CI2019 Pediatric:

Poster Abstracts
Title: Assessing the Benefits of Bimodal Fitting

Category: Audiology

Authors:
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Abstract:
Introduction: Patients with a cochlear implant in one ear and a hearing aid in the other (bimodal) are often not optimally programmed. There is typically little to no coordination between the two devices and the amplification needs of a bimodal listener are different from a patient who only has access to sound through hearing aids. Recently, a bimodal fitting system has been created (Naida Link) that aims to optimize the gains for this population by providing more gain for low frequencies and reduced gain at frequencies corresponding to potential dead regions in the cochlea. It also aligns the loudness growth and dynamic AGC characteristics of the bimodal hearing aid to that of the cochlear implant processor.

Methods: The goal of the current study was to determine if bimodal fitting via the Naida Link yielded better speech understanding abilities compared to an individual’s current standard clinical fitting of a cochlear implant and hearing aid. To test this, patients were tested with unlinked and uncoordinated cochlear implant and hearing aid programs (only relative loudness for the two ears was adjusted). Patients were also tested with the Naida Link system. Speech understanding in noise was compared in the two configurations.

Results: Preliminary results will be discussed.

Conclusion: An efficient and effective bimodal fitting methodology is beneficial to patients as well as clinicians.
Title: Bilingual Language Proficiency in Adolescents with Typical Hearing and Adolescents with Hearing Loss

Category: Rehabilitation/Educational Aspects

Authors: Alliete Alfano, PhD 1, Stacey Lim, AuD, PhD 2, Carolina Gutierrez-Rivas, PhD 2; 1Communication Sciences and Disorders, Florida Intl. Univ., Miami, FL, 2Central Michigan Univ., Mount Pleasant, MI.

Abstract:

Introduction: Though there is evidence demonstrating children with disabilities are able to become bilingual, there are still concerns of how children with hearing loss can learn more than one spoken language (Thomas, El-Kashlan, & Zwolan, 2008). In more recent years, it has been found that there are advantages to speaking more than one language at home, particularly if the parents are fluent in other spoken languages (Thomas, El-Kashlan, & Zwolan, 2008). In the past, however, parents of children with hearing loss were strongly encouraged to speak one language only; generally, this was the language of the majority population in the country--so for example, bilingual parents in the United States were encouraged to speak only English with their children with hearing loss, regardless of the parents’ proficiency in English. The purpose of this study was to compare English and Spanish proficiency in bilingual adolescents with and without hearing loss.

Methods: Sixteen bilingual (English/Spanish) adolescents, 12-19 years old, participated in the study. Eight of the adolescents had severe to profound bilateral sensorineural hearing loss. Hearing loss was identified by 2 years of age and hearing aid fitting/cochlear implantation occurred by 2 1/2 year of age. The remaining 8 adolescents had typical hearing and were age-matched to the adolescents with hearing loss. Participants completed a bilingual history questionnaire and the Woodcock-Muñoz Language Survey in English and Spanish.

Results: An independent-samples t-test was run to determine if there were differences in language proficiency scores in English and Spanish between bilingual adolescents with typical hearing and bilingual adolescents with hearing loss. English Listening proficiency was higher for adolescents with typical hearing (101.2± 9.6) than for adolescents with hearing loss (76.1 ± 18.1), a statistically significant difference of 4.9, t(19) = 6.331, p = .000. English Oral Language proficiency was higher for adolescents with typical hearing (101.8± 7.7) than for adolescents with hearing loss (71.0 ± 14.7), a statistically significant difference of 6.0, t(19) = 4.293, p = .000. Spanish Listening proficiency was higher for adolescents with typical hearing (79.0± 16.5) than for adolescents with hearing loss (25.4 ± 22.1) a statistically significant difference of 9.1, t(19) = 6.356, p = .000. Spanish Oral Language proficiency was higher for adolescents with typical hearing (67.9± 17.9) than for adolescents with hearing loss (33.5 ± 23.5) a statistically significant difference of 9.1, t(19) = 3.081, p = .001.

Conclusion: Results indicate that bilingual adolescents with typical hearing have higher language proficiency in both English and Spanish when compared to bilingual adolescents with hearing loss. Additionally, English proficiency was higher for both groups.
Poster Number: 3  
Abstract ID: 224  
Title: Quality of Life Outcomes After Cochlear Implantation in Older Adults: A Systematic Review  
Category: Audiology  
Authors:  
Ellen Andries, Drs, MSc AUD, Griet Mertens, PhD, MSc AUD, Paul Van de Heyning, MD, PhD; Department of Otorhinolaryngology, Univ. Hosp. Antwerp, Antwerp, Belgium.  
Abstract:  
Introduction: According to the WHO, one third of adults aged 65 or older has disabling hearing loss. Those with severe to profound sensorineural hearing loss could benefit from cochlear implants (CI) as it is shown in several studies that CI can significantly improve auditory gains, cognition and quality of life (QOL). There is growing interest in older CI recipients and their QOL, as QOL is an issue especially of reimbursement strategies. To assess QOL in CI recipients, clinical psycho-acoustic measures such as speech recognition and pure tone audiometry alone are not all-embracing. QOL also needs to be evaluated in a more general way, taking into account personal factors and functional benefits that cannot be described by (speech) audiometry. Therefore, numerous QOL measurement instruments have been developed, divided in two categories: disease-specific and generic instruments. Generic instruments can be used in various diseases as they assess general health states, while disease-specific measures assess particular diseases. Nevertheless, there is lack of consensus regarding QOL measures in CI recipients. Moreover, there are less data in QOL changes available in recent articles compared to data in psycho-acoustic measures changes in CI. Therefore, the aim of this study is to critically review current literature concerning QOL in CI recipients.  
Results: Title and abstract of 475 articles were screened and 35 articles were selected for full-text assessment. The general results will be presented at CI 2019.  
Conclusion: Current literature shows that QOL improves post CI. However, no instruments or methods are generally accepted to assess QOL in CI recipients. The overall results will be presented at CI 2019.
Title: Comparing Measures of the Cochlear Implant Electrode-Neuron Interface to Clinical Measures in Listeners with Enlarged Vestibular Aqueduct

Category: Audiology

Authors:
Julie G. Arenberg, PhD, Kelly Jahn, AuD, Molly Bergen, BS; Speech and Hearing Sciences, Univ. of Washington, Seattle, WA.

Abstract:
Introduction: Etiology of hearing loss can lead to varying development and formation of the inner ear, resulting in differing qualities of the interface between individual, cochlear implant (CI) electrodes and the auditory nerve. However, the relation between etiology and psychophysical and impedance measures is not well understood. The goal of the present study was to compare detailed psychophysical and impedance measures obtained in a small sample of subjects with enlarged vestibular aqueduct (EVA) to those obtained clinically in a much larger sample of patients.

Methods: Detailed psychophysical measures were obtained in 16 CI listeners that received their first implant during childhood. Four participants were diagnosed with enlarged vestibular aqueduct (EVA), which is characterized by an abnormally dilated vestibular aqueduct and typically some degree of cochlear malformation. Five participants presented with the Connexin-26 mutation, and the remaining five had unknown etiologies. Electrode-specific monopolar thresholds, steered quadrupolar (spatially-focused) thresholds, clinical impedances, and electrical field imaging were measured. A retrospective analysis will be performed from a large audiology clinic. From the database, analyses of clinically-measured impedances and monopolar programming levels will be assessed. A preliminary search of the database since May, 2015 to the time of writing this abstract revealed 4969 patients with EVA in their records. Records will also be obtained from CI listeners with other etiologies to match the representation of the original sample of 16 listeners.

Results: In the original sample, CI listeners with EVA had higher intracochlear resistance values and higher behavioral detection thresholds than listeners with other etiologies. A comparison of clinical impedance measures and programming levels at threshold and most comfortable level will be compared between the original sample tested prospectively and the retrospective analysis of data from the database.

Conclusion: These preliminary findings support the need to investigate CI outcomes and optimized interventions for listeners with distinct hearing histories.
Cochlear Implantation in First and Second Generation Immigrant Children of Parents with Limited English Proficiency in the United States: Experiences in Providing Hearing Health Care

Introduction
Since 1960, the United States has experienced the largest influx of migrants in the world. A “First generation immigrant child” is defined as any foreign born child. A “Second-generation immigrant child” is defined as a US born child with at least one foreign born parent. “Children with immigrant parents” refers to both first and second generation immigrant children. The 2017 Current Population Survey indicated that immigrants and their US born children make up 27 percent of the population, with children under 18 making up 44 percent of this group. Forty-nine percent of immigrants 5 years of age and older are reported to be “Limited English Proficient” which is defined as speaking English “not at all,” “not well” or “well” as opposed to speaking “only English” or speaking English “very well.” When an immigrant child of parents with Limited English Proficiency presents with a hearing loss, there are challenges in providing hearing health care. In addition to language barriers, these families often times experience cultural barriers, social support issues and challenges in accessing and utilizing the US healthcare system. There may be limitations in delivering medical recommendations as well as appropriate habilitative/therapy services.

Methods
An evaluation of our patient population was completed which identified approximately 20 children as First or Second- generation immigrants. The intent of this retrospective is to further examine these patients’ records to identify those whose parents demonstrate Limited English Proficiency. These patients will be reviewed to glean information with regard to the aforementioned challenges and barriers, and to report our experiences with this population.

Results
To be provided upon review of records.

Conclusions
To be provided upon completion of review.
Title: Cochlear Implantation in Non Traditional Pediatric Patients: Considerations in Candidacy

Category: Audiology

Authors:
Shelly Ash, MSAudiology, John's Hopkins All Children's, St Petersburg, FL.

Abstract:
Cochlear Implantation in Non Traditional Pediatric Patients: Considerations in Candidacy

Introduction
The original FDA criteria for pediatric cochlear implantation stipulated profound, bilateral sensorineural hearing loss for all candidates under the age of 18 years. The current guidelines, established in 2000, are a profound hearing loss for children under 2 years of age, or a severe to profound hearing loss for children 2+ years of age, and speech perception word scores of no greater than 30%. Children with less severe hearing losses in one ear, or those who have significant residual hearing in one or both ears, have not been considered as traditional cochlear implant candidates. There are instances, however, in which these children would be better served with a cochlear implant in the poorer ear, or in some cases, bilateral cochlear implantation.

Methods
A retrospective chart review of pediatric patients was completed to identify recipients who were considered to be non-traditional candidates for implantation. Ten patients demonstrated a pure tone average of less than 70 dB HL in at least one ear, and/or open set speech perception word scores that exceeded current FDA guidelines for candidacy.

Results
It was observed that the majority of recipients demonstrated progression in hearing loss over time. This, in combination with expedited fitting of amplification, suggested these children had access to auditory information early on. Audiometric data in conjunction with word understanding supported that these children relied heavily upon low and mid frequency information for speech recognition.

Conclusion
An audiogram will demonstrate degree of hearing loss, but sensitivity to sound does not always equate with clarity of speech, the latter of which is a necessity for the development of auditory based language.
**Poster Number:** 7  
**Abstract ID:** 62  
**Title:** Cochlear Implantation for Children with Cochlear Nerve Deficiency: Factors Affecting Speech Perception  
**Category:** Surgery/Medical  
**Authors:**  
Melissa Auchter, AuD 1, Lisa R. Park, AuD 1, Margaret Dillon, AuD 2, Elizabeth Perkins, MD 2, Kevin D. Brown, MD, PhD 2; 1The Children's Cochlear Implant Ctr. at the Univ. of North Carolina, Chapel Hill, NC, 2Univ. of North Carolina, Chapel Hill, NC.  
**Abstract:**  
**Introduction:** Outcomes for cochlear implantation in children with cochlear nerve deficiency (CND) are highly variable. Studies have indicated that children with a hypoplastic or deficient nerve may develop closed set speech recognition (potentially open set), but that children with no indication of a cochlear nerve will only develop sound detection or pattern perception. This population is also at risk for other comorbid conditions that may affect the potential for successful outcomes.  
**Methods:** Retrospective analysis of 62 implanted ears diagnosed with cochlear nerve deficiency. Speech perception abilities were ranked on a validated 7 point scale ranging from non-stimulation to open set skills. This dependent variable was measured against factors potentially affecting speech perception abilities with an ordinal regression analysis. Independent factors included cochlear nerve status, cochlear anatomy, internal auditory canal opening, and the presence of comorbid conditions. Cochlear nerve status was defined on CT and MRI by review of neuroradiologist and board-certified neurotologist as either absent (no bony cochlear nerve canal and no nerve), questionable presence (bony cochlear nerve canal but no visible nerve on MRI) or hyoplastic (visible but small nerve on MRI and small bony cochlear nerve canal).  
**Results:** Of the 62 ears implanted with CND, 23% were able to achieve some open set abilities (defined as scoring at least 10% on an open set task). For the children who did not achieve open set, 45% did continue to use their device for sound awareness clues. Only 32% eventually became non-users or continued to wear the device without noted stimulation. Cochlear nerve status was found to be a statistically significant factor affecting speech perception outcomes. Those classified as having absent nerves were almost twice as likely to perform more poorly than those with hypoplastic nerves. Those with questionably present nerves were 1.5 times more likely to perform poorly when compared with the hypoplastic cohort. There was no difference in performance between those with absent or questionable nerves. Of the 15 ears classified as having absent nerves, 40% became non-users and only 7% had pattern perception. None of the children in this subset were able to achieve any closed or open set speech perception abilities. While not statistically significant, a trend was noted for those without comorbidities having greater odds of being in a higher speech perception category.  
**Conclusion:** Outcomes for children with cochlear nerve deficiency have been repeatedly noted as highly variable. Some children have limited understanding and are good users of their cochlear implant while others struggle and may become non-users. The presence of a defined auditory nerve is significantly predictive of outcomes. Comorbid conditions may also play a role, but did not reach significance in this population. These findings may have significant impact on candidacy and counseling.
Poster Number: 8
Abstract ID: 248
Title: Application of the Speech Questionnaire, Spatial and Qualities of Hearing Scale (SSQ) Adapted for Brazilian Portuguese in Cochlear Implant Users
Category: Audiology
Authors:
Leticia Ferraz, Graduated, Fernanda Caldas, master's degree, Isabella Silva, DOCTORATE DEGREE, Carolina Cardoso, master's degree, Fayez Bahmad Junior, Doctorate Degree; AUDIOLOGIST, IBORL, BRASILIA, Brazil.
Abstract:
Introduction: When considering different disabilities, hearing loss can be one of the most devastating and consequential to the development of oral communication. The Cochlear Implant has been indicated as a rehabilitator resource for people with severe/profound hearing impairment. The battery of tests utilized for hearing screening in this population is efficient to quantify the hearing loss, however, its results do not reflect the day to day communication difficulties
Methods: When considering different disabilities, hearing loss can be one of the most devastating and consequential to the development of oral communication. The Cochlear Implant has been indicated as a rehabilitator resource for people with severe/profound hearing impairment. The battery of tests utilized for hearing screening in this population is efficient to quantify the hearing loss, however, its results do not reflect the day to day communication difficulties
Results: From January to April of 2018, 15 participants filled the SSQ. In general, women with age between 30 to 59 and with an implantation period superior to 3 years, had the higher scores. Quality of hearing was the SSQ part with the best overall performance
Conclusion: The instrument was relevant to evaluate or grade the overall adaptation of the implant, since the users with higher implantation period had higher scores
**Title:** Pediatric Cochlear Implantation-Early Onset Hearing Loss with Late Referral in a Developing Country

**Abstract:**

*Introduction:* International CI guidelines state that children with severe and profound SNHL should receive a CI soon after diagnosis to shorten the period of auditory deprivation and to optimize speech and language rehabilitation using the optimal period of the brain plasticity. There are several criteria that may not allow candidacy for CI. Among them are the lack of early identification and intervention especially where the newborn hearing screening is not fully implemented. Universal newborn hearing screening programs provide the adopted benchmarks 1-3-6 guidelines for best practice that allow preliminary activities that are necessary for cochlear implantation to occur in the shortest time possible. The purpose of this study was to evaluate the impact of age of screening, identification and intervention for pediatric cochlear implant candidates in a developing country CI center.

**Methods:** Twenty patients from a tertiary referral Cochlear Implant Centre, aged 1y 6m to 12y, were studied retrospectively. Audiologic details including age at diagnosis/ intervention, age at cochlear implant candidacy, age at cochlear implantation as well as the access to care were collected.

**Results:** 90% of patients referred to CI Program presented early onset of hearing loss before six months of age, the average age of diagnosis of hearing loss for 20 children was 23.3 months and only 5% had initial intervention before 12 months. Mean time between identification of the hearing loss and arrival at the implant center was almost 2 years. 75% of these patients fulfilled national guidelines criteria and implantation was recommended with a mean age of implantation of 42m. A detailed review was performed to examine the reasons for late implantation and a substantial number of cases, 70% of the population studied were not identified through newborn screening. Other related factors such as the public hearing health care access, the geographical location and family decision contributed to a late coming at a CI center.

**Conclusion:** Considerable efforts have been made over the last few years in developing countries to improve access to hearing health care, but we are still not treating children early enough. The pediatric eligible candidate waits for a long time for initial hearing loss management. Although that population was implanted at later ages, CI can be considered a viable option for most patients who don't have any results with hearing aids.
**Poster Number:** 10  
**Abstract ID:** 207  
**Title:** A longitudinal comparison of performance on a quick measure of spectral modulation detection (QSMD) between electrode types  
**Category:** Audiology  
**Authors:**  
Katelyn A. Berg, BA, Jillian B. Roberts, BHS, René H. Gifford, PhD; Speech & Hearing, Vanderbilt Univ., Nashville, TN.  
**Abstract:**  
**Introduction:** Cochlear implants (CIs) are one of the most successful prosthetics to date; however, significant variability in speech recognition outcomes for CI recipients persists. For CI users with current technology, the greatest improvements on speech recognition can be observed during the first year post-implantation (Krueger et al, 2008). However, solely using speech recognition to assess outcomes is problematic because these tasks often require top-down processing and prior knowledge of the language. This signifies the need for a validated outcome metric that is non-language based and highly correlated with speech understanding, such as the Quick Spectral Modulation Detection (QSMD) task (Gifford et al., 2014). Spectral resolution is correlated with speech recognition and may be improved with greater spatial selectivity of intracochlear electrodes. Recent studies have found more independent channels may be available for perimodiolar arrays using current processors (Croghan et al., 2017) than for those with older technology and lateral wall arrays (Loizou et al., 2000; Fishman et al., 1997; Friesen et al., 2001). However, the literature remains mixed on the impact of electrode type alone on speech outcomes (Doshi et al., 2015; O’Connell et al., 2016b; Park et al., 2017). Thus, the objectives of this study were to describe performance gains on the QSMD task longitudinally, to compare the time course and overall performance on QSMD between electrode types, and to present clinical implications of these results regarding personalized electrode selection and expectations management.  
**Methods:** Comparison of speech recognition and QSMD scores for 531 post-lingual adult ears (168 lateral wall, 241 mid-scala, and 122 perimodiolar) who were implanted between 8/1/2013 to present.  
**Results:** Preliminary linear mixed model analyses revealed a significant main effect of time point for both spectral resolution (p = 0.02) and CNC scores (p < 0.0001). Specifically, significant gains in both spectral resolution and speech recognition were observed over the first year of device use; however, the rate of growth was significantly greater for QSMD than CNC. No significant differences were found between electrode types for spectral resolution (p > 0.05), but a significant effect of electrode type on CNC word recognition was found (p = 0.01) with mid-scala achieving significantly higher scores than lateral wall recipients (p = 0.009). No difference was observed between mid-scala and perimodiolar (p = 0.84) nor between perimodiolar and lateral wall electrodes (p = 0.21).  
**Conclusion:** CI users show continuous improvements in both spectral resolution and monosyllabic word recognition for at least the first year post-implantation for all electrode types; however, more rapid postoperative improvement for spectral resolution compared to word recognition aligns with peripheral processing reaching maturity more quickly than higher level linguistic and neurocognitive processing tasks. Precurved electrode recipients may also achieve higher speech recognition scores than lateral wall recipients, though additional analyses are needed. Planned further analyses will quantify the expected time course of overall performance on spectral resolution and speech perception between electrode types. Electrode placement should be considered as a potential contributing factor to the differences observed in the number of independent channels available for different electrode types.
Abstract:
Introduction: An 11 year old bilateral cochlear implant user reported a sudden loss of function of one of her implants. Subsequent integrity tests determined that the cochlear implant was functioning normally. Nonetheless, the CI user continued to insist that she could not hear anything with that implant during psychophysics testing setting thresholds and MCLs, nor during automatic ECAP threshold (AutoNRT) measurements. The likelihood of success of a re-implantation and the associated rehabilitation, was questionable.
Method: Initially, testing of the allegedly defective device was done routinely, namely sequentially: the problem was reported by the mother, confirmed by the audiologist, integrity testing was conducted, and the results shared amongst the clinicians and specialists involved at each step of the process. This process did not produce a solution. Suspicions were raised that the “malfunction” was possibly psychosomatic in nature. As the child was able to communicate adequately with the contralateral implant alone, an interview in a conversational setting in the company of her mother was conducted. Present at the conversation were her speech therapist, family counsellor, audiologist and a clinical engineer, in order to gain insights into various facets of the whole child.
Results: The interview revealed that the child was experiencing a number of emotional stress issues at the time of the alleged malfunction. Amongst them, a change in her regular audiologist who was moving to another site, moving to a new house and changes at school. The child is also in her early puberty years. Other observations were made where AutoNRT was being measured while she played card games with her audiologist. The processor was switched to Live Mode without informing her and she would reply to questions while continuing to play and without looking up from the game. When asked afterwards if she heard anything during the measurements, she responded “no”.
Conclusions: It is very difficult for a single clinician to diagnose such a case of feigning device malfunction. The involvement and interaction of multiple persons of trust is necessary to even discover what is happening. It was important not to confront the child here with feigning, but instead encourage her that the device had been repaired and that the sound would eventually return. Meanwhile, the development of a close rapport with her new audiologist, as well as having successfully moved to the new house, have helped eliminate some of the stress factors and helped the child “regain” her hearing with the “malfunctioning” device.
Cochlear Implant in Adults with Asymmetric Hearing Loss

Introduction: Recent date show that asymmetric hearing loss could benefit from cochlear implantation (CI) in the poorer ear with continued use of a hearing aid in the better ear with good outcome. We report our experience with a prospective longitudinal study.

Methods: Study with 10 patients with postlingual hearing loss and hearing aid in the best ear. Speech recognition in quiet, in noise and quality of listening in different situation with questionnaire were analyzed. Measurements were performed before and after cochlear implantation and 3, 6, and 12 months. We also analyze some variables such as supportive speech therapy, cause of hearing loss, hearing loss in the best ear and data logging of CI.

Results. We report some data. Among patients average age of onset of hearing loss is 40 years. 50% of deafness is caused by otosclerosis. 80% of patients have performed supportive speech therapy and are good users of CI. From an audiometric point of view, some peculiar aspects are highlighted. The Speech recognition in quiet, with only IC after 6 months reaches the results of the best ear with prosthesis to then exceed them at 12 months. At all time intervals, speech recognition in noise competition in bimodal stimulation is a significantly better than Hearing aids results.

Conclusion. The cochlear implant should be considered in this particular group of patients, with residual hearing in the contralateral ear, given the superior results in speech recognition in noise and quality of life with bimodal stimulation.
Introduction: Objective: To assess speech perception skills in Open Set and the benefit acquired through the use of the second CI and Bilateral CI (BICI) that was sequentially delayed.

Methods: Evaluation of 25 patients who had received a Sequential CI with an interval of over 7 yrs between both surgeries. The speech recognition acquired through the use of CI1, CI2 and BICI benefit was carried out by applying two-syllable words in Open Set. The perceptual subjective benefit obtained with the CI2 was made using Questionnaire of Anecdotal Report. The evaluation was made after 12 month use of CI2.

Results: The results were analyzed in three different groups: 1) 1st CI made before the age 3 and with consistent use of contralateral hearing aid (HA). 2) The same condition but without the use of HA and 3) 1st CI made in patients older than 3 yrs old. G1: were included 9 children with an interval from 11 to 16 yrs (10.7), all perform in Open Set with their CI2, G2: 4 children with an interval from 7 to 15 yrs (10.5), 50% perform in Open Set, G3 11 patients, interval from 8 to 15 yrs (10.4), 7 were users of contralateral HA, 55% perform in Open Set. The average indicates that, there was an improvement of 18% benefit with the use of both CI. Regarding the use of the CI2 throughout the whole day and the preference for the use of BICI, 92% of the patients answered Yes. Regarding the fact of feeling comfortable with BICI, the 100% answered Yes. Regarding similar hearing in both ears, 44% answered that hearing was similar

Conclusion: The best results in speech perception skills were in patients with contralateral residual hearing who used hearing aids consistently before CI2. All the patients said that they felt subjectively better in the BICI condition. The delayed sequential CI, in youth and young adults that were implanted at an early stage, provides an additional benefit in the general performance.
**Title:** Pediatric Cochlear Implant Device Usage: How Much Is Enough?  
**Category:** Surgery/Medical  
**Authors:** Christine L. Brown, AuD, Jillian B. Roberts, BHS, Stephanie R. Yaras, AuD, Jourdan T. Holder, AuD, Kelley C. Corcoran, AuD, René H. Gifford, AuD; Vanderbilt Bill Wilkerson Ctr., Nashville, TN.

**Abstract:**

**Introduction:** Significant variability exists in post-operative speech perception ability and speech and language outcomes for pediatric cochlear implant recipients. Poor post-operative device usage is one factor that has been reported to be associated with poorer post-operative outcomes. The introduction of datalogging technology provides audiologists with the ability to objectively track post-operative device usage in pediatric cochlear implant recipients. The purpose of this study is to describe device use trends for pediatric cochlear implant recipients using information obtained via cochlear implant datalogs and to assess the relationship between recorded device usage and post-operative outcomes.

**Methods:** Data were obtained from a retrospective review of medical records and cochlear implant programming software for 416 pediatric patients under the age of 18 implanted at a tertiary academic referral center. Inclusion criteria included: 1) bilateral sensorineural hearing loss with a pure tone average (PTA) of greater than 70 dB HL in both ears, 2) English as the child’s primary language, and 3) speech perception scores and/or language assessment scores available in the child’s medical record. Exclusion criteria included: 1) use of processors or settings that do not allow for the ability to access datalogging information, 2) cochlear nerve deficiency 3) auditory neuropathy spectrum disorder and/or 4) other significant comorbidities expected to affect cognitive function, development, and/or the ability to learn. Demographic information, parental and patient report of device usage, datalogging information, aided speech perception scores, and pre-and post-operative scores on formal assessments of receptive and expressive language will be assessed.

**Results:** Data will be analyzed to determine average device usage by chronological age and age at time of implantation of the child’s first cochlear implant. Datalog information at 1 month, 3 months, 6 months, and 1 year will be assessed to evaluate the impact of post-activation cochlear implant experience on the trajectory of post-operative device usage over the first year post-activation. Post-operative aided speech perception scores and/or outcomes on formal assessments of receptive and expressive language will be analyzed to assess the relationship of device usage to post-operative outcomes.

**Conclusion:** These data will provide clinicians with age-specific targets for post-operative cochlear implant device usage for maximizing auditory and language outcomes. Further analyses may help to identify a minimum threshold for device usage that should be achieved in order to optimize post-operative outcomes for pediatric cochlear implant recipients.
**Poster Number**: 15  
**Abstract ID**: 278  
**Title**: Music Perception and Speech-in-Noise Skills of Listeners with Typical Hearing or Cochlear Implants  
**Category**: Audiology  
**Authors**: Hannah Calhoun, BS, Stephanie Fowler, BA, Andrea Warner-Czyz, PhD; Audiology, The Univ. of Texas at Dallas, Dallas, TX.  
**Abstract**:  
**INTRODUCTION** Music perception and speech recognition in noise represent the most difficult listening situations for cochlear implant (CI) users. Music perception relies on similar spectral, temporal, and intensity cues needed for speech recognition in noise, but no studies to date directly measure this relationship in CI users. The present study investigates (a) the effect of auditory status (typical hearing vs. CI) on music perception (pitch, timbre, and melody); and (b) the relationship among demographic characteristics (e.g., age, gender), audiologic characteristics (e.g. duration of deafness), music engagement, music perception, and speech-in-noise scores.  
**METHODS** Participants include 10 adults with typical hearing and 10 adults with CI. Most CI users had postlingual deafness (n = 7) and used binaural device configurations (n = 6). Duration of CI experience ranged from 1-23 years (M = 11.7 years). All participants completed pure-tone audiometry, speech recognition in noise (Bamford-Kowal-Bench Sentences in Noise, BKB-SIN) at 70 dB HL, and music perception testing at 65 dBA in a sound booth. Music perception testing included the pitch direction, timbre, familiar melody subtests of the Clinical Assessment of Music Perception for Cochlear Implants (CAMP) test; and the unfamiliar melody subtest of the Profile of Music Perception Skills (PROMS). Participants also answered online questionnaires about demographic and audiologic characteristics, musical training, and music engagement. We conducted multivariate analyses of variance to assess effects of auditory status on music perception scores. We used Spearman correlational analyses to assess the relationship among demographic characteristics, audiologic variables, music perception, speech recognition in noise, and music engagement.  
**RESULTS** CI users exhibit poorer music perception than hearing peers across all domains. Compared to adults with typical hearing, adult CI users required 2.6 times the number of semitones to detect changes in pitch direction, and scored lower on timbre (46.7% vs. 81.3%) and familiar melody tasks (27.2% vs. 70.8%). A positive relationship exists between music perception and musical training in TH subjects, but no relationship exists in CI users. A moderately strong positive relationship emerged between music perception on all subtests and speech recognition scores in noise for the CI group.  
**CONCLUSIONS** Adult CI users show poorer music perception skills than TH adults. Better music perception abilities coincide with better speech recognition in noise in CI recipients. Music perception and enjoyment positively relate to interpersonal communication and well-being in hearing adults, suggesting that audiologists working with adult CI users should query patients about music engagement to meet patient needs beyond traditional measures of communication.
Title: Assessing Acute Listening Fatigue and Its Effects on Speech Recognition for a Deaf and Hard-of-Hearing Adult

Category: Audiology

Authors:
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Abstract:
Introduction: Listening fatigue is a common complaint of children and adults who are deaf or hard-of-hearing. Compared to listeners with normal hearing, deaf and hard-of-hearing individuals often use additional skills and strategies to process what is being said. As a consequence of using such strategies and additional effort, many individuals report feeling exhausted at the end of the day or after extended periods of intense listening. The purpose of this study was to evaluate whether acute listening fatigue is related to a change in speech recognition ability throughout a day. This was examined through weekly testing at both the beginning (AM) and at the end (PM) of the day. Additionally, the relation between acute listening fatigue and various listening environments encountered during a day will be examined.

Methods: One young adult with sensorineural hearing loss utilizing bimodal listening devices (left hearing aid and right cochlear implant) participated. Testing was conducted one day a week for twelve consecutive weeks. Data logging from both devices was gathered for the 6-day period prior to testing and separately on the test day to document listening environments and hours of device use. At both the AM and PM test sessions, the participant was administered the following speech recognition tests: monosyllabic word lists, sentences in multi-talker babble noise, and an adaptive-level sentence test in spatially-complex noise. All word lists and sentence lists were randomized across the 12-week AM and PM sessions. Immediately after each test session, the participant self-rated 1) acute listening fatigue (i.e., fatigue, at that time), 2) general physical fatigue, and 3) listening effort. Additionally, prior to and immediately after the 12-week testing period, questionnaires assessing overall qualities of hearing, chronic listening fatigue, general physical fatigue, and listening effort were administered. Descriptive statistics and correlation analyses will be reported. In particular, correlations between self-reported acute fatigue, change in speech recognition performance (AM-PM scores), and data-logging attributes will be calculated.

Results: To be reported upon completion of data collection.

Conclusion: The information obtained in the study may help otolaryngologists, audiologists, deaf educators, teachers, and families understand why deaf and hard-of-hearing individuals have difficulty focusing on and understanding speech when they are fatigued. The results of this study may persuade individuals with hearing loss to adopt strategies that might lessen fatigue and/or inspire development of new adaptive strategies or signal processing that could lessen fatigue or the effects that fatigue has on speech recognition performance.
Poster Number: 17
Abstract ID: 410
Title: Developing a Clinical Protocol for Providing Adult Aural Rehabilitation for Cochlear Implant Recipients
Category: Audiology
Authors:
Laura Campos, AuD 1, Jocelyn Mellen, MS 2, Shannon Elam, AuD 1, Paul Hynes, AA 1, Krista Iannuzzi, AuD 1, Jennifer Mock, AuD 1, Darcy Strong, AuD 1, Alexandra O’Dell, AuD 1, Melinda Anderson, PhD 3; 1Hearing and Balance Clinic, UCHlth. Univ. of Colorado Hosp., Aurora, CO, 2Rehabilitation, UCHlth. Univ. of Colorado Hosp., Aurora, CO, 3Otolaryngology, Univ. of Colorado Sch. of Med., Aurora, CO.
Abstract:
Introduction: In order to achieve maximum success with a cochlear implant, adult recipients must develop necessary listening and speech perception skills. Clinical audiologists are often well suited to providing support on this skill development, but also have competing responsibilities including device mapping, assessment, and device instruction. By developing a multi-disciplinary approach, clinicians are better able to focus on their areas of expertise while providing patients with the highest level of evidence based care. The focus of this presentation is to describe our center’s approach to the development of a multi-disciplinary clinical protocol for providing aural rehabilitation services to our adult cochlear implant recipients.
Methods: As a busy academic medical center, our team has focused on improving clinical protocols using evidence-based practice. Recent advances in the literature indicate that providing targeted aural rehabilitation to adult cochlear implant recipients may improve outcomes, both in terms of sound and speech perception, as well as on measures of perceived benefit and satisfaction with their implants. Using the evidence base, along with the team’s many years of clinical expertise, we developed a clinical protocol for providing additional aural rehabilitation services with a speech-language pathologist for our newly implanted adults. Our program was modeled after our robust pediatric auditory-verbal therapy program. The revised adult protocol has been in effect since January 2018.
Results: Our protocol will be described, including relevant literature, visit timelines, and services provided within each visit. We will review scheduling considerations, team development and collaboration, and individual patient factors. The team’s process for communicating patient information and needs will be described. Results of our program to-date will be discussed in terms of patient outcomes using measures of benefit, satisfaction, and speech perception. We will also discuss clinical considerations (both logistical and practical) and barriers to service provision. Limitations of the protocol will be reviewed.
Conclusion: The development of a multi-disciplinary adult aural rehabilitation program has been successful from both provider and patient viewpoints. While the development of such a protocol and program may present challenges in some settings, the results of our program indicate that patients derive benefit and providers are able to more definitively address patient concerns.
Title: Clinical Considerations in Pediatric Cochlear Implantation for Single-Sided Deafness

Category: Audiology


Abstract:

Introduction: Several studies have demonstrated the suitability of the cochlear implant (CI) for hearing rehabilitation in adults with single sided deafness (SSD). Though a growing number of children with SSD are receiving CI, few studies have been published on the subject of CI for SSD in pediatrics. Lacking evidence in this area may lead to clinical challenges in determining candidacy and evaluating outcomes in this population. The goal of this study is to evaluate our center’s experience with candidacy determination, outcome measurement, and patient/family satisfaction with CI in pediatric SSD patients.

Methods: Chart review was used to identify pediatric patients with a diagnosis of unilateral hearing loss (HL) who were evaluated for a CI within the last 12 months. Potential predictive variables were evaluated, including age at CI, onset, severity and progression of HL, prior amplification use, etiology, other comorbid diagnoses, speech perception outcomes, patient/family motivation and subjective impression of listening experience with CI.

Results: Four patients were identified, ranging in age from 9 m.o. to 9 y.o. at time of activation. One patient was identified who did not receive a CI due to insurance denial. This small sample had variable hearing histories and experiences with amplification prior to CI. In general, most patients had severe-profound unilateral HL at time of implantation and etiologies which put them at risk for progression in the contralateral ear; the oldest subject had progressive mild sloping to severe HL and received an EAS CI. In younger subjects who were assessed during the critical period for language development, candidacy was determined largely by parental motivation and functional demonstration of lack of benefit from amplification (aided sound awareness testing with the contralateral ear plugged or masked). Older subjects were assessed using aided speech perception testing in quiet and in noise with speech presented from variable locations, and with the contralateral ear either masked or plugged. Postoperative performance measurement has also been variable and affected by age, development, and spoken language development. Generally, subjective impressions of the CI from parents have been positive. In younger children, area of greatest improvement includes sound awareness. Older patients were able to report general satisfaction and subjective benefit with full time use of their CI. One subject has discontinued use of the CI and returned to use of his BAHA due to lack of noticeable benefit and issues with CI programming.

Conclusion: Evaluating candidacy and postoperative performance with CI in pediatric patients with SSD presents with unique challenges due to limited language in younger children and limitations on a child’s ability to self-report. Identifying variables that may predict outcomes with CI in this population, as well as developing standardized methods for assessing the implanted ear, will help to improve determining candidacy and successful outcomes for these patients.
**Title:** Comparison of Evaluation Criteria for Rehabilitation Effect in Children After Cochlear Implantation and Impact of Age and Gender on the Evaluation Criteria

**Category:** Audiology

**Authors:**
Fang Chen, MM 1, Fang X. M. H. Chen, MM 2; 1Shanghai children’s hospital, Shanghai Jiaotong Univ., Shanghai, China, China, 2Otorhinolaryngology and Head & Neck Surgery, Shanghai children’s hospital, Shanghai Jiaotong Univ., Shanghai, China, China.

**Abstract:**

Introduction: To compare four evaluation criteria for rehabilitation effect in children after cochlear implantation (CI) and explore the influencing factors of the evaluation criteria.

Methods: A total of 100 child patients with Freedom cochlear implants in this study were enrolled and randomized into four groups according to different evaluation criteria, group A for standard testing program and vocabulary tables for assessment of hearing, language and learning abilities for hearing-impaired children, group B for modified version of the Categories of Auditory Performance (CAP-II) rating scale, group C for the Parent Version of the Speech, Spatial, and Qualities of Hearing Scale (SSQ-P) and group D for Speech Intelligibility Rating (SIR). Each group contained 25 cases. The evaluating levels or scores of the four evaluation criteria before and at 1, 3, 6, 12, 18, and 24 months after CI were recorded. Pre- and post-operative auditory and speech ability and learning ability of the child patients were compared.

Results: The evaluating levels or scores of the four evaluation criteria at 12, 18, and 24 months after CI were significantly higher than those before CI, and the differences were statistically significant (all P<0.05). The levels or scores of the four criteria were gradually increased with the extension of rehabilitation time, and the younger the age, the faster the increase in level and score of SIR. The levels and scores of CAP and SIR in child patients, regardless of male and female, were increased significantly after CI. As to CAP, gradual increase in speed of improvement was shown from 1 to 12 months after CI, and the slowdown was shown from 12 to 24 months. While in term of SIR, the gradual increase in speed of improvement presented from 1 to 18 months after CI, and the slowdown presented from 18 to 24 months. There was no significant gender difference in CAP and SIR. Both the levels and scores of SSQ-P and SIR increased gradually with the extension of rehabilitation time. In both SSQ-P and SIR, fastest increase in speed of improvement presented from 3 to 18 months after CI, but the slowdown presented after 18 months. Moreover, the younger the age, the faster the speed of improvement in hearing.

Conclusion: The postoperative auditory performance, speech behavior and verbal intelligibility of child patients after CI were improved, while no significant gender difference was shown, and the younger the age, the faster the recovery in hearing.
Poster Number: 20
Abstract ID: 252
Title: Cochlear Implantation in a Child with Charcot-Marie-Tooth Syndrome: Audiological and Surgical Considerations
Category: Audiology
Authors:
Mark Chung, M Aud (Hons), Sherif Khalil, MBChB, MS, FRCS(Otolaryngology), MD, FRCS(ORL-HNS); Auditory Implants, Royal Natl. Throat Nose & Ear Hosp., London, United Kingdom.
Abstract:
Introduction: Cochlear Implantation in children with Charcot-Marie-Tooth disease has yet to be reported in the literature. A few adult case studies exist, but to our knowledge, there has been no report of implantation in the paediatric population. This poster highlights some of the challenges and considerations our multidisciplinary team took into account when a 13 year old boy with CMT was referred to our centre for assessment for cochlear implantation.
Methods: This is a case review which highlights the steps and special considerations the cochlear implant team took with the patient in assessing whether or not they were suitable for cochlear implantation. The team involved included Audiology, Speech Therapy, Psychology, Teachers of the Deaf and ENT consultants.
Results: After due consideration, bilateral cochlear implantation was recommended. The patient initially went with unilateral implantation, but following the success of the first implant requested sequential implantation within 6 months of activation of the first.
Conclusion: CMT is a true peripheral neuropathy, and must therefore be treated differently to the vast majority of ANSD cases which tend to be dys-synchrony. With careful multidisciplinary team assessment, cochlear implantation appears to be a safe and viable auditory rehabilitation intervention for CMT in children.
**Title:** Post-Operative Cochlear Implant Outcomes in Congenitally Deafened Children with Single-Sided Deafness (SSD)

**Category:** Audiology

**Authors:**

**Abstract:**

**Introduction:** Cochlear implantation (CI) for SSD provides patients with access to sound in both ears and may allow for the ability to utilize binaural cues. Several studies have investigated adults who received a CI for SSD, and results consistently show improved localization, speech understanding, quality of life, and tinnitus suppression (Arndt et al. 2011; Van de Heyning et al. 2008; Punte et al. 2011). Results for children with congenital SSD have been sparse and inconsistent (Thomas et al. 2017; van Wieringen et al. 2018). The purpose of the current study was to describe patient characteristics and post-operative outcomes for children with congenital SSD implanted at a tertiary medical center.

**Methods:** A retrospective chart review was conducted to identify pediatric patients with congenital SSD who received a CI. SSD was defined as a pure tone average (PTA) in the non-implanted ear of ≤ 25 dB HL at 500 Hz, 1000 Hz, and 2000 Hz. Pediatric CI recipients with late-onset SSD or auditory neuropathy spectrum disorder were excluded. Datalogging, subjective auditory questionnaire data, and speech perception results were reviewed to evaluate post-operative outcomes in this population.

**Results:** Six patients implanted between November 2014 and September 2018 met inclusion criteria. Children (3 females and 3 males) ranged in age from 18 months to 8 years at age of implantation. Experience with the CI device ranged from 1 month to 5 years. Five patients received a Cochlear device and one received a MED-EL device. Etiologies of this population include: unknown (2), enlarged vestibular aqueduct (2), congenital cytomegalovirus (1), and Waardenburg Syndrome (1). Mean datalogging was 6.1 hours of processor use per day on average (range 4.0-12.5 hours). Subjective questionnaire data and CI only speech perception data will be described for both sound field assessment with use of an ear plug and/or masking in the non-implanted ear as compared to isolated CI stimulus delivery via direct connect. Preliminary data suggest that sound field assessment overestimates CI-only performance.

**Conclusion:** The datalogging results of the current study suggest large variability in processor use for this population. Further the average daily use found in this population was found to be lower than the 7.6 hours (range 1.5 to 15.5 hours) reported for traditional pediatric CI users by Wiseman and Warner-Czyz (2018). Assessment of speech perception in this population can be challenging and should include direct connect stimulus delivery via personal audio cable or Bluetooth. Given the small sample size (n=6), further research is needed to evaluate outcomes in this population especially in light of recent research suggesting that normal hearing in one ear may not be sufficient for typical speech and language development (Anne, Lieu, and Cohen 2017).
Title: Audiological Clinical Validation of New Original Romanian Speech Audiometry Materials for Evaluation of Communication Abilities in Children of Primary School Age

Category: Audiology

Authors: Sebastian Cozma, MD, PhD, Oana Bitere, MD, PhD, Raluca Olariu, MD, PhD, Cristian Martu, MD, PhD, Luminita Radulescu, MD, PhD; ENT, Univ. of Med. and Pharmacy "Grigore T. Popa", Iasi, Romania.

Abstract:

Introduction: Communication and speech pathology in children is determined mostly by hearing loss. The assessment of hearing and speech understanding in children has to include tone and speech audiometry according to age and psychoneural condition, especially in cases with auditory neuropathy spectrum disorders, with a rising prevalence in last years. Different speech intelligibility tests have been developed for some languages, but calibrated materials for Romanian were not clinically validated until now.

Methods: The study group included 24 children (48 ears) between 7 and 12 years, with normal otologic status (tympanometry and pure tone audiometry - PTA). The phonetically balanced words were grouped in 50 bisyllabic words lists and 20 monosyllabic words lists, everyone with 10 words. These original lists were generated using our own original algorithm. Speech perception was tested monaurally in quiet using a recorded speech audiometry material. The results of speech recognition thresholds (SRT), word recognition score (WRS) and maximum recognition threshold (MRT) were statistically analyzed.

Results: For the bisyllabic tested lists we obtained a mean PTA of 13,11 dBHL with a mean SRT of 15,83 dBSPL and a mean MRT of 31,46 dBSPL. For the monosyllabic tested lists we identified a mean PTA of 13,32 dBHL with a mean SRT of 17,50 dBSPL and a mean MRT of 37,38 dBSPL. One of the most important and relevant parameter is the word recognition score, which riches over 95% at 30 dBSPL for both types of lists, starting with 40 dBSPL is constantly over 99% for all bigger intensities for bisyllabic lists and over 98% for monosyllabic lists, suggesting that the speech recognition is a little more difficult for monosyllabic words.

Conclusion: The material we created for speech intelligibility test in children aged between 7 and 12 years is the first Romanian clinical statistically validated test, respecting the standards regarding homogeneity of the material: frequency of the words in the spoken language - communality factor; balanced frequencies spectrum representation similar with common spoken language; known words corresponding to speech and cognitive specific age development, according to national preschool and primary school education curriculum.
Poster Number: 23  
Abstract ID: 443  
Title: Assessment of Auditory Rehabilitation in Children Up to 2 Years Old After the Usage of Hearing Aids  
Category: Audiology  
Authors:  
Katarzyna Cywka, MSc, Anna Sztabnicka, MSc, Justyna Kutyba, MSc, Piotr H. Skarzynski, MD, PhD, Beata Dziendziel, MSc; World Hearing Center, Inst. of Physiology and Pathology of Hearing, Warsaw, Poland.  
Abstract:  
Introduction: The aim of study is evaluation of progress of auditory rehabilitation in children up to 2 years of age after the use of hearing aids and comparison of hearing perception with children which are hearing correctly.  
Methods: The research and control groups consisted of 30 children to 2 years old. The control group included 20 children to 2 years old with the normal hearing. Polish version LittlEars questionnaire was applied.  
Results: The results of audiometric BOA test have shown improvement auditory reactions.  
Conclusion:
Title: Datalogging and Speech Perception Outcomes in Adult Cochlear Implant Patients

Category: Audiology

Authors:
Nichole Dwyer, B.S., Jourdan Holder, Au.D., René Gifford, Ph.D.; Hearing and Speech Sciences, Vanderbilt Univ., Nashville, TN.

Abstract:
Introduction: Cochlear implant (CI) programming software now allows for the assessment of processor use reported as average hours per day that an individual uses his/her processor. Patients are routinely counseled to use their devices during all waking hours to facilitate aural rehabilitation and improve listening performance; however, no studies to date have made use of datalogging systems to examine the relationship between device use and speech perception outcomes in the adult CI population. The objective of the current study was to quantify the relationship between daily processor use and speech perception outcomes for a large clinical population of adults with CIs from three manufacturers.

Methods: A retrospective review of a prospectively collected clinical database was completed. Datalogging information and Consonant-Nucleus-Consonant (CNC) word recognition data were collected from 178 adults (ages 21-88 years) to examine the correlation between average daily listening time in hours and speech recognition performance.

Results: The mean timepoint at data collection was 11.9 months post-operation (SD ± 3.2) with representation from three manufacturers. Average daily processor use was 10.43 hours (range 0-17.4). The mean CNC score was 48.4% (SD ± 21.2). Results of the Spearman correlation indicated that there was a moderate positive association between hours of processor use per day and CNC word recognition score ($r_s = .51$, $p < .001$). A regression analysis revealed that datalogging accounted for 31% of the variance in CNC word recognition data.

Conclusion: Results suggest daily processor use is significantly correlated with speech perception outcomes. This finding supports recommendations made by clinicians for processor use during all waking hours. Future research should consider datalogging in combination with other outcome variables, as preliminary data show a significant correlation with post-operative outcomes.
Poster Number: 25  
Abstract ID: 279  
Title: Family Support Community for Parents of Children with Cochlear Implants; Anytime, Anywhere  
Category: Surgery/Medical  
Authors:  
Marge Edwards, MS, LSLS Cert AVT 1, Teresa Caraway, PhD, LSLS Cert AVT 2, Wendy DeMoss, MS, LSLS Cert AVT 2; 1Hearing First, Driggs, ID, 2Hearing First, Oklahoma City, OK.  
Abstract:  
Introduction: Significant variability exists in post-operative speech perception ability and speech and language outcomes for pediatric cochlear implant recipients. Poor post-operative device usage is one factor that has been reported to be associated with poorer post-operative outcomes. The introduction of datalogging technology provides audiologists with the ability to objectively track post-operative device usage in pediatric cochlear implant recipients. The purpose of this study is to describe device use trends for pediatric cochlear implant recipients using information obtained via cochlear implant datalogs and to assess the relationship between recorded device usage and post-operative outcomes.  
Methods: Data were obtained from a retrospective review of medical records and cochlear implant programming software for 416 pediatric patients under the age of 18 implanted at a tertiary academic referral center. Inclusion criteria included: 1) bilateral sensorineural hearing loss with a pure tone average (PTA) of greater than 70 dB HL in both ears, 2) English as the child’s primary language, and 3) speech perception scores and/or language assessment scores available in the child’s medical record. Exclusion criteria included: 1) use of processors or settings that do not allow for the ability to access datalogging information, 2) cochlear nerve deficiency 3) auditory neuropathy spectrum disorder and/or 4) other significant comorbidities expected to affect cognitive function, development, and/or the ability to learn. Demographic information, parental and patient report of device usage, datalogging information, aided speech perception scores, and pre-and post-operative scores on formal assessments of receptive and expressive language will be assessed.  
Results: Data will be analyzed to determine average device usage by chronological age and age at time of implantation of the child’s first cochlear implant. Datalog information at 1 month, 3 months, 6 months, and 1 year will be assessed to evaluate the impact of post-activation cochlear implant experience on the trajectory of post-operative device usage over the first year post-activation. Post-operative aided speech perception scores and/or outcomes on formal assessments of receptive and expressive language will be analyzed to assess the relationship of device usage to post-operative outcomes.  
Conclusion: These data will provide clinicians with age-specific targets for post-operative cochlear implant device usage for maximizing auditory and language outcomes. Further analyses may help to identify a minimum threshold for device usage that should be achieved in order to optimize post-operative outcomes for pediatric cochlear implant recipients.
Title: Non Use In Late Implanted Pediatric Second Side Cochlear Implant Recipients

Category: Surgery/Medical

Authors:
Sybil Faylo, AuD, Shelly Dolan-Ash, MSc Aud; Audiology/Infant Hearing, Johns Hopkins All Children's Hosp., St. Petersburg, FL.

Abstract:

Introduction: It is well established that early implantation provides improved outcomes for cochlear implant recipients. Literature shows that the critical period for children to achieve adequate speech perception with their implant is prior to adolescence. Until 2013, Florida Medicaid only provided funding for one implant system, thus delaying the sequential surgeries for children by several years.

Methods: Records review and questionnaire to be completed for 5 children who received second side cochlear implants between 6 to 9 years after the first, all of whom were initially implanted at or under three years of age. The objective is to determine if a predictive pattern exists related to speech perception scores, isolation of the second side implant, and any other contributing factors to their non-use.

Results: To be discussed on poster.

Conclusion: Information gathered by this investigation will contribute to counseling regarding expectations of patients seeking second side implant in their adolescent or pre-teen years.
Title: Music-Related Quality of Life and Generic Quality of Life in Adolescents with Cochlear Implants

Category: Audiology

Authors:
Stephanie L. Fowler, B.A. 1, Anthony Tolisano, M.D. 2, Jacob Hunter, M.D. 2, Andrea Warner-Czyz, PhD 1;
1Audiology, The Univ. of Texas at Dallas, Dallas, TX, 2Otolaryngology, UT Southwestern Med. Ctr., Dallas, TX.

Abstract:
Introduction: Adolescents with cochlear implants (CIs) often achieve age-appropriate language, speech, and literacy skills with early intervention and consistent device use. Despite these achievements, adolescent CI users remain at-risk for increased depression, peer victimization, social problems, yielding lower health-related quality of life (QoL). To date, few studies have related the important adolescent behavior of music listening to the development of positive QoL. Research suggests that music plays an important role in Western culture. Americans aged 13 years and older listen to music for an average of 32.1 hours per week. Further, 69% of adults consider music an important factor in their life. Because of the ubiquitous and primarily auditory nature of music, it is important to understand if and how adolescents with hearing loss (HL) differ in music engagement (i.e., attitudes and behaviors towards music listening) from their peers without HL. This exploratory study examines the effect of auditory status (CI vs. typical hearing) on music engagement, music-related quality of life, and generic quality of life in adolescents.

Methods: Adolescents (13-17 years old) with CIs (n=20) with TH (n=10) participated in an online survey consisting of three sections: (a) demographic characteristics (e.g., age, gender, auditory status, music listening habits); (b) Music-Related Quality of Life (MuRQoL) questionnaire, a 36-item questionnaire assessing confidence in and importance of music-related activities; and (c) Short Form Health Survey (SF-36), a generic quality of life measure assessing physical, emotional, and social impact of health on activities of daily living.

Results: Data collection is ongoing. Preliminary data suggest that adolescents with TH engage with music more frequently than adolescents with CIs, but both groups rate music as equally important. The frequency of music engagement corresponds to social well-being regardless of auditory status. Ratings of the importance of music engagement relates to overall emotional well-being in both groups of adolescents.

Conclusion: Music engagement is a typical behavior for adolescents to relate to peers, manage stressors, and process difficult emotions. Potential differences in music engagement may underlie differences in peer social relationships and emotional well-being. Understanding these relationships will enhance our ability to drive future research for maximizing music engagement to match patterns in peers with TH. This, in turn, may guide counseling and therapeutic intervention to enhance not only communication skills, but also music perception and quality of life in adolescent CI users.
Title: Hearing Preservation with a Slim Perimodiolar Electrode for Electro-Acoustic Stimulation

Category: Audiology

Authors:
David R. Friedmann, MD, Emily R. Spitzer, AuD, Susan B. Waltzman, PhD, J. Thomas Roland, Jr., MD; Otolaryngology, Head and Neck Surgery, NYU Langone Health, New York, NY.

Abstract:

Introduction: Outcomes in patients who utilize electro-acoustic stimulation (EAS) have made hearing preservation (HP) a priority. An ideal array would preserve residual hearing while providing adequate electric stimulation to improve speech perception if progression of hearing loss occurs. We sought to understand if a slim perimodiolar electrode could fulfill these goals.

Methods: Charts were reviewed retrospectively for children and adults with acoustic hearing pre-operatively (low frequency pure-tone average (LF-PTA) of 250Hz and 500Hz thresholds ≤65 dB) were implanted with a slim-perimodiolar electrode to determine levels of HP at 3 months and 1 year post-op and speech perception scores.

Results: Of 47 patients, mean pre-operative LF-PTA was 44.79 dB; At 3 months post-operatively, 47%(n=21) had a LF-PTA of ≤80 dB, 36%(n=16) had LF-PTAs >80 dB but measurable; the remainder 22%(n=10) had no measurable hearing. Of 27 patients with data at 1 year, 37%(n=10) maintained a LF-PTA ≤80 dB, 22%(n=6) had LF-PTAs >80 dB but measurable; the remainder 41%(n=11) had no measurable hearing. Significant improvements in speech perception were achieved regardless of HP. Better outcomes were seen for children and patients with lower LF-PTAs pre-operatively. Furthermore, 34% (n=16) of patients use EAS with acoustic component or higher electric cutoffs.

Conclusion: HP is possible using a slim perimodiolar electrode and for patients with significant preoperative hearing, results are similar to electrodes designed for hearing preservation. Good speech perception outcomes are achievable even if residual hearing is lost, obviating the need for re-implantation.
Title: The Impact of Rate Change on Complex Mapping Cases

Category: Audiology

Authors:
Erika Gagnon, AuD The Univ. of North Carolina at Chapel Hill, Chapel Hill, NC.

Abstract:

Introduction: Audiometric data, speech perception, and speech and language assessments are vital measures used to document progress with spoken language development in pediatric recipients using a cochlear implant. If a child is not making expected progress with their cochlear implant technology, complex mapping changes may be required. Case studies of three children will be outlined, each of which decreasing stimulation rate yielded improved speech and language outcomes.

Methods: Retrospective chart reviews of three children with unilateral or bilateral cochlear implants will be presented. Each child has been implanted with the same cochlear implant manufacturer, and has a unique etiology: meningitis, ANSD and unknown progressive sensorineural hearing loss. Map parameters, datalogging, audiometric data, speech perception and language scores will be presented pre- and post-change to stimulation rate.

Results: Each child utilizes the same external cochlear implant technology and was initially mapped with a standard default stimulation rate of 900 Hz, or increased rate of 1200 Hz. Detection audiograms yielded access to sound between 20-30 dB HL from 250-6000 Hz for each. With these settings, limited progress was seen in speech and language development, along with speech perception measures, despite consistent therapy and full-time device use. Due to these unexpected outcomes, mapping parameters were altered, specifically decreasing stimulation rate from 900 Hz to 500 Hz, or 1200 Hz to 500 Hz, with acute change in speech and language progress and/or acute improvement in speech perception measures recorded for each child.

Conclusion: Standard default map parameters provide a starting point for initial mapping. However, when a child is not making appropriate progress despite consistent wear time and therapy, alterations to map parameters may yield improved results. Mapping children with limited language, or ability to provide feedback, requires the audiologist to use their clinical judgement and expertise to further optimize the child’s map. Manipulations made to stimulation rate can yield improved performance in a variety of cases and etiologies.
**Poster Number:** 30  
**Abstract ID:** 38  
**Title:** Pediatric Wear Time and First Year Language Outcomes with Cochlear Implant  
**Category:** Audiology  
**Authors:**  
Erika Gagnon, AuD, Lisa Park, Au.D., Kevin D. Brown, MD, PhD;The Univ. of North Carolina at Chapel Hill, Chapel Hill, NC.  
**Abstract:**  
**Introduction:** Datalogging, the process of tracking a patient’s technology wear time, has become a vital tool in patient counseling, and aids with early device retention. Pediatric clinicians counsel on the importance of full-time device use and parents spend significant time experimenting with retention options to help their child increase the use of their technology. While our center has focused its attention on pediatric cochlear implant wear time, we have yet to quantify the relationship between wear time and early language development. The objective of this study is to compare pediatric cochlear implant device wear time over the first year of implantation with changes in receptive and expressive language scores.  
**Methods:** A retrospective chart review was performed for pediatric cochlear implant recipients who had external speech processors capable of datalogging and speech and language scores at pre-implant and one year post activation. There were 24 children who met this criteria. Age at pre-operative language assessment ranged from 6 months to 5 years. Datalogging measures were obtained across multiple visits during the first year of cochlear implant use during routine mapping visits. These measures were used to calculate a total wear time over the first year. Post-operative scores for receptive and expressive language were subtracted from their respective pre-operative scores, resulting in receptive and expressive language change scores. These change scores were analyzed in relationship to total wear time via regression analysis.  
**Results:** Results reveal a wide range of wear time across ages, with a variety of language growth and regression seen in the first year of cochlear implant use. Device wear time was positively correlated to increases in receptive language. No correlation was noted between cochlear implant wear time and expressive language scores.  
**Conclusion:** Increased cochlear implant wear time yields improved receptive language outcomes in the first year of cochlear implant use. In the pediatric population early device retention can be difficult, frequently parents must explore multiple retention options to find what best suits their child. This time period can be frustrating, but persistence from parents and clinicians is vital to optimize pediatric spoken language development. Further research is needed to better understand the relationship between long-term device use and spoken language development, specifically in terms of expressive language development.
Introduction: This study asks whether the LittlEARS Auditory Questionnaire, a caregiver measure, can differentiate between children with bilateral hearing aids and children with bilateral cochlear implants. Previous literature has shown that the LittlEARS is sensitive to auditory developmental delays but it has not been previously used to distinguish these populations.

Methods: LittlEARS results were collected retrospectively from 43 children with cochlear implants and 43 children with hearing aids. Between one and seven LittlEARS (Mdn=2, IQR=2) were completed over clinical audiology appointments in the first 10 months (IQR=9.5) of early intervention. The children with cochlear implants (14 months, SD=8) were significantly younger than the children with hearing aids (24 months, SD=18) at first presentation of the LittlEARS (t(51.56)= -2.99, p=.004). On average, children with cochlear implants received their hearing devices eight months later than children with hearing aids and they often had their first LittlEARS before implantation. The longitudinal LittlEARS outcomes for children with cochlear implants were compared to those with hearing aids to identify any relationship the scores might have with age and hearing experience using a linear mixed effects model. A logistic regression was conducted to investigate differences in pattern of responses on individual questions.

Results: Children with cochlear implants performed more poorly than children with hearing aids on their first LittlEARS (β0= -4.33±1.56, t=-2.77; β3=12.52±2.44, t=5.12). However, they appeared to progress more quickly, reaching the ceiling of the LittlEARS before children with hearing aids (β1=1.32±.12, t=11.46; β5= -.52±.17, t=-3.08). Response patterns across individual LittlEARS questions were more linear for the cochlear implant group than the hearing aid group. Additionally, developmental delay negatively influenced LittlEARS growth in both groups (β4= -.58±.19, t=-3.11).

Conclusion: Children with cochlear implants and hearing aids begin at different points on the LittlEARS but also progress at different trajectories. Both groups, however, reach the assessment’s ceiling before two years of hearing experience, as expected. Developmental delays further slowed auditory development in both groups. Future work should investigate the effects of progressive hearing loss, age at intervention, and access to residual hearing on LittlEARS outcomes.
Title: Children with Single Sided Deafness Consistently Wear Their Cochlear Implants

Abstract:

Introduction: This study aims to assess the acceptance of cochlear implantation by children with single sided deafness over time. Patients with single sided deafness are at risk for reduced cochlear implant use because they have good access to sound in their contralateral ear and may find it challenging to integrate this hearing with the electrical input from the cochlear implant. Monitoring cochlear implant use can provide insight into patient acceptance of the device. Parent and patient report of cochlear implant use, however, can be unreliable. Instead, this study uses cochlear implant datalogging technology to monitor how long and in what environments children with single sided deafness used their cochlear implants.

Methods: Datalogs were extracted from the cochlear implants of 23 children with single sided deafness. On average, they had a four frequency pure-tone-average of 88.9 dB (SD=12.69) in their implanted ear and 16.44 dB (SD=9.06) in the better ear. On average, the children were implanted at 5.65 years old (SD=4.78, range: 1.13 to 15.92 years) and were 6.25 years old (SD=4.85) when the first datalog was extracted. Between one and eight datalogs were collected for each participant (M=3.74, SD=1.79). Linear mixed effects regressions were used to analyze the relationship between age, hearing experience, cochlear implant use, and coil-offs per day. Nonlinear regressions were conducted to evaluate cochlear implant use in different environments.

Results: Children with single sided deafness wore their cochlear implants for an average of 6.22 hours a day (SD=2.81). There was no change in use as the children aged ($\chi^2(1)=.49$, p=.48) nor as they gained hearing experience ($\chi^2(1)=.5$, p=.48). Datalogging also indicated that younger children were in less ‘Speech-in-Noise’ than older children but that preschoolers were in more ‘Music’ and ‘Speech’ and less ‘Noise’ and ‘Quiet’ than older and younger children.

Conclusion: This is the largest known longitudinal study of cochlear implant use in children with single sided deafness using cochlear implant datalogging software. Longitudinally, children with single sided deafness are consistently wearing their devices. They are also using them in auditory environments similar to their bilaterally implanted peers. Consistent device use may reflect the perceived benefit children with single sided deafness receive from cochlear implantation.
**Poster Number:** 33  
**Abstract ID:** 256  
**Title:** Evoked Stapedial Reflex Threshold Measures in Pediatric Patients with Diagnosis of Enlarged Vestibular Aqueduct  
**Category:** Audiology  
**Authors:** Susan Gibbons, AuD, Amanda Griffin, PhD, Ashleigh Lewkowitz, AuD, Rebekah Tozer, AuD, Jennifer Harris, AuD, Elizabeth Erickson-O’Neill, AuD; Boston Children’s Hosp., Waltham, MA.  
**Abstract:**  
**Introduction:** Optimal cochlear implant programming often requires a patient to perform psychophysical loudness scaling measures of upper stimulation levels, however, these psychophysical measures are challenging (or impossible) for many patients and are not always accurate. Evoked stapedial reflex thresholds (ESRTs) are an objective measure shown to be highly correlated with optimal upper stimulation levels for optimal cochlear implant (CI) programming. Clinically, this reflex is observed as a change in the static admittance, or the amount of energy absorbed by the middle ear system; more specifically, the contraction of the stapedius muscle, measured in response to electrical stimulation through the CI. In the literature, this change in static admittance is a direct result of electrical stimulation from the CI. While ESRTs can be measured in many CI users, it is currently estimated that ESRTs cannot be elicited in approximately 20-30% of all CI patients (Hodges et al., 1997; Spivak & Chute, 1994; Van Den Abbeele et al., 2012). Enlarged vestibular aqueduct (EVA) is present in approximately 5-15% of the pediatric population with sensorineural hearing loss and is characterized by enlargement of the bony canal that connects the inner ear to deep inside the skull. EVA has many causes, not all of which are fully understood; however, the most common cause of EVA is mutation in the SLC26A4 gene. EVA often results in a progressive hearing loss, frequently resulting in cochlear implantation for these patients. This study examines the observation in our clinic that for pediatric CI patients with EVA, measurement of ESRTs often produces a change in middle ear compliance that rings out (continues or persists) following cessation of electrical stimulation from the CI, even to the point of several minutes beyond CI stimulation. To date, there is no available research that investigates this phenomenon in the EVA population.  
**Methods:** This study examines ESRT findings in pediatric patients with EVA. Retrospective analysis of patient demographics, as well as ESRT equipment, parameters, and measurements, was conducted in our population of cochlear implanted children with EVA. These findings are compared with age-matched controls without a diagnosis of EVA.  
**Results:** Preliminary results indicate that this finding is specific only to patients with a diagnosis of EVA. Four patients, ranging from ages 6 to 13, have thus far been observed to have these prolonged changes in middle ear compliance observed in immittance measures following CI stimulation. Patients have both bilateral and unilateral cochlear implants, from two different manufacturers. Findings have been present for both ipsilateral and contralateral ESRT measures.  
**Conclusion:** To date, this study is the first to present findings of ESRT measures that appear to only be related to the cochlear implant population with a diagnosis of EVA. It remains unclear if this finding is related to an anatomical anomaly with EVA, and if there is a diagnostic value to these findings. Ideas for future study of this clinical finding are proposed.
Title: Bimodal to Sequential Bilateral - Deciding When and Why

Category: Audiology

Authors:
Janet Green, AuD, Nicholas Deep, MD, William Shapiro, AuD, J. Thomas Roland, MD, Susan Waltzman, PhD; NYU Cochlear Implant Ctr., New York, NY.

Abstract:

Introduction: The benefits of binaural hearing, localization and improved speech perception in background noise, are the primary reasons pediatric patients with asymmetric hearing loss use a hearing aid in the non-implanted ear. While some continue to use a hearing aid others choose to receive a second implant. The purpose of this study was to determine the factors which influence the parental and recipient decision to discontinue hearing aid use and seek a second implant.

Methods: 32 children were implanted sequentially between the ages of 3 and 14. The average PTA of CI1 at time of surgery was 76.5dB, and the PTA of the contralateral ear was 69.7dB. All subjects wore appropriately fit amplification in the non-implanted ear. The length of time between CI1 and CI2 ranged from 8m to 10y, 11m. The average PTA at time of CI2 was 81.0dB. Twenty five subjects were implanted with the Nucleus device and seven with the Advanced Bionics device. The pre-operative, three-month and one-year post-implant evaluations consisted of age appropriate open-set word recognition measures.

Results: All patients had full insertion of the electrode arrays with no postoperative complications and are full-time users of their bilateral cochlear implants. Eleven of the 32 subjects had measurable speech perception scores prior to CI1. The average speech perception score for this group of 11 subjects was 11.5% in CI1 and 37.4% in CI2. All other subjects were too young at the time of CI1 to perform open-set word recognition tasks. For all 32 subjects at the time of CI2, the average word recognition score was 12% with a range of 0-68%. CI1 word recognition as measured at the evaluation prior to CI2 was on average 74% with a range of 44-100%. At three months post CI2, word recognition was 54.75% with a range of 50-100%. At the one-year evaluation interval the average word recognition score for CI2 was 66.92% with a range of 56-100%. When considering a second implant, while the primary reasons for requesting a second implant provided by parents and recipients were a decrease in perceived hearing benefit and speech understanding with the hearing aid, other factors including listening effort, school issues and fatigue played a role in the decision making process.

Conclusion: It is common practice for children with asymmetric hearing loss to maintain the use of amplification on the non-implanted ear. A question parents often ask is when to consider a second implant. While a decrease in perceived and real benefit is a primary motivating factor, other issues play a significant role in the decision making process.
Poster Number: 35  
Abstract ID: 291  
Title: Measures of Hearing and Vestibular Function Pre- and Post-Cochlear Implantation in a Pediatric Case of Unilateral Acquired Hearing Loss  
Category: Audiology  
Authors:  
Amanda M. Griffin, AuD, PhD 1, Guangwei Zhou, ScD 1, Elizabeth E. O'Neill, AuD 1, Greg Licameli, MD 2;  
1Otolaryngology and Communication Enhancement, Boston Children's Hosp., Boston, MA,  
2Otolaryngology, Boston Children's Hosp., Boston, MA.  
Abstract:  
Introduction: Binaural hearing is essential for effective communication. Lack of binaural hearing can negatively affect one’s ability to understand speech in adverse listening environments and localize sound sources. Studies have shown that unilateral hearing loss (UHL) can have deleterious effects on a child’s development, putting this population at an increased risk for delayed speech and language, academic underachievement, psychosocial issues, and poor quality of life. Management approaches for children with severe-profound UHL vary widely and the current evidence base to support efficacy of any one method is weak. Although not FDA-approved, cochlear implantation (CI) for the treatment of severe-profound UHL is currently being considered at implanting institutions across the United States, given this is the only intervention capable of restoring binaural input to the auditory system. In the current case study, an 11-year-old girl presented with sudden onset of right, UHL and tinnitus. Following unsatisfactory trials with two types of re-routing devices, the patient was given the option of CI.  
Methods: Retrospective case study. Pre- and post-CI hearing evaluations included: pure-tone audiometry, word recognition in quiet, sentence recognition in the presence of a speech masker in five target-masker listening configurations and restaurant noise in four listening configurations, as well as administration of questionnaires used to assess tinnitus perception, hearing in real-world environments, and hearing-related quality of life. Measures were collected in the unaided condition, following month-long trials with two types of re-routing devices pre-CI, and then again at 1-, 3- and/or 6-months post-CI. Comprehensive vestibular evaluation was also conducted pre- and post-CI, which included videonystagmography, rotary testing, video head impulse test, vestibular evoked myogenic potential test, and computerized dynamic posturography.  
Results: Patient successfully underwent right cochlear implantation at approximately 2 years, 9 months post-hearing loss onset. Patient was followed 6 months post-CI activation. Results of pre- and post-CI hearing and vestibular measures will be discussed in detail.  
Conclusion: CI may be a valid option for some children with acquired UHL. Hearing and vestibular function should be thoroughly investigated both pre- and post-CI to ensure the best outcome and minimize the associated risks.
Poster Number: 36
Abstract ID: 208
Title: Case Studies Demonstrating the Rationale for Considering Expanding Cochlear Implant Indications and Criteria for Pediatrics
Category: Audiology
Authors:
Melissa J. W. Hall, MA, AuD, Kristin W. Letlow, AuD; UF Health, Gainesville, FL.
Abstract:
Introduction: Historically, indications and criteria for cochlear implantation in pediatric has been reserved for patients with profound sensorineural hearing loss (from 12 to 24 months), and with severe to profound sensorineural hearing loss (from 24 months to 18 years). As adult cochlear implant indications and criteria have changed and expanded, the field has observed increased benefit for recipients with increased preoperative residual hearing. Publications have demonstrated a significant body of evidence pertaining to the pediatric population and the special considerations they require due to immature maturation of their auditory systems, their uniquely complex listening environments, and of critical importance, the fact that they are in the process of developing speech and language.
Methods: Retrospective chart review of three pediatric cochlear implant recipients. We reviewed individual preoperative needs, audiological evaluation and results, educational placement and support, parental and patient motivation.
Results: We will review the three patients in detail including: company, internal device, external device, programming parameters and needs, and outcome measures. We will report on information regarding school performance, and parental questionnaire. We will compare pre-implant performance and post-implant performance.
Conclusion: Based on the three case studies and the benefit in educational performance, outcome measures, overall patient performance; we are recommending that cochlear implant programs and centers consider advocating for expanded indications and criteria for the pediatric population. In addition, each child’s specific needs should be considered in order to optimize individual performance. Also we are recommending expanded and additional evaluation based on specific patient needs.
**Poster Number:** 37  
**Abstract ID:** 332  
**Title:** X-Linked Stapes Fixation with Gusher: Does Cochlear Implantation Provide Meaningful, Sustained Access to Sound?  
**Category:** Audiology  
**Authors:** Jennifer Harris, AuD, Margaret Kenna, MD, MPH, Dennis Poe, MD, PhD; ORL/CCE, Boston Children's Hosp., Waltham, MA.  
**Abstract:**  
**Introduction:** Genetic causes account for 80% of all permanent congenital sensorineural hearing loss. X-linked stapes fixation with perilymphatic gusher (XSFG) is rare, accounting for only 1-2% of non-syndromic genetic hearing loss. In about 50% of cases, it occurs as a result of a mutation in the POU3F4 gene. It is characterized by progressive or profound mixed or sensorineural hearing loss, as well as specific inner ear anomalies. These anatomical abnormalities typically identified on CT or MRI imaging, include a wide internal auditory meatus and a fistula at the basal end of the cochlea which causes perilymphatic gusher upon mobilization of the stapes or upon making a cochleostomy. Despite the surgical challenges this diagnosis carries, particularly during cochlear implantation surgery, most studies indicate that surgeries can be successful with proper preparation and intraoperative management. Because of the unusual anatomical abnormalities and uncertainty about remaining neural fibers in the cochlea, programming a cochlear implant (CI) and optimizing benefit in these patients presents unique challenges.  
**Methods:** Retrospective chart review was conducted for all patients who had a clinical diagnosis of XSFG and received care through our center. The diagnosis was based on temporal bone imaging and/or genetic testing. At surgery, intraoperative imaging confirmed placement of the electrodes in the cochlea. We examined the following factors: degree and progression of hearing loss, age of patient at implantation, CI manufacturer, type of electrode array, surgical approach and insertion, map parameters including pulse width and programming strategy, detection levels using the CI, and speech recognition abilities.  
**Results:** The majority of study subjects (4/5) had congenital bilateral profound hearing loss, and no measurable preoperative speech recognition. After cochlear implantation, all subjects had high current requirements in their programs, and needed continual increases in current levels to retain acceptable detection thresholds. Despite receiving initial benefit using the CI, 4/5 subjects eventually received minimal benefit from their CIs, and became non-users of their devices. The fifth subject has post-operative speech recognition that continues to improve over time, and uses his device full-time.  
**Conclusion:** When a child carrying the diagnosis of XSFG is being considered for cochlear implantation, families should be counseled with caution about the possible modest degree of benefit. Alternative means of communication, such as sign language, are strongly recommended throughout the cochlear implant process, to ensure the family does not wait for lack of benefit before beginning to stimulate language. Cochlear implantation should only be explored when the child no longer receives benefit from hearing aids, as it is possible that initial benefit from cochlear implantation may not be sustainable. Finally, the underlying causes of the need for increasing power requirements warrants further exploration.
Poster Number: 38
Abstract ID: 74
Title: Intraoperative Electrocochleography: Residual Cochlear Physiology and Speech Perception
Category: Audiology
Authors:
Meghan Hiss, AuD 1, William Riggs, AuD 1, Jameson Mattingly, MD 1, Prashant Malhotra, MD 2, Aaron Moberly, MD 1, Oliver Adunka, MD 1; 1Otolaryngology - Head and Neck Surgery, The Ohio State Univ. Wexner Med. Ctr., Columbus, OH, 2Otolaryngology, Nationwide Children's Hosp., Columbus, OH.
Abstract:
Introduction: Although cochlear implantation (CI) has become standard of care treatment for individuals with severe-to-profound hearing loss who no longer benefit from hearing aids, there is still a considerable amount of variability in outcomes for this population. Previous research found that some of the variability for CI recipients, approximately 22%, can be attributed to factors such as duration of hearing loss, hearing aid use, and percentage of active electrodes (Lazard et al., 2012). Recently, studies have used electrocochleography (ECochG) for assessing residual cochlear function prior to implantation and correlating this measurement to speech perception outcomes (Fitzpatrick et al., 2014 & McClellan et al., 2014). Fitzpatrick et al. found a correlation between ECochG magnitude and consonant-nucleus-consonant (CNC) word scores for adults that accounted for 47% of the variance. As there is a wide range of materials used to assess CI performance, further research is needed to determine if ECochG measures correlate to other speech tests.
Methods: Forty-five patients (48 ears) undergoing CI surgery (age range: 1-87 years old) were prospectively enrolled and divided into two groups. Group 1 had ECochG recorded from the round window prior to electrode insertion. Group 2 had ECochG recorded through the CI electrode immediately post-insertion across four electrodes: e1, e5, e9, and e13. The total response (TR), which is the sum of the significant peaks in each spectrum to the first two harmonics to each frequency (round window: 0.25- 4 kHz; intracochlear: 0.125- 2 kHz) delivered at 100 dB SPL (group 1) or 110 dB SPL (group 2), was calculated for each group. Post-operative speech perception was assessed using AzBio sentences in quiet. Individual subject scores used for analysis were the patient's best post-operative score over a 9 month period (range: 3 months-12 months).
Results: The average TR magnitude for Group 1 was 14.57 dB relative to 1 uV. Speech perception scores revealed a poor correlation with TR. For Group 2, the average TR magnitude was maximal at the apical most electrode (35.9 dB) followed by e5 (31.4 dB), e12 (30.5 dB), and e9 (29.6 dB). There was not sufficient post-operative speech perception data available for correlation analysis for Group 2.
Conclusion: Intraoperative ECochG provides a robust means to measure residual cochlear physiology. The role of cochlear health on speech perception outcomes continues to remain an active area of research. Our results provide preliminary information on the relationship between extra-cochlear recordings and post-operative AzBio scores in quiet as well as how ECochG varies as a function of intracochlear location. Further research with a larger cohort is warranted, including future investigation of how TR and speech perception varies by intracochlear recording location.
Title: Cochlear Implantation in Postlingually Deaf Adults is Time-sensitive Towards Positive Outcome: Prediction using Advanced Machine Learning Techniques

Introduction: Given our aging society and the prevalence of age-related hearing loss that often develops during adulthood, hearing loss is a common public health issue affecting almost all older adults. Moderate-to-moderately severe hearing loss can usually be corrected with hearing aids; however, severe-to-profound hearing loss often requires a cochlear implant (CI). However, post-operative CI results vary, and the performance of the previous prediction models is limited, indicating that a new approach is needed.

Methods: For postlingually deaf adults (n=120) who received CI with full insertion, we predicted CI outcomes using a Random-Forest Regression (RFR) model and investigated the effect of preoperative factors on CI outcomes. Postoperative word recognition scores (WRS) served as the dependent variable to predict. Predictors included duration of deafness (DoD), age at CI operation (ageCI), duration of hearing-aid use (DoHA), preoperative hearing threshold and sentence recognition score. Prediction accuracy was evaluated using mean absolute error (MAE) and Pearson’s correlation coefficient r between the trueWRS and predicted WRS.

Results: The fitting using a linear model resulted in prediction of WRS with r = 0.7 and MAE = 15.6 ± 9. RFR outperformed the linear model (r = 0.96, MAE = 6.1 ± 4.7, p < 0.00001). Cross-hospital data validation showed reliable performance using RFR (r = 0.91, MAE = 9.6 ± 5.2). The contribution of DoD to prediction was the highest (MAE increase when omitted: 14.8), followed by ageCI (8.9) and DoHA (7.5). After CI, patients with DoD < 10 years presented better WRSs and smaller variations (p < 0.01) than those with longer DoD. Better WRS was also explained by younger age at CI and longer-term DoHA.

Conclusion: Machine learning demonstrated a robust prediction performance for CI outcomes in postlingually deaf adults across different institutes, providing a reference value for counseling patients considering CI. Health care providers should be aware that the patients with severe-to-profound hearing loss who cannot benefit from hearing aids need to proceed with CI as soon as possible and should continue using hearing aids until after CI operation.
Poster Number: 40
Abstract ID: 247
Title: Initial Outcomes of a Clinical Trial Investigating Expanded Indications for Cochlear Implantation
Category: Audiology
Authors:
English R. King, AuD 1, Meredith Rooth, AuD 2, Andrea Bucker, AuD 1, Sarah McCarthy, AuD 1, Shelley Anderson, AuD 1, Ellen Deres, AuD 1, Brendan O’Connell, MD 2, Matthew Dedmon, MD, PhD 2, Harold Pillsbury, MD 2, Kevin Brown, MD, PhD 2, Margaret Dillon, AuD 2; 1UNC Health Care, Department of Audiology, University of North Carolina at Chapel Hill, Chapel Hill, NC, 2Otolaryngology/Head and Neck Surgery, University of North Carolina at Chapel Hill, Chapel Hill, NC.
Abstract:
Introduction: Candidacy for cochlear implantation (CI) is currently limited to patients with poor hearing detection and speech perception in both ears. Initial investigations of CI recipients whose preoperative hearing detection or speech perception in either ear exceeded the current candidacy criteria demonstrate a significant improvement in speech perception with CI use as compared to preoperative abilities. The present report is a prospective evaluation of subjects on measures of speech perception and quality of life whose unaided hearing detection and aided speech perception in the ear-to-be implanted and/or the contralateral ear exceed current candidacy criteria.
Methods: Ten subjects enrolled and underwent cochlear implantation at our site as part of this multi-center investigation. Preoperatively, subjects presented with moderate-to-profound sensorineural hearing loss and aided word recognition between 10-60% in the ear-to-be implanted and less than 70% in the contralateral ear. The test battery included measures of speech perception in quiet and noise and quality of life at the preoperative interval and at 1, 3 and 6 months postoperatively.
Results: Subjects demonstrated a significant improvement in speech perception with CI use, for some as early as the 1-month interval. Subjects also reported an improvement in quality of life with CI use as compared to preoperative performance with appropriately fit amplification.
Conclusion: Patients who exceed the current candidacy criteria for cochlear implantation may experience a significant benefit from CI use as compared to alternative treatment options, such as conventional amplification. There is a need for critical evaluation of who may benefit from cochlear implantation to support optimal outcomes and improved quality of life. This need extends to the pediatric population who are evaluated for cochlear implantation often under stricter candidacy criteria.
Title: Assessment of Bimodal Benefit in Pediatric Cochlear Implant Recipients

Category: Audiology

Authors: Kaylene King, B.A. 1, Brendan O'Connell, M.D. 2, Margaret T. Dillon, Au.D. 2, Kevin Brown, M.D., Ph.D. 2, Lisa R. Park, Au.D. 2; 1Department of Allied Health Sciences, Univ. of North Carolina Chapel Hill, CHAPEL HILL, NC, 2Department of Otolaryngology Head and Neck Surgery, Univ. of North Carolina Chapel Hill, CHAPEL HILL, NC.

Abstract:

Introduction: As the candidacy criteria for cochlear implants (CIs) continues to expand, more children with asymmetric hearing loss are receiving cochlear implants. These individuals can combine the use of a hearing aid (HA) and CI. This bimodal hearing may allow low-frequency acoustic cues to assist the listener in understanding speech in the midst of competing maskers. There is a general consensus in the literature that binaural listening leads to better performance than monaural listening, but there is less agreement about the determination of whether the contralateral ear would be best served by a HA or a CI. Additionally, there is no solid clinical guideline that could suggest when an individual is not able to access and benefit from bimodal hearing. This is particularly important in children who are developing language during a time of neural plasticity. The aim of this study is to assess whether a relationship exists between bimodal benefit and the degree of residual hearing in the contralateral ear of bimodal listeners. Secondary factors such as insertion depth, acoustic bandwidth, and individual ear speech understanding were also analyzed. In addition, the performance of the bimodal recipients was compared to the performance of bilateral CI recipients in order to assess whether there is a point at which a second cochlear implant may be a better course of treatment.

Methods: The speech recognition of bimodal and bilateral CI recipients was assessed using the BKB-SIN in collocated and spatially separated noise (+ 90°). CNC word scores were also recorded for each ear alone and in the binaural condition. Postop x-rays were examined by an otologist to determine insertion depth of implanted ears. Hearing aid output was analyzed to obtain information on the audible bandwidth.

Results: For bimodal listeners, results suggest that there is a relationship between differences in single word recognition between ears and spatial release from masking. Audible bandwidth does not appear to be a predictive factor for this group. Outcomes for the bilateral listeners were not as predictive, and factors such as insertion depth may be at play.

Conclusion: There are many different factors which may categorize “bimodal benefit.” Binaural summation, spatial release from masking, and individual ear speech perception should be considered when discussing a second implant for a pediatric bimodal listener. Overall, these results may assist clinicians in determining the point at which a HA is no longer beneficial and the patient may instead reach their highest potential with a second CI.
**Poster Number:** 42  
**Abstract ID:** 26  
**Title:** Characteristics of Mandarin Open-Set Word Recognition Development Among Chinese Children with Cochlear Implants  
**Category:** Audiology  
**Authors:**  
Ying Kong, Audiologist  
; Beijing Inst. of Otolaryngology, Beijing, China.  
**Abstract:**  
**Introduction:** Cochlear implants (CIs) can improve speech recognition for children with severe congenital hearing loss, and open-set word recognition is an important efficacy measure. This study examined Mandarin open-set word recognition development among Chinese children with CIs and normal hearing (NH).  
**Methods:** This study included 457 children with CIs and 131 children with NH, who completed the Mandarin lexical neighborhood test. The results for children at 1-8 years after receiving their CIs were compared to those from the children with NH using linear regression analysis and analysis of variance.  
**Results:** Recognition of disyllabic easy words, disyllabic hard words, monosyllabic easy words, and monosyllabic hard words increased with time after CI implantation. Scores for cases with implantation before 3 years old were significantly better than those for implantation after 3 years old. There were significant differences in open-set word recognition between the CI and NH groups. For implantation before 2 years, there was no significant difference in recognition at the ages of 6-7 years, compared to 3-year-old children with NH, or at the age of 10 years, compared to 6-year-old children with NH. For implantation before 3 years, there was no significant difference in recognition at the ages of 8-9 years, compared to 3-year-old children with NH, or at the age of 10 years, compared to 6-year-old children with NH. For implantation after 3 years, there was a significant difference in recognition at the age of 13 years, compared to 3-year-old children with NH.  
**Conclusion:** Mandarin open-set word recognition increased with time after CI implantation, and the age at implantation had a significant effect on long-term speech recognition. Chinese children with CIs had delayed but similar development of recognition, compared to normal children. Early CI implantation can shorten the gap between children with CIs and normal children.
Poster Number: 43  
Abstract ID: 213

Title: The second cochlear implant showed much faster speech perception development and reached a plateau earlier than the first implant in prelingually deaf children with sequential bilateral cochlear implantation

Category: Audiology

Authors: Ja Yoon Ku, MD 1, Jee Yeon Lee, PhD 2, Yehree Kim, MD 2, Min Young Kwak, MD 2, Hong Ju Park, MD PhD 2; 1Otalaryngology, Asan Med. Ctr., Songpa-gu, Korea, Republic of, 2Otaryngology, Asan Med. Ctr., Seoul, Korea, Republic of.

Abstract:

Introduction: We evaluated the growth patterns of speech perception in the first cochlear implant (CI-1) and second CI (CI-2) in children with sequential bilateral CI and the effects of age at CI operation on the growth patterns of speech perception.

Methods: Seventy children without any cochlear anomalies or cognitive deficits who underwent sequential bilateral CI operations and were followed up for more than 60 months after CI-1 and 36 months after CI-2. Monosyllabic word recognition scores (WRSs) in quiet were used as main outcomes. The periods of CI use when the group mean WRS exceeded 80% or individual WRSs reached a plateau were compared between the groups which were classified by the age at CI operation (G-1, ≤ 3.5 years; G-2, 3.6-8.6 for CI-1 ears, and G-I, ≤ 3.5 years; G-II, 3.6-7.0; G-III, 7.1-13; G-IV, > 13, for CI-2 ears).

Results: For CI-1, the mean WRS of G-1 exceeded 80% at 24 months and G-2 at 54 months. The periods of CI-1 use (40±19 months) up to an individual WRS plateau of G-1 ears were shorter than those (64±25 months) of G-2. The best CI-1 WRSs (97.8%) of G-1 were better than those (89.2%) of G-2 at 60 months after CI-1. For CI-2, the mean CI-2 WRSs of G-I, G-II, and G-III exceeded 80% at 12, 3, and 12 months, which were faster compared to CI-1 ears. The periods of CI-2 use (11-17 months) up to an individual WRS plateau of CI-2 ears did not differ by the age at CI-2 operation and were shorter than those (40-64 months) of CI-1 ears. Though the youngest CI-2 group (G-I) did not show the best WRS in the early postoperative period, they caught up with the other groups at 12 months after CI. The best CI-2 WRSs (95%, 92%, and 87%) of G-I, G-II, and G-III were better than those (65%) of G-IV at 36 months after CI-2.

Conclusion: The earlier CI-1 implantation showed the faster growth of and better speech perception. However, the earlier speech perception ability of CI-2 ears depended on the auditory performance of CI-1 ears and showed much faster growth than CI-1 ears. CI-2 ears reached a plateau earlier than CI-1 ears regardless of the age at CI-2 operation, suggesting that CI-2 ears use the auditory pathways which had been already established by CI-1.
**Title:** Long-Term Change of Speech Perception Ability in Pediatric Cochlear Implant

**Abstract:**

**Introduction:** Word recognition scores (WRSs) using relatively easy word lists for cochlear implant (CI) implantees have a ceiling effect and are limited in evaluating speech perception ability in long-term CI users. We evaluated the growth patterns of speech perception for more than 10 years after CI using two different monosyllabic word lists in children with CI and the effects of age at CI operation on the growth patterns of speech perception.

**Methods:** Eighty-one children without any cochlear anomalies or cognitive deficits who underwent CI operations and had postoperative follow-up more than 10 years (12.3±1.5 years) were enrolled. Monosyllabic word recognition scores using the Asan-Samsung Korean word recognition scores (ASK-WRS) for CI users and Korean standard monosyllabic word recognition scores (KSM-WRS), conventional list for speech audiometry, were the main outcomes. The mean durations of CI use when the WRS reached a plateau were also compared between the groups which were classified by the age at CI operation.

**Results:** For using ASK-WRS, scores reached a plateau at 40-60 months. ASK-WRSs of the ears with CI which was operated at < 3 years showed better WRS and earlier growth pattern than the ears with CI which was operated later. When using KSM-WRS, conventional word lists, score reached a plateau at 7-9 years which is longer than that (5 years) of normal listeners and there was no significant difference between different age groups. Conventional WRSs of the ears with CI which was operated at 1-2 years showed better WRS than the ears with CI operated later (for 2-3 years, p=0.07; for 3.1-7 years, 0.002; for 7.1 and later, p<0.0001).

**Conclusion:** WRSs using ASK word lists reached a plateau at 40-60 months after CI and a ceiling effect, thus cannot differentiate the effect of age at surgery on CI performances. WRSs using conventional word lists reached a plateau at 8.2-10.2 years after CI and did not show a ceiling effect, suggesting that CI users need continuous auditory rehabilitation for more than 10 years after surgery.
Impact of Early Intervention on Children with Cochlear Implants

Category: Audiology

Authors:

Abstract:
Introduction: Access to early intervention is important for children with hearing loss in order for them to develop speech and language. Early intervention specifically designed for children with hearing loss is available in some areas and could determine language development in these children.

Methods: This study surveys parents of children with cochlear implants to determine what type of early intervention services their child received. A copy of the child’s Individual Educational Plan or 504 plan will also be collected to determine what services the child is currently receiving and their present levels of performance.

Results: The results will be compiled and analyzed to determine if children who had early intervention receive fewer special education services than the children who did not receive early intervention. A comparison between children who received hearing impaired specific early intervention services (oral preschool/access to a teacher of the deaf/hard of hearing) and children who received generic early intervention services will also be made to determine if this aspect of early intervention influences future need of special education services. The results of this site-specific study will be compared to previous research from other locations and nationally.

Conclusion: Children who received early intervention as a young child are receiving fewer services in school today compared to those children who did not receive early intervention services. Furthermore, children who received hearing impaired specific early intervention are also performing better in school than children who received general early intervention. This study highlights the importance of early intervention for children with hearing loss.
Poster Number: 46
Abstract ID: 155
Title: The Development of Auditory and Speech Abilities in Auditory Neuropathy Children After Cochlear Implantation
Category: Audiology
Authors: Yongxin Li, PhD, Jingyuan Chen, Master, Ying Shi, PhD, Biao Chen, PhD, Danmo Cui, PhD; Department of Otolaryngology, Beijing Tongren Hosp., Beijing, China.
Abstract: The development of auditory and speech abilities in auditory neuropathy children after cochlear implantation

Introduction: To investigate the development of auditory and speech abilities in auditory neuropathy children after cochlear implantation. Comparing the AN group with the SNHL group in order to discover the difference between them.

Methods: 12 auditory neuropathy children and 12 sensorineural hearing loss children were included in this study. According to the age of implantation, electrode styles, sex and the doctor of surgeon, AN children were compared to the SNHL children. According to the effect of cochlear implantation, we divided AN children into two group. They were good effect group and bad effect group. All the children were evaluated by audiologists using CAP (categories of auditory performance) and SIR (speech intelligibility rating). The evaluation was performed before operation and 1 month, 3 months, 6 months, 12 months, 24 months, 36 months after switch-on.

Results: The auditory and speech abilities could improved with the increasing time of cochlear implant. Data were analyzed by rank sum test. There were no significant differences in CAP and SIR scores between the AN group and the SNHL group (p>0.005). There were no significant differences in CAP and SIR scores between the good effect group and the SNHL group (p>0.005). However, there were significant differences in CAP scores between the bad effect group and the SNHL group (p<0.005), when the evaluation was performed 3 months, 6 months and 12 months after switch-on. There were significant differences in SIR scores between the bad effect group and the SNHL group (p<0.005), when the evaluation was performed 6 months, 12 months and 24 months after switch-on. Meanwhile, there were significant differences in CAP scores between the bad effect group and the good effect group (p<0.005), when the evaluation was performed 3 months, 6 months, 12 months and 36 months after switch-on. There were significant differences in SIR scores between the bad effect group and the good effect group (p<0.005), when the evaluation was performed 6 months and 36 months after switch-on.

Conclusion: Whether the AN children or the SNHL children, the abilities of auditory and speech would improved with the time. It is effective to the AN children to implant cochlear. However, the effect maybe differ. Some of the AN maybe developed like the SNHL, some of them maybe worse than the SNHL.
Poster Number: 47  
Abstract ID: 30  
Title: Early Auditory and Verbal Development in Mandarin-Speaking Children with Unilateral and Bilateral Cochlear Implants  
Category: Audiology  
Authors:  
Haihong Liu, PhD, Professor, Yue Long, Master, Ying Li, Master, Yawen Zhao, Master, Jie Zhang, MD, Jun Zheng, MD, Xin Ni, MD; Beijing Children’s Hosp., Beijing, China.  
Abstract:  
Introduction: The purpose of the present study was to investigate the early auditory and verbal behaviors of young children with unilateral cochlear implants (UCI) and bilateral cochlear implants (BCI), and to investigate effects of age of implantation, education level of caregivers, living environment, and unaided behavioral threshold before operation on early auditory verbal development.  
Methods: The evaluation material of the present study was the Mandarin version of the LittleEARS® Auditory Questionnaire (LEAQ). Assessments were administrated at 0, 1, 2, 3, 6, 9, 12 and 24 months after cochlear implants (CIs) were switched on. A one-way ANOVA was used to analyze the differences of auditory verbal performance between each two contiguous test intervals. A two-sample t test was used to analyze the difference of behaviors between young children with BCI and UCI. Non-parametric tests were used to analyze the effects of potential affecting factors on auditory verbal skills.  
Results: One hundred and ninety-two children receiving cochlear implant (CI) in the first 2 years of life were recruited in the study. One hundred and seventy-three of them received UCI and the other 19 children received BCI. At each evaluation time, the average scores of LEAQ were 1.22, 5.99, 10.54, 14.02, 19.02, 23.65 and 33.31 respectively for UCI group; 4.58, 9.00, 16.00, 18.56, 22.00, 31.50, 29.67, and 34.35 respectively for BCI group. The LEAQ score increased significantly in the first year after CI activation for UCI group and in the second month for BCI group (UCI group, p=0.030; BCI group, p=0.000). The total LEAQ score of BCI group was significantly higher than UCI group after 0, 1, 2, 3 and 9 months of CI use (0 month: t=4.134, p=0.000; 1 month: t=2.512, p=0.028; 2 months: t=2.874, p=0.005; 3 months: t=2.230, p=0.028; 9 months: t=2.316, p=0.023). For receptive and semantic auditory behavior, the scores of BCI group were significantly higher than UCI group after 1 and 2 months of CI use (for receptive auditory behavior, 1 month: t=2.059, p=0.041 and 2 months: t=2.115, p=0.036; for semantic auditory behavior, 1 month: t=2.503, p=0.013 and 2 month: t=2.796, p=0.006). For expressive language behavior, the scores of BCI group were significantly higher than the UCI group after 3 months of CI use (t=2.763, p=0.007). Education level of caregivers had a positive effect on receptive auditory behavior after CIs switched on for 2 months in UCI group (H=10.010, P=0.007) and 3 months in BCI group (H=6.538, p=0.035).  
Conclusion: Auditory and verbal skills improved as the duration of CI use expanding. The study indicated that infants and toddlers who underwent BCI had better auditory and verbal skills than their UCI peers, especially during the early stage after CI activation. The binaural advantage occurred first in auditory skills and then in verbal performance. Higher caregivers’ education level positively correlated with the early development of auditory verbal skills.
Title: Development of Early Auditory Preverbal Skills in Mandarin-Speaking Children with Cochlear Implants and Additional Disabilities

Category: Audiology

Authors: Haihong Liu, PhD, Professor, Yawen Zhao, Master, Yue Long, Master, Jie Zhang, MD, Jun Zheng, Master, Xin Ni, MD; Beijing Children's Hosp., Beijing, China.

Abstract:

Introduction: The primary aim of this study was to evaluate the compare the early auditory preverbal developmental trajectories in cochlear implant (CI) recipients with and without additional disabilities. The second objective was to explore the association between relevant variables (nonverbal developmental quotient, age at implantation, and so on) and outcomes.

Methods: This study included 50 children with CIs, of which 17 children with additional disabilities (mean age at implantation, 28.82 months) and 33 typically developing children (mean age at implantation, 18.01 months). The timeframes of follow-up were 0, 1, 3, 6, 9, 12, 18 and 24 months of the CI use. LittLEARS® Auditory Questionnaire (LEAQ) was employed.

Results: All children showed significantly improvement in auditory preverbal skills along with the CI use. Children with additional disabilities fell behind the control group in domain of receptive auditory behavior from 1 month of CI use, however there was no different between two groups after 18 months of CI use. As for the domains of semantic auditory behavior, expressive language skills and total LEAQ, children with additional disabilities showed a lower progress rate from 3 to 24 months of CI use, even though the gap was gradually narrowing. In addition, children with higher nonverbal developmental quotient (NVDQ) and earlier age at implantation exhibited better early auditory preverbal skills.

Conclusion: The development of early auditory preverbal skills for children with CIs and additional disabilities progressed at a slower rate compared to typically developing children with CIs, and the difference was gradually reduced. The nonverbal cognitive status and age at implantation have an important effect on outcomes.
Abstract:

Introduction: Cochlear implant (CI) is a well established technique for profound-severe hearing children. However, the quality of life for these children is reported limited, especially for Mandarin speaking children with CIs. The primary aim of this study was to evaluate the health-related quality of life (HRQoL) of children with CIs from the parental perspective. The secondary objective was to explore possible relationships between demographic variables (such as age at assessment, gender, age at implantation, and duration of language rehabilitation) and the HRQoL. The third objective was to determine the developmental trajectories of HRQoL.

Methods: This study included parents of 123 children with CIs (mean age, 40.45 months; mean age of CI implantation, 24.74 months; mean device experience, 16.34 months). The time periods for follow-up were at 0, 1, 2, 3, 6 and 12-month intervals of CI use. The Mandarin Children with Cochlear Implants: Parental Perspectives (M-CCIPP) questionnaire was employed to assess HRQoL. The questionnaire (Children with Cochlear Implants: Parental Perspectives) was designed by Archbold et al. in 2002, we have translated this questionnaire into a Mandarin Chinese Version (M-CCIPP) using the method of cross-cultural translation, and reliability analyses of the M-CCIPP showed good internal consistency (Cronbach’s alpha 0.797), the correlation coefficients between overall M-CCIPP scores and the eight subdomains were 0.395-0.992 (p< 0.01), and there were weak or no correlations among the eight subdomains, which indicated the validity was good.

Results: HRQoL improved significantly after in Mandarin children with CIs, especially with the domain of social relations; however, education received a less positive rating. The duration of CI use was positively correlated with 5 domains, suggesting that children who used CIs for a longer time had higher HRQoL ratings. Children with longer language rehabilitation received more positive ratings in the domains of social relations and education (p< 0.05); children whose mothers had higher education levels received more positive ratings in the domain of general functioning (p< 0.05); children living in cities received more positive ratings in the domains of communication, general functioning and self-reliance (p< 0.05). Girls received more positive rating than boys in the domain of well-being (p< 0.05). No significant correlation was found between age at implantation, age at assessment, only child status and HRQoL. All domains showed clear increases in the duration of CI use; the majority of the domains showed steeper progress over the first 3 months of CI use. Communication exhibited the most rapid progress, with education progressing at a slower rate.

Conclusion: Parents were satisfied with all domains of HRQoL. Almost all domains exhibited rapid progress over the first 3 months of CI use, with education progressing at a slower rate. This research underscores the importance of language rehabilitation by revealing that strengthening language rehabilitation could be an effective means of improving the HRQoL of children with CIs.
**Title:** International Classification of Functioning Disability & Health for the Evaluation of Cochlear Implant Outcomes  
**Category:** Audiology  
**Authors:** Artur Lorens, PhD 1, Anja Kurz, PhD 2, Griet Mertens, Aud PhD 3, Henryk Skarzynski, PhD Prof 1; 1Inst. of Physiology and Pathology of Hearing, Warsaw, Poland, 2Klinik und Poliklinik für Hals-, Nasen- und Ohrenkrankheiten, plastische und ästhetische Operationen, Wurzburg, Germany, 3Dienst Neus-keeloorziekten, Hoofd- & Halsheelkunde Universitair Revalidatiecentrum voor Communicatiestoornissen, Edegem, Belgium.  
**Abstract:**  
**Introduction:** Following the newest recommendations of audiological organizations, postsurgical evaluation after cochlear implantation should be based on the newest functional model of disability developed for the International Classification of Functioning Disability and Health (ICF).  
**Methods:** In the functional model, disability is a comprehensive term involving impairment, activity limitations and participation restrictions. Impairment is a problem with function or structure of a body, activity limitations concern difficulties an individual may have in executing activities or tasks, participation restrictions are problems an individual may experience in involvement in life situations. Moreover, ICF defines individual's functioning and its limitations as an effect of a dynamic interaction between health condition(s) and environment (contextual factors).  
**Results:** This classification has been used as a clinical tool for evaluation of professional evaluation and assessment of CI outcomes. The so-called core sets for hearing loss, i.e. lists of particular body functions and forms of activity and participation have been linked to traditional CI outcomes measures.  
**Conclusion:** Introduction of ICF to reporting of CI outcomes aims to document amelioration by means of cochlear implants the activity limitations and participation restrictions of people with hearing loss.
Poster Number: 51  
Abstract ID: 107  
Title: Case Study: Cochlear Implant Performance with a Hypoplastic Nerve in a Pediatric Patient  
Category: Audiology  
Authors: Anna Louthan, Doctorate of Audiology Pending, Debora Hatch, AuD, Stephanie Moody Antonio, MD; Audiology, Eastern Virginia Med. Sch., Norfolk, VA.  
Abstract:  
Introduction: This study tracked the progress of a bilaterally hearing impaired pediatric patient following the cochlear implantation of her left hypoplastic auditory nerve. The patient is a nine-year-old with a mild sloping to a moderately-severe sensorineural hearing loss in her right ear and a profound sensorineural hearing loss in her left ear. The patient’s hypoplastic auditory nerve on her left side makes her nerve anatomy less than optimal for electrical stimulation.  
Methods: The patient was implanted with her left cochlear implant in mid November and her progress was tracked over the following six months. Progress was recorded with clinical testing (pure tone threshold testing, speech awareness threshold testing, and speech perception testing - PBK, CNC, AzBio, BKB-SIN, MLNT, LNT) as well as patient reports of success with the implant.  
Results: Results are pending, but outcomes are expected to be comparable or slightly below implant recipients with normal nerve anatomy.  
Conclusion: Tracking progress over time, as well as comparing the progress to normative data on cochlear implant recipients with normal auditory nerve anatomy, provides information on the success of cochlear implantation of a hypoplastic nerve.
Title: The impact of a drumming-to-speech intervention on prosody perception in children with cochlear implants: An exploratory study

Category: Audiology

Authors: Jessica MacLean

Abstract:
Children who utilize cochlear implants (CIs) often have trouble detecting prosody, an element of speech that uses variances in timing, pitch, and dynamics to communicate meaning (Green et al., 2004; Hopyan-Misaken et al., 2009). Without recognizing prosody, they can miss important conversational elements and may not communicate effectively with others (Paul et al., 2005). Children with CIs match peers in measures of rhythm perception but fall behind in pitch perception (Gfeller, 2000). Research suggests that improvements in speech rhythm perception can lead to improvements in prosody perception (Hausen et al., 2013). I examined the effect of a novel Drumming-to-Speech (DTS) intervention that facilitates practice in identifying speech rhythm to improve prosody perception in children with CIs. I explored the impact of the intervention on prosody and music perception and synchronization ability, and also examined relationships between demographic variables such as hearing age with outcomes.

Twelve preschoolers with CIs completed the DTS intervention, which included four weeks of individual music therapy sessions and at-home practice. Sessions incorporated drumming to stressed syllables in speech and rhymes, as well as practice synchronizing to speech and drumming. Participants completed assessments of music and prosody perception pre- and post-intervention. I conducted a series of nonparametric tests to assess intervention efficacy and examine relationships between demographic variables and intervention outcomes.

While participants did not improve in linguistic prosody perception, they did significantly improve in affective prosody perception. In addition, participants improved significantly in some aspects of synchronization accuracy, as well as in rhythm and melody perception. Additionally, older participants performed significantly better than younger participants. Overall, results indicate potential for the DTS intervention to improve affective prosody perception through identification of speech rhythm, and may suggest a developmental window during which this intervention is most beneficial. Further clinical and theoretical implications will also be addressed. Children who utilize cochlear implants often struggle to detect prosody, or the “melody” of speech. After completing a novel Drumming-to-Speech intervention, preschool-aged children with cochlear implants significantly improved in perception of emotional prosody and music. This presentation will review other findings, clinical implications, and future research directions.
Title: Speech Outcomes with Objective and Subjective Programming in CI Patients with Progressive Hearing Loss

Category: Audiology

Authors:
Diane Martinez, AuD, Sandra Velandia, AuD, Alicia Restrepo, AuD, Tina Stern, AuD, Sandra Prentiss, PhD, Simon Angeli, MD, Fred Telischi, MD, Christine Dinh, MD; Otolaryngology, Univ. of Miami, Miami, FL.

Abstract:
Introduction: Cochlear implant (CI) patients with a history of longstanding hearing deprivation have difficulty judging loudness and pitch due to decrement in auditory memory over time. Therefore, CI programming using patients’ subjective impression of comfort levels may not be the most effective method to maximize speech understanding. Therefore, objective techniques utilizing electrical stapedial reflex thresholds (ESRT) to create CI programming maps should be considered. This may improve speech understanding in patients with long-term progressive hearing loss.

Methods: A retrospective chart review of adult CI patients with progressive severe-to-profound sensorineural hearing loss that initially received subjective CI programming and subsequently underwent objective programming between December 2015 and September 2017 were studied for speech perception with words and sentences pre and post objective programming. Patients with inner ear malformations and history of meningitis were excluded. Demographic information, etiology of hearing loss, CI device, and speech perception outcomes. Subjective, or pre-objective, programming speech perception outcomes were compared to outcomes at 1.5 months post objective programming.

Results: Preliminary data suggests an average improvement in CNC and AzBio (quiet) scores of 20% and 38%, respectively, following objective programming.

Conclusion: Objective programming techniques using ESRTs have been in use for over 20 years, but are not widely applied. Objective programming, when compared to subjective programming techniques, may provide improved speech understanding in adult CI patients with longstanding, progressive hearing loss.
Poster Number: 54  
Abstract ID: 389  
Title: Changes in eCAP Thresholds with Higher Stimulation Rates or Pulse Widths in Children with Cochlear Implants  
Category: Audiology  
Authors: Maria Valeria Goffi-Gomez, PhD, Ana Claudia Martinho-Carvalho, PhD, Ana Cristina Hoshino, PhD, Paola A. Samuel, MS, Robinson K. Tsuji, PhD, Ricardo F. Bento, Full Professor; Univ. of Sao Paulo, Sao Paulo, Brazil.

Abstract:  
Introduction: The increase in pulse width and stimulation rate with biphasic pulses in cochlear implanted patients result in a decrease in the amount of current needed to achieve equal loudness. Meanwhile, the amount of change in stimulation levels in these situations vary among patients. Nerve properties and channel interaction may also influence the eCAP thresholds recorded with different stimulation rates or pulse widths.

Method: Prospective exploratory cross-sectional study. Intraoperative measurements of the neural response telemetry thresholds (tNRT), recovery (REC) and spread of excitation (SOE) functions of 50 children implanted with a straight array device (CI 422) were collected in three electrodes (e16, e11 and e6). Neural response telemetry thresholds (tNRT) were assessed with AutoNRT algorithm (250Hz of stimulation rate), and with 80 Hz of stimulation rate using pulse widths of 25 microsec and 37 microsec. REC was recorded as a function of twenty masker probe intervals, from which the absolute (T0) and relative (tau) refractory period were collected in microseconds. The SOE was recorded as a function of eleven masker electrodes. Custom Sound® EP software provides SOE width in millimeters and for this study it was considered at 75% transection level. Statistical analysis of the correlation between tNRT and REC or SOE was performed for the three electrodes using Spearman test.

Results: Changes in the threshold of eCAP (tNRT) varied from 1 to 57 current units. The effects of changing stimulation rates and increasing pulse width produced differences in thresholds of the tNRT for the evaluated electrodes with statistical significance (p = 0.011). Statistical correlation between the rate effect and the relative refractory period (tau) was only found in the apical electrode. Charge effect showed no correlation with the studied variables.

Conclusion: The change in eCAP thresholds with higher stimulation rates or pulse widths in children with cochlear implants varied with the electrode position. Although the decrease in tNRT with higher stimulation rates and wider pulse widths is expected, it was not found in all patients. The difference found with different stimulation rates could only be correlated with the refractory properties in the apical region of the cochlea in this sample. Key words. Cochlear implant; neural response; channel interaction; spread of excitation, loudness
Title: Beyond the Candidacy Assessment: When Pre-Operative Predictions do Not Correlate with Post-Operative Outcomes

Category: Audiology

Authors:
Melissa Mathieu, AuD, Julie Foulis, AuD; Audiology, CT Children's Med. Ctr., Suite 2F, CT.

Abstract:
Title: Beyond the Candidacy Assessment: When preoperative predictions do not correlate with post-operative outcomes.

Intro: As indications for cochlear implantation expands, surgical techniques are refined, and technology and clinical practice advance, performance outcomes have improved. There are a variety of factors that are categorized in a multi-disciplinary approach to determine candidacy and offer a preoperative prediction on post-operative outcomes. This is critical to provide families with reasonable expectations. Still, the variability in individual post-operative performance remains high. Case studies are presented to demonstrate that cochlear implantation requires careful consideration, but highlights the complexity and difficulty with the prediction of outcomes.

Methods: Retrospective review of the center adapted Children’s Implant Profile (ChIP) candidacy assessment and outcome measurements to ascertain the relationship between key factors as influential in the potential performance with a cochlear implant. Review is conducted with attention to identifying factors which could be included in a revised candidacy assessment to improve the sensitivity of our pre-operative assessment in identifying cochlear implant candidates with potential positive outcomes.

Results: Literature review identifies key factors as influential in the prediction of post-operative outcomes, including age at onset of deafness, duration of deafness, etiology of deafness, status of the cochlea and auditory nerve, age at implantation, mode of communication, (re)habilitation services, educational environment, motivation and commitment by the patient, and motivation and commitment by the patient’s support system (family and friends). Case study review suggests that pre-operative concerns do not always accurately predict cochlear implant outcomes.

Conclusion: Although key factors have been identified to have an influence on cochlear implant outcomes, the variability of outcomes is not always predictable, making it difficult to provide generalized statements regarding candidacy. As such, how can we better predict post-operative outcomes using evidence based guidance, thereby expanding candidacy criteria and improving access to cochlear implant technology.
Poster Number: 57
Abstract ID: 234
Title: Intrauterine Hearing Screening - Our Early Experience
Category: Audiology
Authors:
Rohit Mehrotra, MS (ENT) MEHROTRA ENT HOSPITAL, KANPUR, India.
Abstract:
Introduction: To define the rate and characterize the hearing in the human fetus. Sounds originating outside the abdomen of pregnant women can reach the inner ear of the fetus. Low-frequency sound energy easily penetrates to the fetal ear. In this paper, we present an Ultrasound image study of the fetal auditory response to external stimuli. The acoustic stimulator and the ultrasound sensors were subsequently placed. The fetus can hear during the last trimester of pregnancy. Consistent responses to acoustic stimuli have been observed from 22-34 weeks onwards.
Method: A standard audiometric earphone placed on the abdominal surface of pregnant women. Sound transmission was assessed with a headphone placed near the ear of the fetus within the intact amnion. Sound pressures produced by the headphone averaged 60 to 110 dB. The effect of sound and vibration on the human fetus was studied. A significant alteration of the fetal heart rate and movement occurred following stimulation. Prospective study review in 22-34 weeks pregnant women was done in a one year period (2017–2018) at MEHROTRA ENT HOSPITAL in Kanpur, India.
Results: 100 pregnant women were followed up. The first response was observed at 22-24 weeks of gestational age by a fetus who responded to the pure tone. The number of fetuses responding to each frequency increased with gestational age. Fetuses first responded to the low freq. rather than high freq tones at 24-30 and 30-34 weeks of gestational age respectively.
Conclusions: The observed pattern of behavioural responsiveness reflects underlying maturation of the auditory system. The sensitivity of the fetus to sounds in the low frequency range may promote language acquisition and boost his or her IQ. This development of auditory responsiveness suggests a parallel development in the auditory system.
Title: A Prospective Randomized Cross-Over Study in Single-Sided Deafness on the New Non-Invasive Adhesive Bone Conduction Hearing System with CROS Hearing Aid

Category: Audiology

Authors: Griet Mertens, PhD, MSc Aud, Annick Gilles, PhD Aud, Rajae Bouzegta, /, Paul Van de Heyning, MD, PhD;Otorhinolaryngology, Head & Neck Surgery, Antwerp Univ. Hosp., Edegem, Belgium.

Abstract:

Introduction: Recently, an adhesive bone conduction hearing system has been developed as a novel non-surgical concept for conductive hearing loss or single-sided deafness (SSD). In SSD cases, this device may be a good solution for patients who are unsuitable for, or who do not wish to undergo, bone conduction implant or cochlear implant surgery. To investigate the objective and subjective hearing outcomes with the adhesive hearing system in SSD.

Methods: A randomized crossover study was conducted in 17 SSD participants, using the CROS (contralateral routing of signals) hearing aid as a control. The following outcome measurements were administered in 17 SSD participants after a two-week trial: 1) questionnaires: Speech, Spatial and Qualities scale (SSQ12), Audio Processor Satisfaction Questionnaire (APSQ), and a custom-made questionnaire about the use of the hearing system, 2) sound localization, 3) speech perception in noise in different listening situations.

Results: 0% of the SSD subjects reported that the adhesive hearing system was partially useful or better. Using the APSQ, the adhesive test device was evaluated equally as the control device. Sound localization improved with the adhesive test device compared to the unaided condition and deteriorated with the control device. There was no improvement in speech perception in noise measured with the adhesive test device.

Conclusion: Users’ satisfaction of the new adhesive hearing system was found to be comparable to the control device. Since the hearing outcomes vary highly between patients, appropriate trials with applicable hearing systems are recommended in SSD patients.
**Poster Number:** 59  
**Abstract ID:** 25  
**Title:** Unilateral Cochlear Implantation In Older Children: A Case Study  
**Category:** Audiology  
**Authors:**  
Cameron Budenz, MD 1, Jessica Hoffman, AuD 2, Samantha Morgan, AuD 3, Katrina Stidham, MD 4;  
1Audiology, ENT Faculty Practice; Westchester Med. Ctr., Valhalla, NY, 2Audiology, ENT Faculty Practice LLC, Hawthorne, NY, 3Audiology, Westchester Inst. for Human Dev.; Westchester Med. Ctr., Valhalla, NY, 4Neuro-Otology, ENT Faculty Practice; Westchester Med. Ctr., Hawthorne, NY.  
**Abstract:**  
**Introduction:** With the expansion of cochlear implantation indications, implantation in patients with a unilateral hearing loss is being considered with increased frequency. While unilateral implantation in adults with single sided hearing loss continues to be heavily researched, there are very limited studies evaluating unilateral implantation in children. For children with normal hearing in only one ear, traditional amplification and/or re-routing of the auditory signal to the better hearing aid via CROS and bone anchored hearing aid technologies, is typically considered. For children who do not benefit from signal re-routing or traditional amplification on the affected ear, the potential benefit of cochlear implantation remains largely unknown. The unexplored potential is of particular importance for children with medical conditions which place them at risk for progressive hearing loss in the normal hearing ear. This presentation encompasses the clinical performance of two children with long standing unilateral sensorineural hearing loss fit with traditional amplification, the audiological and medical aspects considered in the eventual pursuance of unilateral implantation, and their clinical postoperative performance in the nine months immediately following implantation.  
**Methods:** Two pediatric subjects over the age of five with sensorineural hearing loss in one ear and normal hearing sensitivity in the other underwent cochlear implantation of the affected ear following an extended trial with amplification. The preoperative test battery included aided and unaided tonal and speech perception testing. Post implantation these measures were re-administered, and subjective measures were included.  
**Results:** This presentation will include clinical data from the nine month period immediately following implantation. Audible thresholds and speech recognition abilities saw improvement within nine months post activation.  
**Conclusion:** Post implantation performance suggests improvement in acuity and enhanced access to speech information in the ear which provided essentially no meaningful audibility pre-implantation, as measured by clinical data.
Title: Evaluation of Hearing Performance with a Variety of Wireless Remote Microphone Technologies

Category: Audiology

Authors: Jace Wolfe, PhD, Sara Neumann, AuD, Mila Duke, AuD; Audiology, Hearts for Hearing, Oklahoma City, OK.

Abstract:

Introduction: Cochlear implant (CI) recipients often experience difficulty understanding speech in noise. Use of remote microphone (RM) technology has been shown to be the most effective method to improve speech recognition in noise. A variety of different RM technologies are available to CI users such as wireless accessory RM systems and universal, adaptive RM systems. Wireless accessory RM systems are typically designed to function exclusively with the sound processor(s) of a specific manufacturer. Accessory RM systems are typically fixed-gain technologies, which means the strength of the signal delivered by the RM to the sound processor is set to a constant level regardless of the ambient noise level. Universal personal RM systems are designed to function with most CI sound processors regardless of the manufacturer. An adaptive universal personal RM system automatically increases the strength of the signal delivered by the RM to the sound processor with the goal of maintaining a favorable signal-to-noise ratio as the ambient noise level increases. The objective of this study is to evaluate the potential improvement in speech recognition in noise that CI recipients obtain with the use of a variety of different wireless RM technologies.

Methods: Twenty bilateral CI recipients, ages 7 and older, were tested in a simulated classroom environment. AzBio sentences were presented from a loudspeaker located 8 feet, 6 inches in front of the participant, and classroom noise was presented from four speakers placed in the corners of the room. Sentence recognition was measured in quiet and in noise (at multiple noise levels ranging from 50 to 80 dBA) in each of four conditions: 1) no RM, 2) use of a wireless, fixed-gain accessory RM system, 3) use of a wireless adaptive universal personal RM system, and 4) combined use of an adaptive universal personal RM system with its radio receiver coupled to the Europort of a fixed-gain accessory RM system (i.e., “combined RM system”).

Results: Repeated measures analysis of variance (RM-ANOVA) indicated a significant main effect of noise level and a non-significant main effect of RM technology. Sentence recognition in quiet was significantly better than sentence recognition in noise, and sentence recognition decreased significantly with increasing noise level. Of note, all RM configurations outperformed performance without RM. However, similar performance was obtained across each of the three RM technology conditions across all noise levels.

Conclusion: RM technology, regardless of coupling methods, is effective in improving speech understanding in noise. Routine use of RM should be considered for all cochlear implant users and coupling methods should be selected based on patient needs. There were no differences in speech recognition obtained with use of the different wireless RM systems evaluated in this study. The lack of difference across the various RM technologies may be attributed to the signal processing within the sound processors used by the participants in this study.
Poster Number: 61
Abstract ID: 60
Title: Evaluation of Speech-in-Noise Performance for Individuals Using a Cochlear Implant and a Conventional Hearing Aid or CROS Device
Category: Audiology
Authors: Alexandra L. O'Dell, AuD 1, Laura Campos, AuD 1, Shannon Elam, AuD 1, Krista Iannuzzi, AuD 1, Jennifer Ochoa, AuD 1, Darcy Strong, AuD 1, Allison Ramakrishnan, AuD 1, Smita Agrawal, PhD 2, Alex Kaizer, MS 3, Melinda Anderson, PhD 4; 1Hearing and Balance Clinic, UCHlth. - Univ. of Colorado Hosp., Aurora, CO, 2Advanced Bionics, Valencia, CA, 3Department of Biostatistics and Informatics, Univ. of Colorado Sch. of Publ. Health, Denver, CO, 4Otolaryngology, Univ. of Colorado Sch. of Med., Aurora, CO.
Abstract:
Introduction: Speech understanding in noise remains the greatest challenge for listeners with cochlear implants, particularly when the desired speech signal is presented at poorer ear. Recent advances in technology allow unilateral implant recipient to use either a conventional hearing aid (HA) or a Contralateral Routing of Signal (CROS) device on the non-implanted ear. The clinical selection of the appropriate contralateral device type is fairly straightforward for individuals with either ‘adequate’ aidable audiometric thresholds (-> HA) or with absent aidable thresholds (-> CROS). However, optimal device selection can less clear for those with limited aidable hearing or bimodal benefit. Differences in speech understanding in noise depending on the specific device may be measurable through speech discrimination tasks in these individuals. We hypothesize that performance on a speech discrimination task will vary based on several factors: 1. the type of device used on the non-implanted ear, and 2. as the originating locations of the speech and noise signals are varied.
Methods: Approximately 40 subjects will be enrolled in the study. The targeted participant for this study is an individual who uses a cochlear implant that can be initialized to work with a HA or CROS devices on the contralateral ear between the ages of 18 and 89 years old, has at least 12 months of listening experience with their cochlear implant, and is a proficient speaker of English. Study visits include informed consent, a case history, hearing evaluation (pure tone air conduction thresholds), hearing device fitting (HA fitting with real ear verification and CROS fitting), and speech-in-noise testing using an adaptive Signal to Noise (SNR) protocol. Outcome measures include speech-in-noise testing with three device configurations (CI only, CI + HA and CI + CROS), and perceived listening effort ratings provided by each subject after each listening trial. Five speech + babble configurations will be assessed, (i) speech at non-CI side + babble presented diffusely, (ii) speech at CI side + babble presented diffusely, (iii) speech from front + babble presented diffusely, (iv) speech at non-CI side + babble at CI side, (v) speech and babble co-located in front.
Results: Results will be discussed in terms of participant performance in all listening conditions as a function of SNR and device configuration. Additional individual factors, such as non-implanted ear thresholds will also be considered. The results of the listening effort scale will be discussed and compared to the performance on the corresponding listening task.
Conclusion: Results will be used to discuss applicable clinical assessments that may be appropriate to determine benefit with a HA or CROS in individuals with limited aidable hearing in the non-implanted ear. Results will also be considered to assess how individual factors such as perceived listening effort or pure tone thresholds may help predict success with a contralateral HA or CROS.
Title: Pre- and Post-Operative Language Skills of Non-Traditional Pediatric Cochlear Implant Recipients: The Case for Earlier Implantation

Category: Audiology

Authors: Lisa R. Park, AuD, Maegan Evans, PhD, Kevin D. Brown, MD, PhD; Otolaryngology/Head and Neck Surgery, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC.

Abstract:

Introduction: Hearing preservation and the benefits of bimodal listening in adults has become established in the literature. Children with similar indications are seeking cochlear implantation. The present report examines pre- and post-operative receptive and expressive language scores among children who receive implants with significant levels of acoustic hearing as compared to those who meet traditional candidacy guidelines.

Methods: This retrospective review included 36 children with bilateral hearing loss who had a pre-operative pure tone average (PTA) of less than 75 dB HL in the better ear at the time of implant. These children were matched with traditional candidates on factors of pre-operative communication mode, age at diagnosis, progression of hearing loss (progressive vs stable), and socio-economic factors (private insurance vs Medicaid). Two separate two-way mixed ANOVAs were performed to investigate the effect of time and candidacy group on receptive and expressive language outcomes.

Results: Results demonstrate that children who are non-traditional cochlear implant candidates present for implantation with delays in receptive language that are equivalent to those of their peers who meet traditional guidelines. Expressively, their language skills are significantly poorer than traditional candidates. One-year after implantation, the traditional hearing loss group falls within normal limits for expressive language while those who presented with more residual hearing continue to show delays. Receptively, the traditional group makes substantial gains over the first year while the non-traditional group does not. While the age of diagnosis between groups was similar, the age of implantation was significantly higher for the non-traditional group.

Conclusion: When children with greater levels of residual hearing who may be cochlear implant candidates based on word recognition skills are implanted at later ages than their cohorts with profound hearing loss, it may be more difficult for them to close the language gap. Children with moderately severe to severe hearing loss should be monitored closely for implant candidacy and referred as soon as possible.
Poster Number: 63  
Abstract ID: 329  
Title: Fixed versus Adaptive Testing in Noise Measures in Cochlear Implant Recipients  
Category: Audiology  
Authors: Sandy Prentiss, PhD, Hillary Snapp, PhD, Alicia Restrepo, AuD, Rachel Fryatt, BS; Univ. of Miami, Miami, FL.  
Abstract:  
Introduction: The objective of this study is to investigate the clinical utility of fixed versus adaptive speech-in-noise measures to determine behavioral speech performance outcomes in cochlear implant recipients. In recent years, speech-in-noise measures have become a primary means in determining cochlear implant candidacy. Likewise, these measures are used to determine aided benefit in CI recipients. However, evidence based guidelines on the use of speech-in-noise measures in the evaluation and management of CI patients are not yet established. As candidacy guidelines continue to change and CI technology evolves, determining the utility of these measures and analyzing the efficacy of speech-in-noise protocols to evaluate aided benefit are essential.  
Methods: Retrospective review of adult English-speaking cochlear implant recipients comparing results on speech-in-noise measures pre- and post-operatively. CI recipients were evaluated using the adaptive BKB-SIN sentences, and the AzBio test sentences at a fixed signal to noise ratio of +5 dB SNR.  
Results: Post-operative speech perception scores utilizing the fixed SNR showed minimal change from pre-operative assessment. Significant differences in speech and noise performance are observed post-operatively with the adaptive BKB-SIN. Mean BKB-SIN scores were greater than 5 dB, indicating CI listeners on average needed an increased signal to noise ratio to achieve 50% speech understanding. The data suggests a possible floor effect may occur with some CI candidates, making improvements difficult to demonstrate at low SNRs for fixed speech-in-noise measures.  
Conclusion: The results support the clinical utility of adaptive speech-in-noise measures to monitor performance changes for CI recipients for listening in noise. Careful consideration of test parameters should be taken to determine benefit provided by CIs when using fixed speech in noise measure. Improvements in speech recognition may not be accurately demonstrated at low signal to noise ratios.
Introduction: Inner ear malformations are a common cause of sensorineural hearing loss and are often thought to be the result of arrested development during embryogenesis, typically with an underlying genetic mutation. Malformations usually seen with non-syndromic hearing losses can affect the cochlea and/or vestibular system, such as with enlarged vestibular aqueduct (EVA) syndrome or certain X-linked hearing losses (stapes gusher), and can also affect the auditory nerve, such as with cochlear nerve deficiency. The effects of these malformations on the biomechanics of the inner ear are not currently well understood. The use of near-field auditory evoked potentials may provide insight into understanding these effects. The present study sought to identify electrocochleography (ECochG) response characteristics present in patients with hearing loss with and without malformations.

Methods: Seven subjects in underwent intraoperative ECochG recorded from the round window using high intensity (105 dB SPL) long duration tone bursts (0.25-4 kHz) and broadband stimuli at the time of cochlear implant (CI) surgery. All recordings were collected prior to insertion of the CI. Measurements of the cochlear microphonics (CM), summation potential (SP), and compound action potential (CAP) were carried out. All subjects had computed tomography prior to implantation to confirm inner ear status and presence of malformation. ECochG responses from a control group of 20 subjects with SNHL without inner ear malformation were included.

Results: Similar CM responses were found between groups. In the malformation group, large positive deflections in the SP evoked by tone bursts were observed in 4/6 subjects, a large negative deflection, similar to endolymphatic hydrops, was observed for 2/6 subjects, and 2 subjects lacked any SP. The presence of an enlarged SP, with and without a CAP, was often observed in response to a broadband click stimulus, despite profound audiometric high frequency thresholds.

Conclusion: ECochG during CI surgery provides a robust opportunity high-frequency the biomechanical effects different malformations have on the inner ear. The results suggest that patients with malformations can have distinctly different ECochG response patterns, likely reflecting the underlying malformation, than those without a malformation. Whether these distinct patterns also reflect functional differences in behavioral performance outcomes remains unknown.
Poster Number: 65  
Abstract ID: 56  
Title: Quality of Life Before and After Cochlear Implantation in Cases of Unilateral and Asymmetric Hearing Loss  
Category: Audiology  
Authors:  
Meredith A. Rooth, AuD 1, Margaret T. Dillon, AuD 1, English R. King, AuD 2, Andrea Bucker, AuD 2, Harold C. Pillsbury, MD 1, Kevin Brown, MD 1; 1Otolaryngology/Head & Neck Surgery, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC,  2Audiology, Univ. of North Carolina Hlth. Care, Chapel Hill, NC.  
Abstract:  
Introduction: Several difficulties arise across the lifespan for unilateral and asymmetric hearing loss populations, and currently approved treatment options address few of those adversities. Patients with unilateral and asymmetric hearing loss encounter limited ability to understand speech in the presence of background noise and identify sound sources. As a result, they encounter a reduced quality of life. Hearing aids (traditional and contralateral routing of the signal devices) and bone-conduction devices either enhance a signal for the affected ear with poor perception or route the signal to the better hearing ear. Unfortunately, these treatment options have minimal effects on quality of life in these populations (Arndt et al., 2011). Cochlear implantation of the affected ear may be a viable option to restore hearing in the affected ear. Restored hearing in the implanted ear could provide the cues necessary to accomplish improved speech perception in noise and localization, as well as improve the quality of life. The present study examined subjective reports prior to and following cochlear implantation in both a unilateral and asymmetric hearing loss population.  
Methods: Forty (40) adults were implanted as part of an investigational device exemption clinical trial examining the benefit of cochlear implantation in cases of unilateral hearing loss population (20 subjects) and asymmetric hearing loss (20 subjects). Subjective abilities/difficulties and quality of life were assessed via the Abbreviated Profile of Hearing Aid Benefit (APHAB), Speech, Spatial and Qualities of Hearing (SSQ) scale, and Tinnitus Handicap Inventory (THI). Subjects completed these scales prior to cochlear implantation and at 1-, 3-, and 6-months post-cochlear implantation.  
Results: Both cohorts reported improved subjective outcomes and maintained these reports through the 6-month interval. A difference in improvement was noted between the two groups, with the unilateral hearing loss cohort reporting greater improvement in subjective abilities/difficulties than the asymmetric hearing loss cohort during the initial months of listening experience. No group differences were evident on the THI.  
Conclusion: Although differences in subjective outcomes were evident between these groups, quality of life reports improved significantly. Cochlear implantation in the unilateral and asymmetric hearing loss populations has the potential to restore binaural abilities and improve quality of life. It is important to identify the potential effects of this treatment as indications for cochlear implantation expand for pediatric cases of UHL and AHL.
**Poster Number:** 66  
**Abstract ID:** 345  
**Title:** Identifying Disadvantaged Groups for Cochlear Implantation: Demographics from a Large Cochlear Implant Program  
**Category:** Audiology  
**Authors:** Natalie Schauwecker, BBA, BS 1, Anthony M. Tolisano, MD 1, Imam Xierali, PhD 1, Bethany Baumgart, AuD 1, Cherysse Lanns, AuD 1, Johanna Whitson, AuD 1, J. Walter Kutz, MD 1, Brandon Isaacson, MD 1, Jacob B. Hunter, MD 2; 1Univ. of Texas Southwestern Med. Ctr., Dallas, TX, 2Otolaryngology, Univ. of Texas Southwestern Med. Ctr., Dallas, TX.  
**Abstract:**  
**Introduction:** To characterize the demographics of patients undergoing cochlear implant (CI) evaluations.  
**Methods:** Using a retrospective chart review between 2009 and 2018 of all adults referred for a CI evaluation at a university CI program. The main outcome measures were assessing the demographics, insurance status, and patient proximity to the CI program.  
**Results:** 784 CI evaluations were performed. The mean age was 64.2 years (range, 18-92 years), 54.7% were male, 87.6% were white, and 89.3% were primary English speakers. Overall, 74.7% qualified for CI, of which 63.8% pursued surgery. The majority (63.9%) had public insurance (e.g. Medicare or Medicaid), followed by private insurance (29.8%) and military insurance (3.3%). Females qualified for CI at a higher rate than males (79.4% vs. 70.9%, p=0.0064) but pursued surgery at the same rate (62.4% vs. 65.1%, p=0.5471). Minorities qualified for CI at a much higher rate compared to whites (90.1% vs. 75.4%, p=0.0027) but were significantly less likely to pursue surgery (57.5% vs. 70.9%, p=0.0282). English and non-English speaking patients qualified for surgery at similar rates (75.1% vs. 81.2%, p=0.3051) but English speakers pursued surgery at a higher rate (65.3% vs. 48.2%, p=0.0131). Although driving distance did not predict patients who qualified for CI, patients who pursued CI lived at a significantly greater distance compared to those who did not pursue CI (34.01 miles vs. 26.78 miles, p=0.0181).  
**Conclusion:** Disadvantaged groups, such as minorities, non-English speakers, and women, qualify for CI at a higher rate, suggesting the possibility of delayed CI candidacy referral, and generally pursue surgery at a lower rate.
Poster Number: 67  
Abstract ID: 209  
**Title:** Late Implantation in a Child with Eighth Nerve Deficiency  
**Category:** Audiology  
**Authors:**  
Mindy Schmelzer, AuD 1, Katrina Stidham, MD 2; 1Speech & Hearing, Westchester Inst. for Human Dev., Valhalla, NY, 2ENT Faculty Practice, Hawthorne, NY.  
**Abstract:**  
**Introduction:** The efficacy of cochlear implantation in children with eighth nerve deficiency has been well documented in the literature. However, a lack of auditory stimulation and/or late implantation may affect outcomes in children with or without eighth nerve deficiency. The lack of experience with sound and language may delay or hinder the development of auditory/oral language skills. In this single subject case study, we will report on a child who was identified at birth with bilateral severe to profound sensori-neural hearing loss and eighth nerve deficiency. The child used acoustic amplification for a very brief period of time and only used American Sign Language until age four.  
**Methods:** A retrospective review of clinical records, audiologic test results and speech perception was performed. Previous auditory brainstem response evaluations and MRIs were reviewed and were consistent with auditory neuropathy spectrum disorder and eighth nerve deficiency, respectively. Sequential cochlear implantation was performed following a brief trial with acoustic amplification. The child received auditory habilitation services three to five times a week.  
**Results:** Post-operative data, collected over a three-year period, indicated significant improvements in speech perception. In addition, the family reported improved listening and spoken language skills and the child transitioned from a traditional school for the deaf to his local school district.  
**Conclusion:** Cochlear implantation in cases of eighth nerve deficiency can result in significant improvement in the development of auditory/oral language skills even in late implantation. Appropriate habilitative services are necessary and the positive influence of early exposure to language, through American Sign Language, may have fostered skill development in this child.
Poster Number: 68
Abstract ID: 393
Title: Comparing Perimodiolar and Lateral Wall Cochlear Implant Electrodes in the Same Patient: A Multi-Institutional Comparison of Mapping Parameters and Audiometric Outcomes
Category: Audiology
Authors:
Zachary G. Schwam, M.D. 1, Matthew L. Carlson, M.D. 2, Maura K. Cosetti, M.D. 1, Alex D. Sweeney, M.D. 3, Vivian Z. Kaul, M.D. 1, George B. Wanna, M.D. 1, Jacob S. Hunter, M.D. 4; 1Otolaryngology-Head and Neck Surgery, Icahn Sch. of Med. at Mount Sinai/New York Eye and Ear Infirmary, New York, NY, 2Otorhinolaryngology/Head and Neck Surgery, Mayo Clinic, Rochester, MN, 3Otolaryngology-Head and Neck Surgery, Baylor Univ., Houston, TX, 4Otolaryngology-Head & Neck Surgery, Univ. of Texas-Southwestern Med. Ctr., Dallas, TX.
Abstract:
Introduction: Design differences between perimodiolar (PM) and lateral wall (LW) cochlear implant (CI) electrodes could possibly lead to differences in speech understanding. While several studies have compared cohorts of patients with each respective electrode, there is a paucity of audiometric and mapping data with respect to individuals who have a PM electrode in one ear, and a LW electrode in the opposite ear. We sought to explore differences in mapping parameters, battery life, and audiometric outcomes in patients who have a PM and LW electrode in opposite ears.
Methods: Retrospective review of proprietary mapping data, estimated battery life, and audiometric outcomes in those adult patients with a PM and a LW electrode in opposite ears. Summary statistics, paired sample t-tests, and one-way analysis of variance were performed.
Results: We will review audiometric and mapping data for a total 65 adult bilateral CI patients (130 ears). To date in our analysis, of those with a PM electrode, 74% had a CI24RE, 17% had a CI512, and 9% had a N24 electrode. LW electrodes were split between the CI422 (70%) and CI522 (30%). All patients in our sample had the PM electrode implanted first. With each patient serving as their own control, Consonant-Nucleus-Consonant (CNC) results for individual ears were significantly better for the ear with the PM electrode (mean 62.11 versus 40.00, p=0.001). However, there was no significant difference for postoperative AzBio scores when one ear was compared to the other (mean 71.38 PM ear versus 46.75 LW ear, p=0.121). Mean binaural AzBio and CNC scores were 80.60 ± 18.98 and 68.22 ± 17.16, respectively. There was no significant difference in either estimated battery life (28.91 PM versus 28.64 LW, p=0.929) or power setting (58.17% PM versus 56.30% LW, p=0.540). There were no significant differences between ears in frequency-specific T or C thresholds, dynamic range, electrically evoked compound action potentials, or pulse width (all p>.05, recorded for channels 1, 6, 11, 16, 22). When the PM and LW groups were analyzed in aggregate, the only significant difference was in CNC results (PM mean 60.00, LW mean 40.00, p=.006).
Conclusion: In our preliminary analysis of about one third of our subjects, there is no statistically significant differences in mapping parameters or battery life. Consistent with previous reports in children in which PM electrodes were implanted first, speech perception scores with lateral wall electrodes are poorer than those in ears with PM electrodes.
Title: Intelligibility of Naturally Produced and Synthesized Mandarin Speech by Normal-Hearing and Cochlear Implant Chinese Listeners

Category: Audiology

Authors:
Ying Shi, PhD 1, Jingyuan Chen, Master's 1, Biao Chen, PhD 1, Yongxin Li, Professor 1, Qian-Jie Fu, Professor 2, John J. Galvin, III, Professor 3; 1Beijing Tongren hospital of Capital Med. Univ., Beijing, China, 2Dept. of Head and Neck Surgery, David Geffen Sch. of Med., UCLA, Los Angeles, Los Angeles, CA, 3House Ear Inst., Los Angeles, CA.

Abstract:
Introduction: Mandarin is a tonal language, and it is important to preserve lexical tone information in synthesized speech. With natural speech, Chinese cochlear implant (CI) users have difficulty perceiving voice pitch cues important for lexical tone perception; it is unclear whether this difficulty persists in Mandarin synthesized speech. In this study, intelligibility of naturally produced and synthesized Mandarin speech was measured in Chinese normal-hearing (NH) and CI listeners.

Methods: Ten NH subjects participated in the study (5 males and 5 females; mean age = 26.0 years, range = 23 to 35 years). All NH subjects had pure tone thresholds < 20 dB HL at all audiometric frequencies between 125 and 6000 Hz. Seventeen Mandarin-speaking Chinese CI users also participated in the study (10 males and 7 females). The mean age at testing was 22.3 years (range = 15 to 48), and the mean CI experience was 9.0 years (range = 1 to 16). Sentence recognition was measured in quiet using Mandarin Speech Perception (MSP) sentences. The validated MSP stimulus set consists of 8 lists (10 sentences in each list) of easy difficulty. Each sentence includes seven monosyllabic words. All sentences were naturally produced by a single female talker in slow clear speaking style (F-Nat) or were synthesized using the iFlyTek TTS engine (www.iflytek.com). Five synthesized voices were selected to represent different talker genders, speaking rates, and speaking styles including: female voice with slow speaking rate (F-Slow); female voice with normal speaking rate (F-Norm); male voice with normal speaking rate (M-Norm); female voice with normal speaking rate and emotional quality as used for story telling (F-Emot); five-year-old boy’s voice in the accented style of Shin-chan, a main character in the popular Japanese manga and anime series “Crayon Shin-chan” (B-Acc).

Results: NH subjects achieved near-perfect performance with both natural and synthesized speech. CI subjects performed best with F-Nat, with poorer performance for the F-Slow, F-Norm, and M-Norm stimuli, and even poorer performance with the F-Emot and B-Acc stimuli. Note that there was also a wide range of CI performance, with some subjects performing near NH levels with the F-Nat, F-Slow, F-Norm, and M-Norm stimuli, and others performing 50% correct or worse with the synthesized speech. A split-plot repeated-measures analysis of variance (RM ANOVA) with speech type (F-Nat, F-Slow, F-Norm, M-Norm, F-Emot, B-Acc) as the within-subject factor and subject group (NH, CI) as the between-subject factor was performed on the data shown in Fig. 2. Results showed significant effects for [F(5,125)=31.9, p<0.001] and subject group [F(1,25)=788.8, p<0.001]; there was a significant interaction [F(5,125)=29.7, p<0.001]. Post-hoc Bonferroni pairwise comparisons showed no significant difference among speech types for NH listeners (p>0.05 in all cases). For CI subjects, performance was significantly better with F-Nat than with any of the synthesized stimuli (p<0.05 in all cases), better with F-Slow, F-Norm, and M-Norm than with F-Emot or B-Acc (p<0.05 in all cases), and better with F-Emot than with B-Acc (p<0.05).

Conclusion: NH listeners achieved near-perfect performance with both natural and synthesized speech. CI listeners performed significantly better with natural speech and were highly sensitive to vocal emotion and accents contained in synthesized speech.
Title: Interaction Between Speech Variations and Background Noise on Speech Intelligibility by Mandarin-Speaking Cochlear Implant Patients

Authors: Ying Shi, PhD 1, Kevin A. Peng, MD 2, Biao Chen, PhD 1, Jingyuan Chen, Masters 1, Yongxin Li, Professor 1, Qian-Jie Fu, PhD 3; 1Department of Otolaryngology, Beijing Tongren Hosp., Capital Med. Univ., Beijing, China, 2House Clinic, Los Angeles, CA, 3Department of Head and Neck Surgery, David Geffen Sch. of Med., Univ. of California, LA, Los Angeles, CA.

Abstract:

Introduction: Cochlear implant (CI) users have been shown to be more susceptible to the variations in speech production encountered in everyday listening, in which speaking rate, amplitude, duration, and voice pitch information may be quite variable. Such variations may be further enlarged by the background noise, especially dynamic noise. The limited spectral resolution provided by the CI limits perception of voice pitch, which is an important cue for speech prosody and for tonal languages such as Mandarin Chinese. In this study, the effect of varying speaking rates and styles and background noise on speech understanding was investigated in Mandarin-speaking CI and normal-hearing listeners.

Methods: Thirteen Mandarin-speaking, post-lingually deafened, adult CI patients and 9 normal-hearing patients. Word-in-sentence recognition was assessed using the Mandarin Speech Perception (MSP) materials, consisting of 5 lists of 20 sentences each. Each sentence contains 7 monosyllabic words, resulting in a total of 140 monosyllabic words for each list. The MSP materials consist of high quality digital recordings of speech produced by an experienced female Mandarin talker speaking in five different speaking styles (slow, normal, fast, emotional, and shouting). Emotional (happy) and shouting recordings were produced at a normal speaking rate. To investigate the impact of background noise, sentence recognition was measured with two types of maskers: speech-shaped steady-state noise (SSN) and six-talker babble masker.

Results: Two-way repeated-measures analyses of variance (RM ANOVA) were performed, with speaking styles and noise types as treatment factors. There was a significant effect of speaking styles \([F(4,32)=16.36, p<0.001]\) and noise types \([F(1,32)=384.73, p<0.001]\). There was a significant interaction between noise types and speaking styles \([F(4,32)=4.63, p=0.005]\). Post-hoc Bonferroni pairwise comparisons showed that performance was significantly better with slow-speech and shouted-speech than fast-speech, normal-speech, and emotional-speech \((p<0.01)\); there were no significant differences among the remaining speech materials, the mean SRT for CI subjects listening to the sentences spoken with different speaking styles in the presence of SSN and speech babbles. There was a significant effect of speaking styles \([F(4,48)=14.75, p<0.001]\) but no significant effect of noise types \([F(1,48)=0.398, p=0.540]\). When SSN was used as the masker, Post-hoc Bonferroni pairwise comparisons showed that performance was significantly better with slow-speech than normal-speech \((p=0.034)\), fast-speech \((p<0.001)\), emotional-speech \((p<0.001)\), and shouted-speech \((p<0.001)\). When six-talker babble was used as the masker, Post-hoc Bonferroni pairwise comparisons showed that performance was significantly better with slow-speech than fast-speech \((p<0.001)\) and emotional-speech \((p<0.001)\). There were also significant differences between shouted-speech and emotional-speech \((p=0.027)\).

Conclusion: NH listeners perform significantly better in speech babble than in steady-state noise regardless of variations in speech rate or style. Both NH and CI listeners are sensitive to speech rate in the presence of background noise.
Poster Number: 71
Abstract ID: 440
Title: Electro-Natural Stimulation in Partial Deafness Treatment: Pediatric Case Series
Category: Audiology
Authors:
Henryk Skarzynski, MD, PhD, Artur Lorens, PhD Eng, Piotr H. Skarzynski, MD, PhD, Beata Dziendziel, MS; World Hearing Center, Inst. of Physiology and Pathology of Hearing, Warsaw, Poland.
Abstract:
Introduction: The aim of the study is to present pediatric cases with normal hearing in the frequencies 125-1500 Hz and severe-to-profound hearing loss in frequencies above 1500 Hz. Cochlear implantation was conducted to restore functional hearing at high frequencies and preserve low and mid frequencies. Prospective clinical study based on the evaluation of hearing preservation.
Methods: A series of 11 children (aged 9 to 16 years old) with good functional hearing to 1.5 kHz and deafness in all other frequencies was evaluated pre- and postoperatively. All of them had a prelingual bilateral hearing loss. During cochlear implantation, a careful insertion of a flexible active electrode was inserted through the round window into scala tympani to a depth of 18 mm by an experienced surgeon.
Results: Hearing preservation was assessed according to the Hearing Preservation Calculation based on the pure-tone audiometry. In the 3-years observation period, the preoperative hearing threshold were completely preserved in two children and partial in the third child. A reliable assessment of speech intelligibility was possible only in the oldest child. Monosyllabic word recognition increased from 65 to 90% under quiet conditions and from 30 to 60% under noise.
Conclusion: As ENS patients are beyond the scope of effective rehabilitation with hearing aids, cochlear implantation seems to be a successful way of restoring hearing ability in the frequencies above 1.5 kHz. Our results are in favour of extending the inclusion criteria applied so far for this group of patients.
Poster Number: 73
Abstract ID: 102
Title: Benefit of Children with Single Sided Deafness and Normal Hearing on the Contralateral Side After Cochlear Implantation
Category: Audiology
Authors:
Georg M. Sprinzl, Univ Prof Dr 1, Philipp Schoerg, MSc 2, Astrid Magele, MD, PhD 1; 1ENT, Karl Landsteiner Private Univ. hospital, St.Poelten, Austria, 2Audiology, Karl Landsteiner Private Univ. hospital, St.Poelten, Austria.

Abstract:
Introduction: Over the last decade cochlear implantation in case of single sided deafness in adults has approved as an alternative treatment option to a conventional hearing aid supply (CROS method). As a consequence to the patients benefit in quality of life, patient’s satisfaction and the encouraging audiological results (speech understanding in noise, spatial hearing) also children with single sided deafness can be provided with a cochlear implant.

Methods: Since June 2013 17 subjects with single sided deafness and normal hearing on the contralateral side were treated with a cochlear implant at the Universitiv Clinic St. Poelten. Hearing thresholds, speech understanding in noisy environment (OLKISA) and spatial hearing were evaluated preoperatively and after a 6-month rehabilitation period in aided and unaided condition. In addition APHAB, SSQ12 and TBF12 were investigated.

Results: Improvement of speech understanding in noisy environment as well as improvement of spatial hearing was measured after the cochlear implantation. Benefits in quality of life were measured by questionnaires. Results will be presented.

Conclusion: The patients’ benefit in quality of life and the audiological results confirm the cochlear implantation as efficient treatment and rehabilitation of adults, teenagers and also children with single sided deafness and normal hearing on the contralateral side.
**Poster Number:** 75  
**Abstract ID:** 416  
**Title:** The Clinical Application of ESRT in Cochlear Implantation  
**Category:** Audiology  
**Authors:**  
Jincangjian Sun, BC, Guanxia Xionhg, MD, Xian-Ren Wang, MD; the first affiliated hospital, Sun Yat-sen university, Guang Zhou, China.  

**Abstract:**  
The clinical application of ESRT in Cochlear Implantation  
Guan-Xia Xiong, Xian-Ren Wang, Jin-Cangjian Sun  

[Abstract]  
Objective To investigate the relationship between intraoperative electrically evoked stapedius reflex threshold (ESRT) and the most comfortable value in postoperative adjustment of cochlear implant, as well as the relationship between the change of post operative ESRT and the change of most comfortable value and threshold level, in order to provide a reference for the patients who are underage or cannot cooperative in postoperative adjustment.  

Methods Twenty-five patients with certain language ability were selected, aged from 6 to 45 years old, with an average age of 15 years. Among the patients, 10 of them was implanted medel sonata, 6 of them was implanted cochler CI512, 6 of them was implanted AB, 3 of them was implanted norotron. Do the intraoperative ESRT of the electrodes from the apex, middle and basal part of the cochlea, Compared with ESRT and, Psycho—physical measurements servation threshold level and most comfortable level in starting and three months after starting up. Results There was a positive correlation between intraoperative ESRT and startup M level, and the changes of ESRT were much higher than those of T level each time, which were basically consistent with the changes of M value. Conclusion The intraoperative evoked stapes muscle reflex can provide a reference for the determination of M level in cochlear starting up. Postoperative changes in ESRT can provide a hint for the adjustment of M level. Due to the simple detection method, routine measurement during parameter setting of speech processor can be carried out.  

[Key words] Electrically evoke stapedius reflex; intraoperative ESRT; cochlear implant
Poster Number: 76  
Abstract ID: 421  
Title: Assessment of Speech Discrimination Score and Aided Hearing Threshold after Cochlear Implantation in Postlingual Deaf Adults  
Category: Audiology  
Authors:  
Jincangjian Sun, BC, Fan-Qin Wei, MD, Guanxia Xiong, MD; the first affiliated hospital, Sun Yat-sen university, Guang Zhou, China.  
Abstract:  
Assessment of Speech Discrimination Score and Aided Hearing Threshold after Cochlear Implantation in Postlingual Deaf Adults  
Fan-Qin Wei, Guan-Xia Xiong, Xian-Ren Wang, Jin-Cangjian Sun[Abstract]  
Objective  
To follow up speech discrimination score (SDS) and aided hearing threshold (AHT) of adult cochlear implant users and to analyze the time of optimal effectiveness obtained by the cochlear implant in postlingual deaf adults.  
Methods  
Sixteen adult cochlear implant users (7 females and 9 males) participated in this study. Their average age is 45 years old at implanting (19 – 69 years old). The average duration of deafness is 3 years (2 months – 9 years). The patients were given examination of SDS and AHT at 3, 6, 12 and 24 months after implantation.  
Results  
The SDS and AHT were improving constantly at 3, 6 and 12 months after cochlear implantation, and the SDS still improved 10% – 30% after the AHT reached the optimal value. Growth rate of SDS from 6 th to 12 th month was lower than that of SDS from 3 th to 6 th month. The SDS was stabilized in the 12 th to 24 th month after implantation.  
Conclusion  
Cochlear implantation can significantly improve the level of hearing and speech discrimination in postlingual deaf adults. The SDS and AHT increases continuously within 12 months and achieve the optimal level in the 12 th to 24 th month after implantation.
Poster Number: 77  
Abstract ID: 141  
Title: Single Sided Deafness prior to CI - Temporary Use of an Adhear after Contralateral Middle Ear Surgery  
Category: Audiology  
Authors: Magnus J. Teschner, MD, PhD, MBA, Dawid Murawski, B.Sc., Thomas Lenarz, MD PhD, Susan Busch, Dr.; Department of Otolaryngology, Hannover Med. Sch., Hannover, Germany.  
Abstract:  
Introduction: Children with a single sided deafness sometimes have to undergo an ear surgery on the better hearing side. In this surgery, the external ear canal is often being plugged with sponges. As a result, the child suffers a temporary conductive hearing loss on the remaining hearing ear. The question arises as to whether this temporary impairment can be adequately compensated with the help of the non-invasive bone conduction hearing aid Adhear.  
Methods: Ten patients undergoing a middle ear surgery with plugging of the external ear canal were treated with an Adhear bone conduction hearing aid (MED-EL, Innsbruck, Austria). Three weeks after treatment, speech discrimination in the Freiburg monosyllabic test at 65 dB and HSM sentence test (HSM at 65 dB and 55 dB noise) were determined before removing the plug. Speech discrimination in the plugged ear was measured with the Adhear and and unaided without the hearing aid. Patient satisfaction with the Adhear was assessed using the SSQ questionnaire and an Adhear user questionnaire.  
Results: The results of the first patients show an average improvement in speech discrimination (Freiburg monosyllabic) of 20% and an improvement in sentence discrimination in noise (HSM sentence test) of 11% with the Adhear compared to the unaided situation. In the SSQ questionnaire, an medium rating of 5.14 was determined for the Adhear. The Adhear user questionnaire showed satisfactory validations of the Adhear. The sound quality was rated as adequate (N = 4) to good (N = 5) by all patients.  
Conclusion: The use of an Adhear bone conduction hearing aid can improve speech discrimination in the situation of postoperative packing of the ear canal, especially in children with single sided deafness. The bone conduction hearing aid can be fixed behind the ear by means of an adhesive coupling device and no surgical intervention is necessary. If the middle ear surgery does not improve the hearing, the patient may continue to use the Adhear.
Cochlear Nerve Deficiency and Cochlear Implantation: A Case Study

Introduction: Cochlear nerve deficiency (CND) affects approximately 18% of pediatric patients diagnosed with a sensorineural hearing loss (Anna X Hang, et al., 2012). In April 2016, a 3 month-old female presented to our clinic with her parents after an Auditory Brainstem Response (ABR) evaluation, performed at an outside facility, suggested a right-sided severe to profound hearing loss and a left-sided severe loss. Type of hearing loss was unknown at that time. The family was interested in having her evaluated by our Multidisciplinary Cochlear Implant and Hearing Loss Team including: Pediatric Otolaryngology, Pediatric Audiology, Auditory-Verbal Therapy (AVT), Social Work and Genetics. The patient was fit with binaural power hearing aids. Radiologic studies suggested a Grade III internal auditory canal (i.e. hypoplastic nerve or cochlear nerve aplasia). Genetic panels did not suggest a genetic cause of hearing loss. After lack of benefit was demonstrated with traditional amplification, meeting with all members of the team and verifying medical candidacy, the patient received bilateral cochlear implantation at the age of 14 months. Unexpectedly at 6 months post activation, the patient showed early signs of speech and language acquisition. Progress halted and the patient began to regress 7 months post activation. The purpose of this case study is to demonstrate the unexpected performance outcomes of cochlear implantation with CND.

Methods: Case study

Results: The patient received bilateral Cochlear Americas CI532 implants simultaneously in March 2017. The surgeon reported full insertion with no complications during surgery. Impedance testing revealed responses across the array, bilaterally; however, intra-operative neural response telemetry (NRT) on the automatic settings showed excessive electrical noise and the software could not determine neural responses. Post-operative assessments with advanced NRT (not available at the time of surgery) revealed 5 out of 5 neural responses across the array at high stimulation levels. Upon initial activation of bilateral implants, immediate sound awareness was noted. Progressive maps, extensive AVT, Early Intervention, along with consistent parental support, yielded pure tone thresholds in the mild hearing loss range with reliable responses to Ling sounds at 6 months post activation. In November 2017, at approximately 7 months post-activation, the patient stopped progressing with auditory attention, recognition of speech, Ling sound reproduction and mimicking conversations. Regression in auditory and speech abilities began in December 2017. Various changes in mapping strategies and consultation with the manufacturer have yet to yield any progress and an inability to repeat past progress. Attempts continue to examine the nature of this regression. At this time, device failure, trauma, and developmental aspects have been ruled out as a cause. At 30 months of age the patient continues to demonstrate poor auditory attention and lack of oral/aural language access.

Conclusion: Despite previous results depicting positive response to sound and early learning stages of speech acquisition, regression in progress and inability to repeat past progress has caused a shift in expectations and further educational recommendations. The patient was once on track for listening and spoken language with supports in a mainstream classroom; however she will now likely be recommended for a visual language supported school.
Title: First Results with a New, Pressure free, Adhesive Bone Conduction Hearing Aid in Children

Category: Audiology

Authors:
Milan Urík, PhD 1, Dagmar Hošnová, PhD 1, Ivo Šlapák, Professor 1, Jan Odstrčilík, PhD 2; 1Department of Pediatric Otorinolaryngology, Masaryk Univ., Brno, Czech Republic, 2Department of Pediatric Otorinolaryngology, Faculty Hosp., Brno, Czech Republic.

Abstract:
Introduction: The aim of this study was to evaluate the hearing benefit, advantages, and disadvantages in a series of patients using a new, nonimplantable, pressure-free, adhesive bone conduction hearing aid in children.

Methods: Sixteen patients were included in the study at the Department of Pediatric Otorinolaryngology of Faculty of Medicine of Masaryk University and Faculty Hospital in Brno, Czech Republic. All patients suffered from conductive hearing loss for at least 3 months. A sound field audiometry, word audiometry test were carried out. Additionally, sound quality (SSQ12) and quality of life (AQoL-8D) were assessed using questionnaires.

Results: Analysis revealed an average aided threshold and an unaided threshold, resulting in a statistically significant average functional gain. Additionally, participants experienced significantly gain in word recognition scores. Both, the SSQ12 and the AQoL-8D showed a statistically significant improvement when comparing the scores at the beginning of the study to the answers after 2 weeks of device usage. Neither skin irritations nor pain were reported during the study period.

Conclusion: In conclusion, this new, adhesive bone conduction hearing aid has a high patient satisfaction rate while causing no skin irritation or pain.
Title: Barriers to Care for Latino Pediatric Cochlear Implant Recipients

Category: Audiology

Authors:
Gabrielle S. Watson, MA 1, Paulina Larenas, BS 2, Lina Reiss, PhD 3, Katharine Zuckerman, MD, MPH 4, Brittany Wilson, AuD 1; 1Department of Otolaryngology - Audiology, Oregon Hlth. & Sci. Univ., Portland, OR, 2Oregon Center for Children and Youth with Special Health Needs, Oregon Hlth. & Sci. Univ., Portland, OR, 3Department of Otolaryngology, Oregon Hlth. & Sci. Univ., Portland, OR, 4Division of General Pediatrics, Oregon Hlth. & Sci. Univ., Portland, OR.

Abstract:
Introduction: Cochlear implantation has become more common in the pediatric population as a result of earlier identification of hearing loss. Outcomes with cochlear implants (CI) in children still vary, and depend on device retention and access to support services, as well as demographic factors such as socioeconomic status. Less is known about the impact of these factors in Latino Spanish-speaking populations. Racial/Ethnic disparities have been identified in the diagnosis and treatment of many health conditions among Latino children, such as children diagnosed with autism spectrum disorders. Little is known about the barriers to care for pediatric CI recipients of Latino Spanish-speaking families in the United States. The goal of the current study is to compare experiences and identify barriers to identification, treatment of hearing loss, and other support services for pediatric CI children of English-speaking/bilingual versus Spanish-speaking Latino parents, i.e. parents with good versus limited English proficiency. The findings will serve as pilot data to support a larger multi-site study which will explore speech and language outcomes and prospective intervention in this population.

Methods: Chart review was used to identify children of Latino ethnicity who received their CI at age 0-12 years of age between the time of 2010-2016. Children with varying degrees and etiologies of hearing loss were included. Subjects were divided into two groups based on English language proficiency as indicated in their medical chart and verified in phone interviews. Semi-structured phone interviews will be conducted with a small subset of parents to probe experiences with initial diagnosis and intervention of hearing loss, including language of child, language of parent, community perceptions of hearing loss, community support and therapy service settings, barriers through diagnosis process, and process improvement. Interviews will be coded for major themes by members of the study team, and themes will be used as the basis for a survey to be administered to a larger subject population.

Results: Findings from phone interviews with Latino parents will be discussed. Themes that emerged from these phone interviews will be used in development of a survey for a multi-center study which will involve multiple implant centers with large Latino populations.

Conclusion: Understanding the barriers to care for Spanish-speaking families of children who use CIs is imperative to improving quality of care, perception of care, and ultimately language outcomes for the child.
**Title:** Evaluating and Optimizing Electrically Evoked Stapedial Reflex Thresholds  
**Category:** Audiology  
**Authors:** Brittany Wilson, AuD, Timothy Hullar, MD, Carrie Slough, AuD; Department of Otolaryngology, Oregon Health and Sci. Univ., Portland, OR.

**Abstract:**  
**Introduction:** Many studies have shown that the electrically-evoked stapedial reflex threshold (eSRT) highly correlates with subjectively measured comfort levels in cochlear implant (CI) programming. Implementation of eSRT may be less widespread as a result of lacking consensus on how to best obtain the reflex, how it evolves over time, and how eSRT should be applied in programming. The goal of the present study is to further evaluate the incidence and stability of eSRT obtained during surgery, postoperatively over time, and with various probe tones, as well as to better understand the functional impact of eSRT programming on the listening experience.  
**Methods:** Subjects are adult CI recipients who elected to receive the Medel Synchrony CI. ESRT will be measured intra-operatively during CI surgery, and at routine intervals from activation to 12 months post-activation, using randomized electrode and probe tone order (226 Hz/678 Hz). Thresholds obtained in all conditions will be compared to subjective comfort levels. After sufficient experience with the CI, speech perception testing will be completed in standard behavioral and eSRT-based programs. After experience in both program styles, subjects will answer a survey probing their experience with both styles of program.  
**Results:** Subjects are adult CI recipients who elected to receive the Medel Synchrony CI. ESRT will be measured intra-operatively during CI surgery, and at routine intervals from activation to 12 months post-activation, using randomized electrode and probe tone order (226 Hz/678 Hz). Thresholds obtained in all conditions will be compared to subjective comfort levels. After sufficient experience with the CI, speech perception testing will be completed in standard behavioral and eSRT-based programs. After experience in both program styles, subjects will answer a survey probing their experience with both styles of program.  
**Conclusion:** ESRT is an important part of standard of care. Better understanding of the relationship of eSRT and the parameters used to obtain it may improve clinical implementation of objective measures in standard of care.
Title: Effect of Delay of Implantation on Speech Perception Outcomes in Children Who Are Non-Traditional Cochlear Implant Candidates

Category: Audiology

Authors: Jennifer Woodard, AuD, Elizabeth L. Perkins, MD, Lisa R. Park, AuD, Kevin D. Brown, MD; Otolaryngology, Univ. of North Carolina - Chapel Hill, Durham, NC.

Abstract: Introduction: As pediatric cochlear implant candidacy expands, children with greater degrees of residual hearing are receiving cochlear implants. Many of these non-traditional candidates develop functional spoken language, making the timing of cochlear implantation a difficult decision for parents, with many parents electing to wait despite counseling to proceed with implantation. The purpose of this study is to determine the impact of parent-delayed implantation on speech perception in children with pre-operative hearing in the severe range or better.

Methods: All children with a pre-operative lower pure tone average (PTA, 250 Hz, 500 Hz, and 1000 Hz) of less than 75 dB HL at the time of implantation were considered for this retrospective review. Inclusion criteria were typical development, lack of significant inner ear malformation, at least 1 year of device use, and post-operative CNC word scores. Serial audiograms and speech perception scores obtained prior to implantation were reviewed. For those who were old enough to complete open set word recognition, a candidacy date was determined using the formula suggested by Hoppe et al (2015); 4FPTA-8 > PBMax. For younger children, the candidacy date was set as the date when the pediatric audiologist first made the referral to the implant team. The length of time between the date of candidacy and implantation was calculated and defined as the “delay time.” Post-operative CNC word scores were measured against the delay time using a linear regression. A multiple regression analysis was used to identify any influencing co-factors.

Results: A significant regression was found, F(4,38) = 5.167, p = .002, R 2 = .353. Both age at implantation (p = .023) and delay (p = .002) predicted CNC word scores. Surgery type (1st ear vs 2nd ear) (p = .562) and array (lateral wall vs perimodiolar) (p = .132) did not predict CNC word scores in this group. Age at implant was positively correlated with higher CNC word scores in this group, likely due to progressive hearing losses; however, delay time was negatively correlated with CNC word scores. Poorer CNC word scores are noted when implantation is delayed in non-traditional pediatric cochlear implant recipients.

Conclusion: While cochlear implant candidacy for adults has evolved, candidacy guidelines for children have not changed in almost two decades. The implications of speech perception difficulties are far reaching in the pediatric population. Our findings suggest that parent delay of cochlear implantation, once conservative candidacy guidelines have been met, leads to poorer outcomes in children.
Poster Number: 83  
Abstract ID: 108  
Title: Audiological Benefit with the Adhesive Bone Conduction Hearing System in Children with Congenital Aural Atresia  
Category: Audiology  
Authors:  
Maria F. Di Gregorio, MD 1, Elvira Alvarado, Audiologist 2, Natalia Claveria, Audiologist 2, Maximo Zernotti, MD 1, Mario E. Zernotti, MD PhD 1; 1ENT, Sanatorio Allende, Cordoba, Argentina, 2ENT, Clinica Santa Lucia, Jujuy, Argentina.  
Abstract:  
Introduction: For patients with congenital aural atresia (CAA) there are few non-surgical options and implantable bone conduction prosthesis surgery is recommended in most cases. The regulations allow surgery from 5 y.o. Therefore the Conductive Hearing Loss remains for a long period of time and need options to overcome this lack of treatment for a better quality of life and safety. Speech communication is one of the most important human abilities and a functioning auditory system is very essential to join communications and to interact with other people. With a hearing impairment speech understanding can be greatly reduced compared to normal-hearing persons. Furthermore, it can be difficult to perceive sounds from the environment with hearing impairment which can be a safety issue. The non-implantable adhesive bone conduction hearing system might be a suitable measure to improve hearing in patients prior to surgery and might be a non-invasive solution for patients that are unwilling to undergo surgery. The aim of this study is to evaluate the audiological benefit and subjective satisfaction of the adhesive hearing system in patients with conductive hearing impairment.  
Methods: Prospective, single-subject repeated-measure study is presented. Each subject serves as his/her own control. Fourteen patients from 3 to 16 y.o., affected by unilateral or bilateral CAA were included. Methodology of evaluation include sound field audiometry, speech recognition in quiet and noise in unaided and aided conditions.  
Results: The mean basic audiometry PTA4 (pure tone average .5,1,2 and 4 KHz) thresholds for the air and bone conduction (AC & BC) were 63.9 dB HL and 12 dB HL respectively. The aided PTA4 in sound field audiometry with the adhesive bone conductive hearing system reached 29.4 dB HL; therefore the mean functional gain was 34.4 dB. Word recognition score (WRS) at 65 dB SPL in quiet changed from 31% (unaided) to 91% (aided).  
Conclusion: The new adhesive bone conduction hearing system is a suitable option to improve the conductive hearing impairment due to CAA. This prosthesis can deliver normal hearing and speech understanding performance without surgery.
**Title:** Assessing Angular Insertion Depth from an Intraoperative X-ray with a Rotating Cochlear Model: Implications for Pediatric Cochlear Implantation

**Category:** Basic Research

**Authors:**
Michael W. Canfarotta, MD, Christopher K. Giardina, PhD, Nicholas J. Thompson, MD, Sarah E. Hodge, MD, Douglas C. Fitzpatrick, PhD, Harold C. Pillsbury, MD, Kevin D. Brown, MD, PhD, Brendan P. O’Connell, MD; Otolaryngology/Head and Neck Surgery, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC.

**Abstract:**

**Introduction:** Post-implantation imaging allows for the assessment of the intracochlear position and angular insertion depth (AID) of the electrode array. The intracochlear position and AID are useful in predicting postoperative outcomes and mapping the external audio processor for optimal speech perception outcomes. Intraoperative x-ray allows for visualization of electrode array placement, however, is limited in deriving the AID. Postoperative computed tomography (CT) scans allow for the calculation of AID, however, are not routinely recommended for pediatric cochlear implant (CI) recipients due to the increased radiation exposure. We have developed a new technique to determine AID using intraoperative x-ray, regardless of head position. The present report reviews the development and validation of this technique, and the potential implications for the postoperative treatment of pediatric CI recipients.

**Methods:** Fifteen adults underwent CI with lateral-wall electrode arrays of varying lengths. Each subject had intraoperative x-ray and postoperative CT scans obtained. A novel algorithm was developed utilizing a rotating/scalable 3D model of the scala tympani to estimate AID from an x-ray taken at an arbitrary angle. The user manipulates a helical vector model of the scala tympani over the x-ray until the projection angle is inferred. Next, the user sweeps through the spiral to tag angular landmarks, including the round window and electrode contacts. Validation of the model involved 1) assessing accuracy, by comparing estimated AID on x-ray to AIDs measured on postoperative CT scans, and 2) assessing precision by comparing inter-rater estimated AIDs.

**Results:** Using the CT algorithm, AID ranged from 392° to 650° across subjects. The x-ray and CT measurements agreed to within a mean of 11.1°. The intraclass correlation coefficients for intra-(0.995) and inter-rater reliability (0.926) of AID were excellent.

**Conclusion:** While CT remains the gold standard in the determination of AID, this new technology using intraoperative x-ray is a reliable tool to measure deep insertion angles, regardless of head positioning and deviation from cochlear view. This technology is particularly beneficial for pediatric CI recipients since it provides information regarding intracochlear position and AID without increased radiation exposure. This scientific advancement could move the field forward in regards to use of patient and device variables in the mapping of the external audio processor.
Title: Spatial Hearing After Cochlear Implantation in Cases of Unilateral and Asymmetric Hearing Loss

Abstract: Introduction: Patients with substantial unilateral hearing loss (UHL) or asymmetric hearing loss (AHL) experience poorer spatial hearing, including speech perception in spatially-separated noise and localization, as compared to normal-hearers. Unfortunately, approved treatment options for severe-to-profound UHL and AHL do not provide significant improvements on these measures. Cochlear implantation has been explored as a potential treatment option for cases of UHL and AHL. The present report reviews the preoperative and post-initial activation spatial hearing of CI recipients with UHL and AHL to assess its effectiveness as a treatment option.

Methods: Twenty (20) subjects with UHL and 20 subjects with AHL underwent preoperative testing, cochlear implantation, and follow-up assessment as part of a single-site clinical trial. Subjects were assessed preoperatively in the unaided condition and with a bone-conduction hearing aid (BCHA). Subjects were assessed in the unaided condition and with the cochlear implant plus the contralateral ear (CI+Contra) condition at 1, 3, 6, 9 and 12 months post-initial activation. The test battery included measures of speech perception in spatially-separated noise and localization using an 11-speaker arc spanning 180 degrees.

Results: Preoperatively, speech perception was similar or poorer in the BCHA condition as compared to the unaided condition. Localization was significantly worse in the BCHA condition as compared to the unaided condition. Subjects demonstrated a significant improvement on speech perception in noise and localization in the CI+Contra condition as early as the 1-month interval. Comparisons between the UHL and AHL demonstrated a more prolonged acclimatization for the AHL cohort.

Conclusion: Subjects with UHL and AHL experienced a significant improvement with the CI+Contra on measures of speech perception in noise and localization. Performance with the CI+Contra exceeded that of the BCHA condition. These results support the idea of expanding cochlear implantation candidacy criteria to include those with severe-to-profound UHL and AHL. Investigations of spatial hearing associated with different hearing configurations are needed as cochlear implantation candidacy expands in the pediatric population.
Title: Evaluating the Efficacy of New Otoprotective Drugs for Cochlear Implantation Trauma with or without Electrical Stimulation using In Vitro and In Vivo Models

Category: Basic Research

Authors:
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Abstract:

Introduction: Cochlear implantation (CI) is widely used to provide auditory rehabilitation to hearing impaired individuals. While there is a trend to implant patients with residual hearing, CI may cause some loss of this residual hearing. The direct effect of implantation of the electrode in affecting macroscopic structures of the inner ear is well described. However, the effect of the electrical field generated by the implant on the residual hearing and cochlear damage is not well-known. Developing in vitro and in vivo models of CI trauma with electrical stimulation, which closely mimics human clinical conditions will help in understanding the contribution of electrical stimulation in cochlear damage and loss of residual hearing.

Methods: A custom stimulator circuit that allows to study several parameters, including stimulation amplitude, pulse width, and total stimulation duration was designed. 1) For in vitro model, the organ of Corti explant cultures from postnatal day three (P3) rats were used and placed in microchannel slide (Ibidi, GmbH) in the incubator and exposed to stimulation or left unstimulated. Parameters (amplitude, pulselength and duration) were changed one at a time. The organ of Corti explants were subjected to FITC phalloidin staining to visualize hair cells using confocal microscopy. The number of surviving hair cells were counted. 2) For in vivo, we assessed the contribution of electrical stimulation in the loss of residual hearing and cochlear damage employing a preclinical guinea pig model of CI. Implanted guinea pigs were subjected to electrical stimulation or left unstimulated. Hearing thresholds were determined by auditory brainstem recordings (ABRs), eABRs and distortion product otoacoustic emissions (DPOAEs) at different days post-implantation. The whole cochleae harvested from stimulated and unstimulated animals were also subjected to CellROX and cleaved caspase 3 staining to determine the levels of oxidative stress and apoptosis, respectively. Three drugs were tested for their efficacy to provide otoprotection for CI trauma with and without stimulation in these models.

Results: In vitro testing suggests that the electrical stimulation may cause some damage to hair cells, mainly with higher stimulation levels and longer times of stimulation. On par with in vitro findings, spiral ganglion neurons and number of hair cells were decreased in guinea pig model of CI subjected to EIT and electrical stimulation compared to control and EIT alone. There were high levels of oxidative stress in EIT + electrical stimulation compared to control and EIT alone. We observed an increase in ABR threshold shifts and DPOAE amplitudes in the stimulated CI group compared to unstimulated implanted animals at all frequencies and time-periods. Our preliminary results suggest that two out of three identified otoprotective compounds provide protection against loss of hair cells in response to CI trauma and/or electrical stimulation.

Conclusion: The stimulator circuit we designed and constructed very closely simulates the electrical field of a cochlear implant. It has enough task flexibility to be used in in vitro and in vivo models of electrical stimulation. The in vitro and in vivo models developed in this study using electrical stimulation can be used to understand the effect of electrical field on inner ear sensory cells and to screen otoprotective drugs for the preservation of residual hearing post CI.
Poster Number: 87  
Abstract ID: 430  
Title: Brain Responses to Silent Lip Reading in Cochlear Implant Users Predict Speech Perception Outcomes  
Category: Basic Research  
Authors: Maya Kuroiwa, MD, Varia Sajeniouk, B.Sc, Trung Le, MD, PhD, FRCSC, Vincent Lin, MD, FRCSC, Joseph Chen, MD, FRCSC, Andrew Dimitrijevic, PhD; Otolaryngology - Head and Neck Surgery, Sunnybrook Hlth. and Sci. Ctr., Toronto, Canada.

Abstract:  
Objectives: Relate lip reading skills with CI performance outcomes  
Methods: Ten post-lingually deafened individuals implanted with a CI were recruited to participate in a brain imaging study to investigate neural correlates of lip reading. High-density electroencephalography (EEG) was recorded while participants watched silent movie clips lasting 2.5 sec of a person reciting single syllable words. Participants were instructed to indicate what word was perceived. Performance on the task was scored as percent correct. Brain responses were quantified using two methods: (1) averaged evoked responses, and brain source imaging to the onset of the movie and (2) time-frequency decompositions with beamformer brain source analysis for alpha and gamma responses to the movie. Correlations between brain responses and clinical measures of speech perception (AzBio and CNC), duration of deafness and lip reading performance were performed.  
Results: Average performance for the lip reading task was 28.65%. Averaged evoked potentials (N1) revealed a significant positive correlation with the lip reading performance. Brain source activation strength of the N1 also revealed a positive significant correlation with AzBio in the right temporal parietal region (Brodmann area 39). Both gamma (35-40 Hz) during stimulus presentation and alpha (8-12 Hz) after stimulus offset revealed significant relationships with AzBio scores.  
Conclusion: These results suggest that brain functions that promote visual encoding of lip reading are positively associated with CI speech perception outcome. A synergistic relationship between lip reading ability and speech perception is suggested.
**Title:** Perception of Prosodic Phrase Boundaries by Children with Cochlear Implants and Hearing Children

**Category:** Basic Research

**Authors:**
James Mahshie, PhD
Department of Speech, Language, and Hearing Sciences, George Washington Univ., Washington, DC.

**Abstract:**

**Introduction:** Perception of prosody can be challenging for children with cochlear implants. As a result of the limited fine structure available through current cochlear implants, acoustic parameters conveying prosodic cues can be less accessible than is the case for hearing children. In the present study we examined the ability of children with cochlear implants, and hearing children, to perceive prosodic phrase boundaries, or chunking.

**Methods:** Seven children with cochlear implants (Mean age = 86.6 months, sd = 13.3 months) and seven age matched hearing children (Mean age = 84.7 months, SD = 12.5 months) served as participants. Two prosody perception tasks were developed based on the approach suggested by Peppe and her colleagues (e.g. Peppe, et al., 2007). The first task used colored images that depicted two alternatives that are distinguishable based on chunking (e.g., the blue & black, and green blocks vs. the blue, and black, and green blocks). The second task involved identifying one of two possible utterances whose content was ambiguous based on the words presented, but that could be distinguished based on prosody (for example, butter, fly, and jam vs butterfly and jam). The stimuli were presented randomly through high quality loud speakers. The children responded to what they heard by pointing to one of two pictures depicting the two possible interpretations of the utterances. There were sixteen trials for both the color chunking and word chunking tasks.

**Results:** There were no significant differences between the CI and hearing groups in perception accuracy of either the color chunking stimuli (p = .615) or the word chunking stimuli (p = .314). The color and word chunking data were subsequently combined for the two groups. A repeated measures t test was conducted comparing accuracy for perception of the color chunking vs word chunking utterances. The analysis revealed that the children perceived the color chunking stimuli with a lower accuracy than the word chunking stimuli (color chunking mean = 68.8%, sd = 25.7%; word chunking mean = 88%, sd = 10.1%, p = .018).

**Conclusion:** The children with cochlear implants and their hearing peers performed similarly on the two tasks requiring perception of prosodic phrase boundaries. This suggests that the children with cochlear implants have access to the relevant acoustic information needed to perceive prosodic phrase boundaries in ways similar to their hearing peers. Both groups, however, tended to perceive the stimuli comprised of concrete words more accurately than the more abstract color descriptions. Thus the semantic attributes of the stimuli, in addition to the prosodic attributes, can significantly affect the accuracy of the ability of the children to accurately perceive the intended prosodic patterns. This has important implications on the type of stimuli that are appropriate to use in assessing this aspect of prosody.

**Reference:**
**Poster Number:** 89  
**Abstract ID:** 191  
**Title:** Effectiveness of Umbilical Cord Derived Mesenchymal Stem Cell Transplantation in Cochlear Implantation  
**Category:** Basic Research  
**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 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 & morphological regeneration spiral ganglion deaf animal model.  
**Methods:** UCB & WJ were collected from pregnant women after obtaining consent, and mesenchymal stem cells were extracted. We transplanted UCB-MSC & 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 & 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 in deaf animal model.  
**Conclusion:** Intravenous transplantation of Umbilical cord derived MSCs can regenerate spiral ganglion neurons and restore hearing in deaf animal model. Therefore autologous umbilical cord derived MSC transplantation may improve functional result of CI.
Poster Number: 90
Abstract ID: 135
Title: Changes of blood flow in the cochlea after noise exposure: an animal model
Category: Basic Research
Authors:
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Abstract:
Introduction: Several mechanisms of damage to the cochlea by noise have been proposed, one of them is considered to be the change of microcirculation. In this study, we aimed to investigate microvascular and related molecular changes in the cochlea caused by temporary or permanent noise-induced hearing loss.
Methods: Changes of cochlear blood flow were measured after noise exposure and related vasoactive factors were observed via various molecular biologic studies.
Results: Changes in microcirculation in the cochlea showed differences with passage of time according to the transient and permanent hearing loss models. Histopathologic studies also showed different changes in the vessels of the cochlea lateral wall and differences in vasoactive factors were observed. These have been associated with changes in inflammatory responses in the cochlea.
Conclusion: Depending on the degree of noise, the microcirculation of the cochlea changes, and different vasodilatation and vasoconstriction affect hearing changes by inducing inflammatory responses.
**Title:** Surgical Considerations For Localized Therapeutic Hypothermia Application In Cochlear Implant Surgery

**Category:** Basic Research

**Authors:**
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**Abstract:**
**Introduction:** Cochlear implantation can result in trauma to the sensory structures and lead to a loss of residual hearing in patients. Patients without residual hearing cannot benefit from conventional hearing aids. However, preservation of this low-frequency function can significantly benefit patients undergoing cochlear implant surgery. The pathophysiology of the injury following cochlear implant is known, however successful translation of therapeutic interventions to limit it have yet to be achieved. Amongst hearing preservation strategies, mild, localized therapeutic hypothermia applied to the inner ear during surgery has shown promising results in a preclinical model. In the present study, we analyzed anatomical variations and suitability of the common surgical approaches, including the standard facial recess (FR) approach versus a transtympanic approach for delivering therapeutic hypothermia in patients.

**Methods:** Ten human adult cadaveric temporal bones were scanned with micro-CT. The images were imported in OsiriX DICOM viewer and distances between the chorda tympani and the facial nerve and FR height were measured and total FR area was derived. Further measurements predicting round window (RW) visibility were recorded. Each bone was drilled by expert surgeons and standard FR and transtympanic approaches were developed. The St. Thomas Hospital classification (STH) was used to record degree of RW visibility. This grading was repeated following further drilling for optimizing visualization of the RW or independent cochleostomy and placement of the cooling probe through the FR or myringotomy. Therapeutic hypothermia was delivered through both approaches using a custom-developed probe and system and temperatures recorded at the RW (Apex), at RW niche, over the lateral semicircular canal (LC) and the supero-lateral mastoid edge (M).

**Results:** The average facial recess area was 13.87 mm² (S.D. 5.52) ranging from 8.44 to 24.28 mm². The introduction of the cooling probe through either approach did not impede full visualization of the RW or cochleostomy as determined by STH grading. The average maximum temperature decrease, using the FR approach, was 4.57 °C (S.D. ± 1.68) for RW, while a transtympanic approach produced a mean decrease of 4.11 °C (S.D. ± 0.98) for RW. No significant differences were found between the two surgical placements.

**Conclusion:** Results show that local hypothermia delivery during cochlear implant surgery, using our customized probe, can be efficiently achieved both through a FR and transtympanic approach regardless of anatomical constraints and without limiting optimal surgical visualization.
Title: Cochlear Size Measurement - Condition for an Individualized Implantation

Poster Number: 92
Abstract ID: 303
Category: Basic Research

Authors:
Luminita L. Radulescu, Associate Professor, Cristian Martu, Lecturer, Corina Butnaru, Assistent Professor, Sebastian Cozma, Associate Professor, Dan Martu, Professor; University of Medicine, Univ. of Med. and Pharmacy, Iasi, Romania.

Abstract:
Introduction: Individualized cochlear implantation involves also the adaptation of the size of the electrode array to the dimensions of the cochlea. The length of the electrode must take in consideration the length of the cochlear duct such that it is achieved more accurate correspondence between the frequency spectra of processed sounds and the location of electrical stimulation, to find a more efficient positioning of the electrode array closer to the cell bodies of the spiral ganglion, and to decrease damage to the delicate structures in the inner ear during the electrode array insertion. For the time being, it is not known what is the optimal ratio between the volume of the cochlear duct and the volume of the electrode array. The aim of our study is to establish if there are some relations between the length of the cochlear duct and 35delG mutation.

Methods: We included two groups: a control group, which consisted of 22 cochlear implanted (CI) children who did not have any GJB2 mutation, and a second group, the study group which included 20 CI children who had 35delG mutation. Both groups were matched in term of age and sex. We have measured on the CT scans: the length of the cochlear duct, the basal diameter of the cochleae and the height of the cochleae of both ears in all subjects. Measurement of the Cochlear Duct Length (CDL) was based on the following formula: 4.16A - 3.98 (where A is the basal diameter of the cochlea measured in millimetres).

Results: Without any GJB2 mutation (in mm): mean=28.8; median=29.3; range: 25.14 to 31.38. With 35delG mutation (in mm): mean:29.716; median:27.63; range:18.48 to 34.7. Mean CDL was 29.8 (range from 28 to 34.3). Without any GJB2 mutation (in mm): cochlear width:8.5-7; median:8; mean:7.88 and cochlear height:3.6-4.5; median:4.1; mean:4.12. With 35delG mutation (in mm): cochlear width:5.4-9.3; median:7.6; mean:8.1 and cochlear height:3.3-4.6; median:4.1; mean:4.01.

Conclusion: The size of cochlea has considerable variation independent of the presence or absence of the GJB2 mutations. CI electrode array has to be chose accordingly. Simple visual evaluation of the CT scan is not enough. Manual measurements are an alternative where/when automatic measurements are not available.
Poster Number: 93
Abstract ID: 417
Title: Case Series of the Temporal Bone Histology of Cochlear Implant Revision
Category: Basic Research
Authors: Alden F. Smith, MD, Gail Ishiyama, MD, Ivan Lopez, PhD, Akira Ishiyama, MD; Head & Neck Surgery, Univ. of California-Los Angeles, Los Angeles, CA.
Abstract:
Introduction: Cochlear implantation is now commonly performed in infancy and childhood in patients who then may require revision surgery in their lifetime. There have been concerns that explantation of the cochlear electrode and reinsertion may cause trauma and thereby compromise the function of the revision implant. There are limited prior investigations into the histopathology of human temporal bones after revision cochlear implantation. Objective: To understand the histopathological changes in revision cochlear implantation
Methods: Five temporal bones (n=5) from five deceased patients were identified with a history of revision cochlear implantation. Bilateral temporal bone histology was reviewed identifying route of insertion, structural changes to the cochlea, electrode translocation if present, and human spinal nerve ganglions count. Where available, clinical performance after reimplantation was assessed. The mean number of months from first implantation to re-implantation was 94 months, with range from 22 – 176 months).
Results: In this series of revision cochlear implantation, 4 out of 5 cases were performed by cochleostomy and one by round window insertion. The revision cochlear implant followed into the same fibrous sheath trajectory in 4 out of 5 cases with a minimum of trauma. In one case, there was translocation. The number of human spiral ganglion neurons was lower in the re-implanted cochlea (mean 15,609) compared to contralateral ear (mean 21,921) but the difference did not achieve statistical significance (p=0.27). Clinical performance data demonstrates adequate to good performance in the revision cochlear implant cases.
Conclusion: In all cases, there was a fibrous capsule surrounding the cochlear implant electrodes with no evidence for dense adhesions or trauma upon explantation and reinsertion. The temporal bone histopathology demonstrates that reinsertion of cochlear electrode can be safely accomplished with a soft-touch technique to ensure a minimum of endosteal and intracochlear damage. There is no evidence that explantation of the cochlear even after years of cochlear implantation is associated with any traumatic damage.
Title: A fluoroscopic analysis of slim modiolar electrode insertions

Category: Technology

Authors:
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Abstract:
Introduction: The slim modiolar (SM) electrode array was designed to reside close to the modiolus,
providing advantages such as reduced stimulus energy requirements, longer battery life, and potentially
more discrete ganglion cell population stimulation than outer wall electrodes. The novel design of the
slim, pre-curved CI532 electrode array requires that it be inserted with a sheath temporarily residing in
the basal turn. Manufacturer guidelines indicate both round window (RW) and traditional cochleostomy
approaches are acceptable for electrode insertion. The aim of this study is to evaluate and compare
three popular insertion approaches: RW, extended RW and peri-RW cochleostomy with video
fluoroscopy.

Methods: Real-time fluoroscopy was used to compare SM electrode insertions performed via the RW,
extended RW, and peri-RW cochleostomies. A total of 15 human temporal bones were used with 5
bones randomly assigned to each insertion approach. An experienced cochlear implant surgeon familiar
with SM electrodes performed all insertions. Fluoroscopy recordings of the insertion were then assessed
by blinded investigators. Objective observations including final angular depth of insertion, degree of
perimodiolar hugging, evidence of tip fold over, and the need to withdraw and re-insert the electrode
were recorded. Subjective observations were also noted, such as the general ease of insertion (e.g.,
smooth insertion versus insertion with resistance) and evidence of electrode bending or kinking at the
modiolus.

Results: Smooth insertions were achieved consistently with both extended RW and peri-RW
cochleostomy approaches. With the RW approach three of five insertions an acute deflection was noted
during the insertion, presumably due to deflection of the array off the modiolus. There were no cases of
tip foldover observed in any of the insertions. However, increased resistance was initially noted during
the electrode insertions through the RW versus the other approaches.

Conclusion: Based on our pilot study, extended RW and peri-RW cochleostomy approaches appear to
reduce modiolar contact by the sheath and electrode array during insertion compared to the RW
approach for the SM electrode. Studying insertions using fluoroscopy is a useful and feasible method to
compare cochlear implant insertion techniques.
Machine Learning & Cochlear Implantation - A Structured Review of Opportunities and Challenges

Authors:
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Abstract:
Introduction: The use of machine learning technology to automate intellectual processes and boost clinical process efficiency in medicine has exploded in the past 5 years. Machine learning excels in automating pattern recognition and in adapting learned representations to new settings. Moreover, machine learning techniques have the advantage of incorporating complexity and are free from many of the limitations of traditional deterministic approaches. Cochlear implants are a unique fit for machine learning techniques given the need for optimization of signal processing to fit complex environmental scenarios and individual patients’ MAPs. However, there are many other opportunities where machine learning may assist in cochlear implantation beyond signal processing. The objective of this review was to synthesize past applications of machine learning technologies for pediatric and adult cochlear implantation and describe novel opportunities for research and development.

Methods: The PubMed/MEDLINE, EMBASE, Scopus and ISI Web of Knowledge databases were mined using a directed search strategy to identify the nexus between cochlear implant and artificial intelligence/machine learning literature. Non-English language articles, articles without an available abstract or full-text, and non-relevant articles were manually appraised and excluded. Included articles were evaluated for specific machine learning methodologies, content, and application success.

Results: The database search identified 298 articles. 259 articles (86.9%) were excluded based on the available abstract/full-text, language, and relevance. The remaining 39 articles were included in the review analysis. There was a marked increase in year-over-year publications from 2013-2018. Applications of machine learning technologies involved speech/signal processing optimization (17; 43.6% of articles), automated evoked potential measurement (6; 15.4%), post-operative performance/efficacy prediction (5; 12.8%), and surgical anatomy location prediction (3; 7.7%), and 2 (5.1%) in each of robotics, electrode placement performance, and biomaterials performance.

Conclusion: The relationship between cochlear implantation and artificial intelligence is strengthening with a recent increase in publications reporting successful applications. Considerable effort has been directed towards augmenting signal processing and automating post-operative MAPping using machine learning algorithms. Future opportunities include applying machine learning to explore ‘big picture’ queries such as disparities in access to cochlear implantation and individualized patient performance prediction. These investigations may inform health technology assessments and policy efforts to enhance delivery of this important technology to eligible populations.
Poster Number: 98
Abstract ID: 424
Title: Binaural Hearing with a Cochlear Implant and an Auditory Brainstem in a Child with Bilateral Nerve Aplasia
Category:
Authors:
Pei shan Leem, Master of Clinical Audiology, Kai Jun Tay, MBBS, Deepak Vishal D'Souza, Master of Science, Mandy Su Yin Phua, Master of Social Science, Tiong-Yong Tan, MBBS, Barrie Tan, MBBS;Ent Center, Singapore Gen. Hosp., Singapore, Singapore.
Abstract:
Introduction: Hearing Habilitation with a Cochlear Implant and an Auditory Brainstem Implant in a Child with Bilateral Cochlear Nerve Aplasia. Is there benefit in bilateral hearing with concurrent use of an auditory brainstem implant and cochlear implant?
Methods: Study design: Case study, retrospective review
Settings: Tertiary referral centre, Singapore General Hospital
Patient: T was a 7 month old child referred to our clinic for hearing loss. After extensive investigation - Magnetic resonance Imaging, transtympanic electrical auditory brainstem response, he was diagnosed with cochlear nerve aplasia. Intervention: T was implanted first with an ABI at 16 months old and subsequently with a CI at 5 years old for bilateral hearing
Main outcome measures: Aided sound field thresholds, Meaningful Auditory Integration Score (MAIS), Speech Perception Categories, World Intelligibility by Picture Identification (WIPI)
Results: At 4 years 1 month post ABI and 8 months post CI switch on, T had a MAIS score of 28/40. Using the Speech Perception Categories, he has Open-set word recognition (with familiar words using live voice testing). With the CI alone, he was able to detect and discriminate all 6 Ling sounds. However, speech understanding was limited. T reported significant benefits with bilateral inputs and this was also consistently observed by his parents. He does not like using either the ABI or CI alone and uses both his implants during all waking hours.
Objectives: To report on the outcomes of hearing habilitation through combination of auditory brainstem implantation (ABI) and cochlear implantation (CI) in a child with bilateral cochlear nerve aplasia
Conclusion: Bilateral hearing habilitation can be achieved using a CI and ABI concurrently. Cochlear nerve aplasia remains a challenging clinical problem. More data is required to clearly delineate the ideal treatment option. The outcomes of this patient provide further evidence for early trial of Cochlear implantation prior to Auditory Brainstem implantation on contralateral ear. (255 words) Key Words: Auditory Brainstem Implant, Cochlear Implantation, paediatric, auditory neuropathy, audiological habilitation, cochlear nerve aphasia
Abstract:

**Introduction:** Light at infrared wavelengths has been demonstrated to modulate the pattern of neural signals transmitted from the angular motion sensing semicircular canals of the vestibular system to the brain. We will review the studies and results that highlight underlying mechanisms and potential applications in basic science and prosthetics. We show physiological and characteristic eye movements and cardiovascular changes evoked by focused, pulsed infrared radiation (IR) stimuli directed at individual semicircular canal or otolith end organs in a preclinical, rodent model.

**Methods:** All procedures were approved by the University of Miami Institutional Animal Care and Use Committee. Bilateral eye movements were recorded in Long-Evans rats anesthetized with ketamine (44 mg/kg) and xylazine (2.5 mg/kg). A head post secured the animal to a modified stereotaxic system during stimulation and recording procedures. For utricular stimulation, IR (1863nm, 200µs, 250pps, different radiant exposures) was delivered through the oval window by coagulating stapedial artery and gentle removal of stapes. For anterior canal stimulation, frequency modulated IR (0.05-1Hz) was directed medial to oval window after carefully removing the footplate and annual ligament. Mean BP and HR were measured via a small animal single pressure implantable device (DSI pressure sensing technologies, HD-S10) inserted into the femoral artery prior to stimulation. Eye movements simultaneously recorded using a custom-modified video-oculography system (ISCAN Inc.) and post-mortem micro computed-tomography confirmed the site of stimulation. Furthermore, we investigated the mechanisms underlying IR responses in the vestibular neuroepithelium focusing on the role of the thermosensitive TRP channels.

**Results:** The activation of vestibulo-ocular motor pathways by frequency modulated pulsed IR evoked significant, characteristic bilateral eye movements. The eye movements were stable through several hours of repeated stimulation. The amplitude of IR-evoked eye movement, also, reduced significantly with temperatures lower than TRPV4 activation threshold as well as after the perfusion of TRPV4 channel blockers. The eye movement recovered at the physiological temperatures and after washout of the compounds suggesting that TRPV4 channels play an important role in IR activation of the vestibulo-ocular motor pathway. PC receptor activation evoked robust changes in BP and HR indicating sympathetic activation. Results are further suggestive of selective activation of the vestibular system by focused IR, which can be used to detail the central pathways and contributions of individual end organs.

**Conclusion:** Results form the basis for future applications of optical neural stimulation to control of neural activity in the inner ear, study the role of vestibular labyrinth in maintaining physiological functions and in pathology, and the development of potential therapeutic applications, including bionic vestibular neuroprostheses. Funding: NIH NIDCD 1R01DC008846 and 1R01DC013798.
Title: Developing International Consensus on the Use of Unilateral Cochlear Implants for Bilateral Severe, Profound, or Moderate Sloping to Profound Sensorineural Hearing Loss in Adults

Category: Economics, and Public Policy, and Practice Management

Authors: Craig Buchman, MD on behalf of the Delphi Consensus Group on Cochlear Implantation in Adults

Abstract:

Background and aims
Hearing loss affects 466 million people (6%) worldwide, with that number expected to rise to over 900 million by 2050. Hearing loss may lead to communication difficulties, reduced well-being and increased risk of dementia (WHO; 2018). Cochlear implants may provide benefit to individuals affected by bilateral severe, profound, or moderate sloping to profound sensorineural hearing loss (SNHL) who receive little or no benefit from hearing aids; however, referral for cochlear implantation (CI) in adults is still not routine.

Using a modified Delphi consensus process, our group developed a series of consensus statements regarding the use of unilateral cochlear implants in adults with severe, profound, or moderate sloping to profound bilateral SNHL. Here we present the process used and the final consensus statements.

Methods
The Delphi Consensus Group consists of 30 international CI experts. Statements were developed based on evidence identified from a systematic literature review. Searches were conducted in: 1) MEDLINE In-Process & Other Non-Indexed Citations and OVID MEDLINE, 1946–present, 2) Embase, 1974–present and 3) Cochrane Library. The identified publications were screened manually against pre-specified eligibility criteria and relevant data were extracted from included studies.

A modified three-step Delphi consensus process was used to vote on and refine the statements, consisting of two rounds of email questionnaires and a face-to-face meeting at a final round. Consensus was defined a priori as agreement by at least 75% of respondents. At each round, the panel reviewed those statements that had not yet reached the agreement threshold and marked their level of agreement according to a 6-point Likert response scale. Panel members were also invited to provide free-text comments on each statement. All statements were reviewed and discussed at the face-to-face meeting.

Results
The Delphi Consensus Group has developed 20 consensus statements on the use of unilateral CI in adults with SNHL. These statements provide recommendations on cochlear implant awareness (1), diagnosis (3), surgical implications (2), clinical outcomes (7), rehabilitation (1), association of hearing loss with cognition, depression and social isolation (5) and cost-effectiveness (1).

Conclusions
These consensus statements represent the first step in the development of a set of international guidelines on best practice for CI in adults with SNHL. Future goals are to develop further consensus statements on unilateral CI in children and bilateral CI in adults and children.
Title: Is Medicaid Your Cup Of Tea? How to Navigate The Medicaid System

Category: Economics, and Public Policy, and Practice Management

Authors:

Abstract:
Introduction: Clinicians often find the Medicaid system to be a challenging maze of processes that lead to more questions than answers. Since the program’s inception in 1965, its complexities and nuances have tested recipients and providers alike. Despite changes in legislation, in states that expanded Medicaid and in those that did not, Medicaid is still the primary payer of health care services for an ever-growing population of individuals, from infants to the elderly, and many people in between. Subject to federal standards, Medicaid programs are administered at the state level, with each state granted the ability to determine coverage for individuals and services. Because of this flexibility, there is significant variation across Medicaid programs. This presentation will provide guidance, resources and troubleshooting for some of the most common questions about Medicaid.

Methods: The content of this session surpasses a basic understanding of routine Medicaid practice, and focuses on solutions to the most recurrent and pressing issues surrounding cochlear implantation such as coverage denial and appeal, navigating reimbursement methods, and understanding healthcare delivery models. Through actual scenarios and real world data, this presentation will educate attendees on the challenges and solutions to address current Medicaid issues including the evolution of Managed Care Organizations (MCO). This short lecture reaches beyond the often heard response of “it depends” to provide a deep and useful understanding of existing and future obstacles and examples of successful ventures in advocacy.

Results: Attendees will gain insight into the intricacies of the Medicaid program, and will be better equipped to engage in the reimbursement process. Cochlear implant clinicians will learn effective ways to advocate for fair payment, ethical practices, and quality care through the casestudies presented in this session. They will be able to identify and strategically navigate ethical pitfalls that sometimes surface when working with Medicaid and Medicaid Managed Care. Conclusions: A significant number of cochlear implant recipients are enrolled in the Medicaid program. While the task of providing services and requesting reimbursement in line with each state’s guidelines can seem daunting, it’s a task that can be managed through perseverance, precedence, and education, as demonstrated through the true scenarios in this presentation.
Introduction: Cochlear implant (CI) systems that combine electric-acoustic stimulation (EAS) in the same ear are FDA approved, commercially available and increasing in the US. Implementation of EAS into clinical practice involves new considerations above and beyond that for the treatment of conventional CI recipients. Audiologists must consider: the equipment, time, and skill-set needed to fit the acoustic component, new costs (additional time spent programming and for verification, ear molds), optimal listening conditions and test battery for initial and follow-up assessment, appropriate billing for services rendered, and associated counseling. The objective of the present report is to review the logistics, considerations and decisions made by a clinical team with long-term EAS research experience when establishing a clinically-feasible EAS assessment and fitting protocol.

Methods: Audiologists experienced with the assessment and fitting of EAS created a list of topics specific to the translation of EAS into the clinical environment. Topics includes: ear mold impression and fitting, testing of residual hearing (measured frequencies, when to assess post-operative hearing), fitting and verification of acoustic or hearing aid component, pre- and post-operative test protocol, billing protocol, and counseling. Each area was evaluated with respect to feasibility in the clinical environment, such as appointment duration, space restrictions, equipment availability, best practices and knowledge from the EAS clinical trial. CPT codes were researched to consider what can be billed on same day of service and in conjunction with CI (re)programming.

Results: Consideration of previous research findings and the above topics resulted in a clinically-feasible assessment and fitting protocol of non-study EAS recipients. The revised protocol includes listening conditions to assess performance outcomes, test battery, and a timeline for when to measure unaided residual hearing, fit the acoustic component, and follow-up intervals. Current limitations include: applicable CPT codes cannot be billed in combination with initial or follow-up CI programming, Medicare does not support ear mold or hearing aid charges, and patients require significant additional counseling time on risks, realistic expectations, procedures, and associated costs.

Conclusion: EAS provides CI recipients with improved speech perception over hearing aid and CI technologies alone. The incorporation of EAS into clinical practice requires additional counseling of risks associated with this treatment option, additional time, equipment and considerations as compared to conventional cochlear implant recipients. Audiologists must consider the optimal test battery to evaluate outcomes, new fitting methods for the electric component, fitting and verification of the acoustic component, and what parameters to adjust if a recipient experiences a change in residual hearing to optimize the fitting and offer best-practice. EAS may be a viable treatment option for subjects with substantial residual hearing and limited speech perception with conventional amplification. When implementing this treatment option in a clinic, multiple factors need to be considered and implemented to maximize patient’s performance, clinician’s time and cost effectiveness.
Multidisciplinary Cochlear Implant Clinic Improves Evaluation Efficiency and Patient Satisfaction

Authors:
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Abstract:
Introduction: The evaluation of children with sensorineural hearing loss (SNHL) is a complex process that requires the involvement of multiple disciplines including otolaryngology/otology, audiology, and speech language pathology. When the patient’s hearing thresholds are at a degree where a cochlear implant (CI) is considered, additional disciplines including psychology and social work become critical in the evaluation and care of these patients. To improve the efficiency and care delivery process to children with SNHL, we have created a multidisciplinary cochlear implant clinic, bringing together the entire team to see patients and their families in one location during the same visit. Coordinated care is provided in this multidisciplinary clinic where the family remain in one room while each member of the CI team sequentially comes to see the patient and provide their respective evaluation and management recommendations. With this unique approach, CI candidacy can be determined with the families typically making only two clinic visits in addition to other diagnostic evaluations such as radiographic studies and genetic testing. At the completion of the second appointment, all members of the CI team meet together with the patient and family to review and discuss the teams recommendations. The patient is then scheduled for surgery if indicated based on a consensus decision made by the team.

Methods: Patients in our program have been evaluated for CI candidacy using the multidisciplinary paradigm since its inception. Since 2010, we have implemented the use of this multidisciplinary clinic. A retrospective review of each patient in our program was performed to determine the number of visits required to determine candidacy and the elapsed time from initial evaluation to the point where candidacy for surgery was confirmed, as well as to when the cochlear implant surgery was performed. These data were compared to patients evaluated and implanted in our program prior to the implementation of the multidisciplinary clinic. In addition, patient and family satisfaction with a “one stop” multidisciplinary clinic was assessed with a questionnaire.

Results: In almost all cases, determination of cochlear implant candidacy was achieved with patients and their families making just two visits to the multidisciplinary clinic. There was also a substantial reduction in the time from initial evaluation to when the patient received his/her cochlear implant. A description of the process and a review of data comparing the number of visits and time from initial evaluation to surgery will be presented.

Conclusion: A multidisciplinary cochlear implant clinic for children with SNHL is feasible and allows for efficient evaluation to determine candidacy with just two clinic visits for patients and their families. This resulted in a substantial decrease in the time from initial evaluation to surgery and ultimately led to improved patient and family satisfaction.
Title: Assessing Cochlear Implant Device Use in Older Prelingual Deaf Children

Introduction: Children with prelingual bilateral profound sensorineural hearing loss (SNHL) have poorer outcomes the older they are to receive a cochlear implant (CI). There is no clear age cutoff as to when a patient will not receive benefit from a CI. Older patients may receive benefit in sound awareness and safety. The goal of this study was to evaluate whether older children receiving CI continued to use CI more than 3 years after implant.

Methods: Retrospective chart review of children with bilateral prelingual severe to profound SNHL who received first CI after the age of 3. Demographics, follow up CI use, and communication type were recorded. Patients were divided into 2 groups: 1) 3 to 4 year olds and 2) greater than 5 years old.

Results: Fifty seven patients were identified. Forty patients were in group 1 with mean age of 1st CI = 3.7 years. Seventeen patients were in group 2 with mean age of 1st CI= 7.17 years. Group 1 wore their CI “all waking hours” 80% (n= 32), sometimes 18% (n= 7), none 2.5% (n=1). Group 2 wore their CI “all waking hours” 65% (n= 11), sometimes 18% (n= 3), none 18% (n=3).

Conclusion: Prelingual deaf children’s continued use of their CI is directly related to the age they are implanted.
**Title:** Reduction in Audiology Time Spent at Cochlear Implant Switch-On Using Artificial Intelligence-Based Mapping and Preliminary Auditory Experience

**Category:** Economics, and Public Policy, and Practice Management

**Authors:**
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**Abstract:**

**Introduction:** There is currently no accepted standard of care for initial activation following adult cochlear implantation. A standardized evidence-based adult delivery model has been previously validated using an artificial intelligence (AI)-based MAP programming paradigm with clinical milestones and outcomes to guide audiological clinical aftercare. The primary objective is to determine whether time spent by an audiologist at initial activation can be reduced by exposing patients to auditory experience and basic information delivered in a just-in-time format by a technician two weeks prior to formal device activation. The AI-based mapping will be deployed.

**Methods:** This prospective randomized study at a tertiary neurotology practice evaluated adult cochlear implant recipients older than 18 years. All patients were post-lingually deafened and met standard accepted candidacy criteria. Exclusion criteria included those not fluent in English, deaf prior to age two, or had a diagnosis of retrocochlear pathology, auditory neuropathy, a cochlear abnormality preventing insertion of at least 10 electrodes, and those unable to complete study requirements. Patients were divided into two groups. Group 1 acted as a control and were switched-on at two weeks post-operatively using standard programming software. Group 2 patients were given basic CI instructions for use by a non-audiologist at their one-week post-operative wound check and had their device turned on with three maps generated by the AI mapping tool. At four weeks post-operatively, group 2 patients were seen by an audiologist for initial stimulation and device switch-on. Both models utilized audiologists to perform standardized mappings at 3- and 6-month post switch-on. We compared performance on speech perception in quiet of the implanted ear using CNC words, the time spent from initial patient contact to chart closure at each visit, use of device accessories using data logging, and patient satisfaction through the SSQ-12 survey.

**Results:** We will present the 3- and 6-month post switch-on sound performance results and time spent by the audiologist to determine if the initial audiology-driven switch-on is reduced with preliminary exposure to AI driven MAPs providing auditory experience.

**Conclusion:** Time saved at initial activation can be spent doing other value-added tasks in audiology, creating more access while reducing the per-incident cost of CI care.
**Poster Number:** 107  
**Abstract ID:** 172  
**Title:** Artificial Intelligence-Assisted Cochlear Implant Mapping: Implications for Clinic Efficiency and Future Directions  
**Category:** Economics, and Public Policy, and Practice Management  
**Authors:** Teresa Zwolan, PhD, Heidi K. Slager, AuD, Casey Stach, AuD; Otolaryngology, Univ. of Michigan, Ann Arbor, MI.

**Abstract:**  
**Introduction:** It is important to balance maximizing patient outcomes with efficient clinical service delivery. In our large University-based clinic, cochlear implant recipients have historically been seen for MAPping of their cochlear implant 7 times in the first year following surgery, then annually or bi-annually thereafter. Programming procedures, use of default MAP parameters, and frequency and length of post-operative programming sessions vary across clinicians and clinics. These differences in MAPping may impact recipient outcomes and clinic efficiency, increasing the need for standardized post-operative management procedures. One emerging method for standardization of the mapping process is use of artificial intelligence (AI) based clinical decision-making tools that provide suggestions for mapping changes based on the recipient’s performance on various tests. This, in combination with a standardized, streamlined post-operative programming schedule, may facilitate more consistent and efficient care for cochlear implant recipients. This presentation will summarize our clinic’s experience using a standardized, streamlined visit schedule and AI-assisted clinical decision-making tool, and we will discuss how our clinical protocols have evolved as a result of such experiences.

**Methods:** As part of a recent clinical trial, 9 newly implanted cochlear implant recipients aged 48-86 years (mean 67 years) were seen at our clinic for post-operative programming of their devices using a streamlined visit schedule (activation, 1 month, 3 months, 6 months) where an AI-based clinical decision-making tool was used during the programming sessions. This tool provided suggestions for MAP changes based on the recipient’s performance on direct-connect tests performed outside the sound booth including audiometry, phoneme discrimination, loudness scaling, and monosyllabic word recognition. Performance was also evaluated in the soundfield using CNC monosyllabic words and AzBio sentences at +10 signal-to-noise ratio both pre-operatively and 3 and 6 months post-activation.

**Results:** All subjects implanted at our clinic to date in this study have shown improvement in CNC monosyllabic word and AzBio sentence in noise scores relative to pre-operative performance. They have accepted the streamlined visit schedule, which eliminated two of our standard post-operative programming sessions in the first 6 months post-activation. Visit lengths were similar to our traditional programming sessions and clinicians reported that clinician-patient relationships were not compromised with the use of a new programming procedure.

**Conclusion:** It is possible to standardize and streamline the post-operative programming process to include fewer programming appointments and to efficiently utilize an AI-assisted clinical decision-making tool during mapping sessions. Changes in patient care that have occurred in our clinic as a result of our participation in this study will be highlighted, including elimination of the Day 2 mapping appointment from our standard post-activation schedule for all recipients, saving 2 hours per recipient. Given that our clinic performs approximately 170 surgeries per year, this change has the potential to significantly improve our clinic productivity and patient access.
Poster Number: 108  
Abstract ID: 16  
Title: Cochlear Implant Billing: Differences Across Centers  
Category: Miscellaneous  
Authors:  
Melissa Auchter, AuD, Erika Gagnon, AuD; The Children's Cochlear Implant Ctr. at the Univ. of North Carolina, Chapel Hill, NC.  
Abstract:  
Introduction: In today's healthcare model, billing codes and reimbursement are highly discussed topics. Audiologists are trying to maximize their efficiency to be able to support their services while also trying to provide best care to patients. Very little is published about correct billing practices, particularly for cochlear implant providers. Audiologists learn billing practices from school or from other providers in the industry, but these may be outdated or incorrect.  
Methods: A survey containing thirteen questions about billing concerns related to cochlear implants was sent out through the American Cochlear Implant Alliance. The survey was specifically address to audiologists who work with cochlear implant patients. The responses obtained, forty people total, were analyzed and compared to look at billing trends across cochlear implant audiology.  
Results: Centers bill differently for mapping and booth testing. Of the 40 responses captured, 68.5% of respondents bill 92604/92602 for unilateral mapping. For bilateral mapping 38.1% bill the mapping code only once, 40.5% use a modifier to accommodate for the extra service, and 21.4% bill the same code twice on the same day. For booth testing 31.5% use 92626 (evaluation of auditory rehab status) whereas 34.8% use some form of pure tone audiometry code (comp audio, air only, CPA, or VRA). 73.2% of respondents bill for booth testing and mapping during the same appointment, but the rest of respondents do not either because of reimbursement or time available during appointments. Billing for troubleshooting appointments revealed the high variability with 43.9% not billing/billing no charge and 56.1% billing some code for the appointment. In addition 64.9% of respondents are unsure of their reimbursement for the codes they bill.  
Conclusion: Billing is not consistent across centers for cochlear implants. Different centers have different ways of billing for mappings, particularly bilateral mappings, and booth testing visits. This survey also indicated that the majority of respondents are not aware of the reimbursement for any of the codes billed. Consistency across billing between centers should only help reimbursement and the general value of cochlear implant audiology services.
Cross-Modal Plasticity: Long-Term Results After Cochlear Implantation in Children

Introduction: Given the multidimensional scope of Cochlear Implants (CI), there are growing needs to provide others measures for assessing the impact of the cochlear implantation, such as brain reorganization besides clinical measures of outcome related to communicative abilities.

Methods: A case-control prospective study was carried out in a group of nine deaf children with visually-impairment. Cross-Modal Plasticity assessment was performed by testing Somatosensory Evoked Potentials (cortical response to median nerve, SEP N20) at different periods: prior to implantation cochlear and after the use of CI (after one and five years). We describe the results of Low-Resolution Brain Electromagnetic Tomography (LORETA) used for the localization of electrical neuronal sources generators of SEP N20 response in deaf children with visual impairment.

Results: Cochlear Implants had on lives of implanted children and their families. The study included results on topographic distribution the cortical response of SEP-N20 where the visual and auditory areas are widely activated with somestesic stimuli in deaf children with visual-impairment with 7 or more years of sensory deprivation before implantation. A significant reduction in the topography of the SEP N20 was observed after five years of stimulation via CI. In general, the analysis of the individual maps showed reduction of the over-activation (SEP N20) found in child with 7 years or more before implantation.

Conclusion: This study makes available electrophysiological evidence about Cross-Modal Plasticity in deaf children with visual-impaired after long-term of use CI. Changes in the topography of cortical response of SEP N20 could be observed in these children who receive CI, suggesting new brain reorganization of the auditory cortex when stimulated through CI. Evidences of Cross-Modal Plasticity may be an expression of how important is the somesthetic information in these subjects, probably due to the relationship with tactile language, as well as the functional interaction of auditory and somesthetic information during the auditory (re)habilitation post-CI.
Poster Number: 110
Abstract ID: 413
Title: Establishing a Smoke Alarm Program for Children with Cochlear Implants
Category: Miscellaneous
Authors: Shelley Duncan, AuD, Maria Leno, AuD, Kimberly Lyle, AuD; Ear, Nose, and Throat, Akron Children's Hosp., Akron, OH.
Abstract:
Introduction: Most house fires occur overnight, and research has shown the difficulty that individuals with hearing loss have waking to a traditional T3 smoke alarm. In particular, children with cochlear implants are not expected to awaken and get to safety when only traditional alarms are available. It was determined that in our area most children with cochlear implants were dependent on other family members to awaken them during these critical times. It was necessary to create a program to create awareness and support funding for families to enable safety and independence for our pediatric cochlear implant patients.
Methods: Our audiology team drafted a proposal and was selected as beneficiary of a local fundraiser. We were able to establish a fund for smoke alarms that utilized the recommended 520 Hz square wave coupled with a vibrotactile alert. Our department is contacting our cochlear implant patient families and communicating the need for equipment beyond the cochlear implant. When need is expressed, our smoke detector fund can provide the financial support needed to allow families to engage with all areas of the child’s needs.
Results: We are tracking the response we get from families, as well as the number of smoke alarms that are dispensed from our current fund. We are also collaborating with local fire departments to extend the awareness for hearing needs in the community. In anticipation of the need for continuing funding, we hope to build greater financial resources through community partnerships and collaboration with other hospital departments.
Conclusion: There is great need for technology that enables safety and independence beyond the cochlear implant. We have established a fund that will support our families that cannot afford such technology, and which is not covered by medical insurance. The fund has also provided an opportunity to contact all of our cochlear implant families to create awareness and generate a call to action that is parent-driven.
Our Early Experience with 200 Cochlear Implants in North India

Introduction: The objective of paper is to show the status of the ADIP scheme in the cochlear implant programme. It was started in Mehrotra ENT Hospital in July 2016. Cochlear Implants (CI) are surgically implanted electronic devices used to treat severe-to-profound sensorineural hearing loss in children and adults who do not benefit from conventional hearing aids. CIs are available in most developed countries and the vast majority of CI recipients live in such countries. More recently, the Government of India under its Ministry of Social Justice’s Assistance to Disabled Persons scheme (ADIP) has launched a cochlear implant programme that has more than 150 centres for performing implant surgeries. Establishing a CI programme in a developing country needs team work, sufficient rehabilitative resources and rehabilitative team consisting of an ENT surgeon, audiologist, speech pathologist/speech therapist, physician, teacher for the deaf and clinical psychologist.

Methods: A total of 200 implants were performed. Data relating to the patients who received cochlear implantation between July 2016 – June 2018 were analyzed.

Results: A total of 200 implantations have been performed. 110 were Male (55%) & 90 female (45%). Six children received cochlear implants in 2016, 47 in 2017 and 147 in 2018. 3.6% children received cochlear implants at age of one years, 6.3% at two years, 9.9% at three years, 44.1% at four years, 16.2% at five years. None of the patients had any inner-ear anomalies on MRI/computed tomography imaging. 80 Children 134 received digisonic device. (67%) and 66 children cochlear freedom device (33%). 83.30% children were regular in follow up rehabilitation program and 16.60% were irregular in this program because of distance and other problems. Average CAP score of less than 2yrs implanted children after 6 months of therapy was level 5-7 as compared to level 3-5 in 3-5yrs children.

Conclusion: No gender difference was found. Early age implanted children had better outcome.
Title: Novel Noun Generalization in Children with and without Hearing Loss

Category: Miscellaneous

Authors: Amy L. Meltzer, B.S., Lynn K. Perry, Ph.D.; Psychology, Univ. of Miami, Coral Gables, FL.

Abstract:

Introduction: Although children with hearing loss (HL) can benefit from cochlear implants and hearing aids, they often show language delays. Further, little is known about the mechanisms by which children with HL learn words. One mechanism by which typically hearing children (TH) learn words is by acquiring word learning biases, e.g., generalizing the names of novel objects by similarity in shape (“shape bias”). Here, we ask whether children with HL exhibit similar word learning biases. Additionally, we investigate how type of hearing technology (cochlear implants- CI or hearing aids-HA) and bilingual vocabulary development influence such biases in these children.

Methods: In the current study, 39 1.5-3.5-year-old children (12 HL-CI, 6 HL-HA, 21 TH) generalized the names of novel objects, choosing between an object matching in shape or material.

Results: As a group, children with HL were significantly less likely to choose shape matches than children with TH. However, there were also large individual differences amongst children with HL. Although some children with HL demonstrated a shape bias, some did not demonstrate any systematic bias, and some even demonstrated a bias to generalize by material. Moreover, children with HL tended to have smaller English vocabularies than their TH peers. Yet, whether a child had hearing loss or not, they were more likely to choose a shape match if they had a larger English vocabulary size.

Conclusion: Further research will investigate where these individual differences come from—why are some children with HL on track with their TH peers, but so many show delayed or atypical biases? How do variations in learning environments, such as bilingualism, influence these trends? This work will contribute to the development of interventions targeting word-learning delays.
Telemedical Fitting of Patients with Cochlear Implants in Central Asia

Introduction: To obtain the best hearing benefits after cochlear implantation, the speech processor must be optimally fitted. The majority of patients have been implanted and are unable to receive correct implant fitting. They have to undertake a long trip to the cochlear implant clinic, and this incurs high cost, time, and travel weariness. To overcome this problem, ‘telefitting’ has been proposed. The center in Kyrgyzstan is sufficiently equipped however programming of cochlear implant system, cannot be conducted by the team there due to a lack of trained specialists and limited experience. The aim of this poster is to present the usage of telefitting between Poland and Kyrgyzstan.

Methods: The Internet allows specialists from Poland to set up a teleconference for audio and video contact with the patient and support specialist, and allows remote desktop software to access a remote computer and perform fitting. Every node is equipped with teleconference terminals from Polycom Inc. with LCD screens, zoomable and movable Polycom cameras, connected to a system with symmetrical Internet connections. There is also a PC computer equipped with clinical interface boxes with appropriate fitting software. The ‘Logmein.com’ application is used for remote control.

Results: The method and a proposed model of postoperative care for implanted patients using telemedicine seems to be a reliable alternative to standard model.

Conclusion: It improves the quality of service provided to patients and saves substantial time and money. The telefitting model increased accessibility to hearing care services in Kyrgyzstan.
**Poster Number:** 114  
**Abstract ID:** 441  
**Title:** Bone Conductive Devices - Clinical Experience  
**Category:** Miscellaneous  
**Authors:**  
Piotr H. Skarzynski, MD, PhD, Bartlomiej Krol, MD, Kamila Kordowska, MD, Andrzej Pastuszak, MD, Magdalna Koziel, MSc, Anna Ratuszniak, Eng. MSc, Henryk Skarzynski, MD, PhD; World Hearing Center, Inst. of Physiology and Pathology of Hearing, Warsaw, Poland.  
**Abstract:**  
**Introduction:** Bone conductive devices are more and more popular during last years. On the one hand surgery is not difficult, on the second hand many countries entered that procedure to reimbursement system.  
**Methods:** The aim of the study was analysis of comparison of bone conduction implants trans and percutaneous. Material consisted of 205 patients where the systems where adopted.  
**Results:** In almost all cases patients were satisfied and audiological outcomes were good or very good. There were very few complications like not enough strong magnet or too thick subcutaneous tissue. In one of the system there is high need to perform meticulous radiological analysis.  
**Conclusion:** Such procedures are recommended as a first choice surgery in congenital atresia with abnormal position of the facial nerve or not appropriate anatomical situations into middle ear.
Poster Number: 115
Abstract ID: 33
Title: Radiographic Determination of Size Growth in the Sinus Tympani as a Possible Influencing Factor of CI Electrode Migration
Category: Miscellaneous
Authors:
Magnus Teschner, MD, PhD, MBA 1, Bayan Alhaj Moustafa, MD 2, Thomas Lenarz, MD, PhD 1, Anja Giesemann, MD, PhD 2, Mete Dadak, MD 2; 1Department of Otolaryngology, Hannover Med. Sch., Hannover, Germany, 2Institute for Neuroradiology, Hannover Med. Sch., Hannover, Germany.
Abstract:
Introduction: As part of a cochlear implantation, the supplying electrode cable is usually fixed in an attached bone slit in the chorda facial angle. This is intended to prevent migration of the electrode. When this procedure is performed on children, the question arises as to how much the distance between the fixation and the round window changes in the course of growth. This could result in growth-related migration.
Methods: In a total of 22 patients, the distance in the sinus tympani between the medial bone of the facial nerve and the round window was measured by means of an existing computed tomography imaging. 11 patients were between 6 months and 1.5 years old, 11 patients were 18 years old. The measurements were performed according to standardized orientation of the imaging.
Results: The results show that there is no increase in the distance in the sinus tympani in the course of growth. The distance was 3.42 mm for the children, for the 18 year old the distance was 3.43 mm.
Conclusion: The fixation of the afferent electrode cable in a drilled bone slit at the chorda facial angle is a sufficient procedure, which is not subject to growth-related influences. Accordingly, the electrode will not migrate from the cochlea through a growth process of the petrous bone.
Introduction: Currently, the most widely used questionnaires for vestibular disorders are retrospective. This induces recall bias, causality (e.g. triggers for events) and the influence of context cannot be reliably investigated. The Experience Sampling Method (ESM) might be a solution for these problems. In this pilot study we investigated the feasibility of a new ESM-based mobile diary: The Dizzyquest, using the Psymate application. We focussed on response rate and vertigo attack occurrence. The Dizzyquest project is in cooperation with the European Network for Vertigo and Balance Research (Dizzynet).

Methods: Five patients with a diagnosed vestibular disorder (Barany criteria) were included. During four weeks, patients filled out the Dizzyquest: an app-based questionnaire based on the Psymate application. The Dizzyquest consisted of momentary assessments of symptoms, context, emotions, cognition and stressful events. The questions were included in end of day questionnaires (‘Evening’ questionnaire) and multiple, random, repeated questionnaires 10 times a day (‘Beep’ questionnaire). Furthermore, patients could fill out a questionnaire in case of a vertigo attack (‘HIT’ questionnaire).

Results: Response rates were 84% on Beep-questionnaires and 85% on evening-questionnaires. HIT-questionnaires were used 15-times. Twenty-eight percent of all evening questionnaires reported vertigo attacks, mostly lasting between 20 minutes and 3 hours, provoked by a variety of self-reported triggers. Vertigo attack occurrence and experienced limitedness in activity were diverse. A correlation was found between attack severity and duration of non-functionality (Spearman 0.782; p=0.001). Patients’ feedback was positive.

Conclusion: These preliminary first results show that the Dizzyquest seems a feasible tool in symptom assessment in vestibular patients. Response rates show a high compliance rate. The application will be optimized for clinical use and research purposes.
**Abstract:**

Introduction: Purpose of this study was to compare the functional benefit of the communicative skills of Egyptian children with unilateral cochlear implants (CI) in relation to those using bilateral hearing aids (HA) in order to compare the role of each amplification device on the communicative abilities of severe to profound and profound sensorineural hearing impaired children.

Methods: Study included 60 children with an age average of 3 to 7 years. Shortly after confirmation of bilateral permanent hearing loss, 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 a comprehensive team evaluation for cochlear implant candidacy and received CI. All children received audiologic management and preschool rehabilitation and all children were enrolled in rehabilitation programs. This study has a prospective design. It started after fitting all children with hearing aids provided that the primary language assessment before rehabilitation is present. A 2nd language assessment was done after 12 months of language therapy to detect the progress of the language development to take the decision either to complete with hearing aids or to decide upon a cochlear implant. 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 Test gave us a summary of the improvement of these children.

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 between the individuals in the study. ANOVA and Post Hoc tests were used. Group A are the hearing aids users for 2 consecutive years, Group B who used hearing aids for 12 months& then shifted to cochlear implantation& used it for another 12 months.

Results: Comparison between the 2 groups in the first year: The receptive LIQ and total LIQ was higher in group A than HA users of group B before CI use. However, there was no significant difference in expressive LIQ. Comparison between HA users and CI users during one year of therapy: CI users showed significantly higher improvement when compared to HA users during one year of rehabilitation in all language quotients (receptive, expressive and total language). Comparison between the 2 years in group A: The receptive LIQ was higher in the 1st year than the 2nd year, while the expressive LIQ and the total LIQ was higher in the 2nd year. Comparison between the 2 years of group B: Receptive, expressive and total LIQ was significantly higher in the 2nd year than the 1st year. Comparison between both groups in the 2 years: There was no significant difference between both groups in any of the LIQs.

Conclusion: 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.
**Poster Number:** 118  
**Abstract ID:** 19  
**Title:** PPVT-5/EVT-3 Special Group Study: Children with Hearing Loss who Utilize Cochlear Implants and Spoken Language  
**Category:** Rehabilitation/Educational Aspects  
**Authors:** Ing Ping Tang, FRCS (Glasgow) ENT dept, Universiti Malaysia Sarawak, Kuching, Malaysia.  
**Abstract:**  
**Introduction:** Updated versions of the commonly utilized Peabody Picture Vocabulary Test - fifth edition (PPVT-5) and Expressive Vocabulary Test - third edition (EVT-3) were released in December 2018. The goal of this special population study was to investigate the performance of children with cochlear implants on the PPVT-5 and EVT-3. Given the large number of confounds and variability that exist within this population, the current study aimed to limit the scope of the collected data to a more homogeneous population, controlling for some known factors that can lead to variability in outcomes. Based on previous research, it was expected that the children in the current study would have significantly lower mean scores on the PPVT-5 and EVT-3 than a matched control group.  
**Methods:** The clinical sample consisted of 70 children with cochlear implants who ranged in age from three to 17 (M=6.3). Thirty-six of the participants were female and 34 were male. Participants were matched to control participants based on age and sex, and the participant’s parents’ education level. The matched control sample was drawn from the pool of nonclinical children who participated in the standardization of the PPVT-5 and the EVT-3. The data for children with cochlear implants was collected between December 2017 and June 2018.  
**Results:** With regard to performance on the PPVT-5, the clinical group of children with cochlear implants obtained a mean composite score that was significantly lower (M=91.4; SD=18.4) than that obtained by the matched control group (M=106.0; SD=14.2; p.<.01). It should be noted that the group mean for the control group was slightly higher than the population mean (i.e., 100), and while significantly lower, the cochlear implant group performed within the average range. With regard to performance on the EVT-3, the group of children with cochlear implants obtained a mean composite score that was significantly lower (M=94.8; SD=16.4) than that obtained by the matched control group (M=103.9; SD=13.1; p.<.01). It should be noted that the group mean for the control group was slightly higher than the population mean (i.e., 100), and while significantly lower, the cochlear implant group performed within the average range.  
**Conclusion:** These results replicate previous research on cochlear implant users that demonstrate relatively lower scores on measures of receptive and expressive vocabulary. As noted previously, for children who have access to sound via assistive technology and for whom spoken English is their primary language, opportunities for incidental learning and exposure to English may differ in important ways from children in the normative sample.
**Title:** Interdisciplinary Collaboration in Research on Spanish-English Bilingual Adolescents with Hearing Loss  

**Category:** Rehabilitation/Educational Aspects

**Authors:** Alliete Alfano, PhD 1, Stacey Lim, AuD, PhD 2, Carolina Gutierrez-Rivas, PhD 2; 1Communication Sciences and Disorders, Florida Int'l Univ., Miami, FL, 2Central Michigan Univ., Mount Pleasant, MI.

**Abstract:**

**Introduction:** There is interest in interprofessional relationships between audiologists and speech-language pathologists. Together, these disciplines can help promote best outcomes and develop research. Involving individuals outside these fields can provide even more meaningful information about the listener’s communication style and abilities. While the collaborative relationship between audiologists and speech-language pathologists has been well-documented, particularly when working with children who have hearing loss (Marconi-Hutkay, 2015), the addition of humanities into that relationship can add even greater insight. The humanities are related to areas such as history, literature, language, ethics, and fine arts. It has been suggested that incorporating humanities into existing IPE practice can allow learners to reflect upon their experiences with their patients, as well as understanding the cultural backgrounds and histories of patients and research participants (Hall, Brajtmnan, Weaver, Grassau, & Varpio, 2014).

**Methods:** In investigating the language and literacy outcomes of adolescents (aged 12-19 years) with significant hearing loss who were raised in bilingual Spanish-English environments, the research team included an audiologist, a bilingual speech-language pathologist/auditory-verbal therapist, and a Spanish language linguist specializing in pragmatics. The main research interest of the audiologist was hearing status, as well as reading comprehension skill. The main focus of research for the linguist was to examine if the pragmatic strategies of the kids with hearing loss differed from those of the hearing kids, in both English and Spanish. The aim was to explore how they utter refusals, give compliments, and ask for favors. The main focus of the research for the speech-language pathologist was articulation development in English and Spanish, as well as language proficiency in English and Spanish.

**Results:** When testing was completed, the research team completed an extensive debriefing to discuss unexpected outcomes, interesting findings and interesting findings.

**Conclusion:** By involving different professions who have expertise across different disciplines, including the humanities, the findings are able to be discussed and analyzed with greater depth, using knowledge from different fields.
Title: Dominio Bilingüe Del Lenguaje En Adolescentes Con Audición Típica y Adolescentes Con Pérdida Auditiva

Category: Miscellaneous

Authors: Alliete Alfano, PhD 1, Stacey Lim, AuD, PhD 2, Carolina Gutierrez-Rivas, PhD 2; 1Communication Sciences and Disorders, Florida Intl. Univ., Miami, FL, 2Central Michigan Univ., Mount Pleasant, MI.

Abstract:

Introduction: Aunque existen investigaciones que demuestran que los niños con discapacidades pueden llegar a ser bilingües, todavía hay preocupaciones sobre cómo los niños con pérdida auditiva pueden aprender más de un idioma hablado (Thomas, El-Kashlan y Zwolan, 2008). En años más recientes, se ha encontrado que hay ventajas en hablar más de un idioma en el hogar, especialmente si los padres dominan oralmente con fluidez otras lenguas (Thomas, El-Kashlan, y Zwolan, 2008). Sin embargo, en el pasado, se alentaba a los padres de niños con pérdida auditiva a hablar un solo idioma; en general, este era el idioma de la mayoría de la población en el país, por lo que, por ejemplo, se alentó a los padres bilingües en los Estados Unidos a hablar solo inglés con sus hijos con pérdida auditiva, independientemente de la habilidad de los padres en inglés. El propósito de este estudio fue comparar el dominio del inglés y el español en adolescentes bilingües con y sin pérdida auditiva.

Methods: Dieciséis adolescentes bilingües (inglés/español), de 12 a 19 años de edad, participaron en el estudio. Ocho de los adolescentes tenían pérdida auditiva neurosensorial bilateral de severa a profunda. La pérdida de audición se identificó antes de los 2 años de edad y el uso del audífono / implante coclear empezó antes de los 2 años y medio de edad. Los 8 adolescentes restantes tenían audición típica y se compararon con la edad de los adolescentes con pérdida auditiva. Los participantes completaron un cuestionario de historia bilingüe y el Woodcock-Muñoz Language Survey en inglés y español.

Results: Se realizó la independent-samples t-test para determinar si había diferencias en los puntajes de dominio del idioma en inglés y español entre los adolescentes bilingües con audición típica y los adolescentes bilingües con pérdida auditiva. La competencia auditiva en inglés fue mejor en los adolescentes con audición típica (101.2 ± 9.6) que en los adolescentes con pérdida auditiva (76.1 ± 18.1), una diferencia estadísticamente significativa de 4.9, t (19) = 6.331, p = .000. La competencia en el lenguaje oral en inglés fue mejor en los adolescentes con audición típica (101.8 ± 7.7) que en los adolescentes con pérdida auditiva (71.0 ± 14.7), una diferencia estadísticamente significativa de 6.0, t (19) = 4.293, p = .000. La competencia auditiva en español fue mejor en los adolescentes con audición típica (79.0 ± 16.5) que en los adolescentes con pérdida auditiva (25.4 ± 22.1), una diferencia estadísticamente significativa de 8.4, t (19) = 6.356, p = .000. El dominio de la lengua hablada en español fue mejor en los adolescentes con audición típica (67.9 ± 17.9) que en los adolescentes con pérdida auditiva (33.5 ± 23.5), una diferencia estadísticamente significativa de 9.1, t (19) = 3.081, p = .001.

Conclusion: Los resultados indican que los adolescentes bilingües con audición típica tienen mejor dominio del idioma tanto en inglés como en español en comparación con los adolescentes bilingües con pérdida auditiva. Además, el dominio del inglés fue mejor para ambos grupos.
Title: Going from Good to Great: CI for a Toddler with SSD

Category: Rehabilitation/Educational Aspects

Authors:
Shelby Atwill, AuD 1, Rebecca Archer, MEd 1, Claire Leake, MS, CCC-SLP, LSLS Cert AVEd 1, Daniel Zeitler, MD, FACS 2; 1Tucker Maxon Sch., Portland, OR, 2Otology, Neurotology & Skull Base Surgery at The Listen For Life Center, Virginia Mason Med. Ctr., Seattle, WA.

Abstract:

Introduction: Common symptoms of unilateral hearing loss (UHL)/single-sided deafness (SSD) include: poorer speech perception, difficulty hearing in noise, trouble with localization and tinnitus. We also have immense research available that documents these challenges exist and persist through the lifespan for people with this condition. In children birth-3 years, we are not easily able to ascertain whether specific children experience these effects, though we know they are common. In cases of SSD, cochlear implantation is the only viable method to restore function in the impaired ear. An osseointegrated (or Baha) auditory implant will allow for detection of sound at the impaired ear by transcranially transferring sound from the poor hearing side to the better hearing side. However, this is not the optimal approach for as it does not restore hearing function to the impaired ear like a cochlear implant does. Traditional hearing aid use is precluded in cases of SSD, as the ear does not have sufficient residual hearing to benefit from amplification.

Methods: Case study of a toddler who received an off-label cochlear implant for single-sided deafness, including description of pre-implant evaluation, surgery, CI activation and audiologic management, habilitation services and post-implant evaluation at 1-month, 3 months and 6-months post-activation. Description of barriers to obtaining CI for this child, and strategies for increased access and coverage.

Results: Positive outcomes for this child, objective and subjective. CI made a dramatic improvement in her quality of life, taking a child who was not far behind her typically-hearing peers to soaring ahead to her previously-unknown potential.

Conclusion: When we withhold all available options from children, we cannot know what their true capacity is. The benefits outweigh the costs in these circumstances.
Title: Evaluation of symbolic Function as Marker to Selection of the Cochlear Implant Candidate

Introduction: Hearing health care guidelines recommend early intervention since there is evidence on positive influences regarding the development of oral language. Some public policies for Cochlear Implant application consider not only the audiological characteristics, but also the development of oral language, adequate psychological and social support of families. However, in the routine it is necessary to investigate other aspects, such as the development of the symbolic function. This function develops in the first years of life, being the basis for symbolic play, oral language and delayed imitation. The objective of this study was to compare two linguistic aspects (one general and one specific) in a candidacy population for cochlear implantation.

Methods: We retrospectively analyzed 19 medical records of children attending a preoperative evaluation for cochlear implantation at an University Hospital. The aspects analyzed were related to the development of general language and oral language. The symbolic evaluation scores of the Behavioral Observation Protocol (2012) were considered and the language was also classified according to expressive language categories. In both test the highest score corresponds to a better performance. We included only children with bilateral sensorineural loss and fitted with hearing aid; those with an audiological diagnosis of auditory neuropathy, with asymmetrical hearing loss and/or with other comorbidities as varied syndromes were excluded. In total, data from 16 medical records with an average age of 42m were analyzed.

Results: 75% of the population studied started the intervention with the focus on the development of auditory and linguistic skills after the first year of life and only 25% started before the first year. Regarding general language performance (evaluation of symbolism), all the children presented performance compatible with age (ceiling score). The oral language evaluation identified that 100% of the children presented a lower performance regarding the chronological age, regardless the time of intervention; these results indicate that oral language was compatible with the performance of children in the first year of life (floor score).

Conclusion: the comparison between the linguistic aspects for a homogeneous population in relation to age and audiological profile showed that considering the general aspects of language made the identification possible of eligible candidates for cochlear implantation.
Title: Additional Disabilities, Cochlear Implants and Informed consent

Category: Surgery/Medical

Authors:
Catherine Birman, MBBS PhD FRACS, William Gibson, MD FRCS FRACS, Elizabeth Elliott, MD MPhil FRACP FRCPCH FRCP;SCIC, Sydney, Australia.

Abstract:
Introduction: Pediatric cochlear implant candidates and their families have high expectations regarding the outcomes of cochlear implant surgery. For a child implanted under 12 months of age, normal language acquisition is now the norm. Children with additional disabilities are common within our pediatric cochlear implant cohorts. Relevant counseling for these families, to provide information that is more specifically tailored to the child helps inform the consent process. The aim of this study was to determine the prevalence of additional disabilities in a pediatric cochlear population, to identify medical and radiologic conditions associated with additional disabilities, and to identify the effect of additional disabilities on speech perception and language at 12 months postoperatively.

Methods: Literature review on informed consent, along with a retrospective chart review of the Sydney Cochlear Implant Centre data base for pediatric recipients over a 12 month period.

Results: Informed consent and education of patients and parents are one of the three pillars of a surgeons responsibility, along with diagnosis and treatment. To ensure best outcomes for pediatric CI recipients, surgery is performed at a young age to optimally harness neuralplasticity. Often under 12 months of age, additional disabilities may not be diagnosed yet. It is helpful to identify risk factors for additional disabilities, to enable more focused discussions about the possibility of additional issues, or factors that could impact on speech and language outcomes. Over a 12 month period- 88 children having 96 operations were identified. The overall prevalence of additional disabilities (including developmental delay, cerebral palsy, visual impairment, autism and attention deficit disorder) was 33%. The main conditions associated with additional disabilities were syndromes and chromosomal abnormalities (87%), jaundice (86%), prematurity (62%), cytomegalovirus (60%), and inner ear abnormalities including cochlea nerve hypoplasia or aplasia (75%) and semicircular canal anomalies (56%). At 12 months postoperatively, almost all (96%) of the children without additional disabilities had a CAP score of 5 or greater (speech), compared with 52% of children with additional disabilities. Children with developmental delay had a median CAP score of 4, at 12 months compared with 6 for those without developmental delay.

Conclusion: Additional disabilities are prevalent in approximately a third of pediatric cochlear implant patients. Additional disabilities significantly affect the outcomes of cochlear implants. This information can inform the pre-operative counselling with families.
**Poster Number:** 125  
**Abstract ID:** 184  
**Title:** Effects of Children’s Hearing Loss on the Synchrony Between Parents’ Object Naming and Children’s Attention to Objects in Parent-Child Interactions  
**Category:** Rehabilitation/Educational Aspects  
**Authors:** Chi-hsin Chen, PhD 1, Irina Castellanos, PhD 1, Chen Yu, PhD 2, Derek Houston, PhD 1; 1The Ohio State Univ., Columbus, OH, 2Indiana Univ., Bloomington, IN.  
**Abstract:**  
Many children with hearing loss show spoken language delays even after long-term use of hearing aids or cochlear implants. Most studies on language outcomes in children with hearing loss have focused on demographic, audiological, linguistic, and environmental factors. Another important, yet unexplored, area is how children’s attention during parent-child interactions affects language development.  
A growing body of research with children with normal hearing suggests that children’s sustained visual attention to objects during play is associated with their learning of novel words and long-term language development. The current study used head-mounted eye-trackers to obtain precise measures of visual attention during parent-toddler interactions. We examined the synchrony between parents’ naming of novel objects and children’s sustained attention to the named objects in joint play. Three groups of toddlers along with their parents participated in the study: Hearing parents and children with hearing loss (HL, 3 had cochlear implants and 2 had hearing aids), hearing parents and hearing children matched to the HL group on chronological age (CA), and hearing parents and hearing children matched to the HL group on hearing age (HA).  
During the experiment parents and their toddlers played with novel objects and each object was arbitrarily paired with a novel name. Both participants’ attention and parents’ speech were recorded during the interaction. We examined 1) the quantity of parents’ naming of the novel objects, 2) the quantity of children’s sustained attention to the novel objects, which was defined as looks to the objects > 3s, and 3) the synchrony between parents’ naming of the novel objects and children’s sustained visual attention to those same objects.  
We found that the parents in the HL group produced similar amounts of object naming as parents in the CA and HA groups. In addition, children in the HL group demonstrated similar amounts of sustained attention to the objects in play as their CA and HA peers. However, there were significant differences in the temporal synchrony of parents’ object naming with children’s attention to the named objects in the HL group compared to their CA and HA peers. Parents’ naming of an object was less likely to overlap with children’s sustained attention on the same object in the HL group. These group differences seem to arise as a function of children’s hearing status, and not driven by children’s chronological age or hearing age. Numerous prior studies have shown that naming objects that children pay attention to is positively associated with children’s vocabulary development. Patterns of less synchronization between parents’ naming moments and children’s sustained attention may lead to difficulties in learning novel words and overall long-term language development.
Title: Factors Affecting Speech Perception and Language Outcomes

Authors:
Shani Dettman, PhD, MEd, Speech Pathology 1, Dawn Choo, Master of Speech Pathology 1, Jaime Leigh, PhD 2, Richard Dowell, PhD 1; 1Dept Audiology and Speech Pathology, The Univ. of Melbourne, Parkville, Australia, 2The Royal Victorian Eye and Ear Hosp., East Melbourne, Australia.

Abstract:
Introduction: A longitudinal paediatric cochlear implant database which includes child, family and device details provides the ability to identify trends in cochlear implant (CI) outcomes over time and define predictor variables known to influence communication.

Methods: Speech perception and language assessment protocols are administered pre-implant, at one to two years post-implant and at five years of age (school entry) with all children at this centre. Data for over 1000 children were entered, at the time of assessment, into a paediatric database complete with child factors (e.g., gender, aetiology, cognitive skills, age at device fitting, communication approach), family factors (e.g., relative socio-economic advantage, language used/English interpreter required, maternal education) and device factors (number of electrodes, surgical complications, implant device, speech processor type). To manage the scores derived from different assessment scales administered as part of this assessment protocol between 1985 and 2018, data were coded using the Categories of Auditory Performance Index - Revised (CAPI-R; e.g., 0=no sound awareness to 8=open set performance >75% with 10dB SNR) and the Categories of Language Performance (CLIP; e.g., 0=greater than 4 SD below the mean to 7=2 SD above the mean).

Results: There have been significant reductions in age at first hearing-aid and age at first CI over time. In recent years, bilateral simultaneous CI surgery accounts for 50% of all paediatric CI surgery. The median CAPI-R for this unselected group was 6 (range 0 to 8; IQR 1) which equates to open-set understanding greater than or equal to 75%, while listening alone. Significant independent predictors of speech understanding were: age at first CI; cognitive status; communication mode; pre-implant pure tone average, and device experience. The median CLIP score for this unselected group was 3 (range 0 to 7; IQR 3), which equates to a standard score between 70 and 85, i.e., greater than one standard deviation below the mean for the normative population. Independent predictors of language were: age at first CI; cognitive status; communication mode; pure tone average; and relative socio-economic advantage.

Conclusion: This retrospective analysis of an existing database demonstrated the utility of category-based coding (CAPI-Revised and CLIP) to enable description of the paediatric CI population (including the description of abilities for children with additional special needs who are frequently excluded from research). The CAPI-Revised and CLIP have the potential to facilitate data pooling in future multi-centre research collaborations and can increase the power of statistical observations to facilitate the provision of evidence-based guidelines for the effective management of paediatric hearing loss.
Title: Munich Music Questionnaire: Adaptation into Italian Language and Application in Cochlear Implant Teen-Agers and Children

Category: Rehabilitation/Educational Aspects

Authors:
Maria C Guarnaccia, ENT, Concetta D’adamo, Speech Therapist, Franca Artioli, Audiologist, Elisabetta Genovese, ENT;Head and Neck, ENT, Modena Policlinico Hospital, Italy.

Abstract:
Introduction: The aim of the study is to translate the Munich Music Questionnaire (MUMU) in Italian language, to adapt it culturally, and to describe the results obtained among children and teen agers users of cochlear implant (CI).

Methods: We translated the questionnaire to Italian, reviewed the grammatical rules and idiomatic words, and adapted it from a linguistic and cultural perspective. The resulting version of this process was applied among infant CI users through an interviews directly to the child.

Results: We submitted the Italian version of MUMU to 35 preverbal children/teen-agers (8-13 years) who had a good period with hearing aids and than had been users of the CI for at least 2 years. We use only the questions related to hearing loss without the other score. The answers to the questionnaire were analyzed by distribution of frequency and percentage of occurrence in each question. The results showed a good use of CI in the listen to music especially for the hearing aids users before CI:

Conclusion: The subjective evaluation tool MUMU was translated and culturally adapted to the population studied. The study showed its applicability in the daily monitoring of CI users, thus providing a profile of the activities related to music in everyday life. The study moreover shows the good results in music perception with use of CI.
Poster Number: 128  
Abstract ID: 328  
Title: Literacy outcomes in children with severe-profound hearing loss and early unilateral and bilateral cochlear implants  
Category: Rehabilitation/Educational Aspects  
Authors:  
Fatma Hassaneen, Bs in Communication Sciences and Disorders, Katrien Vermeire, PhD;Communication Sciences and Disorders, Long Island Univ., Brooklyn, NY.  
Abstract:  
Introduction: Since the 1980s, cochlear implants (CIs) have been used clinically to provide hearing to children with severe-profound hearing loss, because hearing aids do not give sufficient amplification for this degree of hearing loss. Outcomes for children with cochlear implants were measured for many years primarily in terms of speech perception ability, with the underlying assumption being that reasonable speech perception ability would facilitate other aspects of the children’s development and learning. However, although there have been enormous improvements in speech perception outcomes for children with CIs, it has become apparent that good speech perception ability does not ensure age-appropriate outcomes in other areas. Despite improvements in hearing technologies and shifts in communication philosophy and instructional approaches, children with CIs continue to lag significantly behind their hearing age peers in reading and writing achievement.  
Methods: Prelingually deafened children with early unilateral and bilateral cochlear implants will participate in our study.  
Results: Outcome data on measures of reading comprehension and written expression will be presented. Factors impacting outcomes will be explored.  
Conclusion: This study will extend the knowledge about children with early CIs and their literacy achievement in deaf children with early cochlear implants.
Poster Number: 129
Abstract ID: 12
Title: Professional Listening and Spoken Language Coaching: The Multiplying Effect
Category: Rehabilitation/Educational Aspects
Authors:
Mariana Helbig, MA, Cert LSLS AVEdSonidos, Ballwin, MO.

Abstract:
Introduction: Technological advances in diagnosis and treatment of hearing loss, awareness to the importance of early detection and intervention of hearing loss in Latin America = more children with hearing loss have early access to sound: cochlear implantation increased 800% in the years 1998-2006 (Flores, 2007). Another definitive factor for these children to develop audition, spoken language and cognitive abilities, is the availability of effective family centered early intervention. The number of professionals in Latin America equipped to serve children with hearing loss who have access to sound is insufficient. (Flores, 2007) We need to increase the number of Listening and Spoken Language Specialists in Latin America, in order to reach more families, and increase opportunities for children with hearing loss to become active participants of society.

Methods: Discuss the incidence and prevalence of hearing loss in Latin America, the importance of having access to effective early intervention, the impact of empowering the family through early intervention, the relationship between available trained professionals and children with hearing loss in Latin America; through various research papers:

Results: 15 out of 1000 babies are born with hearing loss or acquire it after birth (WHO, 2017), being 1 in 1000 severe to profound. 50,000 children born in LATAM with hearing loss in a year. 10,000 of these children have a profound hearing loss. Cochlear implantation in LATAM increased 800%: 1998-2006 (Flores, 2007) These children should receive services within the first 3-5 years of life; therefore, approximately 150,000-250,000 would need services. If one professional serves 25 children and their families per year, we would need 5,000 to 8,000 professionals. Flores (2007): 2/3 of her subjects (from 30 IC centers in LATAM) responded they were involved in Auditory Verbal Therapy post implantation (TAV in Spanish); however, it was not TAV since families were not included in the therapy, or the services were provided in a group of 3-4 children. Due to the lack of adequate intervention to develop audition and spoken language, 70% of the children had reading levels below their hearing peers. It is through reading that we can access advanced concepts and knowledge, as well as increase vocabulary and culture.

Conclusion: There is a lot of work to be done promoting awareness and training to continue to improve rates of early identification and adequate early amplification of hearing loss in LATAM. Once these children have access to sound, it is imperative that they have access to knowledgeable Listening and Spoken Language Specialists. These professionals have to understand the foundational knowledge to be a guide and support to 2 children with hearing loss and their families, for these children to achieve high standards of development, commensurate to their hearing peers. My proposal is to raise funds, in order to support the provision of one-to-one mentoring and live embedded coaching in Spanish to these professionals via the internet, in order to increase the availability of trained professionals in LATAM. One trained professional could serve 25 families directly. But working collaboratively with 40 professionals, I would be able to reach 1,000 families and preparing a professional who would be in that region, and could then mentor a colleague. This is the Multiplying Effect of Listening and Spoken Language!!
Poster Number: 130
Abstract ID: 327
Title: Listening and Spoken Language Specialist Certification A Global Perspective
Category: Rehabilitation/Educational Aspects
Authors:
Ulrika Löfkvist, PhD, Associate Professor, LSLS Cert AVEd, SLP 1, Uma Soman, PhD, LSLS Cert AVEd 2, Mila Melo, LSLS Cert AVT, Cert SLP 3, Frances Clark, LSLS Cert AVT, Cert SLP 4, Carmen Abascal, Cert SLP 5, Gayla Hutsell Guignard, MSc, LSLS Cert AVT, CCC-SLP, CCC-A 6, Emma Rushbrooke, MPhil, LSLS Cert AVT 7; 1Department of Special Needs Education, Univ. of Oslo, Oslo, Norway, 2Carle Auditory Oral Sch., Urbana-Champaign, IL, 3Infant Hearing Program, Toronto Publ. Health, Toronto, Canada, 4Auditory Verbal UK, London, United Kingdom, 5AG Bell Intl., Madrid, Spain, 6AG Bell Association, Indianapolis, IN, 7Hear and Say Ctr., Brisbane, Australia.

Abstract:
Introduction: There are many studies showing the importance of parental engagement for optimal development of spoken language, besides from early identification of hearing loss and early fitting of hearing technology. Families differs, and the population of children with hearing loss is highly heterogeneous. Therefore, there is a great need of individual, family-centered, and specialized support from well-educated and experienced professionals. Listening Spoken Language Specialist certified Auditory Verbal Therapist’s or Educator’s (LSLS cert. AVT’s and LSLS cert AVEd’s) have at least a bachelor’s degree and additional 3-5 years specialized training and are individually mentored as clinicians, within the field of parental coaching and pediatric hearing impairment. So far, the absolute majority of certified LSLS professionals work in USA, Canada and Australia. Objective: To describe the current situation regarding LSLS certification procedure with a global perspective, as well as the possible hinders and challenges for professionals to become certified LSLS professionals.

Methods: A literature review has been conducted and a digital survey has been created by the authors, that is directed both toward already certified LSLS, professionals who want to become certified, and to professionals who for different reasons do not want to become certified. The survey will be distributed globally, during a period of two months in the beginning of 2019.

Results: Preliminary survey results will be presented illustrating the hinders and challenges, as well as the motivation for global professionals to become LSLS cert. AVT/AVEd, together with descriptive background information about how one can become certified.

Conclusion: There is a need of more international professionals who become specialized as certified LSLS AVT/AVEd, to serve families globally within their own socio-cultural context, and with best practice in listening and spoken language habilitation.
Poster Number: 131
Abstract ID: 77
Title: Long-Term Speech Recognition and Language Skills in Mandarin-Speaking Children with Cochlear Implants
Category: Rehabilitation/Educational Aspects
Authors: Xing Lu, PhD, Zhaobing Qin, PhD; The First Affiliated Hosp. of Zhengzhou Univ., Zhengzhou, China.
Abstract:
Introduction: Cochlear implant (CI) is an effective treatment allowing children with severe to profound sensorineural hearing loss to achieve substantial development in auditory and language abilities. Along with the enhanced skill in surgical technique and the increased financial support from national government and social enterprise, more and more prelingual deaf children became CI recipients and benefited from it. The increased CI population urges the evaluation on the progress in auditory and language skills, especially the long-term performance post-implantation, which related to whether the children with CIs could return back to mainstream society. In this study, we aimed to investigate long-term open-set word recognition and language skills in Mandarin-speaking children with CIs and the predictors of the outcomes, and to explore the relationship between children’s word recognition and their receptive and expressive language skills.
Methods: A sample of 61 prelingual deaf children who received CI at our department were recruited in the study. 61 children with normal hearing matched in age and sex were served as control group. Mandarin lexical neighborhood test (M-LNT) was used to evaluate the open-set word identification performance in children with CIs and children with normal hearing and Revised Preschool/Primary School Language Assessment Test for their receptive and expressive language skills.
Results: Children with CIs showed higher identification scores in easy word than in hard word, as well as higher scores in disyllabic words than in monosyllabic word. Children with CIs demonstrated lower identification scores compared with those of children with normal hearing. Children with CIs also showed lower scores in receptive and expressive language performance when compared with normal hearing peers. A significant correlation was found between open-set word recognition and receptive and expressive language skills. Age at implantation, CI duration, multilingualism and parental education were revealed to be associated with the outcomes of speech perception and receptive and expressive language skills.
Conclusion: Children with CIs achieved progress in long-term speech recognition and receptive and expressive language skills in various degree. However, their performance still exhibited a gap compared with that of children with normal hearing. A significant correlation was found between speech identification and receptive and expressive language skills. Age at implantation, CI duration, multilingualism and parental education were related to the long-term outcomes of speech recognition and receptive and expressive language skills post-implantation.
Poster Number: 132  
Abstract ID: 101  
Title: Very Early Activation After Cochlear Implantation - Our Experiences in 20 Cases of Children  
Category: Rehabilitation/Educational Aspects  
Authors:  
Astrid Magele, MD,PhD 1, Phillip Schoerg, BSc 2, Georg M. Sprinzl, Univ Prof Dr 1; 1ENT, Karl Landsteiner Private Univ. hospital, St.Poelten, Austria, 2Audiology, Karl Landsteiner Private Univ. hospital, St.Poelten, Austria.  
Abstract:  
Introduction: Cochlear Implantation is a clinical routinely treatment for patients with severe sensorineural hearing loss for over two decades. In a previous study we could show, that activation after two weeks is possible without any problems, leading to higher patient satisfaction and rapid hearing rehabilitation. Now we would like to show, that first fitting also at the second postoperative day is feasible.  
Methods: We evaluated retrospectively 20 children, who were implanted in the University clinic St.Poelten. They had a head dressing for 24 hours. At the second postoperative day they got a medical check, to find out possible complications, which could contraindicate the first fitting. Wound healing, swallowing, wound infection, and sensibility of the retro auricular region were evaluated. Also the impedance measurements were compared with the results from the intraoperative measurements.  
Results: In all cases first fitting was possible on the second postoperative day. All of the children tolerated the manipulation at the wound without any problems. In 3 cases a little swallowing at the wound consisted which made the use of a stronger magnet necessary. There were no statistically significant differences between the intraoperative, and the postop impedance measurements for each channel.  
Conclusion: We used in all cases a minimally invasive approach and soft implantation technique in our patients, and conclude that this approach enables us to proceed with the very early activation. With this technique, we are able to reduce the surgical trauma to a minimum, which makes it possible for the wound to heal fully and for the patient to wear the sound processor over the wound without problems. Because of no statistical difference in the telemetry measurements we could confirm our previous study, that telemetry is not a predictor for the time of activation.
**Title:** Musical Participation Among School-Age Children with Cochlear Implants: An Analysis of Web-Based Content

**Category:** Rehabilitation/Educational Aspects

**Authors:**
Alex Meibos, AuD, PhD
School of Speech-Language Pathology and Audiology / Northeast Ohio AuD Consortium, Univ. of Akron, Akron, OH.

**Abstract:**

**Introduction:** Children receiving cochlear implants are achieving greater outcomes than ever before. Researchers have identified greater gains in speech recognition, speech production, and language development outcomes. Families are now hoping that implant benefits can expand to include music appreciation and participation. The purpose of this study was to identify, from web-based content, a set of characteristics describing school-age children with cochlear implants who currently participate in music activities.

**Methods:** Using a qualitative content analysis approach, web-based sources were searched to identify published content related to school-age children with cochlear implants who participate in music activities. Content was gathered from peer-reviewed empirical literature and websites containing characteristics related to the research question. For inclusion in the study, content must have been published or posted online from 2012-2017, in English, and make mention of active music participation by a school-age child that could be coded for analysis (e.g. singing, instrumental, band, orchestra, choir, etc.). Descriptive analysis was used to identify topics in the sources gathered.

**Results:** Content from a total of 49 school-age children was identified from 13 different web-based sources, including web-pages and peer-reviewed journal articles. Based on the data collected, families who foster musical interest tend to influence musical activity uptake by children with cochlear implants, compared to families where music is not as important. Children with cochlear implants from European and Asian countries were found to be more involved in musical activities.

**Conclusion:** Music research and other evidence related to school-age children preferences for participating in music activities is scarce. Of the data observed in this study, a key finding was that school-age children with cochlear implants across the globe tend to lean toward recommended music activities and instruments that are found in the empirical literature, regardless of their age, gender, ethnicity, race, or geographic location. Future research is needed to explore important factors of how to help clinicians, families, and educators of children with cochlear implants facilitate successful and meaningful participation in musical activities.
Poster Number: 134  
Abstract ID: 414  
Title: Appropriate Age of Sound Field Hearing Tests in Cochlear Implant Child Recipient  
Category: Rehabilitation/Educational Aspects  
Authors: Hazama Michio, PhD 1, Mina Sasaki, none 1, Kei Nakahara, MD, D 1, Satoshi Kihara, MD 1, Tatsuya Hojo, MD 1, Takema Sakoda, MD, D 1, Atsushi Kawano, Prof 2, Tadao Enomoto, Prof 1; 1ENT, RINKU GENERAL HOSPITAL, Izumisana, Japan, 2ENT, TOKYO MEDICAL UNIVERSITY HOSPITAL, TOKYO, Japan.

Abstract:  
Introduction: In this study, we investigated appropriate age on sound-field hearing tests on cochlear implant child recipients.  
Methods: In this study, "appropriate hearing performance in sound field hearing tests" means that participant's hearing performance are over the average of the various sound field test results of six elementary school students that the Verbal Comprehension Index score of WISC-IV was in the average range. Test participants were 8 children at our hospital.  
Results: The average age the appropriate hearing performance was obtained by sound field hearing tests, 1)Threshold is 2 years and 6 months, 2)Speech discrimination test in the noise was 4 years and 6 months, 3)Most speech discrimination test was 4 years and 8 months, 4)SRT was 5 years and 7 months, and 5)speech discrimination at threshold was 5 years and 9 months.  
Conclusion: The average age the appropriate hearing performance was obtained by sound field hearing tests, 1)Threshold is 2 years and 6 months, 2)Speech discrimination test in the noise was 4 years and 6 months, 3)Most speech discrimination test was 4 years and 8 months, 4)SRT was 5 years and 7 months, and 5)speech discrimination at threshold was 5 years and 9 months.
Title: Relation Between the Temporal Structure of Classroom Language Use and Language Abilities in Children With and Without Hearing Loss

Category: Rehabilitation/Educational Aspects

Authors:
Samantha Mitsven, BA 1, Lynn Perry, PhD 1, Neil Johnson, PhD 2, Daniel Messinger, PhD 1; 1Psychology, Univ. of Miami, Coral Gables, FL, 2Physics, The George Washington Univ., Washington, DC.

Abstract:
Introduction: Children with hearing loss (HL) experience a sensory barrier to language use and acquisition. Although cochlear implants or hearing aids can help to ameliorate the effects of HL, many children using these devices still exhibit delays or atypicalities in oral language and communicative development (Niparko, Toby, & Tal, 2010). Participation in high-quality inclusive classrooms where children with HL are educated alongside typically developing (TD) peers in an auditory and oral learning environment may improve outcomes for children with HL. Here, we sought to quantify the temporal patterning of children’s language use in an inclusive intervention classroom of children with HL and TD children.

Methods: Data were collected twice per month over the course of the school year in an inclusive intervention classroom of seven children with HL, who had cochlear implants or hearing aids, and two TD peers (Mage=2.77 years). Children’s vocalizations were recorded using audio recorders worn by each child. Pattern recognition software, which allowed for the automated analysis of day-long vocal recordings, was used to detect and characterize children’s speech-related vocalizations.

Results: Linear mixed-effects models were employed to investigate whether the temporal patterning of speech-related vocalizations differed between children with HL and TD children. Our primary measures of interest were vocalization duration and frequency as well as the temporal distribution of children’s vocalizations over the course of the school day. Children with HL did not differ from their TD peers in either the duration or the frequency of their vocalizations suggesting that regardless of hearing status, children were producing vocalizations of commensurate grammatical complexity and were vocalizing at similar rates. The vocalizations of children with HL and TD children exhibited positive burstiness, meaning that vocalizations tended to be clustered in time rather than evenly or randomly distributed. Further, children with HL exhibited a higher degree of burstiness than their TD peers. The burstiness of children’s vocalizations was negatively associated with their receptive and expressive language abilities such that children whose vocalizations tended to be more clustered together in time exhibited lower language skills.

Conclusion: These data provide novel insights into the temporal structure of children’s vocalizations within early education settings, which could facilitate language-based interventions for at-risk populations as well as inform educational practices. Examining the real-time dynamics of children’s speech-related vocalizations provides information that is critical for fostering language development particularly in inclusive classroom settings where children might differentially produce language and where tuning into these vocalization events is important for scaffolding children’s language learning.
**Title:** Psychological Burden of Children Candidates’ Families to Cochlear Implantation

**Category:** Rehabilitation/Educational Aspects

**Authors:**
- Alessandra B. Motta, PhD 1, Gustavo B. Oliveira, student 2, Carmen Barreira Nielsen, PhD 3; 1Audiology and Speech Pathology Department; Psychology Graduate Program, Federal Univ. of Espirito Santo, Vitoria, Brazil, 2Audiology and Speech Pathology Department; Federal Univ. of Espirito Santo, Vitoria, Brazil, 3Audiology and Speech Pathology Department; Federal Univ. of Espirito Santo, Vitória, Brazil.

**Abstract:**

**Introduction:** Hearing loss in a child can cause risks to family relationships in different ways. The possibility of Cochlear Implant (CI), generates high expectations, but also uncertainties and concerns that can lead to stress and anxiety reactions, becoming an important factor in making the decision regarding the surgery and in the psychosocial adjustment of the family. This research aimed to describe and analyze family psychosocial risk of children candidates for CI surgery, checking the emotional burden of care, expectations and motivation concerning the outcomes of the implantable device.

**Methods:** A descriptive, quantitative and qualitative study was carried out, which allowed the understanding of psychosocial aspects of hearing loss in families’ candidates for CI. Families of 8 children and adolescents, from 2 to 14 years of age, who were under the Cochlear Implant Program participated in this study. Demographic and clinical characteristics including age at diagnosis, type and severity of hearing loss, and initial audiologic information were registered. The following instruments were used: a) Burden Interview Scale, to assess parents’ psychological burden; and b) Interview with parents based on the motivational interview theoretical model, to assess parent’s expectations and motivation for cochlear implant surgery. The results were descriptively analyzed.

**Results:** Most caregivers are mothers, with a high education. Moderate indicators of emotional overload were found in most caregivers, with higher scores on items that address concerns about the child’s dependence and future, as well as stress reactions due to the need to reconcile child care and personal needs. Half of the families considered to be more difficult at the moment of the surgery having the fear of sequels shown as a complicator in the treatment process to be followed, although the great majority is motivated with the implantation. All caregivers idealized the improvement in the child’s communication when they reported expecting the child to be able to hear and talk better with the use of CI.

**Conclusion:** Given our findings, it is possible that families of CI’s candidates may be benefited from specific interventions to meet the psychosocial needs to improving the understanding of the advantages and limitations of CI even during the preoperative assessments.
Poster Number: 137  
Abstract ID: 84  
Title: Cochlear Implantation for Pediatric Unilateral Hearing Loss: Hearing in Spatially Separated Noise  
Category: Audiology  
Authors:  
Lisa R. Park, AuD, Margaret Dillon, AuD, Meredith Rooth, AuD, Kevin D. Brown, MD, PhD; Otolaryngology/Head and Neck Surgery, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC.  
Abstract:  
Introduction: Treatment for children with profound unilateral hearing loss (UHL) has historically been limited to rerouting of signals to the better hearing ear. Cochlear implantation allows for stimulation of the auditory pathway of the deafened ear itself. This report will present data regarding hearing in spatially separated noise from an ongoing clinical trial of cochlear implantation in cases of pediatric unilateral hearing loss.  
Methods: Children between 3.5-6.5 years with moderate to profound UHL were enrolled and received a cochlear implant (CI). Open set speech perception was assessed using the CNC word list directly connected to the CI speech processor. Hearing-in-noise was measured using the BKB-SIN with speech and noise co-located and with noise at + 90° azimuth. These measures were obtained with and without the CI at 6 and 12 months post-implantation.  
Results: The use of a CI provided head shadow and summation benefits by 6 months of use. These benefits were well established by 12 months of use. Some participants began to show evidence of squelch at the 12-month test point. Word recognition in the implanted ear increased over time, but did not correlate to spatial hearing abilities.  
Conclusion: Cochlear implantation can provide opportunities for speech understanding in the deafened ear of children with UHL and improvements for hearing in spatially separated noise. Even children with limited CNC word scores are able to realize significant benefits in noise. A hearing-in-noise test paradigm is recommended as an addition to the test battery for children with UHL.
**Poster Number:** 138  
**Abstract ID:** 412  
**Title:** Speech Perception & Speech Production Performance in Pediatric Cochlear Implant Users Enrolled in Oral or Total Communication Programs  
**Category:** Rehabilitation/Educational Aspects  
**Authors:** Olga Peskova, MS, PhD student, Ann Geers, PhD, Peter Assmann, PhD; UTDallas, Richardson, TX.  
**Abstract:**  
**Introduction:** The purpose of this study is to examine the relationships between perception and production abilities in two groups of children using cochlear implants (CIs) who were enrolled in oral communication (OC) or total communication (TC) programs. Participants: 107 children (8 to 9 years of age) implanted under four years of age participated in the study. Children were selected from a large cohort of CI recipients (Geers and Brenner, 2003; Geers et al., 2011). Children were residents of 33 states in the United States and 5 Canadian provinces. Speech perception testing: The Video Game Test of Speech Pattern Contrast Perception (VIDSPAC) (Boothroyd, 1997) was used to evaluate speech perception in CI users. The VIDSPAC provided non-linguistic measures of a child’s ability to discriminate specific phoneme contrasts and were not affected by the child’s vocabulary knowledge. The task required a child to detect a change in pairs of syllables responding to a feature contrast. The VIDSPAC stimuli consisted of two place contrasts, daa/gaa and saa/shaa, two manner contrasts daa/zaa and saa/taa, and two voicing contrasts, daa/taa and saa/zaa. Speech production testing: Each CI participant produced 36 McGarr sentences (McGarr, 1983). The recorded sentences were transcribed by four speech language pathologists. Transcriptions were analyzed using the Computer Aided Speech and Language Analyses (CASALA) software package (Serry et al., 1997). Reports from CASALA determined the percent correct for each consonant in the perception experiment /d/, /g/, /s/, /sh/, /z/, and /t/.  
**Results:** Preliminary findings indicated significant associations between perception and production for the feature contrasts of manner (r=0.65, p<.001), place (r=0.43, p<.001) and voicing (r=0.32, p<.01) for children enrolled in TC programs. Only associations between perception and production for the feature contrast of manner reach significance (r=0.29, p<.05) for children enrolled in OC programs.  
**Conclusion:** The data from this study supports the need for further evaluation of the mechanisms underlying these relationships between perception and production in order to inform future clinical practice.
Title: Automated Assessment of Child Speech Interactions Using Cochlear Implant Data Logging

Abstract:

Introduction: The trajectory of children’s linguistic and cognitive development is influenced by the speech interactions that they have with their caregivers, such as the number of words addressed to the child, or the amount of conversational turns that they participate in (e.g. Zauche et al., 2016). Manual transcription for the assessment of natural language environment is time consuming, which means that such observations are limited to a few hours, and often impractical outside of the research context. Recent technology has, however, opened the possibility to monitor the language environment automatically, unobtrusively, and over extended periods of time. This has spawned a great interest in the topic by researchers and clinicians alike. The ability to automatically capture and analyze the auditory environment has also been implemented in a cochlear implant (CI) sound processor. In its current implementation, this sound processor merely tracks the amount of time that users spend in a speech-like environment, and does not distinguish between their own speech and the speech of others. For pediatric CI recipients such a distinction might be useful, because it could provide insights into their language development through simple metrics such as the quantity and interactivity of caregiver-child interactions. For older CI recipients, such measures could be interesting, too, as a reflection of their social integration.

Methods: A novel real-time speech-classification algorithm has been developed for the CI sound processor, which estimates the amounts of own speech, external speech, and conversational turns, and keeps track of them in the sound processor data logs. The aim of the present study was to compare the real-life accuracy of this new algorithm to manual transcription and to LENA™, a commercially available tool with a similar objective. Specifically, we focused on correlation and agreement between the three methods in naturalistic settings. For this, 12 young children with CI (age 15-56 months) used the new data-logging algorithm over a period of 2 weeks in their daily environment. During that time, each family also made a full-day LENA recording and an audio recording of a 1 hour long parent-child interaction, which was transcribed manually. To assess the performance of the new algorithm, the results of the manual transcription, LENA and the new algorithm were compared. Moreover, during the trial, the sound processor data were made available through mobile apps to the children’s caregivers and CI audiologists, and their impressions were captured with questionnaires.

Results: The results demonstrate that the estimated metrics correlate well with the human transcriptions, indicative of the true linguistic environment of the pediatric subjects. Also, the caregivers highly appreciated the algorithm functionality and insights it provided through the mobile app.

Conclusion: The new real-time speech-classification algorithm provides useful information of pediatric CI user’s linguistic environment and spoken-language use. This suggests that it can potentially be used as a monitoring and diagnostic tool and could help to assess and optimize the day-to-day environment of children with CIs, in order to improve their auditory rehabilitation.
**Title:** Very Early Implantation: A Case Study  
**Category:** Rehabilitation/Educational Aspects  
**Authors:** Sarah Radlinski, MS, LSLS Cert AVT 1, Jolie Fainberg, MA 2; 1Auditory Verbal Ctr., Atlanta, GA, 2Clinic, Atlanta Speech Sch., Atlanta, GA.

**Abstract:**

**Introduction:** The advantage of early implantation has been well documented. The age of implantation supported by FDA has decreased over the years but still remains above the age of implantation that is standard in some countries. Research has demonstrated that the closer we get to a child’s natural language learning timeline, the easier it will be for that child to learn speech and language with less intervention and for less time.

**Methods:** We have implanted, off label, a young child at six months of age for her first ear and nine months for her second ear. She is enrolled in weekly Auditory-Verbal therapy with intensive home carryover. The purpose of this presentation is to review the outcomes to date of this child’s journey to become a listening and spoken language learner. The presentation will share the progress of the child at 3-month intervals throughout her first year of listening (at the time of the convention the child will have been implanted for just under a year).

**Results:** Thus far, the child has made more than month for month progress and, as she was implanted at just 6 months, it is anticipated that within the first year of listening she will close the gap between her language skills and those of same-aged hearing peers.

**Conclusion:** To date, norms for expected progress for children implanted at 6 months of age are not available so this case study will furthermore provide information regarding what outcomes may be possible for very early implanted children. We will additionally emphasize the relationship of Auditory-Verbal therapy and cochlear implant mapping. The AV Therapist and CI audiologist work closely together to optimize the mapping for this child using speech, language and auditory outcomes.
Title: Attitudes and Perspectives of Parents Raising Deaf and Hard-of-Hearing Infants & Toddlers

Category: Rehabilitation/Educational Aspects

Authors:
Ronda Rufsvold, PhD, LSLS Cert AVEd, Maria Hartman, PhD, Elaine Smolen, MAT, LSLS Cert AVEd, Ye Wang, PhD; Teachers Coll., NYC, NY.

Abstract:

Introduction: In 2013, the Joint Committee on Infant Hearing (JCIH) presented twelve goals to supplement the Early Intervention Recommendations outlined in their initial 2007 statement. The document provides comprehensive guidelines and best practices for early hearing detection and intervention (EHDI) programs to ensure every child who is D/HH is provided the opportunity to achieve optimal language, literacy, and learning outcomes. There are some studies investigating the impact of early enrollment in early intervention programs (Moeller, 2000; Yoshinaga-Itano & Apuzzo, 1998; Yoshinaga-Itano, Sedey, Wiggin, & Chung, 2017), however the attitudes and perspectives of the parents of these children have yet to be investigated thoroughly. In 1998, Yoshinaga-Itano and colleagues investigated the language skills of 150 children with hearing loss and found that identification of hearing loss by 6 months of age provides a language advantage across test ages, communication modes, degrees of hearing loss, and socioeconomic status. They found the mean language scores for the earlier identified group to be almost a full standard deviation higher than the mean performance of later-identified children (Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998). Two years later, Moeller (2000) led a longitudinal study investigating the relationship between age of enrollment in intervention and language outcomes of 112 children with hearing loss at age 5. She found similar results to Yoshinaga-Itano et al, wherein significantly better language scores (specifically vocabulary and verbal reasoning skills) were associated with early enrollment in intervention. This study additionally found that high levels of family involvement correlated with positive language outcomes. These data suggest early enrollment in an intervention program along with engaged caretakers are primary factors in a child with hearing loss’ success with language.

Methods: This study utilized a mixed methods approach to understanding the impact of early intervention on parents and children who are deaf/hard of hearing. Participants received early intervention services though a center based program that focused on the development of listening and spoken language for children who are DHH. The data collection consisted of quantitative measures (e.g., demographic information, language assessments, parent centered assessments, and audiological information) as well as qualitative data through the use of semi-structured interviews and focus groups. In the pilot study, three families were recruited. In January 2019, ten more families will be recruited and their data analyzed.

Results: Using thematic analysis, several themes emerged from the preliminary data. These included parents’ experiences understanding their child’s hearing loss, making communication choices, accepting new and unexpected challenges as well as embracing positive aspects of a new journey.

Conclusion: Families experience their child’s hearing loss differently; yet share many similar perspectives and attitudes finding support and community from each other as well as professionals in the field.
**Poster Number:** 142  
**Abstract ID:** 136  
**Title:** Cochlear Implant Fitting for Children  
**Category:** Rehabilitation/Educational Aspects  
**Authors:**  
Mina Sasaki, none 1, Michio Hazama, Prof 1, Kei Nakahara, MDD 1, Satoshi Kihara, MD 1, Tatsuya Hojo, MD 1, Takema Sakoda, MDD 1, Atushi Kawano, prof 2, Tadao Enomoto, prof 1; 1RINKU GENERAL MEDICAL CENTER, IZUMISANO, Japan, 2TOKYO MEDICAL UNIVERSITY HOSPITAL, TOKYO, Japan.  
**Abstract:**  
**Introduction:** There are very few reports about the age at which cochlear implant (CI) children can perform sound-field hearing tests. In this study, we determined the average age when the appropriate hearing performance was obtained by sound field hearing tests. We also investigated fitting process of CI and language development of cochlear implant child recipients.  
**Methods:** In this study, "appropriate hearing performance in sound field hearing tests" means that participants's hearing performance are over the average of the various sound field test results of six elementary school students that the Verbal Comprehension Index score of WISC-IV was in the average range. Test participants were 8 children at our hospital.  
**Results:** The average age the appropriate hearing performance was obtained by sound field hearing tests, 1)Threshold is 2 years and 6 months, 2)Speech discrimination test in the noise was 4 years and 6 months, 3)Most speech discrimination test was 4 years and 8 months, 4)SRT was 5 years and 7 months, and 5)speech discrimination at threshold was 5 years and 9 months. The time when the appropriate hearing performance was obtained by the speech discrimination tests at threshold and SRT was delayed in 4 children out of 8.  
**Conclusion:** The time when the appropriate hearing performance was obtained by the speech discrimination tests at threshold and SRT was delayed in 4 children, and their language development was delayed.
**Poster Number:** 143  
**Abstract ID:** 51  
**Title:** Language Input and Vocabulary Development for Children with Hearing Loss: 1-Year Follow-Up  
**Category:** Rehabilitation/Educational Aspects  
**Authors:**  
Elaine R. Smolen, MAT, LSLS Cert. AVEd 1, Sonia B. Arora, PhD 2, Ye Wang, PhD 1, Maria C. Hartman, PhD 1, Ronda Rufsvold, PhD, LSLS Cert. AVEd 3; 1Health and Behavior Studies, Teachers Coll., Columbia Univ., New York, NY,  2Missouri State Univ., Springfield, MO, 3CCHAT Ctr., Sacramento, CA.  
**Abstract:**  
**Introduction:** Research has shown that language input—parents and children engaged in language-rich interactions—is critical for children’s language development, but the quality and quantity of daily language experienced by infants and preschoolers with hearing loss continues to vary widely. Many children who experience reduced language input lag behind their hearing peers in basic knowledge and vocabulary skills, placing them at risk for academic delays. Although some studies have highlighted the link between language input and language output at single points in time, more research is required to understand the longitudinal effects of the language environment experienced by a child with hearing loss who uses listening and spoken language. This study examined the relation between the quantity of language input experienced by preschoolers with hearing loss and their receptive vocabulary one year later.  
**Method:** Sixteen children with hearing loss (11 with cochlear implants) and their families were recruited from listening and spoken language preschools across the United States. The Language ENVironment Analysis (LENA) system was used to collect and analyze the quantity of language input, yielding information about the number of adult words, conversational turns, and child vocalizations recorded over two days each at the initial time of recording and again one year later. The children’s receptive vocabulary was measured at each time point using the Peabody Picture Vocabulary Test-4. Demographic information was also collected.  
**Results:** Participants were found to have made significant gains in their receptive vocabulary over 1 year, with the lowest initial vocabulary scores related to the greatest change. Children who vocalized at greater rates at the initial assessment had higher vocabulary scores 1 year later, when controlling for initial scores. Surprisingly, the initial number of adult words and conversational turns to which children were exposed did not relate to their change in vocabulary over 1 year. Moreover, no differences in children’s vocabulary acquisition were found due to gender or maternal educational level.  
**Conclusion:** The children in this study added a significant number of words to their receptive lexicons over a year of intensive auditory-based intervention. Those with lower individual standard scores tended to make greater gains, pointing to the potential for children with severe delays to demonstrate significant progress with appropriate therapy. Further, the coaching and resources the families received in their preschool programs may have allowed those with lower SES to develop their children’s vocabularies at rates similar to higher SES families. These findings can be used to inform auditory-based intervention for children at risk for language delays as well as future research into the language environments of diverse families.
Title: Beyond the Cochlear Implant: Examining the Unique Contributions of Educators in Supporting Listening and Spoken Language Outcomes from Birth Through 21

Category: Rehabilitation/Educational Aspects

Authors:
Uma Soman, PhD, LSLS Cert AVEd 1, Jenna Voss, PhD, LSLS Cert AVEd. 2; 1Expanding Children's Hearing Opportunities, Carle Fndn. Hosp., Urbana, IL, 2Communication Disorders & Deaf Education, Fontbonne Univ., Clayton, MO.

Abstract:
Introduction: Children with profound hearing loss who receive cochlear implants are likely to need support in a variety of domains to develop listening, language, and literacy. When parents choose a spoken language approach, educators of children who are deaf or hard of hearing (DHH) can assess the impact of hearing loss on listening and spoken language development and provide intervention in the first five years. Once children enter a school program, in special or general education settings, educators of DHH students can support development of literacy and academic skills, access to grade-level curriculum, as well as foster peer and social relationships. The purpose of this podium presentation is to expound on the role of educator of students who are deaf or hard of hearing and examine the contribution this professional makes to the outcomes of pediatric cochlear implant users. Children who use cochlear implants often receive services from a variety of professionals including audiologists and speech-language pathologists. As more children have access to early identification, amplification, and intervention, it is not uncommon to see children enter early childhood education with age-appropriate skills in areas of listening, language, and speech. We propose that an educator who has experience and expertise in development of language, academic, social skills; and utilizes a “whole child” approach in the rehabilitation process is also a critical member of this team. This educator provides support to help the child keep up with the growing language and academic demands during the school years and transition into college or work. Based on the needs of the child and the family, the role of the educator can be a direct service provider, consultant, caregiver coach or mentor. In this presentation we will discuss the scope of practice for educators of DHH students and suggest ways that they can be included in educational as well as medical settings.

Methods: This abstract is not related to a research project.

Results: This abstract is not related to a research project.

Conclusion: This abstract is not related to a research project.
**Title:** The Functional Head Impulse Test and Oscillopsia in Patients with Bilateral Vestibulopathy (BV)

**Category:** Rehabilitation/Educational Aspects

**Authors:** Raymond Van de Berg, PhD 1, Nils Guinand, PhD 2, Florence Lucieer, Medical doctor 1, Maurizio Ranieri, Engineer 2, Samuel Cavuscens, Engineer 2, Dmitrii Starkov, MS 3, Jean-Philippe Guyot, PhD 2, Herman Kingma, PhD 1, Stefano Ramat, PhD 4, Angelica Perez Fornos, PhD 2; 1Division of Balance Disorders, Faculty of Health Medicine and Life Sciences, Department of ENT, Maastricht Univ. Med. Ctr., Maastricht, Netherlands, 2Service of Otorhinolaryngology and Head and Neck Surgery, Department of Clinical Neurosciences, Univ. Hosp. of Geneva, Geneva, Switzerland, 3Faculty of Health, Medicine and Life Sciences, Maastricht Univ., Maastricht, Netherlands, 4Dept. of Electrical, Computer and Biomedical Engineering, Univ. of Pavia, Pavia, Italy.

**Abstract:**

**Introduction.** The vestibular implant seems feasible as a clinically useful device in the near future. Previously, the first functional benefit was shown by restoring the dynamic visual acuity during walking. Recently, the functional head impulse test (fHIT) was developed to selectively test the high-frequency visual stabilization abilities. This case study investigated the feasibility of restoring the high-frequency visual stabilization abilities with a vestibular implant, using the fHIT.

**Methods.** A 72-years old female with bilateral vestibulopathy and fitted with a modified cochlear implant incorporating three vestibular electrodes (MED-EL, Austria), was selected for this study. After training and understanding the fHIT, she underwent 6 trials of the fHIT: 1) System off; 2) System on, baseline stimulation; 3) System on, positive 3dB modulation around baseline; 4) System on, negative 3dB modulation around baseline; 5) System off, no delay after condition 4; 6) System off, 25 minutes delay after condition 4. Electrical vestibular stimulation was provided by the electrode close to the lateral ampullary nerve on the left side. Each trial of the fHIT (BEON Solutions, Italy) consisted of at least 16 horizontal head impulses (randomly to each side). During the impulses, the patient had to look at a computer screen at a distance of 1.5 meter while randomly oriented Landolt C-optotype letters appeared for 80 milliseconds. After each impulse, the patient had to report which Landolt C-optotype letter was displayed. The percentage of correct answers during the trial was registered for left and right impulses, and compared to the other trials.

**Results.** Electrical vestibular stimulation was able to improve the high-frequency visual stabilization abilities. The percentage of correct answers improved from 19-44% (minimum-maximum) in the conditions without the system on, to 75-94% (minimum-maximum) in the condition with negative 3dB modulation around the baseline (table 1).

**Conclusion.** It is possible to improve the high-frequency visual stabilization abilities by the vestibular implant. This functional benefit of the vestibular implant illustrates again the feasibility of this device for clinical use in the near future.
Poster Number: 146  
Abstract ID: 57  
Title: Restoration of the High-Frequency, Angular Vestibulo-Ocular Reflex with a Vestibular Implant in Humans  
Category: Rehabilitation/Educational Aspects  
Authors:  
Raymond van de Berg, MD, PhD 1, Nils Guinand, PhD 2, Erich Schneider, PhD 3, Maurizio Ranieri, Master 2, Samuel Cavuscens, Master 2, Jean-Philippe Guyot, Prof. 2, Herman Kingma, Prof. 1, Angelica Perez-Fornos, PhD 2; 1Maastricht Univ. Med. Ctr., Maastricht, Netherlands, 2Hôpitaux Universitaires de Genève, Geneve, Switzerland, 3Ludwig-Maximilians-Univ., Munich, Germany.  
Abstract:  
Introduction: vHIT(video Head Impulse Test) has become a gold standard in high frequency testing of the semicircular canals. Therefore vHIT can also be used to evaluate the performance of vestibular implants, which are devices designed to primarily restore the canal function in patients with a severe bilateral vestibulopathy (BV). The purpose of this study was to evaluate whether it is possible to restore the high-frequency, angular vestibulo-ocular reflex (aVOR) with a vestibular implant prototype.  
Methods: Three BV-patients fitted with a vestibular implant prototype, were selected for this study. The device consisted of a modified cochlear implant (MED-EL, Innsbruck, Austria) with vestibular electrodes implanted in the ampullae of each semicircular canal. The high-frequency, aVOR was assessed by the vHIT (EyeSeeCam system), while motion-modulated electrical stimulation was delivered via one of the implanted vestibular electrodes (S1-posterior ampullary nerve, S2-lateral ampullary nerve, S3-superior ampullary nerve). Results obtained with different conditions of the implant were compared to control measurements obtained with the vestibular implant switched off.  
Results: Electric stimulation of the vestibular nerves changed the shape of the aVOR response. When positive transfer function slopes were used, the shape of the aVOR improved for both excitatory and inhibitory head impulses in S1, but only for excitatory head impulses in S2 and S3. It was accompanied by a concomitant decrease in the frequency of compensatory saccades. Inverting the polarity of the slope of the linear transfer function resulted in an inversion of the aVOR response in S1 and S3, as well as an increase in the frequency and amplitude of compensatory saccades in S3, mainly for inhibitory head impulses. For S2, the response appeared similar to that observed in the system OFF condition. As expected, all patients presented low aVOR gains (<0.20) when the system was not activated.  
Conclusion: The obtained VHIT-results demonstrate that it is possible to restore the high-frequency aVOR using motion-modulated electrical stimulation of the vestibular afferents, delivered with a chronically implanted, prototype vestibular implant. This implies that the vestibular implant is able to successfully restore multimodal vestibular function, and that it might become an effective rehabilitation alternative for BV-patients in the near future.
Title: Is the Treadmill Dynamic Visual Acuity Test a Reliable Test to Measure Oscillopsia?

Category: Rehabilitation/Educational Aspects

Authors:
Florence Lucieer, MD 1, Marlou Snelders, 2, Dmitrii Starkov, MSc 3, Angelica Perez-Fornos, PhD 4, Nils Guinand, MD PhD 4, Vincent Van Rompaey, Prof Dr 5, Herman Kingma, Prof Dr 1, Raymond van de Berg, MD PhD 1; 1Department of Otorhinolaryngology and Head and Neck Surgery, Division of Balance Disorders, Maastricht Univ. Med. Ctr., Maastricht, Netherlands, 2Faculty of Health, Medicine and life Sciences, Univ. of Maastricht, Maastricht, Netherlands, 3Faculty of Physics, Tomsk State Res. Univ., Tomsk, Russian Federation, 4Service of Otorhinolaryngology Head and Neck Surgery, Department of Clinical Neurosciences, Geneva Univ. Hosp., Geneva, Switzerland, 5Department of Otorhinolaryngology and Head and Neck Surgery, Antwerp Univ. Hosp., Antwerp, Belgium.

Abstract:
Introduction: To objectify oscillopsia by measuring the dynamic visual acuity (DVA) on a treadmill in patients with bilateral vestibulopathy (BV).

Methods: Fifty-four BV-patients performed the DVA on a treadmill at 2, 4, and 6 km/h. Sloan optotypes were used at a computer screen at a distance of 2.8m. The DVA was defined as abnormal in case of a difference between static and dynamic visual acuity larger than two LogMar at 2 and 4 km/h, and larger than three LogMar at 6 km/h. Results were compared to an age-matched control group of healthy volunteers. All BV-patients also filled in an oscillopsia questionnaire to evaluate the severity of the oscillopsia.

Results: The percentage of BV-patients with normal DVA decreased with walking speed: 85% (2km/h), 69% (4km/h) and 43% (6km/h). Due to walking difficulties, the ability to complete the DVA test also decreased with walking speed: 13% (2km/h), 19% (4km/h) and 56% (6km/h). The same behavior was observed in the control group, especially in healthy patients older than 60years. Only 4 BV-patients did not report significant oscillopsia.

Conclusion: DVA on a treadmill did not objectify oscillopsia in BV-patients. Furthermore, in the healthy control group abnormal DVA responses were also found. Therefore, more research should be performed to search for other tests to measure dynamic visual acuity in BV-patients.
Poster Number: 148  
Abstract ID: 404  
Title: Listening to learn: Family Engagement when Children are Deaf or Hard of Hearing  
Category: Rehabilitation/Educational Aspects  
Authors: Marguerite K. Vasconcellos, EdDSpecial Educaiton, Bucks County Intermediate Unit 22, Doylestown, PA.  
Abstract:  
Introduction: Contemporary understanding holds that childhood hearing loss is a neurological emergency, with a deleterious impact on a baby’s brain. Consistent auditory stimulation provides underpinnings for growth of the auditory cortex. Beginning at four months in the gestation period, the ability of an auditory cortex to function and flourish is contingent upon sensory stimulation. Hearing loss of any degree interferes with the “doorway” of getting sound to the auditory brain center. (Cole & Flexer, 2016) Technological advancements in hearing aids/cochlear implants afford greater opportunity for children with hearing loss to develop spoken language. Technology alone, however, is nothing more than hardware without appropriate interventions. When the intent of intervention is development of listening and spoken language, parents need guidance and coaching to maximize technology usage for children with hearing loss in order to overcome impediments to auditory brain access.

Methods: Qualitative methods were employed to analyze responses to a research protocol based on family engagement research practices. The study was based on the assumption that delineating factors that facilitate or impede family engagement could serve to support outcomes for children who are deaf or hearing impaired. The study used a phenomenological approach. Participants were selected based on response to a poll of the larger population of parents of children enrolled in the hearing support program. These children have deafness or hearing impairment as the primary disability, per their Individual Education Plans. Interview participants represent a selected subset of the overall population of parents of children who are deaf and hearing impaired. All of the children receiving support use amplification (either hearing aids or cochlear implants) and communicate through listening and spoken language.

Results: Participants shared their perceptions of practices that facilitate the ability to engage. In the context of interviews, they cited factors that have impeded this engagement. The voices of parents were unified in desiring consistent, two-way communication that is customized to their child, and matched to their personal needs on the parenting journey. Participants called for intensified efforts to address transitions across the educational lifespan, whether from early intervention to kindergarten, or from high school to college. They seek expertise in support of amplification equipment. They cite reliance on their children’s teachers to impart confidence and competence to them and their children, noting the rapid and continuous advancements in the field. Parents thrive on information, connections, and partnerships that develop self-efficacy in accruing the social and cultural capital that are the keystones of their children’s success.

Conclusion: Engagement efforts must extend beyond random activities; rather, they must form the core of a clearly articulated structure of service that allows for synergistic growth and perpetual forward motion. Activities that are linked to learning, such as literacy nights or technology fairs, are most likely to produce effective outcomes. Opportunities to learn side-by-side with educators will promote competence, confidence, and self-efficacy for families. Events that involve follow up or are part of a series of events with deliberate plans to integrate active participation will also bolster sustainable growth.
Title: Empowering Families of Cochlear Implant Users
Category: Rehabilitation/Educational Aspects
Authors:
Rajesh Y. Vishwakarma, MS(ENT), DLO 1, Leena R. Vishwakarma, MSc, BEd (Special Education-Hearing Impaired) 2; 1ENT & Head-Neck Surgery, B.J.Med. Coll. & Civil Hosp., Ahmedabad, India, 2Habilitation, Shabda-Brahma Speech and Hearing Clinic, Ahmedabad, India.

Abstract:
Introduction: Cochlear Implant is an effective device to give adequate hearing to a deaf child. The recipients can be trained to get good speech and can be integrated in the normal mainstream schools. They can become independent and live a near normal life. Effective habilitation is the key for good education an opportunity in life. Empowering the families is an important factor for the required outcome.

Methods: Families of 50 patients were taken for this prospective study and analysed. All family members-parents, grandparents, and siblings were involved in the process and their outcomes noted and recorded. The progress of children were studied with respect to their communication at home and school. Language development, pragmatic, social skills and conversational skills. Their speech development and expressive communication.

Results: Family is a Dynamic social system and affects the outcome of an implanted child our study showed that there was better outcome in speech and hearing development and confidence of the child in developing different skills and scholastic aptitude with family involvement and empowerment.

Conclusion: families of cochlear implant users should be empowered to get excellent outcomes.
Poster Number: 150
Abstract ID: 292
Title: Auditory Household Noise Reduces Processing Efficiency in Children with Hearing Loss
Category: Rehabilitation/Educational Aspects
Authors:
Rondeline Williams, BA 1, Yuanyuan Wang, PhD 1, Laura Dilley, PhD 2, Derek Houston, PhD 1; 1Otolaryngology, The Ohio State Univ., Columbus, OH, 2Communicative Sciences and Disorders, Michigan State Univ., East Lansing, MI.
Abstract:
Introduction. The early auditory environment is critical for children’s development of later linguistic skills, cognitive abilities, and academic achievement (Ambrose et al., 2015; Hart & Risley, 1995). However, the auditory environment varies substantially, and chaotic environments may have profound long-term consequences for child development across a number of areas. For example, recent research has shown that 5-month-old infants with normal hearing (NH) from chaotic homes exhibited reduced processing speed of complex stimuli (Tomalski et al., 2017). The chaotic auditory environment may be of special concern for children with hearing loss (HL), because perceiving and processing of degraded speech provided by hearing devices itself may require greater efforts, which consumes cognitive resources needed to cope with other adversities (Hicks & Tharpe, 2002). Therefore, we examined the effects of chaotic auditory environments on processing efficiency in children with HL.
Methods. Using the Language Environment Analysis (LENA) System, we collected day-long recordings of the home language environment from 6 children who had 12 months of experience with hearing aids (HAs) or cochlear implants (CIs). The total amount of overlapping noise (OLN), electronic media (TVN), and other background noise (NON) in the recording determined auditory chaos. Children’s processing efficiency was then tested using the Looking-while-Listening paradigm (Fernald et al., 2008). For each trial, children were shown 2 familiar images on a television screen - a target and a distractor object - and were instructed to find the target object. Following Weisleder and Fernald (2013), we used proportion of target looking as a measure of processing efficiency.
Results. Both the correlation between OLN in the home and total chaos and proportion of looking time to the target object approached significance (p=.07 and p=.08, respectively). That is, children in homes with higher instances of noise (such as multiple talkers speaking at the same time) displayed reduced processing efficiency of familiar words.
Conclusion. These findings from children with HL are consistent with results from Tomalski et al. (2017), and suggest that the early auditory environment shapes skills necessary for cognitive development and word learning. Because processing efficiency in the first two years of life has been shown to relate to both lexical and grammatical development in early childhood (Fernald, Perfors & Marchman, 2006), providing an optimal auditory environment may have positive effects on academic achievement, especially for children with HL. Over the next 6 months, 9 more HA and CI users already enrolled in the study will be eligible to participate in this time point. This is a relatively robust sample size for studies involving children with hearing loss (Ching et al., 2009; McGowan, Nittrouer & Chenausky, 2008; Wang, Bergeson, & Houston, 2018), due to the distinct nature of this clinical population.
**Title:** Cochlear Implantation Outcome in Malformed Cochlea  
**Category:** Surgery/Medical  
**Authors:**  
Khabti A. Almuhanna, Sr., Consultant in Otology, MDORL, PSMMC, Riyadh, Saudi Arabia.

**Abstract:**
Cochlear implantation outcome in malformed cochlea.

Primary instigator: Dr. Khabti Almuhanna

Summary:
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 of malformed Cochlea will affect the implantation outcome. Cochlear malformations are not uncommon among patient with congenital hearing loss. The aim of the study is to assess the performance and the outcome of Cochlear implantation in regard to malformed cochlea and compare it with same age group with normal cochlea. Twenty cases out of the 180 were found to fit the criteria.

Result and conclusions: in this study the speech and auditory levels post implantation outcome of malformed cochlea going to be mentioned in comparison with normal cochlea. Type of malformations of cochlea going to be mentioned and the CT. scan will be presented.
Title: Cochlear Implant Surgery in a Patient after Petrosits and Gradenigo Syndrome

Category: Surgery/Medical

Authors:
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Abstract:
Introduction: The Cochlear Implant is a sensory prosthesis capable of restoring hearing in individuals with severe to profound sensorineural hearing loss. Gradenigo’s Syndrome consists of the triad: complicated otitis media with purulent otorrhea, pain in the area of innervation of the first or second branch of the trigeminal nerve and paralysis of the abducent nerve.

Method: Revision of medical records of patients with bilateral sensorineural hearing loss after presenting bilateral cholesteatomatous otitis media that evolved to mastoiditis, petrositis and Gradenigo Syndrome to the Right.

Results: Female, 37 years old, attended the Cochlear Implant Outpatient Clinic of this Service presenting a history of anacusis in the Left Ear after mastoiditis, petrositis and Gradenigo Syndrome for 21 years. In the right ear she reported progressive hearing loss with otorrhea, being submitted to radical mastoidectomy surgery on the left and partial mastoidectomy on the right. She was evaluated by the Multidisciplinary Cochlear Implant Team of this Service (consisting by otorhinolaryngologists, speech therapists, psychiatrists and nurses), presenting in tonal audiometry a bilateral profound neural sensorial hearing loss with 110 dB right middle ear mean of frequencies 500, 1000, 2000, 3000 and 4000Hz) and to the left presented anacusis. The results of speech perception tests (SPT) for trisyllable words were 68%. The Cochlear Implant (CI) Surgery was indicated because the patient, besides not being able to use the Hearing Aids (HA) because she had fixed and calcified bilaterally auricular pavilion, also had audiometric levels indicating little or no benefit with HA. Cochlear Kanso model was indicated because this bilateral pavilion calcification prevented speech processor support. After 5 months of CI surgery, the patient had an audiometric mean in the free field of 83.75 dB and SPT results of 72%.

Conclusion: The field of cochlear implant surgery is growing rapidly due to improved implant quality, less invasive surgical techniques, more staff training for this type of deafness treatment and specific models of speech processor have been useful for a good surgical outcome. Despite the poor improvement in the SPT of the patient, it indicated a better hearing comfort after the CI surgery.
Title: Customizing Cochlear Electrode Selection for Maximal Functional Gain

Category: Surgery/Medical

Authors: Simon Angeli, MD, Otolaryngology, Univ. of Miami Miller Sch. of Med., Miami, FL.

Abstract:

**Introduction:** Recent developments in electrode design and surgical technique modification have focused on maximizing cochlear implant performance while minimizing cochlear trauma during implantation. There is considerable anatomic variability even among cochleae without dysplasia consequently, it may be difficult to create a universal electrode and/or a surgical technique that fits all cochleae. There are many electrode designs in the market: some are intended for deep apical insertion and others are of much shorter length, some are designed to be placed close to the modiolus and others away from the modiolus. Similarly, round window versus cochleostomy insertion continues to be a matter of controversy. The selection of the most appropriate electrode and insertion technique in patients without cochlear dysplasia must be based on factors such as the individual anatomy as it relates to the accessibility of the scala tympani, residual hearing, and the desire for a deep insertion. A deep insertion of an electrode array into the apical segment of the cochlea is desirable for a maximal range of frequency stimulation. However, the goal of bringing an electrode closer to the apical regions must be weighed against the higher risk of losing residual hearing when using longer electrodes for deeper insertions.

**Methods:** Retrospective case series using a technique selection algorithm

**Results:** Cochlear measurements obtained from standard preoperative CT or MR scans aided in the selection of an electrode of appropriate length. Our data have shown that cochlear height measured on coronal views of CT scans was associated with the depth of insertion. Similarly, assessment of the anatomic angle of the round window membrane during surgery helps the selection of the route of insertion, i.e., round window versus cochleostomy. Post-implantation hearing outcome were better using the proposed algorithm than historical outcomes.

**Conclusion:** Pre-operative (imaging) and intra-operative assessment of the visibility and anatomic angle of the round window informs the selection of the route of insertion.
Title: Two Case Studies of Cochlear Implantation in Young Patients with Brown-Vialetto-Van-Laere (BVVL) Syndrome

Category: Surgery/Medical

Authors:
Anne-Marie Crowe, Audiologist BSc, GradDip Aud, MAudSA (CCP), Kirsty Gardner-Berry, BSc, MAud, MASA (ccp), PhD, Paula Berkley, BA Dip Aud, MAud SA (CCP), Rachelle Hassarati, BEng, Wai Kong Lai, PhD;
SCIC Cochlear Implant Program, Royal Inst. for Deaf and Blind Children, Gladesville NSW, Australia.

Abstract:
Introduction
This presentation describes two case-studies of young patients with Brown-Vialetto-Van-Laere (BVVL) syndrome, a rare Riboflavin Transport Deficiency (RTD) disorder. Neurological changes due to the RTD had resulted in affecting hearing, mobility, dexterity, speech and vision. Recent developments have indicated that cochlear implantation can provide more stable auditory access to the speech spectrum to patients with auditory neuropathy, and is thus an option for RTD patients as well. Due to the multi-sensory nature of the disease, a holistic approach is necessary.

Method
In the first case-study, the patient was diagnosed with BVVL syndrome and a mitochondrial mutation associated with Leber's Optic Neuropathy at 22 months. The second case-study was diagnosed with BVVL at age 4 after observations that she had no balance, and her vision was also very poor. After receiving heavy counselling on realistic expectations, the parents of the children were willing to go ahead with cochlear implantation.

Results
In both cases, weekly multidisciplinary support was provided.
For case 1, PEACH+ results showed perceived auditory function of the child in both noise and quiet to have improved post CI by 12 % and 20 % respectively. Severe sensory issues saw the device being pulled off by the child. However, data logging has shown that switching to an off the ear device increased device retention and usage from 1 to 4.7 hours/day with minimal coil offs. 22 months post implantation, he is now happily wearing the sound processor and attempting to reintroduce if it falls off.
Case 2 was aged 11 at the time of implantation, and speech tests showed improvements (Devault 35% to 85%, BKB sentences 0% to 78%, Manchester Junior words 10%-65%) at 6 months post CI. There were no issues with using the CI, and she is now attending mainstream secondary school.

Conclusions
With so few children in the world with this rare genetic condition, it is encouraging to know that with intensive support, cochlear implantation is a viable alternative to improve their hearing abilities.
Title: Cochlear Implant In Child with Genetic Disorder, Inner Ear Malformation and "Bulging Of Oval Window"

Author: Giovanni Bianchin, medicine, Valeria Polizzi, Medicine, Patrizia Formigoni, Medicine, Margherita Bettini, Medicine, Lorenzo Tribi, Medicine; Azienda USL IRCCS di Reggio Emilia, Reggio Emilia, Italy.

Abstract:

Introduction: We report a case of a 9 years old child with split hand and foot malformations (SHFM1) due to a genetic cause. He had a congenital asymmetric hearing loss, worse on the left-sided ear. As the left hearing loss worsened over time, the child underwent cochlear implant (CI) intervention. Before the surgery, ear CT and MRI were performed detecting ear malformation. Were reported incomplete partition type I with enlarged cochlea and vestibule on both sides. On the left side is described an oval image that is a possible herniation of the perilymphatic membrane through discontinuity of the bone wall, which contacts the oval window. This is a rare anomaly which may predispose to bacterial meningitis through opening perilymphatic fistula and is a condition that requires a surgical review.

Methods: We describe our surgical approach. Cochlear implantation was performed. A perilymphatic herniation arising from the oval window was observed, confirming the radiological findings. During cochleostomy a complete reduction of the herniation occurred without CSF gusher. After the electrode insertion the surgical cavity was filled with muscle and a subtotal petrosectomy was avoided.

Results: No complication during and after the operation. CI has been activated without problems.

Conclusion: SHFM1 is associated with hearing loss in 35% of patients. In children with genetic abnormalities, malformations of the inner ear are common. Incomplete partition type I and this bulging of oval window are rare in this kind of patients. Before carrying out an intervention is necessary to foresee and plan the appearance of complications and surgical solution like a gusher or a total petrosectomy, as described in scientific literature in other cases of bulging. In this particular case, the choice of treating the perilymphatic herniation and positioning the cochlear implant in the same surgical session avoided subtotal petrosectomy and allowed hearing recovery.
Title: Endoscopic Assisted Cochlear Implantation in Children with Ear Malformation

Abstract: Cochlear implant (CI) surgery is a routine procedure which can be considered relatively safe and easy to perform due to the now well-standardized technical procedures. Middle and inner ear malformations present technical difficulties for CI surgery most notably due to an anomalous course of the facial nerve (FN) and/or a partial/total hidden round window (RW) niche. The aim of this study is to describe the use of the endoscopic assisted CI approach in children with abnormal anatomy of the structures of the tympanic cavity and inner ear.

Methods: Twenty-five children (mean 3.6 years old; range: 2.8-9) with malformed middle and inner ears and bilateral profound hearing loss were operated on using an endoscopic assisted CI procedure at the Verona and Modena tertiary university referral centers. A chart review of clinical data and videos from the operations was performed. All procedures were re-analyzed and codified.

Results: In all 25 children we were able to perform endoscopic assisted surgery. In all patients discharge from hospital was from one to three day post-surgery. No immediate or late postoperative complications were noted. All of the implanted children showed varying degrees of auditory benefit as measured by Category of Performance (CAP) test with a score ranging from 4 to 7.

Conclusion: This innovative approach proves to be successful in CI placement. It guarantees a strict control of the FN and of the RW niche, and permits to perform a safe cochleostomy with an adequate insertion of the array in the scala tympani, even in patients with very distorted anatomical conditions.
Abstract:

**Introduction:** Children in our multidisciplinary atresia clinic, see a paediatrician, a plastic surgeon, an ENT surgeon from our hospital and also an audiologist from Australian Hearing (our national provider of free hearing aids for children). Children with unilateral and bilateral external auditory canal atresia require unilateral and bilateral bone conduction hearing support respectively. Children initially use bone conductors on a headband when young, and then have the option of bone conduction implantable devices. In children with microtia, who undergo microtia repair when older, surgery for the Bonebridge must avoid disturbing the tissue planes required in future pinna reconstruction. This talk will review the use and indications of the Bonebridge, the surgical technique and our experience with the Bonebridge in our atresia patients.

**Methods:** Children’s records were reviewed from the atresia clinic. Surgical technique and experience with the Bonebridge in our external auditory canal atresia patients are reviewed.

**Results:** Seven children underwent Bonebridge surgery, five with unilateral external auditory canal atresia and two children who underwent bilateral simultaneous Bonebridge surgery. Of the two bilateral cases, one had Treacher Collins syndrome and the other had bilateral Goldenhar’s syndrome. Ages ranged from four years old to 14 years old. Children had improvements in aided speech perception and quality of life SSQ 36 for parents’ scores were often in the normal range.

**Conclusion:** The Bonebridge provides good hearing and improved quality of life for children with external auditory canal atresia.
Title: Hearing Preservation Outcomes Following Cochlear Implantation with the Nucleus CI532 Slim Modiolar Electrode Array

Category: Surgery/Medical

Abstract:

Introduction: The Nucleus CI532 slim modiolar electrode array was designed to provide a thin, atraumatic electrode with perimodiolar electrode positioning. There is a need to better understand the rates of insertion challenges and hearing preservation (HP) with this new electrode. We aim to report our institutional experience regarding HP outcomes with the slim modiolar electrode array. This will allow us to better understand whether the slim perimodiolar electrode array provides HP, and to allow for surgeons to better counsel patients on HP strategies.

Methods: We conducted a retrospective chart review of all pediatric (<18 years) and adult (ages 18-89) cochlear implant (CI) recipients with the CI532 array at a single tertiary referral center from July 1, 2016 to June 2, 2017. Baseline unaided audiograms were obtained before implantation, and postoperative unaided audiograms were obtained at least 1 month after implantation, up to 14 months post-implantation. Patients without postoperative unaided audiogram data were excluded from HP analysis. A low-frequency pure tone average (PTA) was calculated based on unaided measurements at 250 Hz, 500 Hz, and 1000 Hz for both the baseline and postoperative audiograms. HP was calculated as a percentage from the difference in baseline and postoperative PTAs. HP was stratified into 4 groups: complete HP (>75%), partial HP (25-75%), minimal HP (0-25%), and loss of hearing (no measurable hearing).

Results: 86 patients (54 adult, 32 pediatric) received CI532 arrays during the time period studied. 10 patients had bilateral implants, thus 96 CIs were examined. Of this cohort, 46 were HP candidates based on a low-frequency PTA ≤ 70 dB pre-implantation. 24 of HP candidates had complete postoperative audiogram data and were used to evaluate for HP. On initial postoperative audiogram which occurred 1-6 months post-implantation, residual hearing was 45.4% ± 29.5% on average [3 (12.5%) complete HP, 14 (58.3%) partial HP, 7 (29.2%) minimal HP]. Out of the original 46 HP candidates, 3 patients were using acoustic components 1 year after implantation. Long-term HP calculated from an unaided audiogram ≥ 12 months post-implantation was completed for 3 patients, none of whom were using an acoustic component. HP for these patients was 30.5%, 50.9%, and 63.0%, which were all equivalent to partial HP. Tip foldover was observed as a complication in 5 of 86 patients (5.8%) requiring electrode re-insertion or insertion of an alternative array.

Conclusion: The CI532 slim modiolar electrode array initially provides partial HP in patients eligible for HP. However, the number of patients with HP drops significantly 12 months after implantation. 3 patients (3.1%) were using an acoustic component 1 year after implantation. Based on these results, the CI532 array should not be considered to be a HP electrode.
Poster Number: 160
Abstract ID: 115
Title: Predictors of round window membrane visibility in pediatric cochlear implant surgery using temporal bone CT: a retrospective study
Category: Surgery/Medical
Authors:
Jianqing Chen, M.D. 1, Yinwei Wu, M.D. 2, Huan Jia, M.D., Ph.D. 1, Zhaoyan Wang, M.D., Ph.D. 1, Zhihua Zhang, M.D., Ph.D. 1, Hao Wu, M.D., Ph.D. 1; 1Department of Otolaryngology, Head & Neck Surgery, Ninth People’s Hosp., affiliated to Shanghai Jiaotong Univ. Sch. of Med., Shanghai, China, 2Department of Radiology, Ninth People’s Hosp., affiliated to Shanghai Jiaotong Univ. Sch. of Med., Shanghai, China.
Abstract:
Introduction: To predict round window membrane (RWM) visibility and electrode insertion sites using high-resolution computed tomography (HRCT) in pediatric cochlear implant surgery.
Methods: Intraoperative RWM visibility was classified into three types corresponding to three different surgical approaches. Radiologic parameters were measured on preoperative axial temporal HRCT images and correlated with RWM visibility and surgical approaches.
Results: Sixty-two ears of 36 infants less than 1 year old were included in our study. A significant correlation was found between the degree of RWM visibility and the following two parameters: 1) angle A, P<0.01, R²=-0.809; 2) angle B, P<0.01, R²=-0.850. A nonsignificant correlation was found between the degree of RWM visibility and the facial recess width, p>0.05, R²=-0.00015.
Conclusion: RWM visibility could be predicted through preoperative temporal HRCT in infants less than one year old. RWM visibility showed a high correlation with the two angular measurements (angle A and angle B) and was associated with electrode insertion sites and preservation of residual hearing.
**Poster Number:** 161  
**Abstract ID:** 232  
**Title:** Cochlear Implantation in Children with Congenital X-Linked Deafness: Pre-Operation Radiological Assessment and Surgical Technique  
**Category:** Surgery/Medical  
**Authors:** Danmo Cui, Medical Doctor, Yongxin Li, Medical Doctor; Otolaryngology, head and neck surgery, Beijing Tongren Hosp., Beijing, China.  
**Abstract:**  
**Introduction:** X-linked deafness (DFNX) accounts for less than 2% of cases of non-syndromic hearing impairment. Patients with DFNX often exhibit abnormalities of the petrous temporal bone, consisting of a dilated internal auditory meatus and an abnormally wide communication between the internal auditory meatus (IAM) and the basal turn of the cochlea.  
**Methods:** A retrospective chart review was performed with 20 paediatric patients with DFNX who received a CI in our hospital. The length of cochlea and the width of the basal turn of the cochlea, as well as the angle between the round window and the basal turn of the cochlea were measured. CI outcome measures included the results of Categories of Auditory Performance (CAP) and Speech Intelligibility Rating (SIR) tests. Successful implantation was achieved in all case. A modified cochleostomy was used in 2 patients and a modified round window approach was used in the remaining 18 patients.  
**Results:** The mean length of the lateral wall of the cochlea was 17.7mm, the mean radius of the basal turn of the cochlea was 2.6mm. Mean CAP and SIR scores were 4.4 ± 1.3 and 2.5 ± 1.3, respectively.  
**Conclusion:** By measuring the preoperative radiological morphology for patients with X-linked deafness, surgeons can make decision on the use of different electrode arrays and anticipate the encounter of cerebrospinal fluid gusher.
Poster Number: 162  
Abstract ID: 71  
Title: Three-Dimensional Visualization of Cochlear Malformations  
Category: Surgery/Medical  
Authors: Anandhan Dhanasingh, Dr. rer. nat (German PhD) MED-EL GmbH, Innsbruck, Austria.  
Abstract:  
**Introduction:** Cochlear malformation is no longer a contraindication to cochlear implantation. Accurate identification of the involved abnormality from radiographic studies is important prior to operation. This abstract demonstrates the value of 3D segmentation images in the assessment of cochlear malformations especially in the pediatric population.  
**Materials and Methods:** Anonymized preoperative HRCT datasets of temporal bones with a variety of cochlear malformations were made accessible from several clinics across the world with a voxel resolution of 0.5mm. The image data sets were loaded into 3D slicer freeware (3D Slicer, https://www.slicer.org/; version 4.8.0) followed by segmentation of the cochlea along with the IAC, vestibular organ, and vestibular aqueduct (VA). Segmentation of these structures were performed in the axial plane as precisely as possible as by setting tight thresholds of the grey scale to avoid capturing undesired structures.  
**Results:** Enlarged/Large Vestibular Aqueduct Syndrome (EVAS), Incomplete Partition (IP) types I, II & III, Common Cavity (CC), and Cochlear Hypoplasia (CH) were identified in the data set taken for analysis in this study. EVAS showed enlarged VA with a width of 2.76mm. CC and CH cochleae showed a great variation in its size, shape and in the presence and absence of the semicircular canals. IP types on the other hand showed its own characteristics with IP type II with enlarged VA, IP type I with very minimal development of the basal turn and IP type III with a wider IAC connecting the basal turn of the cochlea.  
**Conclusion:** It is a difficult task for many clinicians to mentally compile a series of 2 dimensional images slices into an accurate 3D representation of any anatomic structure. Yet a clear 3-dimensional understanding of anatomy, especially pathologic anatomy, is an enormous advantage to any surgeon undertaking a complex procedure. 3D segmentation, as demonstrated in this study, improves the clinicians’ ability to visualize cochlear anatomy and the nearby structures compared to 2D images. 3D segmentation images can help ensure that a suitable electrode is chosen and implanted efficiently.  
Corresponding author: Dr. Anandhan Dhanasingh (Anandhan.dhanasingh@medel.com)
**Poster Number:** 163  
**Abstract ID:** 219  
**Title:** Research Software in Cochlear Duct Length Estimation, Greenwood Frequency Mapping and Electrode Array Length Selection  
**Category:** Surgery/Medical  
**Authors:**  
Anandhan Dhanasingh, Dr. rer. nat (German PhD)MED-EL GmbH, Innsbruck, Austria.  
**Abstract:**  
**Introduction:** The size of the cochlea varies a lot among the human population bringing the necessity for electrode arrays available in various lengths irrespective of the cochlear implant (CI) brand. This research software helps in the estimation of the patient’s cochlear duct length (CDL) which is then used for the selection of the correct length electrode array matching the patient’s cochlear size and as well in getting the patient specific cochlear frequency map.  
**Methods:** Visual Studio Express 2012 for Windows Desktop is used in the architecture of this research software. The basal turn diameter of the cochlea (“A” value) needs to be measured from the pre-operative CT image of the patient’s temporal bone. This “A” will be taken as the input for the CDL equations proposed by Alexiades et al for estimating the CDL for various insertion depths. Greenwood’s equation is then used in combination with the CDL for the full length of the cochlea in getting the patient specific frequency map.  
**Results:** The research software with the help of the “A” value as input, with few button clicks, gives the patient specific CDL for various insertion depths and the greenwood’s frequency map. The users have the choice to select any electrode array of their choice and place it under the frequency map to see how good it fits to that particular patient’s cochlea. Also, given the possibility to drag and move the electrode array picture to mimic the post-operative actual electrode insertion depth.  
**Conclusion:** This research software simplifies the overall process of CDL estimation and in getting the patient specific cochlear frequency map. The clinicians get the chance to simulate placing the various electrode array lengths in patient cochlea in identifying the best fit electrode. This could help in pushing the CI field into the concept of individualized CI electrode solution that ultimately benefits the patients.
**Title:** Abnormal Cochleovestibular Anatomy and Imaging: Lack of Consistency Across Quality of Images, Sequences Obtained, and Official Reports

**Category:** Surgery/Medical

**Authors:** Danielle M. Gillard, BS 1, John L. Go, MD 2, Nathaniel Chuang, MD 3, Elina Kari, MD 1; 1Otolaryngology, Univ. of California San Diego Sch. of Med., San Diego, CA, 2Radiology, Keck Sch. of Med. of USC, Los Angeles, CA, 3Radiology, Rady Children's Hopsital San Diego, San Diego, CA.

**Abstract:**

**Introduction:** The current imaging evaluation for cochlear implantation (CI) consists of structural Magnetic Resonance Imaging (sMRI) and/or high definition computed tomography (HDCT). CTs are used to provide detailed imaging of the bony anatomy while MRI helps visualize nerve contents within the internal auditory canal (IAC). These studies help identify inner ear anomalies and can help guide the surgeon on electrode selection. There are significant variations across centers on how these studies are acquired and how they are interpreted, partly because of the relatively rare incidence of these abnormalities. These variations, however, can present significant challenges in the management of these children. We have chosen to analyze the imaging results of a group of children with abnormal cochleovestibular anatomy to determine the quality of the imaging, the consistency of sequences included and the accuracy of official radiology reports, to determine if these children are being imaged and assessed correctly.

**Methods:** A retrospective critical review of CT and MRI imaging from 40 pediatric patients diagnosed with profound sensorineural hearing loss and cochleovestibular structure/nerve abnormalities presenting to a tertiary referral academic center with imaging taken at 18 different centers. Images were reviewed by two experienced neuroradiologists and a neurotologist and findings were compared to official reports, when available.

**Results:** Twelve (30%) of patients had an MRI only, while the remaining 28 (70%) had both an MRI and a CT. For 3 (10.7%) of the CTs and 7 (17.5%) of the MRIs the quality was such that there was difficulty assessing the status of the inner ear. Twelve children (30%) who received MRIs were given gadolinium. Extra, unneeded sequences were included in 16 (57.1%) CTs, while 39 (97.5%) of MRIs contained unneeded sequences. Only one patient was missing a CT sequence, while 10 (25%) were missing MRI sequences. Official reports were available for 19 (47.5%) CTs and 16 (40%) MRIs. There was non-concordance between the official report and the our reading for 27 (71.1%) ears on CT and 27 (56.3%) ears on MRI. The most common incorrectly reported items on the official report per ear were: incorrectly described vestibular system (14 or 66.7%), missed modiolar abnormality (21 or 63.6%), missed absent cochlear aperture (8 or 61.5%), incorrectly described cochlear architecture (11 or 57.9%), incorrectly counted nerves in the IAC (26 or 56.5%) and missed bifid IAC (1 or 33.3%).

**Conclusion:** These data demonstrate that the imaging protocols and quality vary widely between the recommended protocol and what is seen in practice. In addition, interpretation of images is highly discordant between official reports and specialist review. Given these findings we recommend that these children be imaged and evaluated at centers with neuroradiologists who are experienced in interpreting abnormalities of the cochleovestibular system.
Title: Enlarged Vestibular Aqueduct: Hearing Progression and Outcomes in Cochlear Implant Patients

Category: Surgery/Medical

Authors:
Sarah E. Hodge, MD, Kevin D. Brown, MD, PhD, Lisa Park, AuD; Otolaryngology - Head and Neck Surgery, Univ. of North Carolina, Chapel Hill, NC.

Abstract:

Introduction: Enlarged vestibular aqueduct (EVA) is the most common congenital malformation of the inner ear and has been associated with progressive sensorineural hearing loss in children. Audiologic intervention in this population varies depending on the severity of the hearing loss and ranges from traditional amplification to cochlear implantation. Cochlear implantation (CI) has been shown to be of optimal hearing benefit in these patients with severe-profound sensorineural hearing loss. There is limited data regarding when the transition from hearing amplification techniques to cochlear implantation should be performed in order to optimize each child’s outcomes. This study seeks to better understand the rate of hearing progression and optimal timing for cochlear implantation in patients with EVA.

Methods: This study is a retrospective chart review of 172 subjects (343 ears) with EVA who were under the age of 18 at the time of diagnosis. Serial audiometric data and speech perception outcomes were studied for each individual ear.

Results: An individual ear was considered to have met CI candidacy criteria once the 3 frequency pure tone average (PTA) met or exceeded 75 dB HL. Forty-six percent of the 343 ears studied met this criteria at the time of presentation to our center. Only 13% of those children were under the age of one year at the time. Of the remaining 184 ears who were not cochlear implant candidates at the time of presentation, complete acoustic hearing history was available up to cochlear implantation for 99 ears. This group was investigated separately as a potential progression cohort. Thirty-four percent of this group experienced a PTA shift of > 15dB HL prior to the age of 18. Twenty-five percent of the potential progression cohort received a CI prior to their teen years, with an additional 6 ears implanted as teens for a total of 31% receiving cochlear implants as children. The mean age of implantation for the total EVA group was 6.88 years. In general, speech perception outcomes in this population are good, with a mean highest CNC word score of 73.3%.

Conclusion: Approximately 46% of EVA subjects who presented to our cochlear implant center met audiometric criteria for implantation at the time of presentation. Of the remaining subjects almost 1/3 ultimately progressed to meet audiometric criteria for cochlear implantation. This strongly suggests that patients with EVA who are identified with hearing loss in childhood should be thoroughly counseled on the likelihood of progression and closely monitored for cochlear implant candidacy. The majority of the EVA population that reach cochlear implant candidacy do so prior to reaching adulthood.
Poster Number: 167
Abstract ID: 331
Title: Comparing Cochlear Duct Length Measurements with CT Temporal Bone and MRI Brainstem Images Using OTOPLAN
Category: Surgery/Medical
Authors:
Jacob Hunter, MD, Brandon Isaacson, MD, Anthony Tolisano, MD; Otolaryngology, Univ. of Texas Southwestern Med. Ctr., Dallas, TX.
Abstract:
Introduction: Accurate measurement of the cochlear duct length (CDL) would assist in the determination of appropriately sized cochlear implant (CI) electrode arrays, assist with surgical preparedness for hearing preservation approaches, and provide a means for frequency mapping the cochlea. Unfortunately, measuring CDL, utilizing temporal bone computed tomography (CT) on standard imaging systems available at most CI centers is not feasible. Furthermore, many CI surgeons routinely only obtain pre-operative magnetic resonance (MR) imaging studies for adults undergoing CI. We used OTOPLAN, an otologic surgery planning software developed by CAScination in cooperation with MED-EL, to measure the CDL in patients who had both pre-operative CT and MR imaging studies in order to assess the differences in CDL measurements between imaging modalities.
Methods: Thirty adult ears in patients who were CI candidates and had both pre-operative temporal bone CT and brainstem MR imaging studies were identified. Using OTOPLAN, two fellowship-trained neurotologists independently measured the CDL twice, first for the CT images and then for the MR images. A third fellowship-trained neurotologist then measured the CDL for only MR images. Intra-rater and inter-rater reliabilities were calculated for each study, and imaging variables such as magnet strength and slice thickness were examined.
Results: Intraclass correlation coefficients (ICC) were calculated for intra- and inter-reliability. Preliminary analysis demonstrates that intra-rater reliability was good for CT images for both raters (ICC 0.839 and 0.816), and intra-rater reliability was good (ICC 0.824) and moderate (ICC 0.637) for MR images. Inter-rater reliabilities for the raters who reviewed both CT and MR images indicate good reliability (ICC 0.803 and 0.776, respectively). When including the third rater (who did not perform measurements on CT images), inter-rater reliability was poor (ICC 0.494). When intra- and inter-reliabilities were calculated between 3 T and 1.5 T magnet strength MR studies, reliabilities remained relatively consistent. For intra-rater reliabilities, 3T MR studies had ICCs of 0.829 and 0.600, while 1.5 T MR studies had ICCs of 0.836 and 0.673. When including the third rater, inter-rater reliabilities indicated moderate reliability for 3 T studies (ICC 0.552) and poor reliability for 1.5 T studies (ICC 0.490).
Conclusion: CDL measurements using OTOPLAN for MR images demonstrates good intra- and inter-rater reliability for those raters who measure CDL first utilizing CT images. However, preliminary data suggests that inter-rater reliability can be improved when first measuring CDL utilizing CT images.
Title: Restoration for Adults with Vestibular Schwannoma in the Only-Hearing Ear: Ipsilateral or Contralateral Cochlear Implantation?

Category: Surgery/Medical

Authors: Zirong Huo, Medical doctor, Zhihua Zhang, MD, PHD, Zhaoyan Wang, MD, PHD, Yun Li, MD, Hao Wu, MD, PHD; Shanghai Ninth People's Hosp. Affiliated to Shanghai Jiaotong Univ. Sch. of Med., Shanghai, China.

Abstract: To explore auditory outcomes of cochlear implantation (CI) in patients with vestibular schwannoma (VS) in the only-hearing ear.

Methods: Retrospective clinical data was collected. All three cases had a long history of hearing loss on one side with newly diagnosed VS on the other side, who then received ipsilateral or contralateral CI. Postoperative hearing outcomes, including the pure tone audiogram (PTA) and open-set speech discrimination score (SDS) were measured during their follow-up, and compared with preoperative hearing level. A thorough search of the English-language literature was performed.

Results: The first two patients received CI respectively in the ipsilateral and contralateral ear without tumor removal. Patient 3 got contralateral CI after tumor resection. At the last follow-up, the PTA was 25, 45 and 25 dB, respectively. Open-set SDS was achieved in all three cases, with the monosyllable word of 60%, 30% and 75%, respectively. Besides the patients included in our study, twenty eight CI cases with VS in the only hearing ear have been reported till now, among which 8 were performed with ipsilateral CI, 17 with contralateral CI and 3 with bilateral CI placement.

Conclusion: For patients with VS in the only-hearing ear, significant hearing deterioration with no obvious tumor growth is a good indication for ipsilateral CI; long-term deafness in the non-tumor ear may not always be a contraindication for CI.
**Title:** Syndrome Deaf-Blindness in the Czech Population and Its Diagnostics Through Next Generation Sequencing (NGS)

**Category:** Surgery/Medical

**Authors:**
Michal Jurovčík, MD 1, Petra Dytrych, PhD, MD 1, Jiří Skřivan, CSc, MD 1, Radka P. Kremlíková, PhD, MD 2; 1Department of ENT, 2nd Faculty of Medicine, Charles Univ. Prague and Univ. Hosp. Motol, Prague, Czech Republic, 2Department of biology and Medical Genetics, 2nd Faculty of Medicine, Charles Univ. Prague and Univ. Hosp. Motol, Prague, Czech Republic.

**Abstract:**

**Introduction:** Deafblindness is a unique disability combining visual and hearing impairment, ranging from partial to complete with prevalence up to 1: 5,500. Up to 50% of deafblindness manifesting in childhood has a genetic background. The most common syndromes are: CHARGE syndrome (CHS) means inborn eye, ear and other organs (genital, kidney, gastrointestinal) defects with choanal atresia and retardation of growth and development is caused by CHD7 mutations with autosomal dominant (AD) inheritance in up to 1:8,500 newborns. Usher syndrome (USH) combines sensorineural hearing loss (SNHL) with progressive retinitis pigmentosa (RP) following SNHL 15-20 years later. At least 10 different genes with autosomal recessive (AR) inheritance are responsible for USH. Prevalence is 1: 6,000-25,000. Stickler syndrome (STL) or arthro-ophthalmopathy is a combination of visual disturbances (progressing myopia, cataracts, glaucoma, andretinal detachment), early progressive joint degeneration and SNHL. Pierre Robin's sequence (cleft palate, retrognathia and glossoptosis) is strongly connected with STL. Mutations in 9 different genes, mostly AD, cause STL with the prevalence 1: 7,500-9,000 inhabitants.

**Methods:** We used newly developed techniques of next generation sequencing (NGS) that bring the possibility of testing many genes at the same time. Patients with deafblindness are ideal candidates for this approach, because of marked genetic heterogeneity.

**Results:** Since 2016 we have confirmed 20 patients with CHS syndrome, 25 patients with USH and 10 patients with STL in the Czech Republic. The accurate genotype-phenotype correlations in our patients have been shown to be of utmost importance for accurate diagnostics and targeting genetic testing. The two thirds of all the patients underwent succesfull cochlear implantation.

**Conclusion:** NGS is a reliable method for diagnosing congenital auditory defects including syndrome deafblindness. Cochlear implantation can greatly improve the quality of life of deafblind children. Early genetic diagnosis can speed up the indication process.
Poster Number: 170
Abstract ID: 111
Title: Surgery for the Basal Turn Ossification of the Cochlea
Category: Surgery/Medical
Authors:
Vladislav Kuzovkov, MD 1, Ilya Skirpichnikov, PhD, MD 2, Igor Kostevich, PhD, MD 3, Aminjon Amonov, PhD, MD 4; 1Hearing Implantation Group, Saint Petersburg ENT and Speech Res. Inst., Saint Petersburg, Russian Federation, 2Chelyabinsk Regional Hosp., Chelyabinsk, Russian Federation, 3Saint Petersburg ENT and Speech Res. Inst., Saint Petersburg, Russian Federation, 4ENT Department, Republican State Ctr. of Pediatrics, Tashkent, Uzbekistan.

Abstract:
Introduction: Cochlear spiral canal ossification is one of the most critical and complicated issues in cochlear implantation. In far the most cases it primarily affects the descending part of the basal turn. In this paper the method of atraumatic drilling of the ossified spiral canal is proposed.

Methods: In the experimental procedure syntopy of the inner ear structures was revealed and some topographic anatomical measurements, which are related to the spiral canal of the cochlea, were made. On 25 cadaveric temporal bones we revealed that the distance between round window membrane and basal turn curvature equals 8.0 mm; the width of labyrinthine capsule, which borders spiral canal and internal auditory canal amounts to 0.36 mm, and its width between spiral canal and internal carotid artery accounts for 0.77 mm. After modeling the surgical procedure on cadaveric temporal bones the method, which is based on atraumatic drilling out of the ossification, was put forward. The drilling starts from the ossified round window membrane and proceeds till the basal turn curvature. In condition of satisfactory irrigation notable color difference between otic capsule and ossified tissue is observed: labyrinth capsule tends to look greyish and ossified tissue - whitish. Bearing in mind this color difference enables gradual drilling out of the ossification along the descending part of the cochlea basal turn and preservation of modiolus. Taking into consideration close adjacency of the internal auditory canal and internal carotid artery lateral basal turn wall should always be kept in mind the landmark.

Results: The above described surgical technique was applied in 45 patients with the ossification of the basal turn descending part. Mean age of the candidates was 12.4 years and time span from the suffered meningitis till the cochlear implantation equaled 12 months on average. In 19 cases the length of the ossified spiral canal varied from 1 to 3 mm, in 26 patients it was in the interval of 4-6 mm and proceeded till the basal turn curvature. It is worth mentioning that in 7 cases there was a discrepancy between the temporal bone CT data and intraoperative findings - the extension of the ossification was bigger than it could be predicted on the base of radiological study. In all the 45 patients the proposed method enabled adequate approach to the cochlea spiral canal and full CONCERTO (MED-EL, Austria) standard electrode insertion. In these cases only straight rigid electrode can be used to make its way through the drilled out spiral canal lumen. Postoperative audiological performance of the implanted patients correlated with the ones without ossification.

Conclusion: New technique is reliable for cases of ossification of the basal turn.
Title: The Significance of the "Hook" Region Anatomy for the Cochlear Implantation Surgery

Category: Surgery/Medical

Authors: Vladislav Kuzovkov, MD, Andrei Lilenko, MD, Sima Sugarova, PhD, MD, Igor Kostевич, PhD, MD; Saint Petersburg ENT and Speech Res. Inst., Saint Petersburg, Russian Federation.

Abstract:

Introduction: The optimal electrode insertion route in hearing preservation cochlear implantation is still a debating point - both RW and cochleostomy approaches are used. In patients with residual hearing it is crucially important not to alter the fine structures of the cochlea. In this particular study we analyzed the anatomic variations of the “hook” region on 35 cadaveric temporal bones and tried to find out the optimal electrode insertion route.

Methods: Basing on the distance between the edges of oval and round windows all 35 cadaveric temporal bones were divided into two groups: “small” and “big” ones (on the ground of classification proposed by F. Atturo, M. Barbara, H. Rask-Andersen). (1.56: 1.09-2.35) It was revealed that this distance correlates with the position of the “hook” region structures: osseous spiral lamina, spiral ligament, basilar membrane, cochlear aqueduct and accessory aqueduct housing inferior cochlear vein.

Results: In the experimental study we put compared 4 types of electrode insertion: via round window, with the use of anterior cochleostomy, anterior-inferior cochleostomy and enlarged round window. According to the goal of the research we compared these approaches and revealed that the most non-traumatic one in both “small” and “big” cochleae is the electrode delivery via round window membrane. This approach enabled electrode insertion without altering “hook” region structures in all cases. When anterior cochleostomy was performed in both “small” and “big” cochlea spiral ligament and lateral portion of the osseous spiral lamina were inevitably damaged in all the specimens. In 33% “big” cochlea cases basilar membrane was also altered. Whereas in temporal bones with anterior-inferior cochleostomy spiral ligament and osseous spiral lamina remained intact in 66% of “big” cochlea and in 50% of “small” cochlea and there was a significant risk especially in “small” bones (83 %) of damaging the cochlea aqueduct and accessory aqueduct. As for the enlarged round window approach we revealed alteration of cochlea aqueduct and its accessory canal in 75% cases (“small” cochlea) and 50% cases (“big” cochlea). It should be mentioned that excessively folded backwards round window membrane leads to large stoma and may cause problems with electrode insertion and necessity to pack it as well as quite significant (20%) risk of altering spiral ligament.

Conclusion: Approach to the spiral canal via round window membrane tends to be the safest non-traumatic way of active electrode insertion. As the distance between round and oval windows can be measured on temporal bones CT it may help to choose preoperatively the optimal approach in cases of labyrinth rotation and facial nerve dystopia when round window niche cannot be visualized and reached.
**Poster Number:** 172  
**Abstract ID:** 45  
**Title:** Intracochlear Pressure Changes During Cochlear Implant Electrode Insertion - a Temporal Bone Study  
**Category:** Surgery/Medical  
**Authors:** Gina Lauer, MD, Arne Ernst, MD, Philipp Mittmann, MD; Unfallkrankenhaus Berlin, Berlin, Germany.  
**Abstract:**  
**Introduction:** Different factors influence the atraumatic insertion of CI electrode arrays. The intracochlear pressure changes influence the preservation of residual hearing. A smooth and slow insertion is as important as a careful opening of the round window membrane. A lot is known about intracochlear pressure changes from research in an artificial cochlear model. The aim of our study was to investigate how the intracochlear pressure changes during the insertion of the cochlear implant electrode array.  
**Methods:** Insertions were performed in fresh temporal bones with three different electrode arrays. Intracochlear pressure changes were recorded with a micro-optical pressure sensor in the apical part of the cochlear and the vestibule.  
**Results:** Significant differences were measured with different electrode arrays. Pressure changes with small voluminous electrodes are smaller than pressure changes in voluminous electrodes. Furthermore pressure changes within the cochlear appear higher than in the vestibule.  
**Conclusion:** Preservation of residual hearing and the audiological outcome after cochlear implantation are important factors in modern cochlear implant surgery. Intracochlear pressure changes should therefore be kept small to preserve intracochlear structures and hence residual hearing. Reduced volume of the electrodes is one key factor to preserve intracochlear structures. Nevertheless co-factors such as insertional speed, opening of the round window and moistening of the electrode array have to be considered.
Poster Number: 173
Abstract ID: 46
Title: Intracochlear Pressure Changes During CI Electrode Insertion - Modifications for Minimizing Intracochlear Pressure
Category: Surgery/Medical
Authors: Gina Lauer, MD, Arne Ernst, MD, Philipp Mittmann, MD; Unfallkrankenhaus Berlin, Berlin, Germany.
Abstract:
Introduction: Different factors influence the atraumatic insertion of cochlear implant electrode arrays. The intracochlear pressure changes influence the preservation of residual hearing. The aim of our study was to investigate whether a modification of the insertion sheath could minimize intracochlear pressure changes during the cochlear implant insertion.
Methods: Insertions of the electrode array were performed in an artificial cochlear model. Intracochlear pressure changes were recorded with a micro-optical pressure sensor in the apical part of the cochlear. The insertion sheath has a 'stopper' that seals the round window during the insertion. The volume of this 'stopper' was reduced in different manners. All insertions were performed with the same speed.
Results: Significant differences were measured with different diameters and volumes of the stopper. With reduced volume of the stopper the intracochlear pressure changes can be reduced significantly.
Conclusion: The design and volume of the insertion sheath have significant impact on intracochlear pressure changes. With reduced volume of the sheath intracochlear pressure changes can be reduced significantly. These differences may ask for rethinking the design of the sheath in order to preserve residual hearing.
Title: Reimplantation in Early Implantated Pediatric Patients - Mismatch in Electrode Locations

Abstract:

Introduction: Reimplantation in initial pediatric cochlear implant recipients are done due to either technology upgrades and/or device failures. This has often done years after the first implantation with patients, using their implant as their "normal" hearing and most likely undergoing extensive developmental adaptation to the stimulation they receive. Before device failure these subjects show, as a rule, good to excellent speech comprehension (depending on the age at implantation). After they receive a new implant at adult age with a different implant technology and electrodes or different speech coding strategies speech performance develops not as expected. It is seen that a big difference in electrode location can lead to a drop in performance.

Methods: In a retrospective study 20 patients who were implanted as children with an enhanced bipolar electrode and deep insertion were analyzed. Reimplantation was performed with recent electrode systems with much shallower insertion depth and different electrode contacts. In addition the speech coding strategy was different. Position of electrode, speech perception scores before and after reimplantation, cochlear covering and distance of contact from round window were calculated.

Results: Patients with a more identical location of the stimulating contacts, especially missing the basal turn, showed improved speech perception scores when implanted with a long electrode covering also the basal turn.

Conclusion: Patients with a big difference in electrode location (first basal contact differs more than 4 mm from previous location) show an increase in performance. Patients without basal stimulation show either equal or worse auditory performance data despite technology advances.
Title: Cochlear Implantation in Two Pediatric Patients with Unilateral Hearing Deafness and Pneumococcal Meningitis

Category: Surgery/Medical

Authors:
Maurizio Levorato, MD, Otolaryngology, Sant Joan de Deu, Children's Hosp., Barcelona, Spain, Barcelona, Spain.

Abstract:

Introduction: Cochlear implant (CI) in unilateral deafness is a topic still debated especially in pediatric patients. We describe the case of two children with unilateral hearing deafness submitted to CI surgery in our institution.

Objective: To describe safety and benefits of CI surgery in unilateral hearing deafness patients affected by pneumococcal meningitis.

Methods: Two children of 7 and 24 months old were implanted in our institution in 2018 after the diagnostic of pneumococcal meningitis and unilateral deafness. CT scan, MRI, ABR, ASSR, OAE, and behavioral audiometry (when possible) were assessed before surgery. Clinical, audiological, and surgical criteria are described and literature reviewed. Post-operative CI programming and the follow up is presented.

Results: The patients were safely implanted with no complications related to surgery or pneumococcal meningitis as far as the follow up indicate. Children accept the implants, audiological rehabilitation and cochlear implant programming are presented and discussed.

Conclusions: The implantation of the deaf ear insure the possible stimulation of the deaf side (that presented early ossification at the time of surgery) and binaural hearing specially in developing central nervous system of young children. Family acceptance is also discussed. We need more evidence to establish the benefits of CI in unilateral deaf pediatric patients.
Title: Unilateral Cochlear Implant Failure Resulting in Explantation and Subsequent Implantation of Long-Deafened Contralateral Ear: Management and Outcomes

Abstract:

Introduction: 9 year old male patient presented 7 years post-cochlear implantation of the left ear for second opinion. Patient was educationally mainstreamed in his home country, communicated solely via spoken Arabic, and was reportedly doing very well with his left cochlear implant until age 8, at which time he developed chronic left otorrhea, left-sided headaches, and decreased audibility from his cochlear implant.

Methods: Retrospective case review.

Results: Radiologic studies yielded findings consistent with significant anatomic changes to the left cochlea and middle ear space from the development of cholesteatoma since implantation. The left ear was explanted and the patient treated for 3 months with antifungal agents due to the development of brain abscesses. Six months later, the contralateral right ear was implanted; duration of deafness in the right ear at time of implantation was 10 years. Counter to common wisdom, performance with the late-implanted right ear ultimately proved to be almost equivalent to that of his early-implanted left ear. Mapping, evaluation, and performance outcomes of both the explanted left device and newly implanted right device will be discussed in detail.

Conclusion: This complex second-opinion case covers numerous aspects of cochlear implantation and examines how medical, surgical, radiologic, and audiologic data need to be considered as a whole in order to best address surgical complications, develop solutions, and understand patient needs in an efficacious manner. Secondarily, this case study raises questions in light of existing literature on outcomes of late-implanted ears in children.
Title: Cochlear Implantation in the Setting of Aberrant Facial and Vestibulocochlear Nerves

Abstract:

Introduction: Facial nerve anomalies have been well described, and their impact on cochlear implantation in patients has been reported. While hypoplastic or aplastic vestibulocochlear nerves have been described, there are only three reported cases of aberrant vestibulocochlear nerves. There have been no reports on cochlear implantation in the setting of an aberrant eighth cranial nerve.

Methods: We present a case of a 16 month old male with bilateral profound hearing loss and subtle left facial nerve palsy. On imaging, he was found to have anomalous intracranial course of bilateral facial and vestibulocochlear nerves, but otherwise normal inner ear anatomy. The facial and vestibulocochlear nerves were identified at their expected origin in the brainstem. On the right, however, the nerves coursed anteriorly, without passing through a stenotic IAC. On the left, only the vestibular nerve traversed through the IAC, but the facial and cochlear nerves coursed anteriorly.

Results: The patient underwent an uncomplicated left cochlear implantation. NRT responses intraoperatively were limited to absent. At time of initial activation, patient showed behavioral responses to mid frequencies, and has been more vocal with use of the implant.

Conclusion: This case describes an aberrant course of the vestibulocochlear nerve, and is the first report of a successful cochlear implantation in a patient with aberrant facial and vestibulocochlear nerves.
Title: The Effect of Intracochlear Electrode Position on Impedance Values and Map Current Level Requirements

Category: Surgery/Medical

Authors:
J. Eric Lupo, MD, MS, Allison Biever, AuD, David C. Kelsall, MD;
Rocky Mountain Ear Ctr., Englewood, CO.

Abstract:
Introduction: It has been documented that closer placement of the electrode to the modiolus and therefore the neural elements of the cochlea results in improved speech perception. Additionally, added benefit may be lower impedance values and lower threshold and comfort levels resulting in a more power efficient implant system which can translate into longer battery life. The effect of intracochlear electrode position, specifically a measure of modiolar proximity, basal angle of insertion and apical angle of insertion on impedance values and map current requirements in a large group of cochlear implant users has been evaluated.

Methods: Data on electrode impedance values and map threshold and comfort levels were prospectively collected from multiple cochlear implant centers over 6 months on newly implanted subjects. Additionally, a high resolution CT scan was completed post-operatively in order to analyze electrode position.

Results: Longitudinal impedance, threshold and comfort level data appear consistent with past results showing lower current thresholds requirements with closer modiolar proximity of electrode array. A detailed 3D analysis of the CT scan was able to yield a modiolar proximity measure and identify both the basal angle and the apical angle of insertion for the electrode array. The relation between these positioning variables was analyzed against impedance levels and power requirements as measured by patient-reported Threshold and Comfort levels. Specific findings of these analyses will be presented in detail within this presentation.

Conclusion: An electrode closer to the modiolus has a direct effect on map power requirements which supports the efficiency of an intracochlear array positioned adjacent to the site of neural activation, thereby impacting power consumption of the device for the recipient. Because of the impact that electrode position has on power requirements and ergo on patient battery consumption, a careful and measured surgical approach is crucial to an optimal outcome.
Poster Number: 179
Abstract ID: 302
Title: Necessity of Electric Auditory Brainstem Response Assessment Prior to Cochlear Implantation in Special Cases
Category: Surgery/Medical
Authors: Cristian Mărțu, Assistant Professor, MD 1, Sebastian Cozma, Associate Professor, MD 1, Dan Martu, Professor, MD 1, Giacomo Mandruzzato, Researcher 2, Luminita Radulescu, Associate Professor, MD 1; 1ENT, Univ. of Med. and Pharmacy, Iași, Romania, 2MedEL, Vienna, Austria.
Abstract:
Introduction: Cochlear Implantation (CI) is the best treatment option for bilateral profound sensorineural hearing loss (SNHL), but its efficiency could be limited by the patency of retrocochlear pathways which are difficult to evaluate in some cases. Although imagistic exploration and audiometric testing are good indicators for successful results after CI, some cases with associated pathology or malformations may need further exploration. In some particular cases the decision for CI might be influenced by the results of direct cochlear stimulation prior to implantation. Electric auditory brainstem response (EABR) is a good indicator for normal neural transmission and might be a predictor for good results after CI.
Methods: EABR has been used to evaluate the opportunity of CI in a group of three patients with bilateral profound SNHL. Stimulation was performed using PromStim System EABR by placing an angled blunt needle electrode in the round window (RW) niche through a small tympanotomy.
Results: Results were good for two of our patients, with response starting from 200cu (100µs phase duration) respectively 600cu (100µs phase duration). In the third patient there has not been found any response until 1000cu/100µs. The electrode has been changed and repositioned but still no response was recorded even at 1000cu/200µs. One case has exhibited cardiac arrhythmia during posterior tympanotomy when facial nerve detection/stimulation was performed. CI had been postponed until EABR testing showed no influence of the heart rate during and after electric stimulation in the RW. After CI implantation and activation, patient had no cardiac problems.
Conclusion: In conclusion eABR is a useful method in predicting the efficiency of cochlear implantation in particular cases where retrocochlear problems are suspected. Simulating CI stimulation may bring additional insight before deciding for CI in cases with associated pathology. Although it is invasive and needs patient sedation/intubation it is a useful tool when usual tests are not enough in identifying retrocochlear hearing loss and deciding whether CI is a useful option for the patient.
Poster Number: 180
Abstract ID: 145
Title: Histopathology of Human Cochlear Implants in Revision Cases
Category: Surgery/Medical
Authors: Magued Mashaly, Prof Dr, MD, Ear, Nose and Throat, Faculty of Med. Cairo Univ.-Egypt, Cairo, Egypt.

Abstract:
Introduction: Cochlear implants have been considered well-tolerated and biocompatible auditory prostheses with a low rate of complications. Nevertheless, there have been a number of case reports in which a pronounced inflammatory allergic reaction resulted in implant failure, extrusion, explantation and re-implantation.

Methods: In this study our objective is to reveal implicit mechanisms of tissue regeneration and tissue capsule formation around the receiver stimulator, extracochlear and intracochlear parts of the electrode. - Fourteen patients who underwent revision surgery for device failure between 2012 and 2017, were enrolled in the study. -- Previous implantation was performed through posterior tympanotomy and cochleostomy approach using only straight electrodes. -- Two fragments were biopsied from implant body capsule and extra cochlear electrode sheath (hose). - Three touch smears of intracochlear parts of electrode were studied using routine histopathological methods (1st at cochleostomy, 2nd at the tip of electrode and 3rd midway along the intracochlear segment).

Results: In all subjects the receiver stimulator and extracochlear part of electrode were completely covered with fibrous tissue growth. - Histopathology of the receiver stimulator fibrous capsule and extracochlear fibrous sheath (hose) stained with Hematoxylin-Eosin showed connective tissue of different maturity (young/mature) with granuloma formation and calcinates. - Cytology of intracochlear part of electrode stained with Giemsa showed fibrous chordae, giant multinucleate cells and macrophages, inflammatory granuloma, lymphoid cells with proliferative features. - The infiltration of foreign body giant cells and lymphocytes at the cochleostomy was significantly more severe than the cellular response at the middle and tip of electrode. - The cellular reaction at the tip and middle of the electrode did not differ significantly, fibrosis and new bone formation were less severe with increasing distance from cochleostomy. - There was no correlation between the duration of implantation and the cellular, fibrotic and osteogenic reactions.

Conclusion: Fibrous tissue encapsulation of the implant bed of the receiver stimulator act as a key stabilizing factor, preventing displacement of the implant. - The heightened tissue reaction at the cochleostomy suggests that trauma of insertion may be the cause. - The local tissue response and foreign body reaction, may cause malfunction of CI and poorer performance after cochlear implantation. So less traumatic techniques of electrode insertion may decrease local tissue response. - These results would open further perspectives to assess tissue reaction on special cochlear electrodes designed for hearing preservation and to investigate the way to avoid inflammatory tissue reaction and connective tissue formation inside the cochlea.
Poster Number: 181
Abstract ID: 150
Title: Cochlear Implantation in Visually Impaired Patients
Category: Surgery/Medical
Authors: Magued Mashaly, Prof Dr, MDEar, Nose and Throat, Faculty of Med. Cairo Univ.-Egypt, Cairo, Egypt.
Abstract:

Introduction: Deaf children are heavily reliant on the sense of vision. Ophthalmic problems in these children have a serious effect on the development of their speech, communication skills and education. Patients with multiple sensory deficits including hearing loss and visual impairment, represent a unique problem, as they have limited options for communication, which relies mainly on tactile stimulation. Several studies concluded that there is a very high prevalence 40-60% of ophthalmic disorders in deaf children.

Methods: Our work is a retrospective clinical study. We reviewed a total of 840 patients comprising the adult and pediatric cochlear implantations (CI) between 2011 and 2017. We report on five cochlear implantation in patients with profound sensorineural hearing loss and significant visual impairment (Usher syndrome - 3 cases; a child with CHARGE syndrome and another child with Keratitis Ictyosis Deafness - KID syndrome).

Results: CI in the 3 patients with Usher syndrome, coupled with auditory - oral education has enabled them to achieve oral communication without reliance on visual sign language. CI of the child with CHARGE syndrome led to limited degree of auditory benefit after 2 years of rehabilitation, it enhanced the child connectivity to the environment, but it did not promote the development of oral language skills. In KID syndrome child, implantation was successful without complications over a period of 3 years with good hearing and speech performance.

Conclusion: Cochlear implantation has a major role to play in rehabilitation of deaf and visually impaired patients, with a significant positive impact on their quality of life. The implant team must acquire certain additional rehabilitative skills, such as tactile methods of communication used by these individuals.
**Poster Number:** 182  
**Abstract ID:** 271  
**Title:** Audiological and Medical Considerations of X-Linked Deafness  
**Category:** Surgery/Medical  
**Authors:**  
Rachel McOmish, Masters of Audiology, Sherif Khalil, MS, FRCS (ORL-HNS), MD; Audiology, Royal Natl. Ear Nose and Throat Hosp., London, United Kingdom.  
**Abstract:**  
**Introduction:** X-linked deafness is a rare genetic disorder. It mostly affects males and is characterised by pathognomonic middle and inner ear anomalies causing a severe mixed hearing loss. Due to the patient’s audiometric profile, making a diagnosis can often be challenging. Patients with this hearing loss are often misdiagnosed as it is not until they have a CT scan and genetic testing that X-linked deafness is discovered. Before diagnosis; patients trial conventional hearing devices which are often unsuitable and give poor access to sound. The most effective treatment is cochlear implantation; however this surgery carries risks of potential inner ear gushers. Intra-operative imaging and careful surgical planning can help negate this risk.  
**Methods:** A retrospective case study review was undertaken at the Royal National Throat Nose and Ear Hospital in London, United Kingdom. The cases presented are three male children with X-linked deafness. Descriptions of our experiences of audiological and medical considerations are reported on.  
**Results:** The three children all had difficulties with obtaining a diagnosis and the pre-assessment phase for cochlear implantation was lengthy. We discuss the case studies in detail highlighting the audiological considerations in each case. Medical management is also discussed and the surgical complexities of each patient are reported. CT scans and intra-operative images will be shown. All of the patients demonstrated post-operative benefit to various degrees.  
**Conclusion:** In the three case studies discussed, the team have successfully managed to improve the patients hearing with cochlear implant surgery. Auditory benefit was demonstrated in all cases. Whilst there are complexities and considerations with this rare cohort of patients, cochlear implantation is an effective form of suitably aiding this population.
Poster Number: 183  
Abstract ID: 262  
Title: The Ratio of Treated Patients and Candidates for Cochlear Implant in the Past Year  
Category: Surgery/Medical  
Authors: Milanko Milojević, MD, PhD (Otorhinolaryngology (ENT), Military Med. Academy, Belgrade, Serbia.  
Abstract:  
Introduction: Serbia has 7 225,000 inhabitants. At the ENT Clinic VMA is checked annually around 10,000 patients with different otologic diseases, of which about 3,000 children and 7,000 adults. Examination of children shows approximately 10% with different levels of hearing impairment.  
Methods: Number assigned to the hearing aids last year was 632, of which 43 children who receive auditory amplification on both sides. Of this number, only two children fulfilled the criteria for KI involving the processing of the entire team and diagnostic procedures. The criteria which are guided in selecting patients were:  
Deafness on both ears at both patients  
No usage of any hearing aid and complete incomprehensibility speech  
Healthy middle ear Porosity cochlea proven with CT and MRI  
Good weighting electrostimulation hearing nerves  
Positive Logopedic rehabilitation after the installation Cochlear implant  
Valid psychological finding and psychiatrist  
Regular findings for general anesthesia  
Results: I patient: 3.5 years old girl, prelingually defness, wears two hearing aids 1.5 years. Biological threshold of hearing about 80 dB, in the process of speech rehabilitation. II old boy nearly six years, prelingually defness, wears two hearing aids, in speech rehabilitation. Biological hearing threshold above 70 dB. Three other children with hearing about 70 db were in diagnostic process, but due to a congenital malformation of the temporal bone and unsatisfactory psychological/psychiatric status did not enter the list of possible candidates for a cochlear implant. So far in Military Medical Academy embedded about 20 cochlear implants. Please note that patients over 18 years lack an expenses covered by the Health Fund and to finance their mounting implants. Until now, these patients were two and possibly two more candidates would also be implanted.  
Conclusion: The ratio of patients examined and possible candidates for KI does not deviate significantly from global standards.
Poster Number: 184
Abstract ID: 44
Title: Electrophysiologic Changes After 'Pullback' of the Slim Modiolar Electrode - First Clinical Impressions
Category: Surgery/Medical
Authors:
Philipp Mittmann, MD, Gina Lauer, MD, Arne Ernst, MD; Unfallkrankenhaus Berlin, Berlin, Germany.
Abstract:
Introduction: The exact position of the cochlear implant electrode array should be within scala tympani for a satisfying audiological outcome. If the electrode array gets closer to the modiolus, lower NRT thresholds and a better audiological outcome can be expected. With the pullback technique an electrode position closer to the modiolus can be achieved. The aim of our study was the detection of electrophysiologic characteristics after the pullback.
Methods: In a prospective monocentric study fifteen patients were implanted with the slim modiolar electrode array. After complete insertion NRT thresholds, impedances and spread of excitation were measured. After pullback NRT thresholds, impedances and spread of excitation were measured again. Postoperative the position of the electrode array was determined with a flat panel tomography.
Results: Significant lower NRT thresholds were detected after the pullback between the eleventh and eighth electrode. The position of the electrode array was verified within scala tympani in all patients.
Conclusion: Cochlear implantation for hearing impaired patients with bilateral or unilateral deafness has become a major role in the rehabilitation process. Perimodiolar electrode arrays are closer to the modiolus and have lower NRT thresholds. Significant lower NRT thresholds were observed after electrode pullback. With lower NRT thresholds perimodiolar electrodes potentially provide a wider range of stimulation levels and better functional results.
Poster Number: 185
Abstract ID: 48
Title: Intracochlear Pressure Changes During Cochlear Implant Electrode Insertion with the 'Pullback' Technique
Category: Surgery/Medical
Authors: Philipp Mittmann, MD, Arne Ernst, MD, Gina Lauer, MD; Unfallkrankenhaus Berlin, Berlin, Germany.
Abstract:
Introduction: Different factors influence the atraumatic insertion of CI electrode arrays. The intracochlear pressure changes influence the preservation of residual hearing. With the pullback technique an electrode position closer to the modiolus can be achieved. The aim of our study was to investigate how the pullback influences the intracochlear pressure changes.
Methods: Insertions were performed in an artificial cochlear model with two different perimodiolar electrode arrays. Intracochlear pressure changes were recorded with a micro-optical pressure sensor in the apical part of the cochlear. After complete insertion of the electrode array a pullback was performed.
Results: Significant differences were measured if the electrode array was wet during the pullback. Pressure changes in electrodes with a smaller volume are lower than pressure changes in voluminous electrodes. Pressure changes during the pullback are small in comparison to the insertion of the electrode array.
Conclusion: Preservation of residual hearing and the audiological outcome after cochlear implantation are important factors in modern cochlear implant surgery. Intracochlear pressure changes during the pullback are small but can be even reduced significantly by moistening of the electrode. Using the pullback technique in cases with residual hearing should not affect the probability of preservation of residual hearing but could lead to a better audiological outcome.
Diagnostic Imaging for Cochlear Implantation: A Rational Check-List

Abstract:
Diagnostic imaging is of primary importance in determining candidacy, assessing potential intra-operative surgical challenges, anticipating probable results, for research, experimental techniques, and documentation. Three essential information we need to obtain is Cochleo-vestibular Anomalies that Preclude Implantation, evidence of Luminal Obstruction which can complicate the surgery intra-operatively and presence of any additional findings that may complicate the surgery or subsequent patient management. Both Magnetic Resonance Imaging and High resolution computed tomography are essential to obtain clinically relevant pre-operative information. It is essential to develop a systematic and rational structured check-list to obtain detailed information. Such pre-op evaluation helps in anticipation of potential complications such as intra-operative CSF leak and facial nerve anomalies and preparing the surgeon in dealing with them to manage safely. Pre-operative knowledge about the status of the Cochlea and Cochlear lumen can also help in choosing the implant and electrode types. Patients can also be counseled pre-operatively about the procedure, consequences and realistic post-operative results. Most important of all, diagnostic radiology helps us in excluding the patients who are not ideal candidates for Cochlear Implantation. MRI is used as a preliminary imaging modality for screening. The MRI is assessed with an inside out approach, starting from the Brain and Auditory cortex to the mastoid. Pathological conditions with potential poor outcomes are identified, counseled and/or such patients are excluded from candidacy. A Computed tomography is done only if potential surgical risks are identified on MRI. With this, we present a rational approach and check-list for radiological diagnostic evaluation for Cochlear Implants.
**Poster Number:** 188

**Abstract ID:** 335

**Title:** Successful Cochlear Implantation in Patients with Congenital Inner Ear Malformation: A Retrospective Case Series

**Category:** Surgery/Medical

**Authors:**
Eric J. Nisenbaum, MD, MSc, Enrique Perez, MD, Adrien A. Eshraghi, MD, Simon I. Angeli, MD, Fred F. Telischi, MD, Xue Z. Liu, MD, PhD; Otolaryngology - Head and Neck Surgery, Univ. of Miami, Miami, FL.

**Abstract:**

**Introduction:** Cochlear implants (CI) have been a transformative technology for the treatment of sensorineural hearing loss (SNHL). Up to 20% of patients diagnosed with SNHL may have associated inner ear malformations (IEM) representing a continuum of developmental arrests of the inner ear. Historically, IEM represented a contraindication to CI placement. However, today patients with IEM are widely implanted, with our institution first publishing on successful implantation in this population in 1988. We reviewed CI patients with IEM at our institution to assess epidemiology of IEM, associated surgical complications, and post-implant audiological outcomes.

**Methods:**
The study was a retrospective case series at a single tertiary academic institution. 657 patients who received CI at our institution between 2004 and 2008 were identified using ICD-9 code “389.18” for SNHL and CPT code “69930” for CI. Patients were excluded if no medical records were found in our EMR. Imaging studies - both high resolution computed tomography and magnetic resonance imaging - were included if the study indication was “hearing loss”, or if they were dedicated temporal bone studies, and were classified as either pre- or post-CI. Radiological reports and medical records were reviewed for IEM, which required either identification of a specific IEM presentation (large vestibular aqueduct (LVA), Mondini dysplasia (MD), common cavity, etc.) or any mention of inner ear anatomical variance. Operative reports for the IEM patients were reviewed for surgical complications, and audiological reports were reviewed for pre- and post-CI speech awareness threshold (SAT).

**Results:**
20 patients (9 male, 11 female) met inclusion criteria and were reviewed. Mean age at implant was 35 years (2-77 years). Average follow-up length was 53 months (0-120 months). 6 patients were prelingual at time of implant, while 14 were postlingual. Types of IEM were as follows: LVA (n=7, 35%), internal auditory canal anomaly (n=6, 30%), MD (n=4, 20%), unspecified abnormal cochlea (n=2, 10%), endolymphatic duct enlargement (n=1, 5%). All 20 patients were successfully implanted. 2 minor intraoperative complications were identified: electrode bending requiring a second electrode in a patient with MD, and a small CSF gusher in a patient with LVA. 19/20 patients were using their CI at time of last follow-up visit. Pre- and post-CI audiological reports were available for 11/20 patients, with a total of 13 implanted ears analyzed. Mean SAT pre-CI was 90.4 dB (SD +/- 13.5), mean SAT post-CI was 25.8 dB (SD +/- 20.4), for a mean gain in SAT of 64.6 dB (range 45-85 dB, P<0.0001 Student’s t-test).

**Conclusion:**
In the hands of an experienced CI surgeon, CI can be safely and successfully placed in patients with a variety of inner ear malformations. Patients with SNHL secondary to IEM can obtain significant audiometric gain from cochlear implantation.
Poster Number: 189  
Abstract ID: 299  
Title: Hearing Preservation with Long Electrode Arrays and Implications for Place Based EAS Fitting  
Category: Surgery/Medical  
Authors:  
Brendan O'Connell, MD, Margaret Dillon, AuD, Michael Canfarotta, MD, Kevin Brown, MD PhD, English King, AuD, Shelley Anderson, AuD, Ellen Deres, AuD, Andrea Bucker, AuD, Meredith Rooth, AuD, Harold Pillsbury, MD; UNC, Chapel Hill, NC.  
Abstract:  
Introduction: It is widely accepted that short electrode arrays (<24 mm) with shallow insertion angles have the highest incidence of postoperative hearing preservation. However, in cases in which hearing is lost and a short array is used, patients demonstrate poorer speech perception than is observed for those with longer lateral wall arrays listening in the electric only condition. While short electrodes remain preferable for traditional EAS candidates (i.e. normal to moderate low-frequency thresholds), the optimal electrode array for patients with moderate to moderately-severe low frequency thresholds, who have a higher likelihood of being destined for the electric only condition, is less clear.  
Methods: Hearing preservation with full length electrode arrays was analyzed in 2 separate cohorts: 1) Subjects with UHL and AHL who were prospectively enrolled and underwent cochlear implantation with a standard 31.5-mm electrode array as part of a clinical trial, and 2) subjects with moderate-to-profound bilateral SNHL who underwent cochlear implantation with a flexible 31.5-mm electrode array. The subjects who received the flexible array consented to post-operative CT imaging, such that angular insertion depth could be determined. Inclusion criteria were presence of an unaided threshold of ≤ 80 dB HL at 125 Hz in the ear to be implanted at the preoperative interval. The unaided hearing thresholds at 125 Hz were retrospectively compared between the preoperative and 6-month follow-up intervals.  
Results: Twenty-five subjects implanted with the 31.5 mm standard electrode array met inclusion criteria. By the 6-month follow-up interval, 7 subjects (28%) maintained a hearing threshold of ≤ 80 dB HL at 125 Hz; full insertion with a long electrode array was achieved in all cases. Five subjects received the flexible 31.5 mm electrode array; 3 (60%) maintained a post-operative hearing threshold of ≤ 80 dB HL at 125 Hz. The mean angular insertion depth of the flexible array was 654 degrees.  
Conclusion: Hearing preservation is possible with full length lateral wall electrode arrays. Preliminary data suggests hearing preservation rates are more favorable with the flexible 31.5 mm electrode array. Complete cochlear coverage is achieved in these cases, which has implications for place-based EAS fitting. Understanding the hearing preservation rates by angular insertion depth is important as pediatric cochlear implantation candidacy criteria expands to include more unaided hearing.
Title: Evolving Demographics Of Cochlear Implantation At A Tertiary Medical Center

Abstract:

Introduction: Statistics of the National Institute of Deafness and Other Communication Disorders report that 58,000 adults and 38,000 children have been implanted with cochlear implants in the United States. Currently, the fastest growing age demographic in the United States is over 65 years of age, with hearing loss being a major ailment in this group. As a result, cochlear implantation will continue to be performed more frequently in the adult population. Due to longer life expectancy, the very elderly is likely to become the largest age demographic to receive a cochlear implant.

Methods: A retrospective chart review was performed at a large tertiary referral center with an adult practice to assess trends in volume and age at time of cochlear implantation between 1990 and 2018. Data was then analyzed using GraphPad Prism 7 software, and all statistical tests were conducted with α=0.05.

Results: 291 patients underwent cochlear implantation in this time frame and were divided into 3 groups, which corresponded to the 1990, 2000 and 2010 decades. The average age of implantation was 37.12 yrs ± 23.41 for the 1990’s, 49.07 yrs ± 20.35 for the 2000’s, and 50.09 yrs ± 16.91 for the 2010 decade. Analysis of Variance between age groups showed statistically significant difference P < 0.05. between them. In the 1990’s, the predominant age range for implantation was 40-59 years (33.33%), 40-59 years (29.87%) for the 2000 decade, 60-79 years (47.23%) for the 2010 decade.

Conclusion: The average age of adult cochlear implantation has increased over the decades due to the growing age demographic and longer life expectancy seen in the United States. This is apparent in the changing trends seen in our own cochlear implant practice. It is likely that the octogenarian population will become the fastest growing implant group in the coming decades.
Poster Number: 191
Abstract ID: 436
Title: Packing the Facial Recess Impacts Intracochlear Electrode Location
Category: Surgery/Medical
Authors: Alejandro Rivas, MD

Abstract:

Introduction: Electrode position inside the cochlea has significant consequences for implant performance. While many surgical aspects affecting electrode position have been studied, little is known about the effects of extracochlear packing on intracochlear electrode position.

Methods: One attending ear surgeon performed electrode round window insertions using 5 human cadaveric temporal bones. Two perimodiolar electrodes (Cochlear® Slim Modiolar 532™ (CI532) and Advanced Bionics® HiFocus™ Mid-Scala (MS)) and one lateral wall electrode (Cochlear® Slim Straight 522™ (CI522)) were used. Cadaveric muscle was used to pack the round window and facial recess for each insertion under the following conditions: 1) inferior to the electrode, 2) superior, and 3) both inferior and superior. Pre- and post-insertion computed tomography scans were analyzed with image processing software to compute distances between electrode contacts and the modiolus.

Results: Packing superior to the electrode in the facial recess down to the round window resulted in decreased distances from the modiolus in the basal turn compared to inferior packing (0.39±0.09mm vs. 0.63±0.16mm, respectively, p<0.001) using the CI532 electrode. A similar effect was seen for CI522 when comparing superior (0.69±0.53mm) vs. inferior (0.95±0.38mm) packing (p=0.04). No statistical differences were observed for MS, or for any electrode in the mid/apical turns.

Conclusion: Round window and facial recess packing alter electrode distance to the modiolus in the basal turn using a cadaveric model. The effect was most pronounced with CI532, and appears to be device-dependent.
Title: Use of Wideband Absorbance to Elucidate the Mechanism of Persistent Postoperative Conductive Hearing Loss After Cochlear Implantation

Category: Surgery/Medical

Abstract:

Introduction: Improvement in bone-conduction thresholds and/or decrease in air-conduction thresholds have been reported in cochlear implant recipients with preserved residual acoustic hearing. The mechanism for the separation between air- and bone-conduction thresholds is unknown; however, changes in middle ear mechanics causing stiffening of the ossicular chain and/or alterations of inner ear mechanics resulting in an inner ear conductive hearing loss have been proposed. Wideband tympanometry (WBT) is an objective method used to measure middle ear transfer function and has been used to characterize various middle ear conditions. WBT analyzes the acoustic energy absorbed by the tympanic membrane and the middle ear at range of frequencies. Middle ear pathologies leading to conductive hearing loss have been associated with unique alterations in the middle-ear transfer function measured using WBT. In the present study, WBT was used to measure the middle ear transfer function at various stages during cochlear implant surgery in fresh human cadavers.

Methods: WBT measurements were performed in four fresh human cadaveric temporal bones at various stages during cochlear implant surgery and electrode insertion. The location of the WBT probe was fixed in the ear canal during cochlear implant surgery. The pressure in the ear canal was varied from 200 to 400 daPa and the energy absorbance at the tympanic membrane was measured using a series of broadband clicks. Wideband energy absorbance patterns were analyzed at the tympanometric peak pressure over a frequency range of 226 to 8000 Hz. A mastoidectomy with facial recess and round window electrode insertion was utilized.

Results: A baseline WBT pattern measured in fresh human cadavers, before the initiation of cochlear implant surgery, showed a band-pass function with spectral maxima near 1 kHz. Opening of the middle ear and the antrum resulted in slight increase in the energy absorbed by the tympanic membrane and the middle ear. No significant changes in wideband energy absorbance were observed during cochlear implant electrode insertion. However, muscle packing near the round window niche reduced absorption of acoustic energy through the middle ear in a volume dependent manner. Furthermore, the introduction of saline into the middle ear, simulating postoperative effusion, compounded this change. This suggests that the round window muscle packing may lead to conductive hearing loss following cochlear implant surgery by dampening the vibration of the stapes and tympanic membrane. Further investigations are needed to determine the long term impact of round window muscle packing on conduction of sound through the middle ear.

Conclusion: WBT can be used to monitor middle ear transfer function during cochlear implant surgery and may offer unique insight into the mechanism(s) of conductive hearing loss following cochlear implant surgery.
Title: Use of Two-Tone Electro-Cochleography to Monitor Electrode Insertion Trauma During Cochlear Implant Surgery

Authors: Aniket A. Saoji, PhD 1, Scott B. Shapiro, MD 2, Adam M. Cassis, MD 2, Neil S. Patel, MD 1, Colin L. W. Driscoll, MD 1, Kanthaiah Koka, PhD 3; 1Mayo Clinic, Rochester, MN, 2West Virginia Univ., Morgantown, WV, 3Advanced Bionics LLC, Santa Clarita, CA.

Abstract:

Introduction: Intra-cochlear electro-cochleography has been used to measure cochlear microphonics (CMs) during intra-operative monitoring of cochlear implant electrode insertion. Generally, for patients with limited residual hearing, a low-frequency acoustic pure-tone stimulus (e.g., 500 Hz) is used to elicit CMs at the apical end of the cochlea. The most apical electrode on the cochlear implant electrode array is then used to measure CMs. During an atraumatic electrode insertion, CM amplitude gradually increases with the advancement of the most apical electrode from the basal end of the cochlea. A significant decrease in CMs may occur with either cochlear trauma or from increased distance between the recording electrode and the tonotopic location of CM generation. For patients with significant residual hearing over a broad frequency range, use of a single source low-frequency CMs is somewhat limited in its ability for monitoring electrode insertion trauma during cochlear implantation. In the present study, two alternating acoustic pure tone stimuli were used to elicit CMs from two different locations along the basilar membrane. The most apical electrode was used to detect CMs generated from two different locations, thus imparting more information which may lead to more effective monitoring during cochlear implant electrode insertion.

Methods: CMs were measured during cochlear implant electrode insertion in patients with significant residual hearing. Two alternating acoustic pure tone stimuli of 500 and 1200/1500 Hz were used to elicit CMs. Each tone was presented for 50-ms with 5-ms onset and offset ramps. The presentation level for both pure tone stimuli was set to 107 dB SPL which is the highest presentation level offered by the sound card. CMs were recorded using the most apical intra-cochlear electrode and an extracochlear ring or ground electrode.

Results: CM measurements from two different locations within the cochlea varied with the advancement of the most apical electrode through the round window. During the insertion of the first few electrodes, CMs gradually increased in amplitude for the 500 and 1200/1500 Hz stimuli. Increase in electrode insertion depth, decreased CMs for the high-frequency stimulus indicating a smooth transition of the most apical electrode through the 1200/1500 Hz location within the cochlea. At the same time, CM amplitude continued to increase for the low-frequency stimulus indicating the advancement of the most apical electrode towards the 500 Hz location towards the apical end of the cochlea.

Conclusion: Intracochlear recordings of CMs generated from two different locations within the cochlea can be used to monitor electrode insertion trauma over a broad frequency range during cochlear implant surgery.
Title: Cochlear Implants for Patients with Inner Ear Malformation: Experience in a Cohort of 877 Surgeries

Abstract: Cochlear implantation (CI) has been recommended as an efficient method for rehabilitation of hearing in patients with bilateral severe-to-profound sensorineural hearing loss (SNHL) and even in patients who are deaf in one ear. About 20% of patients with profound congenital SNHL have abnormalities of the inner ear. 1 Following the first CI performed by Mangabeira-Albernaz 2 in a patient with a malformed cochlea (common cavity [CC] malformation) in 1983, increasing numbers of patients with abnormal cochlear anatomy have been considered as candidates for CI. However, it seems that more severe deformities demand increasingly more delicate surgical techniques and may have worse postoperative outcomes than would be expected. The steadily growing number of CIs performed in patients with inner ear malformation (IEM) has created a need for additional improvements to the surgical technique used for CI to achieve better outcomes and to reduce complications, such as recurrent meningitis, cerebrospinal fluid (CSF) otorrhea, and facial nerve (FN) injury.

Methods: Clinical information on patients with inner ear malformation who underwent CI surgery in our department from January 2010 to April 2017 was analyzed.

Results: Seven hundred and fifty-four CI surgeries (86.0%) were uneventful but cerebrospinal fluid gusher occurred during surgery in 118 cases (13.5%). Not including the patients lost to follow-up, postoperative Categories of Auditory Performance (CAP) and Speech Intelligibility Rating (SIR) scores were collected from 13 patients with common cavity deformity, 38 with IP-I, 11 with hypoplasia, 13 with IP-II, 28 with IP-III, 285 with IP-II, and 43 with cochlear nerve deficiency. The mean CAP scores were 2.55, 3.39, 3.45, 3.77, 3.98, 2.95, and 2.90, and the mean SIR scores were 1.54, 3.68, 3.72, 3.54, 3.80, 2.31, and 2.32. Patients with common cavity deformity who underwent surgery using the traditional facial recess approach or transmastoid slotted labyrinthotomy approach had significantly better post-activation scores on the CAP, SIR, and Meaningful Auditory-Integration Scale/Infant-Toddler Meaningful Auditory-Integration Scale, with no significant differences between the two approaches.

Conclusion: The traditional facial recess approach can be successful and several approaches may be used for electrode insertion and gusher control in patients with a severe deformity, particularly common cavity deformity and IP-III. A gusher was the most common intraoperative finding and occurred most often in patients with IP-III. Careful consideration of the type of electrode used is important.
Introduction: Cochlear implantation in children with severe hearing loss in the cases of middle and inner ear malformation is not easy from surgical point of view, but can be carried out by experienced otosurgeons. The aim of the study was to show intraoperative problems and findings and compare hearing results of cochlear implantation in children with middle and inner ears malformation.

Methods: Our method of choice of treatment of severe hearing loss in children is cochlear implantation, even in cases with different malformations of the ear. The analysis was performed in a group of 57 children; observation period was minimum 1 year. The results were assessed in about 1 month, 3 months, 6 months and 1 year after fitting the implant speech processor, in accordance with the follow-up program adopted in our Institute. Surgical procedure was preceded by CT and in some cases CT and MRI investigation. We observed some perilymphatic gushers and oozers, and we have used various kinds of cochlear implants and electrode arrays.

Results: The acoustic results are quite good but depend on malformation type. We have no observed any severe complications (e.g. facial nerve palsy or meningitis) after surgery.

Conclusion: Our results of cochlear implant surgery in patients with middle and inner ears malformation shown, that is worth, from audiological point of view, and not so risky for patients method of treatment.
Title: Bonebridge in Children with Pinna Abnormalities and Canal Atresia

Abstract:

**Introduction:** Children with pinna abnormalities and canal atresia, either bilateral or unilateral, always present with conductive or mixed hearing loss and this is one of the indications of Bonebridge, a new active osseo-integrated transcutaneous bone conduction implant.

**Methods:** This was a prospective, single-subject repeated measures designed study in which each subject serves as his/her own control. One tertiary centre were chosen to enroll patients from 2013 to 2017. A trial of bone conduction hearing aid was the prerequisite before final decision of Bonebridge implantation was made. The preoperative preparations, surgical techniques and complications were assessed. The subjects’ audiometric thresholds (air conduction, bone conduction and sound field at frequencies 250Hz to 8kHz) were assessed preoperatively, then subsequently at 6 months postoperatively. Subjective satisfaction with the device was evaluated by means of the Hearing Device Satisfaction Scale (HDSS) questionnaire.

**Results:** 10 patients, eight males and two females, were included in the study. Their age ranged from 7 to 18 years old. All patients had conductive hearing loss. Six patients had bilateral microtia and canal atresia. The other four had unilateral microtia and canal atresia. Computed tomography (CT) scans of temporal bone were performed in all the patients preoperatively to assess the suitability of implant placement. The Bone Conduction Floating Mass Transducers (BC-FMT) were placed at sinodural angle in eight patients and at presigmoid area in two patients. All the operations were performed under general anesthesia and took between 45 to 60 minutes. There were no major complications. Only one patient reported mild infection of the incision site, which recovered within a week with local and oral antibiotics. Audiometric thresholds for air and bone conduction showed no significant change with respect to time (P>0.05), for any of the tested frequencies until 6 months of follow-up. This confirmed that the patients’ residual unaided hearing did not deteriorate with treatment. Meanwhile, sound field testing with aided thresholds showed significant improvement over time (p<0.05) at all tested frequencies until 6 months of follow up postoperatively. The aided hearing thresholds for frequencies from 500Hz to 4kHz at 6 months of follow-up postoperatively were between 21 to 30 dB. All the patients were very satisfied with the implant in terms of improvement of the aided hearing thresholds (91% to 98%) and acceptable cosmetic appearance of the sound processor.

**Conclusion:** Bonebridge is a new transcutaneous bone conduction hearing implant that has been demonstrated to be safe and effective in improving patients’ hearing thresholds from the age of 5 years old and above in children with pinna abnormalities and canal atresia. A thorough radiological and surgical planning with CT scan is crucial to locate the site for optimal implant placement to avoid unnecessary surgical complications. It provides another alternative treatment for patients with hearing loss who fail conventional hearing aids.
Poster Number: 197  
Abstract ID: 174  
Title: Into and Out of the Cochlea: A Re-Implantation Saga  
Category: Surgery/Medical  
Authors:  
N Wendell Todd, MD MPH, Jolie C. Fainberg, MA, Nadja Kadom, MD;Emory, Atlanta, GA.  
Abstract:  
Introduction: In patients with normal inner ear architecture on imaging and who received a prior cochlear implant (CI) without difficulty, the expectation is that replacing a failed CI should be straightforward. Here, we present a patient in whom an unusual complication (to our knowledge, not reported) was encountered.  
Methods: Review of audiological and medical and surgical records and imaging data.  
Results: Re-implantation went well except no electrically elicited compound action potential could be elicited via any electrode. The replacement cochlear implant did not provide any auditory perception. CT showed the electrode array to enter the cochlea with three electrodes, but all other electrodes extended toward the Eustachian tube. Subsequent re-implantation into the scala vestibule yielded excellent performance with the CI.  
Conclusion: Mechanical forces, such as from a CI array, can erode the hardest bone in the body over time. This possibility should be a consideration in patients who are being evaluated for CI device failure.
**Poster Number:** 198  
**Abstract ID:** 425  
**Title:** Reliability of Hearing Implants  
**Category:** Surgery/Medical  
**Authors:**  
Paul Van de Heyning, MD PhD  
Antwerp Univ. Hosp., Antwerpe Schilde, Belgium.  

**Abstract:**  
**Introduction:** This study presents the data collected through a database on the type and incidence of cochlear implant treatment device failures and quantifies the risk of failures across time based on the Association for the Advancement of Medical Instrumentation (AAMI) CI86:2017 standard.  

**Methods:** Retrospective, multicenter, analyses of a database study, on the reliability of MED-EL cochlear implants.  

**Results:** Data were collected for 11662 devices (5462 children, 6200 adults). The mean duration of follow up was 46.16 months. The total failure rate for all devices and all subjects was 2.41%. Medical related (1.29% of all subjects, 1.72% children, 0.90% adults) and device failure (1.11% of all subjects, 2.18 % children, 0.16% adults) were the most common causes for explantation. The children’s MRE were significantly worse than the adults with the C40+ (p=0.008) and PULSAR (p=0.020). The MRE of the children with the C40+ was significantly worse than the MRE of children with the PULSAR (p=0.01), SONATA (p=0.003), and CONCERTO (p=0.014). The children’s DFE were significantly worse than the adults with the C40+ (p<0.001), PULSAR (p<0.001), SONATA (p<0.001), and CONCERTO (p=0.023). The DFE of the children with the C40+ was significantly worse than the DFE of the children with the SONATA (p=0.007). The mean annual failure rate for all subjects and devices was 0.63% (1.03% for children, 0.28% for adults). The mean annual failure rate was 0.90% for the C40+; 0.57% for the PULSAR; 0.46% for the SONATA; and 0.39% for the CONCERTO.  

**Conclusion:** Compared to adults, children had significantly worse MRE and DFE due to a higher risk of falling and more vulnerable skull anatomy. Further, the authors conclude that the AAMI standard will ensure better evaluation of device failures in the future.
Poster Number: 199
Abstract ID: 272
Title: Paediatric Cochlear Implantation--Tips, Tricks and Traps
Category: Surgery/Medical
Authors: Rajesh Y. Vishwakarma, MS(ENT), DLO, Kalpesh B. Patel, MS(ENT), DLO, Dipesh Darji, MS(ENT), Chandrakant S. Vishwakarma, PhD, MSc (Audiology);ENT & Head-Neck Surgery, B.J.Med. Coll. & Civil Hosp., Ahmedabad, India.
Abstract:
Introduction: Cochlear Implant is an established option for children with severe to profound Deafness. Many of these children are born with Cochleo-Vestibular Anamolies. Treating children with abnormal Cochlea is a challenge and needs exposure and experience to get the desired Results. Different Surgical Techniques are used for the Implantation. Trans canal Veria Technique is being used at many centres. We revisit the Technique and our modifications of the original. We discuss and compare the posterior tympanotomy approach and the Veria Approach, the difficulties and the learning curve, the comfort and confidence of Surgeon.
Methods: Analysis of prospectively collected data on Imaging, Surgery, Complications and Outcomes on Cochlear Implant candidates have been studied with particular emphasis on Surgery related issues and potential complications and outcomes
Results: 300 patients were enrolled for this study
Conclusion: Paediatric Cochlear Implant Surgery is successful and requires adequate training and exposure and experience for good result
Poster Number: 200  
Abstract ID: 295  
Title: Bone Bridge and Bone Conduction Implant in Children  
Category: Surgery/Medical  
Authors:  
Abstract:  
Introduction: Bone Bridge is the world's first active Bone Conduction Implant. It uses the Transcutaneous technology for sound transmission. It can be fitted in the Sino-Dural Angle or the Retro Sigmoid region. Patients can hear with excellent sound provided through the Bone Conduction bypassing the External and middle ear.  
Methods: Patients with Conductive Hearing loss were selected especially -Microtia, Anotia, Canal Atresia, Pre-op Hearing Assessment was done along with Bone Conduction BERA. HRCT Temporal Bone was done and thickness measured. Bone Conduction Implant was placed  
Results: we operated 10 patients and We observed no major medical complications during or after the surgery. Patients are satisfied and happy.  
Conclusion: Bone Conduction Implant-- the Bone Bridge Surgery is safe and effective for the patients with conductive Hearing loss, mixed Hearing Loss or single sided Deafness. It is very effective and a boon for the patients with Microtia. Anotia canal atresia. Bone Bridge surgery changes the future surgical concept of active Bone Conduction Implant.
**Poster Number:** 201  
**Abstract ID:** 351  
**Title:** Revision Surgery in Cochlear Implants - Indication, Performance and Surgical Challenges  
**Category:** Surgery/Medical  
**Authors:**  
Stefan Volkenstein, Priv.-Doz. Dr. med. Department of Otolaryngology, Head & Neck Surgery, Ruhr-Univ. Bochum, Bochum, Germany.  
**Abstract:**  
**Introduction:** Due to the extension of indication range for the use of cochlear implants (CIs) and the growing number of patients using these devices over the last 30 years, the demand for revision surgery will increase in the future. Possible reasons for revision surgery after a successful use of CI technology may be device failures (hard and soft failures) medical reasons and poor performance. Especially patients with poor speech perception using older devices question if a technical upgrade may improve their performance and quality of sound perception or if another trauma to the cochlea during reopening will harm more than improve. There are many questions still in need to be answered regarding this topic, especially surgical complications after CI revision surgery and the risk of incomplete electrode insertion are discussed in the literature.  
**Methods:** To analyse our experience and outcome after CI revision surgery, we reviewed more than 1300 CI operations we performed in our centre and identified almost 100 cases of revision surgery. We will present and discuss reasons for revision surgery in our patients as well as intraoperative findings and the postoperative outcome in these patients.  
**Results:** Our patient cohort which received revision surgery is widely heterogenous regarding the indication for performing revision surgery, but the number of patients who used implants for more than 10 years happily and who are affected by technical failure is increasing. Despite surgical challenges, speech perception improves in almost all cases significantly.  
**Conclusion:** In summary, revision CI surgery is a safe and effective surgery in most patients. The best choice of electrodes in these cases (e.g. shorter and thinner to avoid an incomplete insertion vs. possible loss in performance) needs to be further analysed in multi-centre studies.
Poster Number: 202  
Abstract ID: 165  
Title: Bilateral Cochlear Implantation in Chang-Gung Memorial Hospital, Taiwan-Preliminary Report of 125 Cases  
Category: Surgery/Medical  
Authors: Che-Ming Wu, Bachelor of MedicineDepartment of Otolaryngology, Chang-Gung Mem. Hosp., Taoyuan, Taiwan.  
Abstract: 
Introduction: Bilateral cochlear implantation is the current trend globally for the treatment of severe or profound hearing loss in adults and children. Existing literature shows that audibility in a noise-filled environment, sound-source and high frequency signal identification in bilateral cochlear implant (CI) recipients are superior to those with only one implant. The purpose of this study is to present the speech perception of Mandarin-speaking children after bilateral cochlear implantation and explore factors (implant time of C1, C2; inter-implant interval and CI use time) that may influence outcome.  
Materials and Methods: From Jan. 2015 to June 2017, there are 125 cases (including 18 self-paid and 107 government reimbursement) bilateral implantation performed in our hospital. Three open-set speech perception tests were used, including an easy-sentence test (ES), a difficult-sentence test (DS), a phonetically balanced (PB) word recognition test. Post-op speech perception tests scores were collected 3 months, 6 months and 12 months after the implantation. the outcomes (each speech perception score) were compared using inter-implant interval categories as <3 years (1st group), 3.1-5 years (2nd group), 5.1-7 years (3rd group), 7.1-10 years (4th group), and over 10 years (up to 15.8 years) (5th group). Follow-up time from 3 months to 3.9 years.  
Results: The mean(median) ES scores of the second ear in each group is 79.2 (86), 91.3 (96), 84.4 (90), 56.7 (70) and 59.3 (65). DS scores is 70.4 (71), 92 (95), 78 (82), 54.1 (67) and 59 (61). PB scores of the 2nd EAR is 73.9 (76), 86.7 (88), 61.6 (60), 47.5 (40) and 45.8 (40).  
Discussion: The interval between the sequential implantations are associated with the outcome of the second implant. Patients with over 7 years of inter-implant interval have worse mean and median scores than those with less than 7 years. The cases who can attend and have the speech test performed after the second implantation also decrease with increased inter-implant interval. Only about 40% of cases with over 10 years of inter-implant interval can have speech scores records after 6 months follow-up.
Title: Surgical Complications of Cochlear Implantation in Children in a Tertiary University Hospital
Category: Surgery/Medical
Authors: Mostafa A. Youssif, MD, PhD, Al Hussein Awad, MD, Usama M. Rashad, MD, Nihal Gamal, MD; Otolaryngology, head and neck surgery, Sohag Univ. Hosp., Sohag Faculty of Med., Sohag, Egypt.

Abstract:
Introduction: Cochlear implantation remains a popular and effective therapy for patients with sensorineural hearing loss that do not get benefit from conventional hearing aids. This study was conducted to analyze the surgical complications obtained in patients that underwent cochlear implantation in a tertiary university hospital.

Methods: Retrospective analysis of the medical files of cochlear implant children who underwent surgery at our institution between October 2014 and July 2016. This population comprised 158 children (53% males and 47% females). Complications were classified into ‘major’ and ‘minor’ complications depending on degree of management.

Results: Overall, the mean age at the time of implantation was 5.3 years. The cause of deafness was congenital in 81.6% of patients and acquired in 18.4% of patients. The overall complication rate was 10.43%, 3.68% being major and 6.75% being minor complications. The most common minor complication in our series was wound complications, and the most common major complication was device failure. Excluding device failures, the major complication rate was 1.84%.

Conclusion: Cochlear implantation is a safe surgical technique for rehabilitation of patients with severe to profound hearing loss, associated with a low surgical complications rate. The majority of surgical complications can be managed with conservative measures or minimal intervention.
Title: Updating indications for ventilating tubes insertion in pediatric cochlear implant candidates who suffer from otitis media

Category: Miscellaneous

Authors:
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Abstract:
Background: The age for implantation in children overlaps the peak age incidence of acute otitis media (AOM) and secretory otitis media (SOM). Ventilating tubes (VT) insertion is performed in pediatric CI candidates who also suffer from OM with the aim of both controlling potential risks of spread of middle ear infection along the electrode array and preventing late sequela of otitis media: eardrum perforation, atelectasis and cholesteatoma.

Objective: To refine indications for VT insertion in candidates for cochlear implantation who also suffer from OM.

Patients and Methods: Of 200 children implanted consecutively 126 were classified as OM-prone (SOM at the time of referral or AOM in the past 6 month), 98 due to AOM and 28 due to SOM. Rate of development of late sequela of middle ear disease was compared between the two subgroups of OM-proness.

Results: 15 children (7.5%) developed late sequela of middle ear disease, all belonged to the SOM group, 3.5% developed eardrum perforation, 3.5% atelectasis and 0.5% Cholesteatoma.

Conclusions: Pre-CI VT insertion in children with SOM who underwent CI did not prevent development of late sequela of middle ear disease; VT insertion with the object of preventing late sequela of middle ear disease in CI candidates who suffer from SOM only is not required; In otitis-prone children a long term oto-microscopic follow-up is needed in order to identify late sequela of middle ear disease.
Electrocochleography and Cochlear Implantation: A Systematic Review

Abstract:

Introduction: In cochlear implantation (CI) the inner ear is exposed at risk of permanent damage and minimizing surgical trauma is of the highest importance. Besides this primary goal, electrocochleography (ECochG) has shown interesting results in both animal and human studies about many aspects of CI that still need further investigation. Given the heterogeneity of papers about ECochG and CI and the absence of a systematic review in the current literature, the aim of our work was to analyze the utility of ECochG in the different stages of CI.

Methods and materials: A search of PubMed from inception to June 20, 2019, with cross-references, was executed. Keywords were: “Cochlear Implant” OR “Cochlear Implantation” AND “Electrocochleography”. The main eligibility criteria were English-language articles, both human and animal studies investigating the use of ECochG in all the different phases of CI. Literature reviews, editorials, case reports, conference papers were excluded, as were papers in which ECochG was just sporadically executed. The quality of the included studies was assessed using “The Strengthening the Reporting of Observational Studies in Epidemiology” (STROBE) Statement.

Results: A total of 91 articles were identified, and 59 papers were included. Nine articles were excluded because written in other languages, fourteen as they were reviews, editorials, and case reports. Two articles were excluded because off-topic. After a full-text read, another 7 papers were excluded. The included articles covered a timeframe from 2003 to 2019. Of the 59 papers, 45 were human studies, and 14 animal studies. Ten related to the diagnostic phase, 43 described the intraoperative monitoring, and 9 were regarding follow-up testing. Hearing preservation was the most discussed topic.

Conclusions: ECochG measurements appeared to be useful in many aspects of CI, such as hearing preservation. Also, they seemed to be feasible in animals as well as in humans. Our review is the first that shows the evolution of the technique and how much has been achieved from the earliest experiments to the most recent signal process refinements and device implementation in CI.