Abstract ID: 21  
Poster Number: 44  
Title: Cochlear Implantation in Children with X Linked Deafness: A Case Report  
Authors: Nacim Ait Mesbah, MD, Sara Boutemeur, MD, Nadia Yahi, MD; ENT, HOSPITAL, ALGIERS, Algeria.  
Abstract: Introduction: Nearly twenty percent of patients with congenital sensorineural hearing loss (SNHL) have radiologic abnormalities of the inner ear discernable on computed tomography (CT) of the temporal bone. Patients with congenital X-linked mixed deafness have shortened cochlea, absent lamina cribrosa, and bulbous fundus of the lateral internal auditory canal. The absent bone between the cochlea and internal auditory canal represents a direct communication between cerebrospinal fluid (CSF) of the subarachnoid space and perilymph within the cochlea which may result in CSF leak once the cochleostomy and predispose patients to IAC insertion during cochlear implantation, facial nerve injury and sub-optimal performance of the electrode. 
Methods: Our objective is to describe the case report, surgical technique, and speech performance outcomes in this patient 
Results: Intraoperative impedances and neural telemetry were obtained to assess for an auditory response to electrical stimulation  
No post-operative discovery of electrode malposition in the IAC No post-operative facial paralysis or facial stimulation by the electrode, vertigo, ataxia, dysmetria or hemorrhage. Day 2 csf leakage from homolateral nostril we performed only one lumbar ponction patient demonstrated improved speech performance following implantation.  
Conclusion: X-linked deafness may successfully undergo CI with excellent potential for auditory rehabilitation.

Abstract ID: 22  
Poster Number: 125  
Title: Effect of Dexamethasone on Intracochlear Inflammation and Residual Hearing after Cochleostomy - A Comparison According to the Administration Route  
Authors: Ah-Ra Lyu, MS1, Kwan Ho Kim, Aud2, Yong-Ho Park, MD, PhD2; 1Medical Science, Chungnam Natl. Univ., Daejeon, Korea, Republic of, 2Otolaryngology, Chungnam Natl. Univ./Hosp., Daejeon, Korea, Republic of.  
Abstract: Introduction: Dexamethasone is widely used steroid that has a potent anti-inflammatory effect. Although there were several reports showing that dexamethasone significantly reduced hearing loss when it applied with locally or systemically, it is still questionable whether systemic or intratympanic injected steroid would go through into the cochlea effectively. In this study, we aimed to compare the effects of dexamethasone which administered with different route on intracochlear inflammation and residual hearing after cochleostomy.  
Methods: Guinea pigs were used for the experimental study with bilateral cochleostomy and the experimental group were classified with cochleostomy only group (CS), intracochlear dexamethasone
group (IC), intratympanic dexamethasone group (IT) and intraperitoneal dexamethasone group (IP). To evaluate the hearing threshold shifts in each group after surgery, Auditory brainstem response (ABR) threshold were recorded after surgery. The changes of intracochlear dexamethasone concentration were measured and intracochlear inflammatory changes were evaluated with qRT-PCR and histopathologic studies.

**Results:** Residual hearings were more preserved in IC and IT groups compared to IT and IP group and IC route were more effective method for dexamethasone delivery into the cochlea than IT and IP route for the high intracochlear concentration. The inflammatory responses in the cochlear were decreased in dexamethasone treated group compared to CS group with different pattern at the early stage. Auditory HCs were more preserved in IC and IT group compared to CS and IP group and IC route was superior than others in the point of view of HC survival and the inflammatory tissue response in the cochlea was less severe in IC and IT group compared to CS and IP group.

**Conclusion:** Local delivery route could induce more high concentration of dexamethasone in the inner ear and it might decrease intracochlear inflammation response which resulted in more hearing preservation than systemic route.

**Abstract ID:** 26
**Poster Number:** 13
**Title:** Does the Addition of a Group Music Intervention to Traditional Listening and Spoken Language Therapy Support the Development of School-readiness Skills in Preschool Children with Hearing Loss?

**Authors:** Glynnis DuBois, PhD student
Department of Speech-Language Pathology, Univ. of Toronto, Toronto, Canada.

**Abstract:** **Introduction:** Theorists have speculated that language, reading, and music overlap in meaningful structural and functional ways that extend well beyond a simple association with audition (Patel, 2014; Tierney & Kraus, 2014) and suggest that these abilities may be scaffolded by the skills acquired through sharing or making music. There has been some investigation into those aspects of childhood music and movement exposure that may help to scaffold development in the areas of phonological awareness (Kraus & Chandrasekaran, 2010; Moritz, et al, 2013), vocabulary, and social skills (Gerry, Unrau & Trainor, 2012). Musical activities may also have some influence on the development of skills related to executive functions. Structured, engaging activities which require the ability to focus and cooperate with others, attend to and synchronize movement to a rhythm, and engage in music making have proven to be effective (Zachariou & Whitebread, 2015). Evidence supports the idea that since children with hearing loss may be delayed in their access to speech and language, some of these skills may also be late in developing (Punch & Hyde, 2011; Rinaldi, Baruffaldi, Burdo & Caselli, 2013), consequently affecting later outcomes in areas such as literacy (Nittouer, Caldwell, Lowenstein, Tarr & Holloman, 2012) and executive functions (Beer et al, 2014; Kronenberger, Pisoni, Henning & Colson, 2013). As this population may also have challenges with balance (Cushing, Papsin, Rutka, James & Gordon, 2008; Livingstone & McPhillips, 2011), and rehabilitation in motor and balance skill has shown some promise in improving this issue (Fernandes, Hariprasad & Kumar, 2015), it is possible that activities in music and movement might also have a positive effect in this area. As recent advances in hearing technology for this group of children now provides children with HL access to both spoken language and music, the potential benefits of the use of music is now becoming an innovative and exciting focus for research.

**Methods:** Participants will be matched and placed into a music and movement group, a craft-based group with background music, or a control group. The intervention groups will attend twelve, facilitated
sessions over a period of three months. Pre- and post-intervention assessments focusing on outcomes in speech, language, pre-literacy, audition, balance, and social skills will be completed.

**Results:** (preliminary data available June 2017)

**Conclusion:** (pending results)

**Abstract ID:** 31  
**Poster Number:** 105  
**Title:** Cochlear Implant and Organ Transplantation in Children  
**Authors:** Magnus Teschner, MD, PhD, MBA, Thomas Lenarz, MD, PhD, Marie-Charlot Suhling, MD; Department of Otolaryngology, Hannover Med. Sch., Hannover, Germany.  
**Abstract:** **Introduction:** Cochlear Implantation in deaf children comes along with leaving of a foreign body (device) in the temporal bone. Organ transplanted immunosuppressed children might have a higher risk for postoperative complications and poses particular challenges in the treatment. The aim of this current investigation is thus to analyze the experience, outcomes and complication rates in children who underwent different organ transplantation and cochlear Implantation.  
**Methods:** Chard records of children (2-18yrs) between 1999 and 2016 were analyzed retrospectively. Intraoperative and postoperative complications and audiological results after cochlear implantation were assessed.  
**Results:** 11 children with kidney-, liver-, lung- and heart transplantations could be included. Overall, the surgeries and the treatments did not show any intraoperative complications or other particularities. Postoperatively 3 patients suffered from complications (1 efflorescence, 2 wound dehiscence). 4 children underwent staged bilateral implantation: 1 suffered from would dehiscence, one from chronic otitis.  
**Conclusion:** Cochlear Implantation in children with organic transplantation is a safe procedure. No major complications should be expected. A close interdisciplinary cooperation ensures good long-term results with any complex individual cases.

**Abstract ID:** 33  
**Poster Number:** 113  
**Title:** The Modified Rambo Transcanal Approach for Cochlear Implantation in CHARGE Syndrome  
**Authors:** Cameron C. Wick, MD, Amy M. Moore, BS2, Daniel E. Killeen, MD1, Brandon Isaacson, MD1; 1Otolaryngology - Head and Neck Surgery, Univ. of Texas Southwestern Med.Ctr., Dallas, TX, 2Univ. of Texas Southwestern Med. Sch., Dallas, TX.  
**Abstract:** **Introduction:** CHARGE syndrome is associated with a variety of temporal bone anomalies and deafness. The lack of surgical landmarks and facial nerve irregularities make cochlear implantation in this population a challenging endeavor. The aim of this study is to describe a safe and efficacious transcanal approach for cochlear implantation that obviates the need to perform a mastoidectomy and facial recess.  
**Methods:** Retrospective chart review from a tertiary care pediatric hospital. Three children with severe to profound sensorineural hearing loss associated with CHARGE syndrome underwent a transcanal cochlear implantation with closure of the external auditory canal via a modified Rambo meatoplasty. An analysis of the temporal bone anomalies and technical nuances were assessed.  
**Results:** The mean patient age was 2.5 years (range 1.5 - 3.8 years). Two were males and two were left ears. All patients had a hypoplastic mastoid, lacked development of all three semicircular canals, and
had some degree of cochlear dysplasia. A full cochlear implant insertion via a round window cochleostomy was achieved in all cases, even in the presence of grossly abnormal middle ear and facial nerve anatomy. There were no intraoperative or postoperative complications. The mean follow-up was 12.4 months (range 3.9 - 25.2 months). All three patients use their device daily. Their guardians report improved vocalization and environmental awareness. Objective post-implantation testing is not yet feasible due to their age and medical co-morbidities.

**Conclusion:** The transcanal approach with modified Rambo meatooplasty closure of the external auditory canal provides a safe corridor for cochlear implantation in patients with CHARGE syndrome. This approach minimizes much of the anatomical variations associated with the syndrome and protects against electrode extrusion. Implant outcomes in this patient population are still variable and largely dependent on the patient’s global cognitive capacity.

**Abstract ID:** 35  
**Poster Number:** 186  
**Title:** Auditory Neuropathy Spectrum Disorder: Proposed Profiles for Improved Audiologic Management  
**Authors:** Alison J. Nachman, AuD  
AUDIOLOGY, UCSF BENIOFF CHILDREN’S HOSPITAL OAKLAND, OAKLAND, CA.  
**Abstract:** Alison Nachman, AuD  
Abstract - TITLE  
Auditory Neuropathy Spectrum Disorder: Proposed Profiles for Improved Audiologic Management  
**OBJECTIVES:**  
This proposal calls for a categorization of auditory neuropathy spectrum disorder (ANSD) into subtypes or profiles based on etiology in order to assist with audiologic care and management. Children with ANSD represent not one type, but a spectrum of disorders or profiles. Research supports the management and audiologic outcomes differ based on the proposed subtypes. With further clarification on guidelines for management of children with ANSD with more specific categories, audiologists can provide improved care. With a deeper understanding of ANSD subtypes, improved care can include faster referrals to cochlear implant programs when appropriate to avoid unnecessary delays in speech and language development.

**METHODS:**  
Literature review of ANSD description and management. In addition, current hospital database of children with ANSD with retrospective analysis of care and management.

**RESULTS:**  
Utilizing ANSD profiles, coupled with current Guidelines for the management of children with ANSD, clinicians can follow a more precise methodology to determine next steps in management and care. When children with ANSD are profiled by their medical history or lack thereof, more specific protocols can be used in addition to the current Guidelines for Identification and Management of Infants and Young Children with Auditory Neuropathy Spectrum Disorder (2008). Previous subtypes have been proposed based on auditory responses, however, with more specific information regarding the ANSD profile, one would not have to wait until behavioral testing can be obtained to provide the family with projected pathway for auditory management and care. Proposed subtypes include a.) Genetic etiology, b.) Genetic Syndromes (Charcot Marie Tooth, Friedrich’s Ataxia, etc.) c.) Prematurity, d.) Hyperbilirubinemia e.) Unknown etiology (not premature, no genetic component identified, no other peripheral neuropathies, no intra-cranial anomalies, and normal neural anatomy,) and lastly f.)
Anatomic etiology (cochlear nerve hypoplasia or aplasia). Specific guidelines for management are provided based on the ANSD profiles. By providing a Guideline for typical outcomes based on the suggested profiles, audiologists will in turn be able to provide improved management and care of these patients and their families.

CONCLUSIONS:

By describing children with ANSD into subtypes or categories, audiologists can provide families and the rest of the medical team with a more confident pathway for the care and management of these often complicated cases. With compounding years of experience of working with this population, professionals can better help to serve and guide families along this journey. By offering families with a projected pathway of care based on ANSD profiles that is more definitive than what is usually offered to families, delays may be avoided.

Abstract ID: 36
Poster Number: 27
Title: Tele-Mentoring: Providing Comprehensive Community Care to Cochlear Implant Recipients
Authors: Shana Lucius, MA, CCC-SLP, LSLS Cert. AVT
Speech Pathology/Hearing Program, Nationwide Children's Hosp., Columbus, OH.

Abstract: Introduction: As of 2012, nearly 400,000 registered cochlear implants had been implanted worldwide (National Institute on Deafness and Other Communication Disorders, 2016). As cochlear implants have become more widely available, there is a need for professional training and mentorship in rural areas where access to qualified cochlear implant services may be limited. Additionally, post-implantation treatment can be challenging, because there are only 700 qualified Listening and Spoken Language Specialists (LSLS) worldwide (agbell.org, 2016). Technology advances in the field have led to an expansion of the candidacy criteria for cochlear implants. As cochlear implant prostheses continue to advance and as we reach more individuals in the hearing loss community, support services will also need to expand. Many individuals in the field have engaged in ‘tele-practice’ as a direct service delivery option for speech pathology, especially as a means to expand treatment for lower incidence disorders such as hearing loss. For states where tele-practice is not yet reimbursable, one option to improve follow-up care is ‘tele-mentoring.’ Using video conferencing equipment, speech-language pathologists with specialized training can serve as a consultant for a clinician who may be seeing a client with a cochlear implant for the first time.

Methods: Tele-mentoring sessions require a secure network such as Skype for Business™, a webcam on both ends, and a speaker headset or a speakerphone on both ends. This poster will present three case studies to show how tele-mentoring can be used to promote improved service access for persons with cochlear implants. Mentoring sessions were set up on a consultative basis at 1 month, 3 months and 6 months post cochlear implantation activation at the direction of the care management provider, LSLS Certified professional. Speech and language standardized testing was completed at the tertiary care hospital (large, urban pediatric hospital) setting at 6 month intervals. Ongoing weekly auditory based speech therapy sessions were conducted closer to the patient’s home by a local, certified speech-language pathologist.

Results:
Patient 1: TG-chronological age 22 months
Patient 2: AC-chronological age 24 months
Patient 3: CD-chronological age 10 years
Implanted at 9 months; Etiology: Connexin, Patient is being worked up for a cochlear implant
Etiology: CMV; progressive HL
Implanted at 10 years Etiology: tumor, post craniotomy post op bacterial meningitis
Pre-Cochlear Implant Evaluation, 6 months post activation, and 1 year post activation Speech & Language Testing completed with LSLS Cert. AVT
Interval testing completed with LSLS Cert. AVT, monthly sessions at tertiary care hospital due to patient being followed closely for possible cochlear implant(s)
Pre-Cochlear Implant Evaluation, 1 post op auditory speech session completed at tertiary care hospital
Ongoing, weekly 60 minutes speech therapy session completed at rural hospital 40 minutes from home with mentoring component: Therapy goals established by LSLS professional and carried out by rural SLP
Ongoing, weekly sessions completed by Early Intervention for Hearing Impaired team in the family’s home with mentoring component: Therapy goals established by LSLS professional and carried out by rural clinician
Ongoing, short term auditory therapy 2x/month for 3-6 months conducted by rural therapist 20 minutes from home with mentoring component: Auditory goals established by LSLS professional
Outcomes: At 1 year post activation; patient has caught up to same-aged typically hearing peers on speech and language measures. Outcomes: This collaboration has allowed for a consistent message to be shared amongst providers working with the family, family is pleased with services, and “team approach”
Outcomes: Patient was implanted on 11/9/16 and remote clinician reported open set speech understanding with left cochlear implant alone and excellent patient satisfaction with receiving services close to home

Conclusion: These case studies demonstrated that tele-mentoring may be one way to improve service access for children with cochlear implants who live far from the tertiary care hospital where they may; otherwise, not have access to specially trained LSLS certified professionals. Costs and time associated with travel were reduced, and all participants demonstrated positive outcomes and expressed the benefits of this model of care. The local professionals, reported an improvement in their knowledge base and confidence in service delivery for cochlear implant patients. Future research is needed to examine long-term performance outcomes in this type of service delivery model and reimbursement from Medicare/Medicaid for “tele-health” including: remote cochlear implant mapping, ENT follow-up, troubleshooting, and ongoing aural re/habilitation.

Abstract ID: 37
Poster Number: 163
Title: Adolescents with Cochlear Implants before the Age of Five
Authors: Karina Fanelli, Audiologist, Norma Pallares, Audiologist, Vicente Diamante, Otologist; CIC PROFESOR DIAMANTE, BUENOS AIRES, Argentina.
Abstract: Introduction: In the last 15 years we had a significant increase of cochlear implants (CI) users. Maybe due to changes in candidacy criteria for CI, the improvement in technologies, clinical manage and surgical techniques and devices social payment. All that, allow us to register different events along progress in patients with CI in auditory, language, social, academic and emotional skills. After many years of programming cochlear implants, we have detected different behaviors in those adolescents who received the CI in the early years of life. They reach different performance in oral communication, emotional and cognitive abilities. Achievements are determined by lots of variables as age at CI,
modality of auditory therapy and handicaps associated. But lots of them present changes in tolerance to the electrical stimulation. The present study focuses on information regarding the changes in comfort and threshold levels in pre-lingually deaf adolescents with CI use since childhood. HYPOTESIS: Pre-lingually deaf adolescents with CI before the age of five experience changes in loudness with the electrical stimulation nearly adolescence. OBJECTIVES: We set two goals to study changes in loudness in adolescent CI users: 1- Determine T and C levels since the tune-up until the present in electrode 20-15-10-5-3-1 2-Describe symptoms

Methods: To study this manifestation, we made a retrospective study of 20 pre-lingually deaf adolescent patients who received CI before the age of five. All of them were implanted at the Centro de Implantes Cocleares Profesor Diamante -Buenos Aires- Argentina. The statistical analysis of the changes in threshold and comfort levels was done with Graph Pad Prism6.

Results: In that group of patientes we found symptoms as discomfort to high frequences, headaches and rejection of use. In the puberty these appeared suddenly. Result will be presented.

Conclusion: Adolescents with CI present a great variety of abilities and limitations that must be contemplated individually within an average context for that group. The present study shows us the frequent manifestation of progressive intolerance to the electrical stimulation once puberty has been reached by children implanted earlier in life. For this reason we consider it of great importance to carry out strict audiological follow-up in this group of patients and to warn them about possible changes in loudness.

Abstract ID: 41
Poster Number: 47
Title: Cochlear Implant in a Patient with Arnold Chiari Syndrome
Authors: Maria S. A. Amaral, M.D.1, Daniela S. F. Costa, Speech Therapist2, Antonio C. Santos, MD.,PhD3, Camila G. C. Barros, MD.,PhD.1, Ana C. M. B. Reis, PHD1, Eduardo T. Massuda, MD.,PhD.1, Miguel A. Hyppolito, MD.,PhD.1;
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Abstract: Cochlear Implant in a patient with Arnold-Chiari Syndrome
Summary
Introduction
Chiari malformation is a congenital disease of unknown etiology characterized by herniation of posterior fossa contents below the foramen magnum level. Three types exist. Chiari type II malformation (Arnold-Chiari) consists of herniation of the tonsils, cerebellar vermis, IV ventricle and a lower portion of the bulb through the occipital foramen. It usually manifests as myelomeningocele in the thoracolumbar spine, hypoplasia of the posterior fossa, herniation of the encephalon in the cervical spinal canal and compressive lesions of the cranial nerves. Computed tomography (CT) and Magnetic Resonance Imaging (MRI) are essential for the diagnosis, and the treatment is surgical. Decompression of the posterior fossa and cervical laminectomy are sufficient if the ventricular shunt is patent. If treated before permanent structural damage occurs 88% of patients have significant remission of symptoms.

Method
Revision of the medical records of patients with Arnold-Chiari Syndrome submitted to Cochlear Implant Surgery. Data on age at the time of implantation, gender, time of hearing loss, pre-and post-CI patient audiological characteristics and patient imaging (Computerized Tomography and Magnetic Nuclear Resonance) were obtained.

Result
A 6-year-old female, with meningomyelocele and congenital hydrocephalus with deafness at 3 years of age after meningitis and used oral language with adequate speech development.

The patient was in Category 0 of hearing and 2 of Language. Tone Audiometry revealed bilateral profound sensorineural hearing loss. The MRI examination showed a diffuse reduction of the white matter, sharp tapering and arching of the corpus callosum with marked dilation of the supratentorial ventricles. (Chiari type II). Computed Tomography of the ears confirms hypoplasia of the bilateral lateral semicircular canal and the cochlea to the right.

Cochlear Implant Surgery was indicated and performed on the left ear with the Medel Implant, Model SONATAti100. On activation, performed 1 month after the surgery, there was no response at level C in the speech processor program.

From the activation, the patient presented gradual improvement of hearing and currently the child is 12 years old, 6 years after surgery, performs speech therapy 3x per week and is in Category 6 of hearing and 5 of Language.

Conclusion
Despite the presence of Arnold-Chiari syndrome (Chiari Type II) and even with neurological alterations presented with DVP, CI surgery has good hearing results.

Abstract.ID: 45
Poster Number: 129
Title: Totally Implantable Cochlear Implant - New Ideas
Authors: Nicolae C. Balica, Assist. Professor, Horatiu E. Stefanescu, Assit. Professor, Marioara Poenaru, Professor, Caius I. Doros, Assoc. Professor;
ENT Department, "Victor Babes" Univ. of Med. and Pharmacy Timisoara, RO, Timisoara, Romania.
Abstract: Introduction: Nowadays there are some technical problems regarding totally implantable cochlear implants. In such cases there are microphone problems which are attached under the skin and picks up a lot of parasite noises (blood vessels pressure etc.).

Methods: Microphone problems might be overcome by an internal detector of incus movements due to intact tympanic membrane and intact ossicular chain. Incus movement LASER assessment might be an option. Totally implantable cochlear implant is placed in the mastoid cavity and it is anchored to the bone. Regarding the auto sustained battery there might be the following solutions: pressure movement chargers attached to the Superficial Temporal and Occipital Arteries, stretching arches chargers attached to the Temporalis and SternoCleidoMastoid Muscles.

Results: A LASER assessment soft for incus movement is needed to be developed. The solution efficiency for pressure movement chargers attached to the Superficial Temporal and Occipital Arteries and stretching arches chargers attached to the Temporalis and SternoCleidoMastoid Muscles is needed to be developed (energy quantification, etc.).

Conclusion: There is a need for an improvement in totally implantable cochlear implants.
Abstract ID: 46
Poster Number: 48
Title: Revision Cochlear Implant in Children
Authors: Maria S. A. Amaral, MD, Myriam D. Isaac, MD, PhD, Natalia Q. Shigematsu, M.D., Ana C. M. B. Reis, PhD, Tatiana F. Gaia, PhD, Eduardo T. Massuda, MD, PhD, Miguel A. Hyppolito, MD, PhD;
Department of Ophthalmology, Otorhinolaryngology, Head and Neck Surgery, Ribeirão Preto Med. Sch.-Clinical Hosp., Univ. of São Paulo, Ribeirão Preto, Brazil.
Abstract: Revision Cochlear Implant Surgery In Children
1. Introduction:
The Cochlear Implant (CI) is a useful, revolutionary sensory prosthesis in medicine that allows the hearing to individuals with this profound sensorineural hearing loss, enabling the sensation of hearing and the recognition of speech sounds.
The surgery of implantation of the CI internal device is not entirely free of risks and may present problems that will require revision surgeries.
2. Method
A retrospective study of patients under 18 years undergoing Cochlear Implant Surgery from 2004 to 2015 in a public hospital in Brazil. Data collected to age at the time of implantation, sex, etiology of deafness, duration of hearing loss, audiological and oral language characteristics of each patient in the pre and postoperative CI, if there was a need for surgical revision and the reason for the same.
3. Results
Two hundred and sixty surgeries were performed in 236 patients younger than 18 years from 2004 to 2015. Seven patients with bilateral CI (2.69%) and 10 children required revision surgery (4, 23%). Twenty-seven surgeries were necessary for these 10 children (1 performed bilateral CI), 16 of which were revision surgeries (6.15%). In 2 children, removal of the CI was necessary, without reimplantation (one child with cochlear malformation, probably incomplete type I partition and another due to trauma). Regarding the etiology of the 8 children who remained with CI, 4 had cochlear calcification after meningitis followed by trauma (1), malformation of the facial nerve (1), failure of the CI internal device (1) and a revision surgery was necessary to a child due to twisting of the electrode bundle.
4. Conclusion
The revision cochlear implant surgery is infrequent, and the patient must be informed of this possibility.

Abstract ID: 52
Poster Number: 175
Title: Optimizing CI Programming using Clinical Methods of Electrode Deactivation
Authors: Sarah W. Kennett, Au.D., Ph.D. Candidate1, Samuel R. Atcherson, Ph.D.1, Charles Finley, Ph.D.2;
1Univ. of Arkansas for Med. Sci., Little Rock, AR, 2Advanced Bionics, LLC, Valencia, CA.
Abstract: Introduction: While cochlear implants (CIs) are considered a highly successful medical device for restoring speech understanding to hard-of-hearing individuals, high individual variability of outcomes remains a significant concern in the field. An important factor in CI performance variability is the effect of the electrode-neural interface. Significant within-user and between-user variability exists in both neural survival and physical location of the electrode in the cochlea. Because the electrode-neural interface is not well understood in the clinical domain, it is not uncommon for clinicians to assume
homogeneity and program devices without consideration for individual variation. Several methods exist for identifying electrodes with poor neural interface, and deactivating those electrodes result in improved outcomes. While these methods are effective, they are not feasible for direct implementation in the clinic. Despite positive trends in outcomes when deactivating pitch-confused pairs using a variety of methods, this recommendation is not a part of common clinical practice.

**Methods:** This project is designed to compare clinical outcomes of conventional CI programming to a research program where electrodes have been deactivated identified by inability to discriminate adjacent electrodes. All measures used in this study are standard procedures using common clinical equipment and assessments as to eliminate the barrier to clinical practice. A total of 28 adults with cochlear implants from Cochlear Corporation, Advanced Bionics, and Med-El will be included in the full protocol. Prior to any programming, the Minimum Speech Test Battery and subjective questionnaires will be presented to each participant. After baseline measures are collected, a psychometric task will be presented to determine electrode pairs with pitch confusion. Those who do not indicate any pitch confused electrodes will conclude their participation in the study. Those in the full protocol will have immediate retesting, exclusively use the new program for an acclimation period, and return for repeat testing of baseline measures. At the end of the study, participants indicate their preferred program.

**Results:** To date, we have collected data on 15 participants and 8 had pitch confused pairs which resulted in inclusion in our full criteria. Prior to data collection it was hypothesized that a majority of participants will have at least one pitch-confused electrode pair, and thus far 8/15 participants fit this criterion. We also hypothesized that individuals will perform better with the research program than with the baseline program. This has also been the case, however we do not have enough participants to indicate statistical significance at this point. In addition, it is hypothesized that participants will prefer the research program to the baseline program. This has been true of 6/8 participants who have completed the entire protocol at the time of this abstract submission.

**Conclusion:** We do not have enough data to state statistical conclusions on any of our research questions at this point, however preliminary data support acceptance of all our research hypotheses. We anticipate conclusions by the conference in July 2017.
The present study investigates the correlation between parent reports and the information obtained from the datalogging feature in the Naida CI Q series sound processors. This feature provides information regarding a child’s daily usage, program usage, battery type and life, loss of lock, time spent in different listening environments, as well as amount of usage of different features (i.e., directional microphones, audio-streaming devices, etc). The study will report on two phases of data collection.

**Methods:** Device usage in children between 18 months and 6 years of age is being evaluated over a 7 week period. Families enrolled complete a daily online survey to capture their perspective of their child’s CI usage, wearing configuration, and frequency and duration of different listening environments (noise, quiet, music). Data logs are downloaded each week and compared to the data obtained from the online survey for that week. This information is used to counsel the family on wear time optimization and listening environment experiences and to determine if any changes in wear time and/or listening environments changed following counseling sessions.

**Results:** Data so far (Phase 1, n=3) show that children (M= 3 years), on average, spent no time in quiet, 5% in noise, 73% speech in quiet, 9% speech in noise, and 14% in music. Following counseling sessions, overall improvements were noted in daily usage and number of unlocked events. Battery type and slot usage features correlated with parental reports on the survey. Phase two of the study will report data on five additional participants. Data pre to post counseling will be compared to determine whether counseling using data log information changes patterns in device use and listening environments. Differences in listening environments and device use based on age and/or school settings will be reported. **Conclusion:** Counselling positively influenced daily usage. Parents were surprised to find that children spent the majority of their time in environments with speech in quiet instead of mostly noise environments. The most common topics discussed during counseling sessions were daily schedule, commute time, routine family activities, and school environment. Phase II will follow families for an additional week with a more detailed survey regarding their listening environments. Results will provide more detailed information regarding datalogging and parent reports of their child’s listening environments and device use.

**Learning Objective:**

- Describe phase one and two results of datalog use in pediatric Advanced Bionics Naida CI Q series recipients
- Learn about potential changes in device use and listening environments following counseling utilizing datalogging information

**Disclosure of Financial Requirements:** This study was sponsored by Advanced Bionics, LLC.
Abstract: Introduction: A misplaced electrode is reported to be one of the most common major complications in the cochlear implantation. The purposes of this study were to investigate the misdirection of the electrode into the superior semicircular canal during cochlear implantation and to suggest surgical principles for correct electrode insertion through the round window membrane.

Methods: In this retrospective case review, operative records and postoperative images of cochlear implantations performed at a tertiary care facility from 1988 to 2010 were reviewed.

Results: In 3 out of 629 cases, electrode insertion into the superior semicircular canal was found. All 3 cases occurred in cochlear implantations using the round window approach, and none was found when using the cochleostomy approach. Insufficient exposure of the round window membrane and intracochlear soft tissue were regarded as the cause of misdirection of the electrode. The electrodes were repositioned appropriately into the cochlea with revision surgery in all 3 cases.

Conclusion: In order to prevent electrode misdirection during cochlear implantation through the round window, the round window membrane needs to be clearly visualized by sufficiently drilling bony overhangs and removing soft tissues around the round window.

Abstract ID: 71
Poster Number: 28
Title: The Family Environment and Cochlear Implanted Children
Authors: Violeta Necula, MD, PhD, Alma A. Maniu, MD, PhD, Magdalena Chirila, MD, PhD, Marcel Cosgarea, MD, PhD, Professor; Otorhinolaryngology, Univ. of Med. and Pharmacy, Cluj-Napoca, Romania.

Abstract: Introduction: The role of cochlear implant in deaf children development is well known. However, the results are highly variable and depends on several factors such as age of implantation, other diseases, the quality of rehabilitation process. But the most important role belongs to the family, family environment in which the child develops.

Methods: The questionnaire „Family Environment Scale” was sent to 98 families who had at least one cochlear implanted child who had more than 1 year of experience. One of the parents was asked to fill out the questionnaire which include also general informations about the child and the family.

Results: A total of 58 families responded to the questionnaire and accepted to participate in the study. Mean values were higher compared with normal families in the areas of cohesion, expressiveness, intelectual-cultural orientation and organization, but the the organization score mean value exceeded the normal values (between 40 and 60). The independence and the conflict areas had lower values than normal families but did not exceeded the lower limit of normal (40).

Conclusion: The families included in study are heavily involved in the rehabilitation process which mean various educational, intelectual and cultural activities. Rehabilitation process requires a huge effort from family, many sacrifices, hard work and training to all members. The high determination, the cohesion and the excessive organization may explain the low level of independence of these family members.

Abstract ID: 76
Poster Number: 151
Title: Cortical Responses of Deafblind Children of the Cuban Cochlear Implants Program after Auditory Rehabilitation
Authors: Lidia E. Charroo Ruiz, MD1, Sandra Bermejo-Guerra, MD2, Antonio Paz-Cordovés, MD3, Manuel Sevila-Salas, MD3, Beatriz Bermejo-Guerra, Md4, Yesy Martínez-García, Nurse2, Gerda González-Sánchez, Nurse2;
1NEUROPHYSIOLOGY CLINICAL, NEUROSCIENCE CENTER OF CUBA, HABANA, Cuba, 2Audiology, Marfán Hosp., HABANA, Cuba, 3Otology - Surgery, Hernamos Ameijeiras Hosp., HABANA, Cuba, 4Audiology, La Pradera Intl. Ctr., HABANA, Cuba.
Abstract: Introduction: The cochlear implants are given the opportunity to gain the sense of hearing to deaf subject. Little is known the role of cortical plasticity as a means to reactivate brain function.
Methods: Prospective study with Cortical Auditory (CAEP) and evaluation of the maps topography of Somatosensory Evoked Potentials by stimulation of median (SEP-N20) and tibial (SEP-P40) nerves in a group of control children and deaf-blind pre-lingual. Electrophysiological findings were correlated with the outcomes after implantation.
Results: CAEP showed significant changes with auditory rehabilitation, being more frequent change latency of P1 peack, consistent with rehabilitation results. SSEP-N20 showed evidence of the neuroplasticity after rehabilitation. Topographic distribution maps of the SSEP-N20 showed reduce of the expansion pre-CI, the over-representation was less extensive while of SEP-P40 no showed changed -strictly localized in area of -somesthetic information representation of the foot. Although vision and hearing are extraordinarily important senses in humans, our findings suggest that somatosensory information plays an important role in everyday communication in deaf-blind subjects. These children base their communication on tactile language and, therefore, cortical somatosensory response change, particularly in the contra-lateral hemisphere (area of her/his dominant hand). As the criteria for cochlear implantation in children expands, neurophysiological evidences of neuroplasticity may play a critical role in determining whether implantation may be beneficial in no-typical pediatric patients, for example deaf-blind children. So, nontraditional measures such as the topographic distribution of the SSEP plus CAEP may show indirectly influence outcomes following audiological intervention in deaf-blind children, such as CI.
Conclusion: Ours findings show that CAEP and topographic distribution of the SEP are interest to the functional study of sensory pathways and cortical activation in deaf-blind children. CAEP evidence change in the auditory pathway could help characterize outcome after auditory rehabilitation, while SSEP-N20 show electrophysiological changes, evidences of brain reorganization after rehabilitation. Changes of the cortical response of the SEP-N20 was interpreted as evidence of new brain reorganization, effect that may to have the use of the hands for communication in these children, with consequent implications to the optimal use of the CI during rehabilitation auditory.

Abstract ID: 77
Post Number: 124
Title: Clinical Implication of Umbilical Cord Derived Mesenchymal Stem Cells in Pediatric cochlear Implantation Patients
Authors: Kyoung Ho Park, MD, PhD
Otolaryngology Head & Neck Surgery, Catholic Univ. of Korea, Seoul, Korea, Republic of.
Abstract: Introduction: Umbilical cord blood (UCB) & Wharton’s jelly (WJ) in umbilical cord have mesenchymal stem cells (MSC) that can differentiate into various tissue cells. This study was performed to confirm the effect of transplantation of human umbilical cord derived mesenchymal stem cells on functional and morphological regeneration of spiral ganglion in deaf animal model.
Methods: UCB and WJ were collected from pregnant women after obtaining consent, and mesenchymal stem cells were extracted. We transplanted UCB MSC and WJ MSC through the brachial vein of the deafened guinea pigs. Hearing test with auditory brainstem response (ABR) conducted at 1, 3, and 5 weeks, and the results were compared with cochlear pathological features.

Results: In deaf animal model, increased ABR threshold and decreased spiral ganglion neuronal cells were noted. After transplantation of UCB MSC & WJ MSC, a significant improvement in hearing threshold compared to control group. Examination of the cochlear morphological features demonstrated that the transplanted group showed a significantly increase in spiral ganglion neuron.

Conclusion: Intravenous transplantation of umbilical cord derived MSC can regenerate spiral ganglion neurons and restore hearing in deaf animal model. Therefore autologous umbilical cord derived MSC transplantation may improve functional result of cochlear implantation in pediatric patients.

Abstract ID: 78
Poster Number: 49
Title: Cochlear Implantation in Charcot-Marie-Tooth Disease: Case Report and Review of the Literature
Authors: Charles L. Anzalone, Jr., MD1, Amy P. Olund, AuD2, Matthew L. Carlson, MD1; 1Otorhinolaryngology - Head and Neck Surgery, Mayo Clinic, Rochester, MN, 2Audiology, Mayo Clinic, Rochester, MN.
Abstract: 1

ABSTRACT

INTRODUCTION:
Charcot-Marie-Tooth (CMT) disease is a peripheral hereditary neuropathy associated with motor and sensory impairment and can result in profound sensorineural hearing loss (SNHL). Currently, the role of cochlear implantation in the setting of CMT and other progressive peripheral neurodegenerative disorders is not well established.

METHODS:
Case report and review of the English literature

RESULTS:
A 70-year-old male with CMT was referred for evaluation of progressive asymmetric SNHL and reported a 15-year duration of deafness involving the left ear. Audiometric testing confirmed profound SNHL in the left ear, while the right ear exhibited moderate-to-severe SNHL. Left-sided cochlear implantation was performed using a conventional length lateral wall electrode. Intraoperative device testing found normal impedance levels throughout the array; however, electrically evoked auditory potentials were absent on all electrodes. Upon initial activation 3 weeks after surgery, the patient reported excellent access to sound in the cochlear implant only condition. He has made good progress at each subsequent visit; speech perception testing after three months showed improvement from 0% to 27% on AzBio sentence and 28% on CNC word testing in cochlear implant only condition.

CONCLUSION:
We report the third case of cochlear implantation in a patient with CMT. SNHL in CMT is hypothesized to result from disruption of synchronous activity of the cochlear nerve. In patients with CMT, cochlear implantation may reconstitute synchronous neural activity by way of supraphysiological electrical stimulation. Our results corroborate two earlier reports that cochlear implantation is a viable option for rehabilitation of SNHL in this unique subset of patients.
Abstract ID: 87
Poster Number: 211
Title: Implantation in Children Under 12 Months of Age: The Effects of Hidden Disabilities
Authors: Kaitlyn M. Tona, Au.D., David Friedmann, MD, J. T. Roland, Jr., MD, Susan B. Waltzman, PhD; NYU Cochlear Implant Ctr., New York, NY.
Abstract: Introduction: The purpose of this study was to examine a cohort of patients with bilateral severe to profound hearing loss who received cochlear implants prior to 12 months of age for the incidence and impact of cognitive, behavioral, medical and/or other issues that either arose over subsequent years or were not evident prior to 12 months of age.
Methods: 108 children under the age of 12 months with diagnosed bilateral severe-to-profound hearing loss were implanted at our center between 2000-2013. Etiologies of hearing loss were as follows: 33/108=genetic, 20/108=Connexin 26, inner ear malformations=9/108, meningitis=3/108, CMV=3/108, Waardenburg=1/108, CHARGE=1/108 and 38/108=unknown. Several years following implantation, 15/108 (14%) of the children were diagnosed with additional issues including global developmental delays, attention deficit hyperactive disorder (ADHD), Usher syndrome, cognitive deficits and autism, which were not evident prior to implantation. Preoperatively, the nature and severity of the hearing loss was determined using objective and subjective testing including ABR and play audiometry and the IT-MAIS was administered to parents. In addition, a communication evaluation was performed on the children. Evaluations were performed routinely from 3-10 years post-implantation using age-appropriate speech perception measures including monosyllabic word tests and sentence tests in quiet and noise. In addition, communication evaluations were performed. All children were in appropriate therapeutic and educational programs following implantation.
Results: All 108 children obtain significant auditory and linguistic benefit from implantation and wear their devices on a regular basis. While all of the 15 children diagnosed with additional disabilities following implantation use and receive benefit from their implants, the auditory and linguistic benefits vary and are commensurate with the severity of their disabilities. In addition, the development of skills in this group was often slower than in those children who were not diagnosed with additional disabilities. 12/15 children attend mainstream schools and obtain additional assistance depending on their individual needs. The remaining three children attend special schools. The child with autism and one child with severe global developmental delays are non-verbal. Despite the fact that they have not developed oral language, they do respond to stimuli in the environment and wear their devices on a regular basis.
Conclusion: Children implanted below one year of age but diagnosed with additional disabilities several years following implantation obtained substantial though varying degrees of benefit from their implants but provide the ability to allow them develop to their full potential and be connected to their surroundings. While early implantation is warranted, it is important to address these potential issues when counseling families.

Abstract ID: 92
Poster Number: 166
Title: Evolution of Mapping and Vestibular Function During Acute Labyrinthitis in a Pediatric Patient with Bilateral Cochlear Implants
Authors: Susan Gibbons, Au.D., Margaret Kenna, MD, MPH, Dennis Poe, MD, Ph.D., Guang Wei Zhou, Sc.D., Amanda Griffin, Au.D., Ph.D., Jacob Brodsky, MD; Boston Children's Hosp., Waltham, MA.

Abstract: Introduction: Vestibular dysfunction can affect pediatric cochlear implant (CI) patients. Vestibular symptoms such as vertigo and imbalance are known to occur in some CI patients during the immediate post-operative period. However, acute vertigo attack in implanted children occurring remotely from the postoperative period has not been previously well described.

Methods: Case report of a 3-year-old patient. Retrospective review of audiological, vestibular and medical chart notes.

Results: A three-year-old girl with bilateral CIs experienced a sudden onset of vertigo and imbalance, accompanied by a change in hearing performance. She had previously undergone right cochlear implantation at 12 months of age and left cochlear implantation at 16 months of age. Cause of the patient’s hearing loss is unknown, with normal pre-operative MRI results. Cochlear implant programming four days after the onset indicated a significant increase in right-sided electrode impedances, resulting in non-compliance across four out of 22 electrode channels. Left-sided impedances and stimulation levels were stable. Tympanometric measurements were within normal limits bilaterally. Vestibular testing eight days after the onset showed evidence of a severe peripheral vestibular loss on the right side. A prednisone taper was prescribed. Her symptoms resolved entirely 10 days later. Cochlear implant testing following steroid treatment indicated right electrode impedances and stimulation levels had returned to baseline levels. Audiological performance testing at this time also indicated stable right CI detection thresholds and word recognition scores, in comparison to measurements obtained prior to the episode. No residual balance deficits were evident at the four-week follow-up visit.

Conclusion: We present a previously implanted child with symptoms and evidences of unilateral acute labyrinthitis that occurred remotely from the perioperative period, resulting in both deterioration in implant function and ipsilateral peripheral vestibular loss. Children with CIs may be at an increased risk for developing labyrinthitis due to the electrode creating a sustained conduit between the middle and the inner ears. Implant programming status should be assessed in a timely fashion for pediatric CI recipients who experience acute onset of vestibular symptoms.

Abstract ID: 94
Poster Number: 140
Title: Early Experience with the Nucleus Kanso Sound Processor

Authors: Philip A. Segel, Master's Degree Audiology, Thomas Boismoreau, BS Mechanical Engineering, Annelise Michel, MS Business; Cochlear EMEA, Basel, Switzerland.

Abstract: Introduction: A First Experience Program (FEP) of the Cochlear TMNucleusR Kanso TM (CP950) Sound Processor was undertaken to determine the impact of an Off-The-Ear sound processing unit on the clinic routine. The 3 aims of this FEP were to 1) Determine the impact of Kanso on the clinical counselling routine, 2) Determine the impact of training on the counselling and fitting process. 3) Obtain experience with upgrades and initial activations with this sound processor.

Methods: 32 clinics in 12 countries in EMEA (Europe Africa and Middle East) were recruited to participate in the FEP of the Kanso Sound Processor post CE Mark. Clinicians completed questionnaires regarding the pre-operative counselling experience, the initial activation experience and the experience for upgrading existing Nucleus recipients to this new form factor.
**Results:** Results-Training: 96% of clinicians agreed/strongly-agreed that the training provided prepared them to counsel on Kanso and fit/program the processor. Results-Pre-operative Counselling: Clinician questionnaires were received on 152 pre-operative counselling sessions with ages ranging from under age 12 months to age 80. When presented with a traditional BTE processor and an Off-the-Ear processor, patients/parents chose the Kanso sound processor 48% of the time. Key reasons for choosing Kanso included not wanting a BTE unit behind the ear any longer, size and weight of the processor and simplicity. Clinicians reported that 43% the counselling session needed to be increased due to having a second processor choice (Kanso). Results-Initial Activation Experience: 40 of the 72 candidates that chose Kanso pre-operatively had been seen for initial activation at the close of the FEP. 30% of activations with Kanso were in children. Centers indicated that activation appointments (mean 4 weeks) were not being delayed due to the fact the processor was an off-the-ear unit. When asked to compare an initial activation of the Kanso Sound Processor to the Nucleus 6 BTE Sound Processor clinicians reported that the time needed was equivalent (78%) of the time and somewhat shorter (22%) of the time. Results-Upgrade Experience: Clinician questionnaires were also obtained for 44 upgrades. 53% of all upgrades were in children. When asked to compare the time spent upgrading recipients to the Kanso Sound Processor to the Nucleus 6 BTE Sound Processor clinicians reported that the time needed was equivalent (55%) of the time and either somewhat or significantly shorter (37%) of the time. In 88% of the upgrades, clinicians agreed/strongly agreed that the patient/parents easily learned to use the Kanso. Finally, when asked whether upgrading patients to Kanso was easy, clinicians agreed/strongly agreed with this statement 98% of the time.

**Conclusion:**
The experience at 32 clinics indicated that fitting the Kanso sound processor is not a significantly different experience than for CP900 technology. While counselling may take longer (more products to show/ more choices for the recipient to make) the actual fitting is no different or even shorter. Whether upgrade or initial activation clinicians agreed that patients/parents easily learned to use Kanso and overall fitting Kanso was easy. Thus, the use of an Off-The-Ear sound processor fits well into the clinic routine./

**Abstract ID:** 95  
**Poster Number:** 173  
**Title:** Simulating Reduced Cochlear Implant Current Spread Improves Speech Perception in Normal Hearing Children and Adults, Yielding Performance Comparable to That of Early-implanted Children  
**Authors:** Kelly N. Jahn, Au.D., Mishaela DiNino, M.A., Julie G. Arenberg, Ph.D.; Speech and Hearing Sciences, Univ. of Washington, Seattle, WA.  
**Abstract:** **Introduction:** Channel interaction likely limits speech perception performance of cochlear implant (CI) users. This study examined the role of channel interaction in the ability of normal-hearing (NH) children and adults to recognize spectrally degraded speech. Simulations of CI hearing that varied the number of processing channels and the degree of current spread were employed. The aim was to assess the development of speech perception as a function of spectral resolution and degree of channel interaction in NH children and relate those findings to NH adults and cochlear implant users.  
**Methods:** NH participants included children (age 8-17 years) and adults (age 22-35 years). The CI listeners were pre-lingually deafened children (age 11-17 years). Speech stimuli were medial vowels and consonants. They were processed using a noise-band vocoder with 8, 12, and 15 channels and synthesis filter slopes of 15 (for adults only), and 30 and 60 dB/octave (all NH subjects). Steeper filter slopes
simulated less current spread and therefore less channel interaction. For CI users, unprocessed speech recognition was assessed using the participants’ everyday settings.

**Results:** For NH participants, vowel and consonant recognition improved with increasing filter slopes. Children continued to benefit from reduced current spread beyond the 30 dB/octave filter slope, where adult performance plateaued. For all listeners, the number of channels did not impact consonant recognition, while vowel recognition improved when the number of processing channels increased from 8 to 12, but not from 12 to 15. Of note, this pattern of vowel recognition was observed regardless of filter slope for adult participants, but only occurred in the steepest filter slope condition (60 dB/octave) for pediatric participants. To analyze the CI data, the implanted ears were divided into two groups based on the mean age of implantation (5.36 years). The ‘early-implanted’ group consisted of ears implanted before the mean and the ‘late-implanted’ group later than the mean. Thus, some of the bilaterally implanted children had both an ‘early’ and a ‘late’ implanted ear. Early-implanted ears performed the same as NH adults and children listening to the vowel stimuli under conditions with 12-15 channels and relatively reduced current spread (30-60 dB/octave). Late-implanted ears performed the same as NH adults in the condition with the poorest spectral resolution (8 channels) and the broadest current spread (15 dB/octave).

**Conclusion:** Consistent with previous vocoder studies in NH adults, vowel recognition improved when the number of processing channels increased from 8 to 12, whereas consonant recognition did not change with number of processing channels. Furthermore, recognition of spectrally degraded vowels and consonants improved with reduced current spread, particularly for children. The differences observed between NH children and adults suggest that the development of spectral resolution continues through adolescence, and that children may benefit more from reduced channel interaction than adults. Additionally, late-implanted ears performed significantly worse than early-implanted ears, and were comparable to NH participants listening to the most spectrally degraded simulations with the broadest current spread. These results provide evidence that early access to CI stimulation may contribute to the development of better spectral resolution.

**Abstract ID:** 96  
**Poster Number:** 147  
**Title:** Long Term Language and Speech Perception Outcomes in Quiet and in Noise for Pediatric Cochlear Implant Users: The Influence of Age at Implantation  
**Authors:** Melissa D. DeJong, Au.D.1, Alyce I. Breneman, Au.D.1, Ruth E. Stoeckel, Ph.D.2, Becky S. Baas, M.A.2, Taylor M. Brown, M.A.2;  
1ENT, Mayo Clinic, Rochester, MN, 2Mayo Clinic, Rochester, MN.  
**Abstract:** Introduction: Studies have shown that children implanted under the age of 12 months have better receptive and expressive language outcomes than older implanted children, but some research has shown that this difference weakens over time. Age at implantation also impacts speech perception skills. Research suggests that these differences also appear to weaken over time. Few studies have looked at the effects of age at implantation on speech perception on more demanding measures such as sentences in noise. Objective: To review receptive/expressive language outcomes and speech perception test results over time including listening in noise for children with initial activation of the cochlear implant under the age of 12 months (Group 1), from 12 to 23 months (Group 2), and from 24-41 months (Group 3).  
**Methods:** Retrospective review of receptive and expressive language scores as well as speech perception tests in quiet and in noise.
**Results:** Review of mean expressive and receptive language scores at the most recent test point indicates that children in Group 1 achieved receptive and expressive language scores within the average range while children in Groups 2 and 3 achieved scores at -1 SD below the mean. Children in each group generally made progress at the rate of maturation. On tests of speech perception, there is a trend for the younger implanted children to reach ceiling levels on word and sentence tests at earlier chronological ages and with fewer months of cochlear implant use. Over time, the older implanted children achieved similar scores on speech perception tests administered in quiet. On measures of sentence recognition in noise, there is a trend for the early implanted children to perform better with the difference continuing over time. Conclusions: Test results support earlier cochlear implantation for maximum development of language and for better auditory skills in more complex listening environments at younger ages. Data will be analyzed to determine if the trends are significant.

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**Abstract ID:** 98  
**Poster Number:** 137  
**Title:** Adaptive Behavior in Young Children Pre and Post Auditory Brainstem Implantation  
**Authors:** Amy Martinez, M.A.1, Carren J. Stika, Ph.D.2, Laurie S. Eisenberg, Ph.D.1, Eric Wilkinson, M.D.3;  
1USC Caruso Family Center for Childhood Communication, Univ. of Southern California, Los Angeles, CA, 2Speech Language and Hearing Sciences, San Diego State Univ., San Diego, CA, 3Huntington Med. Res. Inst.s, Pasadena, CA.  
**Abstract:**  
Introduction  
The auditory brainstem implant (ABI) is currently being investigated in the United States to determine safety, feasibility, and early efficacy in young children. In our Phase I clinical trial, children ages 2 to 5 years are enrolled if they are not candidates for or do not demonstrate benefit from cochlear implants (CI) due to cochlear nerve deficiency or severe cochlear malformations. Many children eligible for an ABI exhibit additional deficits that may impede progress with a sensory device, or interfere with their ability to cooperate in testing and programming. In an attempt to better understand the potential benefits of the ABI and rule out other confounding factors, enrollment in our study is limited to children with no demonstrable cognitive and/or developmental delays. Results to date suggest that progress in auditory skill development with the ABI is slower and less consistent than it is for typical CI users. Children may or may not be successful in developing spoken language as a primary mode of communication. However, these children may demonstrate important benefits in other developmental domains. One component of the trial is to determine whether the ABI can promote advances in adaptive behavior (conceptual, social, and practical skills necessary for people to live independently and to function safely and appropriately in daily life). Research is limited on the adaptive behaviors of children who receive CIs but none has addressed the ABI.  
Methods  
The Vineland Behavioral Scales – 2nd edition (Vineland-II) is a semi-structured parent/caregiver interview that assesses adaptive functioning in four domains: Communication, Daily Living Skills, Socialization and Motor Skills. A clinical psychologist familiar with developmental norms for young children administered the Vineland-II at pre-operative baseline, 12-, and 24-months post ABI activation. Five of nine children enrolled in the study met the inclusion criteria and underwent ABI surgery.  
**Results**
Baseline Vineland-II scores indicated that the children’s adaptive behaviors were within the average to moderately low range compared to typically developing peers. Within 12 to 24 months of ABI use, incremental improvements were evidenced in the Daily Living Skills domain, suggesting that the children are acquiring independent living skills comparable to those demonstrated by their normal hearing peers. Advances were made in fine motor skills; however, little or no progress was shown for gross motor skills, perhaps due to congenital vestibular anomalies observed in these children. Negligible growth was observed in the Communication and Socialization domains.

Conclusion
The Vineland-II revealed a distinctive pattern of strengths and weaknesses found frequently in children with profound hearing loss; i.e., relative weaknesses in communication and socialization skills and relative strengths in daily living skills. These findings may reflect general deficits in these areas, or the limited sensitivity of the Vineland-II to measure incremental gains achieved due to the language-based nature of the test items.

Abstract ID: 100
Poster Number: 148
Title: Influence of Electrode Array Insertion Depth on Long-Term Hearing Preservation and Speech Perception
Authors: Andrea L. Bucker, AuD1, Meredith L. Anderson, AuD2, Margaret T. Dillon, AuD2, English R. King, AuD1, Ellen J. Deres, AuD1, Kevin D. Brown, MD/PHD2, Harold C. Pillsbury, MD2;
1Department of Audiology, UNC Hlth. Care, Chapel Hill, NC, 2Otolaryngology/Head and Neck Surgery, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC.
Abstract: Introduction: Initial investigations of Electric-Acoustic Stimulation (EAS) reported postoperative hearing preservation with a shallow electrode array insertion. Postoperative hearing preservation provided the opportunity to combine cochlear implant and hearing aid technologies in an ipsilateral listening condition, resulting in improved speech perception. Studies reviewing surgical procedures in these cases have offered recommendations to increase the potential for postoperative hearing preservation using varying electrode array lengths. Insertion depth has been shown to be related to speech perception within the initial months of listening experience for conventional cochlear implant recipients, where hearing preservation was not achieved. The present report assessed whether insertion depth influences long-term hearing preservation and aided speech perception in conventional cochlear implant recipients.

Methods: This study reviewed long-term hearing preservation and aided speech perception in adult cochlear implant recipients with electrode arrays offering different insertion depths. Unaided air conduction thresholds in the implanted ear and aided speech perception were assessed at the preoperative, 1-, 6-, and 12-month post-initial activation intervals. Subjects were divided into groups based on their specific electrode array. All subjects received a full insertion of their device and were programmed using behavioral mapping procedures. Postoperative hearing preservation and aided speech perception were compared between electrode arrays.

Results: There was no significant difference between cohorts for hearing preservation, though variability was noted. A potential confounding variable was floor effects in the preoperative residual hearing for the subjects implanted with the longest electrode array. All subjects experienced a significant improvement in aided speech perception as compared to preoperative findings with conventional amplification. There were no differences in speech perception between cohorts at the 12 month interval.
**Conclusion:** Hearing preservation can be achieved with electrode arrays offering different insertion depths. Electrode array selection was not predictive of postoperative speech perception abilities with up to 12 months of listening experience. Consideration of long-term outcomes is needed as hearing preservation procedures expand to the pediatric population.

**Abstract ID:** 102  
**Poster Number:** 41  
**Title:** Attention to Infant-directed Speech in Deaf Infants with Cochlear Implants  
**Authors:** Yuanyuan Wang, Ph.D.1, Tonya Bergeson, Ph.D.2, Shana Lucius, MA3, Derek Houston, Ph.D.1;  
1Otolaryngology, The Ohio State Univ., Columbus, OH, 2The Urban Chalkboard, Carmel, IN, 3Nationwide Children's Hosp., Columbus, OH.

**Abstract:**  
**Introduction:** Very young normal-hearing (NH) infants prefer and learn better from infant-directed speech (IDS) over adult-directed speech (ADS) (e.g., Cooper & Aslin, 1990; Fernald, 1985; Ma et al., 2011; Singh et al. 2009), because IDS tends to exhibit exaggerated acoustic-prosodic properties, such as slower speaking rate, higher pitch, wider pitch range, and longer pauses, relative to ADS (Fernald and Simon, 1984; Fernald et al., 1989; Werker et al., 1994). Infants who receive cochlear implantations (CIs) may show different sensitivity to IDS versus ADS due to early auditory deprivation and degraded auditory input afterwards (Geers et al., 2011; Holt et al., 2012; Pisoni et al., 2000). For example, in one study we found that CI infants’ sustained attention to speech differed from that of NH infants (Yang et al., in preparation). Therefore, the purpose of the present study was to determine whether infants with CIs, like their NH peers, prefer listening to IDS over ADS.  
**Methods:** Using the central fixation procedure, we tested 46 infants - 12 prelingually deaf infants who received CIs before 2 years of age (mean chronological age = 27.24 months; mean hearing age = 11.88 months; CI group), 22 NH infants with matched hearing experience (mean = 11.68 months; NH-HEM group), and 12 NH infants with matched chronological age (mean = 27.55 months; NH-CAM group) - on their listening preference in three blocks: IDS vs. ADS, IDS vs. Silence, and ADS vs. Silence block (the last two served as baseline). We calculated the average looking times to different types of stimuli (IDS, ADS, or Silence) within each block for each infant. To assess CI infants’ developmental language skills, we administered the Preschool Language Scale (PLS; Zimmerman, Steiner, & Pond, 2002) approximately 18 months after implantation.  
**Results:** In the IDS vs. ADS block, both the CI and NH-HEM groups preferred IDS relative to ADS, p = .010 and p = .003, respectively; however, the NH-CAM group looked equally long to IDS and ADS; in the IDS vs. Silence block, all the three groups, in general, looked significantly longer to IDS than to silence, p < .001. In the ADS vs. Silence block, both the NH-HEM and NH-CAM groups looked significantly longer to ADS relative to silence, p = .001 and p = .019, respectively; however, the CI group did not show any preference, see Figure 1. The regression analyses demonstrated that CI infants’ IDS preference quotient (calculated by dividing the average looking time differences to IDS and ADS by the total amount of looking time to both IDS and ADS for each CI infant) in the IDS vs. ADS condition was the single best predictor of PLS Auditory Comprehension, p < .001, and PLS Expressive Communication, p = .052.  
**Conclusion:** The results showed that 1) similar to NH-HEM controls, CI infants prefer IDS over ADS; and 2) the degree of IDS preference predicts language development in CI infants. These findings suggest that infants with CIs may have access to the information provide by IDS for the purpose of language acquisition. They may also inform intervention strategies by indicating what kind of input is most effective for deaf infants to attain age-appropriate language skills.
Identification and Management of Children with Usher Syndrome

Authors: Jolie Fainberg, M.A.1, Melissa K. Chaikof, B.A.2, Susan Trotochaud, B.A.3, Nancy Parkin-Bashizi, M.A., COMS, CVRT4; 1Audiology, Atlanta Speech Sch., Atlanta, GA, 2Usher 1F Fndn., Boston, MA, 3Usher 2020 Fndn., Atlanta, GA, 4Vision Rehabilitation Services of Georgia, Atlanta, GA.

Abstract: Introduction: Usher Syndrome is a rare genetic disorder that is the leading cause of deaf-blindness in the world. It was named for a Scottish Ophthalmologist from the early 1900s, Charles Usher, who recognized it as a syndrome through a number of his patients. Although it is rare, only about 45,000 people in the U.S., it is devastating for those who are affected by it. Caused by an autosomal recessive gene, it manifests itself in three clinical types.

Methods: Parents rely on audiologists for information and guidance in working with their children who have hearing loss, so the audiologist is often expected to counsel and help parents through their choices and decisions. The purpose of this paper is to educate the audiologist about Usher Syndrome and its relevance to newly identified children and their families. We will describe the symptoms and sub-types of USH with regard to hearing, vision and balance including specific information.

Results: Early diagnosis is critical for children with Usher syndrome. While there is currently no cure, the best treatment involves early identification so that educational programs and assistive technologies can begin as soon as possible. Early, bilateral cochlear implantation is an effective treatment for children with severe to profound hearing loss.

Conclusion: Early, bilateral cochlear implantation in children with Usher Syndrome is an effective treatment for children diagnosed with severe to profound hearing loss. It is important for the audiologist to be familiar with Usher Syndrome as they guide families of children with hearing loss. From our experiences, we offer a suggested protocol to facilitate early identification of this disorder.
and upper limits of loudness levels were recorded for 113 males and 93 female recipients (N = 206). Recipients ranged in age from 13 months to 86 years (mean = 18 years; standard deviation = 21).

**Results:** The mean difference in upper limits of loudness levels to the electric stapedial reflex threshold for Cochlear was 19 clinical units with a standard deviation of 11 units. For Advanced Bionics the mean difference was a decrease of 10% clinical units with a standard deviation of 39% and 3.4% with a standard deviation of 11% for MedEl. For each manufacturer the electric stapedial reflex threshold measurements were consistent over time during the timeframe of the study (2013-2015). MedEl had a 0.4 unit decrease per year (SD = 5.7) while Cochlear had a decrease of 1.4 units per year (SD = 8.3) and Advanced Bionics had a decrease of 3 units per year (SD = 45.6).

**Conclusion:** This study supports the clinical relationship between eSRT and behaviorally set upper limits of loudness for Cochlear, Advanced Bionics, and Med-El manufacturers. It also provides support that the electrical stapedial reflex threshold is consistent over time, eliciting confidence that little change will occur over extended periods of time.

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**Abstract ID:** 109  
**Poster Number:** 25  
**Title:** Proportion of Nouns and Vocabulary Size in Young CI Recipients  
**Authors:** Jongmin Jung, PhD1, Derek Houston, PhD1, Jessica Reed, PhD1, Laura Wagner, PhD2; 1Otolaryngology-Head and Neck Surgery, The Ohio State Univ., Columbus, OH, 2Department of Psychology, The Ohio State Univ., Columbus, OH.  
**Abstract:** 

**Introduction:** Research has shown that young cochlear implant (CI) recipients produce their first words rapidly after CI activation (Ertmer & Inniger, 2009; Fagan, 2015). However, the achievement of this promising milestone of first words can be followed by protracted or delayed development of vocabulary (Nott, Cowan, Brown, & Wigglesworth, 2009a). A classic approach to understanding vocabulary development has been to examine the composition of children's lexicons, with a particular focus on early nouns (Bates et al., 1994; Nelson, 1973; Rescorla, Mirak, & Singh, 2000). Children with a greater proportion of common nouns are hypothesized to show more rapid growth. Only Nott and colleagues (2009b), however, have examined the vocabulary composition in CI recipients (23 of their 24 participants with hearing loss (HL) had CIs. Children with HL in their study produced a smaller proportion of nouns than children with normal hearing (NH) when controlling for vocabulary size. However, they did not investigate the effect of the vocabulary composition on vocabulary size in pediatric CI patients. The current investigation is a preliminary analysis of the association between the proportion of early nouns and vocabulary size in young CI recipients.

**Methods:** A total of 141 MacArthur Communicative Development Inventory: Words and Gestures (CDI:WG; Fenson, et al., 2007) were collected from 29 young CI recipients (range of age at implantation: 8 to 24 months; mean = 16.13 months, SD = 4.37) across their first year of CI use. Participants received credit for any word in their expressive vocabulary regardless of modality (e.g., sign or spoken language) as reported by caregivers. The proportion of nouns to total vocabulary size was calculated.

**Results:** The results of repeated measures using mixed-design ANOVA indicated that there was no effect of CI experience on the proportion of nouns (F [8, 65.761] = 1.378, p = .223). By contrast, the partial correlation analysis controlling CI experiences showed a weak but significant association between the proportion of nouns and total vocabulary size (r = .280, p = .012).

**Conclusion:** Our preliminary findings suggested that the proportion of nouns has a potential to be an early predictor of the future vocabulary outcomes. The relationships between the noun proportion and vocabulary outcomes in young CI recipients must be studied further. Comparing CI recipients’
proportion of nouns with the norms for children with NH could help us better understand the vocabulary growth in young CI recipients.

Abstract ID: 112
Poster Number: 19
Title: The Natural History and Rehabilitative Outcomes of Hearing Loss in Congenital Cytomegalovirus: A Systematic Review
Authors: Kyle T. Fletcher, MD1, Tianshi Liu, BS2, Erin M. Wolf, PhD2, Maria Muthoka, MBChB3, Matthew L. Bush, MD1; 1Otolaryngology - Head & Neck Surgery, Univ. of Kentucky, Lexington, KY, 2College of Medicine, Univ. of Kentucky, Lexington, KY, 3Division of Otolaryngology – Head and Neck Surgery, Department of Surgery, Univ. of Nairobi Coll. of Hlth. Sci., Nairobi, Kenya.
Abstract: Introduction: Congenital Cytomegalovirus (cCMV) infection is a common cause of pediatric hearing loss yet the nature of the hearing loss (onset, progression, and fluctuation) is poorly understood. Furthermore, the factors affecting successful auditory rehabilitation outcomes of children with cCMV are unknown. The purpose of this study was to systematically review the literature regarding the natural history and rehabilitative outcomes of sensorineural hearing loss from cCMV infections.
Methods: A systematic search was performed in PubMed, PsychINFO, CINAHL, and Web of Science to identify peer-reviewed research. Inclusion criteria were: 1) studies addressing timing of onset, progression, and/or fluctuation of hearing in cCMV 2) results of cochlear implantation in the cCMV population 3) documentation of cCMV (as opposed to post-natal CMV) via appropriate testing (dried blood spot, cord blood, urine or saliva culture or polymerase chain reaction) 4) hearing loss documented by 2 separate audiological assessments. Exclusion criteria were: 1) case reports or non-original research, 2) language other than English.
Results: Thirty-six articles were reviewed. Studies that reported on universal screening identified cCMV in 0.2 – 1% of newborns and of those newborns 8-22% had hearing loss. Sensorineural hearing loss was more prevalent in children with symptomatic cCMV (growth retardation, prematurity, microcephaly, chorioretinitis, seizures, and/or other neurological abnormalities) compared to asymptomatic cases. Post-natal development of hearing loss was 9 – 68% of cases of cCMV and age of onset ranged from 3 months to 16 years. Cochlear implantation in children with cCMV significantly improves expressive and receptive outcomes; however, symptomatic children and those with cognitive impairments have poorer outcomes than non-cCMV CI recipients. This is limited literature comparing rehabilitation outcomes in cCMV and non-cCMV CI recipients. Conclusion: Late onset and progressive hearing loss is seen in children who develop hearing loss from cCMV. Frequent audiologic follow-up is necessary considering the natural history of cCMV hearing loss. Universal screening should be pursued due to the number of asymptomatic children, at birth, who develop late onset/delayed hearing loss. Cochlear implantation is an effective means of improving speech and language skills in this population.

Abstract ID: 114
Poster Number: 203
Title: Perception of Interaural Time Differences with Cochlear Implants with a Focus on the Ongoing Fine Structure
**Authors:** Tobias Rottmann, Dipl.-Ing., Thomas Lenarz, Prof. Prof. Dr., Andreas Büchner, Prof. Dr.;
Department of Otolaryngology, Med. Univ. of Hannover, Hannover, Germany.

**Abstract:** Introduction: Coding strategies for cochlear implants (CI) which transfer in addition to the envelope of the incoming signal also the ongoing fine structure were introduced into the market some time ago. However, the possibility of bilaterally implanted CI users to perceive interaural differences in the signal fine structure has not been investigated in detail so far. In principle, a fine structure coding strategy reproduce the fine temporal information of the acoustic input signal on the electrical side, so that an ITD (interaural time difference) perception on basis of the fine structure could be possible. The aim of this study is to evaluate the ITD coding effectiveness with a standard CIS coding strategy and a fine structure coding strategy, as well as making a comparison between the two.

**Methods:** For this purpose, two binaural stimuli with interaural time differences were presented in a lateralization experiment to the bilaterally implanted subjects. Both processors are connected via the direct-in to a soundcard of a computer which generates the signals. The method of constant stimuli is used, so that seven fixed ITDs in the range of 50 to 600µs are repeatedly presented. Different electrode configurations with one, four and ten active apical electrode pairs were measured to investigate the effect crosstalk the intra-cochlear electrode contacts.

**Results:** Eleven subjects were included in the study. Seven of these subjects were sensitive to ITDs. They showed good results with the fine structure strategy in the sinusoids condition. With the CIS strategy however, they only reached ITDs in the range of chance level. With the much broader pink noise signal even with the CIS strategy a moderate ITD perception was observed, probably caused by ITD cues in the envelope of the processed signal. However the performance with the fine structure strategy was better than with CIS in most of the cases. We also observed that in general the ITD sensitivity decreased with an increasing number of active electrodes.

**Conclusion:** In those patients, who were able to perceive ITD cues (<600µs) results with the fine structure strategy were superior compared to the CIS strategy. However, our preliminary results also suggest that channel interaction between intra cochlear electrodes might hamper ITD perception in CI subjects.

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**Abstract ID:** 115  
**Poster Number:** 209  
**Title:** Remote Support for First- & Follow-Up-Fittings of Cochlear Implants in Children  
**Authors:** Kelly Schepers, BH1, Karin Bauer, BSc1, Stefano Morettini, PhD2, Alexander Möltner, Dip. Ing. (FH)3, Rudolf Hagen, Prof. Dr. med. Dr. h. c.4;  
1Stiftung Hör- Sprachförderung, CICSüd, Würzburg, Germany, 2MED-EL Elektromedizinische Geräte GmbH, Innsbruck, Austria, 3MED-EL Elektromedizinische Geräte Deutschland GmbH, Starnberg, Germany, 4Klinik und Poliklinik für Hals-, Nasen- und Ohrenkrankheiten der Julius-Maximilians- Univ., Würzburg, Germany.

**Abstract:** Introduction: Tele-health is a broad term for the application of information and telecommunication technologies in the delivery of health services in cases where users are separated from healthcare providers by some distance. Cochlear implant audiology is fairly specialized, and is therefore often only available in larger cities or via ‘outreach’ services, which involve a specialist audiologist travelling to different sites. This can place a real burden (in terms of time and expense) on subjects who live in remote or rural locations, and their families. Hughes et al. (2012) noted that most clinical CI programs require 8-10 visits to the CI center within the first year of device use, and annual or semi-annual visits thereafter. Often, a subject’s visits involve
travelling considerable distance, with the result that they often arrive tired at the CI clinic. Remote delivery of CI fitting services via tele-health is therefore an attractive option and has the potential to improve access to services and to reduce the burden on families.

**Methods:** While prior studies on subjective preference for remote or face-to-face fitting sessions have been performed, this study is the first of its kind to provide a prospective and controlled assessment of the safety and performance of a remote programming option for CI fitting in children. Accordingly, in this study Children who are bilaterally deaf or bordering on deafness, receiving or using a cochlear implant were recruited. This study aimed to compare the outcomes of electrophysiological testing, fitting parameters, pure tone audiometry and speech intelligibility measures within subjects who received a cochlear implant and underwent the implant fitting procedures. Specifically, subjects were fit via 2 procedures (remote and face-to-face) and electrophysiological parameters, pure tone audiometry and speech intelligibility outcomes were assessed acutely after each session in a standard audiological test setup at the study centers. In addition each fitting session was appraised by the remote expert, local host, and the subject via an ad hoc designed questionnaire and the total time in minutes needed to perform each type of session was recorded.

**Results:** Initial data gathered on subjects receiving a follow-up fitting, show a general good acceptance and a positive appraisal of the remote setting by the subjects themselves and the professionals involved. Likewise, fitting maps generated with either setting did not differ significantly and initial data on the outcomes of the two set-ups on speech intelligibility show similar performances for what concern subjects receiving follow-up fittings. In addition, both the remote and the local fitting could be performed in a similar amount of time without experiencing major delays or interruptions.

**Conclusion:** Remote CI fitting was generally well-received by CI-users and medical professionals. Subjects’ performance on audiological tests after remote fitting was not significantly different than after standard face-to-face fitting. Additionally, remote fitting did not take longer to perform that face-to-face fitting.

**Abstract ID:** 118  
**Poster Number:** 222  
**Title:** Improving the Transition Experience for Teens with Cochlear Implants Transferring Their Care from a Pediatric Setting to an Adult Setting  
**Authors:** Janet Olds, PhD1, Elizabeth Shaw-Pickard, M.Sc., AUD(C)1, Shelley Armstrong, M.Sc., AUD(C)2, JoAnne Whittingham, MSc3, Elizabeth Fitzpatrick, PhD4, David R. Schramm, MD5; 1Psychology, Children's Hosp. of Eastern Ontario, Ottawa, Canada, 2Audiology, The Ottawa Hosp., Ottawa, Canada, 3Audiology Lab, Children's Hosp. of Eastern Ontario Res. Inst., Ottawa, Canada, 4Faculty of Health Sciences, Univ. of Ottawa, Ottawa, Canada, 5Faculty of Medicine, Univ. of Ottawa, Ottawa, Canada.  
**Abstract:** **Introduction:** Over the last 25 years, cochlear implants (CI) have been available for children with severe to profound hearing loss, and these patients are now transitioning from the pediatric to adult setting in significant numbers. While youth with a range of chronic health conditions face challenges in making the transition to adult settings, some of the challenges in transition for the CI population are unique. For providers in adult settings, pediatric CI recipients who transition to care are a relatively small proportion of their caseload and have different patient characteristics, which are changing as pediatric CI practices evolve. These differences include communication difficulties secondary to later ages of implantation of early recipients, complex medical and developmental needs, as well as patients with bilateral CI and bimodal devices, all which need to be considered in transition
planning at both patient and system levels. We have conducted research on transition from pediatric to adult CI centers in a single geographic area, with the overarching goal to improve services for CI recipients transitioning from the pediatric to adult setting and to reduce negative impacts associated with transition for both patients and providers. The objective of this study is to examine challenges in service delivery associated with transition, document changes in practice implemented to reduce these challenges, and evaluate the effectiveness of these changes.

**Methods:** A set of recommendations for improved service delivery were derived using the following methods: literature scan and review; focus groups conducted with patients, families, health professionals and other stakeholders; health service utilization data. Recommendations were then prioritized, an evaluation framework developed, and changes at system- and patient-levels implemented in a stepwise fashion. Evaluation of each component of the framework has been developed and implemented.

**Results:** Recommendations for improved service delivery included: formalizing communication between programs; viewing transition as a process and identifying when it is complete; providing patients with familiarity with the new center before the transfer of care; involving community services; implementing tools to summarize health information and to assess youth readiness to transition; formalizing procedures for confidentiality and communication; educating patients about equipment, industry and community resources. Planned evaluation of changes to address individual components has indicated improved utilization, and positive stakeholder feedback, as well as additional areas for improvement.

**Conclusion:** The results from this study indicated improvements in the transition from pediatric to adult services for CI patients within a health service evaluation framework. Evaluation of further changes will continue to be an important component of service delivery and its improvement.

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**Abstract ID:** 119  
**Poster Number:** 97  
**Title:** Aetiology and Outcomes in Paediatric Reimplantation  
**Authors:** Christopher Raine, MB.BS.,FRCS., ChM., Jane Martin, MED, Catherine Totten, MSc., Iqbal Khan, FRCS, David Strachan, FRCS; Dept Otolaryngology, Yorkshire Auditory Implant Service, Bradford, United Kingdom.

**Abstract: Introduction:** Cochlear implants are one of the most sophisticated and reliable devices inserted into the human body. Despite being constructed to very high specifications the human body is a ‘hostile’ environment for electronic components. Various reasons for implant failure have been recognized. It is essential that such failures are rigorously reported and there needs to be close cooperation with manufacturers in order to continue to improve design.

**Methods:** All patients’ demographics and outcomes are prospectively entered into our departmental database. This allows for retrospective evaluation of outcomes. Between 1991 and 2016 - 559 children have been implanted with bilateral implantation being the routine since 2009 (a total of 747 implants). The data collected included age of initial implantation and subsequent failure, surgical details, pre and postoperative assessments and, where appropriate, Categories of Auditory Performance (CAP) & Meaningful Auditory Integration Scale (MAIS), with a minimum of 6 months postoperative follow up after re-implantation. Reasons for implant failure, once official reports had been received from the companies, were classified according to the European Consensus Statement.

**Results:** Of 747 implants 55 episodes were identified (7.36%) - 13 with bilateral CI; 42 unilateral. Data was available for all bilateral and in 39 of the unilateral cases. 1 child was not reimplanted; 7 children had insufficient data or had moved away from our service. There were no surgical complications.
Statistically the 13 bilaterally implanted children showed continued improvement with a positive correlation (0.89). 3 patients regressed on CAP score for a short period however the majority (36) remained static or improved with a positive (correlation 0.88). MAIS school scores showed positive improvement. With regard to the overall cause of re-implantation; 5.5% related to infection and/or extrusion; 9% related to implant performance; 9% with decrement loss of performance related to trauma; 76.5% related to device failure. Of the latter group there was a clear history of trauma in 20%; Younger implantees with a history of trauma were more prone to failure (p=0.023), similarly the age at failure was related to trauma (p=0.035).

Conclusion: Whilst sudden failure is usually quickly diagnosed a gradual decremental decline can be very difficult to identify in younger children. If implanted children are failing to progress then implant integrity should be tested. Surgical reimplantation is safe and if performed as soon as possible produces little loss in function. Single sided implantees do remain stable or continue to progress and all bilateral implantees progressed (as they retained one functioning implant). Trauma in young children is a significant contributory factor despite the robust engineering of implants.

Abstract ID: 120
Poster Number: 39
Title: Rhyme Awareness in Children with Cochlear Implants: Investigating the Effect of a Degraded Auditory System on Language and Literacy Development
Authors: Linye Jing, M.A.1, Katrien Vermeire, Ph.D.1, Andrea Mangino, M.S.2, Christina Reuterskiöld, Ph.D.1;

Abstract: Introduction: Successful literacy learning is the most important achievement for a child in school. Decoding of written words is mostly dependent on phonological processing skills. Phonological awareness skills are a prerequisite for the ability to decode written words as well as the ability to sound out words and learn to spell. Rhyme awareness is a phonological awareness skill essential for children's literacy development. Vocabulary is viewed as a support system for the development of a range of phonological processing skills in young children. De Cara & Goswami (2003) found that normal hearing (NH) five-year-old children with larger vocabularies were more successful in identifying rhyming words from dense rather than sparse rhyme neighborhoods. Children with weaker vocabulary skills did not show the same results. In children with cochlear implants (CIs), literacy is challenging. Little is known about the relationship between vocabulary skills, phonological awareness skills and phonological neighborhood density in children with CIs. Sterne and Goswami (2000) also found that children with CIs rely on orthography to a high degree when making rhyme judgments. The current study investigates performance using a rhyme oddity task in children with CIs and NH peers. Research questions include: 1. Do children with CIs show similar accuracy as NH children? 2. Do children with CIs show similar sensitivity to rhyme neighborhood density as NH children? 3. Do vocabulary skills predict accuracy to the same degree in children with CIs and NH? 4. Do orthographic patterns influence performance in children with CIs to a higher degree than in NH children?

Methods: 4.5 to 7.5 year old children with CIs and 4.5 to 5.5 year old NH children will participate in standardized screening for vocabulary, reading skills, nonverbal intelligence, working memory, and general language ability. In the rhyme oddity task, participants will listen to 3 words (2 rhyming + 1 non-rhyming) and identify the non-rhyming word. Half of the stimuli come from dense rhyme neighborhoods and half from sparse neighborhoods. The rhymes are either spelled congruently (feed/need) or incongruently (role/goal).
**Results:** Predicted results are that children with CIs will demonstrate lower accuracy than their NH peers. However, performance for CI and NH children will be similarly influenced by neighborhood density and vocabulary skills. Results will be discussed considering current research on phonological awareness skills and literacy development in children with CIs, and the effects of statistical patterns in language learning.

**Conclusion:** The results from this study will provide better understanding of factors influencing the development of reading and writing skills in early implanted CI children.

**Abstract ID:** 122  
**Poster Number:** 153  
**Title:** An Integrated Approach to Obtain Electrically Evoked Stapedial Reflex Threshold in Pediatric Cochlear Implant Patients  
**Authors:** Kerri A. Corkrum, AuD, Erin Christianson, PhD, Margaret Meredith, AuD, Susan Norton, PhD; Childhood Communication Center, Seattle Children's Hosp., Seattle, WA.

**Abstract: Introduction:** Creating a valid cochlear implant (CI) map in a pediatric patient can be challenging. Objective measures such as electrically evoked stapedial reflex thresholds (eSRT) have been shown to correlate with most comfortable electrical stimulation levels (M-levels). Traditionally, measuring eSRT is cumbersome because multiple pieces of equipment and more than one clinician are needed for younger patients. Recently, an integrated approach to obtain eSRT that can record and store data directly in the CI programming software was developed. The objectives of this study were: 1) to test the feasibility of an integrated approach to obtain eSRT in a pediatric CI cohort during routine clinic visits; and 2) to evaluate the relationship between eSRT levels and behavioral M-levels.

**Methods:** ESRTs were attempted in pediatric CI patients (N = 32 ears) during routine clinical follow up visits. The majority of these patients were not able to reliably perform loudness scaling but were often able to provide some type of descriptive feedback during behavioral mapping. All patients were implanted with devices from the same manufacturer. The equipment used to obtain eSRT included a laptop computer, a custom interface, and a tympanometer. ESRTs were attempted for four focused electrode clusters (Band 1 apical cluster, Band 2 and 3 mid-array clusters, Band 4 basal cluster) with a 678 Hz probe tone.

**Results:** ESRT was successfully obtained in 72% (23/32 ears) of the ears tested. Three patients had bilateral CIs. The mean patient age was 10.0 years (range = 1.8-18.2 years). Patients had at least 4 months CI experience prior to the eSRT evaluation (mean = 4.7 years, range = 0.4-11.1 years). For all 23 ears at least 1 eSRT response was obtained. Descriptive statistics were used to compare eSRTs to behavioral pre-eSRT M-levels and post-eSRT M-levels for each of the focused electrode clusters. Correlations (r) between eSRTs and mean behavioral pre-eSRT M-levels for clusters of adjacent electrodes ranged from 0.472 to 0.796. Correlations (r) between eSRTs and mean behavioral post-eSRT M-levels ranged from 0.711 to 0.890. The highest correlations between eSRT and pre-eSRT M-levels (r = 0.796) and post-eSRT M-levels (r = 0.890) were for the Band 4 basal electrode cluster. There were no statistically significant differences between eSRTs and mean behavioral pre- and post-eSRT M-levels for Band 1 and Band 4. There was also no significant difference between eSRTs and mean behavioral pre-eSRT M-levels for Band 3. For Band 2 both the pre- and post-M levels were significantly different from the eSRTs.

**Conclusion:** This study demonstrated that it is feasible to obtain eSRTs with the integrated system in a pediatric CI cohort during routine clinic visits. For the majority of patients tested, the results of this study showed good correlations between eSRT and mean behavioral M-levels.
Abstract ID: 127
Poster Number: 120
Title: Infant Exploration Before and After Cochlear Implantation: Behavioral Response to Sound
Authors: Mary K. Fagan, PhD1, Tyler J. Drake, BS2;
1Communication Sciences & Disorders, Chapman Univ., Irvine, CA, 2Communication Science & Disorders, Univ. of Missouri, Columbia, MO.
Abstract: Introduction: Infants’ early adaptation to cochlear implants varies widely, with some infants showing interest in sound shortly after cochlear implantation while others do not. Behavioral measures of attention to sound after cochlear implantation are important for identifying infants who require additional follow up and early intervention. However, few objective measures of infant behavior have been reported.
Methods: Participants were 43 infants, 27 hearing infants and 16 infants with profound hearing loss. Infants (hearing and deaf) were 9.9 months old (SD = 1.3; n = 26) at Time 1, before infants with profound hearing loss had received cochlear implants, and 17.7 months old at Time 2 (SD = 2.9; n = 31), following cochlear implantation. All infants participated at Time 1 or 2, with a subset (n = 14) participating at both time points. Mean age at cochlear implantation was 12.9 months (SD = 2.3), mean age at implant activation was 14.0 months (SD = 2.2), and mean duration of implant use at Time 2 was 4.2 months (SD = 2.6). Infants were presented with two sets of 12 objects that did or did not produce sound when manipulated. Objects were presented one at a time. Behavioral measures focused on time elapsed between object presentation and sound generation by hearing infants and infants with profound hearing loss, with or without cochlear implants.
Results: For 9-month-old infants with profound hearing loss who had not yet received cochlear implants, latency between object presentation and manipulation generating sound was more than twice as long as for age-matched hearing infants. However, between group differences (hearing and deaf) in latency were no longer significant at 17 months when infants with profound hearing loss used cochlear implants.
Conclusion: Potentially, behavioral measures of infants’ interest in generating sound during play can be used to identify infants at risk for suboptimal functioning with cochlear implants.

Abstract ID: 129
Poster Number: 108
Title: Pain Free MRI Scans In Cochlear Implantees
Authors: Ingo Todt, MD, Grit Rademacher, MD, Sven Mutze, Prof., Philipp Mittmann, MD, Arne Ernst, Prof.; Unfallkrankenhaus Berlin, Berlin, Germany.
Abstract: Introduction: The performance of MRI scans in cochlear implantees is currently limited since it is frequently associated with side effects. The occurrence of unclear postoperative vertigo, cochlear implant performance loss with intact cochlear implant system, reasonable suspicion of the occurrence of brain tumors (e.g. acoustic neuroma) or central infarction brings the clinican into a diagnostic dilemma since an MRI scan can be indicated. Beside MRI scan related artifacts, dislodging magnets can be problematic. But the most frequent problem is a scan related pain with an occurrence rate of 70 % to
100%. It was the aim of this study to evaluate the occurrence of pain in cochlear implantees with implant systems including specific system modifications to handle MRI scans at 1.5 T.

**Methods:** In a prospective case study of 6 implantees an MRI scan was performed and the degree of pain was evaluated by a visual analog scale. Scans were performed firstly with and depending of the degree of uncomfortness/pain, without a headband. 3 implantees were carrier of a screw fixation of the cochlear implant. 3 implantees were carrier of a cochlear implant with an internal diametrically magnetized magnet. MRI observations were performed with a 1.5 T scanner.

**Results:** In all patients MRI scans were performed without any degree of pain even without a headband.

**Conclusion:** MRI scanning in cochlear implantees can be performed without any pain This finding allows an expanding of MRI scanning indications if specific cochlear implants are used.

**Abstract ID:** 130  
**Poster Number:** 109  
**Title:** Experiences With MRI Scans In VSB 503 Implantees  
**Authors:** Ingo Todt, MD, Grit Rademacher, MD, Sven Mutze, Prof., Philipp Mittmann, MD, Arne Ernst, MD; Unfallkrankenhaus Berlin, Berlin, Germany.

**Abstract:** Introduction: The performance of MRI scans in VSB implantees is limited since it is associated with side effects. Beside MRI scan related artefacts, pain, FMT movements related changes of the transfer function have been found. The occurrence of e.g. unclear vertigo, suspicion of the occurrence of brain tumors or central infarciation brings the clinician into a diagnostic dilemma since an MRI scan can be indicated. In contrast to the previous VSB 502 system the VSB 503 contains specific MRI related changes (screw fixation, tripolar FMT). It was the aim of this study to evaluate the side effects of MRI scans in VSB 503 implantees at 1.5 T.

**Methods:** In a prospective case study of seven implantees an MRI scan was performed and the degree of pain was evaluated by a visual analog scale. Scan related PTA changes and audioprocessor fitting changes were investigated. Scans were performed firstly with and depending of the degree of uncomfortness/pain, without a headband. MRI observations were made with a 1.5 T scanner.

**Results:** In all patients MRI scans were performed without any degree of pain, change in PTA and AP fitting even without a headband.

**Conclusion:** MRI scanning can be performed with the VSB 503 without complications. Limitations persists in terms of magnet artefacts.

**Abstract ID:** 133  
**Poster Number:** 62  
**Title:** Longterm Experiences with CI and Labyrithectomy in Single Sided Meniere’s Disease and Deafness  
**Authors:** Gunnar Doobe, MD, Philipp Mittmann, MD, Arne Ernst, Prof., Ingo Todt, MD; Unfallkrankenhaus Berlin, Berlin, Germany.

**Abstract:** Introduction: Surgical treatment of single sided Meniere’s disease and deafness by labyrinthectomy and cochlear implant (CI) has been shown to be audiologically and posturally successfull. Concerns persist in terms of the longterm contralateral occurrence of Menieres disease and vertigo control as well as for intracochlear structural changes. The objective was to investigate the longterm outcome of Meniere’s disease patients treated with cochlear implantation and vestibular labyrinthectomy.
**Methods:** In this retrospective study eight patients with initially single-sided Meniere’s disease treated 4-6 years ago with cochlear implantation and vestibular labyrinthectomy were evaluated in terms of audiological outcome, occurrence of Menieres disease on the contralateral side, persisting vestibular dysfunction (Dizziness Handicap Inventory (DHI)) and complications.

**Results:** Audiological outcome showed speech understanding in the range of regular cochlear implant recipients for most of the patients. No patient developed Meniere diseases on the contralateral side. DHI values remained low indicating a high degree of vertigo control. Two patients developed a decompensating tinnitus. One patient developed an ongoing increasing shift of the stimulation threshold.

**Conclusion:** Longterm results with Cochlear implantation and vestibular labyrinthectomy underline the effectiveness in terms of audiological and vestibular rehabilitation. Complications like tinnitus generation and stimulation level shift might indicate intraco cochlear changes related to the labyrinthectomy.

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**Abstract ID: 135**

**Poster Number: 187**

**Title:** Post Operative Complications of Cochlear Implantation

**Authors:** Ait Mesbah Nacim, MD, Boutemeur Sarah, MD, Afiri Zhira, MD, Yahi Nadia, MD; ENT, HOSPITAL, ALGIERS, Algeria.

**Abstract:** Introduction: The purpose of this presentation is to study a major post operative complication of the cochlear implant : the explantation, to analyze its causes, to check if it corresponds to the data of the literature and try to propose some precautions in order to prevent them.

**Methods:** It is a retrospective monocentric study at kouba’s hospital (ALGIERS). The study concerns the pediatric population (under 18 years old) over a period extending from 2006 to 2015, 463 children were implanted. We reviewed the 21 cases of the explanted children to determine their causes.

**Results:** Of the 21 children explanted (4.53%), the average age was 4 years with extremes of 1 to 6 years, there was an almost equal number of boys and girls (11 boys, 10 girls). The time of explantation was on average 36 months with extremes of 1 year to 8 years. The causes of implant removal were classified according to “the European Consensus Statement on Cochlear Implant Failures and Explantations of 2005 “. There were 3 main causes. The most common reason for removal was technical device failure 51.14%(n=12), followed by trauma 33.33%(n=7) and infections 9.52%(n=2). Among these explanted children the majorities were reimplanted (17 cases), 4 children were not reimplanted, the reimplantation was homolateral for 15 children and contralateral in two children respectively with an inexhaustible infection and an ossified cochlea.

**Conclusion:** Cochlear implantation is a safe surgical technique for the rehabilitation of neurosensory deafness. During which the training and skills of the surgeon play a very important role. A database of cochlear implant failures must be established for all implant centers to provide the information needed to improve the quality of cochlear implants.

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**Abstract ID: 136**

**Poster Number: 223**

**Title:** CI and MRI Compatibility - Survey of Information Given to Patients and Implications

**Authors:** Christopher Raine, FRCS., ChM., Jane Martin, MED, Catherine Totten, MSc., David Strachan, FRCS.
Cochlear implants have revolutionised the management of patients with severe to profound sensorineural losses. Preoperative investigations involve radiological assessment of the cochlear by MRI scan, CT imaging or both. For parents and patients one of the main focuses is understanding and hopefully having surgery. In our unit patients have choice of devices. The reasons for varied are quite varied. Issues such as accessories and water compatibility appear to be significant factors to the patients and families. Clinically, it is clearly understood that the magnetic components, and to a certain degree the internal electronics, have a compatibility issue with MRI scanning. Some devices require removal of magnets. Others, are conditional to 1.5 Tesla. No matter what system is used significant voids and distortions are produced by the magnet when imaging the brain. There is a high chance that a child would require an MRI during his/her lifetime. Information from Germany indicates 114 MRI / 1000 inhabitants with head scans using CT / MRI being fairly equal (55% v 45%). Spine and extremities have higher proportion of MRI. The aim of this paper is to investigate what information is given pre implant to ensure informed consent is given. How issues are managed in the acute and non-acute situation will be reviewed.

Methods: A survey was sent to all UK implant centres asking them about the giving of information, formal surgical consent, their experience of dealing with patients potentially needing and actually having MRI scans. Final questions focused on any subsequent issues that arose. Results were used to compare our practice and subsequent management.

Results: 16 centres were approached and 14 replied. - Is departmental information given about MRI scanning? 69% No - Which/how is MRI related information is given? - Verbal 38%, - BCIG safety guidelines 35%, - Manufactures literature 23%, - No specific advice 4%. - Specifically mentioned at surgical consent? Yes 46% - In the past 12 months; median (range) - What external request for advice has been received? - 3 (1 - 25) - What number of actual known MRI scans have your patients had? - 2 (1 - 10) several centres did not know. - What reported issues have been reported? - demagnetised 1; displacement 2.

Conclusion: MRI scanning can be performed without side effects. However, there does seem to be a range of patient experiences and varied outcomes. As a result of our own experience for non-acute imagining; one child, who developed a neurological emergency at another hospital, despite theoretically following manufacturers protocol had magnet displacement whilst under GA. Fortunately, the bilateral voids did not mask the central medulloblastoma. Urgent exchange of the magnets to titanium blanks was performed as repeated MRI scans would be necessary in the future. From the survey reasons behind the need for an MRI scan should always be investigated. Would other imaging such a s CT +/- contrast be more appropriate? Also, clearly we need to pay more attention to consenting with future MRI scanning. Also to develop a consistent effective approach to reduce risk.
bilateral hearing aids (HA) in order to compare the role of each amplification device on the communicative abilities of severe to profound sensorineural hearing impaired children.

**Methods:** Study included 60 children with an age average of 3 to 7 years. All children were typically fitted with hearing aids. When hearing aids were deemed to be inadequate and language development was poor after one year of regular rehabilitation, children underwent evaluation for cochlear implant candidacy. A 2nd language assessment was done after 12 months of language therapy to detect the progress of the language development. Then a 3rd language assessment was done after another 12 months of rehabilitation either with hearing aids or with cochlear implant. Using Modified Preschool Language Scale & Subjective Speech Intelligibility for assessment. The language improvement quotient (LIQ) was used to compare between the rates of progress in language in order to overcome the bias of age matching.

**Results:** Group A is the hearing aids users for 2 years, Group B who used hearing aids for 12 months then shifted to cochlear implantation. The receptive LIQ and total LIQ were higher in group A than group B before CI use. However, there was no significant difference in expressive LIQ. CI users showed significantly higher improvement when compared to HA users during one year of rehabilitation in all language quotients.

**Conclusion:** There was no significant difference between both groups in any of the LIQs. This means that the amount of improvement in group (B) in the second year with the CI was able to overcome the lag of the first year in this group. Comparison between both groups regarding mean of Subjective Speech Intelligibility Test shows no significant difference.

**Abstract ID:** 138  
**Poster Number:** 9  
**Title:** Early Linguistic Developments of Simultaneous Bilateral Cochlear Implantees  
**Authors:** Jae Young Choi, MD, PhD, Michelle J. Suh, MD; Otolaryngology and Head and Neck surgery, Yonsei university college of medicine, South Korea, Seoul, Korea, Republic of.  
**Abstract:** *Introduction:* We analyzed the results of receptive and expressive language performance of simultaneous bilateral cochlear implantees in comparison with patients using bimodal stimulation (unilateral cochlear implantation + Hearing aid).  
**Methods:** Fifteen pediatric patients underwent simultaneous bilateral cochlear implantation (SbCI) and nine patients using bimodal stimulation (CI + hearing aid) were enrolled. CIs were performed by 24months of age. The results of IT-MAIS, CAP, average Developmental quotient (DQ), the ratio of Age equivalent to Chronological age of expressive, receptive language score at postoperative 1 year and the Percentage of Consonants Correct (PCC) index at age of 4 in CI users were analyzed.  
**Results:** In SbCI group, a significant improvement after surgery was noted in CAP scores (Δ4.58±0.1) over bimodal group(Δ3.7 ±0.53, P=.012) at 12 months after CI. IT-MAIS scores of simultaneous CI group (Δ 36.17±4.09 ) also revealed significant gain over the bimodal group (Δ30.17±2.19, P=.004). The DQ of receptive language was higher in SbCI group than bimodal group (87.6 ±15.4 vs.75.5±12.0%, p=.023 ) at postoperative 12months. Moreover, early SbCI was associated with better receptive language skills. PCC index at age 4 showed higher in children with bilateral stimulation over bimodal stimulation. (88.5±13.2 vs. 62±15.8, p=.0138)  
**Conclusion:** Our study shows that deaf children can achieve better results with early bilateral simultaneous CI in language skills than those of unilateral CI users with hearing aid. Even within SbCI
group, earlier surgery achieves better outcome of it. Herein, the analyses revealed that early language developmental success is achieved when earlier bilateral simultaneous intervention is conducted.

Abstract ID: 142
Poster Number: 191
Title: Long Term Cross-Modal Plasticity in Auditory and Visual Sensory Cortices after Hearing Deprivation in the Adult Rat
Authors: Marianny Pernia, Graduate1, Sheila Estevez, Graduate1, Ignacio Plaza, Graduate1, Agustin del Cañizo, MD PhD2, Julio Rodrigo, PhD3, Miguel A. Merchant, MD PhD1;
1Institute of Neuroscience, UNIVERSITY OF SALAMANCA, SALAMANCA, Spain, 2Department of Otorhinolaringology, UNIVERSITY OF SALAMANCA, SALAMANCA, Spain, 3MedEl Spain, Madrid, Spain.
Abstract: Introduction: Cross-modal reorganizations in the auditory and visual cortices have been reported after hearing and visual deficits mostly during the developmental period, and they may underlay sensory compensation mechanisms. However, there are very few data on the existence or the nature and timeline of such reorganization events during sensory deficits in adulthood.
Methods: In this study we looked at long-term changes in activity-dependent immediate early genes c-Fos and Arc/Arg3.1 and the AMPA glutamate receptor subunits GluR2/3 in auditory and neighboring visual cortical areas after bilateral deafness in young adult rats, 15 and 90 days after cochlear puncture.
Results: The number and density of c-Fos-immunoreactive neurons in the auditory cortex (AC) showed a significant, long-lasting decrease 15 days postlesion (dpl). However, at 90 days dpl, a significant recovery in number and density values of c-Fos immunoreactive neurons and an increase in GluR2/3 immunostaining supports long-term recovery in cell activity in the AC. Furthermore, increased c-Fos, Arc/Arg3.1 immunoreactivity in the visual cortex 90 dpl suggests overactivation of this sensory cortical area.
Conclusion: These findings support plastic compensatory rebalance of activity between the auditory and visual cortices after auditory deprivation in the adult. Whether these results in behavioral potentiation of visual drives on auditory regions of the cortex in adulthood remains to be explored.

Abstract ID: 143
Poster Number: 200
Title: Consonant and Vowel Repetition and Confusion in Cochlear Implant Users Measured by Nonsense Syllable Tests
Authors: Arne K. Rødvik, MSc, Janne V. K. Torkildsen, Associate professor, Juha T. Silvola, MD, PhD; Faculty of education/Dept of special needs education, Univ. of Oslo, Oslo, Norway.
Abstract: Introduction: The aims of this study were 1) to investigate how well users of multi-channel cochlear implants (CIs) can repeat vowels and consonants in a phoneme identification test using monomodal and bisyllabic nonsense words as stimuli, 2) to evaluate how age at implantation and duration of implant use relate to these results, 3) to assess how the results on nonsense syllable tests correspond to performance on real word monosyllable tests and scores on the SSQ questionnaire (SSQ = speech, spatial and qualities of hearing scale), and 4) to examine which consonants and vowels are most seldom and most frequently confused.
Methods: The phoneme identification test was conducted by playing CVC (consonant-vowel-consonant) and VCV nonsense syllables to the implanted participants in an anechoic chamber. Recordings of the participants’ repetitions were transcribed phonetically by two independent, trained phoneticians.
Included participants were 40 adults (16 years and above) and 38 children with CIs, and normal-hearing (NH) control groups of 20 adults and 30 children. Only participants with a real word monosyllable score above 50% were included.

**Results:** For the NH control groups, the mean score of the phoneme identification test was 94% (SD = 3%) correct repetitions for the adults and 78% (SD = 8%) for the 6-year-olds, which provided a significant difference in means of 16% (95% confidence interval; range: 12 to 20 %; p < 0.001). The SSQ score was 8.8 (SD = 0.7) for the adults and 9.3 (SD = 1.0) for the children. Preliminary results for the cochlear implanted participants showed a mean score of the phoneme identification test of 48% (SD = 11%) for the adults and 56% (SD = 8%) for the children. The SSQ score was 4.7 (SD = 1.4) for the adults and 6.1 (SD = 1.8) for the children. The results section will be completed before the conference.

**Conclusion:** The significantly higher mean score of the phoneme identification test for the NH adults than for the NH six-year-olds was expected, since adults have a more developed phonemic lexicon and higher phonemic awareness than children. The phoneme identification score of approximately 50% for the CI-users gave a desirable discrimination slope, indicating that the test is of suitable difficulty for this group. We found no ceiling effect of the phoneme identification test, neither in the NH group nor in the CI group, confirming the usefulness of this test.

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**Abstract ID: 147**

**Poster Number: 144**

**Title:** Cochlear Implantation: Outcomes in Children with Cochlear Nerve Deficiency

**Authors:** Annie Rodriguez, Au.D., Melissa Auchter, Au.D.; Univ. of Miami Ear Inst., Miami, FL.

**Abstract:** **Introduction:** Cochlear implantation in children with cochlear nerve deficiency (CND) is an area that has not been fully explored and remains in debate. CND, which includes both cochlear nerve hypoplasia and aplasia, occurs in approximately 12-18% of ears affected with sensorineural hearing loss (Huang et. al, 2011). In the past, CND has been a contraindication for cochlear implantation; however recent studies have shown some patients with CND achieve open-set word understanding and should be considered prior to pursuing an auditory brainstem implant (ABI) (Buchman et. al 2011). To date, little is known about the outcomes and benefits of pediatric cochlear implant patients with CND.

**Methods:** Pre-operative imaging (MRI/CT Scan) as well as pre-operative audiometric thresholds and speech perception scores were reviewed and compared to post-operative neural response telemetry data (NRT) and post-operative audiometric thresholds and speech perception scores.

**Results:** Despite lack of visible nerve tracing on imaging, all three cases presented with NRT measurements, though measurements were found to fluctuate between visits. Post-operative aided thresholds were observed to improve in all patients. Speech perception scores were also found to improve when testing could be completed. Variability in improvement was noted between patients.

**Conclusion:** Based on the preliminary data found in these case reports, cochlear implantation should not be eliminated as a potential option for patients diagnosed with CND. Results found in these three cases suggest that cochlear implantation may be a viable option for children with CND. Auditory progress was noted in all three cases and despite imaging data, nerve responses were seen through NRT measurements.

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**Abstract ID: 148**

**Poster Number: 164**
Title: Evaluation of an Automatic System to Record and Analyze Electrically Evoked Compound Action Potentials
Authors: Lutz Gaertner, PhD1, Andreas Buechner, PhD1, Thomas Lenarz, MD1, Konrad E. Schwarz, PhD2, Stefan B. Strahl, PhD2, Angelika Dierker, PhD2, Philipp Spitzer, PhD2; 1Department Of Otolaryngology, Hannover Med. Sch., Hannover, Germany, 2R&D, MED-EL GmbH, Innsbruck, Austria.
Abstract: Introduction: The measurement of electrically evoked compound action potentials (ECAP) provides a basis for programming the speech processor of a cochlear implant (CI) especially in very young children who cannot give sufficient feedback about their hearing impressions. A novel automatic ECAP recording system which is based on a combination of information that was unused so far in standard clinical software was evaluated against human experts.
Methods: In 21 cochlear implants 234 measurements of the amplitude growth function (AGF) have been taken using a new recording paradigm where the current amplitude was increased in quasi-continuous steps and different recording electrodes have been used. Five experienced audiologists determined the ECAP thresholds in these measurements. The results were compared to a new automatic analysis making use of a physiological based ECAP classifier based on firing probability of the auditory nerve. Peak picking of the N- and P-peaks of the ECAP response were improved by surface analysis of the AGF. Threshold estimation was supported by fitting a sigmoidal model to the AGF.
Results: Pearson’s correlation coefficient r between the thresholds estimated by the human experts and the automatic system was in the range of 0.78 to 0.91 with a median of 0.83. The correlation coefficient R between the thresholds estimated by different human experts was in the range of 0.84 to 0.92 with a median of 0.88.
Conclusion: The novel automatic ECAP recording system leads to thresholds within those estimated by human experts.

Abstract ID: 153
Poster Number: 172
Title: How Does Restricted Speech Perception in Noise Affect the Quality of Life of Children with Cochlear Implants?
Authors: Maria Huber, PhD, Clara Havas, MD; Paracelsus Med. Univ. Salzburg, Salzburg, Austria.
Abstract: Introduction: Cochlear implantation (CI) allows hearing impaired children the development of speech understanding and speech production. However, children with CI have more problems than normal hearing peers to percept speech in adverse listening situations, despite the fact that nowadays most of them were implanted at a very young age and many of them are supplied with CIs on both ears. Comprehension problems in noisy situations may impair the (oral) communication with other persons, which in turn for the long term may have negative effects on the subjective well being of young CI users. Additionally, listening in noise may be more demanding for young CI users than for normal hearing peers, with fatigue as a consequence. Our aim was to evaluate the impact of the ability of speech perception in noise of young CI users on their Quality of Life (QoL) respective their Health Related Quality of Life (HRQOL).
Methods: For this systematic review we looked at papers about QoL, HRQoL and speech perception in noise of children and adolescents with cochlea implants. Inclusion criteria were a) an age of the CI users ranging between 4 and 18 years, b) quality of life instruments are validated for children and adolescents, c) speech perception in noise was examined with standardized audiological tests, d) original research
and e) the paper was written in English. The literature research was conducted in Pup-Med, Science Direct and Web of Knowledge (Thomas Reuters).

**Results:** 28 papers were found as relevant. Nine papers corresponded to criteria a) b) d) and e). Only four papers out of 28 were dealing with speech perception in noise and QoL/HRQoL of children and adolescents with CI. Finally only two papers corresponded to all criteria. The first paper found significant correlations between speech perception in noise and HRQoL (school domain). The second paper did not find significant correlations between speech perception in noise and QoL outcomes. However, bilateral implanted children scored better in speech perception in noise than children with unilateral CI. Furthermore, sequential bilateral cochlear implantation in children was found to improve QoL.

**Conclusion:** In summary, only few studies are dealing with the relationship between speech perception in noise and the quality of life of children with cochlear implants. It is important to study the effects of restricted speech perception in noise of children with CI on their quality of life.

**Abstract ID:** 154

**Poster Number:** 118

**Title:** The Role of the Department of Children and Family Services (DCFS) in Supporting Families of Children with Severe Hearing Loss

**Authors:** Jeffrey W. Yu, MD

Otolaryngology, Univ. of Illinois at Chicago, Chicago, IL.

**Abstract:** Introduction: Children identified with severe to profound hearing loss require interventions from multiple services to help develop language and communication. The goal is to ensure that these children have early and full access to a means of communication. This may include therapy for oral speech-language development or sign language, or both. Aural rehabilitation includes therapies with hearing aids and/or cochlear implantation. The complexity of care for these children often pose challenges to parents and care givers, especially those with social and economic challenges. Families often require extra support and assistance to overcome barriers with access to care. When a child does not have access to these interventions, it is controversial as to whether this fits the definition of neglect. The child protective services which is referred to as the Department of Child and Family Services in the state of Illinois can provide assistance in ensuring families are supported. Clinicians often feel conflicted about enlisting the assistance of DCFS balancing the critical nature of early language development and the family’s right to choose the best course of intervention for their child.

**Methods:** Case series of three patients will be presented. The role of the Illinois Department of Children (DCFS) and Family services will be discussed in each case and how the agency influenced the case and whether it ultimately improved outcomes.

**Results:** The Department of Children and Family services assign a case worker to each family. They serve as a support to parents of children with hearing loss to help attendance for medical, audiology and speech therapy appointments.

**Conclusion:** Contacting the Department of Children and Family services should be considered when all other avenues have been exhausted. The decision to involved DCFS needs to involve a multidisciplinary team that can consider the family’s emotion, social and economic state. The case manager can be an invaluable recourse to ensure attendance to appointment and school enrollments.

**Abstract ID:** 156
Case Series: Does Timing of Cochlear Implantation as Treatment for Single Sided Deafness Affect Outcomes?

**Authors:** Michelle K. Shannon, AuD, CCC-A, Krista M. Winner, AuD, CCC-A, Christine M. Schafer, AuD, Oliver F. Adunka, MD, FACS, Ursula M. Findlen, PhD; Nationwide Children's Hosp., Columbus, OH.

**Abstract:** The candidacy for cochlear implantation has recently expanded to include patients with residual hearing and patients with single-sided deafness (SSD). Research regarding the use of cochlear implantation for SSD is limited by the number of participants. Nevertheless, the published data supports cochlear implantation for single-sided deafness due to improvement in speech understanding in quiet and noise, sound localization and suppression of tinnitus (Tokita et al., 2007; Friedmann et al., 2016). The effect of duration of hearing loss prior to implantation has been addressed in the SSD population but has not been investigated fully. This case series compares the 1-yr post-cochlear implantation outcomes for two teenagers with SSD having significantly different durations of hearing loss.

**Methods:** Two patients received cochlear implants (CI) as treatment for single-sided deafness. Case A was 15 years old at implantation with a long-term history of hearing loss. Case B was 18 years of age at implantation with a 3-year duration of hearing loss from a traumatic accident. At the 1-year post initial stimulation appointment speech perception testing was completed for each patient. A comprehensive speech test battery using CNC words and spatially separated speech in noise testing was utilized. Testing was completed with the CI on (intervention) and with the CI off (no intervention).

**Results:** Results revealed Case A performed at 36% on CNC words and Case B performed at 48% with the implanted ear alone. The scores on CNC words were not significantly different (Carney & Schlauch, 2007). Case A performed better on AZ Bio sentences presented in noise when using the CI and normal hearing ear (87%) compared to the no intervention condition (65%). Case B performed similar on AZ Bio sentences presented in noise when using the CI and normal hearing ear (87%) compared to the no intervention condition (85%). The cases performed the same on AZ Bio sentences in noise in the intervention condition.

**Conclusion:** Duration of hearing loss (13 years compared to 3 years) did not affect speech perception scores at 1-yr post implantation. This indicates that duration of deafness may not exclude a patient as a candidate for cochlear implantation as treatment for SSD. Further, Case A had the longer duration of deafness, but experienced greater benefit when comparing the intervention and no intervention conditions, suggesting that even those with longer durations of deafness can show significant benefit from baseline. It is acknowledged that a larger study needs to be completed to fully determine if duration of deafness should be a factor in determining candidacy for cochlear implantation in this population.

**Abstract ID:** 163

**Hearing Preservation in Children Following Cochlear Implantation**

**Authors:** Neil S. Patel, MD, Nicole M. Tombers, RN, Melissa D. DeJong, AuD, Alyce I. Breneman, AuD, Brian A. Neff, MD, Colin L. W. Driscoll, MD, Matthew L. Carlson, MD; Otorhinolaryngology, Mayo Clinic, Rochester, MN.

**Abstract:** Introduction:
Presently, there are few studies evaluating the rate of hearing preservation after cochlear implantation in children, as only recently has implantation of children with greater degrees of residual hearing become more widely accepted. As a result of improvements in technology, programming strategies, and surgical technique, the number of children with low frequency residual hearing who undergo cochlear implantation has steadily increased. At the same time, the value of electroacoustic stimulation has been demonstrated, reinforcing the value of atraumatic surgical techniques to preserve cochlear function. The objective of the current study is to report pediatric hearing preservation results following cochlear implantation with conventional full-length electrodes.

Methods:
A retrospective review (2000-2016) at a tertiary referral center was performed of all pediatric patients with a ≤75 dB preoperative low-frequency pure tone average (LFPTA; 250-500Hz average), who underwent cochlear implantation with a conventional length electrode. The degree of hearing preservation was determined according to the 2013 HEARRING group guidelines.

Results:
A total of 43 ears, in 35 pediatric patients, met inclusion criteria. The mean age at time of implantation was 8.6 years (range 1.4-17.8 yrs), 20 (57.1%) patients were female, and 25 (58.1%) cases were left-sided. The mean preoperative ipsilateral low frequency PTA and standard PTA (500, 1000, 2000, 3000Hz average) were 54.2 dB (range 15 - 75 dB) and 82.2 dB (range 25 - 102.5 dB), respectively. The mean low frequency PTA and standard PTA shifts comparing the pre- and first postoperative audiogram were ∆25.2 dB (range -5 – 92.5 dB) and ∆18.3 dB (range -8.8 – 100 dB), respectively. Overall, 17 (39.5%) ears demonstrated complete hearing preservation, 19 (44.2%) ears partial hearing preservation, and 7 (16.3%) exhibited no measurable acoustic hearing after surgery. In total, 26 (60.4%) ears maintained functional low-frequency hearing (i.e., ≤80 dB LFPTA) based on the initial postoperative audiogram. There was no statistically significant difference in the initial low frequency PTA shift comparing lateral wall and perimodiolar electrodes (∆22.2 vs ∆28.1; p=0.44), cochleostomy and round window insertions (∆25.2 vs. ∆24.7; p=0.95), or statistically significant association between age at implantation and low frequency PTA shift (r=0.174; p=0.26).

Conclusion:
Varying levels of hearing preservation with conventional length electrodes can be achieved in over 80% of pediatric subjects. These data may be used to guide preoperative counseling in pediatric patients with residual acoustic hearing. Additionally, the favorable rates of hearing preservation achieved in children provide further evidence for the expansion of pediatric cochlear implant candidacy to include patients with greater degrees of residual hearing.

Abstract ID: 168
Poster Number: 3
Title: Examining Speech and Language Characteristics in a Cohort of Children with Cochlear Implants and Childhood Apraxia of Speech
Authors: Becky Baas, M.A., Ruth Stoeckel, Ph.D., Taylor Brown, M.A.; Mayo Clinic, Rochester, MN.
Abstract: INTRODUCTION
The prevalence of developmental disabilities, including speech and language impairments, in children with cochlear implants has been estimated at 30-40% (Wiley, et al, 2005; Birman, et al, 2005). In the retrospective review of cochlear implant patients with GJB2 mutation, childhood apraxia of speech (CAS) was listed as a characterized disability (Wiley, 2006). There has been limited mention of CAS in the
pediatric cochlear implant literature, yet accurate diagnosis and treatment of motor speech disorders greatly impacts the outcome of verbal communication skills.

METHODS
Patients were seen at a healthcare facility with a reputable cochlear implant program and an international reputation for expertise in motor speech disorders. The authors reviewed records from 2008 and 2015 and identified a cohort of children with cochlear implants who also had been given a diagnosis of CAS at the facility. These children were seen initially between 1 and 6 years of age and several had been followed for many years.

RESULTS
This presentation will review and describe this cohort based on age of diagnosis of CAS, receptive and expressive language abilities, phonologic and motor speech characteristics and treatment considerations.

CONCLUSION
Through accurate diagnosis of motor speech disorders in children with cochlear implants, we may improve the rehabilitative outcomes of their communication skills. This co-occurrence of CAS impacts how we provide intervention and prioritize goals.

REFERENCES

Abstract ID: 177
Poster Number: 61
Title: Morphological Basis for Cochlear Implantation
Authors: dragoslava D. djeric, Full professor of University ORL Clinic, Med. Faculty Univ. of belgrade, belgrade, Serbia.
Abstract: Cochlear implantation is an effective procedure for restoring hearing capacity to individuals with severe-to-profound hearing impairment. Since the development of cochlear implantation in the 1960s, both the surgical technique and the implant design have been modified to reduce complication and allow better functional results.
The classical technique for placing cochlear implant (CI) involves mastoidectomy and posterior tympanotomy. However, only few alternatives to this classic approach have been described in the literature. The suprameatal approach was developed by Kronenberger et al. in 1999. This method is a simple and safe surgical procedure that does not endanger the facial nerve and the chorda tympani. The purpose of the present paper is to report the results of our study of anatomical variation and relations of the middle ear on the large collection of the temporal bones. Attention was paid to the structures and landmarks which are important for CI.
In the mastoid region we examined and precisely defined: the type of pneumatization, the position of the sigmoid sinus, the course of the mastoid segment of the facial nerve and the facial recess. We noted great variability in the course of the facial nerve through its mastoid segment. The nerve bifurcation distal to the second genu was found in two cases. Dehiscence in the bony covering of the facial nerve were observed adjacent to the facial recess. Variations in the location of the chorda tympani nerve were also described.

In the area of the attic we described the morphological variations of the medial and lateral compartment and their communication with the other middle ear spaces. The compartment of the attic varies in shape and dimensions, depending upon the position of the auditory ossicles (the body of the incus and the head of the malleus) in relation to the attic walls, the degree of prominence of lateral semicircular canal and the direction of the course of the tympanic segment of the facial canal. Knowledge of the morphological relations and variations is important for classical and alternative surgical method for cochlear implantation.

Abstract ID: 179
Poster Number: 20
Title: Bilingualism and Infancy Hearing Loss: Relationship between First Language and Italian Language Evolution in a Group of Children with Hearing Aids and/or Cochlear Implants
Authors: Maria Consolazione Guarnaccia, ENT- Doctor in Audiology1, Lucia Botti, Speech Therapist1, Patrizia Formigoni, Doctor in Audiology2, Elisabetta Genovese, ENT and Doctor in Audiology3; 1ENT Dept, Hospital of Modena, Univ. of Modena, Modena, Italy, 2Reggio Emilia Hosp., Reggio Emilia, Italy, 3Dept of Diagnostic Medicine, Clinical and Health Publicc, Hospital of Modena, Univ. of Modena, Modena, Italy.
Abstract: Introduction: The purpose of this study is to observe the development of the native language (L1) in bilingual deaf children and to examine the relationship between L1 and Italian language (L2), taking into account different exposure times for each language.
Methods: We evaluated 13 children with bilateral preverbal sensorineural hearing loss. All children were submitted to early hearing aids (HA) and/or underwent to a cochlear implant (CI) depending on the degree of hearing loss (HL). A cross-cultural linguistic interview, “IL.B.S.B.”, created for deaf children, was combined with the MacArthur-Bates Communicative Development Inventory (CDI) to compare the acquisition of L1 and L2. It has been explored the linguistic exposition influences in both languages. The gap between the age of the child at the MacArthur inventories and the age related to the child’s linguistic performance was evaluated. The skills achieved in the second language were compared with the control sample, consisting of thirteen monolingual Italian deaf children.
Results: From a comparison of the linguistic competence reached in L1 and L2 in bilingual deaf children, there’s no statistically significative differences. The qualitative analysis, regarding the acquisition of L2, has showed that all children exposed to L1 within their family have achieved a vocabulary and sentence comprehension performance in Italian that is better than the average performance of the group mainly exposed to L2 within their family. The vocabulary production of L2 is similar in both groups. The abilities achieved in L1 seem to support the L2 acquisition (the language in which the child attend to the speech and language habilitation and education).
Conclusion: The IL.B.S.B., has proven very useful to gather information on times and exposition to the two languages in a structured method. The analysis of the L2 development within our sample of deaf bilingual children with early intervention shows a more adequate development of the L2 when L1 (mothertongue) is sustained in the familiar environment.
Abstract ID: 181
Poster Number: 59
Title: Anaesthesia During Mono and Binaural Cochlear Implantation in Children before 12 Months of Age
Authors: Simona Maria Cozzi, PhD1, Erika Adale, MD1, Bulgheroni Rosella, MD1, Luca Guzzetti, MD1, Fabio Marangoni, MD1, Selmo Gabriele, MD1, Salvatore Cuffari, MD1, Giulio Minoja, MD1, Gregorio Ugazio, MD2, Eliana Cristofari, MD PhD2;
1Anaesthesia and intensive care unit, Asst-settelaghi Varese, Varese, Italy, 2ENT audio-vestibology unit, Asst-settelaghi Varese, Varese, Italy.
Abstract: Introduction: Mono and binaural cochlear implantations are a complex surgical interventions performed in specialized centers and the procedures are conducted under general anesthesia. Many babies have significant comorbidities related to prematurity and coexisting genetic diseases. Despite the young age and relative congenital comorbidities the cochlear implantation anaesthesia is safe. All the patients are followed by audiovestibology unit and in the early postoperative period at general intensive care unit if necessary. Our experience reveals that the surgical and anaesthetic risks are similar to that expected with older pediatric and adult patients
Methods: We have analysed 50 patients before 12 months of age, who underwent to cochlear implants (27 binaural). Operative time, anesthesia time, time in the postoperative anesthesia care unit, and length of stay were also assessed. In our clinical practice, children are followed from audiovestibology center before being inserted in the operating statement. Following a shared process the surgeon and the anesthesia team guarantying the optimization of all preoperative procedures. All babies are followed by anaesthesist from preoperative diagnostic procedure, as sedation for MRI, to the post postoperative period. The infants with their parents visit, before the surgical procedure, the surgical area. The preoperative evaluation follows the intra-hospital pathway and the family receives all the preoperative instructions for fasting and medications. In according with their comorbidities they receive preoperative sedation with oral midazolam 0.3-0.5 mg / kg and local anesthetic cream on the dorsal side of the hands and on forearms. We encourage the parent presence during induction of anesthesia and all babies could carry an object as their “linus’s blanket” into operating theatre. We use audiovisual helping during placement of venous access, otherwise for babies with expected difficult venous access we choose a sevoflurane induction through mask ventilation. Anesthesia maintenance is through continuous infusion of propofol and remifentanil or through halogenated gases and opioids. Endovenous paracetamol is given as postoperative analgesia and, according to postoperative pain scale, we usually use opioids as dose rescue. The postoperative period is managed into the ward or in the intensive care unit for the first 12 hours. We usually register the intraoperative data (surgical and anesthesiological data) and several discharge success data as length of stay, postoperative vomiting and nausea onset, surgical or anaesthesia related complications.
Results: The average age is 10 months. The intrahospital length of stay is 36 hours and the patients admitted to the ICU are 5. None patients developed intraoperative or postoperative complications.
Conclusion: The age of the patient and the anesthesiologist pediatric experience are the main relevant challenges. Our experience reveals that is important for all the surgical equipe (surgeon and anaesthetist) to discuss all the possible difficulties highlighting the hemostasis technique, the intraoperative drugs pharmacokinetics and the cardiopulmonary reserves in young pediatric patients. In conclusion, early implantation is feasible considering all variables involved in the decision making.
process and anaesthesia for cochlear implants in children can be safely carried out in a district general hospital setting.

Abstract ID: 183
Poster Number: 11
Title: Evaluation of Unilateral Cochlear Implant Outcomes in Pre-Lingual Children
Authors: Guilherme Crespo, MD, Raquel Vasconcellos, MD, Fernando Rodrigues, MD, Felippe Felix, MD, PhD, Shiro Tomita, MD, PhD, Francisco Osterne, MS; Otolaryngology, Federal Univ. of Rio de Janeiro, Rio de Janeiro, Brazil.
Abstract: Introduction: Brazilian Public Cochlear Implant Program provides only one Cochlear Implant (CI) per patient. Using standard questionnaires, the aim of this study is to evaluate the success of unilateral CI with language development in pre-lingual deaf children and satisfaction among their families after at least 1-year follow up from implantation.
Methods: Retrospective study performed submitting legal representatives of CI patients to outcome questionnaires - the Infant-toddler Meaningful Auditory Interaction Scale for pre-lingual 4-year-old children and younger; as well as the Meaningful Auditory Interaction Scale for older than 4 years of age pre-linguals. Other information gathered separately was with regards to negative life changes brought after cochlear implantation; and in respect to the wish of getting CI for the other ear if it were to be offered.
Results: Considering the participating patients in this study, 100% of the legal representatives referred there wasn’t any negative life changes after cochlear implant surgery; 81,8% said they would like to implant the contralateral ear, 9,1% said they would not, and 9.1% could not answer this question at this time. All patients with pre-lingual deafness attended speech therapy sessions for hearing training. According to the questionnaires applied to evaluate outcomes, the average score encountered was 30.5 out of 40 points, while only 18,2% of these patients scored less than half of the possible points.
Conclusion: After analyzing our results, both objective and subjective collected data can be considered outstanding. Most patients showed impressive benefits regarding not only functional aspects of hearing, but also satisfactory language development after 1-year follow up and longer periods.

Abstract ID: 184
Poster Number: 201
Title: Consideration of Age at Implantation on Cochlear Implant Programming
Authors: Meredith A. Rooth, AuD1, English R. King, AuD2, Ellen Deres, AuD2, Andrea Bucker, AuD2, Sarah McCarthy, AuD2, Margaret Dillon, AuD1; 1Otolaryngology/Head & Neck Surgery, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC, 2Audiology, UNC Healthcare, Chapel Hill, NC.
Abstract: Introduction: Cochlear implant coding strategies differ in what speech information is coded and how it is presented to the listener. The specific coding strategy selected may influence a cochlear implant recipient’s speech perception. Of the multiple coding strategies available, there is not one coding strategy that consistently demonstrates improved performance. Performance between coding strategies may be influenced by patient variables, including age at implantation. The present report explored the potential relationship between age at implantation and coding strategy on early speech perception outcomes.
Methods: Speech perception was assessed during the first six months of device use between two cohorts who listened exclusively to one of three coding strategies. The two cohorts differed by age at implantation. The speech perception test battery included CNC words in quiet and AzBio sentences in quiet and noise (10 dB SNR). Performance was compared between groups and between coding strategies.

Results: All subjects experienced an improvement in speech perception within the first 6 months of cochlear implant use as compared to preoperative performance with conventional amplification. Differences between age groups and coding strategies were noted.

Conclusion: Contemporary coding strategies may enhance postoperative speech perception abilities. However, age at implantation may warrant consideration when programming cochlear implant recipients at initial activation. A better understanding of the interaction between age at implantation and speech perception with individual coding strategies is needed to optimize individual programs and improve performance across the age spectrum.

Abstract ID: 186
Poster Number: 43
Title: Language Outcomes in Children Following Cochlear Implant Revision Surgery
Authors: Ksenia A. Aaron, M.D.1, Laurie S. Eisenberg, Ph.D.2, Laurel M. Fisher, Ph.D.2, Karen C. Johnson, Ph.D.2, Christine M. Mitchell, Sc.M.3, Elina Kari, M.D.1; 1USC Tina and Rick Caruso Department Otolaryngology-Head and Neck Surgery, Keck Sch. of Med. of USC, Los Angeles, CA, 2USC Caruso Family Center for Childhood Communication, Keck Sch. of Med. of USC, Los Angeles, CA, 3Department of Epidemiology, Johns Hopkins Bloomberg Sch. of Publ. Health, Baltimore, MD.
Abstract: Introduction: Cochlear implant (CI) device failure, although a rare complication, can disrupt communication development in pediatric recipients due to progressive or sudden interruption to the access of sound. Although revision outcomes have been reported, most studies only look at short-term revision outcomes and emphasize detection thresholds and speech perception scores. To our knowledge, none have tracked pediatric spoken language longitudinally both pre- and post- CI revision surgery. Our primary aim is to characterize CI revision surgery in a large, nationally representative, prospective cohort study, and to examine the effects of revision CI on spoken language outcomes.
Methods: Data from participants enrolled at six tertiary academic CI centers, were analyzed. The children (n=188) received their initial CI between 2002 and 2004, and 102 went to received a CI in the contralateral ear. Here, we examine data on revision surgeries and language standard scores (SS) from the Verbal Comprehension Scale of the Reynell Developmental Language Scales and the Core Composite score on the Comprehensive Assessment of Spoken Language.
Results: Of the total ears implanted (n=290), 27 revision CI surgeries occurred (9.3%) between 2002 and mid-2015: 20 ears required one revision, 2 ears needed two revisions, and 1 ear necessitated three revisions. Of the 23 participants with at least one revision, 6 participants were re-implanted prior to any post-CI assessments and therefore, are not further described. All participants scored below normal (SS<85) at the pre-CI (baseline) assessment. Post-CI, pre-revision language scores from the visit immediately prior to the first revision surgery (mean=0.7 years earlier) were classified as either below normal (n=12) or within the normal range (SS 85-115; n=5). The average time from the baseline surgery to the first revision was 5.1 years (range: 1.0-11.9). Participants have been followed for post-revision language outcomes for an average of 2.9 years (range: 0.3-7.1) to date (follow-up is ongoing). In 9 participants’ post-revision language scores remained below normal, 5 remained in the normal range,
and 3 improved from below normal to within the normal range. No clear patterns in etiology of deafness, imaging results, or surgical complications were observed among participants with revisions. Conclusions: The overall revision percentage of 9.3% for this multicenter study is in line with other single-site studies in children (range 2.9-12.9%). Longitudinal data on spoken language skills have not previously been reported for children undergoing revision surgery following CI device failure. Despite individual variability, these results offer insights into pre- and post-revision language outcomes. Notably, language scores remained stable or improved post-CI revision surgery. Ultimately, reimplantation should be carried out with minimal delay to help maintain and improve the trajectory of language outcomes.

Abstract ID: 196
Poster Number: 206
Title: Preoperative Audiological Data as a Predictor of Cochlear Implant Hearing Thresholds after Six Months of Device Activation in Children Younger than Five Years
Authors: Julia S. C. Chiassi, BSc, Fabiana Danieli, MSc, Miguel A. Hyppolito, PhD; Dpto Oftalmologia, Otorrinolaringologia e Cirurgia de Cabeça e Pescoço, Univ.e de São Paulo, Ribeirão Preto, Brazil.
Abstract: Introduction: Predicting cochlear implant outcomes in young children is still a challenge for clinicians. This uncertainty may influence the indications for surgery and candidacy criteria. Therefore, finding preoperative indicators of good cochlear implant prognosis is fundamental for taking evidence-based decisions. The aim of this study was to determine if the preoperative audiological information can predict audiological thresholds with the cochlear implant, in a short-term evaluation in children.
Methods: 47 children with a profound prelingual hearing loss, aged between one and five years old, were studied. Preoperative audiological testing included aided, and non-aided pure-tone audiometry mean threshold (aPTA & naPTA); auditory brainstem response threshold - click stimuli (ABR), and auditory steady state response mean threshold (ASSR). All children had absent otoacoustic emissions and normal cochlear MRI results. Postoperative hearing thresholds were measured with the cochlear implant in field audiometry after a mean of 7.2 (SD=2.1) months of surgery, i.e., about six months after cochlear implant activation. Biological and social data were also assessed to dismiss confounding variables and include essential cofactors, namely, gender; age at hearing loss and CI; etiology; family income and educational level; and speech therapy attendance. A screening analysis of the biological and social variables was conducted for model fitting. For statistic correlations a confidence interval of 95% and the significance level of 0.05 were adopted.
Results: "age at implant" was the only biological factor correlated to cochlear implant hearing thresholds (p-value=0.02), being included in the model aside to audiological data, providing it with more reliability. The complete model including all four audiological evaluations plus the age at implant showed there is a significant correlation between preoperative testing and cochlear implant hearing thresholds (p-value=0.01) with a correlation of 28.6%. The individual significance analysis of each variable obtained the following p-values: naPTA = 0.04; aPTA = 0.69; ABR = 0.85; ASSR = 0.18; age at implant = 0.01. A model comprising only the two significant variables - naPTA & age at implant - was able to predict 24.1% of the cochlear implant hearing thresholds (p-value=0.00; odds ratio= 6.96).
Conclusion: Preoperative audiological data, mainly from thresholds on non-aided pure-tone audiometry, was a significant predictor of cochlear implant thresholds in the first six months after implant activation. Age at implant was a major cofactor to this model.
Abstract ID: 197
Poster Number: 195
Title: Speech Comprehension Abilities of Adults Receiving Bilateral Cochlear Implants During Childhood: How do they Perform in Difficult Hearing Situations Especially in Background Noise?
Authors: Kristen Rak, Priv.- Doz. Dr med., Sebastian Schraven, Priv.- Doz. Dr med., Maria Koeping, Dr. med., Rudolf Hagen, Prof. Dr. Dr. h.c., Wafaa Shehata-Dieler, Prof. Dr. med.; Department of Oto-Rhino-Laryngology, Plastic, Aesthetic and Reconstructive Head and Neck Surgery and, Univ. of Wuerzburg, Wuerzburg, Germany.
Abstract: Introduction: In 1996 the first bilateral cochlear implantation (CI) has been performed for bilateral hearing rehabilitation. This brought about a significantly better speech comprehension, especially in difficult hearing situations. Since 1998, children have also been implanted bilaterally, either sequentially or simultaneously. The children have shown a rapid, very satisfying hearing and language development. Meanwhile, some of these early implanted children already are adults. The question came up, how long term speech comprehension abilities of this population are? Emphasis of this evaluation was the enhancement of speech comprehension abilities by the bilateral use and the scores in background noise, since bilateral use of the CI should bring most benefit in this situation.
Methods: Speech audiometric results of early bilaterally implanted patients elder than 18 years now were evaluated. For this purpose, a retrospective data analysis of the available audiological data sets was carried out.
Results: 46 patients of bilateral CI users fulfilled the inclusion criteria. The mean age of implantation was 8.6 years and the current age was 21.7 years. With the single CIs 66.1% of the presented Freiburger monosyllabic words were correctly understood at 65 dB, whereas at 80 dB 71 %. With the bilateral CI the values enhanced to 69.0% and 77.1%, respectively. The average score on the Hochmair-Schulz-Moser sentence test in quiet was 84.1% and at 10 dB SNR 70.3% with bilateral CI.
Conclusion: The data show that bilaterally implanted children age have a very satisfactory speech comprehension up to the adulthood. Especially in difficult hearing situations like noise, the young adults with bilateral CIs had excellent speech comprehension abilities.

Abstract ID: 199
Poster Number: 30
Title: Development of a Parenting Stress Module for Caregivers of School-Age Children with Cochlear Implants
Authors: Alexandra L. Quittner, PhD1, Michael F. Hoffman, MS2, Ivette Cejas, PhD3; 1Behavioral Hlth. Systems Res., Miami Beach, FL, 2Psychology, Univ. of Miami, Coral Gables, FL, 3Miller School of Medicine, Univ. of Miami, Miami, FL.
Abstract: Introduction: Several studies have shown that parents raising children with severe to profound hearing losses report higher levels of stress in their parenting role than parents of hearing children (Quittner et al., 2010). A condition-specific family stress scale was developed in the early 1990s, prior to the availability of cochlear implants (CIs) (Family Stress Scale, FSS; Quittner et al., 1990), which indicated that communication, discipline, safety and educational placement were among the most stressful parenting tasks. Higher parenting stress was also significantly related to language delays and behavior problems. During the development of the first CI-specific, health-related quality of life measures, focus group participants (e.g., teachers, speech pathologists, surgeons) and individual parent interviews indicated that parents experience frequent and challenging stressors unique to their child’s hearing loss.
and use of a CI. Thus, our objective was to develop a module that reliably measures this type of contextual parenting stress.

**Methods:** Focus groups consisting of health care providers (e.g., audiologists, otolaryngologists) at two cochlear implant centers and professionals at one university-based school were asked about stressors related to parenting a child with a CI. Twenty parents raising a child with a CI, ages 6 to 12 years (M child age = 9.2 years, SD = 1.87), completed a semi-structured interview lasting 45-50 minutes, which was audiotaped and transcribed for content analysis using NVivo. Nine items were generated from this first qualitative phase, with follow-up cognitive testing. During this phase, parents rated the nine items on a 4-point Likert rating scale (extent of stress or concern), with scores standardized on a 0-100 scale; lower scores indicated higher levels of parenting stress.

**Results:** Parents in the cognitive testing group were mostly mothers (90%), with 50% having completed a college degree, 85% caring for another child in the home. We recruited participants with a range of races and ethnicities (65% White, non-Hispanic; 15% African-American, 15% Hispanic, and 5% Asian). Importantly, 10% of families reported that Spanish was the primary language spoken at home. Standardized scores on the Parenting Stress Module ranged from 20.83 (high stress) to 85.19 (low stress), with an average score of 58.33. Parents’ highest rated stessors included: 1) CI/s breaking; 2) CI/s getting lost; 3) child hurt during sports.

Discussion: Qualitative data from healthcare professionals working with school-age children with CIs, and parents who were raising them, reported a number of specific stressors affecting the parenting role. Nine items were generated and rated by caregivers in 20 families at two cochlear implant centers, yielding a wide range of parenting stress scores. Themes included decisions about educational placement, CIs breaking or getting lost, and the reactions of others to the child’s CI/s. Next steps include psychometric evaluation of its reliability and validity. A well-validated parenting stress measure, which takes less than 5-minutes to complete, could be both a key outcome measure to assess family adaptation to school-age children’s use of CIs and a clinically useful measure to guide and evaluate parent-child interventions in this population.

**Abstract ID:** 201  
**Poster Number:** 111  
**Title:** Challenging Situations in Bonebridge Implantation  
**Authors:** Robert Trotic, MD, PhD1, Mihael Ries, MD, PhD1, Jakov Ajduk, MD, PhD1, Iva Kelava, MD1, Andro Kosec, MD1, Dalibor Matkovic, bacc. physioth.2;  
**Abstract:** **Introduction:** The Bonebridge is transcutaneous bone conduction hearing implant system, which provides a valuable and stable audiological benefit to patients suffering from conductive or mixed hearing loss and single sided deafness.  
**Methods:** Bonebridge may be implanted through three different approaches: the transmastoid, the retrosigmoid, or the middle fossa approach. nd:white’aa valuable and stable audiological benefit to patients suffering from conductive or mixed hearing loss and single sided deafness.  
**Results:** Challenging situations can be skin reaction, skin growth over the abutment, dura, sigmoid sinus or some other anatomical structures injuries, and wound infection.  
**Conclusion:** The Bonebridge offers a lower complication rate to percutaneous systems and higher and more reliable hearing gain compared to other transcutaneous or percutaneous systems.
Abstract ID: 203
Poster Number: 45
Title: The Role of Post-operative Antibiotics Following Cochlear Implantation
Authors: Galit Almosnino, MD1, Daniel Zeitler, MD2, Seth Schwartz, MD, MPH2;
1Neuroscience Research Institute, Virginia Mason Med. Ctr., Seattle, WA, 2Department of Otolaryngology, Virginia Mason Med. Ctr., Seattle, WA.
Abstract: Introduction: Post-operative antibiotics following cochlear implantation are widely used. There are no existing prescribing guidelines for surgeons and there is limited and inconclusive data in the existing literature on the benefit. The use of antibiotics when there is no proven positive effect increases cost of care, can contribute to antibiotic resistance and increases the risk of medication side effects. In this retrospective case-control study, we evaluated the outcomes of cochlear implant patients who received post-operative antibiotics versus patients who did not.
Methods: This was a retrospective case-control study in a tertiary referral teaching hospital. All patients undergoing cochlear implantation by both surgeons at our institution between 2013-2016 were identified by CPT codes. We identified 151 patients. Fifteen patients were lost to follow up and excluded from the study. Patient age ranged from 9 months - 91 years. A minimal access incision, tight periosteal pocket approach, and a single intraoperative dose of IV antibiotics was used in all patients. Starting in 2015, one surgeon stopped prescribing post-operative antibiotics. We compared infection rates in a control group that received antibiotics in the 18 months prior to this change by that surgeon (n=95) to the cohort of patients that did not receive post-operative antibiotics (n=36). In a second analysis, 20 patients that received cochlear implants with post-operative antibiotics by the second surgeon were compared to the 36 patients who did not receive post-operative antibiotics during the same time frame.
Results: None of the 36 cases and none of the 95 historic controls nor 20 concurrent controls experienced post-operative infection.
Conclusion: In this small sample, post-operative antibiotics following cochlear implantation did not impact infection rates in the peri-operative period. Post-operative antibiotics may offer no benefit while leading to resistance, allergy, cost, and other side effects. This pilot study should encourage surgeons to re-evaluate standard practice around antibiotic use after CI surgery.

Abstract ID: 207
Poster Number: 219
Title: Parental Psychosocial Experiences in Pediatric Hearing Healthcare: A Qualitative Analysis
Authors: Diana Bigler, BS1, Meagan Pilar, MPH2, Allison Merritt, BS2, Julie Jacobs, MPH2, Matthew Bush, MD3, Christina Studts, PhD2;
1Univ. of Kentucky Coll. of Med., Lexington, KY, 2Department of Health, Behavior, & Society, Univ. of Kentucky Coll. of Publ. Health, Lexington, KY, 3Department of Otolaryngology - Head and Neck Surgery, Univ. of Kentucky, Lexington, KY.
Abstract: Introduction: For parents of children with hearing loss, fragmentation of services is challenging to navigate. Within the hearing healthcare system, parents must coordinate multiple encounters with clinicians, therapists, and other team members. Parents may lack access to necessary medical information and social support to navigate this complex process, leading to anxiety and social isolation. The objective of this research was to investigate the psychosocial experiences of parents of children with hearing loss during the diagnostic and treatment process using a qualitative approach.
Methods: One-hour semi-structured key informant interviews (N=20) with parents of children with cochlear implants, hearing aids, or both were audio-recorded and transcribed. Five research team members reviewed transcripts and developed an initial codebook to identify recurring psychosocial themes (i.e. anxiety, isolation). Two research team members completed sample coding, with interrater reliability exceeding 80% for all codes. Each transcript was then coded by a primary coder and reviewed for agreement by a second coder. Discrepancies were resolved by coder discussion. Representative quotations for codes were compiled and assessed by the full research team to identify connections between psychosocial and clinical experiences in hearing healthcare.

Results: The majority (85%) of parents and children were non-Hispanic White. Annual household income ranged from <$20k to >$90k, and parent education ranged from high school diploma or GED (15%) to graduate education (over 30%). Most parents (90%) were biological mothers of the children. Age of children was equally distributed (2-5) and just over half (60%) were male. Half of children had hearing aids and half had cochlear implants; most (65%) had bilateral auditory rehabilitative devices. Parent experiences differed between two distinct groups: (a) proactive, well-resourced parents, and (b) overwhelmed, under-resourced parents. The proactive parents were strong advocates and described ample family support and resources. In contrast, the overwhelmed parents described feelings of isolation, either in reference to social support or lack of information. In both groups, parents attributed success in gathering information to financial resources or to their own health literacy, rather than to guidance from hearing healthcare providers. Parents frequently described feeling overwhelmed or misunderstanding the significance of the diagnosis or treatment and frustration with perceived lack of guidance and empathy from healthcare providers.

Conclusion: Some parents of children with hearing loss report negative psychosocial experiences in navigating the hearing healthcare system. The effect of these experiences on auditory rehabilitation is unknown. Integrated psychosocial interventions to expand information and support, such as clinically facilitated support groups, could reduce isolation and frustration in this patient population.

Abstract ID: 210
Poster Number: 104
Title: Pediatric Patients with Cochlear Implants: A Qualitative Study on the Obstacles to Full-time Utilization
Authors: Paula A. Tellez, MD1, Frederick K. Kozak, B.Sc., MD1, Ruth Chia, BA MSc RAvd1, Julie Pauwels, MSc1, Grace S. Yi, Md candiate2; 1OTOLARYNGOLOGY, BC CHILDREN’S HOSPITAL, VANCOUVER, Canada, 2UNIVERISTY OF BRITISH COLUMBIA, VANCOUVER, Canada.

Abstract: Introduction: While many cochlear implant patients use their CI full-time, some do not. The aim of this study was to determine by means of parental interview, the reasons why full-time use did not take place and why.

Methods: A retrospective chart review of pediatric patients who received a cochlear implant at our institution between January 1, 1989 and May 31, 2014 and who have been using the CI for a minimum of two years revealed that 35/150 patients were potential part-time or non-users. A telephone/in-person survey was conducted with the parents or caregivers of those identified as less than full-time or non-users to assess the reasons why.

Results: Thirty (85.6% response rate) patients completed the interview process, and 5/30 were found to be full-time users. Of the remaining 25 partial or non-users, 15 patients had a unilateral CI, of which 3 were non-users and 12 were partial users. Ten/25 had a bilateral CI: 3 bilateral simultaneous CI
recipients were part-time users of both CIs, 6 bilateral sequential CI recipients were full-time users of their first CI and partial or non-users of the second CI, and 1 patient was a non-user. The most common reasons cited by parents for less than full-time use included: fatigue from the effort of listening (9/30, 30%), additional medical needs (9/30, 30%) including autism (4/30, 13%), lack of appropriate school classroom support (10/30, 33%) and a perceived lack of benefit (11/30, 37%). Forty-four percent of parents reported negative reactions such as staring, comments or harassment from others; however only 3% reported that this affected their child’s CI use.

**Conclusion:** Reasons for limited CI use in pediatric patients are diverse and often multifactorial, ranging from physical limitations to psychosocial factors and limited community/school support. Counseling families on the obstacles to full time CI use and the realistic expectations for CI benefit in complex needs patients should be considered. Additionally, a lack of appropriate classroom support highlights the need for more community advocacy.

**Abstract ID: 212**
**Poster Number: 81**
**Title:** Cochlear Implantation in a Child Diagnosed with Fascioscapulohumeral Muscular Dysphagia
**Authors:** Young Ho Kim, MD, PhD
OTORHINOLARYNGOLOGY, SEOUL NATIONAL UNIVERSITY BORAMAE MEDICAL CENTER, SEOUL, Korea, Republic of.

**Abstract:** **Introduction:** the facioscapulohumeral muscular dysplasia have symptoms and signs of muscle weakness, such as facial muscle weakness, shoulder weakness, abnormal heart rhythm, weakening of the biceps, triceps, deltoids, and lower arm muscles, loss of strength in abdominal muscle, and foot drop. Furthermore, hearing loss was reported in some patients with this disease. In this study, we reported the clinical characteristics and cochlear implantation (CI) outcome of the patient who had profound hearing loss and facial nerve palsy, and was diagnosed with this disease.

**Methods:** we retrospectively review the clinical information about the patient who had visit our clinic with the symptom of sensorineural hearing loss and facial nerve palsy at both side.

**Results:** Three-year old boy visited with bilateral sensorineural hearing loss and bilateral facial nerve palsy. His new-born hearing screening test showed bilateral failure and auditory brainstem response test 4 months after birth revealed 45dB on right and 55dB on left. He started bilateral hearing aids 16 months after birth and bilateral facial nerve palsy (FNP) was found 23 months after birth. On physical examination, the patient with FNP of House-Brackmann grade IV had symptoms of winging scapula, lumbar lordosis, and absent pectoralis minor suggesting Poland syndrome. Chromosomal study, temporal bone CT, and internal auditory canal MRI showed all normal findings. Pure tone audiogram demonstrated bilateral sensorineural hearing loss with residual hearing at low frequencies and ABR 55dB/85dB on right and 95dB/95dB on left at 1 and 3 kHz. There were latency delay and amplitude decrease of end point of bilateral facial nerve on electromyography of facial muscle. Language developmental study performed at age of 4 showed CAP score 4 and sentence score (audiovisual) 30%, and language age was delayed 6 months. His speech discrimination was poor despite use of bilateral hearing aids so that left cochlear implantation (CI) was done at age of 6. Electrode was inserted fully using round window approach. Postoperative NRT was all normal at 22 channels and transorbital view showed a well-positioned electrode in cochlea. Postoperatively, hearing thresholds at low frequencies on the left ear were preserved well. Preoperative, postoperative 3 and 6 months CAP score/sentence score were 4/40%, 6/83%, and 6/100%. He is using left CI and right hearing aid well without conversation problem.
Conclusion: The patient who was diagnosed with fascioscapulohumeral muscular dysplasia showed good CI outcome. On the basis of these results, CI at the counter side is also being planned.

Abstract ID: 216
Poster Number: 210
Title: The Outcome of Domestic Cochlear Implants in Prelingual Deafness Children
Authors: Wei Lu, MD,PhD
The First Affiliated Hosp. of Zhengzhou Univ., Zhengzhou, China.
Abstract: Introduction: To investigate the development of auditory and speech skills and the security and stability among the prelingual deaf children with Nurotron Venus cochlear implants.
Methods: 78 cochlear implant subjects were recruited from the first of affiliated hospital of Zhengzhou university. Subjects were divided into 5 groups according to the age at the time of implantation.: group A(between 13 and 24 months), group B(between 25 and 36 months), group C(between 37 and 48 months), group D(between 49 and 72 months), group E(between 73 and 96 months). The auditory and speech skills was judged by (IT)MAIS/MUSS questionnaires. Post-operative cochlear radiograph determine the position of cochlear. Following up the complication and usage of cochlear.
Results: The auditory and speech ability of children with CIs improved constantly. The auditory and speech of different groups was statistically significant. All the surgery of 78 cases Nurotron-Venus cochlear implants were successful. Post-operative cochlear radiograph showed electrode in normal position. 2 cases with processor failure. The remaining CIs were implanted completely. The ability of auditory is related to speech.
Conclusion: With 1 year the ability of auditory and speech improved gradually. The score of auditory and speech about the small age groups is lower than older children in the early days. There was no influence on auditory in 12 months. Small children’s score of speech is lower than older children in 12 months. The better ability to integrate auditory information, the better the ability to speech. The Nurotron CIs works safety and effectively.

Abstract ID: 219
Poster Number: 100
Title: Surgical Complications and Morbidity in Cochlear Implantation.
Authors: Ihab K. Sefein, Sr., MD, Assistant professor of Otolaryngology
ENT Department, The Natl. Egyptian Hearing and Speech Inst., Cairo, Egypt.
Abstract: Introduction: Cochlear implantation (CI) has been established worldwide as the surgical treatment for individuals with bilateral severe to profound hearing loss. This is a safe and standard procedure in the hands of experienced implant surgeons. Complications due to surgery are minimal and are often encountered in cases with congenital anomalies of the temporal bone and inner ear.
Methods: All patients receiving cochlear implants at our institution between 2014 and 2015. Our aim was to report the frequency of surgical complications following 112 consecutive CIs in 102 children and 10 adults in the National Hearing and Speech Institute Cairo-Egypt. The international consensus on the reporting of cochlear implant complications proposed by Hansen et al. [5] was used and evaluated.
Results: In all, 112 implantations were performed in 102 Pediatric & 10 adult patients. Overall, complications occurred in 21 patients (18.75%), including major complications in 12 (10.71%) and minor complications in 9 (8.03%) cases. Complications were delayed in 9 (8.03%) of these cases. No death was attributed to device implantation. Major complications occurred in 12 cases included: misplaced electrodes in 2 cases, A cerebrospinal fluid leak (Gusher) in 4 cases, Labyrinthitis ossificans in 1 patient, magnet displacement in 1 case, (CSOM) Central perforation in 1 case, seroma and hematoma (Severe cutaneous infections) in 1 case, Wound infection in 1 case and Persistent pain/discomfort (Migration) in 1 case.

Conclusion: Complications of CI in children are common than adult with trauma as a major factor. Inner ear malformations should prompt specific preventive management. Cochlear implantation in young children did not appear to be a risk factor in this study.

Abstract ID: 221
Poster Number: 5
Title: Optimizing the Benefit of Cochlear Implant Processors for Sound Localization
Authors: Daniel Beaudoin, M.O.A1, Marie-Soleil Houde, M.Sc.S.(A)2, Julie Dufour, M.O.A.1, Francois Champoux, Ph.D3;
1CIUSS Ctr. Sud de l’île de Montréal, Montreal, Canada, 2CISSS des Laurentides, St-Jérôme, Canada, 3École orthophonie et audiologie, Université de Montréal, Montreal, Canada.

Abstract: Introduction: Several studies have successfully linked cochlear implant (CI) processor parameters configuration with increased speech perception. More specifically, it has been suggested that medium to high stimulation rates allow for better extraction of temporal acoustics information than low stimulation rates. This process of temporal extraction is a crucial step in speech perception. However, the impact of a change in CI processor parameters configuration for other processes underlying auditory scene analysis remains unexplored. The main objective of this study is to present the impact of a change in CI stimulation rates on auditory localization in the horizontal plane for bilaterally implanted post-lingually deafened individuals.

Methods: A certified audiologist programmed four electrical stimulations rates of 250, 900, 1800 and 2400 pps in an initial session for each participant. Mapping the device at a comfortable level using T- and C-levels controlled sound loudness level. Stimulation mode was monopolar (MP)+1 for all four conditions with a maxima of 8 and a pulse width of 12-25 μs. The number of active electrodes was kept constant across conditions. The behavioural effect of the modification was assessed using a sound localization task.

Results: Results suggest that an increase of CI stimulation rate can effectively improve sound localization.

Conclusion: This study provides an interesting first indication as to the benefits of modifying the parameters of CIs processors to improve sound localization.

Abstract ID: 223
Poster Number: 26
Title: CI Provision for Children of Deaf Parents
Authors: Annette Leonhardt, Professor Doctor
Lehrstuhl für Gehörlosen-, Ludwig-Maximilians-Univ. München, 80802 München, Germany.
Abstract: CI Provision for Children of Deaf Parents – A Research Programme
Poster
Annette Leonhardt

Introduction. Towards the end of the 1980s the first cochlear implantations in children were performed in Hannover (Germany). At the time, the possibility of deaf parents opting for CI for their children was virtually inconceivable, reactions ranging from restraint to vehement rejection. In the mid-nineties, however, the first cochlear implantations were carried out on deaf children of deaf parents (Begall 1995).

In 2000 the research programme entitled „CI Provision for Children of Deaf Parents“ was launched and currently comprises 7 substudies. The pilot study (2001-2004) was followed by the development of special information material on the subject of CI in children (substudy 2), specifically designed for deaf parents (2006-2009). Further substudies focus on:

• vocabulary development in both speech and sign language in these children (whereby sign language remains the family language and speech as a ‘bridge’ to the world of the Hearing. (substudy 3),
• the respective family situation (substudy 4) and interviews with young adults- who, as deaf children of deaf parents, received a CI in childhood- to determine their current feelings about CI provision. (substudy 5).

Methods
The various substudies included varying research methods as appropriate. Interviews (substudies 1, 2, 3 und 5), AWST-R (active vocabulary test for 3- 5-year-old children) or WWT (vocabulary and word finding for 6 – 10- year-olds), PERLESKO (sign language vocabulary) (substudy 4) and the family system test (FAST) (substudy 4).

Results
Cochlear implanted children of hearing impaired parents show similar development to those of hearing parents if (and only if) early and adequate contact with the Hearing world- e.g. hearing carers, or participation in a crèche, nursery school or playgroup – is guaranteed. The course of development is shown to be positive in almost every aspect.

Speech acquisition depends entirely on contact with the Hearing.
Sign language will continue to be the family language. The children are able to switch from one language to another, communicating with appropriate register.

Conclusion
The number of hearing impaired parents opting for cochlear implantation for their children is on the increase. Whereas the first CI provisions were initiated by the children themselves (in this case older nursery school children or primary school children) or in some cases encouraged by grandparents, it is now the parents themselves who take the initiative as early as possible.

A comparison of CI children of hearing parents and deaf parents will invariably yield some anomalies but many parallels can be observed.

Abstract ID: 224
Poster Number: 220
Title: Cochlear Service Point
Authors: Eliana Cristofari, MD PhD1, Enrico Violin, Aud2;
1ENT audio-vestibology unit, Asst-settelaghi Varese, Varese, Italy, 2Cochlear srl, Varese, Italy.
Abstract: Introduction: From the birth of the center of Varese Hospital Audiovestibology, the steady increase in the number of cochlear implants recipients, brought the center to handle most cases of patients with cochlear implant in Italy, highlighting high timing of assistance in case of malfunctions the device. In particular, the cochlear implant (CI) recipient was forced to come out the center and go to a private facility, then back at the service for testing the replaced components. The association Aguav (parents and users’s association audiovestibology Varese onlus) has strongly advocated the establishment of an internal service to the structure hospital that would obviate the user’s inconvenience and in particular facilitate the paperwork.

Methods: The method has used the analysis of satisfaction and the times of assistance before and after the creation of a service point within the Audiovestibology center. The project named "Service Point Cochlear" came to life in May 2014 and has reset the timing of delivery of assistance to the patient with a substantial improvement in the index of user satisfaction and the center operators. In addition, the Service Point facilitates the user in the management of administrative practices by acting as an intermediary between the user and the National Health System. Through collaboration between Hospital and private entity, the assistance also is provided on the accessories out of warranty with immediate replacement part does not work through the loans provided to you by your Audiovestibology center.

Results: The number and the quality of service to the patient pointed out a significant improvement of satisfaction and quality of assistance to the cochlear implant’s recipients. The improvement are more significant in the first year from the opening of this service.

Conclusion: In conclusion it is clear that the "Service Point Cochlear" today represents the ideal tool for the immediate management of the patient's problems that need assistance with the cochlear implant, and is the only service of its kind on a national level, within a public health facility, made possible thanks to the synergy between public and private.

Abstract ID: 226
Poster Number: 182
Title: Music Training Improves Pitch Perception in Prelingually Deafened Children With Cochlear Implants
Authors: Lieber P. Li, MD, PhD1, Joshua Chen, MD2, Ann Chuang, MD3, Catherine McMahon, PhD4, Jen-Chuen Hsieh, MD, PhD5, Tao-Hsin Tung, PhD6;

Abstract: Introduction: The comparatively poor music appreciation in patients with cochlear implants might be ascribed to an inadequate exposure to music; however, the effect of training on music perception in prelingually deafened children with cochlear implants remains unknown. This study aimed to investigate whether previous musical education improves pitch perception ability in these children.

Methods: Twenty-seven children with congenital/prelingua deafness of profound degree were studied. Test stimuli consisted of 2 sequential piano tones, ranging from C(256Hz) to B(495Hz). Children were asked to identify the pitch relationship between the 2 tones (same,higher,or lower). Effects of musical training duration, pitch-interval size, current age, age of implantation, gender, and type of cochlear implant on accuracy of pitch perception were evaluated.
**Results:** The duration of musical training positively correlated with the correct rate of pitch perception. Pitch perception performance was better in children who had a cochlear implant and were older than 6 years than in those who were aged 6 years (ie, preschool). Effect of pitch-interval size was insignificant on pitch perception, and there was no correlation between pitch perception and the age of implantation, gender, or type of cochlear implant.

**Conclusion:** Musical training seems to improve pitch perception ability in prelingually deafened children with a cochlea implant. Auditory plasticity might play an important role in such enhancement. This suggests that incorporation of a structured training program on music perception early in life and as part of the postoperative rehabilitation program for prelingually deafened children with cochlear implants would be beneficial. A longitudinal study is needed to show whether improvement of music performance in these children is measurable by use of auditory evoked potentials.

**Abstract ID:** 231

**Poster Number:** 66

**Title:** Estimating the Coupling Efficiency and Integrity of VSB Middle Ear Implant Systems Using ABR/ASSR Methods

**Authors:** Ute Geiger, M. Sc.1, Andreas Radeloff, Professor2, Waafa Shehata-Dieler, Professor1, Rudolf Hagen, Professor1, Mario Cebulla, Professor1; 1CHC, Univ.hospital Würzburg, Würzburg, Germany, 2Univ.hospital Oldenburg, Oldenburg, Germany.

**Abstract:**

**Introduction:** The Vibrant-SoundbridgeTM (VSB) is an active middle ear implant that is surgically coupled to different structures in the middle ear, depending on the type of hearing loss and the individual physiology of the middle ear. Hearing improvement is highly dependent on the coupling efficiency between the Floating Mass Transducer (FMT) and the middle ear structure. Estimating the coupling efficiency intraoperatively is particularly in patients with a bone conductive hearing loss of 30 dB HL and higher helpful to achieve adequate hearing results and avoid revision surgeries. Furthermore, in children it is challenging to test reliably the integrity of the implant, hearing degradation, and hearing outcomes after fitting with subjective tests. Currently there is no sufficient method to determine the coupling efficiency and the integrity intraoperatively. For this application we intraoperatively measured auditory brainstem responses (ABRs), while stimulating the patient via the implant.

**Methods:** A wireless streamer (Sivantos MiniTekTM) was used to transmit stimuli from the ABR system via audio processor (SambaTM) to the FMT of the implant. The ABRs were evoked by chirp-sounds, using modified broadband CE-Chirps as well as octave band chirps starting from levels above bone conduction threshold to levels below threshold. For this study, we evaluated ABRs in children and in adult VSB patients on a single patient basis.

**Results:** The ABR-thresholds were related to bone conduction thresholds and to the vibrogram to verify this new method. Overall, ABR measurements via VSB are able to determine the coupling efficiency between the FMT and the middle ear structure. Furthermore, the integrity of the implant can be tested objectively.

**Conclusion:** This method can be used to determine the coupling efficiency, the integrity of the Implant, to objectify the fitting of the VSB, and determining hearing degradation, which can be very helpful in immature or handicapped patients.

**Abstract ID:** 232
**Poster Number**: 176  
**Title**: A Short Form of the Speech, Spatial and Qualities of Hearing Scale for Use with Children: Development Stage  
**Authors**: Jennifer M. Allsopp, MSc1, Catherine F. Killan, MSc2, Paul D. Baxter, PhD3, Edward C. Killan, PhD3;  
1Faculty of Mathematics and Physical Sciences, Univ. of Leeds, Leeds, United Kingdom, 2Yorkshire Auditory Implant Service, Bradford Teaching Hosp. NHS Fndn. Trust, Bradford, United Kingdom, 3Faculty of Medicine and Health, The Univ. of Leeds, Leeds, United Kingdom.  

**Abstract**: A number of self-report questionnaires have been developed to measure cochlear implant (CI) users' hearing ability in real-world settings. For children, a modified version of the Speech, Spatial and Qualities of Hearing Scale (SSQ) is used to assess a child's hearing ability via reports from parents (i.e. the SSQ-P). The SSQ-P consists of 23 items which assess various aspects of speech perception, sound localization and identification and has been used within a range of clinical and research settings. However, clinical experience suggests that the length and complexity of the SSQ-P makes it overly time-consuming to complete, resulting in inaccurate or incomplete assessment of the child’s hearing ability. The aim of this study, therefore, was to develop a short form of the SSQ-P using statistical analyses of previously collected clinical data.  

**Methods**: Completed SSQ-P questionnaires were analysed for 66 children (32 female, 34 male) with bilateral cochlear implants given in either simultaneous (N =31) or sequential (N=35) procedures. All children were at least five years old (median age 8 years 9 months; range 5 years 3 months to 16 years 4 months). Their parent(s)/guardian(s) had fully completed the SSQ at least one year post-second cochlear implant (median test interval = 4 years, range 1 year to 5 years). Where the SSQ had been completed on more than one occasion the most recent results were analysed. Explanatory factor analysis (EFA) was used to identify latent traits within the data and confirmatory factor analysis (CFA) was used to confirm which trait each of the 23 items measured. Each item was then analysed using item response theory (IRT). Via statistical modelling, this assesses which items provide good levels of discrimination within each latent trait.  

**Results**: EFA identified three latent traits (speech, spatial hearing and qualities of hearing) within the data. CFA confirmed latent traits were measured by their corresponding items, with the exception of one speech-related item which was more closely aligned to spatial hearing. IRT analysis excluded 13 items, so that the resultant short form version of the SSQ-P comprised of 10 items, with speech, spatial hearing and qualities of hearing assessed by 4, 3 and 3 items respectively.  

**Conclusion**: A short form of the SSQ-P, the SSQ-P10, has been developed for use in clinical settings with parents of children who use cochlear implants. Validation of this questionnaire, prior to recommending its widespread clinical use, is required.

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**Abstract ID**: 233  
**Poster Number**: 52  
**Title**: Enlarged Cochlear Aqueduct and Surgical Risk of Cerebrospinal Fluid Leak: How Much is Common?  
**Authors**: Giovanni Bianchin, MD, Lorenzo Tribi, MD, Valeria Polizzi, MD, Patrizia Formigoni, MD;  
ENT department, ASMM -IRCCS Hosp. of Reggio Emilia (Italy), Reggio Emilia, Italy.  

**Abstract**: ENLARGED COCHLEAR AQUEDUCT AND SURGICAL RISK OF CEREBROSPINAL FLUID LEAK: HOW MUCH IS COMMON?  
**Introduction**: 

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The last modern radiological techniques have improved the study of the thinner inner ear structures, such as cochlear and vestibular aqueduct, that have often been suggested as a cause of sensorineural hearing loss and intraoperative cerebrospinal fluid (CSF) leak. Cochlear aqueduct (CA) is a small bony canal in the temporal bone that connects the subarachnoid space of the posterior fossa to the basal turn of the cochlea. As well defects in the bony partition of the fundus of the internal auditory canal, malformations of the cochlear and vestibular aqueduct have also been suggested as a cause of perilymphatic gusher following stapes surgery and cochleostomy during cochlear implant. Intraoperative CSF leak is a serious surgical complication with possibility of residual CSF fistula and a hypothetic increased risk for developing meningitis postoperatively.

Methods: Demographic, radiological and surgical results were evaluated in the case histories over the last 15 years at ENT Department, ASMN-IRCCS Hospital of Reggio Emilia (Italy). Special attention has been made on the cochlear and vestibular aqueduct malformation and their correlation with CSF leak during surgery.

Results: Our evaluation, concerning 278 cases of cochlear implant, showed that enlarged CA has an incidence of 2.16% with a percentage of intraoperative gusher observed of 83.4%.

Conclusion: Special attention should be given to preoperative imaging to predict the potential intraoperative risk of CSF leak. In our case series ECA may be the best risk predictor factor of CSF leak at cochleostomy during IC surgery.

Abstract ID: 234
Poster Number: 180
Title: Sequential Bilateral Cochlear Implantation in Children - Minimal Auditory Skills Development Expected According to Hearing Stimulation and Delay Between the Two Cochlear Implants
Authors: Mélanie Laferrière, M.O.A.1, Daniel Philippon, M.D., D.M.D., F.R.C.S. (C)2, François Bergeron, Ph.D.3, Carole Losier, M.O.A.2; 1IRDPQ, CIUSSS de la Capitale-Natl.e-IRDPQ, Québec, Canada, 2CHU de Québec-Université Laval, Québec, Canada, 3Université Laval, Québec, Canada.
Abstract: Introduction: Since 1984, the Québec Cochlear Implant Program has performed more than 800 pediatric cochlear implantations. To validate that the development of children’s auditory skills is optimized as soon as possible and be able to act quickly if the progression differs from what is generally expected, the team has developed in 2007 an observational grid specifying the minimally expected auditory development milestones at 1 month, 3 months, 1 year, 2 years and 3 years following a unilateral implantation. In 2015, a similar tool was developed for paediatric bilateral sequential cochlear implantation cases. This grid was developed from an expert consensus based on clinical experience and available scientific literature. It includes 7 indicators that specify the level of hearing abilities expected according to the experience with the devices and the delay between the two implantations (<3 years, 3-5 years, 5-7 years and 7-13 years). The aim of this project is to validate the indicators and the timeline proposed by the experts.
Methods: A retrospective review was undertaken on children’s files who underwent sequential bilateral cochlear implantation between 2012 and 2016 at the Québec Cochlear Implant Program. Auditory performances data from speech perception tests and questionnaires were retrieved at 2 weeks, 3 months, 1 year, 2 years and 3 years post-implantation. Additional information on duration of deafness in both ears, age at implantation, implantation delay and other deficits were also retrieved.
Results: 78 files were reviewed. The available data make it possible to verify four indicators from the grid: • Auditory skills in silence with the 2nd CI is similar to those with the 1st CI • Auditory skills in light noise (eg, signal-to-noise ratio of +10 dB) with the 2nd CI is comparable to those with the 1st CI • There is a binaural advantage for speech recognition in noise • There is a binaural advantage for lateralization (left-right). Preliminary analysis shows that the majority of subjects develops auditory skills in silence and in noise with the 2nd CI comparable to those observed with the 1st CI. Few subjects demonstrate a significant binaural advantage for speech recognition in noise and lateralization of sounds. Longer-term data are needed to validate these two criteria. The detailed results will be presented and discussed.

Conclusion: Bilateral cochlear implantation is becoming the standard clinical practice in deaf children and this, at an increasingly younger age. This project aim to validate the clinical decisions based on the grid and, thus, support the following clinical interventions.

Abstract ID: 235
Poster Number: 165
Title: Device Wear-Time in Pediatric Cochlear Implant Patients
Authors: Erika B. Gagnon, Doctor of Audiology, Holly F. B. Teagle, Doctor of Audiology, Lisa R. Park, Doctor of Audiology, Jennifer Woodard, Doctor of Audiology, Kevin D. Brown, MD, PhD, Carlton Zdanski, MD; Otolaryngology/Head and Neck Surgery, The Univ. of North Carolina at Chapel Hill, Durham, NC.
Abstract: Introduction: Best practice for pediatric patients with hearing loss emphasizes early diagnosis and intervention with hearing technology. Access to sound via hearing technology is crucial for spoken language development for children who are deaf. Yet, technology -wear-time is a variable often overlooked in patient outcomes. Pressing questions include how often patients utilize their technology, and how device wear time impacts language development. Datalogging, or the ability to track hearing technology wear-time, has been available in hearing aid technology, but has only recently become available with cochlear implants with the current generation speech processors. Prior studies assessing longitudinal hearing aid wear-time in children found that wear-time increased with age, except for a small percentage of patients who maintained limited device use despite the child’s age. The objective of this study is to investigate cochlear implant device wear-time by age, and compare wear-time between ears for bilateral users.
Methods: A retrospective chart review examined over 100 cochlear implant recipients with external speech processors capable of datalogging. These patients ranged in age from 0-21. Datalogging measures were obtained across single or multiple routine visits.
Results: Results reveal a wide range of wear-time across ages, with average daily cochlear implant use increasing with age. For bilateral cochlear implant recipients, a range of wear-time was seen across ears. Conclusion: Similar to hearing aid patients, children utilizing cochlear implants show increased average daily use as they age, with a portion that maintain limited device use. Now that cochlear implant audiologists have access to the patients’ average daily wear-time and an analysis of the daily auditory environment, this new data has become a critical counseling tool regarding length of daily use, faulty equipment, magnet strength and amount of speech input.

Abstract ID: 238
Poster Number: 183
Title: Screening and Analysis of Common Deafness Genes in Patients with Severe Hearing Loss
Authors: shaofeng liu, doctor

Abstract: Screening and Analysis of Common Deafness Genes in Patients with Severe Hearing Loss

Introduction: To discuss mutation types and rate of common deafness genes in patients with extreme severe sensorineural hearing loss by genetic test. To investigate the correlation between the phenotype of gene mutation and the effect of cochlear implantation.

Methods: Select 105 patients with extremely severe sensorineural hearing loss, use patient’s peripheral blood and susceptible deafness gene diagnostic kit to test the GJB2, SLC26A4 and 1555 g, C1494T locus mutations. Use MAIS, CAP and SIR to evaluate the speech recovery effect for 96 patients who had subjected both deafness gene detection and cochlear implantation 6 months and 1 year after the implantation.

Result: Genetic mutations had been identified in 25 of the 105 extreme severe deafness patients, with mutation rate of 23.81% (25/105), GJB2 mutation was detected in 14 of the 105 patients, with mutation rate of 13.33% (14/105), of which 2 cases also had SLC26A4 mutation. 11 cases had SLC26A4 mutation, with mutation rate of 10.48% (11/105), 1 case had 12srRNA1555G mutation, with mutation rate of 0.95% (1/105) and 1 case had 12srRNAC1494T mutation, with mutation rate of 0.95% (1/105).

CAP evaluation results showed that 6 months after implantation, the level of the control group, GJB2 Group and SLC26A4 group was 3.24±0.547, 3.70±0.823 and 2.43±0.535 respectively. 12 months after the implantation, the level of the control group, GJB2 group and SLC26A4 group was 4.55±0.807, 5.30±0.675, 3.86±0.900 respectively. SIR assessment result indicated: 6 months after the operation, the level of the control group, GJB2 group and SLC26A4 group was 1.34±0.476, 2.00±0.816 and 1.29±0.488 respectively. 12 months after the operation, the level of the control group, GJB2 group and SLC26A4 group was 2.25±0.579, 3.00±0.667 and 2.29±0.488 respectively. MAIS assessment result indicated that: 6 months after the implantation, the score of the control group, GJB2 group and SLC26A4 group was 28.25±3.710, 29.80±1.932 and 24.00±3.266 respectively. 12 months after the implantation, the score of the control group, GJB2 group and SLC26A4 group was 31.23±3.708, 34.00±2.309 and 26.00±3.162 respectively. 12 months after the implantation, CAP comparative difference between GJB2 group and control group had statistical significance (P<0.05); GJB2 group compared to SLC26A4, P<0.05; the comparative difference between SLC26A4 group and control group had no statistical significance (P>0.05). SIR comparative difference between GJB2 group and control group had statistical significance (P<0.05); the comparative difference between GJB2 group SLC26A4 group had statistical significance (P<0.05); the comparative difference between SLC26A4 group and control group had no statistical significance (P>0.05). MAIS comparative difference between GJB2 group and control group had statistical significance (P<0.05); the comparative difference between GJB2 group and SLC26A4 group had statistical significance (P<0.05); the comparative difference between SLC26A4 group and control group had statistical significance (P<0.05).

Conclusion: GJB2, SLC26A4 and 12srRNA are the most common gene mutations for deafness patients. The effect of speech recovery for GJB2 gene mutation related deafness patients was better than those of SLC26A4 gene and non-gene mutation related patients after cochlear implantation.
**Authors:** Gunnar Doobe, Resident, Ingo Todt, PD Dr. med., Philipp Mittmann, Dr. med., Arneborg Ernst, Prof. Dr. med.;
ear nose and throat, head and neck surgery, Unfallkrankenhaus Berlin, Berlin, Germany.

**Abstract:** **Introduction:** For decompensated vestibular symptoms in cases of Menière’s disease and single-sided functional deafness the combination of vestibular surgery and cochlear implantation can be reasonable approach. The objective of this study was the investigation of the success of a lateral semicircular canal occlusion with saccus decompression and cochlear implantation.

**Methods:** Seven patients with recurrent attacks of vertigo and severe sensorineural hearing loss caused by refractory Menière’s disease were treated by the mostly one-stage lateral semicircular canal occlusion, saccus decompression and cochlear implantation. In three patients both sides were affected. The success of this method was evaluated by the Dizziness-Handicap-Inventory (DHI) performed preoperatively, postoperatively and after six weeks.

**Results:** Prior to surgery the DHI of all patients indicated distinct physical, emotional and functional deficits. After surgery the impairment could be reduced in all cases even in case of bilateral affection. Regular to good audiological outcome could be achieved by cochlear implantation. Partial preservation of residual hearing was possible.

**Conclusion:** The combination of lateral semicircular canal occlusion, saccus decompression and cochlear implantation can be an effective option for patients with Menière’s disease and severe hearing loss if vertigo symptoms cannot be treated conservatively. Because of the rather atraumatic lateral semicircular canal occlusion this method is possible even in cases of bilateral affection. Compared to the labyrinthectomy or triple semicircular canal occlusion it is the most atraumatic approach with similar effectiveness.

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**Abstract ID:** 243  
**Poster Number:** 92  
**Title:** Electrode Design and Insertional Depth-dependent Intracochlear Pressure Changes: A Model Experiment

**Authors:** Philipp Mittmann, MD, Arne Ernst, MD, Ingo Todt, MD; Unfallkrankenhaus Berlin, Berlin, Germany.

**Abstract:** **Introduction**
Preservation of residual hearing is one of the major goals in modern cochlear implant surgery. Intracochlear fluid pressure changes influence residual hearing and should be kept low before, during and after cochlear implant insertion. The electrode array itself has a non negligible impact on intracochlear fluid pressure changes. The aim of this study was investigate whether perimodiolar and lateral cochlear implant electrode arrays with different characteristics show variable intracochlear fluid pressure changes.

**Methods**
The experiments were performed in an artificial cochlear model. In the apical part a pressure sensor was inserted and the system was filled with water. With every electrode array five insertions were performed. The insertion with an insertionspeed of 0.5mm/s was divided into three parts and statistically evaluated in terms of peak frequency and peak amplitudes.

**Results**
The peak frequency over the thirds was increasing in both electrodes. In terms of peak amplitudes a slight increase was seen in the lateral wall electrode but not in the midscala electrode. Significant differences were found in the first third of the between both electrode array.
Conclusion
Midmodiolar and lateral wall electrodes show different intracochlear fluid pressure changes due to intracochlear placement, electrode characteristics and insertion.

Abstract ID: 244
Poster Number: 93
Title: Single-sided Cochlear Implantation: Observations in Bad Performer
Authors: Philipp Mittmann, MD, Arne Ernst, MD, Sandra Scholz, PhD, Rolf-Dieter Battmer, PhD, Ingo Todt, MD; Unfallkrankenhaus Berlin, Berlin, Germany.
Abstract: Introduction
Patients with single sided deafness can nowadays gain from a cochlear implant. The majority of these patients is well adapted and benefits from the implant. The aim of this study was to evaluate reasons for bad performing in a group of patients with single sided deafness, which received a cochlear implant.
Methods
In a retrospective case series 65 patients were enrolled. Seven bad performers were enclosed. Freiburger monosyllabics, localisation testing and radiological images were evaluated.
Results
Localisation testing showed missing of the ability of laterisation in three patients whereas Freiburger monosyllabics word scores improved in three patients. One patient had no speech perception after one year of rehabilitation. MRI findings revealed cerebral affection in five patients.
Conclusion
Various reasons can influence the outcome in unilateral cochlear implantation in patients with single sided deafness. These reasons are mainly preoperative, operative or postoperative. Nevertheless the majority of patients benefits from the implant.

Abstract ID: 245
Poster Number: 126
Title: Semantics and the Brain: The N400 as Neural Marker of Language Development in Young Cochlear Implanted Children
Authors: Niki K. Vavatzanidis, MSc1, Anja Hahne, Dr.2, Dirk Mürbe, Prof.2; 11) Max Planck Inst. for Human Cognitive and Brain Sci. 2) Technische Univ. Dresden, Dresden, Germany, 2Technische Univ. Dresden, Dresden, Germany.
Abstract: Introduction: Language acquisition is one key motivator for pediatric cochlear implantation, yet we still know little about the developing language network of young cochlear implanted children. The objective of the following study is to assess what effect a delayed auditory access to language has on the overall language development of young children and whether the acquisition process follows the chronological or the auditory age.
A milestone of language acquisition is the learning of semantic relationships between words and objects, i.e. the building of a vocabulary. If after successful learning such a semantic relationship is violated (by e.g. misnaming an object), the cognitive processing of this mismatch becomes visible in the electroencephalogram (EEG) as a negative deflection, the so-called N400 component. The N400 thus enables us to objectively assess the receptive vocabulary of a child.
With this study we intend to establish whether cochlear-implanted children display a N400 similar to normal hearing children, and if so what developmental trajectory it presents during the second year of implantation.

**Methods:** We recorded the EEG of 32 bilaterally implanted children (19 congenitally deaf) at 12, 18 and 24 months (+/- 2 months) after first activation of the first implant. Age at first activation was 9-50 months (average: 21 months, median: 17 months). During the recording the children passively watched pictures of 44 basic level words. The pictures were accompanied by an acoustically presented word which was either congruous or incongruous (e.g. apple - dog) to the picture. Each picture was presented once as congruous and once as incongruous picture-word pair.

In addition, 24 months after implant activation the children performed a language test (SETK-2; normed for normal hearing children of 24-29 months), which was used to retrospectively group the children into low, norm, and high performers.

**Results:** An N400 is observable 12 months after implant activation even in congenitally deaf children. By the time of 24 months post activation the N400 has matured to resemble the N400 of normal hearing children. When grouping the event-related potentials (ERPs) according to language performance, though, it appears that poor performers do not display a semantic mismatch in form of an N400 in either age group.

**Conclusion:** Cochlear-implanted children develop an N400 as early as 12 months after implant activation and show a progressing maturation over the second year of hearing. They thus reflect the results of normal hearing children of the respective chronological age. This suggests that the initial emergence of a receptive vocabulary progresses at a similar pace starting with first contact to spoken language. Children who are not within the normal range of language development after 24 months of implant use are an exception in that they fail to show a neural semantic mismatch sign in form of an N400. Thus the first signs of a diverging language development seem to be visible already in the semantic processing at the auditory age of 12 months.
Methods
Approximately 15 adult bimodal users will be recruited for this study. Participants’ performance on a speech-in-noise listening task will be measured in a number of conditions. In order to obtain a baseline score, the subject will participate in a CI-only condition, both in quiet and in noise. The patient will then be fitted with a HA which uses a traditional fitting formula, with speech perception testing to follow in the bimodal condition. Participants will then be fitted with a HA using the novel hearing aid fitting formula. Speech perception measures will be repeated in the experimental bimodal condition. A subjective rating scale will be completed by the participant during this testing session regarding preference of HA formula. Participants will be instructed to use the HA (programmed with the novel fitting formula) at home for an acclimation period of 2-4 weeks. Following this period, the individual will return for additional speech perception testing in order to determine the presence, or amount, of an adaptation effect. The participant will also complete a questionnaire. Audiologists’ opinions of the device and novel fitting formula will also be captured in the study.

Results
Data collection will begin in early March 2017. The researchers hypothesize that participants will perform better using the novel fitting formula, due to the coordinated processing and timing of devices. A second hypothesis is that participants will prefer the research fitting formula to their conventional fitting formula. Finally, we hypothesize that audiologists will have a high opinion of the novel fitting formula due to a faster fitting process and improved acceptability and outcomes.

Conclusion
Because no data has been collected at this time, we cannot state conclusions. Based on previous evidence from similar studies, we expect our research hypotheses will be accepted. We anticipate conclusions by the conference in July 2017.

Abstract ID: 247
Poster Number: 139
Title: MRI Artifacts and Cochlear Implant Positioning at 1.5T in Vivo - A Mini Case Series
Authors: Philipp Mittmann, MD, Arne Ernst, MD, Grit Rademacher, MD, Ingo Todt, MD; Unfallkrankenhaus Berlin, Berlin, Germany.

Abstract: Introduction:
The number of cochlear implant recipients as well as the number of MRIs is continuously increasing annually. The indication criteria for cochlear implantation have been changed over the years and the growing number of implantations in patients after acoustic neuroma resections underline the importance of a postoperative MR imaging to assess the internal auditory canal (IAC) and the labyrinth. The MRI artifact induced by the cochlear implant magnet is a known problem should be further observed by this investigation.
The aim of this study was to evaluate the visability of the internal auditory canal and the labyrinth in relation to different CI magnet positions and MRI sequences at 1.5 T.

Methods:
We compared the artifacts of cochlear implant magnets at different head positions in three patients at 1.5 T. The observed positions varied with a nasion-external ear canal angle of 90°, 120° and 160° and a variable distance of 5 cm, 7 cm and 9 cm in relation to the external ear canal and different MRI sequences.

Results:
The complete assessment of the internal auditory canal and labyrinth was very good possible with a magnet positioned at 90° and 9 cm and 120° and 9 cm. With 160° and 9 cm the assessment of the internal auditory canal and labyrinth was still satisfying. A high-resolution 3D T2w Drive sequence decreased the visibility of the structures significantly whereas a high-resolution T2w clear sequence allowed sufficient visualisation of the structures.

Conclusion:
The position of the implant and the MRI sequence used, determine the assessment of the IAC and the labyrinth at 1.5 T MRI. A position of the implant magnet at a nasion-external auditory canal angle of 90° or 120° with a distance of 9 cm canal is therefore recommended.

Abstract ID: 251
Poster Number: 119
Title: Triphasic Pulses Reduce Facial Nerve Stimulation in CI Users: Intra- and Postoperative Electromyographic Data
Authors: Youssef Adel, Dipl.-Ing.1, Andreas Bahmer, Prof. Dr. mult.2, Uwe Baumann, Prof. Dr.-Ing.1; 1Audiological Acoustics, Univ. Hosp. Frankfurt, Frankfurt am Main, Germany, 2Theoretical Clinical and Experimental Neurophysiology, Univ. Hosp. Würzburg, Würzburg, Germany.
Abstract: Introduction: Facial nerve stimulation (FNS) is sometimes observed in cochlear implant (CI) users as an undesirable side effect of intracochlear biphasic electrical stimulation, especially in subjects who suffer from otosclerosis or other etiologies which require above average stimulation levels. Two common clinical remedies to alleviate FNS are to extend stimulus phase duration of the respective electrode or completely deactivate the electrode. However, in some cases these options do not provide sufficient FNS reduction or are not feasible. Triphasic electrical stimulation has been previously shown to reduce FNS, but no objective measures were conducted to quantify this benefit. This study presents electromyographic (EMG) data collected intra- and postoperatively in CI users.
Methods: Postoperative EMG recordings were conducted in awake CI users (n = 4). Adhesive surface electrodes were attached at the areas corresponding to muscles innervated by the facial nerve (musculi orbicularis orii and oculi). Stimuli were 1-ms pulse trains presented at 100 pps with pulse duration of 100 µs. They had either symmetric cathodic-leading biphasic or triphasic pulse shape. In each condition, stimulation amplitude was increased until the subject reported uncomfortable FNS, then EMG potentials were collected at 4 equidistant points within that range. Intraoperative EMG recordings were conducted in subjects still under general anesthesia after receiving a CI (n = 5). Subdermal electrodes were attached to the aforementioned muscles, which are commonly part of intraoperative facial nerve monitoring during cochlear implantation surgery. Stimuli were 1-ms pulse trains presented at 100 pps with pulse duration of 150 µs. They had symmetric biphasic or triphasic pulse shape with different polarities. EMG potentials were collected at 10 equidistant points between response threshold and saturation level.
Results: Postoperative EMG data were collected in 3 out of 4 awake CI users up to uncomfortable FNS, while the remaining experiment had to be aborted. Results demonstrated high variability, but individual input-output (IO) functions for biphasic and triphasic pulses were different. Compared with standard biphasic stimulation, triphasic pulses required higher stimulation levels to elicit equivalent FNS as reflected by EMG amplitudes, i.e. the IO function of biphasic pulses was steeper than that of triphasic pulses. Intraoperative EMG data confirmed these findings. Furthermore, a polarity-dependent effect was found where the differences between biphasic and triphasic IO functions were diminished for anodic-leading compared with cathodic-leading stimulation.
**Conclusion:** Triphasic pulses can reduce FNS due to a generally smaller gradient of EMG input-output function compared with biphasic pulse stimulation. This could be explained by differences in spatiotemporal spread of the electrical field produced by the different stimuli.

**Abstract ID:** 252  
**Poster Number:** 177  
**Title:** Factors Influencing Sound-Source Localization in Children with Bilateral Cochlear Implants  
**Authors:** Catherine Killan, MSc1, Andrew Scally, MSc2, Catherine L. Totten, MSc1, Christopher H. Raine, Ch.M.1;  
1Yorkshire Auditory Implant Service, Bradford Teaching Hosp. Fndn. Trust, Bradford, United Kingdom,  
2School of Allied Health Professions and Sport, Univ. of Bradford, Bradford, United Kingdom.  
**Abstract:** Introduction: The ability to hear where sounds come from is an important skill for children in social, recreational and educational settings as well as for their personal safety. Clinical assessments find that localization accuracy for children with bilateral cochlear implants varies from near-normal to an inability to localize above chance level. The reasons for this variation are not yet fully understood. This study therefore aimed to statistically model the effects of inter-implant interval and onset of profound deafness on sound localization in children with bilateral cochlear implants.  
**Methods:** The authors conducted a retrospective, observational cohort study using routinely collected clinical data. Participants were 142 bilaterally implanted children aged 4 years or older that completed at least one of three tests 12 months or more post-second implant. Stimuli were pre-recorded voices randomly roved from 65 to 75 dB(A) in 1 dB steps. Left/right lateralization was assessed via two loudspeakers at ±60° azimuth. Percent-correct scores were calculated and the simultaneous and sequential groups were compared via Fisher's Exact Test. Sound-source localization accuracy was assessed using two forced-choice procedures; a 3-choice test with loudspeakers at -60°, 0° and +60° azimuth and a 5-choice test with loudspeakers at -60°, -30°, 0°, +30° and +60° azimuth. Root-mean-square (RMS) errors were calculated. Children were categorized by inter-implant interval: Simultaneous (N=75), 0 to 23 months (N=12); 24 to 47 months (N=18); 48 to 71 months (N=16) and ≥72 months (N=21). They were classified as “Congenitally Deaf” (thresholds of ≥90 dB(HL) at 2 and 4 kHz in at least one ear from birth) or “Acquired/Progressive” (thresholds initially ≤90 dB(HL) at 2 or 4 kHz bilaterally, later falling below this level). Data were analyzed via multiple linear regression modelling, controlling for time since second implant, age, manufacturer and concentration.  
**Results:** Lateralization data showed ceiling effects and no effect of simultaneous or sequential implantation was seen. Sound-source localization models for both the 3-choice and 5-choice tests found no significant difference between the simultaneous group and children with 0 to 2 years inter-implant interval (p=0.323; p=0.819 respectively). Inter-implant interval of >2 years led to greater RMS error, from 6.3 degrees (5-choice test; inter-implant interval 48 to 71 months; p=0.08) to 25.1 degrees (3-choice test; inter-implant interval >72 months; p<0.001). Acquired/progressive hearing loss led to better accuracy than congenital deafness by 10.4 degrees (3-choice test; p=0.001) and 5.7 degrees (5-choice test; p=0.013) RMS error. Manufacturer was significant in both models (p<0.001).  
**Conclusion:** Unilateral and bilateral auditory deprivation should be minimized for children with profound hearing loss to maximize their future ability to localize sounds via cochlear implants.

**Abstract ID:** 254
Poster Number: 214
Title: Place Dependent Stimulation Rates Improve Pitch Perception in Cochlear Implantees
Authors: Tobias Weissgerber, Dr., Tobias Rader, Dr., Youssef Adel, Dipl.-Ing., Uwe Baumann, Prof.; Audiological Acoustics, Univ. Hosp. Frankfurt, Frankfurt am Main, Germany.
Abstract: Introduction: In normal hearing, the pitch of an acoustic tone can theoretically be encoded by either the place of stimulation in the cochlea or the corresponding rate of vibration. Thus spectral attributes and temporal fine structure of an acoustic signal are naturally correlated. Cochlear implants (CIs) currently disregard this mechanism; electrical stimulation is provided at fixed electrode positions with default place independent stimulation rate assignments. This does not account for individual cochlear encoding depending on electrode array placement, variations in insertion depth, and the proximity to nerve fibers. Encoding pitch in such manner delivers limited tonal information. We hypothesize that this limitation in electric stimulation is at least partially due to the mismatch between frequency and place encoding in CIs.
Methods: 11 subjects with late-onset single-sided deafness and almost normal hearing in the unaffected ear participated in the study. We determined individual electrode locations by analysis of cochlear radiographic images obtained after surgery and calculated place dependent stimulation rates according to models of the normal tonotopic function. In a pitch matching method, subjects were presented with an electric stimulus in the implanted ear and an acoustic stimulus in the opposite ear in alternating order. They were asked to match the perceived pitch of the acoustic stimulus to that of the electric stimulus by adjusting the frequency of the acoustic stimulus. Pitch matching was conducted 6 times for each of the 6 most apical electrodes.
Results: 5 of 11 subjects achieved nearly a one-to-one function between electrical stimulation rate and acoustic pitch perception, while generally matched pitch frequencies as a function of calculated electrical stimulation rate were well-fitted by linear regression (R² in the range 0.70-0.97, R²log = 0.88 for collapsed data). Matched acoustic frequencies as a function of estimated electrode insertion angle ranged from 80 Hz at 605° to 1683 Hz at 190°. Collapsed median data were in the range of one musical octave with respect to the pitch model function.
Conclusion: Results of pitch matching experiments demonstrate thus far unparalleled restoration of tonotopic pitch perception in CI users with single-sided deafness. Future stimulation strategies should take patients’ individual electric frequency-to-place map into account to provide enhanced benefit in terms of the appraisal of music, the perception of tonal languages, or speech perception in noise.

Abstract ID: 257
Poster Number: 12
Title: Correlation of Cochlear Implantation Outcomes in Children With Pre-Existing Cerebral Abnormalities
Authors: Shweta S. Deshpande, Masters in Audiology and Speech Language Pathology, Neelam Vaid, MS (ENT) DNB; BIG EARS, K.E.M. Hosp., Pune, India.
Abstract: Introduction: Imaging examination plays an important role in the pre-implant evaluation of pediatric sensorineural hearing loss (Joshi,2012). Abnormalities detected by pre-operative brain MRI scans on cochlear implant candidates are common (30%), (Jonas,2012) however, its influence on the effect of CI has not been clarified. The purpose of our study is to evaluate the outcomes in children after cochlear implantation with pre-existing neurological abnormalities diagnosed on MRI examination.
Methods:
17 children (age range - 22mnths to 9yrs6mnths) with profound sensorineural hearing loss diagnosed with pre-existing CNS abnormalities on the MRI examinations were selected. The CNS abnormalities consisted of non-specific periventricular signal abnormalities, bilateral non-specific subcortical white matter abnormalities and temporal lobe arachnoid cyst. Temporal lobe involvement was seen in 8 out of the 17 children. The implant age of the children varied from 3 to 24 months. They were followed up for the outcomes pre and 3, 6, 9,12,18 and 24 months post implantation using standardised assessment scales i.e. MAIS/IT-MAIS, LiP, CAP, Monosyllabic Word Recognition test and SIR.

Results:
Only 3 out of 17 children discontinued follow-up after 18 months post implantation. 50% of the children achieved a full score on MAIS and 70% achieved a full score on LiP by around 12 months post implantation. Only 7 out of 13 children achieved a CAP score of 6 i.e. can understand some spoken words without performatives by 1 year post implantation however did not progress further. 10 out of 17 children achieved less than 50% score on word recognition test by 12 months post implantation. The SIR score was 2 (i.e. intelligible speech is developing for single words) only for 4 children after 1 year post implantation.

Conclusion:
Brain abnormalities were common on the brain MR imaging of the patients with sensorineural hearing loss with white matter changes, being the most common finding. These abnormalities did not seem to influence the short-term hearing improvement after cochlear implantation, however they do affect the auditory identification and comprehension of language. Further study with more patients and longer follow-up time is needed to confirm our results.

Abstract ID: 261
Poster Number: 134
Title: Fixed and Adaptive Beamforming Improves Speech Perception in Noise in Cochlear Implant Recipients
Authors: Clemens Honeder, MD, Rudolfs Liepins, MSc., Christoph Arnoldner, MD, Michaela Blineder, MSc., Stefan Flak, BSc., Sonja Reiß, MSc., Alexandra Kaider, Msc., Dominik Riss, MD; Med. Univ. of Vienna, Vienna, Austria.
Abstract: Introduction: Even though many cochlear implant users achieve remarkable levels of speech perception in quiet, speech recognition in noise remains a major challenge for these patients. Directional microphones, which are an established approach to improve speech intelligibility in noise in hearing aid users, became available for MED-EL cochlear implant recipients with the new SONNET audio processor. The aim of this study was therefore to determine if the fixed and adaptive beamforming technology improves speech intelligibility in noise.

Methods: 18 adult cochlear implant patients were included in the study. Speech reception thresholds (SRT) were measured with an adaptive speech test (Oldenburger Sentence Test) in continuously present, speech shaped noise. Target sentences were presented in front of the listener, noise sources were placed at -135° and 135°, respectively. Outcome measures were the differences in SRT with microphone settings: omnidirectional, fixed beamformer, and adaptive beamformer.
**Results:** Analysis revealed that the use of directional microphones improved SRTs as follows: fixed beamformer vs. omnidirectional: -4.27 dB (p<0.0001); adaptive beamformer vs. omnidirectional: -6.12 dB (p<0.0001); and adaptive beamformer vs. fixed beamformer: -1.84 dB (p=0.001).

**Conclusion:** The fixed and even more the adaptive beamformer of the MED-EL SONNET audio processor significantly improved speech reception thresholds in noise. Cochlear implant users will therefore benefit in difficult listening situations.

**Abstract ID:** 265  
**Poster Number:** 82  
**Title:** Predicting the Degree of Difficulty in Cochlear Implant Surgery - The Use of an Objectively Structured Imaging Based Grading System  
**Authors:** Ameet Kishore, FRCS1, Ashwani Kumar, MNAMS1, Neevita Narayan, BSc, MBA2;  
1ENT, Head Neck Surgery, Indraprastha Apollo Hosp., New Delhi, India, 2SpHear Speech and Hearing Clinic, New Delhi, India.

**Abstract:**  
**Introduction:** Hearing preservation and lowering the age for cochlear implant (CI) surgery has resulted in increased emphasis on improving surgical technique. Variations in the anatomy of the temporal bone and in cochlear orientation can often cause an intraoperative challenge to the surgeon. The aim of this study was to assess if the use of an objectively structured grading system based on High Resolution Computer Tomography (HRCT) of the temporal bone, correlated with intraoperative findings and helped the surgeon predict the degree of difficulty in cochlear implant (CI) surgery in our practice.

**Methods:** The senior author is the primary Cochlear Implant surgeon at the institution with a cohort of over 900 cochlear implant recipients in the last ten years. Both HRCT and MRI are routinely used in the preoperative evaluation of all patients undergoing CI surgery. A 10 point imaging based grading system described by Vaid et al [IJOHNS 2015; 67(2), 150-158] was used consecutively in 100 ears to score the findings (which was documented by the second author) and predict potential difficulties. The findings were subdivided into three relevant categories: mastoidectomy, access to facial recess and access to round window. This score was compared to the intraoperative findings, difficulty encountered during surgery and the duration of CI surgery (which was documented by the first author). These scores were analysed for each of the three categories of the surgical approach.

**Results:** The findings on imaging and the resultant score seemed to correlate with intraoperative findings. The hypopneumatised mastoid contributed maximally toward difficulty in mastoidectomy. The finding of narrow and sclerotic facial recess correlated maximally with the difficulty in the posterior tympanotomy. The unfavourable External Auditory Canal - Basal Turn Cochlear line correlated maximally with poor round window access. The surgeon was thus able to predict the potential difficulties encountered. Longer surgical times were seen in patients with a higher score on imaging. The details of the scoring system and findings will be discussed.

**Conclusion:** The use of a structured imaging based grading system can help a CI surgeon anticipate the challenges that might be encountered during surgery and thus predict intraoperative issues and surgical time, and is particularly useful for the novice CI surgeons.
CI2017 Poster Abstracts

Poster Number: 117
Title: Improving Value for Cochlear Implant Patients: The Role of the Audiology Assistant
Authors: Matthew Schmitt, B.S., Sara Hollander, M.A., Douglas Sladen, Ph.D.; Otolaryngology, Mayo Clinic, Rochester, MN.
Abstract: Introduction: Audiologists are under increasing demand to provide cochlear implant services. Time is often spread thin by administrative tasks that could be taken over by an Audiology Assistant. In the current quality improvement project specific tasks were handed over Audiology Assistants in order to provide time for the Audiologist to “work at the top of their license”.
Methods: This quality improvement project took place in a large cochlear implant program with six implant audiologists and two audiology assistants. The current state practice activities were outlined during an initial retreat. During subsequent retreats the staff identified areas in which audiology assistants could be used. The number of potential contact hours was calculated alongside with the time with an Audiologist versus Audiology Assistant. Patient satisfaction was measured.
Results: Data showed that the time Audiologist Assistants were able to perform services decreased overall contact hours, and did not sacrifice patient satisfaction.
Conclusions: This quality improvement project demonstrated that Audiology Assistants are able to improve patient care of a large cochlear implant practice. The change in practice allows patients to move through the program with greater ease.

Abstract ID: 267
Poster Number: 169
Title: Language Outcomes for Children with Hearing Loss Due to CMV
Authors: Debbie Hatch, Au.D.1, Anne Dare, Au.D.1, Rebekah Crisp, Au.D.1, Hannah Hodson McLean, Au.D.1, Elizabeth Abeyounis, M.S.2, Stephanie Moody Antonio, M.D.1; 1Otolaryngology, EVMS, Norfolk, VA, 2Speech Therapy, CHKD, Newport News, VA.
Abstract: Introduction: It is well established that children with hearing loss vary in terms of language outcomes; however, few studies have formally assessed language outcomes in children with hearing loss due to Cytomegalovirus (CMV). CMV is one of the leading causes of congenital hearing loss. There are an estimated 20,000 - 30,000 babies born with CMV in the US every year. According to the National CMV Foundation (2016), 90% of these babies are asymptomatic; however, approximately 10% - 15% will develop hearing loss within months or over several years of life.
Methods: Methods: This is a retrospective review of the language outcomes of 9 children in our clinic that have hearing loss due to CMV and use hearing aids and/or have cochlear implants. In addition, we will highlight one patient who was diagnosed at one year of age with severe-to-profound sensorineural hearing loss and received bilateral cochlear implants at 21 months. After approximately 1.5 years of consistent CI use, she has good receptive language skills and the ability to read but has minimal expressive language skills and relies on an augmentative communication system as well as sign language for her expressive needs.
Results: Results: The nine children in this retrospective study have a varied amount of success in terms of age-appropriate receptive and spoken language.
Conclusion: Conclusion: The range of success for age-appropriate spoken language for children with hearing loss due to CMV is variable. This may be due to the presence and/or severity of other disabilities that may accompany the hearing loss and damage to specific area of the brain caused by the virus.
Abstract ID: 268
Poster Number: 4
Title: Exploring the Stories Hearing Parents Tell their Deaf Children about their Decision to (or not to) Opt for Cochlear Implantation During Infancy
Authors: Kristina M. Scharp, Ph.D.1, Brittan A. Barker, Ph.D.2;
1 Languages, Philosophy, and Communication Studies, Utah State Univ., Logan, UT, 2 Communicative Disorders & Deaf Education, Utah State Univ., Logan, UT.
Abstract: Narratives of identity (re)construction: Understanding the experiences of parents who have children with cochlear implants

Abstract
Introduction:
When families experience major disruptions—such as a diagnosis of hearing loss and/or making the decision for a child to undergo cochlear implantation—family members must often renegotiate who they think they are (their identity) to cope with their new situation. Research suggests that one way they cope and reconstruct their identity is through sharing their personal story. Indeed, narrating simultaneously reflects and constructs a person’s reality. Thus, it might come as no surprise that research has linked narration with psychological well-being outcomes. The present study extends what we know about personal narratives and identity to illuminate the experience of parents with children who use cochlear implants (CIs).

Methods: Researchers collected parents’ online, public-domain blogs that included stories about their experiences with their children who use CIs. Researchers engaged in narrative thematic analysis, the corresponding method to our interpretive narrative approach, to explore story types across parents. Four verification procedures were conducted.

Results: Multiple identity reconstructions emerged in the story corpus that illustrated a range of responses to their family’s experiences. Some parents struggled with their identity, sharing stories of victimization whereas other parents narrated stories that reflect their redemptive ability to learn something from their experience. The emergent identity types allude to the parents’ ability to be resilient and their overall well-being.

Conclusion: Through the introduction of thematic narrative analysis we were able to highlight the importance of understanding how families make sense of and talk about their experiences in relation to their children’s hearing loss. As research suggests, individuals who are able to share their story in a way that solicits supportive communication are activist on behalf of their own wellbeing. This is knowledge that will likely have important future implications for providing comprehensive clinical services and aural rehabilitation for both children with CIs and their families.

Abstract ID: 272
Poster Number: 65
Title: Delayed Facial Palsy Following Uncomplicated Tympanomastoid Surgery
Authors: Bretislav Gal, M.D., Ph.D., Eva Tothova, M.D., Miroslav Vesely, M.D.; Department of Otorhinolaryngology and Head and Neck Surgery, St. Anne's Univ. Hosp. and Faculty of Med. Masaryk Univ., Brno, Czech Republic.
Abstract: **Introduction:** The purpose of this study was to establish the frequency of occurrence of delayed facial nerve palsy following tympano-mastoid surgery.

**Methods:** A retrospective review of all patients who had undergone tympano-mastoid surgery in our department over the previous 10 years was carried out. A total of 620 patients were included in the study. For the review of the chart, we checked intraoperative findings, clinical features of development and recovery of facial nerve palsy. Seven patients were identified as having DFNP palsy over this period of time.

**Results:** The frequency of delayed onset facial nerve palsy following tympano-mastoid surgery in our series was 1.1 per cent. None showed known predisposing factors such as bony facial canal dehiscence or bulging facial nerve herniation. Chorda tympani was cut in 1 case. The onset of the facial palsy occurred between 3 and 14 days postoperatively (average 8.3 days). Complete recovery of facial function was observed between 4 and 10 weeks after surgery (average 6.4 weeks).

**Conclusion:** Delayed facial nerve palsy is a very rare complication of tympano-mastoid surgery. It can occur up to two weeks after the surgery. Postulated mechanisms of delayed facial palsy include neural oedema, vasospasm and mainly reactivation of dormant viral infections (varicella zoster, herpes simplex). The combined use of prednisone and acyclovir was an effective form of treatment for all patients.

**Abstract ID:** 273  
**Poster Number:** 179  
**Title:** Hearing Outcomes After Cochlear Implantation by Etiology of Hearing Loss - A Single Centre Experience  
**Authors:** George Kurien, MD, David Low, MBBS, David Shipp, MA, Trung N. Le, MD PhD, Vincent Lin, MD, Joseph Chen, MD; Otolaryngology - Head and Neck Surgery, Sunnybrook Health Sciences Centre, Univ. of Toronto, Toronto, Canada.

**Abstract:** **Title:** Hearing Outcomes after Cochlear Implantation by Etiology of Hearing Loss – A Single Centre Experience

**Introduction**
The hearing outcomes following cochlear implant (CI) surgery are influenced by various factors including the underlying etiology of the hearing loss. We present the hearing outcomes seen at a single institution in CI patients with an identifiable cause of sensorineural hearing loss.

**Methods**
A retrospective review of prospectively collected data from the CI clinic database was performed on all CI surgeries between 1984 and 2016. Patient demographic data, etiology of hearing loss, preoperative hearing thresholds, and preoperative and 1 year postoperative speech discrimination scores were obtained.

**Results**
420 patients who underwent CI surgery with known etiologies of hearing loss were identified. Of these, 52% were male and mean age at time of surgery was 54.5 years. Mean preoperative PTA for the operated ear was 107 dB, and preoperative speech discrimination scores were 10% (CID, n=64) and 32% (HINT, n=370). The most common identifiable etiology was otosclerosis (n=105), followed by Meniere’s disease (n=56), and meningitis (n=51). Mean HINT scores at 1 year for different etiologies ranged between 34% and 96%. Etiologies with the most favourable HINT scores were Cogan’s syndrome,
Meniere’s disease, and ototoxicity. Least favourable scores were seen in Usher’s syndrome, GJB2 mutation, and meningitis.

Conclusion

Our data show a wide range of hearing outcomes in a CI population over three decades. It is important to consider the underlying etiology when counselling patients about hearing outcomes following CI surgery.

Abstract ID: 278
Poster Number: 138
Title: Upgrading Electric-Acoustic Stimulation External Technology: Speech Perception Outcomes
Abstract: Introduction: Electric-Acoustic Stimulation (EAS) monaurally combines cochlear implant and hearing aid technologies for CI recipients with preserved low-to-mid frequency hearing. The EAS clinical trial enrolled patients with mild-to-moderate hearing loss in the low-to-mid frequency range, who were fit postoperative with an audio processor that combined electric and acoustic modalities. Subjects demonstrated a significant improvement in speech perception abilities with EAS as compared to conventional hearing aids or with either stimulation mode alone. Recently, EAS subjects were upgraded to a newer generation audio processor that offers additional programming capabilities. The objective of this study was to examine speech perception of EAS recipients when programmed with the new audio processor.
Methods: Twenty (20) experienced EAS recipients with greater than 2 years of listening experience were enrolled. Subjects were fit with the new audio processor using behavioral mapping methods. The acoustic component was programmed based on the unaided audiogram using real-ear and/or test box measures. The test battery included assessment of residual hearing and aided speech perception. Speech perception measures included recorded CNC words in quiet and AzBio sentences in quiet and in babble (+10dB SNR). Subjects were evaluated on the day of the fitting and 1 month post-fitting.
Results: Subjects experienced stable speech perception abilities in quiet and a trend for improved speech perception abilities in noise with the new audio processor with additional programming options. Conclusions: EAS recipients may experience additional improvements in speech perception with the new generation audio processor. Individualized mapping procedures will be discussed. Understanding of optimal mapping methods and associated speech perception outcomes is needed as hearing preservation procedures expand to the pediatric population. Pediatric EAS recipients may experience similar gains in performance.

Abstract ID: 279
Poster Number: 181
Title: Does the Benefit of Intraoperative Testing of Cochlear Implants Outweigh Associated Costs?
Abstract: **Introduction:** Neural response telemetry is presently performed during each cochlear implant surgery completed at our center in order to confirm device function and electrode placement. If results are abnormal, the surgeon will then request intraoperative radiographic imaging on a case-by-case basis to verify placement. Corroboration of intraoperative cochlear implant device function and electrode placement is highly valuable; however, existing literature on this topic suggests that intraoperative x-ray, not neural response telemetry, is most often the deciding factor in use of the back-up internal device. Additionally, present literature indicates that intraoperative neural response telemetry shows little correlation with postoperative performance. As such, the impact of intraoperative testing on surgical and clinical management of cochlear implant patients at our center was investigated.

**Methods:** A retrospective chart review was conducted to examine the results of intraoperative testing during cochlear implant (CI) surgeries (n=68) at a pediatric tertiary care center over a 12-month period (4/2015 to 4/2016). Frequency of non-normal results on intraoperative impedance telemetry (e.g. open or short circuits) and neural response telemetry (e.g. absent response) was calculated and then tracked for resolution up to 6 months post-surgery. In an effort to identify factors associated with abnormal intraoperative telemetry results, the data were then examined by CI manufacturer, age at surgery, laterality of CI, presence of abnormal anatomy, and surgical approach. If and how intraoperative testing results impacted surgical and audiological management was investigated by review of records and clinician interview for each surgery. The surgical and audiological value of intraoperative testing of CIs was further evaluated through a cost-benefit analysis.

**Results:** In 34% (23/68) of the CI surgeries reviewed, non-normal intraoperative results were found. Resolution of issues occurred following surgery in more than half of these 23 cases. For a majority of the cases with known lack of resolution, no resolution was anticipated (e.g. hypoplastic nerve). A significant difference in the frequency of abnormal results was found between manufacturers. No significant difference in the occurrence of abnormal vs. normal intraoperative results was found between age at surgery, laterality of CI, presence of abnormal anatomy, nor surgical approach. Surgical and audiological management was influenced by intraoperative testing results for only a small number of cases. Reimbursement for intraoperative testing is low in relation to the additional costs of extending OR time to accommodate testing and the amount of audiologist’s time dedicated to the procedure.

**Conclusion:** The costs associated with intraoperative testing are significant, especially considering how infrequently results of testing were found to change surgical or clinical management; because of this, alternative procedures for the routine verification of device placement and function should be considered and are currently being tested at our CI center.

**Abstract ID:** 280  
**Poster Number:** 132  
**Title:** Long-term Experience with Electric-Acoustic Stimulation  
**Authors:** English R. King, AuD1, Margaret T. Dillon, AuD2, Meredith A. Rooth, AuD2, Ellen Deres, AuD1, Andrea Bucker, AuD1, Harold C. Pillsbury, MD2;  
1UNC Health Care, Department of Audiology, Univeristy of North Carolina at Chapel Hill, Chapel Hill, NC,  
2Otolaryngology/Head & Neck Surgery, Univeristy of North Carolina at Chapel Hill, Chapel Hill, NC.  
**Abstract: Introduction:** Cochlear Implant systems which combine electric-acoustic stimulation (EAS) in the same ear are now FDA approved, commercially available and increasing in the US. The US clinical trial investigated the safety and effectiveness of EAS in subjects with steeply sloping mid-to-high frequency hearing loss. Speech perception is reportedly improved within the first year of listening with EAS as compared to pre-operative results with conventional amplification. The objective of the present
report is to review long-term stability of post-operative residual hearing and aided speech perception results of EAS recipients.

**Methods:** Unaided residual hearing and aided speech perception with EAS were reviewed with long-term use (>5 years). All subjects underwent cochlear implantation with a shallow electrode array insertion, maintained residual hearing in the implanted ear and were subsequently fit with combined stimulation. The aided speech perception test battery included CNC words in quiet and CUNY sentences in steady noise (0 SNR). A repeated-measures ANOVA was used to analyze the stability in residual hearing over time and aided speech perception with multiple years of listening experience.

**Results:** Residual hearing in the contralateral ear remained stable over the study period. Subjects demonstrated variability in hearing preservation in the implanted ear over time. All subjects experienced significantly improved speech perception with EAS as compared to pre-operative performance. Speech perception in quiet and noise was maintained or improved with long-term listening experience, even when a change in residual hearing was present.

**Conclusion:** EAS provides improvement in speech perception as compared to pre-operative performance, despite variations in residual hearing preservation. Optimal mapping techniques in this patient population will be discussed. With change or variations in residual hearing, mapping and programming considerations need to be made. EAS may be a viable treatment option for subjects with substantial residual hearing and limited speech perception with conventional amplification. A greater understanding of long-term hearing stability and aided speech perception is needed as EAS expands to the pediatric population.

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**Abstract ID: 281**

**Poster Number: 75**

**Title:** Our Experience in Pediatric Cochlear Implantation

**Authors:** djilali aiad khaled, Maitre de conference A, djilali aiad khaled, Maitre de conference A, Megharbi Ouziane, Dr; médecine, chu sidi bel abbes, sidi bel abbes, Algeria.

**Abstract:** **Introduction:** The cochlear implant (IC) is used to allow the children reached of a neurosensory deafness to acquire a hearing perception, a comprehension of the word and language acquisition. The majority of these children have factors associated with their profound deafness which condition the functional results.

**Methods:** we undertook an exploratory descriptive and analytical study over a period of 7ans between a year 2008 and 2015 in connection with 43 children implanted in our department and follow-ups, between 2013 and 2015 is an average of 14 implants per year

**Results:** We noted a discrete masculine predominance, the sex ratio is of 1,04 boy for a girl. Middle Age is of 3 years 9 month, a standard deviation of 19 months, with an extreme of 19 month minimal and maximum age of 7 years 41% had similar cases in the family, 21% of the implanted children had two deaf cases in the family, 14% had three cases, two implanted children had four profound deafness in the family, and one had seven deaf cases in the family. We noted the presence of two cases deaf in the siblings in 18% of the established children, and three deaf persons or more in the family in 6,98% of the implanted children. We noted the concept of fever in the personal antecedents at 23, 26%, two cases of meningitis were announced, and persistence of arterial channel among two patients, 04 children had hyperpyretic convulsions. 18,60% of these children had an otitis associated with deafness at the time with the diagnosis, taken drugs during the pregnancy was noted at 27% of the cases. The radiology finds a pathological cochlea in 16% of the patients, cochlea deformity in 14%, cochlear ossification in 2%, a
dilation of the vestibular aqueduct in 7% of the children, procidence of the facial nerve in one patient, and procidence of the side sine in 12% of the children. The congenital causes of deafness was noted in 95,35%, 53,49% are genetic syndromic, and 32,56 are genetic non-syndromic, other share the type acquired in 4,6% which are post-meningeal. The choice of the operated ear: was made according to several parameters: dexterity, residual hearing, and the disorders vestibular. We placed a Medel implant to date in 51%, Cochlear implant in 49%, the insertion of the implant by the round window at 83% and by the opening of the cochleostomy in 16,28%, the geyzer was seen in 9,30%. We carried out an audiometric evaluation in free field and orthophonic of our patients, the consanguinity is a determining factor in hearing perception the production of the language, the relation is significant the P is equal to 0,05, the second factor is the age of implantation, we obtained better results among patients operated at early age, a 0-2 years, and 2-4 years in comparison with the children operated with age more than 4 years.

**Conclusion:** The study of the associated factors with deep deafness in the child allows to understand the hearing evolution of the deaf patients, and to reinforce an orthophonic reeducation in a more rigorous way in order to improve these results.

**Abstract ID:** 283  
**Poster Number:** 32  
**Title:** Health Related Quality of Life in Children with Cochlear Implants Equipped at an Early Age During the First Two Years  
**Authors:** Alexander G. Saenz, Medical Doctotr  
HOSPITAL UNIVERSITARIO, MENDOZA, Argentina.  
**Abstract:** **Introduction:** In the last years there has been an interest in the evaluation of results in children implanted beyond the auditory results. Children and their parents go through a delicate process before and after the placement of the cochlear implant, from the diagnosis but principally in the auditory habilitation. The early years tend to have unexpected or desired results, to accompany the family (parents and implanted child) in the hearing impaired processes requires a solid and interconnected rehabilitation equipment and a tool that allows to supervise non-auditory aspects of impact in life Of the child implanted at an early age. For this reason I have developed an instrument to determine and validate a parent-reported outcomes instrument focusing on the social and emotional skills development given the benefits of using the cochlear implant in children equipped at an early age during the first years of use.  
**Methods:** Development and validation of the HRQLC-CI occurred in four phases: 1) focus groups with 7 parents of children and 12 teachers, audiologist and caregivers of children equipped with CI to develop a draft instrument, 2) item generation, 3) pilot study to assess content validity in 10 patients and 4) psychometric validation.  
**Results:** Focus groups identified symptoms and the associated bother, the dimensions development and the patients and health equipment rehabilitation observations in cochlear implanted children as the central concepts in their experience. Qualitative analysis indicated that saturation was achieved for these concepts and yielded an initial 75-item draft instrument. An expert group understood the questionnaire and found the items to be relevant indicating content validity. Patient input, item descriptive statistics and factor analysis identified 40 items that could be deleted. The final 35-item HRQLC-IC constituting 5 dimensions: functional, social, psychological, physic and favorable and unfavorable factors. The initial psychometric analysis results suggest that the HRQLC-IC met the criteria for item discriminant validity.
Conclusion: The HRQLC-IC seems to be a reliable and valid questionnaire relevant to assess parents, therapist and medical ENT in the habilitation prosses of cochlear implanted children. The use of this questionnaire will provide assessment of quality of life, impact of treatment on patient outcomes in clinical trials, and may aid in treatment effectiveness evaluation.

Abstract ID: 287
Poster Number: 1
Title: Validation of the RCHSD Children’s Implant Profile (ChIP) Score: Improving Outomes of Pediatric Cochlear Implant Candidates
Authors: Heather Rose, SLP-CCC, AVT1, Daniela Carvalho, MD2, Rosabel O. Agbayani, MPH3;
1Developmental Services-Speech and Hearing, Rady Children’s Hosp. San Diego, San Diego, CA,
Abstract: ABSTRACT
Background:
Cochlear implantation (CI) has become the standard of care to provide access to sound for patients with severe to profound hearing loss who do not benefit significantly from hearing aids. Determining candidacy for a CI in the pediatric population is a complex and subjective process. Creation of standard and objective prognostic information would be useful, not only to support decisions about CI in a particular child, but also to help counsel the family about the expectations of possible outcomes and to plan for post-CI services.
The Cochlear Implant Team uses a modified Children’s Implant Profile (ChIP) to determine CI candidacy. The team includes audiologists, speech and language pathologists, an auditory-verbal therapist, physician (pediatric otolaryngologist), developmental psychologist, social worker (as necessary) and educational liaison.
Objectives:
The objective of the study will evaluate the effectiveness of the ChIP score by determining a correlation with the communication outcomes after cochlear implantation, evaluating the effectiveness of the ChIP score used to improve family expectations with the surgery, and to determine the best educational setting for the child.
Methods:
30 Pediatric Patients were evaluated using the ChIP tool and had been implanted for 3 years or more were asked to participate in the study. Consents were obtained, and parents were asked to provide school/teacher information. The teacher/educator was asked to complete a questionnaire, based on the AuSpLan (to assess mode of communication and skill level) and the SIFTER test (to evaluate the academic placement of children with hearing loss). Statistical analysis was performed.
Results:
30 Teacher responses were analyzed using decision tree models to examine the relationship between response variables and possible predictors. For Independent Variable “Understands Spoken Vocabulary” there were significant results for those individuals who were rated “Below Age Level” and combined results of “At Age” or “Above Age Level.” Individuals who were rated below average for understanding spoken language were reported to use Total Communication since cochlear implantation. For those individuals “At Age” or “Above Age Level” 30% was reported to have Age Appropriate reading comprehension skills when reading to self with spoken language.
Conclusions:
Preliminary results show that the ChIP Tool is effective for determining candidacy. The results support ChIP A subjects are more likely to understand spoken vocabulary at age or above age level. Data for CHiP C scores indicate subjects are likely to use Manual Communication (ASL) in comparison to CHiP B or CHiP A subjects. The study is expected to continue to June 2017. At that time, we hope to determine more definitive results to support our hypotheses.

**Abstract ID:** 288  
**Poster Number:** 121  
**Title:** Gene Therapy Restores Hearing Function in a Mouse Model of Genetic Hearing Loss  
**Authors:** Kyu-Yup Lee, PhD, MD1, Min-A Kim, MS2, Nari Ryu, MS2, Un-Kyung Kim, PhD2;  
**Abstract:**  
**Introduction:** Methionine sulfoxide reductase B3 (MsrB3), which stereospecifically repairs methionine-R-sulfoxide, is an important Msr protein that is associated with auditory function in mammals. MsrB3 deficiency leads to profound congenital hearing loss due to the degeneration of stereociliary bundles and the apoptotic death of cochlear hair cells.  
**Methods:** In this study, we investigated a fundamental treatment strategy in an MsrB3 deficiency mouse model and confirmed the biological significance of MsrB3 in the inner ear using MsrB3 knockout (MsrB3(-/-)) mice.  
**Results:** We delivered a recombinant adeno-associated virus encoding the MsrB3 gene directly into the otocyst at embryonic day 12.5 using a transuterine approach. We observed hearing recovery in the treated ears of MsrB3(-/-) mice at postnatal day 28, and we confirmed MsrB3 mRNA and protein expression in cochlear extracts. Additionally, we demonstrated that the morphology of the stereociliary bundles in the rescued ears of MsrB3(-/-) mice was similar to those in MsrB3(+/+) mice.  
**Conclusion:** To our knowledge, this is the first study to demonstrate functional and morphological rescue of the hair cells of the inner ear in the MsrB3 deficiency mouse model of congenital genetic sensorineural hearing loss using an in utero, virus-mediated gene therapy approach. Our results provide insight into the role of MsrB3 in hearing function and bring us one step closer to hearing restoration as a fundamental therapy.

**Abstract ID:** 293  
**Poster Number:** 174  
**Title:** Hearing in Noise Benefit Using the Cochlear™ Mini Microphone 2+ with Nucleus® Sound Processors  
**Authors:** Marian Jones, Master of Audiology  
Design & Development, Cochlear Ltd, Macquarie University, Australia.  
**Abstract:**  
**Introduction**  
The Nucleus® sound processor allows wireless audio-connection, relieving recipients of the use of cables during certain communications. Traditionally, cochlear implant recipients’ access to assistive technology has involved connecting an Audio cable or using an intermediary device such as an FM receiver to the
sound processor. Although assistive technology can provide increased SNR benefit to the patient, they have drawbacks outside of their financial cost. With FM systems, an ear-level or bodyworn receiver is necessary for routing the signal to the patient’s hearing instruments. For children especially, this can create problems due to increased size of the hearing aid with the ear-level receiver, as well as the inconvenience of having a second device to wear.

The Cochlear™ Wireless Mini Microphone 2+ is a clip on microphone that transmits sound directly to the Nucleus® sound processor. Designed for one on one communication in difficult listening situation, and may also be connected directly to MP3 players. It is also compatible with GN Resound hearing aids.

The study evaluates the hearing performance benefit obtained using the Cochlear™ Mini Microphone 2+ wireless accessory and the Phonak Roger FM™ receiver with Nucleus® sound processor users.

Methodology
Twenty-four experienced Nucleus® recipients were recruited. The preferred hearing mode varied across participants with eight bilateral users, eight unilateral users, and eight bimodal users. Speech performance testing in adaptive classroom noise was conducted, comparing the sound processor(s) and GN Resound hearing aid (bimodal subjects) with and without the Mini Microphone 2+ or the Phonak Roger™ FM receiver.

Results
The speech performance results in adaptive classroom noise show that the Cochlear™ Mini Microphone 2+ provides significant benefit over the Baseline (Nucleus® processor(s)/hearing aid alone condition), as well as comparable benefits provided by Phonak Roger™ FM. Full details will be presented.

Conclusion
The Cochlear™ Mini Microphone 2+ is a convenient, easy to use wireless accessory that provides the Nucleus® sound processor user with increased hearing performance in difficult listening situations.

Hearing in Noise Benefit using the Cochlear™ Mini Microphone 2+ Accessory
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Abstract ID: 296
Poster Number: 213
Title: Factors Impacting Long-term Follow-up and Cochlear Implant Use in Children
Authors: Cynthia Warner, AuD1, Alecia Jayne, AuD1, Prashant S. Malhotra, MD2, Oliver F. Adunka, MD, FACS2, Ursula M. Findlen, PhD1;
1Clinical Therapies- Audiology Department, Nationwide Children's Hosp., Columbus, OH,
2Otolaryngology, Nationwide Children's Hosp., Columbus, OH.

Abstract: Introduction: The extent to which children wear their cochlear implant can be taken as an indirect measure of perceived benefit from using the device for communication. However, several factors have been identified as impacting long-term use of cochlear implants, including age at implantation, communication mode/approach, level of technology, and compliance with attending cochlear implant mapping appointments. Etiology of hearing loss as well as the presence of comorbid diagnoses have also been cited as potential factors impacting long-term use and/or benefit. Currently, there is insufficient data to specifically define how etiology, comorbid diagnoses, and audibility realized with the cochlear implant play a part in long-term use and how they may interact with other factors such as communication mode/approach, age at implantation, and compliance with recommended appointments.

Methods: Retrospective chart review of children implanted between 2006 and 2012 was used to explore the following factors among pediatric cochlear implant users and non-users: etiology of hearing loss,
presence and complexity of comorbid diagnoses, age at implantation, chosen communication approach, compliance with recommended follow-up, and distance to the implant center. All children had 5 years or more of follow up post-implantation. Comorbid diagnoses were defined using a modified Pediatric Medical Complexity Algorithm to define severity of comorbid diagnoses and mitigating social issues that can impact follow-through with recommended follow-up appointments. A multifactor analysis was used to evaluate the extent to which factors accounted for variability in a measure of audibility as well as whether a child eventually became a non-user.

**Results:** Consistent with previous results, age of implantation significantly impacted benefit realized by children with cochlear implants. Etiology of hearing loss, especially cochlear nerve deficiency, was associated with poorer long-term use. Increasing complexity of comorbid disease, mitigating social factors, and distance from the implant center impacted a child’s ability to attend audiology mapping appointments. Multifactor analysis suggests that these factors interact in a complex way to contribute to whether a child consistently uses their cochlear implant system or eventually discontinues use.

**Conclusion:** This study supported previous data and added several dimensions to studying how patient variables can impact benefit from cochlear implantation and eventual long-term use. Understanding these factors and how they interact can provide both implanting otologists and audiologists useful information when counseling families who are considering cochlear implantation for their children.

**Abstract ID:** 297

**Poster Number:** 221

**Title:** Current Measurements of Music Appreciation in Cochlear Implant Users

**Authors:** Alvin de Torres, MD1, Meredith Lilly, BS2, James Spratt, BS2, Michael Hoa, MD1; 1Otolaryngology-Head and Neck Surgery, Georgetown Univ. Hosp., Washington, DC, 2Georgetown Univ. Sch. of Med., Washington, DC.

**Abstract:** **Introduction:** Music plays an important role in intellectual, emotional and social development. Cochlear implant (CI) users experience deficits in music perception compared to normal hearing listeners (NHL) due to the difference between the stimulus provided by the CI from the stimulus generated by a normally functioning auditory system. This difference in music perception and appreciation is a result of current cochlear implant technology, which was initially developed for speech comprehension and has yet to be optimized for the more complex task of music processing. As CI technology advances, the ability to target music perception as a primary outcome is becoming more attainable. Consequently, specific methods and tests for evaluating music appreciation in CI users are needed. Music can be broken down into rhythm, pitch, and timbre. While CI users perform at the level of NHLs in rhythm perception, they perform below NHLs in perception of both pitch and timbre. Difficulty with pitch perception is multifaceted, but mainly stems from the inability of the cochlear implant to filter narrow frequency ranges and to deliver finely tuned electrical current to precise locations on the cochlear basilar membrane. Perception of timbre, which is comprised of both temporal fine structure (TFS) and temporal envelope (TE), is challenging due to CI users’ inability to extract information from the TFS of an auditory stimulus, meaning they rely almost entirely on the extracted TE. Abstract components of music, such as emotion, mood, and music satisfaction can also be measured. Our aim is to review the literature and present the current methods in which music appreciation and perception are being evaluated in CI users as well as the steps being taken to improve them.

**Methods:** A literature search was performed targeting pediatric CI users with example keywords being “cochlear implants” and “music” or “music appreciation” using Ovid, Pubmed, and Medline databases. The search was expanded to include adult CI users due to the paucity of pediatric studies. The search
was limited by study type to include comparative studies, clinical studies, case reports, and randomized control trials. The search was further limited to English articles published within the last ten years. Exclusion criteria were concomitant use of hearing aids during the study and significant residual hearing in the CI user group.

**Results:** The literature search generated 46 articles. A case report and comparative study were excluded based on relevance to this review. Studies were analyzed based on the independent variable and grouped accordingly. Dependent variables included audiogram and speech recognition tests, audio and visual stimulus pairing, music and satisfaction questionnaires and surveys, electroencephalography.

**Conclusion:** The current methods described in this review have contributed to the understanding and improvement of music perception in CI users. Promising approaches in improving music perception to date include processor and programming optimization and music training.

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**Abstract ID:** 300  
**Poster Number:** 131  
**Title:** Subjective Feedback and Satisfaction with the Cochlear Kanso™ Off the Ear Sound Processor Reported by Adult Cochlear Implant Users  
**Authors:** Marian Jones, Master of Audiology  
Design & Development, Cochlear Ltd, Macquarie University, Australia.  
**Abstract:** Subjective feedback and satisfaction with the Cochlear Kanso™ Off the Ear sound processor reported by adult cochlear implant users  
M.Jones1,  
1 Cochlear Sydney, Australia  

**Introduction**  
Advances in cochlear implant technology and micro processing over several decades has resulted in the miniaturization of the externally worn CI sound processor from a bulky body-worn device to smaller, current generation BTE processors housed over the ear and attached via a cable to a separate head worn transmitting coil. The Kanso Sound Processor is a new processor design that incorporates the coil and magnet into the processor body allowing the single unit, cable-free processor to be worn completely off-the-ear and offering potentially greater comfort and discretion compared with conventional BTE devices. While the form factor of the Kanso processor has been optimized for an OTE placement, the processor offers the same functionality as the current generation Nucleus 6 BTE processor technology including dual microphones, environmental classifier program SCAN, SmartSound iQ and wireless connectivity. The objective of this study was to evaluate the acceptance of the Kanso Sound Processor with emphasis on subjective hearing performance, retention & comfort, reliability and ease of use.

**Method**  
Twenty research participants aged 18 years of age or older and experienced with a Nucleus CP810 or CP900 series BTE sound processor completed the study. The preferred hearing mode varied across participants with seven bilateral users, four unilateral users, and eight bimodal/SSD users. Subjective feedback and satisfaction as well as acceptance and use of accessories, was assessed via completion of take-home diaries and administration of in-clinic surveys. Participants were asked to rate responses using a 5 point Likert scale and results were analysed using a one-sample signed rank test to identify differences between Kanso vs BTE processor ratings.

**Results**
Survey results comparing user responses for Kanso vs their own BTE processor will be presented. Comparisons of ‘Overall Hearing Performance’ (p<0.05), ‘Listening to Music’ (p<0.05), ‘Comfort’ (p<0.001), ‘Look and Feel’ (p<0.001), ‘Learn to Use (p<0.05) and ‘Ease of Use’ (p<0.01) were all found to be significantly more favourable for Kanso compared with the BTE processor. The majority of participants also reported an increase in confidence while wearing the Kanso processor. There was no significant differences found for other survey questions.

**Conclusion:** Study findings support that humanist factors such as comfort, usability, confidence and aesthetics may rate more highly with an OTE as opposed to a BTE sound processor. The Kanso sound processor may therefore provide an attractive alternative to conventional BTE processors especially for those CI users who highly value discretion and simplicity. Subjective feedback and satisfaction with the Cochlear Kanso™ Off the Ear sound processor reported by adult cochlear implant users

**Abstract ID:** 302  
**Poster Number:** 167  
**Title:** Pediatric Cochlear Implant Datalogging In Under 2 Year Olds  
**Authors:** Naomi J. Gibson, Master of Audiology, Joanne M. Lake, M Sp Ed, Megan Chinnery, BSLT; Southern Cochlear Implant Programme, Christchurch, New Zealand.

**Abstract:** 
**Introduction:** The availability of datalogging gives an objective record of cochlear implant processor use in the under 2 year old cohort.

**Methods:** Collected the datalogging results from 20 cochlear implant users in the under 2 year old population. Separated these results by gender, age at implantation and hearing aid use prior to implantion,

**Results:** Processor use increases as chronological age nears 2 years of age. The female populations processor use became more consistent at an earlier stage in the implantation processor.

**Conclusion:** Improved relationship between professionals and families as counselling is now based on objective evidence. Able to provide a different range of strategies in order to establish consistent processor use. Better informed parents for setting achievable processor use goals. Relationship between professionals and parents are strengthen as processor use goals are objective, open and measurable.

**Abstract ID:** 303  
**Poster Number:** 184  
**Title:** Analysis on Effect of Hearing and Speech Rehabilitation after Cochlear Implantation  
**Authors:** shaofeng liu, doctor

**Abstract:** Analysis on Effect of Hearing and Speech Rehabilitation after Cochlear Implantation  
**Introduction:** To assess and analyze the hearing and speech rehabilitation effect of patients with cochlear implants. Explore the rehabilitation effect of Nurotron cochlear implants in older deaf children.

**Methods:** Make hearing and speech rehabilitation assessment and one year follow-up visit to 98 patients with severe and extreme severe bilateral sensorineural hearing loss who received unilateral implantation of Nurotron cochlea. The youngest case was 1 year and the oldest was aged 16, with average age of 8.86±3.66 years. All patients with cochlear implants selected were divided into three
groups, Group A included 10 cases with age of under 3 years old; group B included 26 cases with age of over 3 years but under 7 years old; group C included 62 cases with age of between 7 to 16. All groups were subjected to hearing and speech assessment by MAIS, CAP and SIR, before the surgery and at 3 months, 6 months and 12 months after surgery and booting respectively.

**Results:** The hearing and speech rehabilitation effect of all patients with cochlear implants gradually improved with extension of rehabilitation time. Scores of open speech assessment (%) of all the groups were as below: group A (9.70±2.41), group B (13.89±3.27) and group C (13.69±3.90) before surgery; group A (24.30±2.36), group B (27.38±5.33) and group C (19.42±2.85) at 3 months after surgery and booting; group A (32.81±2.74), group B (36.81±6.69) and group C (24.89±3.21) at 6 months after the surgery and booting; group A (49.50±5.68), group B (47.31±9.48) and group C (36.83±3.48) at 12 months after surgery and booting. The scores of Chinese Auditory Perception Assessment (%) of all groups were as below: group A (17.20±5.57), group B (20.77±5.16) and group C (24.78±8.06) before surgery; group A (39.90±7.39), group B (48.65±5.36) and group C (44.34±6.37) at 3 months after surgery and booting; group A (55.40±10.46), group B (59.65±8.77) and group C (56.16±7.21) at 6 months after booting; group A (68.70±10.07), group B (72.54±9.79) and group C (67.27±7.57) at 12 months after booting. MAIS scores of all groups were as below: group A (8.90±2.51), group B (13.42±3.35) and group C (13.94±4.40) before the surgery; group A (23.60±3.10), group B (26.31±3.11) and group C (20.55±3.66) at 3 months after the surgery and booting; group A (27.70±3.34), group B (28.81±3.69) and group C (24.68±3.23) at 6 months after the booting; group A (31.90±5.02), group B (31.19±3.81) and group C (28.44±3.33) at 12 months after booting. 12 months after booting, CAP comparative difference between the groups (t=12.79, p=0.002) was distinct and was of statistical significance (P<0.05). 12 months after the surgery and booting, SIR comparative difference between the groups (t=12.61, p=0.002) was distinctive and was of statistical significance (P<0.05).

**Conclusion:** Nurotron cochlear implantation can improve the hearing and speech ability of bilateral extremely severe sensorineural deafness patients, and the longer the rehabilitation time after implantation, the better the effect. The younger the age for implantation, the better the postoperative rehabilitation effect. However, older deaf children can still improve in speech perception and cognitive abilities through cochlear implantation. It is a worthy tentative approach on cochlear implantations in older deaf children.

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**Abstract ID:** 305  
**Poster Number:** 170  
**Title:** Pediatric Case Report of Performance with Three Different Remote Microphone Systems: Receivers Versus Streamers  
**Authors:** Beth A. Holstad, Au.D.  
Audiology, The Moog Ctr. for Deaf Ed., St. Louis, MO.  
**Abstract:** **Introduction:** Parents frequently report that their child has difficulty hearing in noise, despite use of new speech coding strategies aimed at conquering this problem. Subjective and objective benefit of noise programs continues to lag behind that realized with remote microphone systems. Schools struggle with the costs associated with providing IEP mandated digital remote microphone systems, and gravitate toward cost-saving single-receiver options coupled to neckloop systems, streamers; or, microphone streamers alone. Historically, signal delivery through non direct connect systems has resulted in poorer performance. Current systems that stream remote microphone signals with or without a single receiver may likewise result in poorer performance compared to direct connect, bilaterally fitted digital receivers. Conversely, wireless streaming of remote microphone signals, with or
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without a receiver, may be more cosmetically desirable to children, and reduce processor battery drain and power limitations.

**Methods:** Completed fitting and functional evaluation of three systems: 1) a digital, dynamic remote microphone/2-receiver system, 2) a digital, dynamic remote microphone/1-receiver/streamer system, and 3) a streamer alone using 60 dBA recorded presentation of the W-22 word lists (binaurally) and AZBio sentence lists (monaurally) presented at 0° azimuth in quiet, in noise, and in noise with HAT system. Recorded multitalker babble was presented at -180° azimuth for binaural testing, and at the test ear for monaural testing in noise conditions, at a SNR needed to reduce performance in quite by ~50%. Optimal receiver gain or streamer volume was identified as that which allowed performance in noise to equal or approximate that in quiet.

**Results:** In quiet, listening with both implants only, RS repeated words with 84% accuracy. In the monaurally aided condition, AZBio sentences were repeated with 95% and 92% accuracy at the right and left ear respectively. In noise (0 SNR), RS’s accuracy declined to 40% for words, and 57% (right), 38% (left) for sentences. With the addition of a digital, dynamic remote microphone/2-receiver system, RS repeated words with 92% accuracy and sentences with 89% (right) and 93% (left) accuracy. With a digital, dynamic remote microphone/1-receiver/streamer system words were repeated with 92% accuracy, and with a streamer alone, words were repeated with 88% accuracy.

**Conclusion:** For this child, essentially equal performance was possible using a 0 SNR in 60 dBA of noise with these three systems. This unexpected finding suggests future hypothesis-based evaluation of these systems is warranted in larger groups of children, and at higher levels of noise.

Abstract ID: 306
**Poster Number:** 58
**Title:** Who Can Benefit from EAS?
**Authors:** young-myoun, MD, You-Ree Shin, MD; Soree Ear Clinic, Seoul, Korea, Republic of.

**Abstract:** **Introduction:** EAS have produced large improvements in the speech reception abilities of these patients. Prerequisites for successful EAS are the followings; (1) Fully understand how acoustic sound is important in CI use. (2) Validate surgeon’s confidence on his own HP surgery. (3) Try to look for possible candidates to get benefit from EAS. (4) Set up how to effectively apply acoustic sound to CI user! Fitting strategy. Although EAS have been established as highly effective procedures, questions remain about candidate selection: who can benefit from optimal combinations of electric and acoustic stimuli.

**Methods:** 33 subjects (39 ears) who have a variable range of residual hearing pre-CI operation were enrolled in this study, which were divided into two groups by post-CI residual hearing levels; one was characterized by functional residual hearing in the low frequency bands with nearly total deafness in the high frequency range (PD-group: N= 34, Age; mean 27.7 yr (range 3~60Yr)). Initially PD-group were divided into the following subgroups : Electrical partial stimulation(EPS), EPS-extended, Electric Acoustic Stimulation(EAS), EAS-extended 1 & 2, non-EAS. The other group was characterized by severe to profound HL in the most of frequency bands without total deafness (Non-PD group:N= 5, Age; mean 23yr (range 4~49 Yr). All patients were recommended the combined use with natural hearing or amplified sound with HA. The acoustic benefits according to available residual hearing level or frequency range were evaluated by measurement of acoustic and electric-acoustic performance in speech, music, noise in best EAS mapping condition. All patients were asked the reasons to use acoustic hearing with CI.
Proper acoustic range and mapping optimization were different according to postop. residual hearing frequency range and speech processor.

**Results:** Most of subjects preferred to use natural acoustic sound or amplified sound with CI. If the residual hearing level below 250Hz was higher than 30dB, patients preferred to the fitting condition of partial stimulation by CI, on the other hand, patients with residual hearing lower than 30dB at 250Hz needed amplification. In EAS groups, if for some benefits to patients, there must be remained residual hearing of 85dB higher below 250Hz. If not there were not any benefits with EAS mode. In non-PD group, the patients who had some residual hearing at <1KHz showed some benefits with HA. Taking together, we can summarize the available audiologic criteria for acoustic

**Conclusion:** All these patients even though with different levels of residual hearing preferred to use acoustic hearing, however the degree of benefit differed between the groups. So the differentiation between the groups is very important, because the groups are not equal and their goals in treatment are different. Concluding we can say that even though HP was not successful, some residual acoustic hearing might be helpful for the better performance, so we should give a chance to use acoustic sound to all CI users with residual hearing. However, when discussing the possibility of expanding the criteria for EAS CI candidacy, several unique groups need to be reviewed, each having their own special considerations.

**Abstract ID:** 312  
**Poster Number:** 55  
**Title:** A Case of Cochlear Implantation in Neurofibromatosis Type II  
**Authors:** Sung-Won Choi, MD, Se-Joon Oh, MD, PhD, Eui-Kyung Goh, MD, PhD, Soo-Keun Kong, MD, PhD; Otorhinolaryngology Head and Neck Surgery, Pusan Natl.I Univ. Hosp., BUSAN, Korea, Republic of.  
**Abstract:** Introduction: Patients with neurofibromatosis type 2 (NF2) develop bilateral vestibular schwannomas that can cause binaural progressive hearing loss in most individuals. Auditory rehabilitation for profound bilateral sensorineural hearing loss in patients with NF2 poses a great therapeutic challenge.  
**Methods:** Here we report a case of undergoing CI after having been treated with gamma-knife in NF2 and showing improved open-set speech perception. The patient had progressive hearing loss over 5 years and there were observed bilateral acoustic tumor about 2 years ago. His mother had also bilateral deafness. So we diagnosed NF2 and gamma knife radiosurgery was done. Thereafter, the size of masses were decreased and kept stable. But he had still progressive hearing disturbance, so wanted to have better hearing performance. Pure tone audiometry showed approximately 88 dBHL in right ear, 100 dBHL in left ear. Speech discrimination were Rt 32%, Lt 4%. There were response in Rt ear at 90 dB click sound, and no response in Lt ear on auditory brainstem response. Temporal bone computed tomography (CT) showed bilateral enlarged internal acoustic meatus and Magnetic resonance image (MRI) showed bilateral acoustic tumors, which its size were right7×3mm, left 16×9 mm  
**Results:** We decided to do cochlear implantation, preoperative promontory stimulation test showed bilateral similar response threshold and gap detection. We had discussed with the patient to decide the implant site. At first, we recommended the Rt side which showed more superior discrimination scores. But the patient wanted to use binaural hearing that Rt. Ear was used by hearing aid and Lt. ear was used by cochlear implant. So we decided to do CI in Lt ear. There were no specific event in the operation room, Neural response telemetry (NRT) showed the responded in the all channel. At 10 months after
surgery when the mapping were stable, speech discrimination by using HINT showed 96%, CAP score were 7, pure tone audiometry in sound field showed 32 dBA threshold

**Conclusion:** Auditory rehabilitation is essential to preserve the quality of life of NF2 patients. Where there is some residual hearing, this can be achieved through optimization of hearing aids. However, in profoundly deaf patients or patients where treatment is likely to cause profound deafness, cochlear implantation (CI) and auditory brainstem implantation (ABI) provide the best options for rehabilitation. The decision-making process is complex and requires consideration of each side with respect to tumor size, rate of tumor growth, hearing level, presence or absence of cochlear nerve and function, facial function, and patient choice. A number of options exist when planning hearing rehabilitation. CI may be of benefit if a patient requires VS excision where cochlear nerve preservation is thought possible, independent of the level of preoperative hearing in either ear.

**Abstract ID:** 313  
**Poster Number:** 56  
**Title:** Cochlear Implantation after Bilateral Otic Capsule Violating Temporal Bone Fractures  
**Authors:** Sung-Won Choi, MD, Se-Joon Oh, MD, PhD, Soo-Keun Kong, MD, PhD, Eui-Kyung Goh, MD, PhD; Otorhinolaryngology Head and Neck Surgery, Pusan Natl. I Univ. Hosp., BUSAN, Korea, Republic of.  
**Abstract:**  
**Introduction:** Temporal bone fractures often cause a loss of audiovestibular function. Patients with bilateral profound sensorineural hearing loss due to temporal bone fractures but who still have an intact auditory nerve may become candidates for cochlear implantation. However, due to post-traumatic fibrosis or ossification of the cochlea, surgery could be challenging and complicated. Therefore, it is essential to carefully evaluate imaging studies that include computed tomography (CT) and magnetic resonance imaging (MRI).  
**Methods:** The patient was referred to the otology department with bilateral deafness. Two months before presentation, the patient had severe trauma after a traffic accident and was admitted to the neurosurgical department with subdural and subarachnoid hemorrhages for conservative treatment. After the patient recovered from his acute injury, he noticed bilateral hearing loss. An otoscopic examination was normal, and audiologic examination revealed bilateral profound sensorineural hearing loss. A high-resolution temporal bone CT revealed bilateral otic capsule-violating temporal bone fractures. Cochlear implantation was considered for aural rehabilitation. However, the patient decided to wait for natural revival of hearing. After two months the patient admitted his deafness and expressed a desire for cochlear implantation. A repeated audiologic evaluation revealed findings similar to those of the previous test.  
**Results:** On the high-resolution temporal bone CT, obliteration and labyrinthitis ossificans were not detected, as in the previous scan. However, obliteration of the pathway from the right vestibule to the right basal turn was identified on the temporal MRI; this finding was not detected on a previous MRI obtained two months earlier. The left ear was selected as the side for implantation four months after the trauma. A Med-El ConCERTo Flex 28 (Med-El GmbH, Innsbruck, Austria) was used, achieving a full insertion of all electrodes without any difficulty. Intraoperative neural response telemetry tests were positive. Following mapping, programming, and aural rehabilitation, the patient’s auditory performance was excellent with categories of auditory performance (CAP) of 7. On follow-up, he experienced no problems for eight months  
**Conclusion:** Cochlear implantation provides effective aural rehabilitation in severe to profound hearing loss following temporal bone fractures. However, some points must be considered before performing
Cochlear implantation. Temporal bone fractures may lead to ossification of the cochlea. Therefore, we recommend cochlear implantation as soon as possible after a patient is deafened by bilateral temporal bone fractures. Also, when there is a significant time delay between the initial imaging studies (CT and MRI) and cochlear implantation, repeated imaging studies are essential to rule out labyrinthitis ossificans and other structural abnormalities that may inhibit successful placement of electrodes.

**Abstract ID:** 314  
**Poster Number:** 188  
**Title:** Does Electrical Stimulation Improve Neural Synchronisation after Cochlear Implantation? A Comparative Study in Sensorineural Hearing Loss, Auditory Neuropathy Spectrum Disorder and Hypoplastic Cochleovestibular Nerves  
**Authors:** Neevita Narayan, BSc, MBA1, Prabhash Kumar, BSc, MSc1, Ameet Kishore, FRCS2; 1SpHear Speech & Hearing Clinic, New Delhi, India, 2Indraprastha Apollo Hosp., New Delhi, India.  
**Abstract:**  
**Introduction:** The electrically evoked compound action potentials (ECAP) measurements are most popular objective measure due to the ease of recording and less time required for recording. ECAP measurements have the sensitivity of 89% and specificity of 96% (Botros, Dijk & Killian, 2007). There is increasing number of cochlear implantation being carried out in auditory nerve anomalies due to advancement in cochlear implant technology and proven outcomes in this population. Studies have reported improvement in neural synchronisation measured through ECAP measurements in children/adults with no nerve anomalies (Moura et al, 2014; Caldas et al, 2015). Through this study we aimed to demonstrate similar results in recipients with auditory nerve anomalies also. In our study we aimed to look for an improvement in auditory nerve synchronisation following electrical stimulation over a period of time in children with Cochlear Implants. To then compare the improvement in auditory nerve synchronisation across different groups such as: Sensorineural Hearing Loss (SNHL) without auditory nerve anomaly, Auditory Neuropathy Spectrum Disorder (ANSD) & SNHL with hypo-plastic cochlea-vestibular nerves (CVN)  
**Methods:** 45 children in the age range of 2 to 6 years who underwent cochlear implantation with a minimum of 12 months follow up were selected for this study. Of these, 25 children had SNHL without any auditory nerve anomalies. Ten children were in the ANSD group. Ten children were in the hypo-plastic cochleo-vestibular nerve group. At the end of the cochlear implant surgery, Intra-operative ECAP measurements were done in auto and manual mode for 5 electrodes across the array. Postoperatively ECAP measurements were also done at regular intervals of 3,6,9 and 12 months. A retrospective analysis was done on ECAP measurements post 12 months of electrical stimulation. The reason for this analysis was to see if there is any improvement in neural synchronisation following electrical stimulation over time. We looked at the change in T-NRT values and N1-P1 amplitude at T-NRT level. Comparison of the results of SNHL group, ANSD group and hypo-plastic cochlea-vestibular nerve group was done. The data was analysed statistically.  
**Results:** Electrical stimulation over a period of time has improved the neural synchronisation of auditory nerve in all the children with cochlear implants as seen by an improvement in the N1-P1 amplitudes at T-NRT. Analysis showed a statistically significant improvement in neural synchronisation in all three groups of recipients. The SNHL with normal auditory nerve group demonstrated the most significant improvement , followed by the ANSD group as compared to hypo-plastic CVN group.  
**Conclusion:** Overall there is an improvement in neural synchronisation post electrical stimulation with cochlear implants over time. This had been previously reported in cochlear implant users without any nerve anomalies (Moura et al, 2014; Caldas et al, 2015). We too have demonstrated improvement in
neural synchronisation post electrical stimulation in all our cochlear implant recipients. In addition, we have been able to show that children with auditory nerve anomalies such as ANSD and CVN anomalies have also demonstrated improvement in neural synchronisation following cochlear implants. This gives us confidence to take up such children for cochlear implantation when we see such improvement in objective measures as well.

Abstract ID: 316
Poster Number: 76
Title: Management of Surgical Difficulties During Cochlear Implant with Malformed Ear
Authors: djilali aiad khaled, Maitre de conferences médecine, chu sidi bel abbes, sidi bel abbes, Algeria.
Abstract: Introduction: Inner ear malformations constitute about 20% of congenital sensorineural hearing loss; the cochlear Malformations are of special interest nowadays, as the indication for cochlear implant surgery is expanding. In a retrospective evaluation, the aim of this study was to assess the outcomes of cochlear implantation in children with inner ear malformations
Methods: A retrospective review of 43 children who received implants from June 2008 to November 2015 was performed. Six of them had radiologic evidence of inner ear malformations, The preoperative evaluations, intraoperative findings, postoperative complications, and performance outcomes were analyzed.
Results: We noted a clear male prevalence; the sex ratio is of five boys for a girl. Among the 6 children having a cochlear malformation we noted the concept of marriage between blood relations in the parents in at only case 16.67% of these children having cochlear malformation have a major deaf cases in the family. 16.67% of the 6 children established in our service present another case in the family. The similar cases in the siblings were seen at 16.67% of our children. The notion of fever was noted at 16.67% of the children. One patient had a bronchiolite, another had hyperpyretic convulsions, 16% of the patients having malformation of inner ear ears had a standard sero-mucous otitis 66.66% of the children having cochlear malformation had a standard malformation mondini, the vestibular dilatation and of the vestibular aqueduct 50%, and 16 had a common cavity was noted. The cochlear ossification minim was noted in 16% of our patients, and the procidence of facial nerve in one case. There were no serious postoperative complications. All children with Inner ear malformation achieved open-set speech perception abilities, and showed progressive improvement of their speech perception abilities over time. There were no statistically significant differences in performance measured by the Common Phrases test between the groups. Although the repeated-measures analysis of variance indicated that children with Inner ear malformation performed more poorly than those with a normal inner ear.
Conclusion: The results of the present study show that cochlear implantation can be performed relatively safely in deaf children with inner ear malformation and that they receive considerable benefit from their implants.

Abstract ID: 317
Poster Number: 54
Title: Surgical Outcome of Cochlear Implantation in Patients with Chronic Otitis Media.
Authors: Jin-Woong Choi, M.D, Ph.D, Yong-Su Lee, M.D, Jee Hye Chung, M.S, Yong-Ho Park, M.D, Ph.D; Chungnam Natl. Univ. Coll. of Med., Daejeon, Korea, Republic of.
Abstract: Introduction: This study evaluated the surgical outcomes of cochlear implantation in patients with chronic otitis media (COM)

Methods: The clinical data of 12 cases of cochlear implantation in presence of COM was analyzed retrospectively. Rates of postoperative infections, complications and post-implant speech performance were analyzed.

Results: Six patients underwent one-stage operation involving subtotal petrosectomy associated with external auditory canal closure and mastoid and Eustachian tube obliteration. The other 6 patients had two-stage operation involving tympanoplasty or canal wall down mastoidectomy with middle ear and mastoid obliteration and blind sac of the external auditory canal followed by cochlear implantation. There were no infections or medical complications after implantation except one patient who had a breakdown of external auditory canal closure with electrode exposure. All had good speech performance scores at 1 year post-implantation (median CAP, 6; mean sentence test, 72.3±26%). There was no significant difference in speech performance according to the operation methods.

Conclusion: Cochlear implant patients with COM have no increased risk of postoperative infections or complications. In addition, these patients have good speech performances. Cochlear implantation is a safe and effective treatment for patients with severe to profound hearing loss secondary to COM.

Abstract ID: 319
Poster Number: 192
Title: Effects of a Novel Sound Processing Strategy on Music Perception and Enjoyment in Cochlear Implant Users

Authors: Bjørn Petersen, Ph.D.1, Anne Sofie Andersen, Medical student2, Elvira Brattico, Ph.D., Professor2, Therese Ovesen, MD, DMSc3, Hanne Owen, MD4, Franck Michel, M.Sc.EE4, Minna Sandahl, Audiologist4, Peter Vuust, Ph.D. Professor1; 1Dept. of Clinical Medicine, Health Aarhus University, Ctr. for Music in the Brain, Aarhus, Denmark/Royal Academy of Music, Aarhus, Aarhus C, Denmark, 2Dept. of Clinical Medicine, Health Aarhus University, Ctr. for Music in the Brain, Aarhus, Denmark, Aarhus C, Denmark, 3Dept. of Clinical Med., Aarhus Univ. and ENT department, Hosp. Unity West, Denmark, Aarhus C, Denmark, 4Clinic of Audiology, Aarhus Univ. Hosp., Aarhus C, Denmark.

Abstract: Introduction: With the considerable advances made in cochlear implant (CI) technology with regard to speech perception, it is natural that many CI-users and -candidates express hopes of achieving music enjoyment. However, due to limitations in the sound transmission, music listening with a CI is challenging, leading to reduced music perception and enjoyment for CI users.

A crucial element in a CI is the sound processing strategy which usually integrates automatic gain control (AGC) with the purpose of adaptively reducing input dynamic range (IDR) at the front-end and limit the difference in intensity between input and output. However, this approach may result in losses in soft sounds and distortions in loud sounds which eventually could lead to lost information. A new back-end output compression system (xDP) used in the the Saphyr Neo and the Neuro One speech processor device from Oticon Medical (OM) operates with a continuously wide IDR which has previously proven beneficial for CI users. Thus, this strategy could provide a better listening experience, and possibly augment music enjoyment for CI users. This study aims to test two hypotheses: 1) A CI sound processing strategy incorporating back-end multi-channel compression may significantly enhance accuracy in discrimination of details in music at both the neurophysiological and the behavioral level and augment music appreciation in CI users compared to a front-end AGC based strategy. 2) After three months of CI experience, CI users’ music discrimination accuracy at both the neurophysiological and the behavioral
level as well as self-reported music appreciation levels will be significantly enhanced. Furthermore, evoked brain responses to salient feature changes embedded in a whole piece of music, indexing the possibility of automatic extraction of simple sound features from a realistic sound environment will increase and extend to more subtle feature changes after three months of CI experience.

**Methods:** Using electroencephalography and an adapted no-standards musical multifeature paradigm, we will record the mismatch negativity (MMN) response to four different deviants (pitch, intensity, timbre, rhythm) presented in four levels of deviation magnitude. As an additional measurement, EEG-recordings will be performed using a naturalistic paradigm with entire pieces of music with and without lyrics. Complimentary behavioral tests include a multifeature music discrimination test, an emotional speech recognition test and continuous behavioral ratings. Furthermore, CI users are requested to complete a Danish version of the IOWA Musical Background Questionnaire to survey music habits, experience and enjoyment. Tests will be carried out one week after switch on of the implant (T1) and again after 3 months (T2). Participants include OM implant users as well as users of Cochlear, Advanced Bionics or Med-EL brands. Normal hearing controls will provide reference data.

**Results:** This is work in progress. Results will be presented at the conference.

**Conclusion:** This study offers the capacity to guide the development of novel sound processing strategies in CIs, which may improve perception of music in CI recipients and, as positive side-effects, even their perception of details in speech and quality of life. In a wide perspective, the results may represent a substantial step forward in the development of CI outcome, impacting daily life of adult and pediatric CI users worldwide.

Abstract ID: 322
Poster Number: 46
**Title:** Cochlear Implant Outcome
**Authors:** khabti A. Almuhanna, dr., md.
ORL, PSMMC, Riyadh, Saudi Arabia.
**Abstract:** Cochlear implant outcome with malformed cochlea
Primary instigator: Dr.Khabti Almuhanna
Abstract
The cochlear implant (CI) designed to restore some sense of hearing for children and adults who receive little or no benefit from hearing aids. It is well established that The impact malformed Cochlea will affect the implantation outcome.
Cochlear implantation program in place at PSMMC since 2009, Success of any program depend on:
The team work overt, Effective collaboration, Leadership support and higher authority support.
The aim of the study to assess the performance and the outcome of our Cochlear implantation program In regard to malformed coclea. Fifteen cases out of the 180 cases were found to fit the criteria.
Result and conclusion: The average age group at the implant was 3.5 years and ranged between 1-9 years which is higher than other reports. Substantial improvement was recorded in both speech and auditory levels post implantation outcome of malformed cochlea going to be mentioned in comparison with normal cochlea.

Abstract ID: 326
Poster Number: 204
**Title:** Hearing Performance with Different Generations of Fine Structure Strategies
Authors: Tobias Rottmann, Dipl.-Ing., Manfred Schwebs, B.Sc., Thomas Lenarz, Prof. Prof. Dr., Andreas Büchner, Prof. Dr.; Department of Otolaryngology, Med. Univ. of Hannover, Hannover, Germany.

Abstract: Introduction: Coding strategies of cochlear implant systems concerning their performance in speech understanding could be constantly improved over the last decade. The classic CIS (Continuous Interleaved Sampler) strategy still forms the basis for many CI coding strategies. Based on this basic principle, MED-EL has been developed different generations of fine structure coding strategies. Therewith better low-frequency is coded by dynamically adapting the stimulation rate on the most apical channels depending on the incoming acoustic signal. The first generation of the fine structure strategies is called FSP (Fine Structure Processing) which theoretically offered rate pitch information on three but on average only on two fine structure channels. To be able to guarantee fine structure processing on four apical channels regardless of mapping parameters, a more advanced version, FS4, has been developed. Further optimization procedures lead to the newest iteration of fine structure processing, the so-called FS4 HR strategy. HR stands for High Rate and offers an increased stimulation rate in the non-fine structure CIS-type channels in contrast to FS4 LR (Low Rate).

The aim of the two studies presented here was to compare speech perception outcomes of the three fine structure implementations mentioned above (FSP, FS4 LR and FS4 HR).

Methods: 15 subjects (1st study) and 20 subjects (2nd study) with a minimum age of 18 years and a minimum hearing experience of 6 months with the FS4 LR (1st study) and with the FSP (2nd study) strategy have been recruited. All subjects were required to yield a minimum score of 20% in the HSM sentence test in noise to be able to participate in the studies. Within both studies speech tests were conducted right before and after switching the subjects from FS4 LR to FS4 HR (1st study) and from FSP to FS4 HR (2nd study), respectively. In the 2nd study a control group was included keeping the FSP strategy for three months. Testing material consisted of the Oldenburg sentence test in noise, the HSM sentence test in noise and the Freiburg monosyllabic word test. The complete test battery was repeated three months after the switch-over again for both strategies in both studies.

Results: The final data of the FS4 LR and FS4 HR comparison shows significantly better results for the FS4 HR strategy in the Freiburg monosyllables and in the Oldenburg sentence test. Preliminary results of the FSP and FS4 HR comparison show no significant differences.

Conclusion: The final data of the FS4 LR and FS4 HR comparison shows significantly better results for the FS4 HR strategy in the Freiburg monosyllables and in the Oldenburg sentence test. Preliminary results of the FSP and FS4 HR comparison show no significant differences. On the basis of the current study results, it seems viable to give a recommendation for the use of both FS4 HR and FSP in the daily clinical routine. Further study results may show if one of these strategies would be generally preferable.

Abstract ID: 331  
Poster Number: 79  
Title: Cochlear Implantation in the Patient with Open Mastoid Cavity

Authors: Choon Dong Kim, MD, PhD

Abstract: Introduction: Profound hearing loss can be followed by the process of chronic otitis media. The aim of the study is to evaluate management options in cochlear implantation in patients with open mastoid cavity.

Methods: The authors performed 13 cases of cochlear implantation in open cavity mastoidectomy state patients without obliteration of mastoid or with the partial obliteration of mastoid from July 2011 to August 2014. Of these fourteen patients, eight patients received cochlear implantation in open mastoid cavity and others in normal mastoid. The medical records and radiological findings were reviewed retrospectively.

Results: Three of eight patients who had undergone open cavity mastoidectomy did not perform mastoid cavity obliteration before cochlear implantation. Another five patients with an open cavity mastoid had undergone the partial obliteration of mastoid during cochlear implantation. To date, Protrusion of electrode was seen on one patient without obliteration of mastoid.

Conclusion: The lack of protection by the external auditory canal(EAC) and the tympanic membrane heightens the risk of electrode array extrusion. Among the various surgical strategies proposed in the literature to avoid these complications, EAC closure, associated with cavity obliteration and Eustachian tube occlusion, is one of the most reported. It is mandatory to secure an infection-free ear before implantation. It is also essential to create a strong protective layer of tissue capable of covering the electrode array especially in the mastoid cavity.

Abstract ID: 332
Poster Number: 74
Title: The Impact of Electrode Type on Intraoperative and Postoperative Telemetry Measures in Cochlear Implant using Different Surgical Technique
Authors: Amr G. Ismail, MD degree , Assistant Professor of Otolaryngology

Abstract: Introduction: Cochlear implantation (CI) is largely considered successful based on the device’s ability to reliably send electrical signals to the auditory nerve fibers. Telemetry (electrode impedance) is a bidirectional communication system. The telemetry system allows us to test the basic functions of a CI and to detect the electrical problems in each electrode.

Methods: A retrospective analysis of impedance data from 69 CI surgeries occurring at the Hearing and Speech Institute was conducted. Intraoperative and postoperative impedance values were available in 69 pediatric and adult patients during the first fitting 3 weeks to 1 month postoperatively. The data obtained in this study were divided into four groups depending on the type of implanted electrode and device used. In this research, four types of electrodes (Mid Scala, 1J, Flex 28, and Standard) and two surgical techniques (cochleostomy and round window) were used.

Results: Findings showed that there is a statistically significant difference between intraoperative and postoperative mean average of telemetry measure for 1J and Flex 28 electrodes that increased postoperatively. There was no statistically significant difference between intraoperative and postoperative mean±SD of each of the two electrodes (Mid Scala, 1J, Flex 28, and Standard). Comparison between intraoperative and postoperative average of the four electrodes shows statistically significant difference in intraoperative average. The study also showed that there is no statistical difference between telemetry results when either cochleostomy or round-window approaches were used.

Conclusion: Findings of this research showed increase in postoperative impedance with all types of electrodes, which can be referred to the absence of electrical stimulation prior to initial activation of the
device. There is statistically significant difference in intra-operative telemetry average between four types of used electrode.

Abstract ID: 333
Poster Number: 112
Title: A Systematic Review of Safety Outcomes for Implantable Bone Conduction and Middle Ear Devices
Authors: Michael Urban, MBA, MSc, Ruth Zoehrer, PhD, Bettina Schlick, PhD, Severin Fuerhapter, PhD; BU Vibrant, MED-EL Med. Electronics, Innsbruck, Austria.

Abstract: Introduction: In cases of hearing loss, malformations, and other medical conditions of the ear, implantable hearing devices fill a clinical need that often cannot be suitably treated by conventional hearing aids. Due to their invasive nature, however, one of the most obvious concerns with the use of implantable hearing devices is their safety. In this study, publications reporting complications of different Bone Conduction and Middle Ear Implants, which have been systematically reviewed, will be compared.

Methods: Pubmed and DIMDI databases were searched using a comprehensive search strategy to identify articles published between 1996 and 2016.

Results: A total of 3215 records were identified. After removal of duplicates, titles and abstracts were screened, unrelated titles were removed, and the full texts of the remaining 518 publications were extracted. A total of 259 studies comprising data from 14030 subjects reported on safety outcomes. The investigated devices proved to be safe and effective in means of hearing rehabilitation. Surgical complication rates are device specific, and postoperative problems are minimal. The most outstanding complication is connected to skin related conditions in the percutaneous group (both in the BAHA and Ponto, with 38.9%, 39.1%), and in the transcutaneously implanted cohort (the Sophono, with 18.1%). This is particularly surprising with the Sophono being a transcutaneous implant, aiming to avoid soft tissue related complications. The Baha Attract system showed the highest occurrence of 18.8% in patient related problems, such as pain etc., followed by skin related issues with 10.9%. The lowest percentage of overall safety outcomes by far, was seen in the Bonebridge with 7.8%. With regards to partially implantable active middle ear implants, it is worthwhile to mention that complication rates are not only dependent on the specific device but also on the indication and underlying pathology, and therefore type of Vibroplasty. This directly affects complication rates in conductive and mixed hearing loss cases (24.1%) that often comprise pre-operated ears and malformations compared to sensorineural hearing loss cases (19.6%) which imply complete and healthy anatomical structures in the ear.

Conclusion: Comparing the systematically obtained results which were grouped into categories of safety outcomes one can conclude, that subjects implanted with the Bonebridge experience the least number of complications with 7.2% (+0.6% revision surgery). Those pleasing results are followed by the Soundbridge. Emphasis needs to be drawn on differences in safety outcomes dependent on the underlying pathology and therefore type of Vibroplasty. Assuming similar beneficial audiological outcomes/benefits of the here presented devices within their specific indication ranges, the pros and cons regarding surgery, long-term safety and quality of life of the patient need to be taken into account when deciding on a device.

Abstract ID: 339
Poster Number: 171
Title: Electrically Evoked Auditory Steady State Responses from MED-EL Cochlear Implant Users
Authors: Hongmei Hu, Ph.D.1, Konrad Schwarz, Ph.D.2, Stefan Strahl, Ph.D.2, Mathias Dietz, Ph.D.3, Birger Kollmeier, Ph.D.; M.D.1, Stephan Ewert, Ph.D.1; 1Medizinische Physik and Cluster of Excellence Hearing4all, Universität Oldenburg, Oldenburg, Germany, 2MED EL GmbH, Vienna, Austria, 3National Centre for Audiology, Western Univ., London, Canada.
Abstract: Introduction: The evoked auditory steady state responses (ASSR) can be used to objectively estimate hearing sensitivity in individuals with normal hearing and with various degrees and configurations of sensorineural hearing loss. Recently, the use of electrically evoked auditory steady state responses (eASSR) with cochlear implant (CI) users was reported in several studies, where they were able to successfully record and interpret eASSRs in adult Cochlear Nucleus implant users. One of the critical issues of eASSR, especially with increasing stimulation rate, is the electrical stimulation related artifacts. Unlike the random noise which can be reduced by averaging responses to increase signal-to-noise ratio (SNR), some of the CI stimulation related artifacts are synchronous with stimulation and cannot be removed by averaging. These phase locked stimulus artifacts overlap with the evoked response in both the time and frequency domains, such that conventional time windowing and frequency filtering are incapable of removing stimulus artifacts without distorting the evoked response, particularly for high-rate eASSR. This study aims at developing a high-rate eASSR recording system for MED-EL CI users, by using near speech processor stimulation rate.
Methods: Instead of the CI users’ own processors, direct stimulation via a research interface box (RIB II, manufactured at University of Innsbruck, Austria) was used in this study. Three MED-EL CI users were recruited in the method developing stage. Different parameters, e.g., stimulation rates, modulation frequencies, stimulation polarities were investigated. A series of artifact reduction methods were further developed in this study, aiming at reducing CI stimulation coherent artifacts in eASSR. The methods were also applied to dummy recordings in a saline solution that only contain artifacts.
Results: The results show that the CI stimulation pulse artifacts can be reduced in some extent, but could not be totally removed at this stage. EASSR can be recorded from all these three CI users, but cautions should be taken in interpreting the Results: whereas the existence of a neural response can be shown, the magnitude of the response remains blurred.
Conclusion: With the methods developed in this study, we hope it will, at least to some extent, close the gap between exploratory studies and clinical practice of eASSR methods.

Abstract ID: 343
Poster Number: 103
Title: Selecting the Appropriate Electrode Array in Cochlear Implant Surgery
Authors: Horatiu E. Stefanescu, MD, PhD, Caius Doros, MD,PhD, Nicolae C. Balica, MD, PhD, Marioara Poenaru, MD, PhD; ENT, Victor Babes Univ. of Med. and Pharmacy, Timisoara, Romania.
Abstract: Introduction: In order to quickly estimate an individual’s cochlear duct length (CDL), a research software application was developed. Clinicians can use this information to select the cochlear electrode array size that is individually suited to each cochlear implant (CI) recipient. Furthermore, the research software application allows to post-operatively determining the percentage of cochlear coverage, the insertion depth and the insertion angle of individual electrode contacts.
Methods: Before surgery, the maximum basal turn diameter (value “A”) was measured on a coronal section of high-resolution computed tomography (HRCT) of the temporal bone. Based on “A”, the
research software application calculated the CDL, and either the longest or a shorter electrode was chosen for implantation. After implantation, the results of 21 consecutive patients (23 ears) obtained using the research software applications were compared to their postoperative X-ray measurements and to the surgeon’s intraoperative notes.

**Results:** The application was used in 21 consecutive patients (19 children, 2 adults). The A distance measured on CT scans varied from 7.8mm to 9.7mm with a mean value of 9.14mm; SD = 0.415. The measured “A” distances correspond to CDLs varying from 28.5mm to 36.4mm. The mean CDL was 34.05mm; SD= 1.72. Full insertion was achieved in all but 2 cases but there were no electrodes outside the cochlea. There was no electrode fold over detected on imaging. We inserted the electrode mostly through the round window (18/23). For 17 long electrode arrays, the software application suggested an insertion depth of 30.7mm and it was 29.4 mm on average according to measurements on the X-ray. For 5 shorter electrode arrays, the predicted insertion depth using the software application was 27.4 mm and it was 26.6 mm on average according to measurements on the X-ray. In one case we used an even shorter electrode.

**Conclusion:** The results suggest a good correlation between the insertion depths predicted preoperatively using the software application and calculated postoperatively using the X-ray. The insertion length predicted by software was always longer than that calculated on X ray.

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**Abstract ID:** 344  
**Poster Number:** 115  
**Title:** Cochlear Implantation - Lessons from our Deceased Patients  
**Authors:** David Low, MBBS, David Shipp, MA FAAAA, George Kurien, MD FRCSC, Trung Le, MD FRCSC, Joseph Chen, MD FRCSC, Vincent Lin, MD FRCSC; Otolaryngology - Head and Neck Surgery, Sunnybrook Hlth. Sci. Ctr., Toronto, Canada.

**Abstract:**
Cochlear implantation – Lessons from our deceased patients

**Introduction**
Given the increased prevalence of adult cochlear implants, there will inevitably be early mortality in some recipients, with a resultant short duration of utilization. The outcome and utility of cochlear implants in these patients, many of whom are elderly or with significant comorbidity, remains debatable. Our objective was to review the outcome and utility of cochlear implantation in this group of patients.

**Methods**
A search of the cochlear implant database of a tertiary hospital was performed. Patients who died in the years 2011 to 2016 were identified. These patients were further stratified based on their duration of utilization. Their electronic and paper-based records were reviewed, and data was collected. Specific outcome measures analyzed include surgical and anesthetic complications, postoperative speech perception scores and quality-of-life (QOL) measures (SF36 and HHI scores).

**Results**
80 patients were included in our study. The mean age at implantation was 69 years and mean age of death was 76 years. Of those with available data, the HINT-Q scores obtained were comparable to those in the average adult cochlear implant recipient. Their postoperative HHI scores showed a corresponding improvement but their SF36 scores did not reflect an improvement in their overall QOL. Complications are rare.

**Conclusion**
This review of our deceased patients suggest that despite a shorter duration of use, cochlear implantation is still of benefit and safe to perform in elderly patients and those with significant comorbid. The lack of improvement in their overall QOL is likely confounded by their poorer state of health.

Abstract ID: 346
Poster Number: 157
Title: Music Perception and Listening with Electric Hearing
Authors: Chhabinav Kumar, MASLP, Padma Priya D, MASLP, Sreevidya Sherla, MASLP, Anirban Dasgupta, Au.D; AUDIOLOGY, HELEN KELLERS INSTITUTE OF SPEECH & HEARING, SECUNDERABAD, India.
Abstract: Introduction: Music and Speech, the most complex processes of sound made by the human species, form an important part of many people’s lives. Music perception depends solely on intact spectral cue (Yucel&Mediterr,2006). One of the major difference between speech and music is the distribution of spectral energy (Boldue & Jonathan,2006). McDermott,2004-reported that performance on rhythmic pattern perception tasks was similar for implant users & normally hearing listeners. Many implant users describe music as unpleasant or difficult to follow as enjoyment of music is closely linked to the recognition of a familiar song or melody. The ability to identify familiar melodies is one of the most common assessments of CI-mediated music perception. When post-lingually deafened CI users are presented with previously familiar melodies. CI recipients are consistently impaired when compared to normal hearing subjects. This impairment is reduced with the addition of vocal lyrics and musical accompaniment (Shin, et al., 2003).
Methods: Five children with CI were included in the study. Five rhymes were selected with lyrics and were presented in two modes, the instrumental version and electronic keyboard. The responses obtained.
Results: All did not enjoy listening to music with their device and 3 of them presented lower scores of listening habits after implantation. Results indicate a wide range of success with music. Musical enjoyment is influenced by the listening environment and features of the music.3 subjects showed good ability to recognize rhymes with instrumental accompaniment but poor ability an electronic keyboard without verbal cues, indicating that they were recognizing the rhymes by verbal cues rather than by musical qualities such as tones and melodic intervals.
Conclusion: Trends in the patterns of correlation between speech and music perception suggest, music patterns are differentially accessible to CI users. New processing strategies may improve. Music remains an extremely challenging category of auditory stimuli for implant users. Surveys of cochlear implant users’ music listening habits indicate that a quiet listening environment and pre-existing familiarity with the music correlate with an increased enjoyment of music.

Abstract ID: 347
Poster Number: 50
Title: Racial Disparity in Age of Initial Cochlear Implantation in Children: A Local and National Perspective
Authors: Carlyn M. Atwood, BS, Meredith A. Holcomb, AuD, Shaun A. Nguyen, MD, David R. White, MD; Otolaryngology-Head & Neck Surgery, Med. Univ. of South Carolina, Charleston, SC.
Abstract: Introduction: A growing body of evidence supports improved speech, language, and developmental outcomes in congenitally deaf children who undergo cochlear implantation (CI). The
The purpose of this study is to determine whether disparities exist in age of initial CI in our local population and in a national pediatric surgical database.

**Methods:** The 2012-2014 American College of Surgeons National Surgical Quality Improvement Program - Pediatric (NSQIP-P) Participant Use Data Files were queried for cases with Current Procedure Terminology (CPT) code for cochlear implantation (69930) and age less than 3 years at the time of implantation. Also, a local database containing CI cases collected from a single, academic institution in the US from 2000-2016 was evaluated. Cases in the local CI database were included if the patient was less than 3 years old at the time of initial implantation. CI revisions and patients with a diagnosis of auditory neuropathy spectrum disorder were excluded. Only the first ear was included when the patient underwent sequential bilateral implantation. The median age at implantation was compared across available demographic factors. Due to non-normal distribution of the data, the Mann-Whitney U test and the Kruskal-Wallis H test were used to compare age of implantation between groups.

**Results:** There were 889 cases evaluated from NSQIP-P database, with a median age at implantation of 566 days. The population was primarily white (N=649). Patients identified as white underwent CI at a younger median age (545 days) compared to nonwhite patients (641 days). The age distribution comparison showed that the white cohort mean rank was significantly lower than the nonwhite group (p=0.001, Mann Whitney U test), indicating that white subjects underwent implantation at a significantly younger age. Our institutional database included 129 patients, 70 of which identified as white. In this database, children identified as white received their first CI at a younger median age (419 days) compared to their nonwhite peers (609 days). The white group had a significantly lower mean rank compared to the nonwhite group (p=0.009, Mann-Whitney U test), again demonstrating that white patients were implanted earlier than their nonwhite peers. When the same patients were analyzed by primary payer, there was no significant difference in the mean rank between those with Medicaid (median age=511 days), Tricare (median age= 402 days), or private insurance (median age = 475 days; p=0.768, Independent Samples Kruskal-Wallis Test). Because the NSQIP-P database does not include information on payer source, it could not be evaluated in this national database.

**Conclusion:** In both the NSQIP-P database and our local population, nonwhite children underwent CI roughly 3-6 months later than their white peers. In our local database, this disparity is not driven by primary payer. Further studies are required to identify underlying causes of this disparity.

**Abstract ID:** 348
**Poster Number:** 33
**Title:** An Analysis for Information and Expectations of Parents of a Child with Cochlear Implant

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**Abstract:** The aim of the present study was to analyze information and expectations of parents of the children between 1 and 12 years of age who had hearing loss and cochlear implantation (CI) without any additional disability. One of the objectives was to use the data obtained throughout the study to increase services and support before and after the cochlear implantation procedure through the information gathered from the parents.

**Methods:** "Family/Child General Information Form" and Turkish version of "Parent Approach to Children with Cochlear Implantation" which is used at international platform and "Information and Expectation Assessment Form for Parents Who Have Child with Cochlear Implant" which was adopted to our country.
were used. Totally 48 questions including 19 questions about preoperative period of cochlear implantation and 29 questions about postoperative period of cochlear implantation. In the research group, 111 parents (mother or father) who have a child between 1 and 12 years of age with CI without additional disability other than hearing loss were enrolled. A p value of 0.05 was determined as a significance level to interpret all test results and significance was determined at p<0.05 level.

**Results:** As a result of our research, main source of information for the parents who use many information resources about cochlear implant was audiologists (63.1%). In the present study, effects of eight different variables on the questions asked about preoperative and postoperative period of cochlear implantation and statistically significant cases were detected (p<0.05). According to the findings obtained, gender was found significantly effective on school attendance of the child, academic skill level gained after cochlear implantation, considering university hospitals as guiding and supportive institutions for cochlear implantation procedures.

**Conclusion:** At the end of the study, satisfaction level of the parents and children about cochlear implant was found high. Although the parents find the information before cochlear implantation sufficient, training about cochlear implant device and more detailed information about the procedure may affect their expectations after the implantation. We believe that our study would help to detect information and expectation states of the parents about cochlear implantation, to understand needs and expectations of the parents better and develop the services provided to the patients and their family during different stages of cochlear implant process.

**Abstract ID:** 349
**Poster Number:** 185
**Title:** Cochlear Implantation in Children with Borderline Hearing Loss
**Authors:** Eunjung Na, MSc, PhD (c)1, Elizabeth Fitzpatrick, PhD1, JoAnne Whittingham, Msc2, Janet Olds, PhD3, Rosemary Somerville, BA, LSLS Cert. AVT3;
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**Abstract:** **Introduction:** Determining cochlear implant candidacy criteria has proven to be a challenge due to significant improvements in medical and technology. As result, children with residual hearing are increasingly being considered for cochlear implantation however, decision-making can be difficult and tends to occur on a case-by-case basis. The aim of this population-based study was to investigate cochlear implant candidates in one region of Canada whose audiological profile was better than typical audiologic cochlear implant candidacy criteria. We examined their clinical profiles including etiology, age at diagnosis, time to implantation, age at implantation, and pre-implant speech perception/auditory function. In addition, this study examined whether cochlear implantation occurred later for these children and the reasons affecting later ages at implantation.

**Methods:** In this retrospective study, we reviewed the medical charts for all children who received cochlear implants in eastern Ontario, Canada from 1993 to 2016. We extracted medical and audiologic information for all children whose pre-operative PTA threshold was better than 90dB HL. In addition to degree of hearing loss, we also documented other factors related to age at implantation for these borderline children.

**Results:** A total of 348 children underwent cochlear implant surgery from 1993 to 2016 in the eastern Ontario region. Of these, 39 (11.2%) children had residual hearing which was better than typical cochlear implant candidate criteria. Since 2010 these children represent 30 to 40% of children implanted each year. The median age of cochlear implantation for these children was 49.3 months (interquartile
range: 31.2, 84.6) months, and the median preoperative PTA was 85.0 dB HL (interquartile range: 78.3, 88.3). Of the 39 children, 11 (28.2%) presented with auditory neuropathy and 15 (38.5%) had known progressive hearing loss. The remaining 33.3% of the children presented with other factors that influenced decision making such as speech-language development concerns.

Conclusions: In this population-based study, 11.2% of children implanted presented with hearing levels outside typical audiologic criteria for implantation. Primary reasons for proceeding with later cochlear implant intervention for the majority of these children were related to the presence of auditory neuropathy and progressive hearing loss.

**Abstract ID:** 351  
**Poster Number:** 135  
**Title:** Bilateral Cochlear Implantation - Do Patients with Devices from Different Manufacturers Perform Worse than those with Devices from the Same One?  
**Authors:** Jafri Kuthubutheen, MBBS(Hons), David Low, MBBS, Kari Smilsky, MCISc, David Shipp, MA FAAA, George Kurien, MD FRCSC, Trung Le, MD FRCSC, Joseph Chen, MD FRCSC, Vincent Lin, MD FRCSC; Otolaryngology - Head and Neck Surgery, Sunnybrook Hlth. Sci. Ctr., Toronto, Canada.  
**Abstract:** Title: Bilateral cochlear implantation - Do patients with devices from different manufacturers perform worse than those with devices from the same one?  
**Introduction**  
Bilateral cochlear implantation in adults is gaining popularity. In our cohort of bilateral sequential implant recipients, some have received implants from different manufacturers due to the tendering process. Our objective is to compare the outcomes in these patients to those patients with implants from a single manufacturer.  
**Methods**  
Speech perception outcomes and quality of life measures were collected prospectively in our bilateral cochlear implant recipients.  
**Results**  
There was no significant difference in speech perception outcomes and quality of life measures between the 2 groups in our cohort of patients.  
**Conclusion**  
Our results suggest that patients who have bilateral cochlear implants from different manufacturers perform just as well as those from the same manufacturer. This may mean that patients and doctors need not remain with the same manufacturer where there are constraints with cost and availability.

**Abstract ID:** 353  
**Poster Number:** 2  
**Title:** Assessment of quality of life in adolescents with coclear implant  
**Authors:** Helena G. F. Alves, Graduation, Graça C. C. Oliveira, Masters, Jorge H. F. Martins, Masters, Luís F. S. Silva, Masters, Pedro Tomé, Graduation; ORL - Cochlear Implants Functional Unit, CHUC, Coimbra, Portugal.  
**Abstract:** Introduction: With this study it was pretended to understand the influence of the cochlear implant (CI) in adolescents, implanted at a young age, quality of live.
Methods: Considering all the multidimensional involvement of the CI, it was considered of great importance to evaluate not only the effectiveness regarding the auditory and communicative abilities of the cochlear implant, but also aspects related to the establishment of affective relations, autonomy in daily tasks and emotional changes that may affect the quality of life of young cochlear implants recipients. In this study it was requested to 50 adolescents (11 to 20 years old) with severe to profound congenital bilateral deafness and CI users to answer the questionnaire "Quality of life in adolescents with CI-QVAPIC". The questionnaire consists of 33 closed and simple questions, grouped into six dimensions and the respondent must choose the answer qualitatively. The collected data were analyzed descriptively in program SPSS17.

Results: Of the 50 young respondents, 78% are very satisfied with the outcome of their CI and 52% report that their CI has little influence on the limitations of their daily activities, being that 38% states that it has no difficulty in establishing relations with other and 58% that the CI does not affect their participation in social activities. Most individuals report having little difficulty understanding the world that surrounds them and 40% reported that they participated quite frequently in communicative activities with friends. Communicating with strangers is difficult for 44% of the respondents. The CI is not seen as a factor that alters their physical appearance for 56% of the individuals and 50% of the respondents don’t take any special care to conceal their CI. Half of the respondents consider that public services are not prepared for the hearing impaired, but only 38% report that they rarely feel excluded. Finally, 86% consider having a good or very good quality of life.

Conclusion: The adolescents feel that the CI allows them good communication and personal and social integration, not feeling limited by its use, although they consider that the society is not prepared for the hearing impaired. For the majority of the adolescents interviewed the CI allows a good quality of life.

Abstract ID: 355
Poster Number: 136
Title: Unilateral Cochlear Implant: Impact on Quality of Life Measured With the Glasgow Benefit Inventory
Authors: David Low, MBBS, Hosam A. Amoodi, MD FRCSC, David Shipp, MA FAAA, George Kurien, MD FRCSC, Trung Le, MD FRCSC, Joseph Chen, MD FRCSC, Vincent Lin, MD FRCSC; Otolaryngology - Head and Neck Surgery, Sunnybrook Hlth. Sci. Ctr., Toronto, Canada.
Abstract: Title:
The Utility of the Glasgow Benefit Inventory in Unilateral Adult Cochlear Implant Recipients

Introduction

Unilateral cochlear implantation in adult patients with bilateral severe to profound hearing loss is now considered the standard of care. Our objective was to use the Glasgow Benefit Inventory (GBI) to quantify the improvement in quality of life in our patients.

Methods

This was a prospective study in a tertiary care center. A total of 500 post-lingually deafened adults were enrolled in the study. Their pre- and post-operative GBI and HINT scores were collected and analysed.

Results

Interim analysis of the first 224 patients shows a significant improvement in the total (+39.77), general health (+53.53) and social (+23.36) scores of the GBI. The improvement in physical scores were not significant. The total and general health scores of the GBI correlated significantly with the postoperative HINT score and the change in HINT score.

Conclusion
The GBI reflects the improvement in quality-of-life (QOL) after unilateral cochlear implantation in adult patients. This finding concurs with other QOL instruments and provides yet another QOL measure in cochlear implant recipients.

Abstract ID: 356
Poster Number: 22
Title: Cochlear Implant (Re)habilitation in Developing Country of Indonesia

Authors: Eka K. Hikmat, MSpecEd
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Abstract: Introduction: Based on the recent United Nation’s estimate, the current population of Indonesia is about 262,225,009 billion. This makes Indonesia the 4th most populated countries in the world. The majority of this demographic lives in 6,000 of the 17,508 Indonesian islands.
The first cochlear implant surgery in Indonesia was conducted in December 1999. After 17 years since the first surgery, a review on the profile of cochlear implant recipients and how they access (re)habilitation services was needed to map the current conditions as well as to identify future goals of hearing problem prevention and intervention in a developing country like Indonesia.
The primary objective of this study is to characterize the profile of recipients of cochlear implant and how they access (re)habilitation services in Indonesia through analysis of their personal data from hearing (re)habilitation centers where they are enrolled across 4 major cities in Indonesia. The data analysis was based from the period of April 2012 to December 2016. The author considered the following aspects: etiology of deafness, degree of hearing loss, age, sex, pre-and post-lingual proportion of patients, previous use of a hearing aid, time of screening and diagnosis, presence or absence of other disabilities, where, when and how the cochlear implant recipients accessed (re)habilitation services.

Methods: We used descriptive method of 318 cases and examined etiological aspects of deafness, degree of hearing loss, age, sex, pre-and post-lingual proportion of patients, previous use of a hearing aid, time of screening and diagnosis, presence or absence of other disabilities, where, when and how the cochlear implant recipients accessed (re)habilitation services. Data were collected from recipient personal data submitted during their enrollment in hearing (re)habilitation centers in 4 major cities in Indonesia from April 2012 to December 2016.

Results: The etiology of deafness, degree of hearing loss, age, sex, pre-and post-lingual proportion of patients, previous use of a hearing aid, time of screening and diagnosis, presence or absence of other disabilities, where, when and how the cochlear implant recipients accessed (re)habilitation services will be described.

Conclusion: This study allowed us to map the current condition as well as identify future goals of hearing problem prevention and intervention in developing country of Indonesia. More detailed description of this will be presented.
Abstract: Introduction: The Auditory Brainstem Implant (ABI) system is designed to restore a degree of hearing sensation to patients who have bilateral dysfunction of the auditory nerve. This is achieved by direct electrical stimulation of the cochlear nucleus complex in the brainstem. Children with profound hearing loss can be habilitated with a Cochlear Implant (CI). A condition for successful auditory stimulation is a developed cochlea and the presence of an adequate number of cochlear nerve fibers. Based on the results of Auditory Brainstem Implant (ABI) in non tumoral adults, began the use of this device in children with cochlear nerve aplasia.

Methods: This is a retrospective case review study. Eight children with cochlear nerve aplasia and one child with hypoplasia of the cochlear nerve (3 years old) underwent retro sigmoid approach for placement of the ABI. Children underwent otological, radiological, audiological, neurological, psychological evaluations pre-ABI. In eight children the MRI showed bilateral cochlear nerve aplasia and one child had bilateral hypoplasia of the cochlear nerve. In this child it was performed CI in the better ear without audiological results, so it was made an ABI in the contralateral side. The correct positioning of the electrodes was monitored through the Electrical Auditory Brainstem Responses (eABR). It was also used as help in programming the device. The audiological outcomes were evaluated using the CID Speech Perception Categories (Geers, 1994) through tests of the Latin American Protocol, Free Field with ABI, it-MAIS and MAIS scales.

Results: No surgical or postoperative complications were observed. All children use the device in a permanent way. They show variable and positive auditory improvements in speech perception through specific tests and in it-MAIS and MAIS Scales through the parents’ opinion. Changes in quality of life were evaluated through the Glasgow Inventory Test. Statistical studies will be presented.

Conclusion: This study suggests that surgery, programming, auditory and language habilitation, parental involvement, age at implant, other handicaps, are variables that affect results. Speech recognition in open set was observed.

Abstract ID: 362
Poster Number: 72
Title: Spontaneous Migration of a Lateral Wall Electrode Necessitating Reimplantation
Authors: Samuel Gubbels, MD, Nyssa F. Farrell, MD, Darcy Strong, AUD; Otolaryngology, Univ. of Colorado, Aurora, CO.

Abstract: Spontaneous, Significant Migration of a Lateral Wall Electrode Necessitating Re-implantation
Introduction: Migration of cochlear implant electrodes has been reported to occur in up to 9% of patients and appears to occur primarily in lateral wall electrodes. Migration generally occurs in a delayed fashion, spontaneously and involves only 1-6 electrodes.

Methods: Retrospective case report of surgical, radiological and audiological data with literature review.

Results: Migration of 10 contacts of a lateral wall electrode occurred without precipitating head trauma. Migration became first evident at 3 months after uneventful implantation and activation. Initial implantation of all electrodes was confirmed with intraoperative impedance and neural response testing along with normal electrophysiological and functional performance in the postoperative period. Altered impedances and decreased functional performance were the sentinel events which then prompted computed tomographic evaluation demonstrating migration of half of the electrode array out of the cochlea. Migration was confirmed at revision surgery and the patient was reimplanted with a new device and perimodiolar array uneventfully. At re-activation the patient has restoration of his performance to levels similar to those prior to the migration having occurred. The patient’s residual hearing that was preserved upon initial implantation was lost upon reimplantation.
Conclusion: Migration of cochlear implant electrodes generally is limited to a small number of electrodes and may not necessitate reimplantation. More significant migration of lateral wall electrode contacts can occur spontaneously as in our patient and can significantly impair benefit from the device necessitating reimplantation. Reimplantation with a periomodiolar electrode design can restore functional benefit of the device but may compromise any acoustic hearing that was preserved upon initial implantation.

Abstract ID: 367
Poster Number: 196
Title: Considering Treatment Options for Children with Unilateral Severe to Profound Hearing Loss
Authors: Bernadette Rakszawski, AuD1, Jamie Cadieux, AuD1, Janet Vance, AuD1, Meghan Hunt, MA1, Andrea Gregg, MS1, Jill Firszt, PhD2, Ruth Reeder, MS2, Lisa Davidson, PhD2, Judith Lieu, MD2, Keiko Hirose, MD2, Craig Buchman, MD2, Richard Chole, MD2;
1St. Louis Children’s Hosp., St. Louis, MO, 2Washington Univ. Sch. of Med., St. Louis, MO.
Abstract: Introduction: Unilateral sensorineural hearing loss occurs in 3-6% of the school-age population. Research over the past 30 years has documented that these children are at higher risk for speech and language delays, educational difficulties, and behavioral concerns. Children with unilateral severe to profound hearing loss (SPHL) and those with asymmetric hearing loss, that is one ear with SPHL and the other with mild to moderate hearing loss, have documented difficulties with sound localization and understanding speech in noise. Given that best practice for children with bilateral hearing loss is bilateral device fitting (hearing aids or cochlear implants), more families and professionals are seeking treatment for unilateral and asymmetric hearing loss in children. In addition, cochlear implantation of the SPHL ear is being discussed as an option in some cases. The purpose of this study was the trial of a protocol to guide clinicians and families through the various treatment (or non-treatment) options.
Methods: Current clinical interventions include: Observation, Osseointegrated implants, Contralateral routing of signal hearing aids, and hearing assistive technology. The benefits and limitations vary among these options as well as among children of various ages with the single exception that none provide sound stimulation to the SPHL ear. Understanding the potential benefits and limitations for a specific child is pivotal for clinicians and families to determine the best treatment option. The implemented protocol focused on family/child education, trial periods, observation and behavioral measures.
Results: Use of the protocol has helped focus evaluation of treatment options and assess outcomes. Individual cases and results will be shared for children who concluded the trial with observation only, a softband BAHa, a CROS hearing aid, or a cochlear implant for the poor ear. Results include a discussion of test conditions and metrics to consider when hearing is present in a single ear.
Conclusion: The needs of each child and family vary and there is no single treatment option that is optimal for all children. Evaluation of available options is particularly critical if cochlear implantation is considered for children with unilateral or asymmetric hearing loss.

Abstract ID: 368
Poster Number: 36
Title: Language Sampling Practices with Children who are Deaf and Hard of Hearing
Authors: Megan Shannahan, B.S., Kristina Blaiser, PhD, CCC-SLP;
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Abstract: Introduction: Language sampling can be an invaluable tool for speech-language pathologists to assess the communicative outcomes of children who are Deaf/Hard-of-Hearing. This is particularly important as, in isolation, norm referenced assessments are not sensitive to identify error patterns in the use or omission of high frequency noun and verb morphology, errors that are common in children with hearing aids and cochlear implants. However, a recent study reports that professionals who work with children with cochlear implants do not frequently use language sampling and most often use standardized assessments and checklists to evaluate and monitor progress of children with cochlear implants (Neuss et al., 2013). The purposes of this study is to 1) identify common language sample practices of professionals who work with children who are DHH, 2) identify how professionals are using information gained from language samples and 3) outline common practices and propose a clinical protocol for language sample use

Methods: An electronic questionnaire was disseminated to audiologists, SLPs and Educators of the Deaf in the United States. Participant responses were coded in an Excel file and checked for completeness. Descriptive statistics were used to analyze trends

Results: A total of 168 participants participated in the survey (16.8% response rate). Approximately 77.3% (n=129) of participants reported that over 75% of their caseload was children who are DHH. Additionally, 75% (n=123) of the participants reported that they had worked with children who are DHH for over 10 years. Most participants (n=153; 91.6%) reported that they use language sampling as a part of their intervention when working with children who are DHH. Despite this, approximately half (n=63; 51.2%) of participants reported using norm-referenced testing most often when evaluating language of children who are DHH. When asked how they use information obtained from language samples, participants reported most often to monitor progress of clients (n=79; 62.7%), and to set goals for clients (n=75; 60.0%). Participants overwhelmingly agreed that they found language samples useful with the populations they serve (n=130; 94.9%) and that they could offer information that norm-referenced assessments could not provide (n=133; 97.1%), despite them being most popularly used for evaluation of children who are DHH. However, despite these advantages, they were least likely to use information obtain from language samples to determine eligibility of services (n=27; 23.0%).

Conclusion: Results from the current study reflect that most respondents believe language samples offer a unique look into a child’s language development that norm-referenced assessments are not sensitive enough to detect. Despite professionals’ frequent use of language samples to evaluate language abilities and monitor progress, the lack of standardization may contribute to the increased use of norm-referenced testing to determine eligibility for children who are DHH. It is proposed that the results of this study may help establish a standardized language sample protocol that would guide practices in the use of language samples with children who are DHH.
results, speech development, duration of surgery and perioperative morbidity in these two groups are compared up to 3 years after cochlear implantation.

**Methods:** Hearing and speech development after synchronous and metachronous cochlear implantation (15 patients per group, age at implantation 4-47 months) were compared retrospectively (6, 12, 24, 36 months after surgery). Hearing thresholds in pure tone audiometry and hearing results in the Mainzer audiometric speech test were compared. Auditive perception and communicative skills were quantified using the tests of Schmid-Giovannini and Pollack. Statistical analysis was performed by boxplot analysis using SPSS and Excel Software.

**Results:** Mean implantation age was 18.1 months in the synchronous group and in the metachronous group 20.2 months for the first CI and 34.6 months for the second CI. A tendency of better development of speech and auditory skills in the synchronous implantation group especially in short term comparison was found, however, this effect was not statistically significant. When comparing the ears individually the synchronous group showed significantly better results. Total duration of surgery and anesthesia were significantly shorter in the synchronous implantation group.

**Conclusion:** Both approaches lead to significant improvements of hearing and speech development. Simultaneous bilateral cochlear implantation allows the reduction of total surgery time and requires just one hospitalization and rehabilitation process with comparable perioperative complication rates. We postulate an advantage regarding speech and hearing development due to simultaneous development of auditory pathways. Further investigations will concentrate on comparing directional perception and hearing abilities with background noise when children reach elementary school age.

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**Abstract ID:** 370  
**Poster Number:** 77  
**Title:** Epidemiologic Study of Bilateral Deep Deafness Implanted in Our Center  
**Authors:** djilali aid khaled, Maitre de conference A, djilali aid khaled, Maitre de conference A; médecine, chu sidi bel abbes, sidi bel abbes, Algeria.

**Abstract:** **Introduction:** The cochlear implant (IC) is used to allow the children reached of a neurosensory deafness to acquire a hearing perception, a comprehension of the word and language acquisition. The majority of these children have factors associated with their profound deafness, which condition the functional results.

**Methods:** We undertook an exploratory descriptive and analytical study over a period of 7 years between a year 2008 and 2015 in connection with 43 children implanted in our department and follow-ups. Objectives of this study: To study the factors associated with bilateral profound deafness in the children implanted in ENT department of Sidi bel abbes in the west of Algeria: We are study multiples factors socio-demographic: Personal, family antecedents: consanguinity, presence of the similar cases in the family and the siblings: Clinical factors as well as the radiological data of the cochlea. To study the effect of some of these factors on the audiometric and orthophonic results.

**Results:** We noted a discrete masculine predominance, the sex ratio is of 1.04 boy for a girl. Middle Age is of 3 years 9 months, a standard deviation of 19 months, with an extreme of 19 month minimal and maximum age of 7 years. 41% had similar cases in the family. 21% of the implanted children had two deaf cases in the family, 14% had three cases, two implanted children had four profound deafness in the family, and one had seven deaf cases in the family. We noted the presence of two cases deaf in the siblings in 18% of the established children, and three deaf persons or more in the family in 6.98% of the implanted children. We noted the concept of fever in the personal antecedents at 23, 26%, two cases of meningitis were announced, and persistence of arterial channel among two patients, 04 children had...
hyperpyretic convulsions. 18.60% of these children had an otitis associated with deafness at the time with the diagnosis, taken drugs during the pregnancy was noted at 27% of the cases. The radiology finds a pathological cochlea in 16% of the patients, cochlea deformity in 14%, cochlear ossification in 2%, a dilation of the vestibular aqueduct in 7% of the children, procidence of the facial nerve in one patient, and procidence of the side sine in 12% of the children. The congenital causes of deafness was noted in 95,35%, 53,49% are genetic syndromic, and 32,56 are genetic non-syndromic, other share the type acquired in 4,6% which are post-meningeal. The choice of the operated ear: was made according to several parameters: dexterity, residual hearing, and the disorders vestibular. We placed a Medel implant to date in 51%, Cochlear implant in 49%, the insertion of the implant by the round window at 83% and by the opening of the cochleostomy in 16,28%, the geyzer was seen in 9,30%. We carried out an audiometric evaluation in free field and orthophonic of our patients, the consanguinity is a determining factor in hearing perception the production of the language, the relation is significant the P is equal to 0.05, the second factor is the age of implantation, we obtained better results among patients operated at early age, a 0-2 years, and 2-4 years in comparison with the children operated with age more than 4 years.

Conclusion: The study of the associated factors with deep deafness in the child allows to understand the hearing evolution of the deaf patients, and to reinforce an orthophonic reeducation in a more rigorous way in order to improve these results.

Abstract ID: 376
Poster Number: 146
Title: Influences of Working Memory on Hearing Abilities in Cochlear Implant Users
Authors: Hanna Boenitz, M.Sc.1, Bjoern Lyxell, Professor2, Thomas Lunner, Professor3, Andreas Buechner, Professor1, Bruno Kopp, Professor4, Mareike Finke, PhD1;
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Abstract: Introduction
Working memory appears to be an important contributor to speech understanding. The “Ease of language understanding” model by Rönngberg and colleagues (2013) states that in difficult listening situations (e.g. with a cochlear implant (CI)) the working memory is needed to compensate the mismatch between the heard word and the stored word pattern. In our study we aimed to investigate the influence of auditory distraction on the working memory capacity, while being engaged in a visual working memory/n-back task. We investigated adult cochlear implant (CI) users by means of electroencephalography (EEG).
Methods
Thirteen adult CI users were tested in this study. The EEG was recorded while the participants performed a visual n-back task. Participants were presented with a sequence of numbers. In the easiest condition, the participants had to decide if the number was odd or even. In the more complex conditions, participants had to compare the present number either to the previous or the previous to last number, depending on the load condition of working memory. By means of a button press, they had to indicate whether the two numbers were identical. During the visual task, additional auditory distractor stimuli were presented. Participants were instructed to ignore those stimuli. Auditory stimuli included standard and novel sounds (25%). The novel sounds consisted of different environmental sounds. Due to the experimental setting we could analyze auditory event-related potentials (ERPs;
N1aud, Novelty-P3), visual ERPs (N1vis, Target-P3) and visual ERPs following a novel or a standard tone. The analysis of the latter ERPs offers the opportunity to investigate the influence of auditory distraction on the task performance.

Results
Behavioral results indicate slower and less accurate responses in the higher load conditions. Additionally, the responses following a novel tone were significantly faster compared to the standard tones. The sensory auditory ERPs (N1aud) suggest reduced amplitudes for the more difficult condition and additionally showed reduced amplitudes in response of a standard tone compared to a novel tone. The early visual ERPs (N1vis) also showed a relation to working memory capacity: as the task demands increase, the amplitude decreases. The post-perceptual visual ERPs (Target-P3) showed a u-shaped relation in regard to latency. Preliminary results regarding the effects of distraction displayed an influence of working memory as well as type of stimulation. Visual responses following the novel stimuli were increased to standard tones.

Conclusion
Behavioral and also visual results indicate that CI users show a working memory manipulation. The reduced amplitudes of the auditory ERPs suggest an influence of working memory on hearing - not only for speech, but also for tonal stimuli. Behavioral, but also electrophysiological results indicate a facilitation effect rather than a distraction effect of the novel sounds. The novel tone may cause an unspecific state of readiness which might lead to a modulated ERPs response. All in all these results underline the role of cognition in hearing with CIs. Further investigations will be conducted including attempts to also expand these results to CI implanted children.
from the Swedish national patient survey, was sent to consecutive patients and significant others (parents) six months after CI surgery or cessation of the assessment process.

**Results:** New patient information pamphlets were written, one for parents and one for adults. The questionnaire was answered by thirty-nine patients/parents, with a response rate of 79%. All patients/parents reported that they had received both written and verbal information, and that the information on the process steps was very good to excellent. The information shared was described as being in agreement with the activities during the assessment process. The personal treatment by the professionals was reported as totally respectful and considerate by 95%. The patients and significant others stated that risks and advantages with the implant surgery had been explained in a comprehensible way, and that one felt involved in the decision of surgery/no surgery (fully participated in the decision, 95%). The parents of the pediatric population rated their satisfaction somewhat higher than the adult group. For the pediatric group, the median time from referral to assessment was 34 days, from assessment to decision for CI 14 days, and from decision to surgery 43 days. The median days for the adults were 72, 14 and 130. A number of factors, both within the CI team as well as the patients, were identified for outliers.

**Conclusion:** Shared decision making by patient participation can contribute to higher quality in health care provision and satisfaction. This project, "Ready, Steady, Go" utilized the opportunity of collaboration in order to improve information, decision-making, satisfaction, wait time and internal work processes within a CI team. The focus group interview model can be used to co-design and further implement quality improvement activities. Evaluation of the project has shown positive feed-back from patients and gives new insights for further improvement.

**Abstract ID:** 380  
**Poster Number:** 53  
**Title:** Electrocochleography for Monitoring of Residual Hearing during and after Cochlear Implantation via Intracochlear Electrode Contacts  
**Authors:** Andreas Buechner, PhD1, Sabine Haumann, PhD1, Benjamin Krueger, MSc1, Thomas Lenarz, MD, PhD2;  
1Hearing Center, Med. Univ. of Hannover, Hannover, Germany, 2Med. Univ. of Hannover, Hannover, Germany.  
**Abstract:** **Introduction:** In clinical otology, electrocochleography (ECochG) is a well-established tool for evaluating the inner ear and auditory nerve status. With the expansion of CI indication criteria towards more residual hearing, the measurement of those potentials during CI surgery as well as during follow-up visits becomes increasingly interesting. In CI users with significant low frequency hearing, responses to an acoustically presented stimulus can be recorded through the intracochlear contacts of the electrode array using the implant’s built-in amplifier. These data are buffered in the internal memory of the implant and regularly transmitted to the outside computer for further processing. This technique can basically be applied to all stages of a cochlear implant provision, starting with the insertion of the first electrode contacts into the cochlear right up to using the measurement during postoperative aftercare check-ups of the subjects.  
**Methods:** In a clinical study on ECochG a total of 20 subjects with residual hearing to be implanted with the HiFocus MidScala electrode array by Advanced Bionics are currently being recruited. During the electrode insertion as well as at the end of the surgery, ECochG shall be recorded from intracochlear electrode contacts. Postoperatively, subjects will be coming back to the clinic in regular intervals. During the first 4 months, ECochG and pure tone thresholds will be measured at each visit. To investigate the
relation of ECochG thresholds to post-operative hearing thresholds or changes in hearing thresholds over time, the ECochG results shall be compared to air conduction (AC) thresholds. Pre- and post-surgical AC thresholds shall be related to the intra-operative recordings of the ECochG thresholds, particularly looking at the course of the recorded amplitudes during the insertion process. Moreover, post-surgical AC thresholds shall be compared with post-surgical ECochG thresholds from the same dates. Due to the short distance between the potential’s origin and the recording site, only few averages are required to get a sufficiently strong signal, resulting in a recording time of just 1-2 seconds per data point. This regular sampling with minimal delay allows to give timely feedback to the surgeon during the insertion process and the surgeon may adapt his technique accordingly.

**Results:** So far, in ten subjects ECochG has been registered telemetrically via the implant intra- as well as postoperatively. A good correlation between post-surgical AC threshold and ECochG thresholds can be observed. Correlation in a bigger sample and over a longer time span will be shown and discussed in the presentation.

**Conclusion:** In conclusion, the measurement of ECochG might be used as an intraoperative tool to instantaneously detect changes in hearing threshold, therewith supporting atraumatic insertion of the electrode array. Potentially, it could also be used to obtain threshold estimates for the programming of EAS devices, which might be especially useful in children.

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**Abstract ID:** 381  
**Poster Number:** 205  
**Title:** Speech Perception Bottlenecks in Cochlear Implanted Subjects: Integration of the Words and Indexical Cues in Speech is an Additive Rather than a Synergistic Task  
**Authors:** Chad Ruffin, MD, Janice L. Farlow, Ph.D., Taylor Curry, BS, Cullen Taylor, BS, Charles Yates, MD; Department of Otolaryngology, Indiana Univ. Sch. of Med., Indianapolis, IN, IN.  
**Abstract:**

**Introduction**

Perception of the words in speech with cochlear implants requires high cognitive load that may interfere with the simultaneous integration of indexical speech cues. Our central hypothesis is that the number of indexical cues perceived by a listener while simultaneously maintaining maximal levels of linguistic speech perception is significantly less than if each were assessed independently.

**Methods**

Experiment 1: The clinically-used AzBio Sentence Lists were previously verified to be similar in gender and speaker identification under noise-vocoded conditions with normal-hearing listeners. Cochlear implanted adult subjects (N = 3) then listened to the non-vocoded AzBio Sentences. The perception of indexical cues was assessed in two conditions, (1) Indexical-only perception and (2) combined Sentences + Indexical speech perception. In the first condition, a listener identified the gender and speaker in the AzBio sentence token. In the second condition, the primary task was to first repeat the sentence. Then the listener identified indexical cues. Each subject performed both conditions in signal-to-noise ratios (SNR) from 30 to -10 dB.

Experiment 2: The AzBio Sentence Lists were re-recorded to include more speakers and emotion. These stimuli were processed through a noise band vocoder. Each of 3 different groups of normal hearing listeners (N = 15 per group) performed different tasks on the same group of sentences. The Sentence-only group performed only sentence discrimination. The Indexical-only group identified indexical cues. The primary task of the Sentences + Indexical group was sentence perception followed by the secondary task of identifying indexical cues.

**Results**
Experiment 1: There were no differences in indexical performance between the Indexical-only and Sentences + Indexical conditions. The mean time to complete each sentence was not significantly different between conditions.

Experiment 2: The speech discrimination performance in the Sentences-only and Sentences + Indexical conditions was similar to the unmodified AzBio Sentence Lists. Indexical performance was significantly better in the Indexical-only compared to the Sentences + Indexical group on gender discrimination and emotion discrimination. There were no differences in speaker identification between conditions. The mean time for completing both Sentences + Indexical tasks together (16.8 seconds) was essentially the sum time of individual task completion.

Conclusion
CI subjects can integrate a limited number of indexical cues when simultaneously perceiving the words in speech. A noise-band vocoder model suggests that CI users may be significantly less fluent at integrating a greater number of and more complex indexical cues such as prosody. This has important implications for higher-order language processing and patient counseling in both pediatric and adult CI populations.

Abstract ID: 383
Poster Number: 38
Title: Consonant Production Abilities of Children with Cochlear Implants
Authors: Madhu Sundararajan, PhD1, Andrea Warner-Czyz, PhD2, Emily Tobey, PhD2; 1Communication Sciences and Disorders, Univ. of Texas at Austin, Austin, TX, 2Communication Sciences and Disorders, Univ. of Texas at Dallas, Richardson, TX.
Abstract: Introduction: Cochlear implants (CIs) have positively impacted the communication abilities of children with sensorineural hearing loss (SNHL). With access to auditory stimuli through a CI, children with SNHL should demonstrate systematic development in their speech production skills and potentially achieve performance outcomes on par with typical hearing (TH) children. The purpose of this study was to comprehensively explore the development trajectory of consonant accuracy over an extended period of time. In addition, we compared the development trajectories of consonant accuracy in children with CIs and TH children. Furthermore, we explored the association between variables such as age at implantation, duration of device use, level of residual hearing, and consonant accuracy skills in children with CIs.
Methods: One hundred and twenty eight pediatric CI recipients and seventy TH children participated in the study. Participants were followed from 4 to 7 years after implantation. Consonant accuracy was assessed using a sentence imitation task and scores were computed by calculating a percentage of consonants correctly produced. Growth curve modeling was used to examine the consonant accuracy trajectories and the association of consonant accuracy scores and factors such as age at implantation, duration of device use, and level of residual hearing.
Results: TH participants exhibited flat trajectories and achieved over 95% consonant accuracy at the start of the study. Participants with CIs displayed curvilinear growth, with a linear increase in production skills from 4 to 5 years of device use and a plateau in performance from 5 to 7 years. The plateau in performance occurred before the cochlear implanted participants reached 95% consonant accuracy. Age of implantation was associated with consonant accuracy scores at the 4 year testing session, with later implanted participants achieving lower consonant accuracy scores. Level of residual hearing was also associated with the consonant accuracy scores of children with cochlear implants. Children with higher
levels of preoperative residual hearing exhibited higher consonant accuracy scores at 4 years of device experience.

**Conclusion:** This study provided valuable information regarding the growth in consonant accuracy skills in pediatric CI recipients. Our investigation indicated a plateau in performance, occurring once the participants reached 5 years of device use. Forty seven percent of the cochlear implanted participants achieved over 95% accuracy after 7 years of device experience.

**Abstract ID:** 384  
**Poster Number:** 60  
**Title:** Comparison of the Insertion Depth and Hearing Preservation Results between the HiFocus 1j and HiFocus Mid Scala Electrodes in Adults and Children  
**Authors:** Shweta S. Deshpande, Masters in Audiology and Speech Language Pathology1, Neelam Vaid, MS (ENT) DNB1, Ajimsha Km, Au.D.2, Dzemal Gazibegovic, Clinical Research Scientist3;  
1BIG EARS, K.E.M. Hosp., Pune, India, 2Advanced Bionics India Pvt Ltd, Bangalore, India, 3Advanced Bionics Clinical Res. Intl., Cambridge, Switzerland.  
**Abstract:** Introduction  
Different variety of electrode types are available with a range of features and designs to fulfil various anatomical and geometrical variations of cochlea. The HF1j electrode developed by Advanced Bionics LLC is a lateral wall electrode designed to cover up to 1.5 turns or up to app. 540° of the cochlea. A newer version of the HiFocus electrode group Mid Scala was recently introduced. The electrode is designed for structure preservation and for a target insertion depth of 420°. Both electrodes may be inserted using dedicated insertion tools offered by AB.  
**OBJECTIVES**  
The primary objectives of this study are to evaluate the average insertion depth and variation and to assess the potential for hearing preservation of the HiFocus 1j and Mid Scala electrodes in children.  
**METHODS**  
A group of postlingually deafened children aged 1 year or older with regular anatomy who will receive the HiRes90K implant and either the HiFocus 1j or Mid Scala electrode will undergo a plain radiography (x-ray) investigation shortly after the surgery to determine the angular insertion depth. Audiometric thresholds determining the amount of residual hearing will be performed prior surgery and then monitored at device activation, one, three, six and twelve Months later.  
**RESULTS**  
Up to now 15 subjects are enrolled and data for ten (five per electrode group) are present at the time of submission. A mean insertion depth of 480° (SD=46°) is estimated for the 1j and 424° (SD=31°) for the Mid Scala group respectively. A complete preservation within 10dB HL was achieved for seven (four Mid Scala and 2 1j) and partial loss for the remaining two 1j subjects.

**Abstract ID:** 385  
**Poster Number:** 42  
**Title:** Semantic Development in Elementary School-Age Hearing Impaired Children with Cochlear Implants and/or Hearing Aids Compared to Children with Typical Hearing  
**Authors:** Deena Wechsler-Kashi, Ph.D.1, Miriam Faust, Ph.D.2;
Abstract: Introduction: Young implanted cochlear implant (CI) users show great achievement with their CIs. However, at the initial stages of development many of these children display smaller vocabularies, and large inter-subject variability is reported. In some cases, these delays continue in later stages of development and persist throughout the elementary school years. The aim of the present study was to develop comprehensive semantic profiles of school-age HI children, in order to assess how semantic knowledge unfolds throughout development. This is relevant specifically in the semantic domain, which has shown to be a primary source of difficulty.

Methods: Fourteen hearing impaired (HI) children and 14 children with normal hearing (NH), matched for age and gender, participated in the current study. All children attended regular elementary schools and were in grades 1-4 (Average age 8.33, S.D. = 0.91). In the HI group, five children used CIs with/without hearing aids (HAs) and nine used HAs. To explore the children’s lexical-semantic abilities, we used the “MAASE” test (Rom, Morag, & Peleg, 2007), a standardized language test, designed to evaluate complex semantic language abilities of school-age children. The test consists of five subtests, which provide a comprehensive profile of the children’s semantic abilities. These subtasks include: categorization, similarities, differences, multiple meanings and attributes.

Results: Preliminary results show that, as a group, NH children outperformed children with HIs. These differences were statistically reliable for the overall “MAASE” score and for all of the subtasks examined, except for the subtask differences. Moreover, in the small group tested thus far, children with CIs showed higher scores in the overall score and in all of the five subtasks administered, compared to the HA group. However, these differences did not reach statistical significance in the small sample tested to date. Qualitative analysis revealed differences in the semantic profiles displayed by the three groups tested (NH, CI, HA users). In addition, certain retrieval and organizational difficulties, unique to the HI groups emerged: The HI groups seemed to show difficulties naming less-common objects and paid more attention to less salient attributes of words in test items.

Conclusion: The results of the current study reveal differences in the semantic lexicon of HI school-age children, and of CI users in particular. These findings point to differences in the degree of knowledge and characteristics of semantic representation and organization of CI users, consistent with recently reported results. These findings have important clinical implications for more effective evaluation and intervention in school-age children with CIs. Incorporating language therapy and improving semantic knowledge may enhance language and academic achievement.

Abstract ID: 386
Poster Number: 7
Title: Collaborative Partnerships to Improve Outcomes for Children who are Deaf/Hard-of-Hearing
Authors: Kristina Blaiser, PhD, CCC-SLP1, Megan Shannahsan, MA1, Joy Kane, MA2, Paula Mason, MA3; 1Communication Sciences & Disorders, Idaho State Univ., Meridian, ID, 2Idaho Ed.al Services for the Deaf and Blind, Meridian, ID, 3Idaho Services for the Deaf and Blind, Gooding, ID.

Abstract: Introduction: Partnerships between universities and public school settings can provide a symbiotic relationship offering both entities opportunities to better serve children who are Deaf/Hard-of-Hearing. Language sampling is an assessment tool that is effective in identifying the specific needs of children who are Deaf/Hard-of-Hearing, yet many educational professionals lack the time to obtain and analyze these samples on a regular basis. A Communication Sciences and Disorders department and a
school for the Deaf and Blind developed a collaborative relationship to collect and analyze language samples of the children enrolled in the preschool program and use the results for educational monitoring and student training. This presentation will outline the collaborative model that was used and demonstrate how the data was used as a training tool, a progress monitoring protocol, and platform for research.

**Methods:** Undergraduate and graduate students in speech-language pathology collected and analyzed monthly language samples of 21 children enrolled in a listening and spoken language preschool. Language samples taken were fifty utterances long and taken during a free play and narrative activity. Samples were analyzed by university students for 1) Mean Length of Utterance, 2) Intelligibility, 3) Number of Total Words, 4) Number of Different Words, and 5) Words per minute. Additionally, language samples were analyzed for number of nouns, verbs and other types of words to determine complexity of vocabulary lexicon. After completing the language samples, university students were asked to rate their confidence during the sample and describe language facilitation techniques used.

**Results:** In general, student confidence obtaining and analyzing language samples improved over time (Greenwood et al., 2016), however, there was no clear correlation between language facilitation techniques used and confidence. Aggregate student results were shared with the educational professionals and discussed in terms of educational opportunities, students of concern, and curriculum changes. Parent reports were generated quarterly including information on child’s progress across communication domains, home generalization activities, and information related to a child’s acoustic access.

**Conclusion:** Community partnerships between schools and universities can offer a symbiotic relationship by providing university students an opportunity to practice their language sampling and analysis skills; educational professionals to better understand a data-driven perspective on how children in their classroom are progressing; and researchers to examine the language development trends for young children who are Deaf/Hard-of-Hearing.

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**Abstract ID:** 387  
**Poster Number:** 31  
**Title:** The Quality of Life in Small Children in the First Two Years After Cochlear Implantation  
**Authors:** Luminita Radulescu, Dr.1, Cristian Martu, Dr.1, Corina Butnaru, Dr.2, Alexandra Doroftei, Res.3, Sebastian Cozma, Dr.2;  
1ENT, Univ. of Med. and Pharmacy “Grigore T. Popa”, Iași, Romania, 2ENT, Univ. of Med. and Pharmacy “Grigore T. Popa”, Iași, Romania, 3ENT, Clinical Rehabilitation Hosp., Iași, Romania.

**Abstract:** **Introduction:** Cochlear implantation is a very efficient way to treat congenital hearing loss and brings a new perspective in the future of hearing disabled children. The study evaluated patients with cochlear implant using a parents’ perspective questionnaire and analysis of significant parameters.  
**Methods:** The study includes patients who underwent cochlear implantation in the Clinical Rehabilitation Hospital, Iasi between 2015 and 2016. The parents were asked to answer the questionnaire. Evaluation period was between 1 and 22 months after implant activation.  
**Results:** The age at the moment of implantation for the 22 patients included in the study was between 9 and 36 months. In total, a number of 21 parents were satisfied with the cochlear implant. Some parents consider enrolling their children in kindergarten/integrating them in a group of normal-hearing children taking into account the favorable evolution after implantation. Even though they were satisfied with the amount of information they received concerning the surgery and the use of the implant itself, 7 out of 22 questioned parents expected their children to speak immediately after the implant activation.
Conclusion: The cochlear implant certainly has a positive impact on the quality of life, parents showing concern in the early preoperative and postoperative periods regarding the surgical act itself (77.2%) but also regarding the possibility of the implant breaking down (66.3%).

Abstract ID: 388
Poster Number: 149
Title: The Use of Different Microphone Settings in Bimodal CI Subjects to Improve Speech Perception in Adverse Listening Environments
Authors: Andreas Buechner, PhD, Silke Klawitter, MSc, Nogueira Waldo, PhD, Thomas Lenarz, MD, PhD; Hearing Center, Med. Univ. of Hannover, Hannover, Germany.
Abstract: Introduction: Modern beamformer technology has significantly improved speech understanding in hearing aid and cochlear implant users in adverse listening scenarios. Generally, beamformers become more effective when signals from several microphones are taken into account. The possibility to wirelessly transmit the microphone signals between two hearing devices worn on each ear allows for computing more focused forward-facing beamformers, potentially yielding better speech understanding in face to face conversations. Another advantage of this technology is the possibility to transmit a speech signal from one ear to the other ear, which should improve speech perception when the speaker is located aside or in case of an asymmetric hearing loss. The aim of this investigation is to determine the benefit of these features (i.e. StereoZoom and ZoomControl) in bimodal cochlear implant recipients and compare it to omnidirectional setting of the microphone as well as the monaural beamformer UltraZoom.
Methods: Speech perception of twelve adult subjects was measured with the speech signal of the Oldenburg sentence test presented from the front, while speech shaped noise was presented from +/-45° to investigate the effect of the binaural beamformer StereoZoom. In this setup, four conditions were tested: (a) CI only, (b) CI + HA with independent omnidirectional microphones, (c) CI + HA with the monaural beamformer UltraZoom independently working on each device and (d) CI+HA with the binaural beamformer StereoZoom activated. To evaluate the ear to ear streaming ZoomControl, speech was presented on the HA side with the noise coming from the CI side (+/-90°). Results with ZoomControl (e) were compared to the conditions: (f) CI only as well as (g) CI + HA with independent omnidirectional microphones. Moreover, subjective feedback was collected via questionnaires in a long term take-home phase.
Results: As expected, the CI only condition (a) yielded the poorest results, while the addition of the HA (b) already gave an improvement of 2.5 dB SRT. The monaural beamformer setting UltraZoom (c) gave a 1.6 dB improvement over condition (b), while StereoZoom yielded another 1.5 dB improvement over condition (c). Ear to ear streaming ZoomControl (e) led to a significant improvement of 1.5 dB over the bimodal omnidirectional condition (g). Preliminary results for the subjective feedback show positive ratings for the use of StereoZoom and ZoomControl in challenging situations in everyday life.
Conclusion: Modern beamformer technology significantly improves speech understanding in a number of difficult listening scenarios. The wireless audio transmission between hearing devices opens up additional possibilities, which allow for an even higher degree of adaptation to different acoustic environments and therefore potentially higher levels of hearing performance.
Title: The Impact of Post-Operative Air-Bone Gaps on Speech Recognition in Cochlear Implantation for the Purpose of Hearing Preservation

Authors: Jameson K. Mattingly, MD, Renee Banakis Hartl, MD AuD, Samuel Gubbels, MD, Stephen Cass, MD MPH; Otolaryngology, Univ. of Colorado Sch. of Med., Aurora, CO.

Abstract: Introduction: Individuals with bilateral high-frequency hearing loss with mostly preserved low frequency thresholds experience significant hearing difficulties. Although existing hearing aid technology is inadequate, cochlear implantation with an electrode that electrically stimulates the higher frequencies and preserves the lower frequencies for acoustic amplification has proven to be beneficial. In order to realize this benefit, optimal functional residual acoustic hearing must be preserved. While sensory losses occur post-operatively, we recently reported on the surprisingly high incidence of postoperative air-bone gaps (ABGs) (Mattingly et al. Otol Neurotol 2016). As any threshold increase could potentially compromise the ability of the low frequencies to be aided, it remains unclear what impact these ABGs have on speech recognition scores. Here, we examine this relationship.

Methods: This was a prospective, non-randomized, multicenter clinical trial of the Cochlear Nucleus Hybrid L24 implant system in 50 adult subjects. Standard audiometry, including speech recognition tests (AzBio, CNC implant alone, CNC Hybrid mode), were performed pre-operatively and at multiple points post-activation for 1 year. Subjects were grouped based upon their air and bone thresholds at 12 months indicating No ABG, vibrotactile/non-responses (VT/NR), ABG 15-29 dB HL, and ABG ≥30 dB HL, and compared to one another.

Results: Mean AzBio scores at 250 Hz for the No ABG group was 72%, ABG 15-29 dB HL 65%, and ABG ≥30 dB HL 42%; CNC implant only for the No ABG group was 56%, ABG 15-29 dB HL 62%, and ABG ≥30 dB HL 54%; CNC Hybrid Mode for the No ABG group was 82%, ABG 15-29 dB HL 83%, and ABG ≥30 dB HL 67%. Mean AzBio scores at 500 Hz for the No ABG group was 67%, ABG 15-29 dB HL 61%, and ABG ≥30 dB HL 58%; CNC implant only for the No ABG group was 57%, ABG 15-29 dB HL 58%, and ABG ≥30 dB HL 77%; CNC Hybrid Mode for the No ABG group was 83%, ABG 15-29 dB HL 82%, and ABG ≥30 dB HL 79%. Significant interactions (p=0.05) amongst the groups at 250 and 500 Hz were only seen at 250 Hz in the AzBio scores. Significant differences (p<0.05) in comparison to the No ABG group were only seen with the VT/NR (not shown) at 500 Hz in the AzBio and CNC Hybrid Mode groups.

Conclusion: Post-operative ABGs in those undergoing cochlear implantation for the purpose of hearing preservation have no significant differences in speech recognition scores tested 12 months after activation compared to those with No ABG. It should be noted that there was a trend in those with more severe ABGs (≥30 dB HL) to have lower speech recognition scores than the No ABG and ABG 15-29 groups. This lack of significance may be due to the low number of subjects in each group.

Abstract ID: 391
Poster Number: 78

Title: Cochlear Implantation in Post-Meningitis Candidates

Authors: Riad Khnifes, MD, MHA, Noam Yehudai, MD, MHA, Talma Shpak, PhD, Dana Egra-Dagan, MA, Osnat Rot, MA, Michal Luntz, MD; Department of Otolaryngology—Head & Neck Surgery, Bnai Zion Med. Ctr., Haifa, Israel.

Abstract: Introduction: Outcomes of cochlear implantation (CI) in candidates with meningitis related severe to profound sensorineural hearing loss (SNHL) is challenging to predict due to a possible loss of neural structures, associated difficulties related to meningitis and different levels of cochlear
obliteration. The aim of the study was to evaluate outcomes of CI in post meningitis candidates compared to CI in candidates with SNHL due to other reasons.

**Methods:** A retrospective study including 6 adults and 5 children (mean age at CI 31.3±11 and 4.8±3.6 years, respectively) who underwent CI due to meningitis related SNHL, between 1998 and 2013. Each candidate from the meningitis group was matched with a non-meningitis CI user according to age at CI and follow up period.

**Results:** Mean group follow-up was 10.7±3.4 years. Median post CI monosyllabic words score in quiet for children and adults with meningitis related SNHL was 70% (range, 0-90%) and 20% (range, 0-50%), respectively. The patients with post-meningitis implanters performed significantly worse compared to the control group. As expected, patients with associated difficulties were the worst.

**Conclusion:** Post-meningitis CI users who were implanted as adults, perform significantly worse than those implanted as children. Post-meningitis children with SNHL who are initially seem to benefit from hearing aids and are not implanted immediately after the meningitis, should undergo close hearing evaluation monitoring and periodical imaging of the cochlea in order to receive a cochlear implant as early as possible.

**Abstract ID:** 392
**Poster Number:** 202
**Title:** Datalogging Analysis in Paediatric Cochlear Implant Users
**Authors:** Natalia Rossi, Lic., Alicia Cansler, Lic., Norma Pallares, M.A., Vicente Diamante, PhD; Centro de Implantes Cocleares "Profesor Diamante", CABA, Argentina.

**Abstract:** Datalogging represents a powerful tool to help to understand how often assistive listening devices are used and in what types of listening environments. It’s an objective measure of great utility for audiologists that provides important information for programming and travel-shooting. Especially in paediatric population, this information is very helpful to guide parents and caregivers about proper usage of devices.

**Methods:** This is a retrospective study. Datalogging of 40 paediatric CI users were analyzed. Data was obtained for: average hours of daily use, number of times the coil loss the connection with the implant and average daily hours the child is exposed to different listening environments. This data was related with age, presence of other disabilities and auditory skills achieved.

**Results:** There is a tendency to higher average hours of daily use as the age of the children increases. The group of younger children are more likely to experience loss of connection between the coil and the implant. School age children remain a greater average of daily hours in noisy environments.

**Conclusion:** Using datalogging in CI sound processors provides accurate and objective information about the usage of those devices in children. This information is of great help for audiologists both in programing and in helping parents and caregivers to learn about more appropriate use of devices.

**Abstract ID:** 393
**Poster Number:** 130
**Title:** Evaluation of the Beamformer of the SONNET Audio Processor with Respect to Speech Understanding in Noisy Environments
**Authors:** Andreas Buechner, PhD, Manfred Schwebs, MSc, Lutz Gärtnner, PhD, Tobias Rottmann, MSc, Thomas Lenarz, MD, PhD; Hearing Center, Med. Univ. of Hannover, Hannover, Germany.
Abstract: Introduction: Cochlear implant manufacturers are constantly improving speech understanding in noisy environments by improving the signal processing inside the speech processors. In 2014, MED-EL has launched the new SONNET audio processor, equipped with advanced signal enhancement capabilities. By using two microphones in conjunction with a special signal processing algorithm, the directional characteristics of the pinna have been mimicked within this device. This function is called natural beamformer. The signal from the two microphones can also be used to compute a more forward-facing directional microphone, a so called adaptive beamformer. This technique shall lead to improved speech understanding in noisy environments by estimating and reducing disturbing sound coming from lateral directions and from behind. The primary aim of this study is to evaluate the effectiveness of the directionality implemented in the SONNET processor and its impact on speech understanding in noise. Furthermore it will be analyzed, if the patients’ listening effort in noise is being reduced when using the beamformer.

Methods: 20 postlingual deafened subjects with a minimum age of 18 years and a minimum CI experience of three years and at least three months experience with the SONNET audio processor were recruited for the study. All subjects had to achieve a minimum score of 15% in the HSM sentence test in noise (10 dB SNR) to be able to participate in the study. In a sound-treated room the subject was placed in the middle of a multi-loudspeaker array (0°, ±70°, ±135°, 180°). At one acute appointment, different tests in noise were conducted in each subject: the Oldenburg sentence test (OLSA), the Just Understanding Test (JUST) and a visual analogue scale to assess hearing effort. Three different microphone settings (natural beamformer, adaptive beamformer and omnidirectional microphone) were used for the tests.

Results: For the OLSA and the JUST the final results of the study show a significantly improved speech understanding in noise using both the natural (ΔOLSA = 3.6dB; ΔJUST = 3.0dB) and the adaptive beamformer (ΔOLSA = 5.5dB, ΔJUST = 4.4dB) when compared to the omnidirectional setting. These and further results will be shown and discussed in detail.

Conclusion: Based on these findings, we anticipate improved speech understanding for CI patients using the SONNET audio processor in adverse listening scenarios, especially in face to face conversations.

Abstract ID: 396
Poster Number: 197
Title: Utilizing Electroacoustic Stimulation in Individuals with Enlarged Vestibular Aqueducts: An Analysis of Four Cases
Otolaryngology - Head and Neck Surgery, The Univ. of North Carolina at Chapel Hill, Durham, NC.

Abstract: Introduction: Enlarged Vestibular Aqueduct syndrome (EVA) is an inner ear malformation associated with fluctuating and often progressive hearing loss. As hearing declines, many individuals with EVA pursue cochlear implantation. With advances in hearing preservation surgical techniques, some of these individuals are able to maintain low frequency residual hearing. Electroacoustic stimulation (EAS) offers a way cochlear implant recipients with mild to moderate low frequency residual hearing to use both an acoustic signal and electric signal in the same ear. Because of the progressive nature of EVA, this population may be more amenable to electroacoustic stimulation. An investigation into our center’s patients with EVA who were fit with EAS was conducted to explore the following questions: a) could patients with EVA who undergo cochlear implantation show improvements in speech perception more quickly with the use of EAS than traditional fully electric programs? b) If residual
hearing continues to decline after being fit with EAS, could the initial use of EAS early on help the transition to a fully electric map later on?

**Methods:** A retrospective chart review was completed on four individuals with EVA who received sequential, bilateral, full length cochlear implants and were fit with EAS in one ear and a fully electric program in the other. Low frequency pure tone thresholds were assessed, and changes in speech perception scores were compared for each subject. Time between implants, internal electrode array and age at implantation were also reported.

**Results:** Three subjects were fit with a fully electric program in the first ear implanted and their second ears were fit with EAS; one subject was fit with EAS in his first ear and a fully electric program in the second ear. Two subjects are currently using fully electric programs bilaterally as a result of losing residual hearing after a period of listening with EAS. Of the two still utilizing EAS, one subject continues to experience fluctuation in unaided hearing and the other subject’s thresholds appear to be slowly declining. Three subjects achieved better speech perception scores with the EAS ear at a faster rate than the fully electric ear. When one subject who lost residual hearing was converted to a fully electric map, speech perception improved at a faster rate compared to the ear that was initially fit electrically.

**Conclusion:** Individuals with EVA who utilize EAS may need more frequent monitoring due to the progression and fluctuation that often present with this malformation. While it may be likely that the patient will eventually utilize a fully electric map, capturing the low frequency hearing that can be adequately amplified in an EAS system may ease the transition from hearing aid to cochlear implant.

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**Abstract ID:** 399  
**Poster Number:** 99  
**Title:** Hearing Preservation in Post-Lingually Deafened Adults after Cochlear Implantation  
**Authors:** Elisa L. Franco, BSc, Julia S. C. Chiossi, BSc, Fabiana Danielli, MSc, Maria S. A. Amaral, MSc, Ana C. M. B. Reis, PhD, Miguel A. Hyppolito, PhD; Oftalmologia, Otorrinolaringologia e Cirurgia de Cabeça e Pescoço, Univ.e de São Paulo, Ribeirão Preto, Brazil.

**Abstract:** **Introduction:** In recent years, there is an increased interest in minimizing intracochlear trauma and preserving residual hearing during cochlear implantation. The possibility of preserving apical structures of the Organ of Corti may provide the individual with some degree of acoustic hearing and makes possible to take advantage of new technologies that may lead to regeneration of the inner ear in the future. This study aimed to investigate the hearing preservation rate in adults with conventional audiological indications to cochlear implant surgery.

**Methods:** Eleven post-lingually deafened adults, men (27.3%) and women (72.7%), aged 20 to 76 years (average of 48.0 ± 20.4 years), received a cochlear implant in the right (64%) or left ear (36%). The surgical method used employed a round window insertion of electrode array and the use of topical dexamethasone and hyaluronic acid. Four types of electrodes were used, i.e. Nucleus 24k Contour©; CI24RE Contour Advance™; Med-El Standard electrode; and HiFocus™ Mid-Scala. Residual hearing was measured in pure tone audiometry, before cochlear implantation and twelve months after surgery, to investigate hearing preservation. Hearing preservation rate was calculated and then compared with age, side of the implant and design of the electrode array.

**Results:** All subjects presented some level of hearing preservation twelve months after cochlear implant surgery. Ten subjects (81%) presented complete hearing preservation and two subjects (19%) presented minimal hearing preservation. When correlated with age, side of implant or design of the electrode array, the mean threshold variations did not reach statistical significance with any of these variables.
Conclusion: Hearing may be conserved in post-lingually deafened adults after cochlear implantation, independently of age or electrode array.

Abstract ID: 400  
Poster Number: 158  
Title: Cochlear Implantation in Siblings with Riboflavin Transporter Deficiency  
Authors: Kate David, Au.D. Audiology, The Ctr. for Hearing and Speech, Houston, TX.

Abstract: Introduction: The aim of this case study is to review Riboflavin Transporter Deficiency (RTD) and outcomes & cochlear implant (CI) mapping strategies in male siblings with RTD. RTD is a rare progressive motor neuron disorder. It's caused by a gene mutation of SLC52A2 or SLC52A3. Mutations in these genes lead to an abnormal riboflavin transporter protein which results in a reduction of riboflavin available in the body. Children with RTD experience proximal and distal limb weakness; breathing problems; gait ataxia; optic atrophy; bulbar palsy; and SNHL. The onset is usually in infancy and childhood before the age of 8; 0. In the majority of people, SNHL hearing loss is diagnosed first. The time between onset of SNHL and presentation of other symptoms varies but is generally within 1-2 years. Due to the delay in manifestations from the initial diagnosis of SNHL and the presentation of other symptoms, a CI may be recommended with the notion that SNHL is the main disability.

Methods: Patient A passed his newborn hearing screening; however a regression in expressive speech & language was noticed at the age of 3; 0. An ABR at 3; 2 revealed bilateral ANSD. He was fit with bilateral hearing aids at 3; 5. He was diagnosed with bilateral optic atrophy at 3; 5. He developed progressive ataxia with significant weakness in his lower extremities. He received an Advanced Bions (AB) CI for his right ear at 3; 10 and an AB CI for his left ear at 4; 3. He was diagnosed with RTD at 4; 8. Following oral administration of high doses of riboflavin, he demonstrated significant gait improvement. Patient B is the older sibling of Patient A. Patient B passed his newborn hearing screening. He was diagnosed with bilateral ANSD at 7; 11. He was fit with bilateral hearing aids at 8; 0. He was then diagnosed with mild optic atrophy and ataxia. Patient B’s symptoms were milder compared to his brother’s. He received an AB CI in his left ear at 8; 8. Patient B was diagnosed with RTD at 9; 0. He demonstrated gait improvement following high doses of oral riboflavin. Patient A has a history of poor aided sound detection with CI use despite advanced mapping techniques. He does not have closed-set or open set word recognition. Patient B has improved sound detection with CI use; however his closed-set and open-set word recognition is poor.

Results: Children with late onset ANSD and RTD may require unique mapping techniques to provide optimal access to sound. Both patients required unconventional mapping changes to provide them improved access to sound. These mapping changes included: high stimulation levels; deactivation of numerous electrodes; high threshold levels; and change in processing strategy. Despite notable mapping changes; Patient A continues to have limited benefit with CI use. He does not have closed-set or open set word recognition. Patient B receives improved sound detection with CI use. Although Patient B can comprehend speech in open and closed set tests, his word recognition remains poor.

Conclusion: Further investigation into a child’s medical history and additional test batteries are warranted in children who present with late onset ANSD. Cochlear implantation in these children may precede the diagnosis of RTD. Results from additional inquiries will provide more insight for the clinician to determine realistic expectations and counseling techniques. Even in siblings, spoken language outcomes remain variable. CI audiologists should consider utilizing advanced mapping techniques in pursuit of best possible outcomes.
Abstract ID: 401
Poster Number: 94
Title: Imaging the Brain in CI Candidacy Assessment
Authors: Janet Olds, PhD1, Emily Greevy, RN2, David R. Schramm, MD3; 1Neuropsychology, Children's Hosp. of Eastern Ontario, Ottawa, Canada, 2ENT, Children's Hosp. of Eastern Ontario, Ottawa, Canada, 3Otorhinolaryngology, Univ. of Ottawa, Ottawa, Canada.
Abstract: Introduction: It is now recognized that up to 40% of children with severe to profound hearing loss who are candidates for cochlear implantation (CI) may present with other health, including developmental, conditions. For some children, these conditions will be apparent at the time of CI, while for others, concerns will become apparent as children develop. Some of these conditions may be associated with atypical brain development, and it is possible that imaging of the brain may be medically indicated at some later point in development, after CI has taken place. A previous study examined brain MRI images as part of CI candidacy in children and adults, and on the basis of positive findings in 41% of the sample, recommended routine imaging of the brain as part of candidacy assessment. However, given the implications of this recommendation, replication of these findings in a pediatric sample is warranted. The objective of the present study was to examine MRI of the head conducted at the time of imaging of the cochlea for the presence of incidental findings of brain abnormalities, and to examine subsequent specialty services consulted to address these findings, and the implications for candidacy assessment and counselling.
Methods: A retrospective chart review of consecutive cases of children who had undergone CI candidacy assessment over a 2 year period at a single pediatric academic CI program was conducted. MRI assessments of the brain as well as the cochlea were examined for abnormalities. For those children with brain abnormalities, subsequent referrals were documented, as well as interventions, such as neurosurgery, as a result of the findings were also analyzed.
Results: A total of 35 charts were reviewed, representing candidates for both bilateral and unilateral CI. Patients were between 9 months and 15 years at the time of candidacy assessment. Examination of MRI of the brain indicated that abnormal findings were present in the brains of 13 patients (34%), with a range of cortical and subcortical abnormalities documented. On the basis of these findings referrals were made to neurosurgery (14%) and neurology (14%). Neurosurgical procedures were performed in 2 of the patients prior to further consideration of candidacy.
Conclusion: The results of this study indicate the MRI of the head revealed incidental findings of brain abnormalities in a significant proportion (34%) of patients, which resulted in follow-up and intervention among a number of subspecialties. These findings are generally consistent with those documented in a previous study, and have implications for CI candidacy and follow-up after CI. Further research is needed to examine whether there are specific patient or family indicators for brain MRI, whether and how the presence of abnormalities impacts candidacy decision-making, as well whether later development is impacted by the presence of these abnormalities.

Abstract ID: 404
Poster Number: 218
Title: Malformation of the Ear in Juvenile Paget's Disease - Case Report
Authors: Judith Arnolds, surgeon1, Stephan Lang, head of department1, Corinna Grasemann, head of department2, Diana Arweiler-Harbeck, senior surgeon1;
Abstract: Introduction: Juvenile Paget’s disease is an extremely rare disease of the bone with onset during early childhood. Mutations in TNFRSF11B gene causes a loss of function of osteoprotegerin, resulting in a stimulation of osteoclasts via nuclear factor-κB (RANK) pathway, leading to an increased bone turnover. Clinical manifestations are microsomia, deformities of the long bones, fractures, deformities of the skull, and progradent hearing loss.

Methods: A three year old boy was presented at our cochlear implant consultation hour. Malformations of the femur had been evident prepartal, and were confirmed after birth. Newborn hearing screening was conspicuous. Hearing loss was confirmed in ABR at the age of two months (90 dB for clicks on the right, 65 dB on the left). Hearing aids were fitted. Genetic diagnostics revealed a homozygous mutation in exon 1 of osteoprotegerin-gene. Both parents are carriers. The hearing loss appeared to be progressive. At the age of 20 months there was no measurable stimulus response on both sides up to 100 dB in the ABR. MRI and CT revealed a cystic malformation of the cochlea without definable cochlear turns. IAC were funnel-shaped, no middle ear structures could be identified.

Results: Due to high intra- and perioperative risk the patient could not be implanted yet. He is taught sign language to provide communication. Regarding juvenile Paget’s disease the patient is treated with monthly bisphosphonate.

Conclusion: Juvenile Paget’s disease is extremely rare and the malformations of the ear caused by this disease are described seldomly. With this case we would like to draw attention to this hardly known disease.
**Results:** As a result of this study, it is found out that the total point average of the subjects for the Musical Perception Test is 97.5±12.2 (Min: 69, Max: 120), the Internal Consistency Value is 0.898, and the test-re-test correlation is 0.997. This result shows that the Musical Perception Test is a very reliable test. In the study, the highest point received by the subjects was for Rhythm Identification (9.2±1.2), while the lowest point was for the Identification of Number of Instruments (4.2±1.3). In addition, although there is no relationship between the total point from the Musical Perception Test and, the age of the subjects, the gender and educational background is a statistically significant determinant on the total point of the Musical Perception Test. Nonetheless, it has concluded that there is a statistically significant relationship between the level of interest in music, frequency of listening to music and music genre, and the musical perception total point.

**Conclusion:** Music, one of the indispensable factors in our lives, is also very important to those with hearing loss. As a valid and reliable test that objectively assess all the fields of music in our country, the Turkish Musical Perception Test (T-MPT) is the first and only test both for people with normal hearing and those with hearing loss. An objective assessment of musical perception skills of people will provide benefit in the determination of musical performance for those with normal hearing and, in the development of diagnosis, re/habilitation and amplification systems for those with hearing loss.

**Abstract ID:** 407  
**Poster Number:** 106  
**Title:** Clinical Evaluation of Estimation Methods for Cochlea Length  
**Authors:** Max E. Timm, Medical Doctor, Thomas Lenarz, Professor; ENT, Medizinische Hochschule Hannover, Hannover, Germany.  
**Abstract:** **Introduction:** Prior to cochlea implantation (CI), an electrode array well suited for that specific patient must be chosen. In order to do so several factors must be taken into account. One of these factors is the length of the cochlea. Within this study, different estimation methods for length and shape of the cochlear lateral wall were compared.  
**Methods:** The analysis was performed based on preoperative, clinical imaging data of 150 patients who were implanted at the Hannover Medical School. Using the software tool OsiriX, the cochlear lateral wall was segmented and its length was measured for each one of the datasets. In addition, other global cochlea dimensions (e.g. the distance from the round window to the contralateral side of the cochlea, commonly referred to as the A value) were determined which subsequently served as input parameters for length and spiral shape estimation methods proposed in the literature. These estimations were then compared to the OsiriX measurements.  
**Results:** It could be shown that in general, several of the mathematical and parameterized average models included into this study are well suited for cochlea length estimations. However, high deviations from the actual shape and length of a cochlea occurred for some of the analyzed cochleae. This was mostly the case if a cochlea did not adhere to certain average correlation assumptions the applied models are based on.  
**Conclusion:** It was found that model based estimations of the cochlea length and shape in a clinical setting are possible. However, increased estimation errors may occur in specific cases, i.e. these estimations are not reliable. In contrast thereto, measurements like the ones performed in OsiriX are applicable for any cochlea, and the measurement accuracy is not dependent on certain correlations of cochlea dimensions. Hence, this measurement technique should be used if deciding which electrode array should be chosen for a specific patient.
Abstract ID: 408
Poster Number: 212
Title: Improved Contralateral Hearing after Unilateral Cochlear Implantation in a Child with Auditory Neuropathy Spectrum Disorder
Authors: Ronald J. Vilela, MD
Otolaryngology, Texas Children's Hosp., Houston, TX.
Abstract: 
Introduction: Neither the indications nor the outcomes for cochlear implantation in patients with auditory neuropathy spectrum disorder (ANSD) have been as well defined as for patients with standard sensorineural hearing loss. According to the literature, researchers and professionals have yet to arrive at a consensus regarding the benefits of cochlear implants for ANSD although most would agree that, for select patients with ANSD, cochlear implant use can improve detection of speech and discrimination.
Methods: We present a case report of a 21 month old female with auditory neuropathy spectrum disorder diagnosed at 17 months of age and a pre-operative receptive language delay equivalent to a five month old who underwent unilateral cochlear implantation. We review her rehabilitation follow-up with audiology and speech therapy over the two-year post-operative time frame.
Results: Testing done two years after cochlear implantation demonstrate an improvement of her receptive language to be equivalent to that of a normal 4-year, 3 month old, a remarkable amount of progress in such a short amount of time. More impressive is the inexplicable improvement of hearing in her contralateral, non-implanted ear from 50dB speech detection threshold pre-cochlear implant to 20dB speech reception threshold three months after activation of her cochlear implant.
Conclusion: Cochlear implantation in this patient with ANSD has provided astonishing improvement and receptive language with an unusual finding of improved hearing in the contralateral, non-implanted ear. This has yet to be described in the literature.

Abstract ID: 413
Poster Number: 34
Title: Turkish Adaptation, Validity and Reliability of Preschool Language Scale-Fifth Edition (PLS-5): Turkish Preschool Language Scale-5 (TPLS-5)
Authors: Ayse Sanem Sahli, PhD1, Erol Belgin, PhD2; 1VOCATIONAL SCHOOL OF HEALTH SERVICES, HEARING AND SPEECH TRAINING CENTER, HACETTEPE UNIVERSITY, TURKEY-ANKARA, Turkey, 2FACULTY OF HEALTH SCIENCES, AUDIOLOGY DEPARTMENT, MEDIPOL UNIVERSITY, TURKEY-ISTANBUL, Turkey.
Abstract: 
Introduction: Speech and language assessment is very important in early diagnosis of children with hearing and speech disorders especially in preschool period. But, stil there is not a standard, reliable and valid language test in our country to evaluate receptive and expressive language skills of preschoolers. Aim of this study is to determine the validity and reliability of Preschool Language Scale (5th edition) test with its Turkish translation and adaptation.
Methods: Our study is conducted on 1320 children aged between 0-7 years 11 months. While 1044 of these children have normal hearing, language and speech development, 276 of them have receptive and/or expressive language disorder. After the English-Turkish and Turkish-English translations of PLS-5 made by two experts command of both languages, some of the test items are reorganized because of the grammatical features of Turkish and the cultural structure of the country. Throughout the test, adhered to questions and pictures in the Picture Manuel. The test which is reorganized in the light of
data obtained in pilot application, is applied to children chosen randomly with layering technique from different regions of the country especially from Ankara, the capital of Turkey, then 15 days later the first test applied again to 120 children.

**Results:** While 1044 of 1320 children aged between 0 and 7 years 11 months are normal, 276 of them have receptive and/or expressive language disorder. While 98 of 103 healthy children of 120 taken under the second evaluation have normal language development, 8 of 9 who used to have language development disorder in the past still remaining. (Kappa coefficient: 0.468, p<0.001). Pearson correlation coefficient for TPLS-5 standard gauge are; IA raw score: 0.937, IED raw score: 0.908 and TDP: 0.887 respectively. Correlation coefficient for age equivalence is found as IA: 0.871, IED: 0.896, TDP: 0.887.

**Conclusion:** TPLS-5 is the first and only language test in our country that can evaluate receptive and expressive language skills of children between the age of 7 years 11 months. Results of the study show that TPLS-5 is a valid and reliable language test for the Turkish children. In the light of data gathered by evaluating 1320 children, receptive and expressive language skills of children in our country can be evaluated by a reliable language test from the birth. Thus, children with hearing and speaking disorder can be diagnosed early and early intervention can be made.

**Abstract ID:** 414  
**Poster Number:** 64  
**Title:** Factors Impacting Loss of Residual Hearing and Potential Otoprotective Strategies  
**Authors:** Adrien Eshraghi, MD, FACS, Kadri Ilıa, MD, Jamal Ahmed, MD, Fred F. Telischi, MD, Simon Angeli, MD, Sandra Prentiss, MD, Diane Martinez, MD, Sandra Valendia, MD; university of Miami Miller Sch. of Med., Miami, FL.  
**Abstract:** Introduction: Cochlear implant electrode insertion causes inner ear trauma, resulting in possible loss of residual hearing. There is numerous benefits from preservation of inner ear structures and hearing post implantation. Those include improved understanding in background noise, the ability to maintain sound awareness without wearing the external device and benefit in case that reimplantation is necessary. The objective of this study is to analyze various clinical and surgical factors that impact preservation of residual hearing post-implantation.

**Methods:** A retrospective study is performed to analyze loss of residual hearing in a cohort of 300 patients implanted in a large academic center. 64 patients met inclusion criteria for analysis of hearing preservation (HP) data. The HP is graded and analyzed using a formula outlines by Skarzynski and colleagues. The impact of age at implantation, etiology of hearing loss (HL), respect of soft surgery principals, cochleostomy vs. Round window insertion, partial vs. full insertion and effect of initial stimulation were analyzed using appropriate statistical analysis.

**Results:** The overall hearing preservation rate was 64%. No correlation was observed with age at implantation, etiology of hearing loss, full electrode insertion, gender, side of implant or pre-lingual deafness vs post-lingual deafness. The cochleostomy group had significantly higher proportions of patients with complete loss of residual hearing than the round window approach. There was a significant increase in rate of complete loss of residual hearing with non-soft surgery group when compared to the soft surgery group. There is a significant change in residual hearing post initial stimulation only at 6 kHz.

**Conclusion:** Respect of soft surgery technics and round window insertion help to protect residual hearing. Further studies are needed to evaluate the impact of the electrical stimulation on organ of corti and hair cells.
Abstract ID: 415
Poster Number: 21
Title: Teletherapy: Factors that Promote Success
Authors: Sandra Hancock, MS, Hannah Eskridge, MSP, Lillian Henderson, MSP, Maegan Evans, PhD, Erin Thompson, MS, Christine Kramer, MS; Children’s Cochlear Implant Ctr. at UNC, NC, NC.
Abstract: Introduction: “Telepractice is an appropriate model of service delivery for audiologists and speech-language pathologists” (ASHA, 2010). Conducting Listening and Spoken Language sessions through teletherapy has been shown to result in positive outcomes in speech and language development for patients with hearing loss (Houston, T.K. et al., 2016). Benefits of teletherapy include savings of time and resources, however, there remain factors that can make teletherapy challenging for families. This presentation will discuss factors that contribute to and detract from successful teletherapy experiences.
Methods: The potential to participate in teletherapy services was considered through parent and therapist communication during an audiological or speech and language evaluation appointment. Patient families were identified for inclusion based on their expressed interest in teletherapy by submitting an application requesting this service. A questionnaire was developed and sent to families to assess the effect of certain factors on participation in teletherapy.
Results: Results reveal factors impacting families' participation in teletherapy. These factors include scheduling, comfort with technology, behavior management of the child, parent perception of effectiveness, and parent perception of the need for therapy.
Conclusion: Despite the availability and effectiveness of teletherapy for the development of spoken language for children with hearing loss, there continue to be obstacles to overcome in making this service a perceived acceptable option to a wider patient population.

Abstract ID: 416
Poster Number: 156
Title: Increasing Perception of Bass/Low-frequencies via Phantom Electrode Stimulation Improves Music Appreciation in Cochlear Implant Users
Authors: Joseph Crew, PhD, Aniket Saoji, PhD, Leo Litvak, PhD; Research and Technology, Advanced Bionics, Valencia, CA.
Abstract: Introduction: Cochlear implants (CIs) are expected to give high levels of speech understanding in quiet and easy listening conditions to most recipients. With this dramatic improvement in outcomes over time, now the focus is beginning to shift to music perception and appreciation as well as speech comprehension in difficult listening environments. For music, attempts to restore “fine-structure” cues via the CI (e.g., time coding, current steering) have been limited in improving objective measures of music perception (e.g., melodic contour identification, melody identification, instrument identification). A parallel approach of improving subjective aspects of music appreciation seems to be a more feasible short-term goal. Previous work using phantom electrode stimulation (Saoji and Litvak, 2010; Saoji et al., 2013; Nogueira et al., 2015) has shown increased perception of low frequencies and a general improvement in overall perceived sound quality. In the present study, we measured subjective rankings in music appreciation for a number of experimental strategy phantom maps and control condition programs.
**Methods:** Subjective rankings of a given stimulation program relative to a patient’s own baseline program were recorded for many CI patients while listening to short samples of music. The music material consisted of five songs that were the same for everyone and five songs solicited from the research patient. There was no requirement of a type of music, and there was no requirement for a particular type of CI patient (e.g., unilateral, etc.). All testing was acutely performed via a direct connect interface to a single CI. Patients were not instructed that their baseline program was one of the experimental programs to be ranked, thus giving a blind placebo control condition. Experimental maps included a control condition in which the low frequency cutoff was extended, phantom strategies with the phantom channel stimulated at different points in a stimulation frame, and phantom strategies with compensatory high frequency gains.

**Results:** When simply adding a phantom channel, no difference in rankings was shown relative to the baseline program. In this situation, the patients reported that the increased bass competed with the lyrics/vocals leading to a neutral ranking. When compensatory high frequency gains were introduced to the experimental phantom strategy, patients rated these programs as much better relative to baseline. Patient reports indicate that bass was increased but tonal balanced was maintained and the vocals were clearer and more intelligible. Control conditions in which high frequencies were adjusted or the input filter cutoffs were adjusted showed a slight improvement relative to baseline but a smaller improvement relative to the phantom strategy with high frequency gains. A final comparison of a tweaked phantom strategy relative to baseline showed a dramatic improvement in music appreciation across subjects. Additionally, subjects indicated that they would use this new program most or all of the time.

**Conclusion:** The results from this study suggest that simply adding a phantom electrode channel will not increase music appreciation on average. However, if high frequencies are adjusted to compensate for the increased perception of low frequencies via phantom, patients consistently rate this experimental program better for listening to music.

**Abstract ID:** 421  
**Poster Number:** 73  
**Title:** Compliance With CDC Pneumococcal Vaccination Schedules: An Important Challenge For Pediatric Cochlear Implant Programs  
**Authors:** Stephen R. Hoff, MD, Bushra Ayub, MD, Nancy M. Young, MD; Pediatric Otolaryngology, Northwestern Univ./Ann & Robert H. Lurie Children’s Hosp. of Chicago, Chicago, IL.

**Abstract:** **Introduction:** In 2002, the CDC issued vaccination recommendations for pediatric cochlear implant (CI) candidates and recipients to minimize the risk of pneumococcal meningitis. No national unified approach to ensuring children receive the recommended schedule has been agreed upon. The schedule includes a pneumococcal conjugate (PCV 7 or PCV 13) and pneumococcal polysaccharide (PPV23) vaccination. Pneumococcal conjugate vaccinations are part of the schedule of recommended vaccinations for all children in the US. They are effective in children under age 2 years. Polysaccharide vaccination is given only to children at increased risk of pneumococcal disease, including CI candidates and recipients. It is not administered before age 24 months. The CDC schedule has been modified as knowledge and vaccinations have evolved. Ensuring that children receive the recommended schedule is labor intensive. Our program has noted that children who transfer care often require vaccinations after transfer to meet the CDC schedule recommendation. It is important to determine whether children who
Methods: Retrospective chart review of pediatric CI recipients who transferred care to a tertiary care children’s cochlear implant program between 2004 and 2016. Charts were reviewed for patient demographic information, date of implant(s), vaccination status, and risk factors for pneumococcal disease. A random sample of children implanted at our program were also reviewed for comparison. Whether CDC vaccination guidelines for PCV7, PCV13 and PPV23 were met at time of implantation(s) and at time of transfer was determined.

Results: 81 pediatric cochlear implant recipients were transferred to our program since 2004. Children came from 95 centers in 25 states and 4 foreign countries. 78 (96.3%) originated from US institutions, and 4 (4.9%) were international transfers. 10 (12.3%) patients had additional risk factors for meningitis, including cochlear malformation and immunodeficiency. 26 (32.1%) patients met CDC schedule guidelines in force on the date of transfer, while 55 (67.9%) did not. Of those who had not completed the recommended schedule of vaccinations, 4 (7.2%) had not received the recommended pneumococcal conjugate vaccination (PCV7 or PCV13). 33 (60%) had not received the 23-valent pneumococcal polysaccharide vaccine (PPV23), and an additional 18 (32.7%) were dually deficient in not having received PPV23 and at least one of the conjugate vaccinations. A total of 51/55 (92.7%) of those missing vaccinations were missing PPV23, which was 63% of all patients transferred. Analysis of vaccination of status of children implanted at our center will be completed for comparison.

Conclusion: This study raises concerns that implanted children frequently may not receive the pneumococcal vaccinations recommended by the CDC. Reason for this situation include changes in the recommendations over time and the labor intensive nature of determining childrens' vaccination status. This compliance problem is an important public health issue. Challenges to improving this situation, as well as use of electronic records to better ensure compliance will be discussed.
Results: CM thresholds and behavioral audiometric thresholds could be measured for 35 (6 subjects missing 125 Hz behavioral, 4 test frequencies shown No Response at highest stimulus level) frequencies from the nine cochlear implant ears. A strong correlation (r² = 0.72, p < 0.01) was obtained between CM thresholds and the behavioral audiometric thresholds. The mean difference between the ECoG responses and audiometric thresholds was -2.6 (±13.0) dB.

Conclusion: CM thresholds can be used to routinely measure and monitor residual hearing in pediatric cochlear implant patients.

Abstract ID: 437
Poster Number: 168
Title: Facial Stimulation in Current Cochlear Implant Recipients: Contributing Factors and Management Approaches
Authors: Jennifer Harris, AuD, Amanda Griffin, AuD, PhD, Elizabeth Erickson O’Neill, AuD, Marilyn Neault, PhD, Greg Licameli, MD;
ORL/CCE, Boston Children’s Hosp., Waltham, MA.
Abstract: Title: Facial stimulation in current cochlear implant recipients: contributing factors and management approaches

Introduction: Facial stimulation occurs as an infrequently seen side effect of electrical stimulation produced by a cochlear implant. Clinicians at our pediatric center report an apparent increase in the incidence of facial stimulation among recently implanted cochlear implant recipients within the first few months of use. Reports consist of eyelid twitching or blinking on the side of the implant, typically when mapping upper stimulation levels or when the device is activated in live-voice mode. The aims of this study are to 1) determine leading factors responsible for the observed increase in facial stimulation and 2) review current practices for the management of this side effect.

Methods: Retrospective chart review was conducted for all patients who received cochlear implant programming services at our center and were implanted with internal devices that are currently available at the time of this submission. For two groups of patients (those with vs. without documented facial stimulation), the following variables were examined: cochlear implant manufacturer, model of implant and electrode array, age of patient, surgical approach and insertion, etiology of hearing loss, and cochlear anatomy. For patients with facial stimulation, these additional data were recorded: map parameters including pulse width and programming strategy, and map adjustments that were made to reduce facial stimulation. Data were analyzed to determine the factors most strongly correlated with observed facial stimulation. Further, management approaches for reducing facial stimulation in pediatric patients were investigated through chart review and clinician interview.

Results and Conclusions: Facial stimulation was managed effectively for all patients under investigation, though the method of management varied considerably. Recognizing the factors that increase a patient’s probability of experiencing facial stimulation is valuable information to the programming audiologist. Results should be considered in comparison with correlative factors and management strategies for legacy internal device users as well. Findings from this study can help inform clinical practice on how best to avoid and manage undesired facial stimulation in the pediatric cochlear implant population.
Abstract ID: 438
Poster Number: 142
Title: Examining Hearing Aid Fitting Formulas for Music Appreciation for Bimodal Cochlear Implant Listeners
Authors: Joseph Crew, PhD, Smita Agrawal, PhD, Leo Litvak, PhD; Advanced Bionics, Valencia, CA.
Abstract: Introduction: As more hearing aid (CA) users get cochlear implants (CIs), mapping of these bimodal (CI in one ear; HA in the opposite ear) patients becomes a greater concern. Standard clinical practice is moving away from fitting each device independently and towards combined bimodal fitting in which the settings from one device influences the settings on the other device. Previous work has focused on speech intelligibility in quiet and in noise; however, the effect of HA programming on music perception for bimodal CI users has not been investigated. In this study, we examined the influence of different HA fitting formulas on subject music rankings.
Methods: Bimodal research patients subjectively ranked different HA fitting formulas (Adaptive Phonak Digital, NAL-NL 2, DSL v5a, and a new Phonak Bimodal Fitting Formula) while listening to short samples of music. The music material consisted of five songs that were the same for everyone and five songs solicited from the research patient. There was no requirement of a type of music. All testing was acutely performed acoustically using the patient’s own CI processor and an experimental Naida Link HA.
Results: Preliminary results show that the Phonak Bimodal Fitting Formula was ranked highest when listening to music with the DSL v5a fitting formula coming in second; the NAL-NL 2 and Adaptive Phonak Digital fitting formulas were ranked the lowest.
Conclusion: The results from this study suggest that changing the HA fitting for a bimodal CI user may improve music appreciation. Future work will examine what aspects of the HA fitting influence subjective music perception as well as what aspects of music may be contributing to improved music appreciation via bimodal listening.

Abstract ID: 440
Poster Number: 155
Title: Cochlear Implant Indication Related to Auditory Neuropathy Spectrum Disorders Patterns
Authors: Sebastian Cozma, MD, PhD1, Cristian Martu, MD, PhD1, Oana Bitere, MD, PhD2, Raluca Olariu, MD.1, Cristina Hera, MD.1, Luminita Radulescu, MD, PhD1; 1ENT, Univ. of Med. and Pharmacy “Grigore T. Popa”, Iasi, Romania, 2Audiology, Rehabilitation Clinical Hosp., Iasi, Romania.
Abstract: Introduction: Auditory neuropathy can be early diagnosed by specific elements and their relations that can be revealed in a battery of objective auditory tests: otoacoustic emissions, cochlear microphonics, electrocochleography, brainstem evoked response audiometry (BERA) and auditory steady state response (ASSR). In this study we analyzed the patterns of our auditory neuropathy cases related with the indication of cochlear implantation.
Methods: The study group included children diagnosed with auditory neuropathy spectrum disorders (ANSD), the majority from the neonatal auditory screening. They were refered to our department after the failure of auditory tests in maternity or for follow-up due to the presence of risk factors for hearing loss. The auditory assessment included for each child the following tests: otoacoustic emissions, timpanometry, BERA, ASSR, free field adapted audiometry, cochlear microphonics. We analized the data base following two particular patterns: the evolution of hearing loss in time and the presence or the
association of elements defining the category of auditory neuropathy spectrum disorders. The relation of cochlear implantation indication with these two patterns is discussed.

**Results:** We identified 34 children with ANSD, 6 cases with normal hearing and 28 with different levels of hearing loss, 3 patients with fluctuant deafness and 7 patients with progressive forms. The main ANSD characteristic elements found in our group were: the presence of cochlear microphonics, auditory dysynchrony (BERA), mismatch of BERA thresholds versus ASSR thresholds, the presence of otoacoustic emissions with auditory thresholds on BERA or ASSR over 40 dB, free field tonal responses at better levels than BERA or/and ASSR levels. The indication of cochlear implant was made for 15 children, 12 with cochlear implant only and 3 with bimodal stimulation (cochlear implant and hearing aid). 16 patients were conventional hearing aids fitted (13 with acoustic stimulation only, 3 with bimodal stimulation).

**Conclusion:** Cochlear implantation was the first indication for all children with hearing loss thresholds over 90 dB HL bilaterally. Many children with auditory neuropathy spectrum disorders present progressive hearing loss to the profound form with clear indication of cochlear implantation. We had cases with moderate or severe hearing loss with CI recommendation after a longer period of hearing aid fitting and speech therapy with no evident progress in speech understanding and speech production.

**Abstract ID:** 444  
**Poster Number:** 35  
**Title:** Investigation of the Perceptions of Parents' Children with Cochlear Implant: The Influence of Music Therapy in their Children's Auditory Re/habilitation  
**Authors:** Ayse Sanem Sahli, PhD1, Erol Belgin, PhD2;  
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**Abstract:** Introduction: The support that parents give to their children is very important in the re/habilitation of children with cochlear implant. Perspective of parents to the music therapy used in the auditory re/habilitation of the children and directing the children to the music activities affects the auditory and speech-language development of the child positively. The purpose of this study is to investigate the perceptions of parents who have a child with a cochlear implant for the use and influence of music in children's education.  
**Methods:** 70 parents (mother and/or father) who can hear normally and have a child with cochlear implant are involved in the study. All participants are informed verbally before the application and they signed the “informed voluteer form” in which information about the content of the study is given. Also “volunteer approval form” is given too. " Child and Parent General Information Form" and “Music Evaluation Questionnaire for Parents were used. A p value of 0.05 was determined as a significance level to interpret all test results and significance was determined at p<0.05 level. 72.4% of parents who have cochlear implanted child said that music is very important in the education of their children, music increases concentration (82.7%) and creativity (72.4%), music is fun for kids (75.9%) and memory skills of children develop with music (75.8%).  
**Results:** 72.4% of parents who have cochlear implanted child said that music is very important in the education of their children, music increases concentration (82.7%) and creativity (72.4%), music is fun for kids (75.9%) and memory skills of children develop with music (75.8%).  
**Conclusion:** In our study, it was seen that a large majority of parents with a child with a cochlear implant were thought that music is very useful method in the auditory re/habilitation process of children. Music
is a method that can be used for different purposes in the education of children with hearing loss. Parents' perception about music therapy is very important in planning and implementing the training of cochlear implanted children.

**Abstract ID: 447**  
**Poster Number: 141**  
**Title: Using Augmented Reality to Improve Patient Education in Auditory Brainstem Implant Surgery**  
**Authors:** Kevin Wong, BA, Elliott D. Kozin, MD, Daniel J. Lee, MD; Otolaryngology, Massachusetts Eye and Ear Infirmary, Boston, MA.  
**Abstract:** **Introduction:** Patients and their families are now more connected than ever and are often seeking new ways to access health information to help with decision-making. Smartphone ownership has reached near-saturation levels for the first time in the history of the United States, and almost half of adults now own smart tablets. Although many sources such as the Internet provide a wealth of information for common medical conditions and procedures, the same has not shown to be true for rarer treatments and disease processes. At our institution, we are conducting a prospective clinical trial of auditory brainstem implants (ABI) in non-tumor pediatric patients. Unfortunately, scant educational materials such as illustrations or diagrams currently exist for parents trying to conceptualize a highly complex, intracranial placement of an ABI electrode and this complicates counseling of parents. Here, we describe a novel approach to improve patient education by generating 3D augmented reality (AR) models of an ABI implant.  
**Methods:** Intracranial anatomy with an ABI were digitally rendered into 3D models using Meshmixer (San Rafael, CA) and AMIRA 3D for Life Sciences (Burlington, MA). The model was incorporated into a three-dimensional “game environment” using Unity 3D game engine (San Francisco, CA) and projected into an AR field using Vuforia (Needham, MA). The final product is compatible with iOS as well as android-based devices, and can be coupled with a Google cardboard viewer (Mountain View, CA) for a low cost, fully immersive experience.  
**Results:** The development of an AR app was achieved using a suite of free and open source software programs. Coupled with a mobile device and virtual reality viewer, this app provides an easily accessible, immersive, and highly visual way for parents to learn anatomy and conceptualize ABI placement. Using this app, parents enter an AR environment, view the 3D projection of the brainstem with the implant in real time, and have the ability to zoom, rotate, and clip through layers of the models. Because the app is based on the optical inputs of a smartphone, the model is highly mobile and portable among institutions.  
**Conclusion:** We successfully exported a 3D model of an ABI onto a mobile smartphone using AR technology. Future applications of AR technology in medicine include incorporating user interaction capabilities and expansion of applications for use in diagnosis and surgical planning.

**Abstract ID: 455**  
**Poster Number: 128**  
**Title:** Benefit of Directional Microphones on Speech Perception in Noise of Unilateral and Bimodal Cochlear Implant Users  
**Authors:** Kristina Anton, MSc1, Rolf-Dieter Battmer, Prof. Dr.1, Martina Brendel, Dipl.-Ing.2, Arneborg Ernst, Prof. Dr.1;
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Abstract: Introduction: For cochlear implant (CI) users understanding speech in noise remains a challenge. In such conditions the use of directional microphones (beamformers) improves the signal-to-noise ratio (SNR) by attenuating sounds from back and sides of the listener while maintaining signals from the front. Adaptive beamformers adapt their maximal attenuation depending on the noise source position. Advanced Bionics (AB) offers sound processors with an omni-directional microphone behind-the-ear (BTE) as well as a T-Mic. The T-Mic is a microphone placed at the opening of the user’s ear canal which is an advantage in terms of better speech understanding in noise. Furthermore an AB adaptive beamformer called UltraZoom (UZ) improves speech intelligibility for CI users in noisy listening conditions as well. The next AB sound processor will offer an additional, four-microphone binaural beamformer called StereoZoom (SZ), in which both processors receive audio data from the contralateral one in order to form a more focused beamformer and stronger attenuation of noise.

Methods: In this study ten unilateral and ten bimodal experienced adult CI users with a Naida CI processor will be recruited. Both groups will perform speech perception tests with UltraZoom versus the two omni-directional microphone options, bimodal subjects will be tested with StereoZoom in addition. Speech perception threshold (SRT) in noise will be measured via the Oldenburg sentence test (OlSa). Speech will be presented from the front (0°), while noise will be presented in two different loudspeaker configurations: (A) +/-60°, +/-120° and 180° and (B) +/-30°, +/-60° and 180°.

Results: Previous clinical studies with ten bilateral adult CI users showed an improvement in SRTs of 4-4.5 dB for UltraZoom compared to omni-directional microphones and 1.5 dB in addition for StereoZoom. These tests were performed with a setup using eight equally dispersed loudspeakers in a circle presenting OlSa sentences in front of the listener (0°) and noise from all other loudspeakers. Technical measurements of SNRs were conducted in both setups. The beamformers showed benefits of around 4 dB (UZ) and 1.5 dB (SZ) in setup A and around 2 dB (UZ) and 3 dB (SZ) in setup B. Results for the clinical study will be shown for these two beamformer settings compared to the BTE microphone and T-Mic.

Conclusion: Based on precious study results and technical measurements, UltraZoom and StereoZoom will likely result in improved speech intelligibility. Furthermore the narrower beamformer StereoZoom offers bimodal and bilateral CI users to focus on a single talker for communication in a difficult noise situation.

Abstract ID: 457
Poster Number: 189
Title: The Benefit of Noise-Reduction Technologies with and without Visual Cues for Cochlear Implant Recipients
Authors: Michael Dorman, PhD1, Sarah Natale, MS1, Smita Agrawal, PhD2; 1Speech & Hearing Science, Arizona State Univ., Tempe, AZ, 2Advanced Bionics, Valencia, CA.

Abstract: Introduction: Cochlear Implant recipients often have access to audio-visual cues for speech understanding. That is, they report that most of the time they can see the person to whom they are listening. It has been demonstrated that access to visual cues leads to significant improvement in performance in quiet as well as in noise. In this experiment, we evaluated the value of noise-reduction technologies in environments where visual speech cues are present.

Methods: Speech understanding was evaluated in ten adults (experienced CI users of Advanced Bionics CII and/or HR90K implants, 5 unilaterals and 5 bilaterals) using audio-visual speech material in restaurant background noise. A computer monitor was placed in front of the subject to present visual
speech cues. Three programs were created using participants’ everyday program on Naida Q90 processors: (1) omnidirectional T-mic, (2) UltraZoom, and (3) Roger Pen (70%/30% input). Participants were tested at (i) individualized SNR at which scores with T-Mic in noise were 30-50% that in quiet and (ii) an additionally challenging SNR with 5 dB more noise added to the individualized SNR. Testing was conducted with audio only (A-only) and with audio-visual cues (AV). Ease of listening ratings were obtained in each condition on a 5-point scale ranging from very difficult to very easy.

Results: In the absence of visual cues, as expected, UltraZoom and Roger significantly improved speech scores (T-Mic < UltraZoom < Roger) at both noise levels (p<0.001). AV scores were significantly better than A-only scores across all technology conditions with the increment being highest for T-Mic perhaps due to ceiling effects. Even with visual cues, UltraZoom and Roger continued to elicit higher performance than T-Mic. Roger scores were significantly better than UltraZoom scores at the more challenging SNR (p<0.005). Similar trends were observed in the subjective ease of listening ratings. Interestingly, the ratings also showed that while adding visual cues significantly improved scores in noise with the T-Mic, listening was still rated as moderate to difficult. Listening with Roger in the same noise conditions was rated as easy.

Conclusion: Findings indicated that Roger Pen performed better than UltraZoom, which was better than the omnidirectional T-Mic. The Roger Pen allowed speech understanding scores equivalent to scores with the T-Mic in quiet. Concomitant visual cues additionally boosted performance by 13-35%. Even with visual cues present, currently available noise reduction technologies can restore speech understanding in noise to approximate levels of understanding in quiet with conventional microphones.
reversing polarity of external device magnet, she completely recovered auditory performance. She is following up without any problem over two years.

**Results:** MRI evaluation is a powerful diagnostic tool that should be available for the benefit of CI recipients. Many researchers have investigated the compatibility of 1.5 T MRI with CI. Their results reported that patients with CI could safely undergo 1.5 T MRI without removing the internal magnet. In many cases, an accurate compressive bandaging of the temporal bone, without magnet removal, is adequate to perform MRI from 0.2 to 1.5T without significant risks. However, it is possible to witness a magnet displacement even after proper bandaging. For MRI systems with field strength above 1.5T, the removal of the inner magnet with a small skin incision is necessary. We think that it is most likely that the magnets physically reversed orientation and ended up back in the pocket when she pressed button like material herself. In this case, we think that the pressure bandage may have not been initially, which allowed the magnets to flip over. Although it is conceivable that the polarity of the magnets was reversed by the magnetic field of the scanner, this has never been reported, and if this did occur, the strength of the magnet would likely be greatly attenuated, which was not the case.

**Conclusion:** This complication was easily managed by reversing the orientation of the external magnet in the head coil. If the magnet becomes displaced or demagnetized during MRI, the magnet could be replaced using a procedure similar to that required if the magnet had been removed before the MRI. This report highlights the importance of pressure bandage the device adequately before 1.5T MRI. Furthermore, we need to remodel pocket of inner magnet and to make the inner device sufficiently compatible with magnetic field.
the Processor Mic by 20 percentage points. Performance with Roger Pen and Visual cues on average came within 5 percentage points of the Processor Mic’s performance in quiet.

**Conclusion:** Current monaural noise reduction technologies both with and without the presence of visual cues can significantly improve speech understanding in moderate levels of noise.

**Abstract ID:** 468  
**Poster Number:** 51  
**Title:** Cochlear Implantation in Children with Sensorineural Hearing Loss Caused by Congenital Cytomegalovirus Infection  
**Authors:** Thomas A. Babcock, M.D., Amit Wolfovitz, M.D., Michael E. Hoffer, M.D., Fred F. Telischi, M.D., MEE, FACS;  
Department of Otolaryngology-Head and Neck Surgery, Univ. of Miami Miller Sch. of Med., Miami, FL.  
**Abstract:** **Introduction:** Congenital cytomegalovirus (CMV) infection is the leading cause of non-genetic congenital sensorineural hearing loss (SNHL) in children. Although approximately 90 percent of infants with congenital CMV infection are asymptomatic at birth, 10 to 15 percent develop hearing loss. Among infants with symptomatic CMV infection at birth, 65-70 percent develop hearing loss as well as associated neurodevelopmental delay and characteristic central nervous system abnormalities, including intracranial calcifications, migrational abnormalities such as polymicrogyria, cerebral and cerebellar volume loss, ventriculomegaly, and white matter disease. In spite of the prevalence of congenital CMV infection-associated SNHL, there is a relative paucity of literature regarding cochlear implantation in this patient population and subsequent speech perception and speech intelligibility outcomes. Therefore, we aim to review our institutional experience with cochlear implantation in children with SNHL caused by congenital CMV infection and examine preoperative audiometric data, radiographic findings, intraoperative findings, and speech perception and speech intelligibility outcomes.  
**Methods:** Retrospective chart review of children with SNHL caused by congenital CMV infection that underwent cochlear implantation at our academic tertiary care facility between 2010 and 2016. Preoperative audiologic evaluation and pattern of hearing loss, radiographic findings, intraoperative findings and surgical technique, and speech perception and speech intelligibility outcomes were assessed. Variables impacting results were explored, including concomitant neurodevelopmental delay and characteristic intracranial radiographic findings as well as unilateral versus bilateral cochlear implantation.  
**Results:** Preliminary findings suggest children with SNHL caused by congenital CMV infection derive benefit from cochlear implantation, albeit variable. Variability in speech perception and speech intelligibility outcomes following cochlear implantation in children with congenital CMV infection-associated SNHL is likely in part due to heterogeneity in comorbid neurodevelopmental delay and central nervous system abnormalities.  
**Conclusion:** Cochlear implantation has the potential to improve hearing and speech in children with SNHL caused by congenital CMV infection. Parents should be counseled extensively regarding the wide range in performance and post-implantation individualized, multidisciplinary rehabilitation should be strongly emphasized. Further studies are needed to elucidate specific factors associated with congenital CMV infection that may influence outcomes.

**Abstract ID:** 471  
**Poster Number:** 40
Title: Nasal Resonance Characteristics in Mandarin Speaking Children with Cochlear Implants
Authors: Yajing Wang, PHD
Abstract: Introduction: The present study evaluated the effect of cochlear implantation (CI) and implant age on speech nasal resonance in a prelingually deaf group of Chinese children
Methods: This study examined fifty prelingually deaf children with CI and fifty age-matched children with normal hearing (NH). The CI children were divided into two groups based on implant age. Twenty-nine children received implants before or upon reaching 4 years of age, while twenty-one children received implants after the age of 4. The subjects were asked to recite two Chinese phrases and three Chinese sentences that included oral, nasooral and nasal text. A Nasameter II (Model 6450; KayPentax) was used to obtain nasalance values of different stimuli.
Results: For the oral text and Chinese phrase/baba/stimuli, the CI group did not differ significantly from the NH group (p=0.397, p=0.950). For the nasooral text, nasal text and mama/stimuli, the CI group showed significantly lower nasalance scores than the NH group (p<0.05). For the nasal text stimuli, the nasalance scores of the group receiving implants before or upon reaching 4 years of age were significantly higher than the scores of the group receiving implants after reaching 4 years of age (p<0.05).
Conclusion: The present study shows that hyponasality creates speech problems among Mandarin-speaking children with CI, suggesting that inadequate control over nasal-oral balance levels persisting after children receive CI requires attention during speech therapy.

Abstract ID: 474
Poster Number: 8
Title: Cochlear Implant Evaluation in Patients with Single Sided Deafness
Authors: Raquel A. Lauria, Bachelor of Medicine. Otolaryngologist, Mariana Toro, Bachelor of Medicine. Otolaryngologist., Luiz Henrique Chequim, Bachelor of Medicine. Otolaryngologist, Vagner Rodrigues, Bachelor of Medicine. Otolaryngologist. Otologist, Walter Bianchini, MD, Arthur Castilho, MD, Agricio Crespo, MD;
Department of Otolaryngology, Head and Neck. University of Campinas (UNICAMP), UNICAMP, Campinas, Brazil.
Abstract: Introduction: Severe and profound unilateral hearing loss can cause difficulties to hear, especially with tinnitus and in environments with background noise. The best performance in terms of sound location in patients with binaural hearing depends on the head shadow effect, the "squelch" effect and the binaural summation. Recent evidence suggests that cochlear implants in single sided deafness (SSD) can restore binaural hearing, improve the ability to locate sounds and also reduces the intensity of tinnitus. The purpuse of the study is to perform cochlear implant surgery in patients with unilateral severe or profound sensorineural hearing loss, who did not benefit from hearing aids.
Methods: Methods: The procedures were performed in 4 different patients, who used the CROS ("contralateral routing of offside signals") hearing aid system four weeks prior to the surgery. The cochlear implant activation was performed one month after the procedure. Speech intelligibility test (Hearing in Noise Test - HINT), tinnitus evaluation and sound localization tests were performed before surgery (without rehabilitation and with the CROS system) and also in the first, third, sixth, ninth month and one year after surgery.
Results: Results: The patients submitted to the cochlear implant presented better results in relation to hearing in noisy environments, audiometric thresholds and sound localization, compared to CROS and
non-rehabilitation. There was no complication related to surgery. Only two patients had tinnitus, with improvement of the Tinnitus Handicap Inventory after surgery, however without statistical relevance.

**Conclusion:** Cochlear implant for patients with SSD is a good option for hearing rehabilitation and can improve hearing in noisy environments, audiometric thresholds and sound localization. Further investigation is necessary for proper assessment of tinnitus.

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**Abstract ID:** 475  
**Poster Number:** 98  
**Title:** Radiographic Predictors of Successful Cochlear Implantation for Pediatric Patients with Symptomatic Cytomegalovirus  
**Authors:** Rounak B. Rawal, MD, Holly F. Teagle, AuD, Carlton J. Zdanski, MD; Univ. of North Carolina Hosp., Chapel Hill, NC.  
**Abstract:** Multiple radiographic findings have been reported for pediatric patients with sensorineural hearing loss (SNHL) secondary to symptomatic cytomegalovirus (CMV). Here we present outcomes from the largest retrospective case series of patients in this population undergoing cochlear implantation, and correlate them with pre-operative radiographic findings.  
**Methods:** Retrospective single-institution chart review at tertiary academic center. All pediatric patients undergoing implantation at the authors’ institution with known congenital CMV who underwent pre-operative imaging (MRI or CT) were included.  
**Results:** Between 1993-2016, 59 patients fit criteria. Mean age at implantation was 3.7 years (range: 9 mos - 19.3 years). Cerebral MRI lesions and anomalies were noted in 35/51 patients (81.3%); inner ear pathology was noted in 8/59 patients (13.6%). One intraoperative complication was encountered (1.7%), and no patients required revision. Neither cerebral MRI lesions nor inner ear pathology significantly predicted complications (p=0.69, p=0.99). A variety of speech perception scores are presented and correlated with radiographic anomalies.  
**Conclusion:** Pre-operative radiographic imaging may be more helpful in predicting post-operative speech reception scores than in predicting intra-operative complications. However, speech perception scores must be weighed with pre-existing developmental delay or neurologic impairment. Cochlear implantation should be considered in all patients with CMV and severe SNHL.

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**Abstract ID:** 480  
**Poster Number:** 17  
**Title:** Cochlear Implantation in Cases of Unilateral Hearing Loss (UHL): Therapy Implications for Children  
**Authors:** Maegan K. Evans, PhD, Holly Teagle, AuD, Sandra Hancock, MS, Harold Pillsbury, MD; UNC, UNC Chapel Hill, Durham, NC.  
**Abstract:** Previous research on adults with UHL has shown an improvement in speech perception, localization, and/or quality of life with a cochlear implant as compared to an unaided listening condition. With the potential of neural plasticity in their favor, it is of interest how children with UHL could benefit from cochlear implants to develop auditory skills. A case study report by Greaver, Eskridge and Teagle (2016) revealed that five children with UHL consistently wear their devices and have shown improved outcomes in speech recognition when the implanted ear is isolated. Under an investigational device exemption (IDE), in a current clinical trial, 20 children with UHL will receive a cochlear implant. During the first year post-implant, each child will receive a total of 21 auditory-verbal based therapy sessions. This presentation will show a model for therapy, based on an aural
A rehabilitation protocol developed for adults with UHL, which will be used during these sessions with the children included in the trial.

**Methods:** A tool was developed to guide therapy for children with UHL and to track improvements in auditory skills with their implant.

**Results:** Results show that all adults with UHL show overall improved outcomes in their auditory skills post implantation. Preliminary data on performance of children with UHL who receive a cochlear implant during auditory-verbal based therapy sessions over time will be discussed.

**Conclusion:** Therapy for children with a UHL is a new area to be explored. Continued research on the type of therapy, frequency of therapy, and efficacy is needed.

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**Abstract ID:** 481  
**Poster Number:** 87  
**Title:** Cochlear Implants: Insertion Assessment by Computed Tomography  
**Authors:** Raquel A. Lauria, Bachelor of Medicine. Otolaryngologist, Vagner Rodrigues, Bachelor of Medicine. Otolaryngologist, Alexandre C. Guimarães, MD, Walter Bianchini, MD, Arthur Castilho, MD, Agricio Crespo, MD; Department of Otolaryngology, Head and Neck. University of Campinas (UNICAMP), UNICAMP, campinas, Brazil.

**Abstract:**  
**Introduction:** Cochlear implants (CIs) functionally restore hearing in individuals with profound hearing impairment. Imaging exams play a key role in CIs with regard to both planning implantation before surgery and quality control after surgery. Selecting the optimal insertion depth should be patient-specific by means of determining corresponding residual hearing. The development of a tool for measuring the insertion depth would be valuable in clinical practice. The aim of this study was to assess a technique for measuring the insertion depth of cochlear implants (CIs) based on computed tomography (CT).

**Methods:** Five formaldehyde-preserved human temporal bones were implanted with two different types of electrodes through the round window membrane: The modiolar research array (MRA) and The Contour Advance device. The human temporal bones were first implanted with MRA electrodes and then imaged by CT. These electrodes were then removed, and Contour Advance electrodes were implanted in the same temporal bones and imaged by CT. Linear and angular measurements of CIs were assessed by CT. We comprehensively characterized two CI models while obviating possible changes that can be caused by different cochlea sizes by using the same human temporal bones to evaluate the implant models.

**Results:** We observed significant differences between both insertion measurements for the two evaluated electrode arrays because of their different design and construction characteristics (p < 0.05).

**Conclusion:** The present study demonstrates a practical and useful tool for evaluating CI electrodes in clinical practice. Further studies should measure preoperative and postoperative benefits in terms of speech recognition and evaluate the preservation of residual hearing in the implanted ear. Such studies can also determine correlations between surgical factors, electrode positions, and performance. In addition to refine surgical techniques, the precise evaluation of cochlear length and correct choice of CI characteristics can play an important role in postoperative outcomes.

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**Abstract ID:** 482  
**Poster Number:** 15
Title: Language Outcomes Following Cochlear Implantation in Pediatric Patients with Cochlear Nerve Deficiency

Authors: Elizabeth Erickson O'Neill, Au.D.1, Ashleigh Lewkowitz, Au.D.1, Amanda Griffin, Au.D., Ph.D.1, Jennifer Harris, Au.D.1, Denise Fournier Eng, M.A.2, Jennifer Johnston, Ed.D.2, Nicole Salamy, M.S.2, Amy Szarkowski, Ph.D.3, Greg Licameli, M.D.4; 1CI Program, Boston Children's Hosp., Waltham, MA, 2CI Program/Deaf and Hard of Hearing Program, Boston Children's Hosp., Waltham, MA, 3CI Program/Deaf and Hard of Hearing Program/Harvard Medical School, Boston Children's Hosp., Waltham, MA, 4CI Program/Harvard Medical School, Boston Children's Hosp., Boston, MA.

Abstract: Introduction: Cochlear nerve deficiency (CND) is defined as a small or absent cochlear nerve, diagnosed via MRI and/or CT scan. Owing to the abnormal auditory nerve, these children are not considered typical candidates for cochlear implantation (CI), as benefit is highly variable. Audiological outcomes in this population are well documented in the literature; however, investigation of language outcomes is limited. This study will examine how cochlear implantation affected language acquisition for pediatric patients with CND, secondary to non-syndromic hearing loss.

Methods: Retrospective review of 703 medical records of children who received CIs at a tertiary care pediatric hospital between 1995-2016 identified six children with a diagnosis of CND. Audiological, speech-language and psychological chart notes were reviewed to determine access to sound pre-and post- cochlear implantation, the type and quality of early language opportunities, and later development of language abilities.

Results: Consistent with the existing literature, audiological outcomes varied across the cohort. All patients achieved sound awareness through their CI(s), with CI detection thresholds ranging from 20 to 75 dB HL. Of the children who were old enough to measure speech understanding (n=4), abilities ranged from basic pattern perception to open-set word understanding. For this group of children, both the early language exposure and the post-implantation of children the language outcomes were highly variable. Two of the children are competent users of language; one child (whose hearing loss was progressive) is bilingual in English and a home language and the other is fluent in ASL. For these two individuals, was early access to a natural language (spoken or signed) seemed to be a significant factor in their later use of language. The other four children have significant delays in receptive and expressive language.

Conclusion: Language outcomes for this small group varied considerably and most of the children do not meet the expectations for spoken language outcomes we hold for the majority of children who receive cochlear implant(s). Thus, cochlear implant teams are encouraged to think more broadly regarding both cochlear implant candidacy and parental counseling, pre- and post-operatively. Pre-implantation consultations should minimally include otologic, audiologic, speech-language, and psychological evaluations. We advocate for in-depth discussion with families prior to implantation regarding: expected auditory outcomes, appropriate audiologic and speech-language intervention post-operatively, anticipated changes in quality of life, the need for access to a natural language - spoken or signed - to support development of communication, language and thinking, and potential implications for communication modality/opportunities.
Abstract: Introduction: Outside the small circle of those well informed about Usher syndrome type I, easily identifiable motor milestones alerting one to consider for the syndrome are largely unknown. Ophthalmologic diagnostic elements (optical coherence tomography, electroretinography, and at the gross stage retinitis pigmentosa) continue to evolve. Genetic testing is often not covered by insurance.

Methods: Data review of one cochlear implant team’s (a surgeon, an audiologist) personal experience of 22 years and 507 children implanted.

Results: Eight patients, of whom six represented three sets of siblings, walked independently at a median age of 22.5 months (range 16-36 months). The ages of 1st ear implantation ranged from 6 to 33 months, median. The median age for diagnosis of Usher I was 11 years (range 5-22). Prior to the diagnosis of Usher type I, two sets of siblings (i.e., four patients) had geneticist-placed diagnoses of Waardenburg syndrome (one set of siblings) and connexin 26 (another set of siblings). Each patient is a comfortable listening-speaking communicator.

Conclusion: For the child with congenital bilateral profound hearing impairment and with image-normal temporal bones, not walking independently by age 18 months should be an alert to the potential diagnosis of Usher syndrome I.

Abstract ID: 484
Poster Number: 29
Title: Effect of Phonological Errors on Speech Intelligibility in Early and Later Implanted Pediatric Cochlear Implant Users
Authors: Olga Peskova, MS1, Nirmal Srinivasan, PhD2, Ann Geers, PhD3, Emily Tobey, PhD3, Peter Assmann, PhD1;
1Behavioral and Brain Sciences, UT Dallas, Richardson, TX, 2 Audiology, Speech-Language Pathology, and Deaf Studies, Towson Univ., Towson, MD, 3Behavioral and Brain Sciences, The Univ. of Texas at Dallas, Richardson, TX.

Abstract: Introduction: Cochlear implants (CI) allow children with hearing loss (HL) to achieve speech perception and production outcomes to make their speech understandable to normal hearing (NH) adult listeners. This capability is accompanied by a wide variability of scores. In order to understand the factors that contribute to this variability, we investigated the effects of phonological errors, age of implantation and duration of CI use on speech intelligibility of earlier and later implanted CI users.

Methods: Later implanted participants included the group of 107 children implanted between the ages of 2 and 4 tested at 8 years of age. Early implanted participants included the group of 60 children implanted between the ages 1 and 3 (±2 months) tested at 8 years of age. Speech intelligibility performance and number of phonological errors were evaluated using McGarr sentences (McGarr, 1983), which varied in length from 3 to 5 to 7 syllables and were defined as low and high context sentences. Three NH listeners independently heard one sentence from one child and wrote down the words they understood. The average score was calculated for intelligibility. Sentences produced by CI users were transcribed by four speech language pathologists. Broad transcriptions were analyzed using the Computer Aided Speech and Language Analyses (CASALA) software (Serry et al., 1997) to determine the percent correct for each consonant and calculate percent of omissions and substitutions.

Results: Significant negative correlations between speech intelligibility scores and phonological errors for both groups were evident. The earlier implanted group had significantly fewer omission and substitution errors compared to the later implanted group.
Conclusion: The significant reduction in the number of errors for the earlier implanted group indicate advantages of early implantation, longer duration of CI use and newer speech processing strategies relative to later implanted group.

Abstract ID: 486
Poster Number: 89
Title: Diameter of Nerve for Predicting Outcome of Cochlear Implant in Children with Severe Cochlear Nerve Deficiency
Authors: Yongxin Li, professor
Otolaryngology, Beijing Tongren Hosp., Beijing, China.
Abstract: Introduction: Cochlear nerve deficiency (CND) is often associated with poor cochlear implant (CI) outcomes, and patients with cochlear nerve absent may be considered as relative contraindication for CI. The purpose of this study was to report the outcome of 21 CI patients who have only one nerve in internal auditory canal (IAC) and the relationship between diameter of this nerve with postoperative performance.
Methods: We present 21 children diagnosed as cochlear nerve absent with only one nerve in IAC who received cochlear implant surgeries in our center during January 2009 to January 2016. These patients all underwent HRCT to determine the malformation of cochlear and MRI to measure the diameter of the point in oblique sagittal plane scan. Postoperative performance of the CI children was assessed by Auditory Performance (CAP), Speech Intelligibility Rating (SIR), Meaningful Use of Speech Scale (MUSS) and meaningful auditory integration scale/infant-toddler meaningful auditory integration scale (MAIS/IT-MAIS) 1 year after surgery.
Results: 20 of 21 patients got an improvement on auditory performance comparing with pre-operation (p<0.05), including 6 patients with cochlear malformation (IP-I and common cavity). The average nerve diameter is 0.99±0.79mm. There is significant relation between nerve diameter and SIR, MUSS and MAIT/IT-MAIS (p<0.05). And the nerve diameters between patients with malformation (0.75±0.43mm) and non-malformation (1.08±0.82mm) groups are significant different (p<0.05). But the performances are no differences.
Conclusion: Patients with serve cochlear nerve deficiency could benefit from cochlear implant. And the nerve diameters in IAC on MRI may be a moderate predictor of postoperative outcome for CI patients with only one nerve in IAC.

Abstract ID: 487
Poster Number: 162
Title: Intraoperative Electrocochleography (ECochG) in Response to Acoustic Stimulus Using the Cochlear Implant Electrode Array and Post-activation Speech Outcomes
Authors: Robert T. Dwyer, AuD1, Jourdan Holder, AuD1, Brendan P. O’Connell, MD2, George B. Wanna, MD2, Marc L. Bennett, MD2, Alejandro Rivas, MD2, David S. Haynes, MD1, René H Gifford, PhD1, Robert F. Labadie, MD2; 1Hearing and Speech, Vanderbilt, Nashville, TN, 2Vanderbilt, Nashville, TN.
Abstract: Introduction: Even with improvements in cochlear implant (CI) technology, large variability in speech understanding outcomes exists. Duration of deafness has consistently been most shown to be the primary variable affecting outcomes in CI listeners—primarily driven by the extreme ends of the function. Fitzpatrick et al. (2014) recently showed high predictive value of electrocochleography (ECoG)
on CNC word recognition in adult CI users. The primary purpose of this study was to determine the feasibility of measuring intraoperative ECochG in response to acoustic stimulus using the electrode array and secondly, to correlate this with post-activation outcomes.

**Methods:** 28 adult patients with normal cochlear anatomy undergoing cochlear implantation with an Advanced Bionics Mid-Scala device were studied. Acoustic tone bursts (125 Hz, 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz) were presented to the operative ear via foam insert earphone after electrode insertion. ECochG responses were recorded using the implant electrode array.

**Results:** ECochG responses were successfully measured in 27/29 (93%) ears using the electrode array. The range of the total response (TR) measured was 55 dB. No significant correlation between the magnitude of the TR and post-operative CNC was observed for 11 ears reaching the 3-month time point at the time of abstract preparation (p > 0.05). Further we found no correlation with CNC word score and duration of hearing loss, age at implantation, pre-CI sentence recognition, nor cognitive status (MMSE).

**Conclusion:** ECochG can reliably be measured in most CI patients. Responses to acoustic stimuli were successfully measured in 27/29 (93%) of device insertions. Loss of lock on one device and a kinked stimulus delivery tube resulted in lost data for the remaining 2 cases. Preliminary findings suggest that ECoG magnitude obtained intraoperatively following electrode insertion is not correlated with word recognition; however, the 11 patients had not yet reached expected performance asymptote at the time of abstract preparation. We will continue longitudinal assessment with additional analyses.

**Abstract ID:** 490  
**Poster Number:** 154  
**Title:** Timing of Implantation in Pediatric Progressive SNHL: Are We Waiting Too Long?  
**Authors:** Maura Cosetti, MD, Jillian Levine, AuD, George Wanna, MD; Otolaryngology, New York Eye and Ear Infirmary of Mount Sinai, New York, NY.

**Abstract:** **Introduction:** Age at implantation is a well-known predictor of outcome for children with congenital, profound sensorineural hearing loss (SNHL), with data suggesting earlier implantation maximizes post-operative speech understanding. In contrast, optimal timing of CI in pediatric patients with progressive SNHL remains controversial. The objective of this study is to understand the impact of age at CI on speech understanding in children with progressive SNHL.

**Methods:** A retrospective chart review was performed of all pediatric patients with a diagnosis of progressive SNHL who underwent cochlear implantation (CI). Variables affecting CI candidacy, including pure-tone average, hearing-aid fitting, etiology of progressive hearing loss, age at implantation, closed and open-set speech perception, and educational environment were collected and trends toward implantation decision-making were analyzed.

**Results:** Children (n=12) with progressive SNHL who ultimately underwent CI were identified. Age at CI ranged from 13 months - 16 years (mean 5 years) with average follow-up of 12 months. Post-operatively, all patients demonstrated improved speech perception, including patients with access to open-set speech shortly following implantation. Overall, younger age at implantation was an independent predictor of post-operative speech understanding.

**Conclusion:** CI candidacy decisions in pediatric patients with progressive SNHL who receive some benefit from binaural amplification are often challenging and multi-factorial. Although ideal timing remains controversial, age at implantation appears to play a significant role in post-operative speech understanding and should be an important factor in timing of implantation.
Abstract ID: 491
Poster Number: 70
Title: Correlations of Intracochlear and Extracochlear Electrocochleography during Cochlear Implantation in Children and Adults
Authors: Christopher K. Giardina, B.S.1, Tatyana E. Fontenot, M.D.1, Stephen Pulver, M.S.1, Craig A. Buchman, M.D.2, Oliver F. Adunka, M.D.3, Kevin D. Brown, M.D., Ph.D.1, Harold C. Pillsbury, M.D.1, Douglas C. Fitzpatrick, Ph.D.1; 1UNC Chapel Hill, Chapel Hill, NC, 2Washington Univ. at St. Louis, St. Louis, MO, 3The Ohio State Univ., Columbus, OH.

Abstract: Introduction: Preservation of cochlear integrity throughout cochlear implant (CI) insertion is paramount in maximizing speech and hearing outcomes for both children and adults. However, intraoperative feedback to surgeons regarding CI positioning and basilar membrane trauma are limited. Electrocochleography (ECochG) during CI insertion has been used but approaches vary by recording location, at either intra- or extracochlear sites. Specifically, groups have reported a steady increase in intracochlear response and a stable extracochlear response as indicators of hearing preservation. The purpose of this study was to characterize intra- and extracochlear ECochG responses during CI insertions for a broad range of CI subjects and array types. Our hypotheses were that intracochlear responses would be larger and grow during insertion, whereas extracochlear signals would be smaller but better able to detect cochlear trauma.

Methods: In 74 CI recipients (29 children and 45 adults), ECochG was performed at the round window (RW) before CI insertion and at an extracochlear (n=53) or intracochlear (n=21) site throughout CI insertion. Tone bursts were presented to the ipsilateral ear using a Natus Bio-Logic AEP Pro. The frequency which elicited the largest RW response at 90 dB nHL (typically 500 Hz) was used as the stimulus frequency during CI insertion. The extracochlear electrode was a custom-built copper probe which remained fixed on the promontory via a retractor-clamped mount. For intracochlear recordings, manufacturer-provided telemetry software allowed for a digital short to be created between the apical contact and the reference contact, which we then connected our recording device to.

Results: Intracochlear responses at the beginning of CI insertion were on average 10.7 dB larger than extracochlear responses, and were not different between children and adults (p>0.81, t-test). Throughout CI insertion, intracochlear responses could grow at least 5 dB in magnitude (38%), remain steady within 5 dB (48%) or even decline in magnitude (14%). There were also differences in typical response patterns between modiolar and lateral wall arrays, with modiolar arrays increasing in magnitude 13-fold more on average than the lateral wall arrays. For extracochlear recordings, responses tended to remain steady (within 5 dB) in most cases (72%), with occasional cases having larger (5 dB) drops (28%). Interestingly, in both intra- and extracochlear recordings, responses could drop by more than 5 dB and have partial or complete recovery by the end of CI insertion (25% extracochlear, 24% intracochlear).

Conclusion: Intracochlear responses to tones are generally larger than extracochlear signals, but growth during CI insertion was not common and was more likely in modiolar than lateral wall arrays. Response patterns during CI insertion are array-specific and a simple drop in magnitude at either intra- or extracochlear site may not be an absolute metric for trauma.

Abstract ID: 493
Poster Number: 90
Title: Predicting Auditory Outcomes from Radiological Images and Electrode Types in Cochlear Implant Patients with Incomplete Partition Malformation

Authors: Yongxin Li, professor
Otolaryngology, Beijing Tongren Hosp., Beijing, China.

Abstract: The purpose of this study was to evaluate the radiology and hearing-speech rehabilitation in inner ear anomalies with Incomplete Partition for cochlear implant (CI) users using different electrode types.

Methods: The subjects were 40 patients with profound congenital bilateral sensorineural hearing loss for CI. These patients were retrospectively selected from our electronic database in which all inner ear malformations with incomplete partition utilizing a different electrode styles (short electrode, FLEX 24,FLEX28) between 2013 and 2015. The patients were grouped by different electrode types. Computed tomography (CT) data and magnetic resonance (MR) images were reviewed by two radiologists. Categories of Auditory Performance (CAP), Speech Intelligibility Rating(SIR), Infant-Toddler Meaningful Auditory Integration Scale or Meaningful Auditory Integration Scale (IT-MAIS or MAIS), Meaningful Use of Speech Scale (MUSS) were collected pre- and postoperatively at 24 months and were analyzed by an audiologist.

Results: The average basal turn length of the cochlea is 9.02±0.76 mm. The average basal turn height of the cochlea is 2.49±1.60 mm. There is a significant correlation between electrode types and SIR scores (r=0.656, p<0.05). Among the three groups, the basal turn height of the cochlea and SIR and MUSS are significantly different (p<0.05). But there were no difference of CAP and MAIS.

Conclusion: The speech ability rehabilitation of inner ear anomalies with Incomplete Partition with CI is significantly different in three electrode types groups. The shorter the electrode, the worse the speech performance.

Abstract ID: 500

Poster Number: 216

Title: Revision Cochlear Implantation: A Retrospective Review of Young Adults Who Received Their First Implant During Childhood.

Authors: Jennifer Woodard, AuD, Andrea Bucker, AuD, Margaret Dillon, AuD, English King, AuD, Ellen Deres, AuD, Harold C. Pillsbury, MD, Kevin D. Brown, MD;
Otolaryngology, Univ. of North Carolina - Chapel Hill, Durham, NC.

Abstract: Revision cochlear implantation: A Retrospective Review of Young Adults Who Received Their Original Implant During Childhood.

Jennifer Woodard, AuD, Andrea Bucker, AuD, Margaret Dillon, AuD, English, King, AuD, Ellen Deres, AuD, Kevin D. Brown, MD and Harold C. Pillsbury, MD

Introduction

Multichannel cochlear implants (CI) have provided access to sound for profoundly deaf individuals for over thirty years. While all manufacturers’ devices carry a ten-year warranty, a high percentage of devices are known to last well beyond their original warranty. Still, many users have encountered problems with their cochlear implants that cannot be rectified through mapping and or replacement of their external CI sound processors thus requiring revision of their internal device. The purpose of this study is to examine trends in speech perception performance pre vs. post-revision, in a population of recipients who received their first implants at a young age, and then underwent revision surgery after more than 10 years of device use.
A retrospective review was completed of CI recipients who received their first devices at a young age and were followed for over 15 years until undergoing surgical revision. Transition to another manufacturer occurred in half of the recipients; those who stayed with the same manufacturer received a newer generation of device. Speech perception performance results over time were analyzed.

**Results**

Revision cochlear implantation was pursued primarily due to soft-failure (pain and decline in performance) and in one case, to match technology used in the contralateral ear. The average age at original implantation was 5 years with a range of 2-9 years. The average length of device use prior to revision was 16 years. Average age at revision was 24 years. Recipients were able to achieve speech perception scores comparable to their pre-revision “best” performance scores within 3-6 months post-activation.

**Conclusion**

Positive outcomes were seen for long-term implant users who were revised as adults. Further analysis of this population is warranted to examine preferred map parameters as this cohort has gone from using “vintage” technology to current state-of-the-art devices that include many processing features that were not available at the time of their original activation.

**Abstract ID:** 501  
**Poster Number:** 217  
**Title:** Long Term Electric Charge Requirements for Children Enrolled in the Childhood Development After Cochlear Implant (CDACI) Study  
**Authors:** Teresa Zwolan, Ph.D.1, Caroline Arnedt, AuD1, Nae-Yuh Wang, Ph.D.2, Christine Mitchell, ScM2, Samantha Zwolan, B.A.1, Cdaci Investigative, Team1; 1Otolaryngology, Univ. of Michigan, Ann Arbor, MI, 2Otolaryngology, Johns Hopkins, Baltimore, MD.  
**Abstract:** Introduction: The Childhood Development after Cochlear Implantation (CDACI) study is a longitudinal multicenter, national cohort study to systematically evaluate cochlear implant (CI) outcomes in children. In 2008 we reported on the mapping characteristics of 188 children enrolled in this important study. Data included examination and comparison of mean Comfort (C/M Level) measures (in charge per phase) obtained 6, 12, and 24 months post-activation. We found that all three devices (Advanced Bionics, Cochlear, and MedEl) demonstrated significant increases in C/M levels between device activation and the 24 month appointment. Significant differences in mean C/M levels were noted between devices. Additionally, children with cochlear anomalies demonstrated significantly greater C/M levels than children with normal cochleae.  
**Methods:** In this study, we performed a longitudinal evaluation of mapping data for 188 children enrolled in the CDACI study. All subjects were 5 years old or younger at the time they received their initial cochlear implant. This is an extension of our previous study where we now include mapping data obtained 60 and 96 months post-activation, resulting in a comprehensive longitudinal picture of mapping characteristics of children following 8 years of device use. Unlike our previous study, we now have speech recognition and speech/language data since the children are older, and we are able to examine the relationship between charge level and various outcome measures.  
**Results:** Data for charge levels obtained at device activation and 12, 24, 60, and 96 months post-activation were compared. We evaluated and compared differences over time for all three devices, and report on differences between devices at the various intervals. We examined differences in charge level as a function of implant center (six different centers continue to participate in this study) and compared the charge levels of children with and without cochlear anomalies. Lastly, we examined the relationship
between charge level and outcome as measured by various speech perception and speech/language measures.

**Conclusion:** The CDACI study has enabled us to evaluate the longitudinal mapping characteristics of pediatric patients who use 3 different devices and were implanted at a variety of implant centers. Analysis of such data enables us to better understand the long term mapping characteristics of children with cochlear implants, and provides us with an improved understanding of the relationship between CI charge levels and outcomes with a CI as measured with various speech perception and speech/language measures.

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**Abstract ID:** 502  
**Poster Number:** 67  
**Title:** Rapid, Cost-free Method to Precisely Align Position of Bilateral Cochlear Implants  
**Authors:** John Germiller, M.D., Ph.D.,1 N. Wendell Todd, M.D.2, Stacy G. Justus, RN3, Kara Prickett, M.D.2;  
1Otolaryngology, Children's Hosp. of Philadelphia, Philadelphia, PA, 2Otolaryngology, Emory Univ., Atlanta, GA, 3Surgery, Emory Univ., Atlanta, GA.

**Abstract:**  
**Introduction:** Precise positioning has important aesthetic implications for patients undergoing bilateral cochlear implant surgery. A few millimeters asymmetry between the two magnet positions can be noticeable to the patient and others, and can create dissatisfaction, even the perception that a surgeon has sloppy technique. Cochlear implant surgeons are well aware how difficult it is to create perfect symmetry when positioning two devices in separate surgical fields. Precisely marking both implant positions preoperatively, e.g. with methylene blue dye marks on the skull surface, can greatly help alignment. However, measuring and marking a location on one side, then transferring that reliably to the opposite side, can be difficult and time consuming. We present a rapid, easy method to accurately and reliably mark both sides of a patient’s scalp in exactly the same location, using common packaging materials normally discarded during surgery.

**Methods:** Author S.G.J. conceived the concept, which has subsequently been used by the other authors at their institutions. After the surgeon marks the desired location of the device on the first side, a piece of transparent plastic (e.g. discarded packaging) is used to trace the outline of the auricle, two other fixed landmarks (lateral canthus and nasal spine), and a dot at the position of the CI magnet, all using felt-tip pen. The head is then turned, the transparent plastic is simply flipped upside down. The existing markings are aligned onto the auricle and landmarks on the second ear. The scalp is then marked precisely at the proper position for the second magnet.

**Results:** Since January 2014, the technique has been used in 36 bilateral cases (20 sequential, and 16 simultaneous bilateral). Precise alignment was successful in all cases, as demonstrated by both inspection and postoperative x-rays. The technique took approximately 30 seconds.

**Conclusion:** Achieving aesthetic symmetry of bilateral cochlear implants can be done precisely and reliably using this method, with very little time and effort, and no cost.

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**Abstract ID:** 503  
**Poster Number:** 215  
**Title:** Analysis of Factors Predicting Improved Speech and Language Outcomes After Cochlear Implantation for Post-meningitic Sensory Hearing Loss  
**Authors:** Christopher M. Welch, MD, PhD1, Lisa Park, AudD2, Kevin Brown, MD, PhD1;
Otolaryngology/Head and Neck Surgery, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC, 2The Children’s Cochlear Implant Ctr. at UNC, Durham, NC.

**Abstract**: Title: Analysis of Factors Predicting Improved Speech and Language Outcomes After Cochlear Implantation for Post-meningitic Sensory Hearing Loss

**Introduction**: Meningitis is the most common cause of postnatally acquired sensorineural hearing loss. Prompt intervention is recommended in the setting of post-meningitic hearing loss as the cochlea can ossify within weeks. Outcomes after implantation for meningitis, however, are mixed. The purpose of this study is to identify factors that predict improved speech and language outcomes after cochlear implantation for post-meningitic hearing loss.

**Methods**: This study is a retrospective review of patients undergoing cochlear implantation after a diagnosis of meningitis to determine factors associated with speech outcomes. Patients were evaluated for timing of cochlear implantation, degree of cochlear abnormality encountered during implantation, and post-operative speech and language measures. Speech outcomes were represented by the speech recognition index in quiet (SRI-Q). Intraoperative findings were classified according to the Smullen and Balkany scale. Findings were appropriately adjusted for age or inability to complete full audometric testing due to comorbidities. Linear regression analysis and Kruskal-Wallis testing were used to determine whether these factors were significantly correlated with improved hearing outcomes.

**Results**: Analysis of 62 pediatric patients with a diagnosis of meningitis subsequently receiving cochlear implantation revealed an average age at implantation of 5.1 years. The average time elapsed between diagnosis of hearing loss and cochlear implantation was 2.5 years with a median of 1.3 years. Linear regression analysis of time from diagnosis of hearing loss secondary to meningitis to cochlear implantation versus to speech outcomes as measured by SRI-Q revealed a significant correlation (R square 0.108, p = 0.024). 32 of 36 patients with information available on cochlear abnormalities at the time of implantation demonstrated some degree of cochlear fibrosis. Kruskal-Wallis analysis demonstrated a significant correlation between cochlear abnormalities and speech outcomes as measured by SRI-Q (p < 0.05).

**Conclusions**: Patients undergoing cochlear implantation for post-meningitic hearing loss have improved speech outcomes with a shorter time from diagnosis of hearing loss to cochlear implantation and fewer cochlear abnormalities at the time of implantation. It is therefore critical to intervene by cochlear implantation as early as possible following sensory hearing loss in the setting of post-meningitic hearing loss.

**Abstract ID**: 505

**Poster Number**: 199

**Title**: The Effect of Wireless Microphone Technology on Familiar Word Recognition in Toddlers with Cochlear Implants

**Authors**: Susie Robertson, Ph. D. Speech and Hearing Science1, Patti M. Johnstone, Ph. D. Speech and Hearing Science1, Kristen E. T. Mills, M.S.1, Karen Martin, M.S.1, Kelly R. Yeager, Au.D.1, Elizabeth L. Humphrey, Au.D.1, Smita Agrawal, Ph.D. Communication Disorders2; 1Audiology and Speech Pathology, Univ. of Tennessee Hlth. Sci. Ctr., Knoxville, TN, 2Advanced Bionics, LLC, San Francisco, CA.
Abstract: The Effect of Wireless Microphone Technology on Familiar Word Recognition in Toddlers with Cochlear Implants

Introduction: Research has shown that young children who hear more speech daily are faster and more accurate at word processing than those who hear less speech. Much of a toddler’s speech and language exposure takes place at a distance from the talker at home, in automobiles, and day care centers. Toddlers with hearing impairment (HI) are at a disadvantage. Research has shown that children with HI are less able to understand speech than peers with normal hearing (NH). Amplification devices, such as cochlear implants (CI), can exploit wireless adaptive digital modulation (ADM) systems to improve audibility of speech over distance. ADMs have been shown to improve speech perception abilities in older children and adults. The purpose of this study is to assess ADM technology on a familiar word recognition task in toddlers aged 18-42 months who use CIs and compare their performance to that of toddlers with NH.

Methods: Ten toddlers (ages 18-42 months) with sensorineural hearing loss (CI users) and 2 groups of toddlers with NH (10 matched for hearing-age; 10 matched for chronological age) will participate. Using a looking-while-listening experiment paradigm, the subjects are presented auditory stimulus at 65dbSPL simultaneously with 2 pictures of familiar words on a screen. The child’s gaze is videotaped. Two measures, accuracy and processing speed, are assessed for word recognition. The HI group participates in 2 experiments on different days using two different microphone configurations (No ADM and ADM), counterbalanced across subjects. Toddlers with NH participate in one experiment with no ADM. Productive vocabulary is assessed with a standardized vocabulary measure.

Results: The subjects’ look time to the images is used to assess word processing. Two measures will be obtained: Accuracy, based on the proportion of look time to the correct target during each trial, and processing speed, based on the latency to orient to the target from the distractor after target word onset. Preliminary results (HI group, n =3; NH group, n =3) show greater accuracy and faster processing speed in the ADM condition than in the No ADM condition. Furthermore, the HI group ADM condition results were similar in accuracy and processing speed to the NH group, indicating that ADM technology may provide toddlers with HI improvements in word recognition to the level of performance of normal hearing peers.

Conclusion: These results demonstrate the advantage of wireless ADM in toddlers with HI who use CIs. The results will be discussed in the context of current theories of early lexical acquisition and the detrimental effects of degraded speech on word processing. These results will provide crucial information regarding the potential of ADM technology on early word processing in toddlers. The findings provide evidence that may be useful for pediatric audiologists and early interventionists whose priority is promoting early language development in young children with HI.

Abstract ID: 506
Poster Number: 71
Title: Intra- and Extracochlear Electrocochleography with Impedance Measures during Array Insertion Predict Anatomic Trauma to the Mongolian Gerbil Cochlea
Authors: Christopher K. Giardina, B.S., Kendall A. Hutson, Ph.D., Stephen Pulver, M.S., Douglas C. Fitzpatrick, Ph.D.; UNC Chapel Hill, Chapel Hill, NC.
Abstract: Introduction: Cochlear implant (CI) arrays which remain completely within the scala tympani facilitate better speech and hearing outcomes. Though CI positioning greatly affects CI performance, feedback to the surgeon during implantation is limited. Two rapidly-assessed metrics during CI insertion
are electrocochleography (ECochG) and impedance measurements. ECochG has been shown to predict basilar membrane (BM) trauma, but methodological approaches vary by recording location (intracochlear or extracochlear). Additionally, intracochlear impedance has shown to vary with CI insertion depth and proximity to modiolar structures. The purpose of this study was to characterize changes in intracochlear ECochG, extracochlear ECochG, and intracochlear impedance throughout CI insertion. The goal was to determine which approach is most sensitive to BM trauma in a normal hearing gerbil model. Our hypotheses were that intracochlear signals would be larger and more variable than extracochlear signals, that extracochlear magnitude drops would be more indicative of trauma than intracochlear response changes, and that changes in impedance would precede changes in ECochG response.

**Methods:** In 10 Mongolian gerbils, an extracochlear electrode was placed on the promontory while an intracochlear electrode was placed through the round window (RW) and advanced in 200 um steps. At each step, simultaneous intra- and extra-cochlear ECochG was performed to 500 Hz and 4 kHz tone bursts at 40 and 80 dB nHL. Impedance of the intracochlear electrode was also performed at each step, using a biphasic current pulse (180 us, 88 uA). The extracochlear electrode was a Neurosign Facial Nerve probe while the intracochlear electrode was a flexible Ag electrode placed on a hydraulic micromanipulator. Insertion continued until the intracochlear electrode hit an endocochlear structure. The cochleae were then removed, fixed, decalcified, and dissected to appreciate the location and quality of trauma.

**Results:** In the anatomically undamaged cochlea, perioperative recordings showed no change in ECochG or impedance levels with insertion depth. In all other cochlea, gross trauma to the BM was associated with drastic fluctuations in the ECochG magnitudes and impedance measures. Intracochlear ECochG magnitude could increase (n=3), remain steady (n=3), or decrease (n=3) before a large drop occurred, indicating BM trauma. Extracochlear ECochG could dip and return (n=1) or remain steady before a large drop (n=8), and impedance could increase (n=2) or decrease (n=7) before BM trauma. Impedance changes often preceded a loss in ECochG (n=6).

**Conclusion:** Simultaneous intra- and extra-cochlear ECochG with runtime impedance measures reveal patterns of response changes indicative of both atraumatic and traumatic CI insertions. Intra- and extra-cochlear ECochG provide distinct information, and runtime impedance may be an important metric for assessing CI position and minimizing BM trauma.
the implanted ear. In adults, the instance of successful ESRT measurement may be increased if higher (above 226 Hz) probe frequencies are utilized to detect the stapedius reflex (Wolfe et al, 2016). In the present study, effect of probe frequencies (226, 678, and 1000 Hz) and differences between implanted and non-implanted ear were studied in pediatric population.

**Methods:** Twenty unilateral Advanced Bionics cochlear implant recipients participated in the study (mean age = 6.7 years, SD = 3.7) at the Apollo center. Tympanograms were performed to see the status of middle ear. ESRTs were measured as a function of probe frequency in the ipsilateral and the contralateral ears.

**Results:** Ipsilateral ESRTs (implanted ear) could be measured across 8,9, and 10 subjects out of 20 subjects for probe tones 226 Hz, 678 Hz, and 1000 Hz respectively. In contrast, contralateral ESRTs (non implanted ear) were able to be measured across 18 subjects out of 21 subjects (with 17, 18, and 18 for probe tones 226 Hz, 678 Hz and 1000 Hz). Three out of 10 subjects for whom ipsilateral reflex could not be measured has a type B tympanogram.

**Conclusion:** As in adults, the success of measuring of ESRT in children increases with increasing probe tone frequency, and when measuring from the non-implanted ear. The use of the higher frequencies may lead to an increase in obtaining clinical ESRTs and therefore be of use in programming of pediatric recipients. Future studies will further explore the differences between middle ear resonant frequency of implanted and non-implanted ears.

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**Abstract ID:** 511  
**Poster Number:** 69  
**Title:** Rapid Fixation of Thin Cochlear Implants to the Skull Surface Using a Single Resorbable Screw (“Pericraniopexy”)  
**Authors:** John Germiller, M.D., Ph.D., Luv R. Javia, M.D., Brian P. Dunham, M.D., Ken Kazahaya, M.D.; Otolaryngology, Children's Hosp. of Philadelphia, Philadelphia, PA.

**Abstract: Introduction:** With the advent of thinner cochlear implants, many surgeons no longer recess the device below the surface of the skull. While this reduces surgical time and risk, it also eliminates a primary means to secure the implant against displacement and migration. Tie-down suture fixation, as recommended by the manufacturer, is time consuming, and especially difficult under the limited exposure provided by newer minimal incision techniques. We present our technique for rapid, simple, secure fixation to the skull using only a single resorbable screw. This is used to “tack” the periosteum down to the bone just anterior to the device, and in combination with a tight periosteal pocket, it provides immediate, secure fixation, and provides additional insurance against anterior device migration.

**Methods:** Since 2011 we have employed single screw pericraniopexy on thin-profile devices from all 3 manufacturers. For this method, no drilling of a well, channel, or shelf is needed. The device is placed into a tight subperiosteal pocket in the usual fashion. The periosteum is closed, then the anterior “shoulder” of the device is located by palpation. A single screw hole is tapped, through the intact periosteum, into the skull, anterior to the main device cable. A resorbable 1.5mm cortex screw (3- or 4-mm length) is inserted, along with a resorbable washer cut from a 2-hole plate. Together, the screw and washer securely “tack” the periosteum down to the bone in this location.

**Results:** Since 2011, screw pericraniopexy has been employed successfully in 42 patients receiving thin devices (52 ears). No device migration was reported at follow up exams in clinic 2-4 weeks postop. Additionally, in the 30 bilateral cases, no episodes of asymmetry due to device migration events were reported. An additional 64 patients (70 ears) also underwent pericraniopexy as an adjunct to a
traditional bony recess securing a thicker device (during 2012-early 2015). There were no complications in either group.

**Conclusion:** Single-screw pericraniopexy is fast (1-2 minutes), easy to perform, and relatively inexpensive. It avoids the need to drill a bony well, shelf, or channel. Since it secures the implant along its anterior corner, it helps prevent the most likely, and most problematic, form of device migration, i.e., anterior displacement toward the mastoid. It uses readily available instruments and stock screws used commonly for craniofacial procedures, which resorb completely over weeks to months. It is precise enough to allow careful symmetric positioning in bilateral cases. Finally, it is broadly applicable regardless of surgical technique, even when there is limited device exposure (minimal incision surgery).

**Abstract ID:** 513  
**Poster Number:** 160  
**Title:** Bimodal Ear to Ear Audio Streaming: Speech Understanding Advantages in Complex Listening Situations  
**Authors:** Sarah Downing, M.S., CCC-A, Emily Cardenas, Au.D., CCC-A, Smita Agrawal, Ph.D.; Advanced Bionics, LLC, Valencia, CA.  
**Abstract:** **Introduction:** The ability to stream full-band audio signals between two ear level devices (e.g., between two Hearing Aids (HA) or two Cochlear Implant (CI) sound processors or between a CI sound processor and an HA) in real time offers opportunities for signal enhancement in several interesting ways. One application (StereoZoom) allows creation of a four-microphone array via two-way communication between the dual-microphone systems on each of the two hearing devices. The resulting third-order directional system creates a narrower fixed target beam as compared to dual-microphone systems. This could allow users to focus on a single speaker directly in front of them in very noisy environments. In a second application (ZoomControl), audio input at one ear is streamed simultaneously to both ears, thus reducing the signal deficit at the contralateral ear due to headshadow. The direct microphone input at the contralateral ear is attenuated to further enhance the SNR. This could improve speech understanding in noise in situations where the speaker is not in front of the listener, such as when talking on the phone or driving a car. The objective of this study was to assess the benefit of the above two applications of ear-to-ear audio streaming (StereoZoom and ZoomControl) in adult bimodal listeners (cochlear implant in one ear and a hearing aid in the contralateral ear). At the time of the study, these were experimental applications. They are now available for clinical use.  
**Methods:** 19 adult bimodal participants (13 males, 6 females, mean age 61 years) with a Naida CI Q90 processor in one ear and a Naida Link hearing aid in the contralateral ear participated in the study. Speech understanding was evaluated using AzBio sentences (60 dBC) in cafeteria noise. SNR was based on the noise level for each participant where their bimodal score in noise was approximately half their score in quiet. An S0N±60,±90,180 speaker configuration was used for assessing the effectiveness of StereoZoom. ZoomControl was assessed with speech on the HA side and noise from the CI side (SHANCI). Bimodal benefit was also measured in both study set-ups by switching off the HA. Ease of listening ratings were obtained in each condition on a 5-point scale ranging from very difficult to very easy.  
**Results:** Activation of StereoZoom led to a mean 21% improvement in speech scores in noise (p<0.0001). ZoomControl use improved speech scores by 28% (p<0.0001). Additionally, significant bimodal benefit was measured in both test set-ups (21% and 33% respectively, p<0.0001). Ease of listening ratings were commensurate with the sentence scores.
**Conclusion:** Ear-to-ear audio streaming can allow bimodal listeners to take advantage of enhanced directional capability and focused listening, thereby improving speech understanding and ease of listening in challenging listening situations.

**Abstract ID:** 516  
**Poster Number:** 143  
**Title:** Psychophysical Measures and Vowel Identification in Children with Cochlear Implants  
**Authors:** Julie G. Arenberg, Ph.D., Mishaela DiNino, M.S., Kelly Jahn, AuD; Speech and Hearing Sciences, Univ. of Washington, Seattle, WA.  
**Abstract:** *Introduction:* Auditory perceptual outcomes are highly variable, even in early implanted children. How the auditory system develops with input from a cochlear implant is not well understood. The present study examines basic perceptual measures: thresholds obtained with focused electrode configurations and psychophysical tuning curves, and vowel identification as a measure of speech perception.  
**Methods:** Six children between the ages of 11 and 17 years who are implanted with the Advanced Bionics device participated in this study. Five of the children are bilaterally implanted and three of them performed testing with each ear separately, yielding eight ears tested. Both monopolar and focused quadrupolar stimulation were used to measure thresholds across all channels in each ear tested. A fast, sweep-procedure was used to obtain thresholds (Bierer et al., 2015) and psychophysical tuning curves (PTCs). PTCs were obtained using a forward masking paradigm for at least one channel (in the middle of the array) for each ear. Tuning curve width was quantified using an equivalent rectangular bandwidth calculation. A closed set of 10 vowels in /hVd/ context (naturally-spoken by a female talker) were presented in the sound field.  
**Results:** Consistent with previously collected data from adults, focused thresholds were higher and more variable across the array than those obtained with monopolar stimulation. Ears that had higher focused thresholds on average also had broader tuning. Performance on vowel identification was poorer for ears that exhibited higher focused thresholds and broader tuning. Results will also be compared to those obtained previously in adults.  
**Conclusion:** Results indicate that these direct stimulation psychophysical measures can be readily obtained in children. Most of the relationships between measures are similar to those observed in postlingually deafened adult CI listeners.

**Abstract ID:** 517  
**Poster Number:** 101  
**Title:** Cochlear Implantation in Children with Cochleovestibular Anomalies  
**Authors:** Manuel E. Sevila Salas, ENT Specialist, Surgeon, Antonio Paz, Surgeon, Sandra Bermejo, Audiologist, Xeneida Hernandez, Audiologist; Programa Cubano de implantes cocleares, La Habana, Cuba.  
**Abstract:** *Introduction:* Cochlear implantation with cochleovestibular abnormal anatomy is a real challenge for both surgeon and audiologist and there are permanent questions about risks and functional results. We reviewed surgical procedures performed in children with cochleovestibular anomalies from 2007 to 2016 describing surgical and auditory outcomes.  
**Methods:** Retrospective analysis of patients with inner ear malformations who underwent cochlear implantation between January 2007 and October 2016 performing standard facial recess approach was
made. Diagnosis of cochleovestibular abnormalities were defined by high resolution computed tomography and Magnetic Resonance Imaging.

**Results:** Cochleovestibular malformations were found in 34 patients and enlarged vestibular aqueduct was the must frequent anomalie. CSF Gusher occurred in 19 cases but there were not complications and electrodes insertion was achieved in all cases. All children showed improved auditory performance.

**Conclusion:** Despite surgical risks cochlear implantation is surgically feasible in patients with cochleovestibular abnormal anatomy.

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**Abstract ID:** 520  
**Poster Number:** 6  
**Title:** Cochlear Implants and Bilingualism: A Realm of Possibilities  
**Authors:** Michele Berke, PHD, Laura Petersen, MA Ed, Rory Osbrink, MA; California Sch. for the Deaf, Fremont, CA.

**Abstract:**  
**Introduction:** With the concern of sensitive or critical periods of language acquisition, most cochlear implantation has equated to early intervention services focussing exclusively on one language and one modality; English auditory language development. Research is finding that the brain has more plasticity than originally thought and that it processes both auditory and visual language similarly. Parents are often advised that if a child is to receive a cochlear implant, it is not advisable to learn another language. However, the benefits of bilingualism for all children have been researched extensively and studies show that children exposed to more than one language have cognitive and academic advantages. This presentation reviews the data on cochlear implants and bilingualism as well highlights student perspectives on the benefits of being bilingual.

**Methods:** A review of the research regarding the benefits and the pedagogy in which children with cochlear implants receive language instruction to acquire a language other than spoken English. We will share excerpts from our videotaped interviews of 12 bilingual students with cochlear implants from a variety of educational placements.

**Results:** We will review the findings regarding how bilingualism and specific teaching methods increased academic abilities including written and spoken English skills. Via videos, students with cochlear implants will share examples of how their bilingualism personally benefits them both academically and socially. The interviews revealed that a bilingual approach allowed students to have a deeper understanding of both languages.

**Conclusion:** Children with cochlear implants are often limited to instruction in spoken English but being bilingual can benefit both their spoken and written English. A variety of educational approaches are used with children with cochlear implants however a bilingual approach can provide a broader language foundation in which they can further their language development.

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**Abstract ID:** 206  
**Poster Number:** 10  
**Title:** Listen to Me: Benefits of Intensive Education for Parents of Children with Cochlear Implants  
**Authors:** Julie A. Cooper, MS, CCC-SLP, LSLS Cert AVT1, Nikolas H. Blevins, MD2, Matthew B. Fitzgerald, PhD, CCC-A1;
Abstract: Listen to Me: Benefits of Intensive Education for Parents of Children with Cochlear Implants
Julie A Cooper, MS, CCC-SLP, LSLS Cert AVT
Nikolas H. Blevins, MD
Matthew B Fitzgerald, PhD, CCC-A

Introduction: Pre-lingually deafened children who receive cochlear implants (CIs) can often learn to
develop spoken language and even attend mainstream classrooms. Although these children typically
receive a variety of special services, parental education regarding hearing loss and its consequences
for language development are delivered in a much less structured manner. Parents are often forced to
educate themselves as to how to best facilitate language development in their child with hearing loss.
To address this issue, the Listen to Me! (LTM) Summer Institute was developed to empower parents to
maximize listening and spoken language in their children with cochlear implants. In this one-week
program, parents participate in presentations from experts in the field, therapy and class observations,
a support group, and role-playing to implement goals in the home; children participate in therapy and
class. The goal of this investigation was to determine the effectiveness of Listen to Me! at improving 1)
parental knowledge about developing spoken language with their child’s cochlear implant(s), 2)
parents’ advocacy skills, 3) length of CI use per day, and 4) child’s intervention services upon returning
home.

Methods: To examine efficacy of this program, two steps were taken. First, before and after attending
LTM, parental ratings were obtained from 43 parents as to their knowledge in areas related to spoken
language development in children with CIs. Second, four months after completing the program, 35
parents completed a survey which measured whether parents had applied the information provided in
LTM into their daily life and educational setting of their child. Both sets of survey results were subjected
to repeated-measures analyses of variance.

Results: Results from these ANOVAs indicated a significant improvement in parental knowledge across
all conditions. More important, the parents displayed a significant improvement in the implementation
of this knowledge. After completing LTM, 85% of responders reported successfully advocating for their
child, 60% reported improving their child’s technology, 100% reported increased device use (if the
child was not wearing the device all waking hours prior to LTM), and 63% reported an improvement in
their child’s intervention services. Anecdotal reports suggest that these improvements in access to
technology or services were most likely to have occurred if the child’s levels of technology and/or
services was less than ideal for language development prior to enrolling in LTM.

Conclusions: Taken together, these results suggest that an intensive one-week program can result in
significant increases in parental knowledge, improve parent advocacy skills, the length of CI use per
day, and intervention services. The benefits observed here suggest that professionals seeking to
maximize outcomes of children with CIs should provide additional focus on parent education and
engagement.

Abstract ID: 526
Poster Number: 122
Title: Visual Cortex Activation Decrement following Cochlear Implantation in Pre-Lingual Deafened
Children
Authors: Jiahao Liu, ME, Maojin Liang, MD, Yuebo Chen, MD, Yajing Wang, MD, Yiqing Zheng, MD;
Abstract: Visual cortex activation decrement following cochlear implantation in pre-lingual deafened children

Objective: Visual take-over of the auditory cortex in pre-lingual deaf children have been widely reported. However, there were few studies on visual cortex plasticity post cochlear implantation. In this study we investigate the hypothesis whether extrinsic auditory stimulation following cochlear implant in pre-lingual deafened children can induce visual cortex plasticity.

Method: Visual evoked potentials (VEPs) were recorded in 37 cochlear implanted children (4 groups with different use time) and 8 control subjects, in response to sound and nonsound stimulus. Latency and amplitude were analyzed for P1, N1 and P2 components on OZ electrode. Comparisons of VEP were conducted between the sound and nonsound stimulus and among different groups in order to view evidence of visual cortex re-organization.

Results: The latencies of the P2 component was significantly larger at the occipital site (Oz) in CI 0M than in the other four groups. After exclusion the effect of age, a significant negative correlation was found between CI usage and P2 latency of nonsound stimulus. Occipital P1N1 latency and P1 amplitude was not affected by group or stimulus category. But N1 and P2 amplitude was significantly being larger in response to sound stimulus than to nonsound stimulus.

Conclusion: Our findings suggest that P2 latency development with the CI usage and may be a biomarker of visual cortex plasticity.

Keywords: pre-lingual deafness, cochlear implant, visual evoked potentials

Abstract ID: 527
Poster Number: 194
Title: When is a Benefit Acontralateral Hearing Aid for Cochlear Implant Recipients
Authors: María Eugenia Prieto, audiologist, Leopoldo Cordero, Dr;
Centro de Investigaciones Otoaudiológicas, buenos aires, Argentina.

Abstract: Introduction: Limited access to bilateral sound early in life disrupts normal auditory development and challenges educational and behavioral performance (1). In daily practice we understand the difficulty for some patients to use cochlear implant associated with ContralateralHearing Aids (CHA). Many patients who receive a cochlear implant (CI) do have some residual hearing in the opposite ear; anyway some of users discontinue use of their hearing aid Many studies suggest the use of CHA mainly to improve speech perception in noise and localization. However, we realize that not all the patients could use it effectively, thus becoming potential candidates for a second implant.

Methods: Objective: Our study aimed to assess whether the auditory residue could be a critical factor for the use of CHA. To establish whether participants experienced more benefit using bimodal (CIHA) stimulation than a cochlear implant (CI) alone, and whether this increase was related to patient factors. And to investigate the effect of contralateral hearing aid wear to habilitation outcome and why some stop to be users. Method: We performed retrospective review of 30 children receiving a unilateral CI whose where users of bimodal stimulation out-grid-align:none;text-autospace:none'>These patients’ needs compatible and new technologies in both sides. Also needs to be fitting together.

Results: 22/30 patients continues to be users of bimodal stimulation with good performance, speech recognition and sound localization. 4 patients get a contralateral cochlear implant after they lose discrimination because a progressive hearing histories. 4 patients became unilateral CI users. Two of them refuse to get the second implant but they are considering doing because they lose speech recognition in noise. The other 2 child have handicaps and prefer unilateral stimulation.
Conclusion: Periodic audiologic evaluation and rehabilitation control along the time were critical for the consisting use of CHA. The benefit of wearing hearing aid on contralateral ear for CI recipients lied on the average aided hearing threshold. Therefore, some patients decided to use it also when the hearing decrease. The patients that decided to get a CI contralateral after a long-term using HA shows a faster performance after CI. The actually users of bimodal stimulation are successful in noise discrimination, localization and casual discrimination and also sometimes better that bilateral CI. These patients’ needs compatible and new technologies in both sides. Also needs to be fitting together.

Abstract ID: 582
Poster Number: 86
Title: Music Enjoyment in SSD Patients: The Synergistic Effect of Electric and Acoustic Stimulation
Authors: David Landsberger
Abstract: Introduction: Although there have been many studies of music perception with a cochlear implant (CI), musical sound quality has been difficult to quantify. For example, ratings of music enjoyment on a scale of 1-100 by deaf CI users are difficult to interpret. The emergence of CI users with normal contralateral hearing presents a unique opportunity to assess music enjoyment quantitatively in CI users by referencing it to that obtained in a normal ear, which provides a known and readily interpretable baseline.

Methods: In the present study, we investigated sound quality of music in Single-Sided Deafened (SSD) subjects with a CI using a modified version of the MUSHRA (MUltiple Stimuli with Hidden Reference and Anchor) method. Listeners rated their enjoyment of brief musical segments of the songs “Ring of Fire” and “Rhapsody in Blue” on a scale of 0-200 relative to a reference stimulus, defined as 100. The reference was the unmodified musical segment presented to the normal hearing ear only. An “anchor” stimulus (defined as 0) was also provided only to the normal hearing ear. The anchor was the same musical segment processed with a 6-channel noise vocoder simulating a 6.5 mm shift. Stimuli consisted of acoustic only, electric only, acoustic and electric, as well as a number of conditions with low pass filtered acoustic stimuli to simulate varying degrees of hearing loss and bimodal stimulation. Acoustic stimulation was provided by headphone to the normal ear and electric stimulation was provided by a direct connect cable to the subject’s clinical speech processor.

Results: Ten out of 11 subjects rated combined electric and acoustic stimulation the best, with a trimmed mean rating “Ring of Fire” as 133 and “Rhapsody in Blue” as 120. The combination of acoustic and electric stimulation was significantly better than unilateral acoustic processing alone. The sound quality of electric stimulation alone was much worse than acoustic stimulation alone. In all tested conditions, adding electric hearing to acoustic hearing provided improvement in sound quality.

Conclusion: In summary, music enjoyment from electric stimulation was extremely poor relative to an interpretable normal-hearing baseline. Interestingly, adding the electric stimulation actually enhanced the sound quality of unilateral acoustic stimulation. This effect also happened with low pass filtered, acoustically presented musical segments, suggesting that similar results may be found for bimodal CI users.

Abstract ID: 528
Poster Number: 208
Title: Musical Perception and Musical Satisfaction in Adults with Cochlear Implant
Abstract: Introduction: After cochlear implantation, the level of listening of music and music satisfaction varies between users. The aim of our study is to evaluate the musical perception and satisfaction of postlingual hearing impaired adults with cochlear implant.

Methods: Thirty-four (21 male, 13 female) cochlear implant users who have postlingual hearing loss and no additional problem have been included in the study. CI users are divided into groups according to their chronological age, age of cochlear implant and duration of implant use. CI users are 20 years of age or older. As the data collection tool, 'Personal Information Form' consisting of questions about the demographic characteristics of the participants was used first. 'Music Performance Profile for Cochlear Implant Users', which was adapted from the 'Music Training and Background Questionaire' developed by V. Looi and the 'Listening To Music With A Cochlear Implant Questionaire' for musical perception and music appreciation, was used afterwards. The questionnaire consists of questions about cochlear implant, history of listening to music before hearing loss, music styles, instruments, music recognition, affecting factors of listening to music and music therapy programs. Ethics committee approval was obtained from Hacettepe University for the study and informed consent form was used for all participants.

Results: Patients who underwent cochlear implantation under the age of 40 years (N:17) received statistically higher scores for the sound nature of the instruments (piano and violin). Also, adults using cochlear implant for more than 5 years were found to have higher musical perception and satisfaction as istatistics (p<0.05).

Conclusion: The musical perception and appreciation among the users varies depending on many factors. The most important factors affecting musical perception and satisfaction are age of cochlear implant, duration of CI and gender. Apart from these, the sound characteristics of the listening of music and the features of instrument are also decisive factors on the musical perception and satisfaction.
preprocessed with MarsBaR toolbox for region of interest (ROI) analysis, and 90 cerebral cortical ROIs were used for the analysis. For statistical analysis, LASSO (Least Absolute Shrinkage and Selection Operator) regression analysis using average glucose metabolism of 90 ROIs with regard to post-CI 3 year open set word and sentence scores. In prelingually deaf CI users, activations of the superior temporal gyrus, supramarginal gyrus, and inferior frontal gyrus were predictors of higher post-CI 3 year speech outcome under the A-only condition. Meanwhile, under A-V condition, an additional activation of the anterior cingulate gyrus was necessary to show better speech outcome. In prelingually deaf CI users, activations of the ventral attention network and prefrontal top-down modulator are important to better process language under the A-only condition. Under A-V condition, an additional activation of the salience network is necessary to better understand multimodal information. Taken together, FDG-PET-based machine learning using LASSO could predict CI outcome in prelingually deaf subjects, functional neuroimaging-based outcome prediction may be of help for precision medicine in CI subjects.

Abstract ID: 274  
Poster Number: 198  
Title: Evaluation of a Novel Bimodal Fitting Formula in Pediatric Bimodal Cochlear Implant Recipients  
Authors: Carisa Reyes, Au.D.1, Jeffrey L. Simmons, M.A.1, Jacquelyn L. Baudhuin, Au.D.1, Smita Agrawal, Ph.D.2; 1Boys Town Natl. Res. Hosp., Omaha, NE, 2Advanced Bionics, Valencia, CA.  
Abstract: Introduction: The objective of this study is to evaluate the benefit of a novel hearing aid prescription formula in children with a cochlear implant device in one ear and a hearing aid in the contralateral ear. This bimodal fitting formula (BFF), designed specifically for bimodal listeners, aligns frequency response, loudness growth functions, and automatic gain control (AGC) characteristics between electric hearing (via Naída CI sound processor) and acoustic hearing (via Naida Link hearing aid). A second objective of the study is to evaluate the contribution of two types of frequency lowering algorithms to bimodal benefit in children.  
Methods: Speech understanding in noise will be measured in children between 8 and 18 years of age utilizing bimodal listening. Performance will be evaluated with the children’s own hearing aid as well as with the Naida Link hearing aid fit to match DSL v5 targets versus the BFF. Subjective feedback will also be obtained and assessed. Speech understanding will be re-measured with the BFF after a one month long take home trial to evaluate effect of chronic experience. At this second visit, bimodal benefit will also be measured as a function of frequency lowering algorithms.  
Results: Results will be presented at the meeting. Outcomes will be evaluated as a function of audiometric profiles. The research audiologists’ programming experience and recommendations will be shared.  
Conclusion: A new bimodal fitting formula and a new hearing aid have been made available to work specifically with the Naída CI sound processor. The intent of this BFF is to optimize bimodal hearing while simplifying the hearing aid programming process. The present study will likely be the first pediatric study to evaluate the effectiveness (acute and chronic) of this new bimodal hearing system.

Abstract ID: 530  
Poster Number: 116  
Title: Use of Device in Cochlear Implant Recipients in a Large Scale CI Program
**Authors:** Ranjith Rajeswaran, MASLP1, Lakshmi Maya, BASLP1, Mohan Kameswaran, MS., FRCS., MAMS., DSc.,2; 1MERF-institute of Speech and Hearing, Chennai, India, 2Madras ENT Res. Fndn. (P) Ltd., Chennai, India.

**Abstract:**

**Introduction:** Cochlear implant is a bio-medical device that is surgically placed in the cochlea that helps a hearing impaired to regain hearing sensitivity. Subjects with severe to profound sensory neural hearing loss across all ages undergo CI worldwide. On an average, about 360 patients undergo CI annually at MERF. It is important to monitor their hearing status and their speech outcomes using CI over a period of time. These patients attend 1 year of habilitation compulsorily. The long term communication outcome depends on the consistent use of the device; hence this study was taken up with the objective to identify the challenges faced by the subjects with CI and their parents. The study focuses on assessing the long term use of CI by children and to explore the factors that could influence the usage of the device on daily basis.

**Methods:**

Children who have undergone CI during the period of June 2012- June 2016 were taken up. A chart was created to document the details of implant and other possible factors influencing the usage of CI on daily basis. The parameters included were age of implantation, educational qualification of parents, educational placement of child, language exposed at home and at therapy, mode of communication, CAP and SIR scores. The subjects were categorised into 3 groups based on their usage of CI: Group A- full time users, Group B- part time users, Group C- Non-users of CI. Information from the patients who were currently attending the rehabilitation at different centres of MERF and patients who had finished one year of habilitation were called to the centre.

**Results:**

Most of the recipients were consistent users of the implant, among the non users there is a positive correlation with education level, annual income. Children implanted at very younger age used the device consistently compared to children implanted at very later age.78% used device irregularly after first year of Implantation.

**Conclusion:** Long term success of the CI is the effective use of oral communication, this can be influenced by the use of device apart from other factors such as training etc., From this study we have understood that most of recipient used device irregularly after first year of implantation. This could be due to lack of monitoring, mentoring and motivation. Though other factors like annual income, age at implantation, educational level plays a role in use of device, extended duration of monitoring the children in the CI clinic may help to overcome these factors.

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**Abstract ID:** 140  
**Poster Number:** 152  
**Title:** The Development of Musicality in Children with Cochlear Implants Evaluated by Musical Ears  
**Authors:** xueqing chen, MD, meng wang, MD, tianqiu xu, MD, yan zhong, MD, jinye luo, MD; Beijing Tongren Hosp., Capital Med. Univ.;Beijing Inst. of Otolaryngology, Beijing, China.

**Abstract:**

**Introduction:** The aims of the study were to evaluate the musicality of children with cochlear implants by using the questionnaire of Musical Ears Evaluation Form for Professionals, compare the differences of musicality between children with cochlear implants and those with normal hearing, establish normal comparison data of musicality development for children with hearing loss.

**Methods:** All children participated in this study were divided into two groups, including cochlear implant group (CI group) and normal hearing group (NH group) as control group. 109 children in CI group were diagnosed with prelingual, severe to profound hearing loss. They were all implanted unilaterally before 3 years old and within 4 years after cochlear implantation. The age at implantation ranged from 8 to 36
months with a mean of 18 months. The hearing age at evaluation ranged from 1 to 46 months with a mean of 15 months. 180 children with normal hearing in NH group were all under 4 years old. The age at evaluation ranged from 1 to 47 months with a mean of 15 months. The questionnaire of Musical Ears Evaluation Form for Professionals was used to evaluate the musicality, including abilities of singing; recognizing songs, tunes and timbre; responding to music and rhythm, for all children in this study. All statistical analyses were executed using the SPSS 20 statistical software with a criterion of statistical significance set at P<0.05.

**Results:** The scores for overall musicality in children both with cochlear implants and with normal hearing showed significant improvement over time (P<0.05). The scores for the three subcategories of musicality in children both with cochlear implants and with normal hearing also showed significant improvement over time (P<0.05). The regression function for prediction of overall musicality scores (y) from age (x) was y=1.8x-0.008x^2+3.6 (R^2=0.874, P=0.000), the regression function for prediction of singing scores (y) from age (x) was y=0.5x-0.001x^2+3.0 (R^2=0.831, P=0.000), the regression function for prediction of recognizing songs, tunes and timbre scores (y) from age (x) was y=0.6x-0.002x^2+0.9 (R^2=0.808, P=0.000), the regression function for prediction of responding to music and rhythm scores (y) from age (x) was y=0.7x-0.005x^2+1.5 (R^2=0.848, P=0.000). The score for overall musicality was not significantly different between CI and NH groups in the same hearing age (P>0.05). There were significant differences between the two groups in the same chronological age (P<0.05).

**Conclusion:** The musicality in children both with cochlear implants improved significantly over time. The musicality in children with cochlear implants was not significantly different from children with normal hearing in the same hearing age. The musicality in children with cochlear implants was significantly lower than that of children with normal hearing in the same chronological age.

**Abstract ID:** 271  
**Poster Number:** 145  
**Title:** The Immersion 360 System: Bringing the Outside World into the Clinic  
**Authors:** Francois Bergeron, Ph.D.1, Kevin Leung Kam, M.Sc2, Walid Chafiq, M.Sc2, Bastien Bouchard, M.Sc3, Dominique Demers, M.Sc.4;  
1Speech & language pathology, Université Laval, Québec, Canada, 2Neuroprothèses, Université de Montpellier, Montpellier, France, 3Technologies Immersion, Québec, Canada, 4Clinical and biomedical sciences, Université Laval, Québec, Canada.  
**Abstract:** Improvement in auditory perception is a major objective of therapeutic interventions for the hearing impaired child. Numerous tests are proposed to guide these interventions and assess their benefits. Optimally, these tests should explore complex abilities such as those encountered by hearing impaired children in daily life. Thus, many contemporary tests were designed on sentence recognition against a speech spectrum noise coming from fixed sources. While sentences appear as a realistic daily stimulus, one can argue that a speech spectrum noise issued from fixed positions with variable or arbitrarily predetermined signal to noise ratios can be far from what children experience in real life. Yet, it is possible to create more realistic test environments. The Immersion 360 system proposes a virtual environment that can reproduce any everyday sound experience and thus, support a more realistic testing condition to assess auditory perception. This project aimed to specify the psychometrics of this system and define norms for speech perception for French speaking normal-hearing people.

**Methods:** Thirty young adults with normal hearing were assessed in Canada and in France with the French adaptation of AzBio in 9 virtual environments (car, garage, cafeteria, restaurant, ball game in a
gymnasium, race training in a gymnasium, kindergarten, road traffic, street traffic). Presentation and signal to noise levels were set at the levels measured on the recording sites.

**Results:** Descriptive analysis specify the average, variance and confidence intervals at 95% for each test condition of the Immersion 360 system. Normative data are derived from these metrics.

**Conclusion:** A new test based on virtual environments is now available to assess speech perception in a realistic testing condition. Future work will focus on defining norms with the French pediatric version of AzBio presently in development.

**Abstract ID:** 531  
**Poster Number:** 127  
**Title:** Design a Model for the Cochlear Implant Electrode Array Inside the Cochlea to Study of Current Distribution for Different Design Configurations  
**Authors:** Marawan M. M. Ahmed, M.Sc.1, Mohamed Badawi, PhD2; 1Electrical Engineering, Faculty of Engineering, Alexandria Univ., Alexandria, Egypt, 2Medical Equipment Technology, Faculty of Allied Med. Sci., Pharos Univ. in Alexandria, Alexandria, Egypt.

**Abstract:**  
**Introduction:** Cochlear Implants (CIs) are implantable devices that bypass the non-functional inner ear and directly stimulate the auditory nerve with electric currents, thus enabling deaf people to experience sound again.  
**Methods:** In this paper, we aim to design an innovated cochlear implant model, using CST STUDIO program used to calculate the electric field distribution and current density distribution around the channels of the cochlear implant electrode array.  
**Results:** This computer models is employed to design a general model for the cochlear implant electrode array inside the scala-typany of the cochlea of the patient.  
**Conclusion:** With this model we are able to monitor the effect or the influence of different design configuration on the performance of the cochlear implant.

**Abstract ID:** 508  
**Poster Number:** 68  
**Title:** Electrically-evoked ABR (EABR) for Potential ABI Candidates via Endoscopically-guided, Direct Round Window Stimulation  
**Authors:** John Germiller, M.D., Ph.D.1, Luv R. Javia, M.D.1, Daniel J. Lee, M.D.2; 1Otolaryngology, Children's Hosp. of Philadelphia, Philadelphia, PA, 2Otolaryngology, Massachusetts Eye and Ear Infirmary, Boston, MA.

**Abstract:**  
**Introduction:** Electrically-evoked ABR (EABR) testing can evaluate cochlear nerve responses to electrical stimulation, and can be used in children with cochlear nerve deficiency to assess nerve status prior to CI or ABI. Historically, electrical stimulation has been delivered by a transtympanic needle electrode placed on the cochlear promontory. However, precise positioning can be somewhat uncertain, since it is not done under direct view of the middle ear. Also in principle, such stimulation might be attenuated by variations in cochlear anatomy and bone thickness. In an effort to more closely simulate the direct stimulation of cochlear fluids provided by an actual CI, we have begun performing EABR via direct stimulation of the round window (RW) membrane under endoscopic guidance. We report results from our first 10 patients.  
**Methods:** EABR was performed unilaterally in 4 children and bilaterally in 6 (total 16 ears; median age 24 mo). All had apparent cochlear nerve aplasia based on parasagittal magnetic resonance imaging
(MRI) views of the internal auditory canal. The middle ear was accessed by transcanal tympanotomy. Under endoscopic visualization, a 1-mm ball-tip probe was placed directly on the RW membrane to stimulate fluids of the scala tympani. Nerve responses were measured by wave V on EABR. For comparison, EABRs were generated under traditional stimulation of the bony cochlear promontory, with either needle or blunt tip probes.

**Results:** Stimulation and EABR measurement was successful using both methods in all 16 ears, and there were no complications. In 14 ears, no responses were detectable by either method, consistent with cochlear nerve aplasia. One of these patients subsequently underwent ABI, during which nerve aplasia was confirmed. The remaining 2 ears had measurable responses by both methods. In both cases, responses were detectable at lower thresholds via RW stimulation than via promontory stimulation (450-700 vs. 700-900 microamperes).

**Conclusion:** Direct, endoscopic-guided electrical stimulation via the RW membrane is safe and effective for eliciting EABR responses, and may result in improved detection of small responses in patients with severe cochlear nerve hypoplasia. As ABI surgery is invasive with variable outcomes, improving the sensitivity of EABR testing is crucial to determine the presence of a functional cochlear nerve in the setting of equivocal anatomy on MRI.

**Abstract ID:** 533  
**Poster Number:** 83  
**Title:** Surgery of the Basal Turn Ossification  
**Authors:** Vladislav Kuzovkov, Professor, Ph.D., M.D., Yuri Yanov, Prof., Member of Russian Academy of Sciences, Andrei Lilenko, M.D., Serafima Sugarovq, M.D.; Saint Petersburg ENT and Speech Res. Inst., Saint Petersburg, Russian Federation.

**Abstract:** **Introduction:** Cochlear spiral canal ossification is one of the most critical and complicated issues in cochlear implantation (CI). In this paper, we propose a method for atraumatic drilling of the descending part of ossified spiral canal, which is primarily affected in the great majority of cases.

**Methods:** In the experimental procedure using 25 cadaveric temporal bones, syntopy of the inner ear structures was verified. Topographic anatomical measurements related to the cochlea spiral canal were made.

**Results:** The mean distance between the round window membrane and the basal turn curvature was 8.0 mm, the width of the labyrinthine capsule which borders the spiral canal and internal auditory canal was 0.36 mm, and the width between spiral canal and internal carotid artery was 0.77 mm. Based on these measurements, the surgical procedure based on atraumatic drilling out of the ossification was tested on cadaveric temporal bones. Drilling starts from the ossified round window membrane and proceeds until the basal turn curvature. Using correct irrigation allows identification of the color difference between the otic capsule (greyish) and ossified tissue (whitish). Recognizing this color difference enables gradual drilling out of the ossification along the descending part of the basal turn while preserving the modiolus. The close adjacency of the internal auditory canal and internal carotid artery to the lateral basal turn wall should always be kept in mind. This surgical technique was applied in 45 subjects (mean age 12.4 years) with an ossified descending part of the basal turn due to meningitis. The ossification was detected by pre-operative temporal bone CT scans. Subjects’ mean time from meningitis until CI was 12 months. In 19 subjects the length of the ossified spiral canal was 1-3 mm, in 26 subjects it was 4-6 mm and proceeded until the basal turn curvature. It should be noted that in 7 subjects the extent of ossification was greater intraoperatively than it could be predicted based on temporal bone CT data.
Conclusion: In all the 45 subjects the proposed method enabled adequate approach to the cochlea spiral canal and full insertion of the STANDARD electrode array (MED-EL, Austria).

Abstract ID: 535  
Poster Number: 84  
Title: Insertional Trauma Depending on the Hook Region Anatomy  
Authors: Vladislav Kuzovkov, Ph.D., M.D.1, Andrei Lilenko, M.D.1, Igor Kostevich, M.D.1, Aminjon Amonov, M.D.2; 1Saint Petersburg ENT and Speech Res. Inst., Saint Petersburg, Russian Federation, 2Republican Scientific Ctr. of Pediatrics, Tashkent, Uzbekistan.

Abstract: Introduction: The optimal method for electrode insertion for cochlear implantation is still a point of debate amongst clinicians, with both the round window (RW) and cochleostomy approaches currently being used. In subjects with residual hearing, it is of crucial importance that the fine structures of the cochlea are not damaged.

Methods: In this study, the anatomic variations of the “hook” region on 35 cadaveric temporal bones are analyzed in order to identify the optimal electrode insertion route. Based on the distance between the edges of oval and round windows, all 35 of the cadaveric temporal bones were divided into two groups: “big” or “small”, based on the classification method proposed by F. Atturo, M. Barbara, H. Rask-Andersen (1.56: 1.09-2.35). It was shown that this distance correlates with the position of the following “hook” region structures: osseous spiral lamina, spiral ligament, basilar membrane, cochlear aqueduct, and accessory aqueduct housing inferior cochlear vein. The following four electrode insertion methods are compared: (i) via the round window, (ii) with the use of an anterior cochleostomy, (iii) with an anterior-inferior cochleostomy, and (iv) with the enlarged round window.

Results: Each of these four approaches were compared across both “big” and “small” cochleae, and the least traumatic method was identified as involving electrode delivery via the round window membrane. This approach enabled electrode insertion without altering the “hook” region structures. When anterior cochleostomy was performed in both “big” and “small” cochlea, the spiral ligament and the lateral portion of the osseous spiral lamina were inevitably damaged in all of the cadavers. In 33% of the cases involving “big” cochlea, the basilar membrane was also damaged. In temporal bones following anterior-inferior cochleostomy, the spiral ligament and the osseous spiral lamina remained intact in 66% of the “big” cochlea and in 50% of the “small” cochlea. There was an additional risk (83%), especially in “small” cochlea, of damaging the cochlea aqueduct and the accessory aqueduct. For the enlarged round window approach, damage was observed in the cochlea aqueduct, and its accessory canal, in 75% of the “small” cochlea and in 50% of the “big” cochlea. It should be noted that excessive backwards folding of the round window membrane leads to large stoma, which may cause problems with the electrode insertion, as well as a significant (20%) risk of altering the spiral ligament.

Conclusion: In summary, approaching the spiral canal via the round window membrane tends to be the safest and least traumatic method of inserting the active electrode. As the distance between the round and oval windows can be measured on a temporal bone CT, it is advised to preoperatively decide upon the optimal approach, particularly for cases of labyrinth rotation and facial nerve dystopia where the round window niche cannot be visualized and reached.

Abstract ID: 536  
Poster Number: 85
Title: A New Device Fixation Technique: Long-term Results in Children

Authors: Vladislav Kuzovkov, Ph.D., M.D., Serafima Sugarova, M.D., Yuri Yanov, Prof., Member of Russian Academy of Sciences;
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Abstract: Introduction: Reliable and approved surgical techniques can help minimize postoperative complications in paediatric cochlear implant (CI) surgery. The CONCERTO PIN device was the first CI specifically designed for reliable minimally invasive surgery, which is especially useful in children where the drilling of a bed and holes for sutures can cause rare but life-threatening complications such as epidural hematomas. This method reduces surgical time and thereby minimizes the impact of anaesthesia on the patient, which is of particular importance when very young children receive a CI.

Methods: Subjects were 116 children (aged 7 months - 16 years) who were unilaterally implanted with the CONCERTO PIN device between October 2013 and December 2015. A 5-7 cm mid-size “lazy S” shaped postauricular incision was used because, compared to a larger incision, it allows greater control of bleeding and reduces the duration of soft tissue exposure. We used the classic mastoidectomy/posterior tympanotomy surgical approach and fully inserted the electrode array via the round window whenever possible. If round window insertion risked damage to adjacent structures, e.g. facial nerve, insertion via cochleostomy was performed. No bony bed was drilled and holes for the pins were only created in the cortical layer of the flat bone just behind the squamous suture. Bone thickness was assessed in each subject using routine computed tomography. Every surgical stage was estimated and timed. The mean postoperative follow up time was 3 years.

Results: The full insertion of electrode arrays of pre-selected length was possible in all subjects. Round window insertion was performed in 91.9% subjects, cochleostomy in 8.1%. The mean total surgical time was 31 ± 8.3 min. No major complications occurred after CI. The implants are stable and securely fixed in every patient. No evidence of device migration or rotation was observed. Minor complications occurred in less than 3% of subjects and included hematomas (serums) and one case of acute otitis media.

Conclusion: Using the minimally invasive surgical method described herein to implant the CONCERTO PIN allowed the surgeon(s) to secure the CI without increasing the risk of postoperative complications in pediatric CI recipients.

Abstract ID: 509
Poster Number: 159

Title: Evaluation of a Contralateral Routing of Signal System for Unilateral Cochlear Implant Recipients

Authors: Sarah Downing, M.S., CCC-A, Emily Cardenas, Au.D., CCC-A, Joan Oexmann, Au.D., CCC-A, Smita Agrawal, PhD;
Advanced Bionics, LLC, Valencia, CA.

Abstract: Introduction: It is well-establishe
This experimental CROS configuration is also capable of beamforming, which could further improve speech understanding in noise. This CROS implementation is currently not approved for commercial use.

**Methods:** Adults with at least one Advanced Bionics CII and/or HR90K implant will participate in the study. Truly unilateral CI recipients (with no current contralateral hearing device use) will be tested without and with a wireless CROS device. Speech understanding will be evaluated in quiet at 50 dB A from S0, Sipsi and Scontra with AzBio sentences. Speech understanding will also be evaluated with AzBio sentences at 65 dB A from S0, Sipsi and Scontra in 20-talker babble presented from a circular 12 speaker array. Effectiveness of beamforming will be evaluated with signal from front and noise from all 12 speakers. Speech understanding in bimodal and bilateral recipients will also be evaluated to measure benefit of input at both ears in this test configuration. Bimodal recipients will be tested without and with Naida Link HA. Bilateral recipients will be tested unilaterally with the first CI only and bilaterally. Subjective feedback regarding ease of use and benefit of CROS will also be obtained.

**Results:** With the CROS device off, speech scores were lowest when speech was presented from the unimplanted side (Scontra) and highest when speech was presented from the implanted side (Sipsi). Preliminary results show the listening with the CROS device improved speech scores in the Scontra as well as S0 conditions such that scores were now closer to those in the Sipsi condition. Preliminary results also show that when S0, beamforming with CROS further improves speech scores as compared to beamforming with CI only.

**Conclusion:** For unilateral recipients who cannot or do not want to opt for bilateral or bimodal hearing, the wireless CROS device could effectively allow access to some of the benefits of listening with both ears.

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**Abstract ID:** 328  
**Poster Number:** 88  
**Title:** First Experience With A New Thin Lateral Electrode Array  
**Authors:** Thomas Lenarz, M.D. Ph.D., Nils Prenzler, M.D., Rolf Salcher, M.D., Andreas Buechner, Ph.D.; Department of Otorhinolaryngology, Hannover Med. Sch., Hannover, Germany.  
**Abstract:**  
**Introduction:** To be viable, a new cochlear implant (CI) electrode array design must combine: improved surgical ease of use, structure preservation, particularly important for paediatric application, resist backing out of the cochlea and balance hearing preservation against addressing sufficient cochlear tissue to support electrical-only hearing.

**Methods:** The new electrode array was designed taking account of the detailed 3-dimensional variability analysed from 20 microCT scans of human cochleae. It builds on positive experience with a mid-scala array but has only a slight curvature, being designed to take a lateral scala tympani position. Through four major design iterations, manual and automated insertion experiments on a 3-dimensional force measurement system allowed differential stiffness to be tuned such that insertion forces of under 60 mN were achieved. The final design tested here is 23 mm long, varying from 0.25 x 0.55 mm at the most apical contact to 0.6 x 0.8 mm at the proximal marker contact. To confirm the above design objectives, 10 arrays were implanted in freshly frozen human temporal bones. The insertions were made using a combination of pure and extended round window approaches. Surgical access was realistic, including the facial recess. To stabilize the array, a channel was carefully drilled in the facial recess to accommodate the electrode lead. Each implanted bone was vibrated to assess resistance against extrusion. Both microCT and histological analysis were conducted.
**Results:** For each bone it was possible to insert all 16 stimulating electrode contacts, with insertion being straightforward in all cases. In two cases the round window was deliberately extended to improve access. No translocations were found. A mean insertion depth of 405 degrees was achieved. There was no difference in either, ease of insertion, or insertion depth, for extended or pure round window approaches. No backing out was observed during the brief agitation and vibration of each implanted bone.

**Conclusion:** The new array appears well suited to clinical application, particularly where a simple one-handed insertion technique is desired. Its small dimensions allow flexibility for cochleostomy, as well as extended or pure round window approaches. The insertion depth achieved is sufficient to support electrical only hearing, with a slightly deeper insertion likely in clinical practice. With minimal trauma observed in this series, our intention is next to study hearing preservation with this array.

**Abstract ID:** 338
**Poster Number:** 110
**Title:** Critical Review of Suprameatal Approach for Cochlear Implantation
**Authors:** Vedat Topsakal, MD PhD
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**Abstract:**

**Introduction:** Mastoidectomy with Facial Recess Approach (MFRA) is considered the reference standard for cochlear implantation. The SupraMeatal Approach (SMA) was developed more recently and does not require mastoidectomy. We aim to identify the optimal operative approach for cochlear implantation based on postoperative complications and hearing preservation in children and adults with a systematic literature review and a retrospective cohort study for paediatric cochlear implantation.

**Methods:** Studies comparing MFRA and SMA in children and adults were eligible for inclusion for the review. Original reports with moderate relevance and validity were included. Relevance and validity were assessed using a self-modified Critical Appraisal Tool. This review concords with PRISMA guidelines. Secondly we assessed cochlear implant complications in children implanted between 1996 and 2014 before the age of 5 years in the UMC Utrecht. The severity of complications (minor or major) was documented using Hoffman and Cohen criteria. Complications were reported to occur intraoperative, early postoperatively or late postoperatively. Intraoperative surgical challenges were correlated to complication occurrence.

**Results:** Only retrospective, non-randomized studies were identified (Level-III evidence) and 294 citations were retrieved. Six articles were selected for full-text inclusion and 4 articles were selected for data extraction. No article found a significant difference between MFRA and SMA with respect to postoperative complications in children and adults. One study found a significantly (p < .023) higher pediatric MFRA mastoiditis rate, however, meta-analysis did not indicate an overall effect. Analyses of our own data showed an average age-at-implantation of 2.13 years (SD: 1.14). SMA patients were significantly (p < .001) younger (1.04 years (0.55 - 4.2)). Most complications were minor (MFRA: 64.0%; SMA: 73.1%) and occurred early postoperatively (MFRA: 61.5%; SMA: 76.9%). More complications occurred in SMA compared to MFRA patients (61.5% vs. 20.6%; p < .001) and often in young SMA cohorts (6-12 and 18-24 months; p < .008 and p = .016). Especially more infectious complications occurred in SMA patients (p<.05). Logistic regression showed that the surgical technique and not the age-at-implantation caused infectious complication occurrence.

**Conclusion:** No evidence was identified in existing literature for lower complication rates between the MFRA or SMA for cochlear implantation in children and adults. Pediatric data were only available for
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children implanted above the age of 24 months. There is a need for Level I evidence to resolve the around postoperative outcomes of SMA. Significantly more (infectious) complications occurred in young cochlear implant patients when own data were analysed. Because young children are prone to develop acute and serous otitis media mastoidectomy (MFRA) could have a protective effect in this population.

Abstract ID: 538
Poster Number: 95
Title: Step-by-Step Surgical Timing in Subperiosteal Pocket Technique of CI
Authors: Kadir Serkan Orhan, MD, Mehmet Çelik, MD, Beldan Polat, MD, Levent Aydemir, MD, Erkan Öztürk, MD, Yahya Gülüden, MD;
Istanbul Univ., Istanbul, Turkey.
Abstract: Introduction: Cochlear implants (CI) are a surgically-implanted electronic devices that restore hearing to people with profound or severe hearing loss who found no benefit using conventional sound amplification devices. The routine surgical procedure for CI is the mastoidectomy with facial recess approach The subperiosteal pocket technique (SPT) can be safely and effectively used in CI. In this study, we aimed to determine a reasonable time by measuring the surgical duration (SD) of SPT with step-by-step.
Methods: This study is a retrospective analysis conducted on a group of 40 pediatric CI recipients who underwent surgery by the same right-handed senior author (Y.G) between March 2009 and August 2016. Patients who had any anatomic variant or pathology of temporal bone structures were excluded from the study. Operations that had extended surgical time related with anesthesia or other abnormal surgical progress such as surgical device failure were also excluded. Patients were randomly divided into 2 groups, right side (n=20) and left side (n=20). The SDs were calculated using surgical video recordings or intraoperative observing. The surgical time (Second) was calculated as the interval from skin incision to skin closure suture. Surgical stages were determined respectively, as follows in 8 steps: 1- Retroauricular incision with elevation anterior-based Palva flap (PF). 2-Subperiosteal pocket (SP) creation.3- Cortical Mastoidectomy (CM) with posterior canal wall thinning. 4- Posterior tympanotomy. 5-Removing Round window niche (RWN). 6-Placement of the device in the pocket and suturing tail of PF incision. 7-Electrode array insertion. 8-Suturing PF and skin closure.
Results: The mean age of the total 40 CI recipients at the time of surgery was 3.2 ± 2 years (range, 1-11 years; mean age of left-side group was 2.3±1.3 years and right-side group 3.4±2.2 years). Thirteen patients were male and seventeen were female. Prelingual hearing loss was observed in 35 of the patients, and only 5 patients were diagnosed as having post-lingual hearing loss. Implant models of three different companies were used. Twenty-three recipients were implanted with a Nucleus devices (Cochlear Ltd., Lane Cove, Australia), 5 received Clarion devices (Advanced Bionics Corp., Valencia, CA, USA) and 12 were implanted Med-el devices. The average durations in SPT stages was respectively as follows: 266.2 ± 40.735 ± 22; 316.8 ± 57; 429.7 ± 164; 81.8 ± 45; 204.3 ± 43; 72.7 ± 35 ;808 ± 22. The average total SD was 2820 ±348 second.
Conclusion: In our study, we described 8 steps respectively in SPT. The most time-consuming steps are suturing PF and skin closure, posterior tympanotomy, CM and posterior canal wall thinning, retroauricular incision and PF elevation, respectively. These results can be used in CI centers with residency programs, which should be for a reasonable time, with good learning periods for junior surgeons.
Abstract ID: 584
Poster Number: 114
Title: Robotic Cochlear Implantation: First Clinical Results
Authors: Wilhelm Wimmer - Artifical Hearing Research
ARTORG Center for Biomedical Engineering, Univ. of Bern, Bern, Switzerland.
Abstract: Introduction: Robotic cochlear implantation is a new minimally invasive approach for CI surgery. The procedure is currently evaluated in a clinical trial at the Inselspital in Bern, Switzerland. The aim of this presentation is to report preliminary clinical results of the first cases of robotic cochlear implantation.
Methods: The clinical study was approved by the local IRB and regulatory body. Preoperative assessments included morphological evaluation using CT, taste examination and facial nerve neurography. During surgery, four bone fiducial screws were inserted behind the ear and CT (0.2 mm resolution) was performed to plan a drill trajectory from the mastoid surface, passing through the facial recess to the center of the round window. Access to the middle ear was drilled using a previously developed task specific image-guided robotic system. Sufficient clearance of the drill trajectory from the facial nerve was confirmed using intraoperative cone beam CT imaging. Upon completion of drilling and screw removal, a tympanomeatal flap was created and the round window membrane was exposed. An implant bed was prepared and the electrode array was manually inserted using a specifically manufactured insertion tube. Correct placement and nominal function of the implant was verified by telemetry and postoperative CT imaging. Postoperative facial nerve neurography and taste examination took place two weeks postoperatively. Audiological assessment was performed as part of routine clinical care.
Results: Robotic middle ear access was completed in 4 patients, with successful electrode insertion according to the preoperatively defined plan. Audiological results for all patients are currently being collected.
Conclusion: We have demonstrated in 4 patients that a CI electrode can be successfully inserted into the cochlea through a 1.8 mm keyhole access created by a surgical robot. The workflow with the robotic setup requires additional setup time and extensive teamwork.

Abstract ID: 204
Poster Number: 224
Title: X-linked Malformation Deafness, a New Syndrome?
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Abstract: Introduction: X-linked malformation deafness is a rare hereditary cause of congenital or rapid progressive hearing loss. Of all hereditary hearing loss, mutations on the X-chromosome are rare, and may cause syndromic as well as non-syndromic deafness. Four non-syndromic hearing loss loci have been mapped to the X-chromosome, DFNX1-4. Among non-syndromic x-linked hearing loss, DFNX2 is the most common (around 50%) and its causative gene has been identified as POU3F4. DFNX2 is caused by a variety of mutations within the POU3F4 gene or its regulatory elements. The affected children
present with a severe-profound mixed hearing loss and temporal bone imaging shows a typical inner ear malformation classified as Incomplete Partition type 3 (IP3). Cochlear implantation (CI) is one option of hearing restoration in severe cases. In this study we evaluate this group of pediatric CI recipients, compared with a control group, and discuss possible links to neurodevelopmental symptoms.

**Methods:** Ten children with X-linked deafness and cochlear implants (first implanted age 0.9-2.8 years) were evaluated with a retrospective chart review in combination with additional testing by a multidisciplinary team. Hearing, language, cognitive results and mental health were compared with a control group of children with non-syndromic hearing loss (GJB2, Connexin26) with CI (n = 10). Mutation analysis of the POU3F4 gene was performed and the genotype was compared with outcome.

**Results:** Mutations in POU3F4 were found in nine of the ten children with IP III malformation. Children with X-linked deafness showed low level of speech recognition, especially in noise, delayed or impaired spoken language abilities and executive functioning deficits which correlated with mental ill-health issues. By contrast, controls revealed more age-appropriate results in these domains. Children with X-linked deafness also displayed hyperactivity and poor concentration ability. However, eight of ten children expressed high non-verbal cognitive ability despite their other hearing- and cognitive-related issues.

**Conclusion:** The children with X-linked deafness in the present study displayed poorer performance on measures of executive functions as well as spoken language skills in comparison to the control group with Connexin26 deafness. The findings of the present study suggest a link between POU3F4 deafness and neurodevelopmental anomalies. This “POU3F4 syndrome” presents with mixed severe-profound hearing loss and behavioral disturbances, such as attention deficit hyperactivity or autism spectrum disorders. Although CI is a feasible alternative for children with X-linked malformation deafness, the children need extensive support. Oral communication alone is possible but the majority of children in the present study exhibited language and cognitive difficulties.