on the low-pass cut-off frequency". We then reproduced these tests with 27 hearing-impaired listeners (52 ears) with a high-frequency hearing loss and we then compared the results. We found different patterns of results which allowed us to classify the patients in 4 categories, depending on the contribution of the low-frequencies for intelligibility. This test allows to know if a patient only uses his low frequencies to understand, and if EAS will provide him enough benefit. Classical audiometry tests are not sufficient to investigate how a patient uses his low-frequencies residual hearing to understand. This test may be a complementary tool for the evaluation of EAS candidacy.

D12 – 438

Audiologic and rehabilitative findings in congenital inner ear malformations with cochlear implantation

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Improvements in audiological and radiological test methods make it possible to diagnose the anomalies earlier than before. The aim of this study is to report the impact of cochlear implantation in children with different types of inner ear malformations. This is a retrospective study. All subjects were classified according to Sennaroglu and Saatci's classification and had undergone implantation. They were matched and compared with a group of children with normal cochlea who had undergone cochlear implantation. All subjects were programmed two weeks after surgery. Incomplete partition (IP) type II and Large vestibular aqueduct (LVA) malformations were followed similar to CI patients with normal cochlear anatomy. Type I and common cavity patients needed more frequent follow up for programming, because the parameters showed more variability when compared to normal cases. They were tested with closed and open set speech perception tests (MAIS, IT-MAIS, Turkish Common Phrases, Word Identification Test). After cochlear implantation patients with IP-II and LVA malformations demonstrated speech perception similar to patients with normal cochleovestibular anatomy. IP-I and common cavity patients showed very slow progress in the first year and they showed better performance in the second year. In spite of difficulties in audiological management and rehabilitation, early implantation in malformations gives better outcome.

D12 – 440

Cochlear implantation in patients with bilateral cochlear trauma

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Temporal bone fracture, which involves the otic capsule can lead to complete loss of auditory and vestibular function, whereas the patients without fractures may experience profound sensorineural hearing loss due to cochlear concussion. Cochlear implant is indicated in profound sensorineural hearing loss due to cochlear trauma but who still have an intact auditory nerve. Patients who have cochlear implanted after the cochlear trauma in our department between 2001 and 2006. All patients performed very well with their implants, obtained open set speech understanding. They all became good telephone users after implantation. Their performance in speech understanding was comparable to standard postlingual adult patients implanted. Cochlear implantation is an effective aural rehabilitation in profound SNHL caused by temporal bone trauma. Preoperative temporal bone CT, MRI and promontorium stimulation testing are necessary to make decision for the surgery and the side to be implanted. Surgery could be challenging and complicated because of anatomical irregularity. Moreover fibrosis and partial or total ossification within the cochlea must be expected.

D02 – 161

Initial use of Hebrew version of the Speech, Spatial and Qualities (SSQ) questionnaire for hearing performance assessment of CI candidates and unilateral implantees

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The successful use of cochlear implant (CI) and improvements in hearing aid (HA) technology led to a more significant involvement of individuals with severe to profound hearing loss in the hearing society. Evaluation of

performance in these individuals should include also performance in dynamic listening environment, aspects which are not well enough represented in the traditional hearing assessment tools. The Speech, Spatial and Qualities (SSQ) questionnaire was developed for this purpose. The aims of the study were to compare hearing disabilities rating as measured by the SSQ questionnaire between CI candidates with severe to profound hearing loss that use powerful conventional HAs bilaterally and experienced unilateral implantees and to validate the use of the SSQ questionnaire in the Hebrew language version. Group 1: 13 adults CI candidates (mean age: 42.3yrs) with severe to profound hearing loss who use powerful conventional hearing aids bilaterally; Group 2: 13 adults unilateral CI users (mean age: 52.23yrs) with more than one year of experience with the CI. The SSQ questionnaire was designed to measure a range of hearing disabilities. It includes 43 items in three sections (Speech, Spatial and Qualities of hearing) The 'speech' section addresses hearing of speech in various real life difficult situations. The 'spatial' section addresses directional and distance hearing and the 'qualities' section focuses on signal segregation, clarity/naturalness and listening effort. Each item is rated on a scale from 0 to 10. The SSQ questionnaire was completed by each of the participants. The original English version of the SSQ questionnaire was adapted to the Hebrew language. Reliability of 0.94 Cronbach was obtained for the Hebrew version questionnaire. Mean total SSQ score of the unilateral CI users was significantly higher than that of the CI candidates with severe to profound hearing loss who use powerful conventional HAs bilaterally, 5.84 (SD 1.2) Vs 3.21 (SD 1.5) respectively. Similarly, mean score of each of the three sections of the questionnaire ('speech', 'spatial' and 'qualities') was higher in the unilateral CI users as compared to that of the CI candidates, 6.14 (SD 1.08) Vs 3.0 (SD 1.06) for 'speech', 4.07 (SD 2.31) Vs 2.15 (SD 1.2) for 'spatial' and 7.25 (SD 1.2) Vs 4.44 (SD 2.3) for 'quality'. The study results support real-world hearing function advantages of CI users (even unilateral) over CI candidates with severe to profound hearing loss who use powerful conventional hearing aids.

D02 – 155

Parental estimation of cochlear implantation outcomes in children operated in optimal vs. school age

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The importance of age at implantation on hearing and speech development in prelingually deaf children is very well known. But there is also huge range of possible outcomes and numerous factors responsible for that, regardless of age at operation. In children operated beyond optimal age very important is the level of hearing and language skills achieved before implantation. Our survey included children that were preoperatively intensively rehabilitated through verbotonal method (in Croatia there is a long tradition and experience in rehabilitation of hearing impaired children through verbotonal method that emphasizes the importance of listening in speech development. The aim of the survey was to find out the parental estimations of outcomes, benefits, satisfaction and concerns on various aspects of cochlear implantation regarding age of their children at implantation. At the time of the survey there were 273 implanted children in Croatia. A survey was carried out on parents of 100 of them. Children were divided according to the age at implantation in 5 groups (0-2, 2-4, 4-6, 6-10, >10 years). A questionnaire was performed under the supervision of employees of independent market research agency, and included questions on various aspects of implantation (hearing and speech outcomes, non linguistic benefits, impact on family lives etc.). Parents answers indicated high level of open set understanding and intelligible speech in all groups of children, as well as clear non linguistic benefits and huge impact on entire families life quality. However, some differences between groups that occurred will be discussed. All groups of children achieved high level of open set understanding, although they also suggest that critical age for achieving it in aurally rehabilitated children operated in non-optimal age is around 10 years. Accordingly, all answers indicated high level of parental satisfaction with listening development and general outcome of CI regardless of the age at implantation. Majority of children had speech intelligible to untrained listeners, but parental satisfaction with speech is slightly lower than with listening skills. However, parents' answers indicated concern regarding possible device failure, as well as importance of high-quality contacts with manufacturer representatives and service.

D02 – 149

Supporting children in their home language: A case study

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Objectives: This presentation aims to look at ongoing support of 2 children in their home language after cochlear implantation. The family plays a crucial role in the development of spoken language and parents who have Punjabi as

their home language feel more confident talking Punjabi rather than English. The outcomes for each child are monitored at regular intervals using the First 100 Words checklist from the Living Language Starter Programme with words in Punjabi also noted. The Living Language checklist is used with parents pre implant and at 6, 12, and 24 months. Supported by the Family Liaison Officer (FLO) parents use culturally appropriate play activities with their children to develop language. The effects of this support will show in the child's development of spoken language skills. Discussion: The FLO works closely with families and encourages parents to be involved in the development of spoken language in English and Punjabi through play and sharing books. She also supports parents' access to training courses and workshops run by the Yorkshire Cochlear Implant Service. Conclusion: Supporting families in their home language has shown to be beneficial in the development of the whole child enabling him/her to integrate fully into the family. It enhances their understanding not only of spoken language but also of culturally appropriate language.

D02 – 151

Deaf children with cochlear implants: The parents' point of view

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The aim of this study was to assess the outcomes of deaf children with cochlear implants (CIs) from a broader perspective of quality of life or of the effects on the child and 20 parents of children who had received a CI participated in this study. They were in the age range 3.4 to 12 years. Average age of implantation was 3.1 years and their duration of use of CI range from 12 to 98 months. family from the parents' point of view. The parental views and experiences were surveyed using the redefined scales of the questionnaire, Children with cochlear implant: parental perspectives (Archbold, et al. 2002) validated by Nunes et al. 2005. It consists of 51 statements covering different areas, such as: Communication now, self-reliance now, wellbeing and happiness, social relationships, education, parental support to the child, etc. We evaluated the different scales with ANOVAS using the chronological age, ages at implantation, and duration of use of CIs, as group factor. As tentative trends, in our data we conclude that: 1) In respect of the child's progress in education, children younger than 4 years were keeping up with children of her/his own age. Children older than 10 years reached worse academic achievements, from the parents' point of view. 2) Parents whose children were older than 10 years reported higher level of stress as a result of supporting the child in the rehabilitation process. 3) Parents whose children were implanted between the age of 2 and 4 years expressed highest improvements in their child's current communication abilities and self-reliance. 4) Parents whose children were implanted over 4 years old perceived that children showed a lower level of progress in education. Also these parents reported higher level of stress resulting from the amount of support needed by the child. In respect of the child's progress in education, children younger than 4 years were keeping up with children of her/his own age. Children older than 10 reached worse academic achievements, from the parents' point of view. Parents whose children were implanted between the age of 2 and 4 years expressed highest improvements in their child's current communication abilities and self-reliance.

D12 – 449

Acoustic structure of voice in children after cochlear implantation

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The aim of the study was to assess the changes in the voices of children provided with cochlear implants. 100 children aged 3-12 y.o.a. were included in the study. In all of them laryngologic and phoniatic examination as well as the fiberoptic assessment of the larynx were performed. The subjective voice assessment included evaluation of voice tone, the way of producing the sound, voice attack, voice intensity and phonation time. Next, acoustic analysis of sustained "a" vowel was performed with the use of KAY digital spectrograph including Multidimensional Voice Profile software (MDVP). Based on the results of subjective and objective analysis it has been stated that the parameters describing voice frequency, amplitude and noise change after providing the child with cochlear implant. Improvement of voice quality indicates that child's auditor control improved after cochlear implantation.

Audiological evaluation of patients after re-implantation of a cochlear implant

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Paediatric application of cochlear implants (CI's) results in inherent necessity for re-implantation during the patient's lifetime. Re-implantation might be required due to the CI failure or a need for an upgrade. At our department cochlear implantation programme began in 1987 and at that time patients received the Belgian LAURA multichannel system. After 22 years most of the implanted LAURA's had to be replaced. This study was undertaken to evaluate the audiological results after re-implantation. This study reports on our all 15 patients in whom the LAURA system has been replaced by the Nucleus Freedom cochlear implant. In each of these patients the surgery was uneventful and in all cases full insertion of the Contour Advance electrode was possible. The data analysis comprised evaluation of the free field thresholds and speech understanding results (CVC monosyllabic words, NVA adult list in quiet, phonemic evaluation). For the LAURA period the best result ever has been selected for analysis, after re-implantation the last result available was selected. The average free field thresholds with the LAURA system were 42dBHL, after re-implantation: 31dBHL. The speech audiometry improved from average 59% (LAURA) to 70% with the Freedom CI. None of the patients showed deterioration of the auditory performance after re-implantation. Re-implantation of CI's is feasible without risk for deterioration of the auditory performance. The improved audiological results observed in this study parallel the technological improvements in the field of cochlear implants.

Effects of perimodiolar cochlear implant electrode pull out on intracochlear structures

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The pull out or pull back of the intracochlear positioned cochlear implant electrode is a unwanted procedure in cases of explantation or a controlled procedure in cases of a wished approximation of perimodiolar electrodes in cochlear implant surgery. The aim of the present study was to observe the effects of a electrode pull out on a macroscopic and a histological level. 7 fresh sectioned temporal bones were histologically observed after acryl-embedding, 5 fresh temporal bones were histologically observed after decalcification and electrode removal. Additional 5 cochlea were observed by the digitally captured video analysis during the pull out procedure after removal of the bony roof of the scala vestibule. Histologically observation of electrode pull out showed no perimodiolar changes. In cases of electrode pull out a tip turning towards the basilar membrane in the first mm of the basal turn of the scala tympani could be observed. This mechanism does not lead to destructions of the basilar membrane. Electrode pull out/ back does not lead to significant intracochlear tissue changes.

Vestibular sensitivity threshold determined by relativity method

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Discussing cell membrane potential in the previous chapter we have paid much attention to spontaneous electric activity – membrane noise of electric potential. Speaking about living systems, we have to consider the existence of spontaneous noise in all the systems. That is why the threshold phenomenon is to be regarded from the standpoint of the probability of the appearance of a response following a specific stimulus. This approach is based at two postulates: 1. the appearance of a response obeys the 'all-or-nothing' principle, and 2. constant spontaneous noise is present in the system. The first assumption is well known in modern physiology (e.g., nerve action potentials, ionic channels, and some receptor unit activity). In our case we assume, that the response (or sensation) might be measured numerically – like amplitude of action potential, but this parameter appears to be of no importance for the event. It either appears or does not appear. This approach also assumes that the system measured has its own spontaneous noise. In the vestibular system

we have already spoken about beating cilia, membrane noise, now we are coming closer to the electroencephalographic (EEG) rhythms. They are noise from the point of view of separation of EP (evoked potentials). In our case we present the problem study of the function reflecting the probability of the appearance of vestibular EP (VestEP) relative to spontaneous rhythms of the EEG, being plotted against stimulus intensity. To obtain such a relationship it is necessary to have available dozens or even hundreds of VestEP waveforms at each of several stimulus intensity levels. The recording time for one EP is about 3 minutes, 2-3 days is the time required to define the probability function. Seems, the patients are reluctant to tolerate such procedure! That is why the proposal is to obtain the probability function indirectly, using the dynamic VestEP parameters plotted against acceleration. The procedure looks like as following. First several VestEPs are recorded in the range of accelerations between 5 and 20 sm/s² (Fig. 1). Fig. 1. Vestibular evoked potentials recorded at different accelerations. Then the amplitude of the most stable N1 peaks in these recordings being normalized, i.e., has been adjusted to the same magnitude (Fig. 2). The next step is to approximate the curves being obtained to half-sinus plots, which differ from each other only with respect to only one parameter – phase (Fig. 3). Now we are coming to another important definition in relativity – reference point or standard in our study. What kind of standard are we using for comparison? There are two principal approaches to this choice: internal and external standards. The internal standard is more sensitive to the individual specifics of the exact person studied, while the external standard helps to compare the individual parameters with those of the population in whole. Internal standard means that one of the parameters, being obtained for the person examined is used for the comparison with others. External standard means that for comparison usually some averaged data are used. Fig. 2. Phase normalization of EP peak – approximation of it to the sinusoid form. Fig. 3. Phase changes of the EP peak at the different acceleration levels. Usually, the internal standard is used when the number of examinations is small, while the external standard for larger scale statistical studies. We begin our studies with the internal standard using one of the present curves. After establishing the standard we are coming to the final step of the threshold estimation, i.e., plotting the phase difference between the standard curve and other curves recorded against the acceleration. Depending of the curve we accept as being standard (the one belonging to smallest, medium or highest acceleration) we can obtain one of the three types of graphs. Two of them are parabolic in shape and the last one is sigmoid. Since just the sigmoid form of curve corresponds to the classical representation and is defined by strategy of comparison of all the graphs recorded with the one obtained at the highest acceleration level, it is possible to make final conclusion that for the internal standard it is necessary to use the data obtained at the high acceleration level (suprathreshold stimulus). The threshold (known in chemical, biochemical and pharmacological literature as the dose-effect) curve has typical sigmoid shape and might be expressed by the equation: $y = 1/(a/x + b)$ where y – is phase change, x – acceleration, a and b – constants. The constant a might be interpreted as the range of spontaneous system noise, and also characterize the width of quasilinear portion of the curve. The natural meaning of the constant b might be interpreted as the displacement of the curve from the 0 point of coordinates. It characterizes the sensitivity of the system and to some extent might be regarded as ideal threshold (Fig. 4). The other parameters of the curve might be also of importance. Incline angle of the curve quasilinear part characterizes the synchronization of the receptors activation. Saturation indicates in relative units the amount of the receptors activated. It is worth mentioning that in modern pharmacology and chemistry they use sometimes the midpoint of the quasilinear portion of the dose-effect curve; it is usually called the dissociation constant. It is remarkable, that the use of the relativistic approach for the description of the interaction of the physical receptor with stimulus has approached us to the unified terminology and phenomenology general for all the biological sciences. Fig. 4. Dose-effect curve for the dependence of phase shift on the acceleration. A general overview of the literature dedicated to this problem suggests at least three important conclusions: 1. Different authors have used widely disparate units for threshold evaluation; 2. Differences in the acceleration evaluation exceeds 4 orders of magnitude, i.e., 10.000 times; 3. Most part of more or less reliable evaluations are positioned in the range of 2-5 cm/s² and 0,5-10 o/s².

An audit of explantation and re-implantation on the Nottingham Cochlear Implant Programme

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The Nottingham Cochlear Implant Programme is due to celebrate its 1000th cochlear implant in 2009. A retrospective audit has been undertaken to review the rate and reason for device failure and explantation, and the outcome of re-implantation. Patients on the Nottingham Cochlear Implant Programme undergo annual programming reviews following completion of their first year

of device use. They also undergo regular rehabilitation and medical reviews. To date, 63 recipients have been explanted and 56 re-implanted. All patient information, together with any supporting information from the relevant manufacturers, has been reviewed. A range of factors, including device, length of device use before failure, failure type and performance before and after failure will be presented. Results of this retrospective review will be presented. Cochlear reimplantation is in general safe and effective. The implications for the individual patient will be discussed. Management of failed and failing devices is resource consuming and an important factor in the planning and management of a cochlear implant programme.

D02 – 153

First 100 words of Turkish hearing and hearing impaired children

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Lists of frequently used words can be derived from Turkish corpus; however, a list of 1st 100 words does not appear to be available. Rehabilitation materials could be enriched by including first 100 words. The LittEARS Diary (Veekmans et al 2004) incorporates a categorized first word form for parents to systematically record words their child understands and says. The aims of this study are to determine and compare the first receptive and expressive 100 words of both hearing and hearing impaired children, examine how long it takes and publish results for reference. First word forms were filled in for 50 hearing children, age range 9 -24 months; and for over 50 hearing impaired children, mostly CI users, CI or hearing aid fitted before 36 months, hearing age range 1-24 months. This 24 month period was divided into eight 3 month time intervals. Some children had forms filled in at regular intervals some at just 1 point in time. A list of 'likely' first words for each category of words was derived from results of a pilot study, any words subsequently reported, not on 'likely list' were added. Parents were asked to refer to this list while filling in first word forms for their children. Data on forms was transferred to Excel and analyzed using SPSS. Hearing and hearing impaired children acquire similar words first. CI and hearing aid users tend to acquire 100 words faster than hearing children (age based on hearing age). There is a wide variation in speed of acquisition for both groups. Both hearing and hearing impaired children, initially, understand more words than they can say. Faster word acquisition of hearing impaired children is probably due to higher chronological age. Reference to 'likely' word list prompted parents to more accurately report words their child understood and said.

D10 – 345

The influence of increasing the IIDR in Nucleus 22 recipients

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This study was undertaken to investigate the influence of the Instantaneous Input Dynamic Range in a group of recipients using the Nucleus 22 device, when upgraded from the Esprit 3G to the Freedom processor. They are a heterogeneous group, ranging in age from 14 to 18, with at least 11 years of device use. This was an acute study with repeated measurements, using sound field aided assessments and the BKB sentence repetition test at a conversational level (60dB(A)) and soft speech level (50dB(A)) in quiet, and in noise at the recipient's most challenging SNR. A custom-made questionnaire was completed in the acute phase by both recipient and parents, and repeated after 3 months for follow up. Testing was initially carried out with the recipient's current 3G processor using a 30dB IIDR and repeated after converting their map for use with the Freedom processor, using a 50dB IIDR. No other changes were made to their map settings. Although data collection is still ongoing, a slight improvement was seen in sound field measures, particularly for 0.5 kHz. At this time the effect of increasing the IIDR appears most advantageous in noise, no effect was seen for conversational and quiet levels. Follow up questionnaires are still being collected and the results will be discussed. Although these recipients have been used to a reduced IIDR for a number of years, an increase in IIDR appears to have some immediate advantages for detecting soft sounds and speech understanding in noise, in more challenging SNR's. A further study will investigate the influence of the IIDR using a more challenging test with roving speech levels in a selected group of recipients, able to perform on such a test.

D10 – 343

Spread of Excitation – a non invasive assessment of cochlear implant electrode placement

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Objectives: To evaluate possible dependence between shape of the Spread of Excitation profile and electrode placement assessed by CT scans in Nucleus 24 implant users. Method: Postoperative Spread of Excitation profiles recordings were made for electrode number 5, 10, 18. CT scans according to cochlear view technique was performed for 2 selected patients Results: Abnormalities in implant electrode placement in the cochlea was found, accompanied by disturbed spread of excitation profiles. Conclusions: A clear dependence between disturbance of Spread of Excitation profile and abnormalities in implant electrode placement for selected patients was confirmed. Further investigation in bigger group of Nucleus 24 implant users is planned to check if it is a general correlation. A possible confirmation of mentioned correlation would provide an useful, noninvasive, objective tool to assess implant electrode position and placement and provide important information, crucial for speech processor fitting. It could be useful especially for children, CI users, due to its immunity to movement during measurement, in opposite to Computer Tomography.

D10 – 351

Influence of non-optimal values of electric al stimulation parameters on hearing benefits

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To obtain hearing benefits after cochlear implantation it is crucial to optimally fit the system to the individual need of every patient. Great variability between patients and the fact, that optimal values change in time make this a difficult task. In the Institute of Physiology and Pathology of Hearing, fitting procedure that contains many psychophysics and objective measurements was introduced to assure optimal fitting of the system. However, it is still very interesting to find out, how non-optimal fitting may influence hearing benefits, especially when the error is relatively small. Aim of the study was to observe the influence of non-optimal fitting to hearing benefits. Material of the study consists of 61 patients. In 3 experiments, some characteristic of the patient's program: loudness, balance, threshold were non-optimally changed. The results of speech comprehension tests obtained on those programs were compared to those obtained on optimal program. Unexpectedly big deteriorations of hearing benefits were observed after relatively small change in electrical stimulation values. Those results prove that it is very important to find optimal values of stimulation parameters and even slight error can worsen the patient's results.

D12 – 446

Rehabilitative outcomes in pediatric auditory brainstem implantees

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Objective: In this study the auditory perception, linguistic outcomes and the psychometric evaluation results in Auditory Brainstem Implanted children are presented. Methods: Between July 2006-November 2008 12 prelingual children with various inner ear malformations, which are contraindication to cochlear implantation, were operated in Hacettepe University with the collaboration of the Departments of Otolaryngology and Neurosurgery. Three patients were fitted with vibro tactile aids for basic tactile therapy before ABI operation, when the radiological examination demonstrated the absence of the acoustic nerve. Rest of the patients had been already fitted with hearing aids in different clinics and had been involved in special education programs. Denver Developmental Screening Test-II (DDST-II) which detects slow development in four functional areas of development (personal-social development, fine motor, language, gross motor) was conducted to all of ABI candidates to evaluate developmental condition. Also, Stanford-Binet Intelligence Scale L-M Form was used to evaluate the intelligence quotient (IQ). None of these children had an auditory experience until they were implanted 6 out of 12 children had associated several

disabilities such as developmental delay, intellectual disability, attention deficit and/or hyperactivity disorder and cleft palate. To evaluate the auditory and linguistic progress of the ABI children a battery of tests are administered. The evaluation was carried out at 1-, 3-, 6-, 9-, 12-, 15- and 18-months post-switch on. The main test components of this test battery were; Ling 6 Sound Detection-Identification Test., Pattern Perception, Word Identification in Turkish Test and The Daily Sentences in Turkish test. Also IT MAIS or MAIS and MUSS scores were obtained in order to obtain information about their ability to derive meaning from environmental and speech sounds and changes in their vocal expressions. Results: All 12 patients that have been programmed and followed sufficiently, showed benefit from the application of ABI. Patients with no other handicaps demonstrated rapid progress in the detection and identification of Ling's six sounds, MAIS - IT MAIS and MUSS scores, pattern perception outcomes. Particularly two children showed extremely good performance even in open set speech performance tasks. These two children show us that ABI conveys a valuable opportunity for auditory habilitation in children who have no additional disability. The preliminary results we obtained after application of the ABI are better than those obtained in our patients with ADHD. Conclusion: Additional handicaps slow the progress of the children as in other patients with cochlear implantation. In spite of their lack of open set scores their parents report that they feel much more confident in their educational settings and in their family. Those cases show very clearly that the results of hearing (re)habilitation cannot be described only in terms of open set speech discrimination, although this should be our goal. Individual expectations and the individual degree of satisfaction must be taken into consideration when evaluating the benefits from ABI. Besides the most important advantages which two ADHD children achieved, were positive attitude and increment in their audio-visual attention skills.

Poster Session

P01

Music induced hearing loss

Abdi S.

TUMS

With massive growth of environmental noises, many people putting themselves at risk for hearing loss by listening to loud music specially with portable music players. Our research is relatively cross sectional study and our purpose was to find association between listening to loud music (specially for headphone users) and hearing loss. We have done Pure tone Audiometry for all of the patients. We tested the frequencies of 250, 500, 1000, 2000, 4000, 8000 and the mean of hearing thresholds was normal (12dB) for all frequencies. Tympanometry was normal type, Acoustic reflex was present. All the patients were asked about their habits during listening to music or using headphones. We divided them into two groups based upon loud music listeners (group 1) which include 60 patients, aged (15-30) years old and headphone users (group 2) which include 60 patients aged (15-30) years old. Hearing evaluation were done for each of them at first visit and after six months. Patients in group 1 were listening to music with average of 2-4 hours per day at 90-120 db. and other patients in group 2 were using headphones and frequency usage for this group was three or more times in a week, with an average of 30-150 minutes in each use. at 104 db. We repeated the tests after six months. Examination frequencies at 2000, 4000 and 8000 showed a tendency of being higher than their past for both groups. The mean of hearing thresholds was increased to 20 db for group 1 and 25 for group 2. As hearing impairment rise among people specially teenagers we approach to a deeper research to find relation between listening to loud music and hearing loss. The results have shown us that loud music can cause damage to hearing and headphone users are suffered more. loud music can cause damage to hearing and headphone users are suffered more.

P02

Evaluation of HiRes 120 in children – Monitoring speech perception and speech production in children switched on with HiRes 120

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The new sound coding strategy from Advanced Bionics is called HiRes 120 and implements virtual channels by steering current between two adjacent electrodes. The aim of the project is to: 1) Verify the ability to fit HiRes 120

easily in children at the first fitting; 2) Define the benefit of HiRes 120 for production, perception and music development 3) Monitor the outcome over a 24 month period 4) document psycho-physical fitting parameters. Children between 12 months and 4 years of age are included in the survey. All subjects are first fitted with HiRes 120 using either their Harmony or Platinum Sound Processor. Pre-implantation, baseline is evaluated using the Children's Implant Profile (Nottingham Version) and a free field audiogram if it is under clinical routine. The children are evaluated with a series of questionnaires: MUSS, (IT) MAIS, SIR, CAP, PRISE and the Music Stage Profile questionnaire at approximately the 3,6,9,12,18 and 24 month visit. Performance data using the clinics clinically routine tests are collected. To date 6 subjects have started the survey. 10 centres in Europe, Russia and Africa are taking part in the survey. The survey design will be presented as well as the preliminary data. The adult HiRes 120 Study has showed a significant benefit for adults, both subjectively and objectively using HiRes 120, compared to HiRes. Based on these findings, a pilot pediatric study was performed in which children were upgraded from the Auria sound processor/HiRes to HiRes 120 onto the Harmony. It was seen that fitting and managing HiRes 120 in children was easy and immediately accepted by the children. This study will validate these findings in a large group of children.

P03

Outcomes of (re)Habilitation by cochlear implant in auditory neuropathy (AN) cases: follow-up data on auditory and speech perception

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Management of re(habilitation) of AN which is characterized by absent or distorted auditory brainstem response (ABR)s with presence of otoacoustic emissions (OAEs) and cochlear microphonic (CM)s in relation to various hearing levels and/or lower speech discrimination scores (SDS) is a challenging problem not only because of variability in its clinical features, but also due to unknown lesion site in each given case. One of the (re)habilitation options is CI surgery, while hearing devices, FM systems and even 'wait and watch' are the others. Our purpose in this study to present follow-up data of our AN cases (re)habilitated by CI. Seven male subjects diagnosed and implanted (Nucleus: 4, Medel: 3) between January 2005 and February 2008 were included to this study, and their preoperative and 12 months-postoperative data related with audiologic and auditory-speech perception tests (IT-MAIS,MAIS,MUSS,EARS) were evaluated. CI was applied in one ear of 7 AN subjects with bilateral profound hearing loss, and mean hearing level with CI was 30dB. While mean of preoperative lip-test scores was 9.5%, it reached to 95.2% at the end of 12 months. The other speech tests also presented similar improvement. Our data supports that CI improves not only their hearing level but also speech test scores in AN subjects, as reported by the previous clinicians, although there is no specific information of the lesion site in a given case.

P04

Narrative writing in 18 children with cochlear implants

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To create a narrative is a demanding task, even for hearing children with typical language development. The ability is strongly related to academic success. The performance in narrative writing, the writing process as well as the written product, was explored in 18 children with cochlear implants (CI). The children with CI were compared to 75 age-matched hearing children. The group of children with CI was split in two different ways; according to age at testing and according to age at implantation. The narratives were elicited by pictures and collected by means of keystroke-logging. The results showed, that the difference between the children with CI and the hearing children was most prominent for two measures; the percent pause time (in the group of children older than 13 ys) and for the percent content words. We believe that the relatively high frequency of content words and the use of more pause time in the children with CI is reflecting linguistic and cognitive processing limitations in complex linguistic tasks like narration. Further, the children implanted after 5 ys of age, performed more like the hearing children in this study. Our interpretation is that they benefited from the early linguistic input due to progress in deafness since they received their diagnosis later than the rest of the children.

P05

Racing against time for cochlear implantation in ossified cochlea after meningitis

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Meningitis is known as the most common cause of acquired hearing impairment. We present a 5-year-old girl who received cochlear implant (CI) after developing postmeningitic profound sensorineural hearing loss (PSNHL). The surgery was challenged by partial cochlear ossification despite mild fibrotic changes revealed by magnetic resonance imaging (MRI) taken 7 days before the surgery. A 5-year-old girl was referred to our outpatient clinic with hearing loss after having pneumococcal meningitis 1 month ago. Behavioral audiometry indicated bilateral PSNHL with a sensation of pain to live voice at 120dB HL. Hearing loss was confirmed by ABR testing. The patient didn't benefit from high power hearing aids and was evaluated by cochlear implant team on day 40 after the initial diagnosis of meningitis. Computed tomography (CT) and MRI taken on day 42 were consistent with normal anatomy. Decision for CI was made on day 50 and MRI repeated on day 52 revealed mild fibrotic obliteration of the cochlear canal. Immediate action was taken and the patient underwent CI surgery on day 59. Partial ossification of the basal turn was encountered during the operation. Cochleostomy was performed through the second turn and MED-EL Combi 40+ with compressed electrode array was inserted. Four out of 12 electrodes remained outside the cochlea. Intraoperative impedance measurements showed no open or short circuit findings in electrodes 1-8. Cochlear ossification after meningitis is an unforeseeable situation that can progress rapidly. Radiologic evaluation should be repeated just before the surgery. Despite all precautions, CI surgeons should expect the unexpected in postmeningitic patients and be comfortable with a cochlear drill-out procedure. Multiple array CI should also be readily available in the operating room. Preparedness is the key in success in postmeningitic CI surgery. Cochlear implantation should be done as soon as possible after postmeningitic PSNHL.

P06

Speech development after cochlear implantation in children with bilingual parents

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The bigger part of children getting a cochlear implant at our department have a migration background. Aim of this work was to investigate the influence of being educated bilingual on quality of speech and speech development in general in children after cochlear implantation. A further question was whether children with parents of different nationalities indeed are educated bilingually or whether they are mostly educated in the language of the country they are growing up, in this case Germany. From 1996 to 2007 56 children with bilingual parents and 39 children out of monolingual families were implanted. Using standard hearing and language tests (e.g. Göttinger and Mainzer Kindersprachtest) as well as logopaedic tools, figures concerning development of speech comprehension, receptive and expressive speech were determined. Data on main language and second language were collected via questionnaire. The median age of implantation in both groups was about 3 years (range 1-5 years). Almost all children with bilingual parents indicated German as main language. There were almost no significantly different results in the employed tests for evaluation of speech comprehension. In some cases the second language is used actively, but in most children the use is limited to single words and expressions. The development of speech seems almost not to be influenced negatively by bilinguality of parents. Therefore performance of rehabilitation exclusively in German language is suitable. Factors like early implantation and excellent cooperation between family, rehabilitation, educational centers and clinic play a decisive role concerning the outcome of cochlear implantation. Children with cochlear implants usually have the ability to develop bilinguality, so that according to our experience families should be encouraged to do so.

P07

Cochlear implantation in auditory neuropathy: A case study

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Auditory neuropathy (AN) is characterized by absent auditory brainstem response (ABR), normal otoacoustic emissions (OAE) or cochlear microphonics (CM). The aim of the present study is to discuss the outcomes in a patient with AN managed with cochlear implant. A five-year-old girl was diagnosed with AN based on positive OAE and absent ABR. She had profound (90dB HL) sensorineural hearing loss and has been a consistent hearing aid user for 3 years since she was one year old. She was not satisfied with the hearing aids and received a cochlear implant when she was four. Pre and postoperative audiologic evaluation, speech discrimination (SD) results and Meaningful Auditory Integration Scale (MAIS) outcomes were compared. She had 30dBHL pure tone threshold average (PTA) score and identified closed-set Ling sounds after implantation. Closed-set speech discrimination score and MAIS score improved after one year of cochlear implant use. The application of cochlear implantation in AN is controversial since the anatomical locus of the pathology is not exactly known. Selection criteria for cochlear implantation with AN patients are important. All patients can benefit from cochlear implantation more or less. However better outcomes can be obtained by normal anatomy of inner ear and brain. Successful cochlear implantation in a child with AN was described in this study. Our patient showed positive improvement after cochlear implantation. Based on our findings we suggest that cochlear implantation is a viable option for patients with AN who have profound SNHL, and can be an effective method for auditory habilitation in AN patients.

P08

Preservation of residual hearing with respect to the length of the electrode array

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Preservation of residual hearing is considered one of the important aspects of cochlear implant surgery. Beside of surgical technique, type of electrode array; length of inserted electrode array might play a role in determining preservation of residual hearing. In this study we present the results of residual hearing preservation in different length of electrode arrays in cochlear implantation.

P09

Fine Structure Processing (FSP) in cochlear implants: Outcomes in children

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The Fine Structure Processing technology, incorporated in the Opus 1 and Opus 2 Speech Processors from Medical Electronics (MED-EL), was developed to increase the speech perception in patients with cochlear implants. The goal of the research was to evaluate the impact of changing speech processor CIS PRO+ or TEMPO+ for OPUS 1 and OPUS 2 in children with MED-EL cochlear implants. The study was conducted at Audiological Research Center – University of Sao Paulo/Bauru (CPA-HRAC/USP) and evaluated 35 children with Pulsar CI100 Cochlear Implant. All children were users of Continuous Interleaved Sampler (CIS) Strategy for at least three months (average 17 months). A group composed of 33 children received an OPUS 1 processor while 2 children received an OPUS 2 speech processor, both with FSP Strategy. The evaluation procedure included: open interview with parents, protocols to evaluate the auditory and language abilities (IT-MAIS/MAIS and MUSS) and speech perception tests. All procedures were conducted twice: before and after three months of the use of FSP strategy and took into consideration patient's age (from 2 to 11 years old). Parents of 29 children described significant changes in speech production (intelligibility improvement) and auditory improvement in daily tasks such as watch TV and listen to music. Parents of the remaining children (equal to 17,1%) reported no changes with the speech processor update. Outcomes of the protocols to evaluate the auditory and language abilities and speech perception tests showed the following improvements: 90 to 98,1% for IT-MAIS/MAIS; 51,3 to 76,3% for MUSS and 47,6 to 54% for speech perception tests. Preliminary data indicate auditory perception improvement in the presence of FSP Strategy. Further investigation is under way.

P10

Cross-over evaluation of the HiRes 120 Strategy in new users

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In April 2007, Advanced Bionics introduced a novel speech coding strategy called HiRes 120 to the European market. HiRes 120 processes the signal in 120 virtual channels to improve the frequency resolution. The strategy is supported by the behind-the-ear processor Harmony. This investigation examined subjects' performance with both the HiRes and HiRes 120 strategy using the Harmony processor in new users, following a cross over study design. Twenty-three subjects were enrolled in the study. The group was divided into two sub-groups: Group I starting with HiRes at first fitting; and Group II starting with HiRes 120. Every three months subjects were converted to the other strategy, respectively. Evaluations were performed prior to each strategy change via speech perception tests, psychophysical tests and questionnaires. Fourteen subjects have already passed their 6-months appointment. Subjects in Group I showed an improvement of 16% in their speech understanding using the HSM sentence test in noise (10dB SNR) between their 3-month appointment with HiRes and 6-months appointment with HiRes 120. Group II improved by only 8%. There is an overlap of learning effect and effect of the speech coding strategy; therefore the results need to be evaluated in a comparison between the two groups. When switched from HiRes to HiRes 120, Group I showed results which were better than expected due to the learning effect only. Group II showed results less than the expected learning effect, after being switched from HiRes to HiRes 120. Our data indicate a benefit for HiRes 120 compared to the standard HiRes. HiRes 120 did not reveal any specific difficulties when used from first fitting onwards.

P11

The C1 Harmony Processor: Evaluation of a new behind-the-ear Processor for the first generation Advanced Bionics' cochlear implant

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At the medical University of Hannover there are more than 450 users of the Advanced Bionics first generation "C1" implant (Clarion 1.0 and 1.2 devices), worldwide approximately 8,500. These implants are driven by previous-generation processors including Platinum Sound Processor (PSP), Platinum behind-the-ear (BTE) Processor, Clarion S-Series and Clarion 1.2. Up to now the Harmony BTE has been approved for the use with CII and HiRes90K implants. The same hardware which drives the current HiRes90k implant, equipped with appropriate Digital Signal Processor (DSP) code can also drive the C1 implant, this combination being called C1 Harmony. The objective of this study was to confirm the safety and efficiency of the C1 Harmony prior to commercial distribution. The protocol of the ongoing study consists of two stages: one acute and one chronic. Sound quality is assessed for users of all the above named processors, ensuring coverage of the CIS, MPS and SAS sound coding strategies. The chronic stage involves a baseline measure, ideally for speech in noise test, with the current processor, before a one month take home trial of the C1 Harmony. The test battery also contains a free-field audiogram, sound quality questionnaires and a battery log. Only programming changes require to address sound quality issues are proposed. In particular, the sound coding strategy should remain the same as previously used. Following the one month of use the test battery is repeated for the C1 Harmony. Group sizes of 30 participants are determined for both stages. Preliminary results from a total of 8 acute evaluations show stable communication between the C1 Harmony and a range of C1 implants. The speech perception results collected during acute testing do not show a significant difference between the subject's use of their current processor or the C1 Harmony. The majority of subjects prefer the sound quality of the C1 Harmony over that of their current processor, even when speech perception results were slightly lower. The results to date demonstrate stable communication between the C1 Harmony and all implants tested. Sound quality and speech understanding for the C1 Harmony so far are comparable to the subjects' current clinical processors. These results are encouraging, especially considering the subjects' long experience with their current processors.

P12

Insertion studies with a prototype thin perimodiolar electrode in human temporal bones

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The HEARing CRC

The aim of this study was to assess the feasibility, refine the design and examine the biosafety of a prototype thin perimodiolar cochlear electrode in human temporal bones. A series of insertion studies in human temporal bones were conducted with prototype variants. The prototype electrode is a thin, pre-curved array, which is held straight for insertion by retraction into an external polymeric member, in contrast to use of an internal stylet. The electrode and insertion assembly is inserted into the basal turn of the cochlea and the electrode then advanced using a similar insertion technique to the Advance-Off-Stylet technique. Over an 18-month period, seven electrode insertion studies were conducted at the Hearing Cooperative Research Centre (University of Melbourne) and concurrently at a number of international research clinics. In Melbourne, all insertions were performed under microfocus fluoroscopic control, and video recordings were made of both the microsurgical procedure and the fluoroscopic image. Except for initial insertions, a cochleostomy approach was used. In early studies sufficient information was obtained via the fluoroscopic imaging. In later studies biosafety was evaluated through acrylic fixation and histologic sectioning to allow more detailed examination of the final electrode position within the cochlear lumen and to carefully examine specimens for any evidence of intracochlear trauma. Fluoroscopic analysis of the initial electrode insertions identified the potential for fold-over of the electrode tip as a result of impaction on the modiolum or outer scala wall. This was addressed by specific design changes including reduction in the degree of electrode precurvature and reducing insertion depth to approximately 400 degrees rather than 420 degrees. Various modifications of the polymeric straightening member were trialled to adjust the insertion depth and facilitate ease of removal. Histological analysis of insertions of the final electrode design demonstrated excellent perimodiolar positioning of the electrode within scala tympani, and no evidence of intracochlear damage in 7 of 8 temporal bone specimens. In one specimen, analysis showed that the electrode inserted through the cochleostomy into scala tympani immediately passed upwards through the basilar membrane into scala vestibuli, where it then remained in a perimodiolar position. The combination of fluoroscopic analysis of the trajectory and dynamics of electrode insertion, video of the microsurgical technique and subsequent histologic analysis of final electrode position has been very effective in allowing development of a new and improved electrode array. The final design is suitable for a first-time-in-human clinical trial as it was reliably inserted without evidence of intracochlear trauma.

P13

Meningitis like cause of hearing loss

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In the period from 2002. to 2008. at the Department of Audiology, ENT Clinic, University Clinical Centre Tuzla, 16 patients, who had suffered from meningitis, arrived for a checkup as a part of auditory treatment by means of BERA (Brainstem Evoked Response Audiotometry). Out of above mentioned 16 patients, 11 of them were males and 5 females. The youngest patient was 4 months old at the moment of meningitis suffering, and the oldest was 80 months old at the moment of meningitis suffering. The youngest patient was 8 months old on the day when BERA was done, and the oldest was 81 months old on the day when BERA was done. Out of 16 patients who arrived for a checkup at the Audiology Department, 1 male patient did not arrive for BERA examination. Out of 15 patients who underwent BERA examination, 4 patients had pathological findings. Two patients had bilateral profound hearing impairment, 1 patient had unilateral hearing impairment at the borderline of mild and moderate partial deafness and 1 patient had moderate hearing impairment in one ear and profound hearing impairment in other ear. One postmeningitis deafened patient have got a cochlear implant and second patient is in preparing for getting a cochlear implant. First postmeningitis implanted patient had not changes on temporal bones, but second patient has minimal ossification changes in basal turn of cochlea. Our results (13% of patients with changes on temporal bones after meningitis) are in accordance with results of other studies.

P13/1

Application of the diary of early language (Di-EL[®]) in monitoring language development in infants using cochlear implants and hearing aids

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Objectives: The advent of universal newborn screening has resulted in significant number of infants receiving cochlear implants during the first six to twelve months of life. The evaluation of implant performance, as well as pre-implant speech benefits from use of hearing aid, is challenging in such young children who have not as yet developed language. Analysis of pre-verbal behaviours can be effective, but is time-consuming and requires skilled clinicians. The aim of this study was to evaluate the effectiveness of a novel technique for assessing emerging language in children using cochlear implants or hearing aids. **Materials and Method:** The effectiveness and validity of the Diary of Early Language (Di-EL), a technique in which parents collected data about their child's first 100 single words was measured by determining whether it could be implemented by parents and whether it provided information about early implant use that was not available from other tests. Validity of the Di-EL was determined from two perspectives. First, the level of agreement between the lexical data obtained from each participant's 100-word Di-EL and the lexical data obtained from the MacArthur-Bates Communicative Development inventory (CDI) was determined. Second, the correlation between raw scores obtained on the Di-EL, the CDI and the Rossetti Infant Toddler Language Scale was computed. Results indicated the Di-EL to be an effective and valid tool for collecting lexical data in young children using cochlear implants. It provided "on-line" information about lexical acquisition not available from other tools and parents reported it to be a valuable educational tool. Further support for the Di-EL technique was found in a subsequent study which evaluated the language of two groups, one including normally hearing children, and a second group of children with hearing loss. **Results:** The Diary of Early Language was easily completed by all parents of all children in the study. Results showed that the time period for acquisition of all lexical targets was longer for the children with hearing loss as compared to their normal hearing peers. The patterns of acquisition were found to be similar, although specific differences in lexical content were noted between the two groups. **Discussion & Conclusion:** The Diary of Early Language is an effective tool for monitoring the early language performance of children using cochlear implants or hearing aids.

P14

Are medical indications sufficient reason for cochlear implant surgery?

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Last decade of XX Century will be remembered by application of some of the most sophisticated methods in treatment of children with severe hearing impairment, such as cochlear implant. But question could be asked – are only medical indications enough for application of cochlear implant? Looking at children with cochlear implant we mainly talk about their good results on verbal performance, and considerably less about the road to good verbal expression, which is the main goal of this popular orthologic intervention. Goal of this paper is to present a case study of a child who had all medical implications for cochlear implant, but the intervention was never done. Case study: J.P.M., a boy born in 2005, was diagnosed with severe hearing impairment at the age of 2 years 5 months. Hearing amplifiers were administered to be used during a period of 6 months. After this period, cochlear implant surgery was planned. At the time when he was diagnosed, J.P.M. had no words in his vocabulary but only inarticulated voice resembling a scream. His intellectual abilities were average. The mother of child was unhappy with the knowledge that her child has severe hearing impairment and that he should undergo surgical intervention for cochlear implant. In the next period, she saw different specialists in order to get some treatment before surgery, but was refused with advice to simply play with the child. After one month, she found a speech-language pathologist and an audiologist who were willing to start with treatment immediately, and after 1 year 5 months the child developed speech that started to be intelligible for broad social surrounding. For this reason, the mother decided she does not want her child to undergo surgery.

In conclusion, we suggest that only medical parameters might not be a sufficient reason for cochlear implant surgery. The children's parents have to be psychologically prepared and ready for this intervention in order to provide best conditions for successful outcome.

P15

Murat Reader Series

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Early screening of hearing problems leads to early cochlear implantation and rehabilitation. Parents are getting a lot of information and intervention programmes are offered. Once rehabilitation has started, they usually want to be involved in the acquiring of language of their child. Julie Kosaner created four books about the little boy, Murat. They tell us everyday situations that are very recognizable for most of the children. All these books are especially made for young children and their parents. Many ideas are given for narrating, playing, material is added to exercise with. Most of the books have been translated in several languages, we recently translated two of them in Dutch. Parents can certainly use the books on their own but ideally, they should be used by professionals during rehabilitation sessions where parents are included. Relevant pages can be handed to parents so that they can continue working on the story at home. The professional is the guide, he gives each child an individual approach. The 'Murat Reader Series' enables professionals and parents to work with a child with a newly acquired ability to hear speech in a way that will promote development of spoken language.

P16

Delayed retroauricular CSF collection in cochlear implantation

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This is the first description of a retroauricular delayed cerebrospinal fluid collection in a child after 18 months of cochlear implant use. A 4 years old boy, with profound bilateral hearing loss of unknown origin was implanted in 2006 at age 2 with a HiResolution 90K[®] cochlear implant. The surgical intervention was performed with a minimal invasive retroauricular approach. Due to very thin temporalis squama thickness, housing of the receiver was accomplished exposing the dura, leaving a bone island in the center. During surgical revision a laceration of the dura was found underneath the receiver, requiring local sealing and repositioning of the implant. Exposure of the dura is a procedure usually performed during housing of the receiver to avoid excessive protrusion of the implant in subjects with an insufficient bone thickness. This has proved to be in most cases a safe procedure, but in this child, maybe due to small local trauma, has caused dura discontinuity. Exposing of the dura should therefore be avoided, especially in children.

P17

Literacy and deaf children

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As an abstract symbolic system language is concretely realized by way of speech, writing and gesture. All of the aforementioned manners of realizing language have their advantages and disadvantages; however they supplement each other reciprocally with the result being an individuals need to communicate with other people. Written speech is the basic means of general and speech-language development of deaf children. In the process of mastering writing skills children must become aware of the rules which they need to adopt: hand writing, the use of capital and small letters, punctuation and manner of expression. The aim of our study was to examine whether or not, and to which extent the deaf children have mastered the use of the capital and small letters in writing, as well as their knowledge of the correct use of punctuation signs. The instruments which we used in our study include the Test on Capitalization and the Punctuation Test (N. Dimic). The sample consisted of deaf children, attending grades six to eight. Within the scope of the Punctuation Test the best results were achieved within the task Period at the end of a sentence and Question mark, while the weakest results were obtained within the following task Quotations, exclamation, period. Within the scope of the Test on Capitalization it was observed that the best results were achieved within the scope of the tasks Name of State and City Name, whilst the worst results were seen in writing Street Names, where none of the children

gave a completely correct answer. Deaf children obtained better results (at all age levels) on the Test on Capitalization. Irregular use of punctuation and capital and small letters can deform a message (thought) and lead to the loss of the readability of what is written.

P18

Musical melody recognition in users of cochlear implants, hearing aids and bimodal system

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To evaluate and compare the performance in musical melody recognition in hearing impaired adults who are users of hearing aids and cochlear implants in various stimulation modalities: bilateral acoustic, unilateral electric, bilateral electric and bimodal binaural. To compare the recognition ability among the users of various stimulation modalities, identifying the variables that may determine better performance in order to promote optimisation of music perception with hearing prostheses. An analytical, prospective comparative observational study was conducted on a sample of 20 randomly selected hearing-impaired adult patients using one of four hearing stimulation modalities and a control group of five normal-hearing subjects. Music perception abilities were assessed for all subjects who were asked to recognise a list of 20 randomly presented musical melody fragments (FMM) from a closed set of 10 items with vocals and 10 items without vocals presented to each subject in random. Performance for each subgroup was analysed and the mean frequency of correct responses and the standard deviation calculated. Comparison of the performance for each subgroup was made through examining differences between category variables by using non parametric Kruskal-Wallis test for K independent samples using a significance level of $\alpha=0.05$. Twenty randomly selected subjects divided in four subgroups based on hearing stimulation modality, all 18 years of age or older; with severe - profound bilateral hearing loss, (average Pure Tone Audiometry thresholds: $> 60\text{dBHL}$), absence of retrocochlear pathology or disorders at the central auditory processing level were included in the study. The modalities in use defining the subgroups were: unilateral cochlear implant; bilateral cochlear implants; bilateral hearing aids and bimodal stimulation (electro-acoustic). A control group of 5 normal-hearing adults with average Pure Tone Audiometry hearing thresholds between 0-20dBHL and achieving between 90-100% correct speech scores on speech recognition tests presented at 55dB HL were also assessed for musical melody recognition. The bilateral cochlear implant subgroup displayed similar results to those observed for the control group with respect to: the variable of list. Is that the selected items of vocal musical melody fragments (FMM) ($p<0.003$) being similar in the variable of instrumental musical melody fragments (FMM) ($p<0.001$) as well as in melody recognition ($p<0.001$). In addition all subgroups demonstrated that the vocal musical melody fragments are more easily recognisable ($p<0.003$) than the fragments with only instrumental backing ($p<0.001$). Hearing impaired patients using bilateral cochlear implants show greater music perception ability on the musical melody recognition tasks than those using other stimulation modalities. In general, patients demonstrated better recognition of melodies with vocal rather than non-vocal/instrumental backing alone.

P19

Early cochlear implantation in three children with auditory neuropathy

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Deafness caused by auditory neuropathy is nowadays considered as a good indication for cochlear implantation. In case of young children with auditory neuropathy it is an option to first wait for possible delayed auditory and language development. However, in cases of severe hearing problems early implantation may also be considered in order to optimally stimulate auditory and language development. We have implanted three young children with auditory neuropathy around one and a half year of age. Two of them were preterm newborns in which the auditory neuropathy was discovered after two referrals on the hearing screening in the baby care unit. The third case was discovered late because it had passed the regular newborn hearing screening with Oto-Acoustic Emissions (OAE). In all three children no auditory brainstem responses were found, while normal to subnormal responses were found with OAE measurements. They all did not show behavioral responses to environmental stimuli of low and normal levels. All three children were implanted with a Cochlear Freedom 24 Contour Advance implant. Normal NRT-responses could be measured in two of the three children. The two children with normal NRT-responses soon achieved adequate behavioral hearing thresholds after using the implant. Development of spoken language has

been started in these both children. The third child still has raised behavioral thresholds and limited development of auditory and language skills. Deafness or severe hearing impairment due to auditory neuropathy is a good indication for early cochlear implantation. The good CI performers with auditory neuropathy do as well as implanted children with purely cochlear deficits. The factors that may predict the amount of success of implantation in this group will be discussed in more detail during the conference.

P20

Prevalence of auditory neuropathy (AN) in audiology practice in Turkey

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AN is a challenging problem. Our purpose is to look for its prevalence and clinical appearance in Turkey. This retrospective study included all children younger than 16 years of age, applied to the department between 01.2005 and 02.2008 (exception of newborn hearing screening-NHS- referrals). The data were derived from pure tone, speech, OAEs and ABR tests, and further medical risk factors of the subjects were evaluated. AN was recognized in 20 ears of 12 children (B/U: 8/4) among 633 children with SNHL (1.89%) detected in 3152 applicants to the department (0.38%). The clinical tests revealed that while hearing loss ($15\text{dB}<$) was present in both ears of 11 cases, ABRs were absent/abnormal in 18/2 ears and CMs were detected in all. Acoustic reflexes were absent in all, but, OAEs were present in 8 ears. (Re)Habilitation was managed by CI and hearing aids in 7 and 4 cases, respectively. FM system was given to the only case presenting normal hearing level, but poor speech discrimination in noisy environment. In the medical history, the major problems associated with AN were found in 4 of 12 children (hyperbillirubinemia: 2, prematurity: 1, low birth weight: 1). AN is relatively new and challenging problem for the audiology departments because of its various clinical features and difficulties in the management. The AN prevalence in Turkey (1.89%) was lower than the previous reports (8.44% - 14%) for hearing impaired children. We should expect that it will be higher in Turkey in future, particularly because of NHS and increase in NICU-graduate-babies. Moreover, we think improvement in diagnostic criteria and availability of ABR testing each children suffering from either difficulties in speech recognition, noisy environment or simply learning problems by ABR and OAE will provide diagnosis of overlooked cases.

P21

Musical activities of young listeners

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A questionnaire study was undertaken by the South of England Cochlear Implant Centre (SOECIC) to investigate the extent to which young deaf children with cochlear implants (CIs) are exposed to and are able to appreciate music in comparison with their normally hearing peers. The questionnaire was developed by a multi-disciplinary team and consists of 50 questions which explore various aspects of music exposure and appreciation. It was distributed to parents of children with normal hearing (screened by an additional questionnaire) at local playgroups and nurseries and to parents of children who had been implanted for at least one year at SOECIC. All children were aged between 1 and 5 years with no known additional special needs. Questionnaires were received for 23 children with cochlear implants; 13 female and 10 male with a mean age of 44.2 months \pm 9.1 months. This group was matched to 23 children with normal hearing; 13 female and 10 male with a mean age of 44.0 months \pm 9.2 months. Initial exploration of the data suggests that parents of implanted children feel that music is important and that implanted children spend a similar amount of time listening to music when compared with their normally hearing peers. However, implanted children appear to respond to music in a slightly less sophisticated way. Children with cochlear implants also respond to singing and sing themselves at an older age and with less accuracy than those with normal hearing. Full analysis of the data is currently being undertaken and will be presented with the conclusions at the Symposium. It is anticipated that these results will offer an insight into the ability of children with CIs to appreciate music, which will be useful for carers and professionals who are working with them.

P22

Comparison of speech understanding in quiet and noise with TEMPO+ versus OPUS 2

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CIC Rhein Main Friedberg

The MED-EL OPUS 2 Processor has been compatible with the C40+ Implant since 2008. The aim of this poster was to discuss whether the C40+ users using OPUS 2 have only technical benefit or also benefit in speech understanding after upgrading. Therefore, patients were tested for understanding of monosyllables (Freiburger DIN 45621) as well as sentences (Hochmair-Schulz-Moser) in quiet and in noise with TEMPO+ and also with OPUS 2 after a testing period of 4 weeks ($n = 13/23$). The speech was presented from 0° , 1 meter in front of the patients (DIN ISO 8253-2). The signal was presented at 65dB and noise was presented at 55dB also from 0° . Tests were measured in a standardized room. In all test conditions, the patients' speech understanding was at least as good (and in some cases, better) with OPUS 2 as it was with the TEMPO+ processor. Some of these results were statistically significant. Findings revealed that patients who were moderate performers with TEMPO+ benefited the most from using OPUS 2. Patients benefited from upgrading to the OPUS 2 processor in every condition tested. Benefits were not only from technical aspects like the integrated T-Coil or direct FM-connection, but for most patients, speech understanding in quiet and noise also improved. The greatest benefit measured was found in the area of speech understanding in noise. The reason could be fine structure processing (FSP): by combining Fine Structure and Envelope information, speech information is better selected in noisy situations. In the future, testing of a larger group may provide more highly significant results. It is also possible that testing patient performance with OPUS 2 after a longer period (>4 weeks) of use may yield even better results.

P23

Intratympanic steroid injection as salvage treatment for sudden sensorineural hearing loss: A randomized, double-blind, placebo controlled study

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The purpose of the study is to verify through a randomized, double-blind, placebo control trial whether intratympanic steroid injection (ITSI) is beneficial to hearing recovery in patients with sudden sensorineural hearing loss (SSHL) after failure of initial systemic steroid therapy. A total of 60 idiopathic sudden sensorineural hearing loss subjects who had poor response to initial systemic steroid therapy were included in the study. The subjects were randomized into ITSI group or intratympanic normal saline (ITNI) group matched by age and sex. Both groups received 4 times injections within 2-week period. Hearing levels were compared between two groups one month after injection therapy. In ITNI group, pure tone threshold was 71.7 ± 19.3 dB before intratympanic injection. After therapy, hearing threshold improved an average of 4.8 ± 6.4 dB, and 13.3% subjects improved 10 dB or greater. The ITSI group had pure tone threshold of 67.2 ± 18.9 dB before intratympanic injection. After therapy, hearing threshold improved an average of 9.4 ± 8.3 dB, and 43.3% subject improved 10 dB or greater. Both the response rate and hearing improvement level in ITSI group were better than in ITNI group with statistical significance. These results proved a beneficial effect of intratympanic steroid injection as a salvage therapy in the treatment of idiopathic SSHL subjects who failed to respond to initial systemic steroid therapy. Prospective, randomized, double blind, placebo controlled study.

P24

Development of hearing and speech-abilities in cochlear implant users in dependence on cause of deafness

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The success of rehabilitation in cochlear implant patients is influenced by many factors. The presented study shall answer the question whether the cause of deafness plays an important role for the outcome of rehabilitation. Retrograde

and antegrade survey of data of 271 at the Cochlear Implant Centrum Ruhr in Essen implanted and rehabilitated patients within an Access database and evaluation with special hint at cause of deafness and development of speech and hearing ability after implantation. For evaluation of progress and outcome we used Freiburger numbers and monosyllables, Aachener Aphasia test, Speech-tracking and OLSA in adults, test after Schmid-Giovannini, Pollack, Mainzer and Göttinger speech test as well as OLKISA in children. Statistical analyses was performed with the program SPSS 15.0.271 patients: 163 children (c), 18 juveniles (j) and 90 adults (a). Bilateral implanted 23 (5 a, 4 j, and 12 c). Causes of deafness were Ushers' syndrome in 8 cases, other syndromes in 11 cases, consanguinity 11, connexion 26: 7, systemic infection 9, meningitis 6, noise trauma 5, sudden hearing loss 7, ototoxic medication 6, trauma 5, prematurity 5, Meniere's disease 2, otosclerosis 4, medulloblastoma 2, Mondini's dysplasia 5 and others. Not only the primary cause of deafness but also the associated phenomena concerning the syndromes and the pathomorphologic correlates in otosclerosis and meningitis for instance influence outcome and results of fitting and rehabilitation. Vice versa the knowledge of the cause of deafness offers possibilities to influence the success of fitting and rehabilitation.

P25

Results of Partial Deafness Cochlear Implantation (PDCI) – patient's perspective

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Introduction: The partial deafness is characterized by normal or slightly elevated thresholds in the low-frequency band with nearly total deafness in higher frequencies. In the case of partially deafened children, their high frequency hearing loss limits oral communication to a large extent. Limitation in speech comprehension distorts the process of developing interpersonal bonds and relationships. It also challenges the position development in the group and threatens the ability to cope with school requirements. This can significantly reduce the quality of life after maturation even after application of cochlear implant system and improvement in auditory perception. The aim of the study was to present patient's self report of the social and educational experience and various limitation during the childhood and adolescence due to the high frequency hearing impairment and the benefit of electric and acoustic stimulation (EAS) after partial deafness cochlear implantation (PDCI) in the adulthood. Method: 26 years old women at the moment of implantation, described how she was able to get on with her social educational and working life before and after cochlear implantation. Results: After a short period following activation of the cochlear implant, a quite large and highly significant improvement in the patient's quality of life and recognition of monosyllabic words were observed. Conclusion: The obtained results demonstrate that the combination of electric and acoustic stimulation improved significantly quality of life in partially deafened patient.

P26

Results of a stimulation concept based on "Selected Groups"

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A channel-picking cochlear implant (CI) strategy is described, in which both the spatial distribution and the spectral relevance of the picked channels are being considered. Available channels are subdivided into groups, so-called "Selected Groups" (SG), and within each group only a specified number of channels with the largest amplitudes are picked for stimulation. The hypothesis is that most of the perceivable spectral information is already being conveyed by the highest filter band outputs within a stimulation area (group). Eight MED-EL implant subjects (nine ears) participated in this study. Speech reception thresholds for German Oldenburg sentences in CCITT noise were measured. In Experiment 1, the SG group size was varied from one to four. In Experiment 2, stimulation pulse durations were doubled within groups of size two. The stimulation frame rate was kept constant across all configurations in order to avoid rate change effects. Experiment 1: For SG configurations up to a group size of three, no relevant difference to continuous interleaved sampling (CIS) was found. Experiment 2: Speech intelligibility with SG and doubled phase duration was on a par with CIS. On average, stimulation pulse amplitudes for doubled phase durations decreased by 4.8 dB. Experiment 1 shows that with a group size of up to three, the CIS performance can be achieved with a substantially lower number of stimulation pulses. The dynamic selection of up to one third of the stimulation pulses still includes all relevant pulses. Hence, SG provides a simple and robust selection algorithm for increasing the efficacy of the applied

stimulation pulses. Experiment 2 shows a substantial pulse amplitude reduction without a loss in speech perception for a group size of two. This may be a crucial benefit in future low-power or fully-implantable CIs.

P27

Round window cochleostomy using the Omni-Guide flexible fiber CO2 laser – A temporal bone study

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Round Window cochleostomy has received renewed interest in recent years as the techniques of “soft” cochlear implant techniques have been developed for hearing preservation. Implantation at the round window limits the amount of drilling and can lead to less acoustic trauma, less leakage of perilymph and decreased exposure to infection. Laser cochleostomy has been proposed to further limit bleeding and bone dust at the cochlea and therefore preserve hearing. The Omni Guide flexible CO2 fiber is a novel hand held laser which can provide improved access to the round window during traditional posterior tympanotomy cochlear implantation. Ten cadaveric temporal bones will be dissected using standard posterior tympanotomy cochlear implantation via the facial recess. Photographic documentation of the access to the round window will be obtained through the facial recess. The flexible fiber CO2 laser by Omni-Guide will be used to perform cochleostomy via the round window. We will report on the variance in exposure of the round window via the facial recess. We will document successful access to the round window with the handheld CO2 laser fiber Soft surgery techniques for cochlear implantation will continue to develop as more patients with residual hearing are implanted. Emphasis on atraumatic surgery will result in better hearing preservation. Laser cochleostomy via the round window will decrease trauma to the cochlea. The novel handheld flexible CO2 fiber by Omni-Guide improves surgeon access to the round window.

P28

Social emotions in deaf children with a CI between 1 and 5 years of age

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In interacting with others, it is essential to adhere to prevailing social norms and values. Social emotions such as shame and empathy serve this purpose. Shame shows that the child understands a moral standard has been violated (Barrett, 2005); empathy encompasses an emotional response to another person's feelings (Miller & Eisenberg, 1988). Little is known about the effect of a CI on children's social-emotional development. This study aims to research the extent to which 1- to 5-year-old CI children show these social emotions. Three measures were developed and validated in a pilot with 105 hearing children (Mage = 33,49 months, sd = 14,28): 1. Empathy Questionnaire (EQ) for parents and teachers, measuring emotional contagion, attention for others' emotions, and prosocial behaviour (based on Hoffman, 1987). An extra scale, measuring intention to interact with peers, was added to the teachers' form. 2. Empathy Observation Task (EOT), measuring children's attentional and prosocial responses to three emotions (happiness, sadness, anger), acted out by the experimenter. 3. Shame Observation Task (SOT), adapted from Barrett (2005), measuring shame behaviours after children were led to believe they broke a toy. The observational tasks were administered nonverbally, to prevent bias due to poor linguistic skills. The data showed good psychometric qualities and validity of the instruments. E.g., scales of the EOT and EQ correlated as expected (Attention: EOT x EQ, $R = .37$, $p < .043$; Prosocial: EOT x EQ, $R = .44$, $p < .011$), as did the SOT and EQ (SOT x EQ, Attention, $R = .26$, $p < .041$; SOT x EQ, Prosocial, $R = .32$, $p < .011$). The instruments allow valid and reliable measurement of social emotions. They are currently being administered to CI children. In this presentation, performances of CI children are compared to a matched hearing control group.

P29

The program of early diagnostics and rehabilitation of hearing at newborns and children of younger age in the Grodno area

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In July of 2007 in the Grodno area the realization of “Program of early diagnostics and rehabilitation of hearing at newborns and children of younger age with a hearing disorder” began. The aim of the work is to find out the

hearing disorder at the given population of children by means of objective techniques, and the beginning of corresponding treatment and rehabilitation beginning already about 6 months of a life of the child is as soon as possible. The purpose of work is the estimation of results of 1.5-years existence of the program, by means of the analysis of results of inspections of children advised in the Grodno State Clinical Hospital in “The Center of a pathology of hearing and speech”. It is surveyed 1018 newborns directed from branches of born helping(children from group FR), and also children of younger age directed by otolaryngologists of children's polyclinics of Grodno and area in “The Center of a pathology of hearing and speech”. Following objective techniques of research of hearing have been used: registration of auditory brainstem response (ABR) at all directed children, registration otoacoustic emissions as product of distortion (DPOAE) and impedance at children with a pathology revealed at research of ABR. Results and conclusions. Out of 1018 surveyed children 75 repeated inspection ABR since the result was distinct from the norm is appointed. 49 children are surveyed repeatedly. From them 14 children had norm. At 13 children relative deafness of 1-3 degrees character is confirmed, it is recommended hearing aid. At 22 children a deep hearing disorder of perceptive character diagnosed. It is qualified on cochlear implantation of 8 children (5 of them are implanted). The rest of them are in the state of observation. Thanks to the objective methods of observation of hear we have chance to find out the pathology of hear from the duration of newborn it gives the opportunity to choose the right tactic of feather work with patient from the early rehabilitation and in future we can see the result in speech of the child.

P30

Psychological family determinants of successful language development – case study of two deaf adolescents with CI

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The considerations on the subject of how the dimensions of motherhood (Stern 1985, 1995) determine the development of language are presented in the form of case studies of two adolescents A and B, girls, ages 18 and 19 at the moment of this study, with pre-lingual deafness, who received many years ago single channel cochlear implants. One of them, adolescent girl A, achieved high competence in oral language (later also in natural sign language). The other, girl B, remains practically without any language. Qualitative analysis (clinical interviews with mothers) from the psychological perspective - interpersonal approach - of those 2 case studies of implanted adolescents confirms the earlier research. The dimensions of maternal identity that act in favour of effectiveness of language development are: confronting the child's deafness (and not it's denial), investment in motherhood not involved in affective defence mechanisms (like i.e. denial), sharing emotions with the child's father, also those connected with the child's deafness, bringing into the relationship with a child also the verbalised experiences related with him/her, as well as a self representation as the deaf child's mother, enabling identifying with his/her handicap. Research project supported by grant from MNiSzW Nr 2PO5E 109 28.

P31

How do deaf adolescents experience themselves? Deaf identity and oral or sign language communication

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The research included adolescents pre-lingually deaf (n=20), ages 18-22, having high competence in oral language (n=10) or sign language (n=10) with hearing parents as well as hearing adolescents (n=40). For the description of personal identity were used I-Others Questionnaires 1 and 2 (modification of Traits Questionnaire by Jarymowicz) and for the description of social (here: cultural) identity DIDS (Deaf Identity Development Scale by N. Glickman, 1993). The tools were culturally and linguistically adapted, including the translation in Polish language (paper version) and interpreting into Polish sign language (CD version). Results show that it is the deafness, not the language (oral or sign) that co-determines personal identity of deaf adolescents with high language competence and hearing parents, which relates to the positive polarity of self-perception and denial of negative characteristics. Social identity (here: cultural) of the deaf adolescents is different in groups distinguished based on the type of language: deaf adolescents with high competence in oral language identifies with hearing persons, their language and values; deaf adolescents competent in natural sign language identifies with Deaf persons, their language and culture. It should be remembered that both groups of deaf adolescents include, following Erikson, persons with the foreclosed identity. This fact is also confirmed by the results of the presented research which allows us to describe the deaf personal identity. Research project supported by grant from MNiSzW Nr 2PO5E 109 28.

P32

Improving quality of care in aetiological investigation of bilateral hearing loss in newborns

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Etiological investigation of significant bilateral congenital hearing loss in children is a time consuming process. We aim to improve effectiveness, duration of the diagnostic evaluation and patient friendliness. We started a retrospective survey of our current multidisciplinary diagnostic approach, in which audiologists, otolaryngologists, medical geneticists, (metabolic) pediatricians, pediatric neurologists and ophthalmologists participate. Data of children with significant hearing loss (>40dB HL) referred to our multidisciplinary diagnostic team from February 2006 till December 2008 are included. In this period we have seen 36 young children with a mean age of 7 months (median 5 months; range 1 – 24 months) and 27 older children with a mean age of 67 months (median 51 months; range 25 – 242 months). The main focus of data analysis is on the younger group (newborns) because of the need of early diagnosis and intervention. We analyzed the number of visits to our outpatient center, how many different medical specialists were visited and in which order. Especially, we evaluated whether visits could have been combined or avoided. Furthermore we looked at the characteristics of our patients group (age, degree of hearing loss, additional problems and etiology of the hearing loss). Patient satisfaction questionnaires were sent to the parents of the patients. Results are based on 63 children seen by our multidisciplinary diagnostic team over the last three years. At the time of writing the data analyses is being done. This study is performed from a perspective of quality of care and diagnostic effectiveness. The results of this study will help us improve the effectiveness and optimise the diagnostic process. Knowing the aetiology of the hearing loss of young children is becoming more important because children receive cochlear implants at a younger age.

P33

Longitudinal effects of fine structure stimulation in Mandarin

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Speech perception outcomes of tonal-language-speaking cochlear implantees still lag behind the outcomes of their non-tonal-language-speaking peers. One reason for this is the limited capability of cochlear implants to reliably convey pitch cues, which carry lexical information in tonal languages. The present study examines the possible benefits of using fine structure stimulation strategies, which are expected to improve tonal language speech perception. 10 adult native speakers of Mandarin, all of them experienced users of the MED-EL C40+ cochlear implant, participated in the study. Speech reception with the subjects' personal TEMPO+ speech processor was compared against the performance with an experimental speech processor, configured either with a 10 channel CIS strategy (10CIS) or a 10 channel fine structure strategy (FS). The study population was randomly divided into two groups. Upon entering the study, group A used 10CIS for six weeks before switching to FS for another six weeks, whereas group B did vice versa. In all three test sessions (at initial switch over, after six weeks and after twelve weeks) speech reception was assessed with a lexical tone identification test and the Mandarin Hearing in Noise Test (M-HINT). Subjective quality of sound was rated on a visual analog scale and the Nijmegen Cochlear Implant Questionnaire (NCIQ) was administered. After an initial performance drop in sentence recognition at the acute switch over, most of the subjects improve with both experimental coding strategies beyond the TEMPO+ baseline. In the tone identification task the FS scores were immediately on a par with TEMPO+ and subsequently improved when using the fine structure strategy in everyday life. The results indicate the potential of fine structure strategies to improve tonal language speech perception and suggest that they require time to become fully accessible.

P34

Gusher-phenomenon in cochlear implant-surgery a predictably complication?

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The Gusher-phenomenon is characterized by an increase of perilymphatic pressure and discharge of it through the cochleostomia. It can be observed in stapes surgery and of course in cochlear implantations. 485 cochlear implantations had been performed since 1998 at the ENT-department of the

AMEOS-Klinikum St. Salvator in Halberstadt/Germany. 272 of these patients were prelingual deaf children. In 5,1% (N = 14) of these children a Gusher-phenomenon had been diagnosed intraoperatively. Analyzing MRI- and CT-scans Gusher-phenomenon was assumed in only 7 cases. In all operations the perilymphatic pressure via the cochleostomia could be successfully controlled by ENT-surgeons. After insertion of the CI-electrode into the Scala tympani cochleostomia had been closed by using tissue and fiber-glue. All patients got antibiotics intra- and postoperatively (Ceftriaxon). Only one time it was necessary to perform a second surgery because of continuing liquorrhea. In this single case the middle ear had been closed with tissue. The stop of liquorrhea was controlled by using an endonasal endoscopic to look into the epipharynx. The Gusher-phenomenon is a possible complication in cochlear implant-surgery. Preoperatively MRI- and CT-scans can help to detect it, but unexpected cases can be found while opening the cochlea. Standards in CI-surgery are necessary to prevent complications. In all of our patients we could control the Gusher-phenomenon without help of a neurosurgeon. A preoperative vaccination against Streptococcus pneumoniae (Prevenar or Pneumovac) and Haemophilus influenzae typ B should be performed in cases in which a Gusher-phenomenon seems possible.

P35

Auditory midbrain implant: Present clinical results and future directions

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Tumor-induced damage in the cochlear nucleus may be responsible for the limited success of the auditory brainstem implant (ABI) in neurofibromatosis type 2 (NF2) patients. Therefore, an alternative implantation site that bypasses the damaged pathways in the brainstem may provide better hearing performance in NF2 patients. The central nucleus of the inferior colliculus (ICC) provides access to almost all ascending auditory information and has a well-defined tonotopic organization which is important for an auditory prosthesis. This was our motivation for developing a new generation of central auditory prosthesis for deep stimulation of the inferior colliculus in the auditory midbrain. The auditory midbrain implant (AMI) is a single-shank multi-electrode array designed according to the dimensions of the human inferior colliculus with the goal of stimulating the different frequency layers of its central nucleus. The AMI clinical study has been performed in 5 NF2 patients. In all of the patients tumor removal and AMI implantation have been performed in a single surgical setting through the lateral suboccipital infratentorial-supracerebellar approach. None of the patients developed complications either due to tumor removal or AMI implantation. Until now, a follow up of up to two years have shown no evidence of electrode migrations in these 5 patients. Paresthesia was the most common nonauditory side effect which could be managed successfully by turning off the responsible sites at the first fitting. All the patients can receive environmental sounds and show lip-reading enhancement using their AMI. Psychoacoustic evaluation of the AMI patients revealed 3 interesting phenomena in the auditory pathways of the midbrain. First, the hearing performance depends strongly on the location of the implant in the midbrain. Stimulation of the ICC can produce better results compared to the lateral lemniscus and dorsal cortex of the inferior colliculus. Second, adaptation is an issue for stimulation of certain areas of the auditory midbrain and in order to overcome the adaptation, 3-D stimulation strategies may be required. Third, stimulation of the IC can induce high levels of plasticity which provides a higher chance of better hearing performance compared to cochlear nucleus but from the other side requires more flexible speech processing strategies. Based on our new insights into the properties of the auditory midbrain in human, we have developed a new generation of multiple shank AMI for better 3-D stimulation of the ICC. In addition, with proper placement of the implant into the ICC and using new flexible stimulation strategies to cope with adaptation and plasticity, better results compared to the ABI may be achieved in NF2 patients.

P36

Complications after cochlear implantation in children

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To review the complications of pediatric patients undergoing cochlear implantation (CI). Retrospective analysis of all children who underwent CI at an academic center. All complications were reviewed and classified into 3 types: cochlear reimplantation, other revision surgery, medical treatment. We reviewed a total of 111 children records among 292 consecutive CIs performed between 1994 and 2008. Age ranged from 1 to 15 y.o. (mean 44 months ±

17) and 51% of the patients were male. The device was a Nucleus®Cochlear Implant in all the cases, and the most commonly used was the Nucleus®24 Contour™; Cochlear Implant. All patients were examined annually excepted those implanted in 2008 who had a follow-up of at least 6 months. The overall rate of complications was 9% (10 of 111). Rate of cochlear reimplantation was 3.6%. The cause of reimplantation was infection in 2 cases, device failure in 1 case and misdirection of the electrode array into the internal auditory canal in 1 case with Mondini deformity. Reason for device failure was an impact failure; the device failed immediately after major head trauma. All, but one, reimplantations were performed on the ipsilateral side. Rate of revision surgery without cochlear reimplantation was 3.6%. In 1 case, infection resulted in a receiver migration with skin flap breakdown and subsequent exposure of the receiver through the skin. It was cured by fixation of the receiver covered by a cutaneous flap. In 2 cases with acute mastoiditis, infection was a complication of AOM. Both cases were treated by intensive antibiotic treatment, and a grommet insertion in one. In 1 case, a tympanic retraction pocket close to the electrode array was treated by tympanoplasty. Rate of early postoperative complications was 1.8% including 1 case of scalp hematoma and 1 case of transient facial palsy. These cases were treated successfully with conservative medical treatment. Finally, none case of device malfunction neither CSF leaks or meningitis was observed. Cochlear implantation in children continues to be reliable and safe, with a low percentage of severe complications, in experienced hands.

P37

The extrusion of the cochlear implanted electrode through the auricle skin: case report

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This presentation describes a case of cochlear implantation for deafness due to bilateral chronic otitis media as well as a complication after cochlear implantation in a 25-year-old male. A 25-year-old male with profound bilateral sensorineural hearing loss caused by chronic otitis media, who had previously performed 2 operations for the both ears was implanted with a cochlear implant (MED-EL) on the right side. Both ears are with an open cavities. During surgery the residual of cholesteatoma was found. No postoperative complications were observed. The patient responded to acoustic stimuli. 1 year after implantation, the electrode was found extruding through the skin of the auricle. The photos of the extrusion are presented. The electrode was covered with soft tissue and skin. 2 months after the surgery the extrusion of the electrode in the same place was seen again. There is no cholesteatoma present. Cochlear implantation can restore hearing in deafness due to bilateral chronic otitis media. Patients with chronic otitis media who had undergone cochlear implantation require follow-up for an extended period of time. Late complications due to persistent middle ear disease can arise years after surgery.

P38

Assessment of speech reception threshold in implanted children

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Introduction: Speech and hearing rehabilitation constitutes an essential part of auditory training in children after cochlear implantation. particular tests and measurements have been developed to monitor and control outcomes of this process. Verbal communication, which is the basic intent of cochlear implant treatment in pediatric population can be measured by speech tests. Because of the specificity of the group there is a need for the methods which are applicable in young children. Adaptive Auditory Speech Test is the new tool, developed by prof. F. Coninx, and adapted to polish language under European Project "Hearing Treat". AAST is a quick and reliable closed set test, using 6 easy words from child's vocabulary. Aim: The aim of the study was the assessment of SRT in implanted children with the use of AAST. Material and Method: AAST was performed in the group of 311 implanted children, aged from 3 to 16 years. Children were tested in free field condition both in quiet and in noise. Results: Average speech reception threshold in the group was 28dB in quiet and SNR was 9,2dB for testing in noise. Conclusions: AAST is useful tool to assess speech comprehension in implanted children. Some of the research reported were supported by Marie Curie Host Fellowships for Transfer of Knowledge; Remediation of Hearing Loss; Nr. 042387.

P39

General effects of fitting of speech processor parameters in group of patients below and above 50 years old – comparative evaluation

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The research has been carried at ENT Department of Medical University of Warsaw. 55 postlingually deafened patients underwent the operation of cochlear implantation. From among the whole group 26 patients were above 50 yrs, 23 were less than 50 years. The average age of an older group in time of the surgery was 58,7 yrs (the oldest patient-74 yrs, the youngest - 50 yrs). These patients received following cochlear implant systems: Nucleus 24 (n=9), Nucleus Freedom (n=4) from Cochlear, DigisonicSP 20el. (n=14) from MXM Neurelec. The second investigated group was in age between 14 and 49 yrs. The mean age was 32,1 yrs. These patients were implanted with: Nucleus 24 (n=6), Nucleus Freedom (n=6), DigisonicSP 20 el. (n=8) and Harmony from Advanced Bionics (n=4). All of evaluated patients underwent through the process of qualification for the cochlear implantation positively. None of them had that serious health damage, that could hardly influence the post operative effect of cochlear implantation. The effects of fittings of speech processors were investigated in periods of 1,2,3,6 months, 1,2, 3 years after the first switch on of the CI system. On a base of evaluation of general effects of fittings it was found, that younger patients got used to the stimulation much faster, they also achieved positive effects of rehabilitation in shorter time and reached better hearing level than the group of patients above 50 yrs. The data from other cochlear implantation centers seem to confirm the presented tendency. Older patients might achieve their results slower than younger patients. Cochlear implantation is still the only mean of cure, that ensures them even if not in hundred percent comfortable life, than at least allows them successful communication with other people.

P40

Evaluation of Prativis – Computer-based Phonological Training

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Introduction: Many preschool and school-aged children are referred to a speech and language therapist for speech disorders. Since 1991 many children with severe hearing loss and deafness have been treated with cochlear implants (CI) in Sweden. Research has shown that there is considerable variation in how the child acquires spoken language. Prativis is a Swedish interactive computer program that offers individually adapted and to a certain extent self-instructive training programs for hearing and hearing impaired children with phonological disorders. Aim: This study is the first evaluation of Prativis. It includes children with normal hearing and with cochlear implants who have phonological disorders. Research questions: 1. Can the Prativis program contribute to improving the child's articulation and speech intelligibility? 2. What do users think of Prativis as a treatment method? Methods: The study comprises four children with phonological disorders. Two with normal hearing and two with cochlear implants. Introduction and training period: The users were informed to train with Prativis for six weeks, 20-30 minutes, 5-6 times a week divided between the speech and language therapist, teacher and home. Assessment methods and evaluation there of: A questionnaire regarding intelligibility was filled out (before and after the six-week training period and four months later). A user questionnaire was turned in at the conclusion of the six-week training period. The children carried out the Prativis naming test on three occasions. Results: All the children improved their phonology on the naming test. One child with cochlear implants improved her intelligibility after 6 weeks practise and even some more at follow up. The users appreciated the video, pictures and ability to record. Conclusions: This study showed that practising with "Prativis" resulted in an increase in the amount of correct words in all children, an evident improvement regarding intelligibility in two of the children and a less obvious effect in the other two.

P41

Deafness and ADHD: outcomes after four years of CI use of a child implanted with 18 months of age

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Main aim of this case study is to analyse language development in a deaf child with Attention Deficit Hyperactivity Disorder (ADHD). Participant: Spanish child deaf since birth; CI fitting: 17 months. ADHD diagnosed: 58 months. She began a treatment with Metylphenidate immediately after diagnostic. Material: 155 speech samples (from before CI activation until second month of Metylphenidate treatment). Samples were transcribed (MacWhinney, 2000) and analysed to obtain data of phonological, lexical, grammatical and pragmatic development. Standardized tests were also used. First year of CI use: 1) Vocal development: slow, but comparable to other CI children. 2) Symbolic play: initially very poor, but an important progression occurs soon. 3) Lexicon: poor (few words, and all non-referential). Second year: 1) Phonology, intelligibility and lexicon: excellent progression; 3) Grammar: progression is slow (e.g. frequent article-noun agreement errors, low MLU). Third and fourth year: 1) Phonology and lexicon: the child catches up with her age peers; 2) Grammar: few errors, but they are atypical (pronouns, prepositions, verb agreement...) and non-systematic. 3) Pragmatics: her discourse is clearly atypical, as noted especially in her difficulty to answer cooperatively (Grice, 1975) to direct questions. Post-Metylphenidate: 1) lexical errors increase slightly. 2) Pragmatic skills improve notably. Despite slow initial progression in all areas (phonology, referential lexicon and grammar), her language levels were age appropriate after four years of CI use. Most important difficulties are related to pragmatics (most probably due to ADHD). Note that this child received intensive language therapy, and her family participated actively in the rehabilitation, which may have facilitated progression. If conditions are appropriate (early CI, intensive language therapy, family implication, medical treatment), a deaf child with ADHD may catch up with her age peers on time to enter mainstream primary school. Authors would like to thank the help of the parents and the language therapists María Jose Ruiz and Paloma García. María del Mar Cid collaborated in transcription of the final set of videotapes.

P42

Pragmatic abilities of children with hearing impairment

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The purpose of the study was to get a characteristic profile of pragmatic abilities of children with hearing loss (HL), using hearing aids (HA) or cochlear implants (CI) and to compare it to that of hearing children. The participants were 24 children with HL, ages 6:03-9:04 years. 11 of them used CI, and 13 used HAs. 13 children with normal hearing with similar chronological ages and similar language ages served as controls. The pragmatic abilities were assessed during an interaction with a familiar adult partner by using the pragmatic protocol of Prutting & Kirchner (1987). The protocol contains verbal, non-verbal and paralinguistic aspects. The protocol assesses the extent by which the use of the different behaviors is appropriate, during a 15 minutes communication interaction. The interactions were videotaped and were analyzed later. The results showed that children with HL used varied pragmatic functions, but showed more incidents of inappropriate use of the different abilities, compared to the hearing children. The difference between the groups was significant only for the verbal parameters. There were no differences between the children who used CI and those who used HAs. The different or less effective pragmatic abilities of the children with HL may be explained by less flexible use of language structures, difficulties in the domain of theory of mind, difficulties in auditory perception of spoken language, and less exposure to varied pragmatic situations and strategies. The results of this study indicated the need to relate to pragmatic communication abilities during rehabilitation programs with children with HL and to expose them to variety of natural conversational interactions, and practicing language abilities and auditory abilities, during varied natural interactions. Future research should continue to examine the pragmatic abilities of children with HL at a later developmental stage and with different conversation partners in varied contexts.

P43

Electrode impedance variations in children using the Contour Electrode of the Nucleus 24 Cochlear Implant System from intraoperatively to 36 months post-tune up

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The objective of this study was to measure impedance variations over a series of time intervals, in Common Ground Mode in children using the Contour electrode. Data were collected for ten children over time: intraoperatively, during the initial fitting session, 1 month, 2 months, 6 months, 12 months, 24 months and 36 months later. In general impedances increased from the intra-operative to the initial fitting session, decreased for the first month and were then relatively stable at the subsequent periods of time. This behaviour was observed when using the uncorrected and corrected data for differences in electrode surface area. Impedances values were lower for the corred measurement at the different periods of time of the study. Impedances were influenced by whether the electrodes were stimulated or unstimulated in the speech processor maps. The impedances of the electrodes not used in the maps, were relatively unchanged after the initial tune-up session, when compared with the variations observed in stimulated electrodes. Impedance variations after the surgery could be explained by resistive characteristics of the medium surrounding the electrode (fluid and tissue) as well as by the effect of stimulation. The electrical stimulation effect along time shows in stimulated electrodes lower impedances than in unstimulated electrodes. Our results are consistent with other studies that found impedance variations over time but future studies should include measurement of electrode impedance in different stimulation modes, with different electrode types in children and adults, over time, beginning with intraoperative measures.

P44

Forms of care of patients implemented in the International Center of Hearing and Speech

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Rehabilitation of cochlear implant patients is a multi-aspect process. Depending on the patient's age it should include in the first place: therapy of hearing, speech, support of general development, assistance in education and adaptation in peer society. Because of the complexity of realized activities it is necessary to introduce methods and tools for the assessment and if required modification of progress of the rehabilitation process. This study contains an overview of the major and most effective methods of the management of patients - users of the cochlear implant system implemented in the Institute of Physiology and Pathology of Hearing in Warsaw. It presents different forms of activities run by the multidisciplinary team of the Department of Implants and Auditory Perception and Clinic of Rehabilitation with the particular attention on the formula of patients' visits and the set of tools used for the assessment of the progress of patient's abilities and skills. Organization and implementation of activities, merging engineering and technical tasks with speech therapy, education and psychology, is aimed at the assessment of the progress of post-operative rehabilitation. Because of the diversity of forms the rehabilitation program is always tailor-made for the needs of each patient.

P45

Monitoring and control measures of rehabilitation program after cochlear implantation- one-week rehabilitation stay

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Introduction: As rehabilitation of cochlear implant patients is many-faceted, a multidisciplinary approach is necessary involving not only speech and auditory therapy but also development, educational and social support. Monitoring and control measures have to be applied to ensure the optimized application of the therapy. Methods: Over 1500 patients have been implanted in the Institute of Physiology and Pathology of Hearing in Warsaw/Kajetany. One week stay program in International Rehabilitation Center in Łeba was designed to monitor and control rehabilitation process. It is available for the patient twice a year. 144 patient took part in this program in 2006. The complex assessment includes speech, pedagogical and psychological evaluation and enables to form guidelines and recommendation for individual rehabilitation program. Results: Base on our results of complex evaluation, we found out that in 55% cases, the therapy is effective and helpful for the patient, in 35% cases some modification were proposed and 10% showed the need of significant change

in the therapy program. Conclusion: The implementation of the monitoring and control method of rehabilitation program after cochlear implantation will increase the cochlear implant users' benefits, what in turn leads to higher improvement in quality of life and cost-effectiveness of the treatment.

P46

Rare late-onset complications after cochlear implantation in children

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Mechanical problems after cochlear implantation are rather rare. If indeed complications like facial nerve paralysis, electrode misplacement, foreign body reaction, vestibular dysfunction and flap breakdown have to be seen, they occur shortly after operation. Month and years later mainly fitting problems, developmental delays or device failure demand care and attention. In some single cases mechanical problems lead to severe situations that need medical interference. Two cases of a late mechanical complication are reported to show the need of fast and secure surgical intervention. A five year old girl, was presented by its parents six weeks after sequential bilateral cochlear implantation with a punctate infection above the receiver stimulator package. Local and systemic antibiotics brought only short improvement. After talking to the parents, an operative revision with exploring the implant package was performed. Intraoperative a spearing suture of the implant fixation was identified as reason for the local reaction. After shortening the suture a trouble-free wound healing could be observed. Like in the first case, the parents of a eight years old boy, by this time bilateral implanted, showed up because of a local skin reaction above the receiver stimulator package. A movable foreign body was detected during clinical examination. Conventional X-ray showed a dislocated magnet. On demand parents tell about a severe fall of their son on the corresponding side month before. By a short operative procedure including a small incision over the implant package the magnet could be replaced. Wound healing was again completely unproblematic. The cochlear implant was working properly before and after accident and operation and had been worn permanently. Late-onset complications without implant failure are rather rare incidents and should be treated with great care because of their potential consequences. Primarily great value should be placed on regular examinations of all implanted children and adults. By this procedure these and other problems can be detected and parents get a competent contact. After detecting mechanical problems early they can be solved often by a short operative procedure.

P47

A biodegradable coating reduces insertion forces in cochlear implantation

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For cochlear implantation in patients with residual hearing, a low traumatizing electrode insertion is necessary to prevent inner ear structures from damage. Insertion forces have been reported to affect the insertion trauma significantly. A prototype electrode array, with a cellulose based coating is presented and evaluated. Eight coated and eight uncoated electrode arrays were inserted into a scala tympani model using a custom made device and insertion forces produced were recorded in near real time. To evaluate the feasibility of the insertion process, five coated electrode carriers were implanted into human temporal bones and processed undecalcified. The mean insertion forces were markedly reduced for coated electrode arrays for electrode insertion depths above 15 mm with 1.01 cN vs. 1.44 cN, 2.57 cN vs. 4.79 cN, and 6.28 cN vs. 12.72 cN for insertion depths of 15 mm, 20 mm, and 25 mm, respectively. The maximum insertion angle was higher in coated electrode arrays with 459.4° vs. 352.5°. The insertion of coated electrode arrays was feasible. The coating material was evident up to the apical turn of the cochlea. Presented is a coated prototype electrode array that may reduce insertion forces and surgical trauma. Additionally, when loaded with drugs, it may serve as a drug delivery system to provide drugs to the apical parts of the cochlea, where hair cells reside in patients with residual hearing.

P48

Alternative method of hearing assessment in cochlear implanted children

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Activation and programming of cochlear implant require knowledge of stimulation thresholds and comfort levels. Correctness of fitting is difficult to establish and the risk of under-stimulation remains. Gains in linguistic behaviors may develop immediately after implantation. The aim of our study is to evaluate the linguistic behaviors immediately after implantation using 26 simple questions addressed to the family of 20 implanted children within first 12 months after the first fitting. Their answers were compared with those obtained from parents of 100 normal hearing children younger than 12 months of age. We show the results of the evaluation at 3, 6 and 12 months of the 20 implanted young. The questionnaire might be an additional useful tool in evaluation of correctness of fitting and of well function of the device in the first 6 months following the implantation in small children. The paper discusses the results and reliability of the questionnaire that is assessed.

P49

The influence of electrode placement on speech perception scores after cochlea implantation

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The correct placement and the atraumatic insertion of the cochlear implant electrode in side the cochlea are important issues for good speech perception after implant activation. The influence of placement of the electrode into scala tympani or scala vestibuli has been controversially discussed, depending on surgical techniques and electrode characterisations. Usually the goal is to place the electrode into scala tympani. Therefore, the audiological outcomes of 662 CI implantations between 2002 and 2008 were evaluated to further study possible effects of electrode position on long-term speech perception scores. 540 CIs were inserted in scala tympani and 122 in scala vestibuli. Mean age of the patients at the time of implantation was 25,8 years. Speech perception was tested up to 7 years after implantation using the Freiburger Test for monosyllabic words, the Freiburger numbers and the HSM sentences test. Test results were compared between the two groups of a scala tympani and a scala vestibuli insertion. Speech perception was significantly better following cochlea implantation and further improved during the time of observation. A statistically significant difference in speech perception scores depending on electrode placement could not be proven in the overall cohort. Our Data suggest that there is no difference in speech perception score following scala tympani or scala vestibuli insertion for a long lateral wall electrode with a long active part of the array. Scala vestibuli seems to be as good as scala tympani using long electrodes with insertion into the second turn of the cochlea.

P50

Interactions of dissociated neurons of the spiral ganglion with semiconductor materials

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Cochlear implants provide auditory information by electrical stimulation of auditory neurons in patients with severe sensory hearing loss. The biological adaptation of auditory neurons with semiconductor materials used in micro-processor technologies may lead to further improvement in hearing quality for implant users. Recent data have shown the growth of explants of the spiral ganglion on semiconductor materials. The interactions of spiral ganglion neurons, glial cells and other non-neuronal cells with semiconductor materials have yet to be described. To evaluate these interactions we established a protocol to culture dissociated cells of postnatal spiral ganglion. The growth of these cells in different media (Neurobasal vs. DMEM) and the interactions of the cells with semiconductor materials (Si vs. Si3N4) were examined, using immunohistochemical and fluorescence techniques. Dissociated neurons of the spiral ganglia showed improved cell growth in Neurobasal media compared with DMEM media. Cells plated on Si chips showed impaired cell survival compared with Si3N4 Chips in both culture conditions. This cell culture system gives the opportunity to examine cell growth of spiral ganglion neurons without the interactions and stimulations of surrounding cells, in different

cell culture conditions and on varying substrates. Beyond that a possible stimulation of these neurons with neurotrophins and correlations with electrophysiological recordings can be tested. These could lead to a better understanding of the molecular biology of auditory neurons and to a development of improved electrode materials for cochlear implants.

P51

The development of musical pitch in children with cochlear implants

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This study aims to demonstrate the pitch related musical development of pre-lingually deaf, cochlear implanted children participating in an (re)habilitation programme of targeted and graded exercises designed to build pitch perception and production skills within a musical context. Three age groups of children participated: 2-4 years, 7-10 years and 11-18 years. Each group undertook an age appropriate (re)habilitation programme of musical pitch development including vocal training, singing exercises, playing melodies and melodic recognition. Video recordings were made of all the sessions. The video materials were analysed and graded in relation to accurate pitch production. Analysed video recordings will be presented to demonstrate an increasing acquisition of musical pitch in the singing voice. Results from each group will illustrate the effect of the (re)habilitation training programme in each case. Although psycho-acoustic tests of cochlear implant hearing have tended to show disappointingly poor performance on pitch related tasks, structured programmes based within a musical context with cochlear implanted children with latest generation devices can lead to the development of the ability to sing in tune. Knowledge has been gained of specific musical techniques which can develop musical pitch perception and production in the singing voice of cochlear implanted children, supported through the video and analytic evidence of the efficacy of these techniques.

P52

Psycholinguistic abilities of cochlear implanted children

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Increasing numbers of severely and profoundly deaf children are receiving cochlear implants (C.I.) at an early age in the last years. Studies of these children have shown positive effects from the use of cochlear implants on their language development (e.g., Geers, Nicholas & Sedey, 2003; Spencer, 2004; Svirsky et al, 2000). Nevertheless enormous individual differences in the way kids react to a cochlear implant has been reported. Differences in speech and spoken language development after a cochlear implantation has been attributed to some factors such as, age of implantation, duration of use of implant, and the language modalities used in children's. The aim of this study was to analyse variations in language skills of 18 deaf children who received a C.I. between 9 months and 13 years of age. Children's language development was assessed using the Illinois Test of Psycholinguistic Abilities (ITPA; Kirk, McCarthy & Kirk, 1996). The different parameters related to language skills are presented. The possible associations between language performance measures with the factors previously mentioned are discussed.

P53

Research on infant vocalizations and prelinguistic behaviours in searching for predictors of language development in deaf infants with cochlear implants

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The study is a summary of existing models and methods of analysing prelinguistic behaviours and preverbal vocalizations of hearing infants in searching for predictors of language development in deaf infants before and after implantation. The cochlear implantation of deaf infants in clinical practice requires the creation of a battery test to find early predictors of normal and deviant language. From the beginning of 2008 we started gathering the materials about preverbal communication skills and vocalization development of two groups of infants: deaf infants with cochlear implants and normally hearing infants. We videotaped children spontaneous play while being alone

and with parents. Additionally, spontaneous vocalizations are recorded by digital recorder for further acoustic analysis. Preliminary study of the first data set will be presented. The longitudinal study will examine the qualitative and quantitative aspects of pre-verbal communication behaviours and pre-first word vocalizations of deaf infants. Further results may give theoretical as well as practical implications for early intervention programs for deaf infants with cochlear implants.

P54

Fine structure in cochlear implants: speech recognition with a competing talker

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Several studies have shown the importance of F0 or voice pitch information for the segregation of competing speech sounds. As most present-day implant systems emphasize temporal envelope information, the addition of temporal fine structure (FS) may support a more robust encoding of F0 in cochlear implants. The investigated FS coding strategy presents temporal fine structure information on low-frequency channels and combines them with mid- to high-frequency CIS channels. On the FS electrodes, pulse packages are triggered by the zero-crossings of the corresponding band filter outputs and scaled with the channel envelopes. Hence, both fine structure and envelope information are represented. Speech reception thresholds (SRTs) for German OLSA sentences with a male talker and a female masker sentence were measured in 7 MED-EL recipients to date. Acutely compared coding strategies included CIS, a fine structure strategy with 4 apical FS channels from 100-800 Hz (FS-1), and a setting comprising 2 FS channels from 300-800 Hz (FS-2). Mean SRTs were -5.1dB for FS-1 with 4 FS channels and -4.7dB for CIS, indicating a small, however not significant acute benefit with fine structure stimulation. FS-2 with temporal FS representation in a filterbank starting at 300 Hz resulted in a mean SRT of -0.5dB. Results indicate the importance of low-frequency information when encoding temporal fine structure, and in particular the need to include the pitch range of male voices. FS-1 was acutely on a par with the CIS control condition, which always utilized the same number of channels and identical frequency bands as FS-1. Representing temporal FS only above 300 Hz (FS-2) substantially degrades performance. The present results are promising when considering recent findings of longitudinal studies, which at first often show an acute decrement in performance with FS stimulation, to then substantially improve only after several months of FS listening experience.

P55

The endomeatal approach for cochlear implant surgery

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An alternative surgical approach using the external auditory canal as a natural access pathway for cochlear implant positioning is described. It avoids performing a mastoidectomy and the subsequent posterior tympanotomy. The technique was developed and practiced in temporal bones and after that was applied in 14 patients. The surgery has an endomeatal first stage, which begins with a stapedectomy-like tympanomeatal flap. This flap allows an easy access to scala tympani via round window. The internal part of a groove is drilled on the postero-superior aspect of the EAC, parallel to its axis. Once the endomeatal stage is completed, a standard retroauricular approach is performed, in order to make the receptor-stimulator well and to complete the groove externally until it connects the middle ear with the external mastoid surface. The groove has a special shape, with an overhang in its superior lip. A second flat well is drilled in front of the receptor bed. The electrode array is introduced in the scala tympani through the round window, the electrode guide is located into the groove and retained inside it by the overhang and with bone pate. The flat cavity is used for accommodation of the guide's extra length. Surgical time was significantly shorter than in regular approach. There were neither surgical nor healing complications. Electrode insertion was easy and complete. This approach avoids the antromastoidectomy and posterior tympanotomy, which are replaced by the EAC groove. It is faster and safer, eliminating the risk of facial nerve injury. It also allows a better access to the round window. The insertion angle into scala tympani matches its initial axis, allowing a less traumatic electrode insertion. This technique has a potential application in EAS, due to its better insertion angle and access to round window.

P56

Guideline for the pull back of perimodiolar Nucleus 24 electrodes

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The pull back of inserted perimodiolar electrodes has been shown to decrease the intracochlear spread of excitation. But detailed descriptions how to carry out this technique are missing. The aim of the present study was to give a surgical guideline for the controlled pull back of the perimodiolar Nucleus 24 electrode to optimize perimodiolar position. In a temporal bone study with 9 different temporal bones we performed 54 electrode insertions under different conditions. Digital capturing and calculation of the intracochlear movements allow the estimation of guidelines. Different factors influence the initial intracochlear distance of the electrode from the modiolus. Even in initial close perimodiolar positions the controlled electrode pull back enhances the proximity to the modiolus. A 1,5 to 2 mm electrode pull back allows the narrowing of the electrode to the modiolus without changing the insertion depth in all cases.

P57

Reading comprehension in Flemish deaf children

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To investigate reading comprehension in Flemish deaf children with cochlear implants or hearing aids and to assess effects of early implantation. Reading comprehension of 74 Flemish deaf children has been assessed with a standardized test for hearing children; 44 children With CI's (CI at 48 months) and 30 children with hearing aids (HA). Reading scores are expressed, for children in grade 1-4 and 5-8 separately, as z-scores. Performance of the study group is contrasted with reference data of 50 Dutch children with CIs (CI at 74 months) (Vermeulen, 2007) and to data of Dutch children with HA (Wauters, 2006), using non-parametric tests. The effect of age at implantation in Flemish children is analyzed with linear regression. The z-scores of the Flemish children in grade 1-4 are: CI=-1.2, HA=-2.1; in grade 5-8: CI=-2.6, HA=-3.1. The Dutch z-scores are in grade 1-4 CI=-2.1, HA=-4.2; in grade 5-8 CI=-5.4, HA=-7.2. There was a significant effect of early intervention in Flemish CI children. Their age of implantation (corrected for length of device use) was associated with reading comprehension ($R^2=.2763$, $p.001$). For all groups, except the grade 1-4 CI users, the reading comprehension performance of the Flemish children was significantly better than that of the Dutch children. There were no significant differences between the Flemish CI and HA users but there were in the Dutch group. In the Flemish group the significant differences between grade 1-4 and 5-8 indicate an effect of age at intervention. The better reading comprehension in the elder Flemish group (CH and HA) compared to the Dutch may be attributed partly to the mode of communication in school-settings. Explaining factors of the differences will be further discussed. Early intervention, by implantation or amplification in Flanders leads to exceptional good reading comprehension levels in young children.

P58

Pediatric cochlear implants: a longitudinal multidiscipline rehabilitation programme

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The number and the variation in demographics of pediatric cochlear implant recipients are increasing. This makes it necessary to create a rehabilitation programme which can accommodate every individual child and its parents. This study describes the outcomes obtained from a parents' evaluation and the consequent implementation of improvements in the pediatric CI rehabilitation program at the Leiden University Medical Centre. Our pediatric CI program is structured in so called 'auditory weeks' (AW's). In the first year after implantation the child participates in six auditory weeks which take place at regularly increasing time intervals. During the AW the child and its parents get individual support in the auditory, speech-language and social-emotional development on a daily basis. After this year of rehabilitation the child and its parents come two times a year for follow-up (FU). The parents' appreciation questionnaires on the AW's were sent to the parents of 60 children (with 50% response). The FU was evaluated on 47 children (43% response). In addition we analyzed the results of the IT-MAIS parents' questionnaires on auditory

and language development of their children. Parents appreciate the contents of both AW's and FU. Most parents have the opinion that the programme is sufficiently adapted to the possibilities of their child. Furthermore they report that participating in the programme with their child helps them to keep track of their child's development. Based on the responses various adjustments were made, e.g. the timing and intensity of appointments was modified (from 5 to 6 weeks) and a journal book was introduced. Parents are satisfied about the AW's and FU. The mean auditory and language development of the children with a CI participating in AW's is at least as good as results from the literature.

P59

Multi handicapped children with a CI – necessity of long-term integral therapeutic pedagogy process

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The appropriate long term resource orientated attendance of multi handicapped children supported with a CI and their social environment has to proof the following requirements: interdisciplinary exchange, social networking, cooperative supervision. These essential offers from interdisciplinary clinical experts towards other surrounding institutions of the child are described by a case report. Therapeutic interventions are presented within a comprehensive pedagogy process based on a case of a multi handicapped 3 ½ years old boy. The child showed a posture retardation, a doubtful intellectual retardation, multiple sense retardation, a little speech production development and questionable "aggressive" social behaviour. The described integral therapeutical approach comprehends beside the pedagogy diagnostics and speech- and sense training, especially a resource orientated parental consultancy, social networking and cooperative supervision with overextended educators. With these interventions we achieved a relaxed behaviour of the educator acting with the child and a consolidation between parents and educators and their cooperation. To be in negotiation with parents and the cooperative supervision of the other educators around the child is the main support for a motivational start. The educators and parents have developed their own ideas for solving problems, supported by the therapeutical pedagogy process. Discussion: A successful long-term therapy of multi handicapped children with CI is based on a complex but lean and result orientated process as part of a quality control case-care management. At first it seems very cost intensive but it is only a time displacement of professional interventions. Conclusions: The long-term resource orientated process is the base for a most likely undisturbed process and positive support of the affected child. Within this framework and its individual character the child can develop as best himself.

P60

The influence of the IDR in cochlear implant recipients

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A previous study, undertaken to investigate the influence of increasing the IDR in paediatric recipients, showed no clear benefit in quiet and only a minor benefit in a selected group of children in higher levels of background noise (5 or 0dB SNR). This study was set up to investigate the influence of the IDR using a more challenging speech test in a selected group of children and young adults. This is a comparative study using a test with roving speech levels and adaptive noise comparing the outcomes of 3 groups of recipients: Recipients using a Harmony processor with a 60 and 75dB IDR, recipients with a Freedom processor, using a 50dB IDR and recipients with the 3G processor using a 30dB IDR. Data collection is ongoing and the results will be discussed on the poster. An increase in IDR has been shown to be advantageous in adults. Both devices used, process sound very differently and this along with other factors may influence the outcome. Equally working with children and young adults can introduce other variables such as confidence, tiredness, cooperation and language development, which can influence the outcome.

P61

The development of pronouns in pediatric cochlear implanted children

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Several studies have shown that early cochlear implantation has a positive effect on the overall oral language development of deaf children. Only few studies have looked in more detail at morpho-syntactic development. This

study is the first to analyze the development of pronouns in a cohort of Dutch-speaking cochlear implanted children. As the proper use of pronouns is an important pre-requisite to take part in conversation, the outcomes are taken to be a possible measure for the effectiveness of cochlear implantation. 9 Dutch-speaking oral deaf children who received a CI before 20 months have been followed longitudinally until the age of 8 by means of monthly recordings of spontaneous speech. The control group consists of 15 Dutch-speaking hearing children for which similar longitudinal production data are available. Three milestones in the development of pronouns and their morphological attributes (person, number, case, gender, animacy and deficiency) are investigated: first emergence of pronouns and of pronoun attributes; and pronoun productivity, measured in terms of Tokens, Types and Type/Token Ratio. The outcomes indicate that CI-children acquire pronouns in a delayed way. Their first pronoun, as well as the different attributes investigated, emerge later than in hearing children. Importantly, the order of emergence of these attributes, although delayed, is similar to the one found in hearing children. Importantly, early implantation is associated with an early first emergence. With respect to pronoun productivity, all CI-children were able to catch up with their hearing peers by the age of 7. Based on spontaneous production data, cochlear-implanted children develop pronouns in a delayed but non-deviant way when compared to hearing age-matched peers. As such, a CI may be considered to be an effective way to provide pre-lingual oral deaf children with the necessary sensory input to acquire pronouns and therefore also to enhance their conversational skills.

P62

Logopedic evaluation post normal cochlear implants versus malformation cochlear anatomy

Villalba M., Pascual F., Valdecasas Bernal G., Quevedo S.

Between all the sensory faults present in the moment of the birth, the most frequent is the deep hypoacusia, with an incident estimated between 0,8 and 3 cases every 1.000 births in USA and between 1,5 and 2 every 1.000 births in Europe. The internal ear malformations are present in approximately 20% of the patients with neurosensorial congenital auditory lost, being able or not to be associated with other malformations not related to the ear. The functional deficit of these congenital malformations of ear is very changeable, being major as major is the malformation degree. Objectives: Know the performance obtained in the test of logopedic rehabilitation by the patients with internal ear malformation after the placement of a cochlear implant, as well as the study of new strategies of rehabilitation adapted to this group of patients. We have designed a prospective observational study of cases and controls. The first group is integrate by 16 deep carrying hypoacoustic patients of cochlear implant and affected of different cochlear malformations, whereas the control group is formed by 32 patients equally deep hypoacoustic and implanted, but with normal anatomy of internal ear. There have been gathered the results of the test LIP PROFIL and MTP3,6 and 12, in the moment before the surgery, a month, to three, six, twelve and eighteen months after the intervention. The results before the intervention, as those obtained once turn on the cochlear implant, are sensitively worse in the group with cochlear malformations. The study of the cochlear malformations is a topic of full current importance, that why effort center in guarantee a few satisfactory results for this group of patients.

P63

A rare but life-threatening complication of acoustic brainstem implant in a child

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A sub-dural hematoma developing over the opposite side after acoustic brainstem implant (ABI) surgery is a rare but important complication. The experience of simultaneously using an ABI on one side and a cochlear implant (CI) on the other, has also not been reported. A relevant case report is presented and discussed. The girl developed meningo-encephalitis and profound hearing loss at the age of 5 years. At 8 years of age, she received a right cochlear implant after a drill-out procedure of the obliterated cochlea. Although there was much benefit initially, the results deteriorated over time because of electrode migration. At the age of 12 years, the family decided to have an ABI on the left side. Post-operatively, she developed pain over the opposite side of the head. CT scans revealed a right frontal subdural hematoma which was then surgically drained. The patient recovered well and gained significant improved hearing outcomes with the ABI. Despite repeated mapping, simultaneous use of ABI & CI led to auditory confusion and increased numbness of the body. Hence, the use of the CI was discontinued. This is a rare but potentially life-threatening complication of ABI surgery. Its development may be misleading as the headache is felt not at the operative site but a distance away. The unwary

surgeon may miss out on an early diagnosis with dire consequences. The experience from this patient suggests that the simultaneous use of ABI and CI is incompatible. This is the first report of a subdural hematoma developing after an ABI, and occurred on the opposite side of the head. Although there have been a number of studies on patients with bilateral cochlear implantation, this patient provides a rare opportunity to study the use of a CI on one side and an ABI on the other.

P64

The results of screening otoacoustic emission in newborn of 2 ukrainian regions for 2006-2007

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Universal newborn hearing screening have been established in many countries to enable early detection of permanent congenital hearing impairment. However we have not universal newborn hearing screening programme on standing basis in Ukraine. The large-scale screening otoacoustic emission (OAE) examination was performed in 4 maternity hospitals of Lviv and Chernihiv regions in 2006-2007. For this period there was borned 11523 children and 9262 children was examined by Echocheck. The main results of our investigation include coverage rate (80%), OAE (-) for one ear (116 children), OAE (-) for two ears (92 children) and referral rate (2,2%). All children with OAE (-) was referred for BERA examination in Kyiv institute of otolaryngology named by Kolomyichenko. It was first large-scale screening OAE newborn examination in Ukraine. The number of Ukrainian maternity hospitals, which equipped by screening OAE, was increased in 2008.

P65

Simultaneous pulsatile stimulation with channel interaction compensation

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A simultaneous stimulation concept is presented. Fully phase-synchronous stimulation pulses are applied simultaneously in two or more intracochlear electrodes. As compared to sequential stimulation, the pulse amplitudes are modified taking into account parameters of spatial channel interaction. The underlying algorithm is designated as "Channel Interaction compensation (CIC)". The channel interaction model assumes spatial unit current responses that have exponential decays with constants alpha towards the apex and beta towards the base. Furthermore, the maxima of unit current responses are exponentially decaying from apex to base, characterized by a third constant gamma. Six MED-EL implant subjects using PULSAR devices have been tested. Speech reception thresholds (SRT's) for German Oldenburg sentences in CCITT noise have been measured for different numbers of simultaneous channels. Phase durations and overall pulse repetition rates have been kept the same as in the sequential CIS control condition. The mean spatial distance between simultaneous electrode channels has been maximized. Spatial decay constants have been adjusted for optimum performance. In each of the tested patients, there are simultaneous configurations which show no degradation in speech perception as compared to the sequential CIS. In two subjects, the SRTs are not statistically different from CIS, even for an overall number of 10 and 11 simultaneous electrodes, respectively. For optimum performance, a proper setting of decay constants alpha, beta, and gamma is required. Uncompensated simultaneous stimulation usually results in a significant decrement in speech perception. The results so far indicate that simultaneous stimulation with CIC represents a reasonable concept. It can be advantageously applied, e.g., in low power applications, where stimulation pulses with reduced amplitudes and longer phase durations can be used.

Film Session

F01

The CIRCLE Game: A Music Education Programme for Dutch Pediatric Cochlear Implantees

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Music is a powerful tool in education; children love to make music and several studies showed correlations between musical capacities and language skills in normal hearing children. Also there is a correlation between melody recognition and speech perception skills in adult cochlear implantees. This inspired us to develop a music programme for Dutch children with a cochlear implant: the CIRCLE game. Main aims of the programme are the introduction to music, the enlargement of musical engagement and supporting the auditory development. The CIRCLE game comprises of six music lessons of 45 minutes each. A range of music instruments, activities and newly composed songs are used to teach the children about auditory skills (detection, discrimination, and identification) and sound characters (volume, duration, frequency and timbre). The programme is suited for children between ages 2 – 8 years and with a maximum of 3 years cochlear implant experience. The first edition of the CIRCLE-game started in 2006 with 18 participants. In 2008 the second edition of the programme was run with 28 participants. Parents were asked to fill in an appraisal questionnaire at the end of the programme. In total 30 questionnaires were returned. Results showed that 93% of the children enjoyed the music lessons to a large extent and 80% of the parents noticed a surplus value of the CIRCLE game on one or more aspects of their child's development. According to the parents' report the CIRCLE game fulfilled its aims, although this has not yet been confirmed objectively. The CIRCLE game is a useful programme to introduce music to pediatric cochlear implantees. This video presentation will show how different musical and auditory goals are translated into activities for the CIRCLE game.

F02

Endoscope assisted cochlear implantation

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It is sometimes difficult to obtain full exposure of the round window membrane through conventional retroauricular facial recess approach. A variety of transcanal approaches such as suprameatal approach or routine transcanal middle ear exploration by elevating a tympanomeatal flap has been advocated in order to visualize the round window definitely. However such techniques may carry some risks such as facial nerve or tympanic membrane injuries. This video demonstrates the help of a 0 degree otosendoscope inserted through the facial recess in defining the exact borders of the round window as well as optimizing the view of the scala vestibuli lumen facilitating electrode insertion. It is useful to view the posterior mesotympanum through the facial recess by endoscopic examination especially in cases which the exact borders of the round window membrane can not be fully visualized. Round window electrode insertion and scala vestibuli insertion can be facilitated by endoscope assisted cochlear implantation.

F03

The Suprameatal approach for cochlear implantation

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The suprimeatal approach (SMA) was developed in our department as an alternative to the mastoidectomy-posterior tympanotomy approach (MPTA). The trigger for the development of this technique was the desire to simplify the surgical procedure and to avoid damage to the facial nerve and chorda tympani. Recently, non-mastoidectomy approaches are successfully used for cochlear implant (CI) surgery in different centers worldwide. To date, more than 450 patients underwent CI with the SMA in our department. Surgical technique The patient is placed in the supine position as for retroauricular tympanotomy. A skin flap is raised following a small hook incision. Be sure that the anterior skin cut is high and anterior over the root of the zygoma in order to be able to expose the suprimeatal area and prevent too bulky flaps. A skin flap and a large periosteal flap are elevated. A bony well is drilled in the parietal bone. A superior and posterior subperiosteal pouches are prepared

to accommodate the body of the implant and the ground electrode. Two tie down holes are drilled for implant fixation. The skin of the posterior wall of the external auditory canal is incised horizontally 5 mm lateral to the annulus and is retracted anteriorly with a 1/4 inch Penrose drain. A six o'clock vertical incision is made in the meatal skin and a tympano-meatal flap is elevated to expose the middle ear cavity. The chorda tympani is exposed and a 1-2 mm long groove is then drilled in the wall of the middle ear cavity postero-superior to the chorda tympani and lateral to the body of the incus. The visualization of the incus body serves as a target for drilling and prevents injury to the facial nerve which is located medial to the incus. A cochleostomy is performed in two stages. Initially, drilling is performed in the promontory using a 0.8 mm diamond burr, antero-inferior to the oval window until the membrane of the spiral ligament is exposed but not penetrated. This avoids entry of blood and debris into the cochlea during the subsequent bony work. A tunnel is drilled in the one o'clock position of the suprimeatal region (left ear), posterosuperior to the external auditory meatus in an oblique line from postero-superior to antero-inferior ending in the groove. In order to avoid possible injury by drilling, the middle cranial fossa dura is first exposed using a 2 mm cutting burr. Once the dura has been visualized, a 1.5 mm cutting burr followed by a 1.5-2 mm diamond burr are used for creation of the tunnel, depending on the distance between the middle fossa dura and the wall of the external auditory canal. Care is taken to maintain a safe distance between the tunnel and the bony external auditory canal wall which may vary between 3 and 7 mm. The tunnel is created inferior to the dura, with a mean length of 12 mm in adults and 7 mm in children and a diameter varying between 2 and 2.5 mm. Drilling is ending in the groove, lateral to the incus until bone dust is appearing. The bone dust is washed out by water irrigation. The tunnel opening should not have a sharp angles, they should be smoothed in order to prevent kinking of the electrode. The spiral ligament is incised and the cochleostomy is widened in the direction of the round window in order to ensure entry into the scala tympani. The electrodes are passed through the suprimeatal tunnel and groove into the cochleostomy. Small pieces of connective tissue are used for meticulous sealing of the cochleostomy and one piece is placed between the chorda and tympanic membrane. The implant is placed into the posterior pouch and the ball electrode is positioned underneath the temporalis muscle. The tympanomeatal flap is placed back and fixed by small pieces of gel-foam. The subperiosteal flap is used to cover the electrode. No surgery-related complications were recorded in our series. Using a non-mastoidectomy approach as SMA in CI surgery provides a wide exposure of the middle ear with better visualization of the promontory and enables easier drilling of cochleostomy and better controlled insertion of the electrode also in cases of malformed and ossified cochlea. The better visibility of the cochleostomy site enables preservation of the hearing rests and ensures insertion of the electrode into the scala tympani. The exclusion of mastoidectomy in the SMA shortens the duration of surgery to about one hour, improves the aesthetic results with no retroauricular bony defects, and eliminates possible injury to facial nerve and chorda tympani. Short operative time and minimal drilling are conditional for implantation under local anesthesia. Damage to chorda tympani had become very important issue since the number of bilaterally implanted patients increased.

F04

Auditory Verbal Therapy as the way of working with youngest implanted patients

Pankowska A., Barej A., Lutek A., Zielinska E., Zgoda M., Skarzynski M.

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Film presents fragments of activities conducted with children who underwent surgery after the first year of life. The material illustrates the most important techniques used in work with a child and its parent.

F05

7-day rehabilitation stays as the effective form of care for implanted children

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Film presents group activities with children using cochlear implants. Those activities are conducted during the 7-day rehabilitation stays in the International Rehabilitation in Łeba. The activities involve auditory training exercises and developmental plays.

F06

The importance of early intervention in building up communication abilities at children with cochlear implant

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Applying and verifying a rehabilitation-compensation program in order to build up and develop communication abilities at very young children with cochlear implant. Verbal comprehension test Sibiu (autor Rodica Popescu) – verbal audiometry – activities for auditory training and hearing education – activities of building up communication abilities – rhythmic – the Parents-Children-Group. A very young child with cochlear implant benefiting of a rehabilitation program immediately after implantation developed verbal communication abilities like a hearing child of the same age. The efficiency of our rehabilitation program is shown by a case study. The rehabilitation methods of children with cochlear implant – from our point of view – should take into consideration: activities of auditory training and hearing education, activities of building up and developing communication abilities, rhythmic, the Parents-Children-Group according to the principle "all day, every day". After surgery, the hearing impaired child needs assistance both from the speech therapist and from the family. The cochlear implant brings benefits to the hearing impaired child only when it is included as soon as possible in a rehabilitation program.

F07

The first two years of the life of Mauro. An information film about the counselling and therapy of hearing impaired baby and toddler

Tollenaere C.

The early screening of hearing problems leads to early cochlear implantation and early rehabilitation. Constantly, professionals are looking for adaptive therapy methods to make the intervention as efficient as possible for the child and its parents. After the diagnosis, a mountain of information is heaped on the parents. They need and want to know what will happen with their child and what the environment will expect from them. An interchange of information, experiences and ideas is very welcome, especially when it contains concrete, practical and visual issues. During 2 years, we followed a deaf child with a bilateral CI, from the age of 3 months. The boy was filmed in different situations, from the beginning in the intake, the (medical) examinations, until recently in therapy sessions and in many forms of counseling. The film shows very clearly the proceeding of an early intervention with a deaf child. For future parents of a deaf child, the film gives an image about what they can expect in the near future. It offers them general information and enables them to have realistic expectations. For professionals the film can be used as a means of information during workshops and congresses. It also gives the initial impetus to make objectives concrete and to develop creative ideas. The interchange of information, ideas and experiences in the counseling and therapy of deaf and hearing impaired babies and toddlers is very important for parents as well as for professionals. The development of different tools, like this film, can be very useful and offer an answer to many questions.

F08

Programming patients' internet route with cochlear implant

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ENT specialists from Colombia and Spain

The planning of a program of cochlear implants, in occasions plans serious problems derived from the distance from the implanter center and the place of origin of the patients. We have tried to replace this problem displacing audiologists to some equidistant cities of reference among them and with a distance not superior to 100 kilometers. The idea of the programming for internet is not new but apparently it has not a good time of many followers. In the present study we try to establish a network to long distance among Colombian and Spanish cities and to verify the viability and possibility of this project. We have used for this study the equipment of programming of Advanced Bionic, with line ADSL of 2 MG, coverage of mobile of 3 G compatible with internet, card connected to the PC of programming with port USB or PCMCIA, 3'5 G plus web cam. Safety levels were in use for avoiding it on stimulation of the patient. We try to establish and to verify the possibility of this project showing the results of programming between patients by internet route and those with habitual technologies. Our project would allow the free

displacement of the well-established patients having always a place where to go and be valued. They would save themselves the direct treatment with the programmer for the cases where there existed problems not solved with the habitual technologies.

F09

Programming session of Remote Fitting Method

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The movie presents the remote fitting of cochlear implant system. Setup consisting of two PC computers (with proper videoconferencing and remote desktop software) on both sides is presented. Session flow is synchronously filmed from local and remote place. Examples of objective and psychophysical measurements used for programming of the system is demonstrated.

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