Title: Multiple Perspectives of Condition-Specific Quality of Life in Pediatric Cochlear Implant Users

Introduction: Most studies of quality of life (QoL) in cochlear implant (CI) users focus on generic versus condition-specific measures, which may not tap the direct effects of hearing loss and CI on life satisfaction. Parents and CI users (8-16 years) rate generic QoL similarly, but most reports of condition-specific QoL rely on parent proxy. Though parents may adequately rate observable characteristics (i.e., physical well-being, academic performance), they have greater difficulty rating more internal domains (i.e., self-esteem, self-advocacy). We need to examine multiple perspectives of QoL to assess not only independent, but also comparative measures of condition-specific QoL in pediatric CI users. This study examines how pediatric CI users and their parents independently rate condition-specific QoL. Also, this project explores the effect of respondent by comparing ratings of condition-specific QoL within parent-child dyads.

Methods: Forty-six children and adolescents using CI and their parents participated in this study. Pediatric CI users had a mean age of 11.8 years, mean age at CI activation of 2.3 years, and mean duration of use of 9.5 years. Both children and parents completed a condition-specific measure about the QoL of the child or adolescent with CI. Participants rated each statement on a 17-item questionnaire using a 4-point Likert scale, ranging from almost never (score=1) to almost always (score=4). The questionnaire covered four categories, including family relationships, self-worth, hearing in different situations, and feelings about the CI, from the respondent’s perspective. Adolescents and their parents independently completed the online survey. A paired t-test compared respondent ratings by item within each parent-adolescent dyad. Statistical significance was determined using an alpha value of .05.

Results: Six items significantly differed by respondent. Parents underestimated the extent of overprotection of their child with a CI relative to the CI users themselves (p=.01). Pediatric CI users rated items about self-advocacy and self-worth more positively than their parents (p<.01). No other item comparisons reached statistical significance.

Conclusions: Parents appear to have more concerns about their child’s QoL, specifically self-esteem and self-advocacy, compared to the pediatric CI users themselves. These concerns may underlie the perception of overprotection expressed by the children and adolescents with CI. Professionals working should consider the range of perspectives on quality of life and social function when counseling families of children with CI, facilitating open dialogue within family units to assuage parental concerns and promote child independence. with families of children with CI.
Title: The Relationship between Communication Abilities and Friendship Quality in Adolescents with Cochlear Implants

Authors: Christine Evans, M.S., Andrea D. Warner-Czyz, PhD; School of Behavioral and Brain Sciences, The Univ. of Texas at Dallas, Richardson, TX.

Abstract:

Introduction: Historically, adolescents with hearing loss feel lonelier, less socially accepted, have more difficulty making and maintaining friends, and experience higher rates of peer victimization versus hearing peers. Quality friendships can protect adolescents from feeling lonely or experiencing peer victimization even if they are socially rejected from a peer group, thereby acting as an essential component of quality of life. We do not know the extent to which cochlear implants (CIs) affect the quality of social relationships and social participation, and the possible effect of communication deficits associated with hearing loss on such social outcomes. This study examined friendship quality in adolescent CI users and the relationship between friendship quality and self-reported communication abilities.

Methods: Participants included 32 adolescents (12-18 years) wearing at least one CI. All used oral communication. All participants independently completed an online survey that included: (a) a demographic questionnaire with items about peer relationships and social engagement; (b) communication competence ratings of speech perception and speech intelligibility. Participants who reported at least one friend (n=24) also completed a 40-item Friendship Quality Questionnaire (FQQ) (Parker & Asher, 1993), which clusters peer relationship characteristics into six subscales of friendship quality (validation and caring; conflict and betrayal, companionship and recreation, help and guidance, intimate exchange, and conflict resolution). Spearman correlation coefficients assessed associations among self-reported speech perception in noise, speech perception in quiet, and FQQ scores.

Results: Mean FQQ scores across all domains mirrored patterns in published reports of chronologically younger children with typical hearing and diverged from patterns reported in age-matched peers with typical hearing. A significant correlation emerged between mean FQQ rating and speech perception in noise such that adolescents who reported poorer speech perception in noise also reported overall lower quality friendships (p<.001).

Conclusion: The impact of HL on social well-being demands attention, especially in adolescence when friends take a more prominent social role over family. Speech perception in noise may provide information about risk for decreased social satisfaction, possibly because CI users may avoid peer interaction and social events in difficult listening situations (school dance, cafeteria, concerts). Future work should explore the relationship between friendship quality and other aspects of quality of life such as life satisfaction in adolescent CI users. Identification of the role of CI on social well-being will drive changes in counseling, signal processing, accessory design, and communication strategies to enhance quality of life in adolescents using CIs.
Recognition of Vocal Emotion in Mandarin Speaking Adults with Cochlear Implants

Introduction: Correctly recognizing talkers’ emotional states is essential for spoken communication. Deficits in emotional state recognition may have a negative influence on social relationships and life quality, particularly in individuals with cochlear implants (CI). In current CI technology, pitch-dominant information is highly reduced. Mandarin is a tonal language in which the acoustic information used to signal lexical tone (fundamental frequency, amplitude, duration) is also recruited for expressing emotional and linguistic prosody. Consequently, speakers of a tonal language (e.g., Mandarin) with CIs may show more difficulty recognizing emotion in speech, compared with speakers of non-tonal languages (e.g., English, Japanese). One way to address this question is to examine how the accuracy of individuals with CIs compares to that of healthy listeners hearing noise-vocoded speech resembling CI input. The purpose of this study is to explore the ability of emotional prosody recognition by Mandarin-speaking adults with CIs, and to compare their performance with that of Mandarin-speaking normal hearing (NH) counterparts.

Methods: Seven Mandarin-speaking adults with CIs and 11 NH Mandarin-speaking adults were recruited. Stimuli were three short Mandarin sentences selected from the ACC Database (Chinese Corpus Consortium, 2006) produced by a professional actor and actress. The stimuli expressed four emotions (‘angry’, ‘happy’, ‘sad’ and ‘neutral’) included the four standard lexical tones of Mandarin. The participants heard each sentence and then indicated in a four-alternative, forced choice task which of the four emotions they heard. A short warm-up trial was provided prior to formal testing. CI listeners only heard natural speech, while NH listeners heard natural speech and three noise-vocoded CI-stimulations (4-, 8-, and 16-spectral channel) of speech for the same sentences. Listeners’ accuracy was recorded using DirectRT experiment monitoring software (Empirisoft).

Results: Accuracy of vocal emotional recognition by NH listeners varied as a function of speech type, with highest recognition for natural speech (70%), and decreasing accuracy with lower bandwidth synthesis (67%, 53%, and 50% for 16-, 8- and 4-channel vocoded speech, respectively). CI listeners showed significantly difference than their NH counterparts for natural speech (p < 0.05). CI performance in natural speech (49%) was equivalent to that of NH adult performance with 4-channel noise-vocoded CI-stimulated speech (50%).

Conclusion: Mandarin-speaking adults with CIs show significant deficits in recognition of emotional states for natural speech, compared to NH adults. For noise-vocoded speech designed to resemble CI input, Mandarin-speaking CI listeners match lower-channel input (i.e., 4 channel) than has been previously reported (8 channel) for comparable non-tonal language studies (e.g., English, Japanese). Possible reasons for these differences will be discussed.
Title: The Role of Datalogging in Monitoring QOL Outcomes Following Cochlear Implantation

Category: Rehabilitation/Educational Aspects

Authors:
Kylie Chisholm, Speech Pathology, Colleen Psarros, Audiology, Rachelle Hassaratti, Biomedical Engineer;SCIC, Gladesville, Australia.

Abstract:

Introduction: The introduction of datalogging into cochlear implant technology has enabled clients and clinicians to monitor device usage patterns which can provide valuable information to facilitate optimisation of listening environments. Quality of life can be reflected in the environment scene analysis of datalogging when combined with other measurement tools including the SSQ and the HUI3. The importance of using a test battery to identify potential areas of improvement for clients was investigated.

Methods: Datalogging of 150 recipients aged between 8 months and 85 years - X were examined over a period of 3 months post cochlear implant device activation. During that time, the SSQ was administered and compared to preoperative SSQ measures. The HUI3 was administered to determine QOL status at the 3 month post CI interval for a cohort of the clients.

Results: The scene analysis of datalogging correlated with subtests on the SSQ in particular the quality and the speech scales.

Conclusion: Datalogging is a quick accessible ongoing measure of factors that impact on a cochlear implant recipients quality of life. Regular review of datalogging can provide insights that can assist clinicians in supporting improvements in quality of life of their clients. It is cautioned that datalogging cannot be used in isolation and should be matched with a QOL measure such as the SSQ and / or HUI3.
Title: Effect of Telephone Training on Phone Use and Auditory Identification in Adults with CIs

Category: Rehabilitation/Educational Aspects

Abstract:

Introduction: Although technological advances, such as text messaging, Skype, and social media, have increased communication access for adults with hearing loss, using the telephone remains an important skill for everyday life, particularly in business settings (Lyford, Worsfold, & Johnson, 2015). Adult cochlear-implant (CI) users, even those with strong speech recognition in face-to-face conversation, report difficulty comprehending speech over the phone because of the degraded auditory signal and background noise. For these individuals, a lack of confidence and negative initial experiences with the telephone immediately post-implantation significantly affect the daily use, or nonuse, of the phone (Fu & Nogaki, 2005). Only a few recent studies have investigated strategies to build CI users’ speech discrimination skills and confidence placing and receiving calls on the telephone, with most using proprietary training programs that limit replicability (de Sousa et al., 2015; Lyford et al., 2015; Mathur, Jeyaraman, Mathur, & Batra, 2015). This study explored the efficacy and feasibility of using a widely available free resource to conduct telephone training.

Methods: This pilot study investigated the effects of a telephone training program on the auditory-identification skills and frequency of telephone calls made and received by an adult CI user. One participant, a 33-year-old male with profound hearing loss and bilateral CIs, took part in the A-B multiple-probe, single-case-design study. The researcher, a certified Listening and Spoken Language Specialist, conducted nine training sessions using sentence matrices, widely available as part of a free resource for CI recipients. The participant practiced identifying words in four- to seven-word sentences in person, over the phone in quiet, and over the phone in noisy conditions and role-played common telephone scenarios during the training. The participant’s auditory identification of 20 seven-word sentences presented over the phone in noise was measured in baseline and maintenance probes. His frequency of phone calls placed and received during the baseline, intervention, and maintenance phases was also recorded.

Results: The participant’s independent use of the telephone and auditory-identification skills both increased following nine training sessions. The participant’s accuracy in auditory identification improved from 65% during baseline to 90% during maintenance. His frequency of telephone use was stable at 0 or one call per week during baseline and intervention, but increased to a mean of four calls per week during the maintenance phase. The free resource used during training was rated easy to use and adaptable for intervention with other teens and adults. Graphs of the experiment’s results will be presented.

Conclusion: This study offers evidence that motivated adults who use CIs can improve their listening skills in the auditory-only condition on the phone and increase their frequency of phone use. Adults and their family members can adapt the free sentence matrices over nine short training sessions. Future studies will seek to replicate the results of this experiment with using a multiple-baseline-across-participants design while also incorporating role-play of situations that are socially significant to the individuals. Although more research using rigorous experimental design is needed, the data show promise for improving the telephone skills of adults with CIs.
Title: The Relationship between Language Development and Quality of Life in Children with Hearing Loss

Category: Rehabilitation/Educational Aspects

Authors:
María J. Suárez, PhD 1, Gustavo M. Ramirez, PhD 2, Candelaria M. Hernández, UD 2, Paula Rodríguez, UD 1; 1Developmental Psychology and Education, Univ. of La Laguna, La Laguna. Tenerife. Canary Islands, Spain, 2Univ. of La Laguna, La Laguna. Tenerife. Canary Islands, Spain.

Abstract:

Introduction: Given the important role of oral language in development, hearing loss poses a substantial risk of deficits in oral language development and affects the child's ability to express his or her thoughts and feelings in the hearing world. For this reason, it is not surprising that as a consequence there are deficiencies in their social development (Moog, Geers, Gustus, Brenner, 2011) and concomitant risks in their general health and well-being (Huber, 2005; Tambs, 2004; Wake et al., 2004). Studies indicate that severe and profound deafness, due to its consequent effects on language acquisition (Svirsky, 2000), socioemotional functioning (Dammeyer, 2009; Hintermair, 2007) and academic performance (Clark, et al., 2012; Kastner, May & Hildman 2001, Lin et al., 2008), are associated with measurable deficits in the quality of life of those affected by them.

Methods: The aim of this preliminary study is to analyze whether or not there is a relationship between the psycholinguistic abilities of the children in the sample and their quality of life, considering both the parents' perception and the children's own perception. The participants were 10 deaf children (5 with cochlear implants and 5 without implants) and 10 hearing children aged between 7 and 12 years, and their parents. The PEABODY Picture Vocabulary Test and the Illinois Psycholinguistic Skills Test were used to assess psycholinguistic skills and the KINDL-R Questionnaire to assess the quality of life of children.

Results: The data show differences in psycholinguistic abilities among deaf and hearing children. There are no differences in the quality of life of both groups.

Conclusion: A linear relationship between the psycholinguistic abilities and the quality of life is verified, observing that at a higher communicative level, better quality of life.
**Title:** Metacognitive Strategy Instruction to Improve Reading Comprehension in Children with Hearing Loss  
**Category:** Rehabilitation/Educational Aspects  
**Authors:**  
Sneha Bharadwaj, Ph.D 1, Emily Lund, Ph.D 2; 1Communication Sciences and Disorders, Texas Woman’s Univ., Denton, TX, 2Communication Sciences and Disorders, Texas Christian Univ., Fort Worth, TX.  
**Abstract:**  
**Introduction:** Despite technological advances in hearing aids and cochlear implants for children with hearing loss, literacy achievement for this population has not increased over the past several decades. Although there are many models explaining how reading occurs, from the simple view to more complex models, the majority acknowledge that reading comprehension is central to the purpose of reading. Reading comprehension is an interaction among lower-level components (vocabulary, decoding, understanding syntax) and higher-level components (inferencing and comprehension monitoring). This interplay between high and low level skills means that strategies for reading comprehension interventions likely cannot target a singular domain and impact reading comprehension outcomes: interventions must address higher-level language skills. Comprehension strategies, for example, are metacognitive functions in that they represent a reader’s understanding and control over their own comprehension processes. The National Reading Panel (2000) recommends direct instruction of reading-comprehension monitoring strategies for struggling readers. Research has shown that elementary-school students with hearing loss are less adept at monitoring their own comprehension than are students with typical hearing. Thus, objective of this single-case design study was to examine the effectiveness of teaching comprehension monitoring strategy on strategy use as well as on reading comprehension performance in children with hearing loss.  
**Methods:** Four children (C1-C4) with bilateral severe-profound hearing loss between the ages of 10-11 years and enrolled in the 3rd-5th grade classroom in a regional day school for the deaf at a public school participated in the study. Three children used cochlear implants for amplification and one child used hearing aids. Two comprehension monitoring strategies namely Retell and Questioning were taught to all four children. A third strategy namely Prediction, was used as a control strategy. Children received intervention during school hours for 20 minutes, twice a week for 13 weeks across a total of 26 sessions. Children participated in baseline sessions followed by one intervention session and one probe session each week. Sessions were videotaped to monitor treatment fidelity and to code for strategy use.  
**Results:** Participants C1, C2 and C4 demonstrated a functional relation between Retell strategy instruction and strategy use as confirmed by a trained, independent observer. Similarly, as confirmed by an independent observer, a relation between Retell strategy use and improvement in reading comprehension was evident for C1 and C2. Due to the limited number of intervention sessions spent on Questioning strategy, C1, C2, and C3 demonstrated a trend towards an increase in performance, suggesting that more time in instruction would have led to an increase in strategy use.  
**Conclusion:** Findings revealed moderate evidence for a functional relation between comprehension monitoring strategy instruction and the strategy use. Data also suggested that strategy use was related to reading comprehension performance. Findings of the current study provide preliminary support for teaching comprehension monitoring strategies to children with severe-profound hearing loss to improve reading comprehension skills.
Title: Aural Rehabilitation for Adult Cochlear Implant Users via Telehealth Delivery: Development and Preliminary Results

Category: Rehabilitation/Educational Aspects

Authors:
Diane M. Brewer, MA 1, Claire Bernstein, PhD 2; 1Speech and Hearing Science, George Washington Univ., Washington, DC, 2Hearing, Speech and Language Science, Gallaudet Univ., Washington, DC.

Abstract:
Introduction: The aims of this study are to evaluate the effects of a short-term aural rehabilitation (AR) intervention protocol as compared to a cognitive training (CT) protocol for adult postlingually deafened cochlear implant users when provided via telehealth technology. Group performance on speech recognition (CasperSent, AzBio), psychosocial outcomes (Hearing Handicap Inventory, HHI; Glasgow Benefit Inventory, GBI), and functional communication outcomes (Client Oriented Scale of Improvement, COSI) will be compared. Null hypothesis: No significant group differences in post-treatment performance.

Methods: The experimental design is a multi-site randomized controlled clinical trial in which 24 postlingually deafened adult cochlear implant users are randomly assigned to either the AR treatment or CT active control group. Inclusion criteria are postlingual deafness, age 18 years or older, between 3 months and 3 years postactivation, and no prior AR. In addition, participants must demonstrate fluency in English, pass a cognitive screener, achieve sentence recognition scores between 10% and 85%, and a speech tracking score of 20 words per minute or greater. Each group completes 6 weekly 90-minute individual treatment sessions via a telehealth platform. The AR group protocol includes auditory training, informational counseling, and communication strategies training while the CT group completes puzzles and problem-solving activities. Assessments are completed pretreatment, 1 week and 2 months posttreatment.

Results: This poster presentation will report on pilot findings and preliminary results with initial participant(s) related to telehealth software platform, considerations for delivering services via telehealth technology, and adaptation of an AR protocol/program for this medium. Initial findings on TeleAR intervention on outcome measures including speech recognition, hearing handicap, and functional communication goals will be presented featuring a case study.

Conclusion: Access to AR services is limited by numerous factors including distance, mobility, time, and available professionals. TeleAR offers an avenue for patients to receive care. Our preliminary piloting work and results from the first participant has shown that an AR program can be successfully delivered via telehealth technology. Results of this randomized controlled clinical trial will provide evidence of the potential effectiveness of a short-term AR intervention via telehealth delivery.
Title: Aural Rehabilitation for the Preschooler with Limited Language

Abstract:

Introduction: Despite early detection and intervention practices in the United States, clinicians and deaf educators still encounter children who enter their preschool years with very limited language. The families and service providers of these children, who did not benefit from their well-intended early intervention have many questions about the kind of rehabilitation these children should receive and their effects on the development of adequate spoken language skills. The purpose of this study was to document the effects of structured learning activities on four preschool-aged children with hearing loss and very limited spoken language over a twelve month period.

Methods: Four preschool children with hearing loss age 36 months participated in this study. All 4 participants were severely delayed in spoken language skills as measured by a mean number of different receptive word count of 2 and standard score achievement that was 2 standard deviations below the mean on a norm-referenced omnibus language measure. All 4 participants had 0-3 early intervention experiences. Specific operant-conditioning based speech and language tasks were completed daily in a preschool setting with a teacher of the deaf and once a week in a clinic setting with a SLP who had expertise in children with hearing loss and their parents. Number of different receptive words and first word combination use were collected via spontaneous Language sample procedures at 8 time points over a twelve month period. A repeated measures, one-way ANOVA was performed at each test interval to determine effects of the intervention and an all pairwise multiple comparison procedure via the Holm-Sidak method was completed to identify the significance of improvement between data points. A correlation analysis was performed to determine if the two measures (number of different receptive words and number of different word combinations) were related.

Results: All four participants demonstrated steady and statistically significant improvements in pre/post vocabulary and word combination interventions over the 12 month period. There was a highly significant effect of test interval. Pairwise comparisons revealed significant increases in the number of different receptive words between each consecutive quarter and highly significant increases in the number of different receptive words when comparing pairs of non-consecutive quarters. There were no significant correlations between number of different receptive words and number of different word combinations at any of the test intervals.

Conclusion: Structured language approaches should be considered when working with children with hearing loss between the ages of 3 and 4 who do not demonstrate benefit from birth to three early intervention services. Lack of correlation between number of receptive word knowledge and number of spontaneous word combination use may reflect a difference in cognition and/or information processing required to preform each of the tasks. Rehabilitation considerations for other children with similar profiles as well as future directions for study and practice will be discussed.
Title: A Comparison of English Vocabulary Learning between Children with Hearing Loss from English and Non-English Speaking Homes

Category: Rehabilitation/Educational Aspects

Authors:
Michael Douglas, MAEducation, MED EL, Nashville, TN.

Abstract:
Introduction: Despite appropriate and systematic intervention, children with cochlear implants, continue to demonstrate lower receptive and expressive vocabulary knowledge than their peers with normal hearing. This difference holds true whether the children with hearing loss are from non-English speaking or English-speaking homes. Evidence in the extant literature suggest that children with hearing loss from non-English speaking homes experience positive omnibus language outcomes given intervention; however, extant research does not indicate if interventions for specific domains (e.g., vocabulary,) influence children from majority and minority language-speaking homes in the same way.

Methods: Using data from a previous study, three vocabulary instruction conditions (explicit, direct instruction, follow-in labeling and incidental exposure) were evaluated on two groups of preschool children with hearing loss in a repeated measures design. Four children from English-speaking homes and four from minority-language participated in three intervention conditions each week across six weeks, with intervention implemented by four teachers of the deaf.

Results: Results were entered into a repeated measures analysis of variance, and this study was powered (alpha = .05, traditional assumptions) to detect a between-groups effect size as small as .25. Results indicated no statistically significant differences between the groups; and visual analysis confirmed all participants learned the most words in the explicit, direct instruction condition and the fewest words in the incidental exposure condition. While follow-in labeling did result in learning, it was not as much as explicit and minimal learning occurred with incidental exposure. A statistical equivalence test confirmed a lack of between-group differences overall.

Conclusions: A re-analysis of extant data to statistically confirm that vocabulary interventions are successful with children from minority language homes indicate that despite differences in home languages, structured and focused intervention resulted in the most learning. Given the gap that continues to persist between children with hearing loss and children with normal hearing in vocabulary knowledge, explicit vocabulary instruction should be considered for other children with hearing loss who have similar profiles.
Title: Cochlear Implantation in Cases of Asymmetrical Hearing Loss: Auditory Rehabilitation Outcomes

Category: Rehabilitation/Educational Aspects

Authors: Maegan Evans, PhD, CCC-SLP, LSLS Cert. AVEd. 1, Sandra Hancock, M.S., CCC-SLP, LSLS Cert. AVT 1, Hannah Eskridge, MSP, CCC-SLP, LSLS Cert AVT 1, Christine Kramer, M.S., CCC-SLP, LSLS Cert. AVEd 1, Margaret Dillon, AuD 2, Meredith Rooth, AuD 2, Kevin Brown, MD, PhD 3, Harold Pillsbury, MD, FACS 3; 1UNC, UNC Chapel Hill, Durham, NC, 2UNC, UNC Chapel Hill, Chapel Hill, NC, 3UNC, UNC Chapel Hill Hosp., Chapel Hill, NC.

Abstract:

Introduction: In the past, adults with single-sided deafness (SSD) or asymmetrical hearing loss (AHL) have not been considered candidates for a cochlear implant. This study is a part of a clinical trial to determine whether adult subjects with AHL experience an improvement in speech perception, localization, and/or quality of life with a cochlear implant, as compared to an unaided listening condition. All subjects received their cochlear implant and participated in an aural rehabilitation program post-initial activation of the external processor as part of the clinical trial. Conventional cochlear implant recipients, with moderate-to-profound hearing loss in both ears, have shown improvements in speech perception outcomes following aural rehabilitation. It is of interest whether cochlear implant recipients with a pure tone average between 35 and 55 in the contralateral ear would experience similar improvements. The aural rehabilitation program developed a test protocol to determine the amount of auditory skills progress made in the participants’ implanted ear. The results of the test protocol administered to the adults with AHL will be discussed along with how auditory skills in adults with AHL compare to adults with SSD.

Objective: To determine the progress in auditory skills following cochlear implantation in an adult with asymmetrical hearing loss.

Methods: A repeated measures, multi subject design has been used to quantify outcomes of adults with asymmetrical hearing loss. Progress will be reported in percentages.

Results: Variation in progress is demonstrated across adults.

Conclusion: Overall, adults with asymmetrical who receive a cochlear implant show benefit regarding restoration of auditory skills in their implanted ears.

Learning Objectives: Describe testing protocol requirements for adults with UHL and AHL adults, asymmetrical hearing loss) Summarize preliminary outcomes of auditory skills for adults with asymmetrical hearing loss (adults, asymmetrical hearing loss) Summarize preliminary outcomes of auditory skills for adults with asymmetrical hearing loss compared to adults with single sided deafness (adults, asymmetrical hearing loss, single sided deafness)
Introduction: Previous research on adults with Unilateral Hearing Loss (UHL) has shown an improvement in speech perception, localization, and/or quality of life with a cochlear implant as compared to an unaided listening condition. With the potential of neural plasticity in their favor, it is of interest how children with UHL could benefit from cochlear implants to develop auditory skills. A case study report by Greaver, Eskridge and Teagle (2016) revealed that 5 children with UHL consistently wear their devices and have shown improved outcomes in speech recognition when the implanted ear is isolated. Under an investigational device exemption (IDE), in a current clinical trial, 20 children with UHL will receive a cochlear implant. During the first year post-implant, each child will receive a total of 21 auditory-verbal based therapy sessions. This presentation will show a model for therapy, based on an aural rehabilitation protocol developed for adults with UHL, which will be used during these sessions with the children included in the trial.

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

Results: Preliminary data on performance of children with UHL who receive a cochlear implant during auditory-verbal based therapy sessions over time will be discussed.

Conclusion: Therapy for children with a UHL is a new area to be explored. Continued research on the type of therapy, frequency of therapy, and efficacy is needed.
Cochlear Implanted Children and Aural Rehabilitation in 21st Century

Title: Cochlear Implanted Children and Aural Rehabilitation in 21st Century
Category: Rehabilitation/Educational Aspects
Authors: Maryam Yaribakht, MA 1, Guita Movallali, Phd 2; 1psychology & Education of Exceptional children, ISLAMIC AZAD UNIVERSITY TEHRAN SCIENCE RESEARCH BRANCH, TEHRAN, Iran, Islamic Republic of, 2Psychology & Education of Exceptional children, Univ. of Social Welfare & Rehabilitation Sci.(USWR),Tehran, Iran, TEHRAN, Iran, Islamic Republic of.

Abstract: Cochlear implanted Children and aural rehabilitation in 21st century  Maryam Yaribakht, MA. student in Psychology &Education of Exceptional Children ,Azad University,Tehran,Iran.Guita Movallali, Audiologist ,Ph.D. in Psychology &Education of Exceptional Children, Associate Professor, Pediatric Neurorehabilitation Research Center, University of Social Welfare & Rehabilitation Sciences(USWR),Tehran, Iran.

Introduction: Technology now has broaden our facilities and possibilities to help deaf children a lot. Tele-intervention (TI), to deliver remote Part C early intervention (EI) services to families in their home is a rapidly-growing strategy under the Individuals with Disabilities Education Act (IDEA) to meet the needs of infants and toddlers who are deaf or hard of hearing. Iran is a country having a large population distributed over a broad topography with a considerable number of deaf children living in rural areas with limited access to rehabilitation centers. Nowadays cochlear implant is performed in over hundreds of children each year in our country. This pilot study compared tele-intervention to conventional intervention for children with hearing loss who use cochlear implant.

Methods: A total of 30 children (mean age 2.4 years) and their families from all across the country were randomly assigned to TI and conventional intervention groups (who has been enrolled in AVT programs). The tele-intervention sessions were conducted via Telegram and Imo social networks. Pre-test and post-test measures of child outcomes in auditory skills, receptive auditory behaviors, semantic and productive auditory behaviors, and preverbal skills were collected. We used Little EARS Auditory Questionnaire and preverbal skills Questionnaire as our tools and compared the cochlear implanted children’s improvements in a six month period rehabilitation process for both two groups. Analyses of covariance (ANCOVAs) were used to measures outcomes.

Findings: The TI group scored statistically significantly higher on the receptive auditory behavior and preverbal skills measure than the conventional intervention group. There were no significant differences in semantic and productive auditory behavior between the two groups.

Conclusions: These findings highlight the usefulness of TI in post cochlear implant rehabilitation. Results suggest that early intervention via tele-intervention may be as effective as, or even more effective than conventional intervention for children with hearing loss who use of cochlear implants. TI can be a valuable solution to typical barriers such as distance and the shortage of trained interventionists in remote areas.
Poster Number: 14  
Abstract ID: 110  
Title: Guiding Adults in Rehabilitation  
Category: Rehabilitation/Educational Aspects  
Authors:
MaryKay Therres, M.S., CCC-SLP, Beverly Elwell, NA; MED-EL, Durham, NC.  
Abstract:
Introduction: It is well known that rehabilitation after cochlear implantation is crucial for children to achieve maximal outcomes. But what about adults? Does rehabilitation after cochlear implantation make a difference? Research has now begun to look at the relationship between outcomes which include speech perception and quality of life with rehabilitation which can be analytic or synthetic. Analytic training focuses on the elements of speech. Synthetic training is language based and the individual can use content and knowledge to predict and derive meaning. A positive relationship has been found to exist. Additionally, a positive relationship has also been found between outcomes and active rehabilitation versus passive rehabilitation. Knowing that rehabilitation can impact outcomes then drives professionals to recommend that adult recipients engage in active rehabilitation. However, there are significant barriers to adults obtaining services. These include insurance reimbursement and availability of services from a professional.  
Methods: To assist in providing rehabilitation to adult recipients, this presentation will outline activities that can be used in home therapy. Participants will be provided with a template of analytic and synthetic exercises and ideas to assist in providing recipients active auditory training for home practice. Resources that recipients can use on their own or with a conversational partner will also be discussed.  
Results: An adult CI recipient will discuss her experience with rehabilitation emphasizing what aspects she felt were key to her outcomes. Charting her progress also proved to be helpful for her audiologist during programming sessions. Discussion will focus on vital components of rehabilitation for recipients and what information from the recipient may be useful for professionals.  
Conclusion: Adult recipients who participate in active rehabilitation show improved outcomes in speech perception and quality of life. For recipients who do not have access to rehabilitation services from a professional, a different service delivery model will need to be utilized. This presentation will review a template that can be individualized and offered to recipients to use at home. Additionally, available resources for individual or practice with a conversational partner will be reviewed. The aim is for professionals to support and empower recipients to have improved outcomes by providing them with the necessary tools or ideas they need to engage in active rehabilitation.
**Title:** The Insufficiencies of Formal Assessment Use to Identify the Language Needs of Children with Hearing Loss

**Category:** Rehabilitation/Educational Aspects

**Authors:**
Krystal Werfel, PhD. 1, Michael Douglas, MA 2; 1Communication Sciences and Disorders, Univ. of South Carolina, Columbia, SC, 2Education, MED EL, Nashville, TN.

**Abstract:**

**Introduction:** Children with hearing loss (CHL) who use listening and spoken language increasingly reach performance within or above the average range on norm-referenced assessments of language ability prior to entering school; however, they continue to perform below expectations on language-based academic skills, such as reading. The purpose of this study was to identify limitations of making service provision decisions primarily on the basis of norm-referenced assessments for children with hearing loss.

**Methods:** Language sample analysis was completed and compared between two groups of four-year-old children; one with hearing loss and the other with normal hearing (CNL). Both groups scored within 1.5 standard deviations of the mean on a norm-referenced omnibus language measure. Comparisons were made between mean length utterance (MLU), number of different words (NDW) and % omission of words or Brown's morphemes.

**Results:** The CHL had an average MLU of 4.63 (SD = 1.73), compared to 5.66 (SD = 1.14) for CNH (p = .084; d = 0.71). Additionally, CHL exhibited less lexical diversity than CNH. The CHL had an average NDW of 150.38 (SD = 47.59), compared to 188.23 (SD = 41.12) for CNH (p = .040; d = 0.85). CHL also had a higher percentage of utterances that contained omissions of words or morphemes (mean = 15.09%, SD = 8.34) compared to CNH (mean = 3.61%, SD = 2.70; p < .001; d = 1.85).

**Conclusion:** Based on the limitations of norm-referenced assessments and the findings of this study, language sample analysis should be used as primary evidence of language weakness for children with hearing loss.
Title: Comparison of /r/ Production in Children with Cochlear Implants and Children with Normal Hearing

Category: Rehabilitation/Educational Aspects

Authors: Ellen Gurss, Graduate student, James Mahshie, P.h.D., Cynthia Core, P.h.D.; George Washington Univ., Washington, DC.

Abstract: For children with severe to profound prelingual hearing loss, the accessibility to sounds can be significantly diminished, resulting in deficits in both speech sound perception and production. The /r/ phoneme is a later acquired speech sound than most others and therefore is more likely to be effected by delayed access to sound resulting from hearing loss. The goals of the current study were to 1. examine /r/ production accuracy of prelingually deaf children with cochlear implants (CIs) and normal hearing (NH) children, 2. examine whether context of /r/ in the word had any added effect on accuracy of production, and 3. examine whether a child’s hearing age (time since CI activation) had an effect on /r/ production accuracy.

Methods: Twenty one /r/ containing words from the Bankson-Bernthal Test of Phonology (BBTOP) (Bankson & Bernthal, 1990) were obtained from 21 children with CIs (mean age = 62 months) and 20 NH children (mean age = 59 months).

Results: We used a mixed effects logistic regression to examine the effects of hearing status (fixed effect), individual abilities (random effect), and additional variables of age and phonetic context of the sounds (singletons or clusters). For all children, we found a positive relationship between accurate production of /r/ and children’s hearing age. Within the group of children with CIs, both hearing age and phonetic context of the /r/ predicted accuracy of production (p = .01 and p = .04, respectively). Hearing age predicted differences in production between the two groups (p = .02). Both groups of children showed considerable variability in accuracy of /r/ production.

Conclusion: The findings suggest that hearing age and phonetic context could be used to predict accuracy of /r/ production in both implanted and hearing children. A single factor that appeared to predict differences between the two groups of children was hearing age. Clinical implications of these findings will be discussed.
Title: Can Normal Hearing School-age Children use Phonological and Lexical Characteristics to Learn Novel Words when Presented with Spectrally Degraded Speech

Abstract:

Introduction: Cochlear implants (CIs) have been enormously successful in partially restoring hearing for children following implantation, allowing many children to communicate using spoken language. However, a large degree of variability in language outcomes remains. While there are many factors that likely contribute, some of the variability has been attributed to age at implantation, amount of time spent listening with CIs, participation in early intervention, aural rehabilitation, and pre-implant residual hearing. Several studies have suggested that children with CIs may have poor word-learning skills (e.g., Houston & Miyamoto, 2011). While CIs provide access to sound, children who use a CI may have a more challenging time learning new words due to the degraded auditory input provided by the device. Word learning in normal hearing children is facilitated by word characteristics, such as phonotactic probability and neighborhood density. However, less is known about whether these characteristics are accessible by a child listening with their CI. Our study aimed to explore the role of spectral degradation on novel word learning in typically developing school-aged children listening to CI simulated speech.

Methods: Forty NH children, aged 5-13 years, participated in this preliminary study. Participants were divided into two groups, vocoded speech (VS) and non-vocoded speech (NVS). All stimuli used were adapted from Storkel (2001). Twelve novel words, which varied by phonotactic probability and neighborhood density, were presented in an electronic storybook where the speaker’s face was displayed on the top half of the screen while the story pages were displayed on the bottom half of the screen. The story was composed of three chapters, and across all chapters, participants received a cumulative 10 exposures to each object label. At the end of each chapter, participants were given a four-alternative-forced-choice (4AFC) task, where they were asked to identify each of the objects presented in the chapter. To evaluate retention of learning, participants returned to the lab to complete an additional identification task three to seven days later.

Results: Participants displayed age-dependent patterns of performance. Older participants (11-13 years) showed an increase in novel word identification across chapters for both VS and NVS groups. Additionally, older participants demonstrated a low phonotactic probability advantage for learning, consistent with prior works. Younger participants (5-10 years) did not show significantly different patterns of learning for different phonological or lexical characteristics, but the NVS group showed higher rates of object identification than the VS group. Participants who were 5-7 years old did not perform above chance for either the VS or NVS groups.

Conclusion: Younger children (5-10 years) were unable to use phonological or lexical characteristics to learn novel words regardless of whether the words were presented in the clear or in the vocoded condition. We hypothesize this may be due to the large cognitive demand from presentation of 12 words. Additional data will be collected from eight, 5-10-year-old NH children where only eight novel words will be presented. Results and clinical implications will be discussed.
Title: Speech Intelligibility and Consonant Production Errors in Pediatric Cochlear Implant Users

Category: Rehabilitation/Educational Aspects

Authors: Olga Peskova, M.S. 1, Nirmal Srinivasan, Ph.D. 2, Ann E. Geers, Ph.D. 1, Emily A. Tobey, Ph.D. 1, Peter F. Assmann, Ph.D. 1; 1The Univ. of Texas at Dallas, Richardson, TX, 2Towson Univ., Towson, MD.

Abstract:

Introduction: Cochlear implants (CIs) allow children with hearing losses (HL) to improve communication outcomes and to make their speech understandable to normal hearing (NH) listeners. However, these outcomes are associated with wide variability of performance scores. The purpose of our study is to investigate different types of consonant production errors and their association with speech intelligibility in pediatric CI users.

Methods: Participants included 107 children who received a CI during the 1990s were drawn from the sample reported by Geers & Brenner, 2003. These children were implanted between the ages of 2 and 4 years and were tested when 8 years of age. Speech intelligibility and number of speech errors were determined using McGarr sentences (McGarr, 1983), which varied in length from 3 to 5 to 7 syllables and were defined as low and high context sentences. Three NH listeners heard, independently, one sentence from one child and wrote down the words they understood. Average scores were calculated to evaluate the intelligibility. Sentences produced by CI users were transcribed by four speech language pathologists. Broad transcriptions were analyzed using the Computer Aided Speech and Language Analyses (CASALA) software package (Serry et al., 1997) to calculate the percentage of omission and substitution errors for manner, place and voicing features.

Results: Significant negative correlations between speech intelligibility scores and consonant production errors were evident and similar to those in Tobey et al., 2003. Stronger negative associations between manner and voicing errors and speech intelligibility were evident compared to association of place errors and speech intelligibility. Omission errors had stronger negative associations with speech intelligibility than substitution errors. Fricative, stop and nasal sounds had the strongest negative associations with speech intelligibility compared to other consonant manners (liquids, glides) (p<.05).

Conclusion: Significant negative associations between speech intelligibility and fricative, stop and nasal errors support a need to develop more focused rehabilitation techniques to improve communication outcomes.
Title: What Factors Affect the Sound Localization Ability in Sequential Cochlear Implant Children?

Category: Rehabilitation/Educational Aspects

Authors: You-Ree Shin, Ph. D. Soree ear clinic, Seoul, Korea, Republic of.

Abstract:

Introduction: Many studies have reported that speech recognition, directional discrimination, and improved sound quality have been reported in the noise situation after bilateral cochlear implants. Children who sequential bilateral CI with early 2 nd CI (under 8 years) were improved word recognition in open-set and the shorter the interval between primary and 2 nd CI, the better the performance. Likewise, we would like to investigate the factors that affect the sound localization ability of children who have sequential CI.

Methods: We tested 42 children who received bilateral CI with a sound localization test. All children received their implants sequentially, before the age of 3 for the first implant and 1-18 years for the second implant (average 9 years old). First, the children were divided into four groups (<5 years, 5-8 years, 9-13 years, and >14 years) on the basis of age of the 2 nd CI to figure out that there is an age effect according to age of the 2 nd CI. Second, the children were divided into two groups (using Hearing Aids (HAs) over one year before the 2 nd CI, using HAs under one year before the 2 nd CI) to evaluate the effect of preoperative hearing experience before the 2 nd CI on sound localization. We conducted a directional test with eight speakers at 360 degrees (45 degree angle between speakers.) The tests were performed at 12 months after the 2 nd CI we also compared the directional results with PCT (Percent of Correct Trials), RMS (Root-Mean-Square) and MAE (Mean Absolute Error).

Results: The correlation between the score of PCT, RMS, and MAE and the age of the 2 nd CI were significantly different in each group (p<0.000, 0.001, 0.001). And children who used HAs over one year before the 2 nd CI performed better than another group in PCT, RMS and MAE test and the difference was highly significant (p<0.012, 0.028, 0.009).

Conclusion: Early 2 nd CI (before 5 years old) was beneficial to the directional skill. The auditory experience of HAs before the 2 nd CI has a significant effect on sound localization. We can predict the performance of sound localization after the 2 nd CI according to the preoperative auditory experience and also it can be useful information for pre and post operative counselling for the children that will do.
Poster Number: 22
Abstract ID: 60
Title: Evaluating the Effect of Access to Speech Reading Cues on Word Learning in Children with Hearing Loss
Category: Rehabilitation/Educational Aspects
Authors: Jena McDaniel, MS-SLP 1, Stephen Camarata, PhD 1, Michael Douglas, MA 2, Rene Gifford, PhD 1, Paul Yoder, PhD 3; 1Hearing and Speech Sciences, Vanderbilt Univ., Nashville, TN, 2Education, MED-EL, Durham, NC, 3Special Education, Vanderbilt Univ., Nashville, TN.
Abstract: 
Introduction: Reducing visual input to emphasize auditory cues is a common practice in pediatric auditory (re)habilitation. However, the extant literature offers minimal empirical evidence for whether unisensory auditory-only (AO) or multisensory audiovisual (AV) input is more beneficial to children with hearing loss, including children with cochlear implants, for developing spoken language skills. This study evaluated the effectiveness and efficiency of a receptive word learning intervention with and without access to visual speechreading cues for preschool children with hearing loss.
Methods: A single case adapted alternating treatments design is used with four preschool children with permanent hearing loss who wear bilateral cochlear implants or hearing aids consistently. Pre-intervention language, speech production, auditory perception, and multisensory integration skills characterize the participants and inform future studies. The AV, AO, and control (no teaching) word sets are balanced for phoneme audibility, phoneme visibility, and lexical neighborhood density. The dependent variable is the percent accuracy for identifying words receptively in probes that only provide auditory information. The examiner taught participants to associate novel words with unfamiliar objects. Only the presence or absence of access to speechreading cues differentiates the AV and AO conditions.
Results: Data during probes without visual cues from three participants provide strong evidence of a functional (causal) relation between the active interventions and accuracy identifying target words. Data from the fourth participant provide moderate evidence of a functional relation between the active interventions and accuracy identifying target words. No participants demonstrated a differential rate of learning in the AO versus AV conditions. Neither an inhibitory effect predicted by a unisensory theory nor a beneficial effect predicted by a multisensory theory for providing visual cues was identified.
Conclusion: Following instruction in AO and AV conditions, participants accurately identified taught words during AO probes with similar rates of learning. When using an AO testing format as an optimal test of auditory learning, there was no inhibitory effect of access to speechreading cues on word learning. Therefore, these findings do not support the widespread practice of prohibiting access to visual speechreading cues in order to isolate auditory input to increase the rate of word learning, even when such learning is subsequently assessed without access to visual cues. Future research is required to replicate the findings and to determine whether the same pattern of results is observed for children with hearing loss with different audiological and language profiles, for tasks of varying difficulty levels, and across different timespans.
Title: Daily Device Use in Pediatric Cochlear Implant Users Over Time

Category: Rehabilitation/Educational Aspects

Authors: Kathryn B. Wiseman, Au.D. 1, Andrea D. Warner-Czyz, PhD 1, Kimberly M. Fiorentino, Au.D. 2; 1Univ. of Texas at Dallas, Dallas, TX, 2Callier Ctr. for Communication Disorders, Dallas, TX.

Abstract:

Introduction: Cochlear implants (CIs) afford auditory access to sound for children with severe-to-profound hearing loss. However, children who do not wear their device consistently potentially risk the ability to develop communication skills. Parent report implies 7-24% of pediatric CI users wear their device inconsistently, not reaching the “8 hours per day” benchmark used in the literature. Recent work using datalogging, an objective measure of daily device use (i.e., average hours of device use per day), suggests inconsistent CI use may be a broader issue, with 50% of pediatric CI users wearing their device <8 hours per day. Few studies explore how daily device use changes over time, though one study of young CI users reports only 11% increase device use over time, while 84% show no change and 10% decrease use, per parent report. It remains unclear if these trends in daily device use persist when measured via objective datalogging. This study aims to examine trends in daily device use measured via datalogging in pediatric CI users over time and to explore demographic and audiologic factors associated with increased use over time.

Methods: Retrospective chart-review yielded 30 children with CI implanted ≤ 5 years (age at study onset: 0.8-16.2 years, M=4.3, SD=4.3). Datalogging values were recorded for each patient with >1 measurement (range: 2-8) over a 2-year time period (M=.6 years, SD=.4). Descriptive and comparative analyses were performed. Difference score was calculated by subtracting the earliest datalogging value from the most recent to quantify change over time.

Results: Data collection is ongoing but preliminary results indicate 53% of pediatric CI users increased daily device use by 1 hour or more from earliest to latest measurement. Forty percent showed minimal/no change, and 7% decreased device use over time. Half of the sample never achieved consistent use (≥8 hours) and 30% attained consistent use for all measurements. Thirteen percent reached consistent use during the course of the study. Chronologic age affected daily device use. Only 8% of children <2 years showed at least 8 hours of CI use during any session, but the percentage of children with consistent device use for at least one measurement increased with age. Presence of concomitant conditions also affected outcomes. Children with additional disabilities with inconsistent CI use at study onset showed significantly smaller increases in daily device use than those with no additional disabilities, t(20.02)=-3.67, p=.002. No other variables significantly affected daily device use over time.

Conclusion: Despite large variability in measurements, half of pediatric CI users increased device use over time at rates higher than estimated by parent report. Child age influences wear time, with less consistent device use in the first few years of life and more consistent use thereafter. Families of children with additional disabilities who struggle with consistent use may need extra counseling on strategies for device retention.
Title: Language is Caught, not Taught: Supporting Parents in Developing and Monitoring their Child’s Functional Listening Skills to Guide Implantation Decisions, Maximise Listening and Learning Opportunities and Understanding its Impact on Outcomes

Abstract:

Introduction: Evidence and research in the field of cochlear implantation and language development for children with hearing loss and pediatric cochlear implant outcomes has indicated two key areas that have been shown to significantly impact outcomes. The first, the importance of a child’s functional listening skills. This is beyond the detection and discrimination of ‘hearing’, to incorporate the skills necessary in everyday environments that involve the cognitive components of ‘listening’. The second, the impact of parental input. Given that language is not learnt in a clinical setting, but in everyday experiences in a child’s natural environments, ways to influence and improve these interactions to maximise their listening and language opportunities can support parents in developing their child’s outcomes throughout their cochlear implant journey. The Functional Listening Index-Pediatric (FLI-P) v1.1 has been in use with children with hearing loss from 0-6 years in a number of cochlear implant clinics and early intervention programs internationally. After 4 years of use and data collection from one of these clinics with over 500 children and 2000 data points, for children with all types and degrees of hearing loss using a range of devices, the current study set out to review and redevelop the FLI-P to create v2.0 to support parental use of the tool through cochlear implant candidacy and beyond, without the need for administration by an experienced clinician.

Methods: Analysis and feedback from use of the FLI v1.1 was examined to determine areas for optimisation, review and redevelopment. Additional items were added to support real life listening environments (in noise and using digital signals from early ages). Items were reordered, and wording and scoring simplified to increase reliability and widen use. Data were collected comparing differences in a group of 20 children with cochlear implants, and reliability explored with differences between parent and clinician use, with parents from a range of Socio-Economic and Cultural backgrounds. Qualitative information was gathered from parents and clinicians regarding use and impact on changes in knowledge, behaviour, decisions and clinical practice through the implant process.

Results: Data identified a stronger alignment in sequential order of items and increased sensitivity in development of auditory skills in noise and using digital signals. Qualitative reports from families indicate the difference in knowledge and information of ways to develop listening skills with their child, and steps required in doing so. Parents reported a clear preference in being able to use the tool to track their own child’s progress, and resulting increased levels of engagement.

Conclusion: The impact of the FLI-P v2.0 for parents has been a shift in the type and level of information it has provided families to support their decision making through cochlear implant candidacy and beyond, and resulted in greater levels of knowledge of their child’s stages of auditory development. A subsequent effect on the natural awareness for parents in maximising appropriate listening opportunities to support their child’s development has been evident, and active engagement, involvement and parent-led learning.
Title: Cultural Sensitivity: The Need for Integrating Hispanic Cultural Differences in Practice Management and Understanding its Effects on Parent Engagement and Cochlear Implant Outcomes

Category: Rehabilitation/Educational Aspects

Authors: Myriam De La Asuncion, AuD, Annie Rodriguez, Doctorate in Audiology; MED-EL, Durham, NC.

Abstract:

Introduction: Hispanics are currently the largest cultural minority group in the United States. According to the NIDCD, nearly 1 out of every 7 Hispanic currently has hearing loss. The total general number of Hispanics is expected to increase dramatically. As the general Hispanic population increases, so will the Hispanic population with hearing loss and deafness. This poses an immense need in learning and understanding the Hispanic culture and the unique needs of this population particularly those whose first language is Spanish. It will be imperative to demonstrate cultural sensitivity but even more critical to become culturally competent.

Methods: This “cultural sensitivity” perspective changes the way we approach, counsel, support, and provide services to our Hispanic families. Although it is important to provide clinical care and deliver services in their native language, it is even more important to capture the culture which may differ greatly from region to region. Discussing these differences within the Hispanic culture will provide professionals with great insight in regards to their own beliefs, traditions, perspectives, and ultimately decision making processes. It can greatly influence your delivery of optimal care and create an environment for great success for the child with a cochlear implant and their family.

Results: Given the anticipated rise of the Hispanic population in the upcoming years and the limited amount of Spanish speaking professionals, hearing professionals will need to develop the proper skills to be able to manage this population effectively. These skills include cultural awareness, closing the cultural gap, appropriate counseling and overall improved clinical management. Professionals who are able to develop such skills can then provide more realistic recommendations that will empower families in making decisions and improving compliance without omitting a part of their own culture. Striving for cultural competence also allows hearing professionals to develop awareness about their own cultural beliefs and clinical practices. In addition, it enables them to better understand their own culture and how it can greatly affect behavior/views, the way we communicate, parent, and even educate.

Conclusion: Overall, it is evident that the fastest growing minority group in the US is Spanish speaking (Ramirez & de la Cruz, 2003). Data from the American Speech and Hearing Association (ASHA) indicate that approximately 95% of members are Caucasian Americans. Within special education, 86% are Caucasian American, 1% African American, and 4% Hispanic American (Boyer & Mainzer, 2003), and among audiologists, 80% are English speakers (Ramkisson & Khan, 2003). Within the US, only 4% are registered in ASHA as being bilingual. As projections indicate a significant increase in this population, there will not be enough providers to deliver appropriate services. This limitation of Hispanic providers being able to serve their own population in their native language, demonstrates a significant need for professionals to develop necessary skills needed to attain cultural competency and deliver optimal care for improved outcomes post cochlear implantation. As well as allowing for Hispanic families to feel empowered in making decisions about their child, and in turn provide self-advocacy skills, and continue to feel a part of their community and culture.
Poster Number: 26
Abstract ID: 129
Title: Strategies for Improving Communication Intervention for Minority Language-Speaking Families of Preschool Children with Hearing Loss: Insights Derived from Automated Digital Recordings, Qualitative Interviews, and Questionnaires
Category: Rehabilitation/Educational Aspects
Authors:
Alice A. Eriks-Brophy, PhD, Univ. of Toronto, Toronto, Canada.
Abstract:
Introduction: Early intervention for preschool children with hearing loss (PCWHL) relies on caregivers as the primary language models to stimulate the child’s communication development. As more and more families from minority language and cultural backgrounds are enrolling in early oral language intervention programs for their PCWHL, it is important for clinicians to understand and respect the communicative behaviors, values, and beliefs about language and disability held by these families in order to provide them appropriate services and to enhance caregiver involvement in and satisfaction with services received.
Methods: This study used data collected from the Language Environment Analysis System (LENA) along with qualitative interviews and Likert scale questionnaires to examine caregiver-child interaction patterns, language socialization practices, beliefs about childhood hearing loss, and caregiver satisfaction with auditory-oral language intervention services received for their PCWHL. Participants were 15 families representing minority cultural backgrounds who spoke non-Western languages with their PCWHL in the home and who were receiving auditory oral language intervention services in English at various sites in the Greater Toronto Area, along with 5 English-speaking families. Minority languages spoken by the participating families were Mandarin (5 families), Tamil (2) Tagalog (2) Urdu (1), Bengali (1), Tibetan (1), Malayalam (1), Dari (1) and Vietnamese (1). The PCWHL ranged in age from 8 to 48 months. Fourteen children were males and 6 were females. None of the children had additional conditions that might affect their communication development. Degree of hearing loss ranged from moderate to profound. Thirteen of the children wore hearing aids, 5 wore bilateral CIs, and 2 wore one CI and one hearing aid.
Results: Summary LENA results showed differences in Conversational Turn Count, Adult Vocalizations, and Child Vocalizations in the communication environments of minority language versus English language speaking PCWHL, with some subtle differences among individual minority language groupings. Based on in-depth analyses of the qualitative interviews and questionnaires, it is argued that these differences are best interpreted as reflecting the influence of caregivers’ culture on beliefs about language socialization, the roles of children as communicators, and understandings of childhood hearing loss rather than as representing deficits in the communication environments created by caregivers input, interactions, and language stimulation.
Conclusion: An understanding of the ways in which cultural beliefs and practices might affect communication development, family involvement, caregiver satisfaction, and overall quality of life in families of PCWHL from minority language and cultural backgrounds is an essential component in the development of cultural sensitivity and in the provision of appropriate supports, suggestions, and services to these families.
**Poster Number:** 27  
**Abstract ID:** 36  
**Title:** Engaging Parents Task Force: Bringing Parent Perspective into Clinical Design  
**Category:** Rehabilitation/Educational Aspects  
**Authors:**  
Erika Gagnon, AuD, Hannah Eskridge, Master of Speech Pathology, Erin Thompson, Master of Science in Speech and Hearing Sciences; The Univ. of North Carolina at Chapel Hill, Durham, NC.  
**Abstract:**

**Introduction:** For the past two years, our pediatric cochlear implant center has implemented a ‘co-treat’ model, bringing speech language pathologist and audiologist together for joint appointments. This model has increased collaboration among clinicians and parents throughout our center. While this model has aided in patient care, we felt that further parent outreach was warranted to help isolate the needs specific to low-income families. Socioeconomic status is a key factor impacting a child’s ability to acquire age appropriate spoken language, thus increasing the disparity for children with hearing loss born into poverty to meet their language potential. The “Engaging Parents, Develop Leaders” tool is designed to be used as an interactive group exercise to address specific needs of organizations that work with parents. This self-assessment contains four domains: Building a Culture of Respect, Inclusion and Equity, Coaching Parents on Competence and Confidence, Listening to and Forming Partnerships with Parents, and Partnering with other Organizations to Serve the Whole Family. Each domain includes a series of questions with a scaled answer choices of “always, sometimes, never or don’t know”. Based on scores in each domain, guidance and recommendations are included in this tool to assist the organization undergoing the self-study.

**Methods:** A task force comprised of clinicians, support staff, parents and university students was assembled to complete the “Engaging Parents, Developing Leaders: A Self-Assessment and Planning Tool for Nonprofits and Schools” tool. A diverse group of patient caregivers were selected, including: a single mother (English as her second language), single father, married couple and grandparents, to attend three task force meetings. The first two meetings allowed for anonymous completion of the questionnaire and wrap-up with a group brainstorming sessions. The final meeting ranked top areas of focus from brainstorming sessions and created an action plan to be executed by our center to better meet the needs of our patients, parents and community.

**Results:** In this session, the presenter will outline how to utilize the “Engaging Parents, Developing Leaders: A Self-Assessment and Planning Tool for Nonprofits and Schools” tool, including our center’s results from each domain to reveal key areas of strength, emerging strengths and key areas for opportunity. Reflection and brainstorming with parents from each of these meetings brought a host of ideas. Key themes from parent discussion will be outlined along with the action plan implemented after the conclusion of the task force.

**Conclusion:** As a pediatric center, collaboration with our patient’s parents is imperative to learn our center’s strengths and areas for improvement. Giving parents a voice to share their unique needs and desires has allowed our center to make impactful changes guided by parent input to improve access and quality of services delivered.
**Title:** Parental Expectation from Children with Cochlear Implant: Questionnaire Based Study at King Abdullah Ear Specialist Center Patients

**Category:** Rehabilitation/Educational Aspects

**Authors:**
Roa Halawani, consultant Otolaryngology, Fellow Otology 1, abdulrahman alsanosi, Prof. Otolaryngology at King Saud University 1, faisal alshowear, MD, house officer 2; 1Otolaryngology, King Abdullah Ear Specialist Ctr., Al Riyadh, Saudi Arabia, 2Otolaryngology, King Saud Univ., Al Riyadh, Saudi Arabia.

**Abstract:**

**Introduction:** Hearing is important in the development of a healthy child. Hearing loss can affect child’s development in many aspects such as communication, social, speech, and academic function. According to multiple studies a child with hard hearing has a high risk for developing behavioral, emotional, and psychological disorders. One of the causes of hearing loss is sensorineural. A study done in Saudi Arabia showed that our country has a high prevalence rate of sever to profound sensorineural hearing loss in comparison to the developed countries. A study done in 1996 in Lowa city, USA, stated that preimplantation expectations of parents of a CI child in awareness of environmental sounds 89%, improved speech perception 50%, and speech production 36%. Then three years postimplanation expectations showed that awareness of environmental sounds 61%, improved speech perception 78%, and speech production 74%. Another study done in Brazil in 2014, stated that parents have good expectations of their CI child in their communication, independence, and social participation. Parental expectations are important to measure the parent’s knowledge about CI. There are multiple studies worldwide about parental expectations. None of these studies in Saudi Arabia. The aim of this study is to measure parental expectation about their cochlear implanted child.

**Methods:** A cross sectional study in form of a questionnaire conducted on parents the children who are going to undergo cochlear implant in King Abdullah Ear Specialist Center. Questions related to communication abilities, social skills, academic achievements, change in future life, rehabilitation demand and stress on the family due to hearing impairment.

**Results:** The response of the questions related to communication abilities showed that parents were expecting children using CIs to use the telephone (88%), to be able to detect soft sounds (79%), to listen in crowds (74%), to be able to easily understand others (64%), and to show improvement in communication skills (93%). Majority of the parents have a high expectations regarding improvements of communications abilities (79%), social skills (86%), academic achievements (66%) and believe that cochlear Implant will change their child’s future life in (94%) Moreover, regarding rehabilitation demand It shows that 98% of parents are aware about the rehabilitation demand and agree about their major role in participation in it.

**Conclusion:** Overall, the existing questionnaire-based study showed that parents have high expectations from their children with cochlear implant.
Title: Teens with Cochlear Implants and Their Parents-Looking Back and Looking Forward

Abstract:

Introduction: Parental engagement is known to have a positive impact on listening and spoken language for children with hearing loss leading to literacy proficiency. As these children reach teen and young adult years, the social emotional impact of early attention, extensive and intense interventions emerges. Young adults first identify how and why their upbringing was unique and then how to best transition into self-awareness and advocacy as their responsibility and to plan for their future independently.

Methods: Eight cochlear implant recipients ranging in age from 13-19 participated in a one week leadership camp experience in the summer of 2017. A total of 65 young children with hearing loss attended the week long camp where the teens were given various tasks and assignments that included supervising the young campers, organizing special activities and participation in an intense leadership and team-building curriculum. The teens completed written and oral feedback about their experiences and curriculum. In addition to anecdotal observations, the teens and their parents were interviewed after the camp experience.

Results: Themes emerged in how to best support families of newly identified children that included opportunities to learn how to advocate for inclusion in educational settings. Listening and Spoken Language Therapy was a critical component for both parents and the teens to language development and ability to thrive in inclusive settings. Self-awareness—“I learned that it is not all about me” was a common theme amongst the teens throughout the week. They were no longer the center of attention, instead were the givers of attention to younger children with hearing loss. Key learnings from the teens’ perspective included realizing that their upbringing was unique due to intense therapy, they have limitations and that it is up to them to work through them as they grow into adulthood, they had to overcome fears, misconceptions, weaknesses, all without the benefit of parental opinion and guidance throughout the week and that their parents/family members were committed to their success/outcomes. Every participant noted that they were successful because their parent(s) were aggressive with technology and therapy. They were made aware of this by spending time with many children of differing circumstances and supports with differing outcomes. Participants concluded that they will be more involved in the hearing loss community and began to develop plans to do so in their communities.

Conclusion: Learning directly from parents and their children is a powerful and informative approach to creating and implementing engagement and support services for families new to navigating hearing loss. Taking the approach and attitude that these recipients are the future, we plan to further explore how to grow and develop competency in leadership, advocacy and engagement with this population that will lead to meaningful support to families and professionals.
**Title:** Using Strengths-Based Coaching of Parents to Impact Functional Listening Outcomes  

**Category:** Rehabilitation/Educational Aspects

**Authors:**  
Erin Thompson, M.S., CCC-SLP, LSLS Cert. AVTThe Children's Cochlear Implant Center at UNC, The Univ. of North Carolina at Chapel Hill, Chapel Hill, NC.

**Abstract:**

**Introduction:** The greatest challenge for children who are deaf or hard of hearing is the ability to acquire age appropriate language to communicate. As services and technology continue to improve, we see greater potential for and improved outcomes in a child’s ability to overcome this challenge. With JCIH recommendations for access to a hearing screening by 1 month of age, a diagnostic evaluation to confirm a hearing loss by 3 months and quality intervention by 6 months of age, children with hearing loss are often caught up to their hearing peers in speech and language by the age of 3. However, many children do not have access to qualified professionals in their local area to provide quality intervention in order for them to succeed even after 1-3-6 is met. Our center has been providing training and coaching to parents and caregivers for over 25 years. We are now implementing strengths-based coaching in our co-treat service delivery model with parents and caregivers of children who are deaf or hard of hearing. Both audiologists and speech-language pathologists have been trained in strengths-based coaching practices based on the principles of adult learning theory, positive psychology, appreciative inquiry, and Non-Violent Communication. These approaches have been applied via the co-treating model to help engage parents and caregivers in audiology appointments, increase maternal sensitivity and impact functional listening outcomes. As practitioners, does how we coach parents and caregivers regarding functional listening goals impact results? Does using strengths-based coaching with parents and caregivers in a co-treat model yield increased outcomes in a patient’s functional listening skills? This talk will share results of a retrospective analysis of functional listening skills using the Functional Listening Index by The Shepherd Centre.

**Methods:** Thru a retrospective look at our use of the Functional Listening Index (FLI) with approximately 111 children we are able to assess changes in listening skills when strengths-based coaching was utilized with parents of the patients we see. Measures were obtained across single or multiple routine visits.

**Results:** Results will present functional listening outcomes for children with cochlear implants in relationship to device wear time, percent of visits co-treated and impact of comorbid factors. Case studies will be presented illustrating the benefits and limitations of the co-treat model when coaching parents and caregivers about functional listening skills for children with cochlear implants.

**Conclusion:** The use of strengths-based coaching with parents and caregivers, thru a co-treat model, is changing our ability to impact functional listening skills in children with cochlear implants. Using a measure, such as the FLI, allows us to assess the impact of co-treating in relation to other factors such as device wear time and co-morbid factors.
Abstract:

Introduction: This study explored the views of families in children with cochlear implants in Croatia.

Methods: 20 families from 4 different regions in Croatia (5 from each) were interviewed using a semi-structured format.

Results: There are seven themes: availability, costs, the assessment process, the impact of implantation on vocalisations, communication, listening, inclusion and responsiveness, education, managing technology and overall perceptions.

Conclusion: The parents in this study revealed the availability of the newest CI models, about their costs, the benefits of unilateral and bilateral cochlear implantations, waiting times for cochlear implant surgery, and the management of the new technology.
Poster Number: 32  
Abstract ID: 88  
Title: Listening to Learn: Family Engagement when Children are Deaf or Hearing Impaired  
Category: Rehabilitation/Educational Aspects  
Authors:  
Marguerite K. Vasconcellos, Ed.D. Special Education, Bucks County Intermediate Unit 22, Doylestown, PA.  
Abstract:  
Introduction: There is a growing body of research that connects family engagement and enhanced student outcomes. In addition, there is an understanding that when a child has a hearing impairment, the need for family engagement is highlighted. Recognizing that connection, this study intended to explore the practices that parents of children who are deaf or hearing impaired perceive as facilitative of and obstacles to meaningful family engagement in special education.  
Methods: A phenomenological perspective was taken in examining the shared life experiences of parents who have a child who is deaf or hearing impaired. An initial poll of families of children with hearing loss in a southeastern Pennsylvania regional service agency identified parents who self-described with high levels of family engagement. A selected subset of those families was invited to participate in person to person interviews, and to respond to a brief writing prompt. Interview responses provided thick, rich descriptions of the responses were recorded electronically, transcribed and then analyzed to identify themes.  
Results: The emergent themes emphasized the acquisition and development of social and cultural capital that parents experience upon realization that their child has a hearing impairment. Cultural capital includes the need to acquire knowledge, confidence and competence regarding their child’s hearing impairment and its’ implications. They must learn, with lightning speed, about technology options and applications. Moreover, they must make crucial decisions regarding communication methodologies on behalf of their child. Social capital, as identified through this study, refers to the connections parents make on their child’s behalf, and as a function of the phenomenon of parenting a child with hearing loss. This capital is also found in the acquisition of resources required to support their children and attain self-efficacy on the parental journey. As resources are enacted, parents leverage their social capital by building networks of support. Ultimately, engaged and empowered parents become effective advocates at the local, state and national level.  
Conclusion: There is a delicate balance required as parents move toward acceptance of their child’s hearing loss. Bit by bit, they acquire the building blocks of social and cultural capital and re-establish a delicate equilibrium. When any aspect of this balance is disrupted, parents note obstacles to engagement. This session will focus on the educators’ role in supporting the acquisition of necessary social and cultural capital for families as they journey along the paths of parenting a child with hearing loss.
**Title:** Audiologists’ Preferences in Programming Cochlear Implants: A Preliminary Report  
**Category:** Audiology  
**Authors:** Leanne M. Browning, BS 1, Yingjiu Nie, Ph.D. 1, Ayasakanta Rout, Ph.D. 1, Meredith Heiner, Au.D. 2;  
1Communication Sciences and Disorders, James Madison Univ., Harrisonburg, VA, 2Audiology, Virginia Commonwealth Univ. Hlth. System, Richmond, VA.

**Abstract:**  
**Introduction:** Cochlear implants have become a viable option for those with severe to profound sensorineural hearing loss and little to no word recognition ability. However, the techniques audiologists use to program these devices are not standardized. There is little data available which analyzes how audiologists handle clinical cochlear implant programming between the top manufacturers. These companies supply default settings in their products, but is it unknown how often audiologists use these in practice in the United States.  
**Methods:** In the present study, a questionnaire was designed based on the European model by Vaerenberg et al. (2014) which addresses which settings professionals are using with their patients, how they approach bimodal fitting with a cochlear implant and a hearing aid, and which tests they use to evaluate patient and device performance. This questionnaire was distributed through the platform, Qualtrics, to cochlear implant audiologists throughout the United States by email. Audiologists were selected for participation based on pre-existing contacts and their membership in audiology social media groups. Participant recruitment will continue until 50 responses are recorded. To limit survey participation, only those who supplied their email address to the researcher were given a link to complete the survey. Additionally, all responses remain anonymous, and information from the optional incentive survey is separated from survey data.  
**Results:** Preliminary results indicate a preference for the default value for some parameters, like default pulse width, but not others. Additionally, there are differences between manufacturers, including in the use of default strategy. Relative to Cochlear, there is a trend toward less use of default for MED-EL and Advanced Bionics. Preferences for bimodal fitting techniques trend toward using a partner company’s hearing aid, like Cochlear and ReSound, when available, and using the manufacturer’s bimodal fitting formula.  
**Conclusion:** It is expected that there will continue to be a trend of audiologists preferring to use manufacturer default settings for at least some parameters as more data is collected. New and experienced audiologists may benefit from this research in that they may better understand the state of the art of cochlear implant programming. It is clear that there is much variability among audiologists’ cochlear implant programming practices, and documenting these differences is important for the betterment of the field.
Abstract:

Introduction: Patients who present with substantial unilateral hearing loss (UHL), with moderate-to-profound hearing loss in one ear and normal hearing in the contralateral ear, report poor speech perception in noise, localization, and quality of life. Currently approved treatment options for substantial UHL include contralateral routing of signal (CROS) hearing aids and bone-conduction hearing aids (BCHA); however, these solutions do not provide binaural cues. Recent investigations have demonstrated cochlear implantation of the poorer hearing ear may be a viable treatment option for these patients. Cochlear implant (CI) recipients with substantial UHL experience improved speech perception in noise, localization, and quality of life as compared to unaided conditions or when listening with CROS hearing aids or BCHAs. With the rise of this treatment option, clinical audiologists must consider how to translate the research test battery and CI fitting methods into clinically-feasible protocols. The present report reviews the research test battery and CI fitting methods for subjects participating in a clinical trial on CI in UHL, and discusses how it can be applied clinically.

Methods: Twenty subjects received their CI as part of a FDA clinical trial investigating cochlear implantation in cases of unilateral hearing loss. The research test battery included measures of unaided and aided thresholds, speech perception in spatially-separated noise, localization, and quality of life. The test battery took approximately 3 hours to complete. Subjects completed mapping procedures that differed from mapping procedures of conventional CI recipients. The research and clinical audiology teams reviewed how the test battery could be modified once subjects completed the study endpoint and were followed by the clinical team. Considerations included duration of test time, consistency of measures for review of long-term performance, soundbooth set-up, and what mapping procedures may optimize subject performance.

Results: Revised test battery and mapping procedures, as compared to that used for conventional CI recipients, were created for CI in UHL subjects considering the normal hearing in the contralateral ear and research findings. The test battery used in the clinical trial was modified to be clinically feasible (approximately 30 to 45 minutes, depending on the interval) while maintaining consistent data to review long-term performance. The proposed test battery and mapping procedures will be discussed.

Conclusion: Patients with substantial UHL may experience improved speech perception, localization, and quality of life with the use of a cochlear implant. Clinical audiologists must consider the optimal test battery and mapping procedures to effectively evaluate and treat CI recipients with normal hearing in the contralateral ear.
**Poster Number:** 35  
**Abstract ID:** 116  
**Title:** Fine Structure Speech Coding Strategy Results among Adult Cochlear Implant Users  
**Category:** Audiology  
**Authors:**  
Tarek El Dessouky, Dr, MD AudiologyENT department, Beni-Suef Univ., Beni-Suef, Egypt.  
**Abstract:**  
**Introduction and aim of work:** Speech perception with cochlear implants has drastically improved to a point where patients reach near-normal levels in quiet environments. The algorithms to translate the acoustic signal into patterns of electrical stimulation the so-called speech coding strategies, are one of the factors that have helped to achieve these high levels of speech perception. The aim of this work was evaluation of Fine Structure Processing (FSP) strategy in comparison with their variations of the standard Continuous Interleaved Sampling (CIS) strategy denoted CIS+ and High Definition CIS (HDCIS).  
**Subjects and Methods:** This study group consisted of twenty adult post-lingual CI users (age ranged from 17 to 60 years) all patients were implanted with MED-EL SONATA implant, using OPUS II speech processor and were using FS4 speech strategy then replaced with HDCIS speech strategy. All patients were subjected to full history taking, mapping first with FS4 then with HDCIS, aided sound-field (aided thresholds and aided speech testing in quiet and noise) in addition to Arabic version of Nijmegen Cochlear Implant Questionnaire (NCIQ).  
**Results:** Aided sound--field revealed non-significant difference when comparing aided thresholds using FS4 and HDCIS strategies. SRT showed slight non-significant improvement with HDCIS strategy compared to FS4 strategy. NCIQ results showed slight non-significant improvement in basic sound perception, advanced sound perception, activity limitations and speech production with FS4 strategy and slight non-significant improvement in self-esteem and social interactions with HDCIS strategy. There were also slight non-significant improvement in music appreciation and TV and telephone use with FS4 strategy compared to HDCIS strategy. Results of speech reception threshold and outcomes of the Nijmegen Questionnaire in FS4 and HDCIS strategies showed no correlation except for speech production sub-domain which was statistically significant. HDCIS strategy showed slight non-significant higher scores in digit, spondee and monosyllabic word discrimination with and without visual cues as regards hearing in quiet and SNR +10 while FS4 strategy showed slight non-significant higher scores in spondee and monosyllabic discrimination tests with and without visual cues and in digit without visual cues in SNR 0 and SNR -10.  
**Conclusion:** This study showed statistically non-significant difference between FS4 and HDCIS speech coding strategies as regards speech recognition although Subjects had better scores in quiet and 10 SNR with HDCIS strategy and better scores in 0 SNR and -10 SNR with FS4 strategy. Using the subjective questionnaire (NCIQ) there were no statistical significant difference between the 2 speech coding strategies, but outcomes demonstrate that telephone speech recognition, TV use and music appreciation for CI users are improved when using FSP compared to HDCIS. The recipients should be given the opportunity of choosing between the strategies.
Incorporating Electric-Acoustic Stimulation Assessment and Fitting into Clinical Practice

Introduction: Cochlear implant (CI) systems that combine electric-acoustic stimulation (EAS) in the same ear have recently been 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.
Introduction: Vaerenberg et al. (2014) conducted a global survey of cochlear implant (CI) programming practices and found only 6% of CI audiologists even occasionally change rate of stimulation during CI programming. The effect of stimulation rate on subjective and objective performance in CI recipients has not been studied since 2006 when rate of stimulation was evaluated as part of the Freedom clinical trials. With the advent of new processing strategies and expanded implantation criteria, a modern evaluation of stimulation rate is necessary. In our clinic we routinely program recipients with various rates of stimulation in an attempt to optimize performance. A review of patients’ preferred MAPs over the past three years reveal that only 30% routinely use a MAP created with a 900Hz stimulation rate. This QI project was implemented to thoroughly evaluate stimulation rate using a more standardized protocol. We evaluated subjective preference for stimulation rate and objective word and sentence recognition scores per stimulation rate over time.

Methods: Ten new CI recipients were programmed using 720, 900, 1200, and 1800 Hz stimulation rates over a 5 week period. A rigorous, uniform schedule was followed during initial programming to include: Day 1: Initial activation Program using 900 Hz stimulation rate with counted T’s and measured C’sDay 2: One day post activation Program using 900 and 1200 Hz stimulation ratesProvide both MAPs for home use Day 3: One week post activation Identify preferred program/stimulation rate Complete CNC word testing for the 900 and 1200 Hz MAPsReprogram and optimize the 900 and 1200 Hz MAPs Day 4: Two weeks post activation Identify preferred program/stimulation rate Complete CNC word testing for the 900 and 1200 Hz MAPsIf the 900 Hz MAP is preferred, reprogram using 720 HzIf the 1200 Hz MAP is preferred, reprogram using 1800 Hz Day 5: Three to five weeks post activation Identify preferred program/stimulation rate Complete CNC word testing for current MAPs Optimize and create programs for the preferred rate of stimulation Complete AzBio sentence testing following initial activation with Day 1 MAP and after 5 weeks of CI use with Day 5 optimized MAP. During the last session, patient perception for both the Day 1 MAP and Day 5 MAP will be judged for sound quality and speech understanding using a Likert scale of 1 to 5.

Results: Data collection is almost complete. A repeated measures ANOVA will be used to analyze the difference between stimulation rates for CNC word scores. A dependent t-test will be used to analyze the difference between subjective rate preference and performance with Day 1 MAP vs optimized, final MAP.

Conclusion: Analysis is still underway. We will focus conclusions/discussion on clinical relevance and the application of this material into a comprehensive CI programming protocol.
Introduction: Streamlined programming techniques have been advocated to create MAPs for cochlear implant recipients. Limited research has been conducted evaluating MAPs created using streamlined techniques. Review of PubMed database shows only one article evaluating streamlined cochlear implant programming and this article was published in 2005. This Performance Improvement project was completed to thoroughly evaluate and compare cochlear implant recipients’ perception of sound quality and speech intelligibility for MAPs created using traditional programming vs. streamlined programming techniques.

Methods: Ten experienced cochlear implant recipients participated in this Performance Improvement project. Three separate MAPs were created during a single visit. MAP 1: Standard MAP using patient’s optimized parameters. Ts and Cs were measured for 12-14 electrodes. Cs were swept for equivalent loudness levels. MAP 2: Streamlined MAP using patient’s optimized parameters. MAP 3: Streamlined MAP using 900 Hz stimulation rate, 25 msec pulse width and 8 maxima. MAP 3 was created only if the patient’s optimized parameters were not the standard recommended parameters of 900 Hz stimulation rate, pulse width of 25 and 8 maxima. Streamlined programming guidance was followed to create MAPs 2 and 3. Attempts were made to ensure the patient perceived all 3 MAPs with equivalent volume. Patient perception for each MAP was judged for sound quality and speech understanding using a Likert scale of 1 to 5 (1=poor and 5=excellent). Speech perception for CNC words, sentences in quiet and sentences in noise was assessed using the 3 different MAPs.

Results: • 90% of subjects preferred the measured MAP with optimized parameters $F(1)=6.688, p=.029$, effect size =.426. • C level differences between measured and streamlined MAPs extremely variable for individual patients and electrodes. • No significant difference found between the averaged C levels for the 3 different MAPs. There was a statistically significant difference in the pattern of C levels. Cs for apical electrodes for measured MAPs were lower than Cs obtained using streamlined programming $F(1)=10.353, p=.011$, effect size=.535. • When Ts are relatively flat across the array, performance and subjective rating less variable than when Ts show substantial differences across the array. With variable Ts streamlined programming resulted in poor sound quality and inadequate volume since the dynamic range was equal for all electrodes. • Tendency found for increased performance with measured MAPs created from optimized parameters, but this did not reach a level of significant difference.

Conclusion: The CI field must develop an efficient method to optimize individual programming parameters and create faster programming methods while achieving optimal patient outcomes. • Streamlined programming techniques decrease programming time, but if strictly followed, may sacrifice optimal performance. • Preliminary recommendations to improve programming: 1) Optimize rate for each recipient. 2) If streamlined programming is used, it is essential to sweep all Cs for equivalent loudness.
Poster Number: 39
Abstract ID: 85
Title: P300 Response to Tones and Speech Sounds in a Cochlear Implant User
Category: Audiology
Authors:
Maria Stella A. Amaral, MD, Victor G. Calderaro, MA, Sarah C. Bernal, MA, Francine R. D. Santos, MA, Myriam D. Isaac, PhD, Ana Cláudia M. B. Reis, PhD, Miguel A. Hyppolito, PhD; Department of Ophthalmology, Otorhinolaryngology, Head and Neck Surgery., Ribeirão Preto Med. Sch.- Clinical Hosp., Ribeirão Preto, Brazil.
Abstract:
Introduction: The P300 cortical auditory evoked potential is generated by the expectation of rare stimuli among other frequent stimuli (Oddball paradigm). P 300 can be used in clinical practice to assess cortical function of individuals with cognitive function impairment related pathologies. In subjects with hearing loss, it can be generated by speech or pure tone stimulation, presented in free field. The cognitive evaluation has some limitation to old people candidacy to cochlear implants.
Methods: Retrospective chart review of a subject with bilateral sensorineural severe to profound hearing loss, submitted to Cochlear Implant (CI) surgery. P300 testing was conducted in the moments before CI surgery, during the device activation and 6 months after activation. To obtain P300 responses, speech sounds and tone burst stimuli were presented.
Results: Female, 77 years old, with bilateral sensorineural hearing loss for the past 20 years, etiology under investigation. She was submitted to CI surgery with a device from the MED-EL® brand. P300 testing was conducted in the phases pre CI surgery, during CI activation and after 6 months of device use. For both pre CI and CI activation phases, the patient was unable to discriminate the different sound stimuli presented. After 6 months of CI use, the P300 wave response was traced for the speech sounds and pure tone stimuli. The P300 latencies for speech sounds were higher than for pure tone stimulation.
Conclusion: P300 is a non-invasive objective test and in this particular case it showed the improvement of a patient’s cognitive function after CI surgery. The increased latency for speech sound stimulation could represent a higher listening effort for this stimulus.
Title: Electrical Compound Action Potential Tonotopy in Different Electrode Types
Category: Audiology
Authors:
Florian Christov, Resident 1, Michael Gluth, 60613, MD 2, Stefan Hans, audiologist 1, Stephan Lang, Professor, Chairman 1, Diana Arweiler-Harbeck, Professor 1; 1Uniklinik Essen Germany, Essen, Germany, 2Univ. of Chicago, Chicago, IL.

Abstract:
Introduction: There exists a wide range of cochlear implant electrode array designs, but they all share the common aim of providing idealized cochlear nerve stimulation. While indications for use of a special design are not absolute, slim straight electrodes may be favored for their potential to minimize insertion trauma and preserve residual hearing; whereas, contour advance electrodes are positioned in close proximity to the auditory nerve fibers. The aim of this study was to investigate the impact of these two array types on the interaction between electrodes and the auditory neurons in different parts of the cochlea.

Methods: Adult and pediatric cochlear implant recipients (CI24RE/CI512 and CI422, Cochlear®) between 2008 and 2013 were included. A retrospective analysis of threshold Neural Response Telemetry (tNRT) 12 months after surgery was undertaken and analyzed for differences in tNRTs between electrode array types regarding the electrode tonotopic location within the cochlea.

Results: In total 168 implants were included in the study. Perimodiolar electrodes were found to have significantly lower mean tNRT thresholds than straight electrodes. Perimodiolar arrays had lower thresholds in the basal region than the medial or apical regions and straight arrays had lower thresholds in the apex than the medial or basal regions. The highest thresholds for both array types were measured in the medial region. The lowest thresholds were in the basal region with perimodiolar arrays.

Conclusion: tNRT thresholds were different for both electrode array types and this difference included contrasting patterns of stimulation based on the tonotopic location of electrodes within the cochlea.
Title: Spread of Excitation Differences in Perimodiolar and Straight Arrays in Children and Adults

Authors:
M. Valeria S. Goffi-Gomez, PhD 1, Ana Tereza Magalhaes, PhD 1, Ana Cristina Hoshino, PhD 1, Paola A. Samuel, MS 1, Robinson Koji Tsuji, MD. PhD 1, Ricardo F. Bento, MD. PhD 2, Rubens V. Brito Neto, MD. PhD 2; 1ENT, Hosp. das Clínicas da Faculdade de Medicina da USP, São Paulo, Brazil, 2ENT, Faculdade de Medicina da USP, São Paulo, Brazil.

Abstract:
Introduction: The position of the electrodes in the cochlea is crucial for the adequate interface with the neuronal structures. The inter-electrode distance and the distance from the electrode to the ganglion cells may interfere in the nerve fibers recruitment leading to a reduction in the electrical compound action potential (eCAP) threshold. But closer position to the neural fibers may also reveal a narrower spread of excitation, that may lead to further improvements in spectral discrimination among cochlear implant patients. The primary goal of the study was to determine whether the spread of excitation (SOE) width is narrower in perimodiolar array than in the straight electrode array.

Methods: Retrospective chart review of 399 intraoperative recordings of children and adults implanted with straight (CI 422) and perimodiolar (CI 24 RECA) Nucleus® arrays, were collected from a mid-array electrode (11 or 10). Data from patients with etiologies such as cochlear malformation, meningitis or other infectious disease were excluded. The threshold of the electrical compound action potential (tNRT - neural response telemetry threshold) was recorded using the AutoNRT and the SOE series was recorded through the eCAP at a constant current level above the threshold as a function of the masker electrode through the Custom Sound® EP software. The type of electrode array was collected from patients’ files, and Mann Whitney test was used for the statistical analysis of the SOE width differences (in millimeters) at 75% transectional level.

Results: NRT data collected from 156 adults and 243 children were analyzed. TNRT, amplitude of the peak of the SOE function and SOE widths were statistically different between both electrode arrays in children and adults. Mean tNRTs were 191 current levels (cl) in children and 193 cl in adults for the perimodiolar array and 199 cl in children and 196 cl in adults with the straight array. Peak amplitude of the SOE curve were 84.02 μV in children and 81.97 in adults for the perimodiolar array and 91.70 μV in children and 102.12 μV in adults with the straight array. Median SOE width at 75% was 1.46 mm in children and 1.86 mm in adults for the perimodiolar array, and 2.29 mm in children and 3.03 mm in adults for the straight array, with statistical difference between adults and children.

Conclusion: Perimodiolar arrays shows not only lower thresholds of the eCAP, but also narrower spread of excitation (SOE) width than in the straight electrode array.
**Title:** Electrical Stapedial Reflex Thresholds Elicited by Global Stimulus  
**Category:** Audiology

**Authors:** M. Valeria S. Goffi-Gomez, PhD 1, Ana Cristina Hoshino, PhD 1, Paola A. Samuel, MS 1, Carina Rodriguez, AuD 2, Amy Stein, AuD 2, Robinson Koji Tsuji, MD. PhD 1, Ricardo F. Bento, MD. PhD 1; 1ENT, Hosp. das Clinicas da Faculdade de Medicina da USP, São Paulo, Brazil,  2Advanced Bionics, Valencia, CA.

**Abstract:**

**Introduction:** In order to achieve cochlear implant (CI) benefit it is extremely important to have an appropriate speech processor program. One means of ensuring appropriate device fitting is to use objective measures, such as the stapedius reflex. Stapedius reflexes can be elicited electrically by an adequately intense stimulus and can be used to predict the maximum comfort level. The electrical stapedius reflex thresholds (eSRT) can be measured stimulating individual electrodes, speech burst stimulation, or all electrodes global stimulation. Global stimulus representing all the electrodes being stimulated at the same time, and integrate the electrical acoustic reflex measurement system by triggering stimulation from the immittance bridge may accelerate the measurement in uncooperative children and reduce clinical effort associated with measuring the eSRT. The aim of this study was to evaluate the differences in obtaining eSRT responses using global stimulus versus speech bursts stimulus.

**Methods:** Adults and children with normal middle ear pressure and eardrum mobility implanted with Advanced Bionics CI were randomly selected during their routine fitting session. Interacoustics AT 235 was used to register the reflex, connected to the computer with an integrated middle ear analyzer (IMEA). In the IMEA system, AT 235 performs middle ear measurements under the control of research software connected via a computer programming interface to a Neptune speech processor to deliver electrical stimulation. The processor runs specialized software to recognize the pure tone output from the contralateral port of the middle ear analyzer, measures the tone’s amplitude and generates an electrical stimulus at a corresponding level. The IMEA mapping was designed such that a 1dB change in the analyzer tonal output produce a 10 clinical units (CUs) change in electrical stimulation level. To calibrate the IMEA system a 2000 Hz pure tone was presented at 80 dB SPL from the middle ear analyzer and mapped to 250 CU level by default. During eSRT collection, coding strategy and stimulation rate were maintained. Stimulus were 500 μs pulses of either a global stimulus of all electrodes or speech bursts. The criteria for determining the presence of a reflex was a definite, repeatable deflection of at least 0.03ml. For each patient eSRTs obtained using global stimulation were compared with eSRTs obtained using speech bursts.

**Results:** Seventeen patients were evaluated. Reflexes were recorded in 82% of the sample with all the stimulus types. The current unit (CU) of the eSRT when measured with all electrodes were lower than or equal to the lowest eSRT taken with speech bursts. The lowest value of the thresholds with speech burst were at the 4 th band (basal region) in 77% of the patients.

**Conclusion:** The global stimulus to all electrodes elicited lower electrical stapedial reflex thresholds than speech bursts, probably due to the recruitment of all ganglion cells showing the reflex arc may be triggered with the first intensity that reaches its sufficient level.
**Poster Number:** 43  
**Abstract ID:** 211  
**Title:** Clinical Assessment of Speech Perception for Spanish Speaking Children  
**Category:** Audiology  
**Authors:**  
Annie Rodriguez, Doctorate in Audiology, Myriam De La Asuncion, Doctorate in Audiology; MED-EL Corp., Durham, NC.  
**Abstract:**  
**Introduction:** Childhood hearing loss has been proven to cause substantial delays in speech and language, communication, and psychosocial development without early intervention. Proper assessments and understanding the full spectrum of the child’s speech and language development is crucial. About 2 to 3 of every 1,000 children in the United States are born with hearing loss in one or both ears per the National Institute on Deafness and Other Communication Disorders (NIDCD). With an increase in population size, the prevalence of hearing loss in the Hispanic population has grown. The fastest growing minority group is Spanish speaking (Ramirez & de la Cruz, 2003) and nearly 1 out of every 7 Hispanics currently have hearing loss (NIDCD). The Hispanic population continues to grow and has become the second largest minority group in the United States. The need to accurately assess this population in their native language is imperative. Currently, approximately 4% of hearing health professionals are Spanish speaking, therefore limiting assessment and knowledge of outcomes and impacting the patient’s quality of life.  
**Methods:** Assessment of speech perception in the pediatric population is important for various reasons including determining if the child is benefitting from their cochlear implants and/or hearing aids, helps track the child’s progress over time, and gathers speech perception data which will aide in the child’s (re)habilitation. A test battery is needed to accommodate children of different chronological and linguistics ages, auditory processing skills, and communication modes. Given this, these assessments must vary between closed-set and open-set formats. In this overview, we will include various speech perception assessments that are currently available in Spanish for young children and their current limitations.  
**Results:** Currently, there is an increase interest in accurately measuring speech perception and tracking progress in the Hispanic population, especially in children. As the Hispanic population in the United States continues to increase coupled with the limited amount of Spanish speaking professionals in the hearing loss industry, professionals will need to expand and continue to develop ways to assess speech perception in young Hispanic children. In addition, professionals will be able to assess what is currently available in Spanish and the current limitations.  
**Conclusion:** Overall, accurate assessment of speech perception in Hispanic Children is crucial. The rise in this population in conjunction with the limited amount of Spanish speaking professionals calls for the need to explore current test materials and expand on them. Per the American Speech and Hearing Association (ASHA), approximately 95% of members are Caucasian Americans. Within special education, 86% are Caucasian American, 1% African American, and 4% Hispanic American (Boyer & Mainzer, 2003), and among audiologists, 80% are English speakers (Ramkissoon & Khan, 2003). Within the US, only 4% are registered in ASHA as being bilingual, which equates to approximately fewer than 300 audiologists and under 8000 speech-language pathologists. The need to investigate current pediatric Spanish speech perception tests and develop new test batteries is particularly relevant as this population continues to rise.
CI2018 DC Poster Abstracts

Poster Number: 44  
Abstract ID: 271  
Title: Speech Perception Analysis via Automated Phoneme Alignment  
Category: Audiology  
Authors:  
Lydia C. Wang, Student 1, Tilak Ratnanather, PhD 2, Daniel Tward, PhD 2, Zachary Heiman, Student 2;  
1Montgomery Blair High Sch., Silver Spring, MD,  2Biomedical Engineering, Johns Hopkins Univ., Baltimore, MD.  
Abstract:  
Introduction: Clinical speech perception tests are commonly used to assess or track the ability of people with hearing loss to hear with a hearing aid or cochlear implant. They are generally based on lists of words or sentences, and are presented in a sound booth, sometimes with noise. Often, the number of correctly perceived sentences, words, and/or phonemes are recorded in the clinic to save time. Since a person may not hear the whole sentence correctly, but hear most of the words correctly, it would be beneficial to analyze the erroneous phonemes, which may be classified based on features of sound production. To this end, an automated program for computing the accuracy of phonemes from responses in clinical speech perception tests is developed and implemented.

Methods: The program accepts a set of true sentences or words, and the corresponding set guessed by a person with hearing loss. An electronic pronouncing dictionary (known as CMUdict) translates the sentences into phonemes, and a variant of the Levenshtein Minimum Edit Distance algorithm aligns phonemes in the guessed sentences with those in the correct ones. The program then displays the accuracy for each phoneme, as well as perception information based on frequency-specific phoneme attributes.

Results: The program was tested with several people with hearing loss, with and without hearing aids or cochlear implants. Some users responded to different sets of 30 sentences, recorded in Clear Speech by male and female American English speakers; other users responded to AzBio sentences with talker babble. Results are also shown for a monosyllabic word test key for an adult cochlear implant user.

Conclusion: The automation and output of this new program could permit speech language pathologists and audiologists, particularly in telepractice, to measure phoneme perception in real time. Future work includes evaluation and validation for clinical usage, implementation in mobile auditory training apps, and implementation in other languages, such as Korean.
Title: Evaluating and Optimizing Electrically-Evoked Stapedial Reflex Threshold (eSRT) Measurements in Adult Cochlear Implant Recipients

Category: Audiology

Authors:
Brittany K. Wilson, Au.D. 1, Carrie E. Slough, Au.D. 1, Timothy E. Hullar, M.D. 2; 1Audiology, Oregon Hlth. and Sci. Univ., Portland, OR,  2Otolaryngology, Oregon Hlth. and Sci. Univ., Portland, OR.

Abstract:
Introduction: Objective measures are important in programming cochlear implants to establish or confirm appropriate stimulation levels for best outcomes. The electrically-evoked stapedial reflex threshold (eSRT) is an objective measure that highly correlates with subjectively measured comfort levels (r=0.75-0.91). Implementation of the eSRT into clinical protocol has been less wide spread as a result of limited information on how best to obtain the reflex, where to set comfort levels in relation to eSRT, and how the eSRT evolves over time. The goal of this study is to evaluate the incidence of eSRT obtained intra-operatively, postoperatively, and with various probe tones, to determine its correlation with behaviorally measured comfort levels, and to determine the stability of eSRT over time.

Methods: Adult (>17 years of age), English-speaking, cochlear implant recipients will undergo eSRT measurement intraoperatively (surgeon visualizing stapedial muscle reflex) and at milestone appointments up to 12 months post-activation, using an immittance bridge and various probe tone frequencies (226 Hz, 678 Hz, and 1000 Hz). Rate of eSRT presence will be compared across conditions (intraoperative vs. postoperative) and probe tone frequencies, and will be tracked over time to determine if changes in threshold or presence/absence occur. eSRT thresholds will be compared to the subject’s behaviorally-measured comfort levels at each milestone appointment. After established use with the implant, the subject will be given an eSRT-based MAP and behaviorally-measured MAP. Aided speech perception testing will be completed after experience with the two programs to compare performance. A subjective questionnaire will also be administered probing sound quality differences and program preference.

Results: Preliminary results from intra-operative eSRT measurements on 8 subjects revealed an effect of anesthesia type on eSRT threshold. eSRT was measured during routine implant surgery using Total Intravenous Anaesthesia (TIVA), and again after 1.8% sevoflurane inhalation agent was added. eSRT thresholds consistently increased with the addition of the sevoflurane.

Conclusion: Results corroborate previous research findings that suggest the eSRT is sensitive to dose-dependent changes in anesthesia. Further postoperative results will provide information as to whether one probe tone frequency yields higher rates of eSRT visualization, as well as higher correlation with behaviorally-measured comfort levels. Furthermore, understanding the stability of the reflex over time will directly benefit clinical practice. Once better understood, a secondary goal of this study is to develop a correction factor for intra-operatively obtained eSRT, which could be used in a population of patients where eSRT is difficult to measure, such as patients with middle ear pathology.
Title: Long Latency Auditory Potential (P300) Outcomes in a Patient with Acoustic Neuroma after Cochlear Implant Surgery

Category: Audiology

Authors:
Maria S. A. Amaral, MD, Victor G. Calderaro, MA, Sarah C. Bernal, MA, Carla Dias, MA, Eduardo T. Massuda, PhD, Ana Cláudia M. B. Reis, PhD, Miguel Á. Hyppolito, PhD; Department of Ophthalmology, Otorhinolaryngology, Head and Neck Surgery., Ribeirão Preto Med. Sch.- Clinical Hosp., Ribeirão Preto, Brazil.

Abstract:
Introduction: The P3/P300 long latency auditory evoked potential is a cortical potential that can be visual or auditory and results from focal attention on rare stimuli, among other frequent stimuli. P300 investigates attention and memory, being useful to investigate cortical processing from the rare stimulus. P300 is an objective and non-invasive test that can assess cortical cognitive function.

Methods: Retrospective case review of a subject with sensorineural severe/profound hearing loss and bilateral acoustic neurinoma. P300 testing was conducted in the moments before Cochlear Implant (CI) surgery, during the device activation and 6 months after activation.

Results: Male, 62 years old, progressive bilateral hearing loss for five years, worst on the right side, with unilateral tinnitus and vertigo. Pure-tone audiometry revealed sensorineural profound hearing loss to the right and severe to the left. Magnetic Resonance Image indicated the presence of bilateral eighth cranial nerve neurinoma. The neurinoma was removed from the right side, with no preservation of the cochlear nerve, and CI surgery was indicated for the left ear. He was implanted with the Neurelec ® - Evo device and submitted to electrophysiological testing for P300 in the CI preoperative moment, with no answer, since the wave was not generated. Right after CI activation, the P300 wave appeared, and presented reduced latency and increased amplitude after 6 months of device use.

Conclusion: In this case, P300 appears to be dependent on the auditory stimulus to be generated, showing that it can be a useful tool to estimate improvement in cortical cognitive function after restoring hearing function through cochlear implantation.
Title: Does the Upper Limit of Eight Effective Channels Apply to Contemporary Cochlear-Implant Listeners?

Introduction: Since the advent of multichannel cochlear implants, a wide body of research has demonstrated that hearing performance improves with increasing numbers of channels. However, prior evidence shows that gains in speech understanding asymptote at approximately eight electrodes. The influential studies that established this upper limit were published about 20 years ago. Since that time, cochlear implants have made technical advances, surgical techniques have improved, and candidacy criteria have evolved. Such developments create new opportunities for cochlear-implant recipients to derive benefit in areas where previous patients were more restricted. In this study we re-examine the number of effective channels by exploring how patients who were implanted relatively recently perform on speech tests while varying the number of active electrodes.

Methods: Ten cochlear-implant listeners participated in this study. Subjects were tested with their clinical maps, which used between 18 and 22 active electrodes, as well as reduced-channels maps using only 4, 8, and 12 electrodes. Experimental maps were created by assigning the output of multiple analysis filters to a single electrode, with electrodes spaced evenly along the array. Frequency boundaries and total stimulation rate were held constant across maps. Speech recognition was measured using a closed-set matrix sentence task with a competing talker across four different signal-to-noise ratios. To investigate individual variability, a psychophysical task was conducted to capture across-subject differences in spectro-temporal resolution.

Results: On average, performance on the speech recognition task significantly improved with additional numbers of channels. The improvements extended beyond 8 channels, with the All-channel condition providing significantly better speech recognition than 12, 8, and 4 channels. However, subjects varied in their ability to utilize spectral information. Some subjects gained little benefit above 4 channels, while other subjects demonstrated continuous improvements up to 8, 12, and All channels. The change in performance from 4 electrodes to All electrodes was significantly correlated with spectro-temporal resolution across subjects.

Conclusion: For a group of cochlear-implant listeners with contemporary devices, speech recognition with a competing talker significantly improved as the number of active electrodes increased up to 22. This finding augments the historical evidence showing no improvements beyond 8 electrodes. Additionally, individual cochlear-implant users with good spectro-temporal resolution were particularly able to take advantage of the spectral detail provided by greater numbers of electrodes. These results suggest that technological innovations that increase spectro-temporal resolution, such as improvements to the electrode-neural interface, may allow more cochlear-implant users to glean meaningful benefits from full electrode arrays in modern devices.
Title: Usher Syndrome as an Emerging Indication for Cochlear Implantation: Our Experience and Systematic Review

Category: Audiology

Authors:
Adrien Eshraghi, MD, MSc, FACS 1, Emre Ocak, MD 1, Melissa Auchter, AuD 2, Diane Martinez, AuD 2, Sandra Velandia, AuD 2, Domitille Lochet, SLP 3; 1Hearing Research Laboratory, Univ. of Miami, MIAMI, FL, 2Otolaryngology, Univ. of Miami, MIAMI, FL, 3Ear Institute, Univ. of Miami, MIAMI, FL.

Abstract:
Introduction: Usher syndrome (US) is a rare autosomal recessive disorder characterized by sensorineural hearing loss, retinitis pigmentosa, and vestibular dysfunction. Three distinct clinical subtypes of US (Types 1, 2, and 3) have been described characterized on the basis of audiovestibular findings. There is limited data about the outcomes of cochlear implantation (CI) in these patients. The objective of this study was to evaluate the benefits of CI in US and to discuss the main goals and requirements in the lifetime treatment plan.

Methods: A retrospective study of implanted children dually diagnosed with sensorineural hearing loss and US was conducted in our department. Pre- and post-implantation audiologic tests were performed including pure tone audiometry, speech perception measures, and qualitative assessment of auditory performance. To investigate the outcomes of CI in US, we also performed a systematic review of US and CI between 1997 and 2017. Four electronic databases were searched. Inclusion criteria comprised of US patients with CI.

Results: Our study group consisted of 8 patients all diagnosed as US1. Preimplantation assessment indicated that all of the subjects were pre-linguistically profoundly deaf and had varying degrees of auditory-oral habilitation. There was postimplantation improvement in sound detection and speech recognition measures in closed-set format in all patients. After systematic review, the searches identified 26 unique studies, of which 8 were enrolled in the final synthesis including 109 patients.

Conclusion: Managing US appropriately is important because of the multiple disabilities of these patients. The retinitis pigmentosa associated with US is late onset and progressive in nature. Thus, we recommend to make ceaseless effort to diagnose these patients as early as possible and provide with the best available hearing amplification or CI, if applicable, accompanied with intensive training and/or habilitation prior to the development of retinitis pigmentosa. In this study we discussed the algorithm of proper lifetime management of these patients.
Title: Psychoacoustic Evaluation and Validation through the External Auxiliary Cable and the ASSE Coala Software

Category: Audiology

Authors:
M. Valeria S. Goffi-Gomez, PhD 1, Ana Tereza Magalhaes, PhD 1, Paola A. Samuel, MS 1, Ana Cristina Hoshino, PhD 1, Byanka Cagnacci, PhD 2, Robinson Koji Tsuji, PhD 1, Ricardo F. Bento, MD. PhD 3; 1ENT, Hosp. das Clinicas da Faculdade de Medicina da USP, Sao Paulo, Brazil, 2Audiology, Santa Casa de Misericordia de Sao Paulo, Sao Paulo, Brazil, 3ENT, Faculdade de Medicina da USP, Sao Paulo, Brazil.

Abstract:
Introduction: Many clinicians use measures of performance to verify changes made to a program and to assess the progress in cochlear implant (CI) users. But in some places, the settings for this assessment are less than ideal. Some clinics might not have enough space or budget to afford a sound booth and an audiometer. The Otoconsult group in association with Cochlear Ltd. have recently designed a tool that allow clinicians to assess performance using the Auditory Speech Sounds Evaluation (ASSE) with an external auxiliary cable, the Coala link, that automatically calibrates the sound processor before each test. It enables audiologists to do precise measurements on cochlear implants without a sound booth or an audiometer. The aim of this study was to contrast the results of psychoacoustic evaluation in cochlear implant users in a sound booth and through the direct connection of the calibrated auxiliary, the Coala link.

Methods: Cochlear implant users for at least 3 months who were routinely attended from August to December 2017 were selected. Patients were assessed with recorded speech recognition tests and auditory thresholds in a sound booth and with the external auxiliary through the Auditory Speech Sounds Evaluation (ASSE Coala) software. The results were statistically analyzed.

Results: Results from twenty patients, seven of them bilaterally implanted, totalizing twenty-eight ears, were analyzed. Thresholds were statistically similar, except for 250 Hz. Speech recognition average was 54% when performed in the sound booth and 58% through the Coala link, with no statistical difference.

Conclusion: The performance of speech recognition and thresholds in sound field booth and the ASSE Coala was similar, with differences probably related to calibration.
Abstract:

Introduction: Adult patients with sensorineural hearing loss (SNHL) considering cochlear implantation (CI) are commonly driven by a desire for improvement in two ecologically important domains: (1) speech perception, and (2) environmental sound awareness (ESA). Deficiencies in ESA have important practical consequences in daily life, chiefly safety, such as the ability to identify alarm sounds or the cry of one’s baby. Despite its ecological validity, ESA for safety-relevant sounds remains a presumed, but unsupported, benefit of implantation. The clinician and patient are currently without data to inform evidence-based decisions or expectations regarding ESA for safety sounds following implantation.

Objective: The primary objective of this study was to determine if cochlear implantation improves performance on a measure of safety relevant environmental sound identification.

Methods: A sample of 13 adult, postlingually deaf cochlear implant candidates (CICs) under best aided conditions and 38 experienced cochlear implant (ECI) users were tested using a set of seven safety relevant sounds from the Familiar Environmental Sound Test – Identification (FEST-I), a validated, computerized environmental sound identification task. Identification of safety-relevant sounds in these two groups was also compared to the rate of identification of 18 common environmental sounds that were not specifically relevant to safety. Demographics and pre-implantation auditory perception skills were compared between groups using aided speech recognition performance and spectral resolution.

Results: There was no significant difference between safety-relevant environmental sound identification skills in our sample of ECI users versus CIC patients. This finding was true despite equivalent pre-operative speech recognition performance between the two groups.

Conclusions: Our findings show that despite the commonly held notion that environmental sound awareness may be a benefit of cochlear implantation, our sample of ECI users did not demonstrate significantly improved environmental sound identification skills for safety-relevant sounds compared to CICs tested under best aided conditions. These results suggest the need to modify our pre-operative counseling for patients considering cochlear implantation and may suggest ESA as a potential target for post-implantation training or rehabilitation.
Abstract:

Introduction: Assessment of benefit of cochlear implant often relies on speech testing which could not be applied on young pre-lingual children. In the last decade aided auditory evoked cortical potentials have been used to assure cortical processing of sound conveyed by the cochlear implant. Assessment of these potentials revealed good attribution to speech development in these children. It seems that further investigation of their role in the mapping of cochlear implants is demanded as the age of implantation is decreasing.

Methods: In this study measurements of auditory evoked cortical potentials in response to three speech stimuli were studied in 20 children with favorable map. Their ages were old enough to be tested using speech tests. The rational was to put standards of measurements of aided speech- evoked cortical potentials to be applied later on children who do not fit speech testing.

Results: there was a strong correlation between favorable auditory-evoked cortical potential responses and favorable maps.

Conclusion: Aided Auditory-evoked cortical potentials using speech stimuli can be used with confidence in monitoring of maps of cochlear implants.
Introduction: The P3 or P300 long latency potential is an event related potential as a cortical electrical phenomenon. P300 is related to the expectation of a stimulus, which can be visual or auditory; being a result of focal attention on rare stimuli, among other frequent stimuli (Oddball paradigm). P300 investigates recent attention and memory and can be useful to investigate the time of cortical processing from a visual or auditory stimulus. P300 is an objective and non-invasive test capable of assessing cortical cognitive function. The aim of this study was to evaluate the behavior of the cortical auditory potential (P300) in Cochlear Implant (CI) users, with unilateral fitting, identifying the benefit of unilateral CI over time, its durability and localization of cortical processes of stimulus detection and discrimination, on a cerebral processing level.

Methods: This study was approved by the Institutional Review Board under number 38224814.2.0000.5440. We selected adults of both sexes, with severe and/or profound bilateral post-lingual deafness, all candidates for CI surgery and submitted to implantation of the Neurelec®, Evo device. The subjects’ data was collected regarding age, sex, hearing loss etiology, audiological characteristics in the phases pre-CI and at CI activation, and P300 measurements were taken in the preoperative of the CI surgery and in the CI activation moment. The auditory stimulus generated to elicit the long latency auditory potential (P 300) was presented in free field, at the frequencies of 1000 e 2000Hz with an intensity of 90dBHL.

Results: Twelve subjects were evaluated, five female and seven male. The mean age at the time of surgery was 52,1 years old. Eight surgeries were performed in the right ear and four in the left ear. The etiology of deafness is under investigation for nine patients, one of the cases is due to sudden hearing loss, one due to meningitis and one is related to genetics. The mean hearing threshold, obtained with pure-tone audiometry, was 110,7 dB HL in the pre-CI phase and 56,37dBHL in the CI activation phase. We did not see any difference in wave latency or amplitude in CzA1 and CzA2 during the pre-CI and CI activation phases, showing that there was replication of the wave tracing in both variations. The P300 latency mean value in the pre-CI phase was 349,82 ms and in the CI activation phase, it was 392,87 ms. The P300 amplitude mean value in the pre-CI phase was 3,52 μV, and in the CI activation phase it was 3,25 μV. We noticed a significant increase in the subjects’ mean latency values when pre-CI and CI activation phases were compared (p = 0,0478 - paired t-test) and a reduction in mean amplitude levels (p = 0,44 - paired t-test), however for the amplitude this reduction did not present significant evidence.

Conclusion: The P300 shows higher latency at the moment of CI activation. This finding suggests that in patients with CI, at the moment of CI activation, cognitive processing is slower because they make considerable effort to process auditory information, also suggesting that the latency increases due to the fact that the stimulus reception is done with the implanted electronic device.
Title: Characteristics of Early Auditory and Language Development in Mandarin-Speaking Children after Cochlear Implantation

Category: Audiology

Authors:
Xing Lu, MD, Zhaobing Qin, MD, PhD; Department of Otology, The First Affiliated Hosp. of Zhengzhou Univ., Zhengzhou, China.

Abstract:
Characteristics of Early Auditory and Language Development in Mandarin-Speaking Children after Cochlear Implantation

Introduction: Along with the increased population of prelingual deaf children receiving cochlear implants (CI) every year in China, one of the most direct ways to demonstrate the benefit of a CI is to evaluate the patient’s progress in speech perception and language production. The objectives of the current study were (1) to evaluate the early auditory and language performance developed by Mandarin-speaking children with CIs over the first year after implantation and compare the results with those of children with normal hearing and (2) to analyse the effects of possible associated factors.

Methods: The Infant-Toddler Meaningful Auditory Integration Scale (ITMAIS)/Meaningful Auditory Integration Scale (MAIS), Mandarin Early Speech Perception (MESP) test and Putonghua Communicative Development Inventory (PCDI) were used to assess auditory and language outcomes in 132 Mandarin-speaking children with CIs at pre-implantation and at 3-, 6-, 9- and 12-month intervals after CI activation. The effects of possible associated factors were examined.

Results: All participants showed significant progress in auditory and language skills during the first year of CI use. ITMAIS/MAIS scores exhibited significant improvements between two successive test intervals (P<0.05). There were significant improvements in the receptive and expressive vocabulary performance between two successive test intervals (P<0.05). CI children exhibited a ITMAIS/MAIS and PCDI developmental trajectory similar to that of children with normal hearing. The increased number of participants who could be assessed by categories 1-6 at each test interval showed significant improvement in speech perception of paediatric CI recipients. Age at implantation and socioeconomic status were associated with both auditory and language outcomes. Preimplantation hearing level was negatively associated with early prelingual auditory development and speech perception. Preimplantation hearing aid use was found to be positively related to prelingual auditory development. Sex was not found to be a predictor with any outcome variables except expressive vocabulary.

Conclusion: Mandarin-speaking children with CIs demonstrate early auditory and language development patterns similar to normative developmental trajectories. Delays in expressive language skills are expected to be compensated for by the rapid development in the early stages after implantation. Earlier implantation and higher socioeconomic status are associated with improved early auditory and language skills.
Poster Number: 54  
Abstract ID: 361  
Title: Telephone Recognition in Adults with Cochlear Implants  
Category: Audiology  
Authors:  
Larissa Silva, Bacharel, Christina Oshino, PhD, Valeria Goffi-Gomez, PhD, Robinson Tsuji, PhD, Ricardo Bento, PhD, Ana Claudia Martinho-Carvalho, PhD, Rosangela Andrade, PhD; Univ. of Sao Paulo, Sao Paulo, Brazil.  
Abstract:  
Introduction: In our current technological world, where instant connection through the use of telephones is indispensable in everyday life, adults with Cochlear Implants (CI) report difficulties in using it, and their use may represent great challenges, as well as moments of daily frustration and stress. The possibility of understanding speech on the telephone in adults with CI represents an important aspect for quality of life. The objective of this study was to evaluate the ability of speech recognition on the telephone in adults with Cochlear Implants.  
Methods: Cross-sectional clinical study, approved by the Research Ethics Committee of the institution and carried out in a group of 12 adults users of CI. The evaluation was performed through the speech recognition task in live speech condition and in the telephone using lists of sentences monosyllables words constructed for the Brazilian Portuguese.  
Results: In the present study, 60% of the subjects presented good or very good performance (≥ 80%) in the ability to recognize sentences on the telephone. In the comparison of live speech recognition and telephone condition, a worse performance was found for telephone condition for both sentence recognition and monosyllabic recognition. No significant statistical correlations were found between time of deafness and time of device’s use and auditory recognition on the telephone.  
Conclusion: Selected CI adult users which are able to recognize more than 70% of live speech can also recognize speech on the telephone. The evaluation of the speech perception on the telephone is fundamental, in the sense that, when necessary, a specific auditory training program can be included throughout the auditory rehabilitation.
Title: Use of Sentential Context During Speech Recognition in Adults with Cochlear Implants

Category: Audiology

Authors:
Aaron C. Moberly, MD, Jessa Reed, PhD; Otolaryngology, The Ohio State Univ., Columbus, OH.

Abstract:
Introduction: Sentence context facilitates comprehension, particularly under challenging listening conditions (e.g., in noise or when hearing a degraded signal). Consequently, to “make sense” of the speech stream, cochlear implant (CI) users may rely on sentential context more than their normal-hearing (NH) counterparts. Yet research suggests that CI users vary in their abilities to utilize context. One line of findings suggests that we can only capitalize upon context cues when the speech signal is sufficiently clear, such that individuals with poorer perception will be less likely to benefit from context. Alternatively, other research suggests that use of context primarily “kicks in” when the signal quality is poor. The current study tackles this debate by examining the extent to which CI users benefit from sentential context as a function of the quality of the sensory input, and how this use of context relates to listeners’ cognitive abilities. The objective of this study was three-fold: (1) To investigate whether the use of sentential context depends on the quality of the sensory input; (2) To examine whether neurocognitive functions (working memory capacity, processing speed, inhibitory control, and nonverbal reasoning) relate to the ability to use sentential context; and (3) To determine whether, as a result of their prolonged hearing loss, adult CI users use sentential context to a greater degree than NH peers.

Methods: Data from 81 adults were analyzed: 41 were experienced CI users, and 40 were NH controls. CI participants were assessed in quiet for isolated word recognition, recognition of meaningful sentences, and recognition of semantically anomalous sentences. NH controls were tested using the same materials that were spectrally degraded through 8-channel noise-vocoding. All participants were also tested using a battery of neurocognitive measures.

Results: The degree to which CI participants used sentential context depended on the quality of sensory input (i.e., isolated word recognition) in a quadratic fashion; that is, use of sentential context was greatest at intermediate levels of isolated word recognition. The same was not true for NH controls. A trend was found for inhibitory control as a predictor of the degree of use of context. Lastly, CI and NH participants made use of context to a similar degree.

Conclusion: Adult CI users make use of sentential context to aid in speech recognition, and do so optimally at intermediate levels of sensory degradation. Inhibitory control may play a role in this process. These findings provide further evidence for the interaction of sensory and cognitive processing during spoken language recognition under degraded listening conditions. They also suggest the potential application of aural rehabilitation approaches aimed at improving use of sentential context to optimize outcomes for adults with CIs.
Title: Cochlear Implantation in Young Children with Single Sided Deafness: Characteristics and Early Data

Category: Audiology

Authors:
Lisa R. Park, AuD, Meg Dillon, AuD, Meredith Rooth, AuD, Holly Teagle, AuD, Kevin D. Brown, MD, PhD; Otolaryngology/Head and Neck Surgery, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC.

Abstract:

Introduction: Treating children with substantial unilateral hearing loss (UHL) is typically limited to rerouting of signals to the better hearing ear. An ongoing clinical trial is evaluating whether young children with UHL experience an improvement in speech perception, localization, and quality of life (QOL) with cochlear implant (CI) use. The present report will review pre-operative findings and early outcome data.

Methods: Children between 3.5-6.5 years with moderate to profound UHL were enrolled. The pre-operative test battery included pediatric and parental QOL questionnaires, speech perception, and localization assessment. These measures were repeated post-activation and localization testing was carried out with and without the CI.

Results: Pre-operatively, subjects reported greater cognitive and general fatigue than their parents reported perceiving. Improvements in speech perception, localization, and QOL were demonstrated as early as 3 months post-activation.

Conclusion: Children with UHL tend to perceive greater difficulty with fatigue than their parents’ rankings would suggest. Early data suggests that CI use in children with substantial UHL provides improvements in speech perception, localization, and QOL, even within the early months of device use.
Poster Number: 57  
Abstract ID: 359  
Title: Quality of Life Outcomes for Children with Cochlear Implants  
Category: Audiology  
Authors: Jenna R. Sawalta, B.A., Arielle Abrams, B.S., Analee Haas, B.A.; Allied Health Sciences, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC.

Abstract:

Introduction: As cochlear implant candidacy continues to expand, children undergoing implantation come from diverse backgrounds and have distinct experiences with hearing loss. Children with co-morbidities often experience a wide range of outcomes in regards to cochlear implant use and benefit. It is becoming increasingly important for audiologists and other professionals working as part of a cochlear implant team to be prepared to adapt their testing, programming, and counseling techniques to a child’s developmental, physical and emotional capabilities. Currently there are several questionnaires available to help evaluate quality of life outcomes for children with cochlear implants including the Quality of Life Scales and Katz Activities of Daily Living.

Methods: Through a retrospective case review of three children with distinct medical histories who underwent cochlear implantation at the University of North Carolina Hospitals our objective is to highlight the diverse outcomes of cochlear implant use, benefit and satisfaction. Two children with comorbidities, both with Cerebral Palsy, as well as one child with no co-existing conditions are currently being reviewed. We will also be reviewing different quality of life assessments and their use in clinical settings today.

Results: Results pending.

Conclusion: Conclusion pending.
**CI2018 DC Poster Abstracts**

**Poster Number:** 58  
**Abstract ID:** 144  
**Title:** Growth Performance Curves for Monitoring Cochlear Implant Performance  
**Category:** Audiology  
**Authors:**  
Lindsay M. Schlobohm, Au.D., Brittany K. Wilson, Au.D., Corey S. Shayman, BS, Sachin Gupta, MD, Timothy E. Hullar, MD; Otolaryngology-Head and Neck Surgery, Oregon Hlth. and Sci. Univ., Portland, OR.  
**Abstract:**

Background: Certain factors are known to affect outcomes with a cochlear implant, including duration of deafness, surgical technique, device design, programming, and other factors. Despite efforts to track progress, we lack a standardized method for measuring whether a recipient is demonstrating expected progress with their cochlear implant. Pediatric “growth curves” were developed for similar use, to track the development of any particular child and detect potential problems early on so that intervention can be implemented. In cochlear implants, lagging performance relative to standardized growth curves could identify a need for intensified therapy, extensive remapping, anatomic evaluation of electrode placement, or neuropsychologic evaluation in elderly patients. Here, we describe curves suitable for rapid, intuitive assessment of performance over time and provide examples for their utility.

**Methods:** Subjects were postlingually deaf English speakers, ages 65 years and older who received a cochlear implant at our center from 2011 to 2016. We measured AZBio sentences and CNC word scores in quiet preoperatively as well as at 1, 3, 6, and 12 months postoperatively. The lowest (10%), highest (90%), and middle (50%) decile performance ranges were identified based on AZ Bio and CNC scores, and median scores were calculated at each time-point to create performance curves. The curves were then used to identify subjects with unexpectedly poor or diminishing performance.

**Results:** A retrospective chart review was completed. Among 179 potential subjects, 60 had complete datasets for both speech perception tests. By the 1 month postoperative milestone, subjects in the 90% decile reached nearly 100% on AZBio, while all other curves reached more than half their eventual improvement by this milestone (median AZBio= 53%, CNC= 40%). The scores of 15 subjects crossed the 10%, 50%, or 90% performance growth curves at some point, indicating deviations from expected progress. Most of the 15 patients were poor performers. Of these 15 subjects, 4 patients improved on both AZBio and CNC, 4 subjects worsened on both AZBio and CNC; for the remaining 7 subjects, only one metric crossed a standardized growth curve. The cause for decreased performance in the 4 subjects included hydrops, inappropriate programming, unsuspected auditory processing disorder, and one without an identified cause but whose failure to improve as expected had previously gone unnoticed.

**Conclusion:** Performance growth curves are a simple, intuitive method for tracking patient progress. “Falling off the curve” may allow earlier identification and intervention to improve patient outcomes.
**Title:** Do Borderline Cochlear Implant Candidates Show Post-Operative Benefit?

**Category:** Audiology

**Abstract:**

**Introduction:** Advancements in cochlear implant (CI) technology and assessment materials have yielded a greater number of CI candidates. Further, some centers have chosen candidacy protocols under which individuals may qualify for implantation based solely on their speech recognition performance in noise. The purpose of this study is to report outcomes in this population at our center.

**Methods:** Retrospective chart review for all post-lingually deafened adults implanted from January 2011 through June 2017 identified 38 out of 761 (5.0%) adult cochlear implant recipients who scored ≥ 50% on AzBio sentences in quiet in the ear to be implanted and 163 out of 761 (21.4%) who scored > 60% in the bilateral hearing aid conditions during their candidacy evaluation. Of the 163 adults exceeding labeled indications in the bilateral hearing aid condition, 27 also scored > 50% in the ear to be implanted. Speech perception scores, audiometric thresholds, preoperative hearing aid use, and the Abbreviated Profile of Hearing Aid Benefit (APHAB) were reviewed to evaluate outcomes in this population. Additionally, those recipients who met criteria for electro-acoustic stimulation (EAS) were identified and their outcomes were compared to the outcomes of recipients who did not meet the criteria for EAS use.

**Results:** Repeated-measures analysis of variance revealed no significant benefit in the implanted ear, at the group level (p = 0.60) but a significant benefit in the best-aided condition (p < 0.0001) with mean benefit of 14-percentage points. There was a high degree of variability in individual scores post-implantation. Within this group, a trend was noted for those with pre-operative hearing aid use to demonstrate greater benefit with CI than those who were not using hearing aids at the time of their candidacy evaluation. APHAB scores demonstrated significant perceived benefit (p < 0.0001) with global communication problems decreasing by nearly 30-percentage points. Finally, ten of the recipients has precipitously sloping hearing loss were found to meet EAS candidacy. The EAS-qualifying patients received greater benefit post-implantation than those who did not meet EAS candidacy, regardless of degree of post-operative residual hearing or use of an acoustic component.

**Conclusion:** Patients who fall outside of labeled cochlear implant indications—based on sentence recognition in quiet—derive significant benefit from cochlear implantation based both on speech recognition and subjective communication difficulty; however, postoperative benefit may be less than traditional implant candidates. Subjects who met EAS candidacy were found to have greater benefit than those who were not EAS candidates. Lastly, pre-operative hearing aid use may be an indicator for better post-implantation outcomes; however this should be studied in greater detail with a larger population to draw conclusions.
Poster Number: 60  
Abstract ID: 257  
Title: The Need for a Sequential Bilateral Cochlear Implant Candidacy Protocol?  
Category: Audiology  
Authors: Allison Biever, Au.D. Rocky Mountain Ear Ctr., Englewood, CO.  
Abstract:  
Introduction: Over the past 30 years, the candidacy guidelines for cochlear implantation have changed tremendously. Recipients once had to demonstrate bilateral profound sensorineural hearing loss in order to qualify for a cochlear implant. Today, candidates present with significantly more residual hearing. With the advent of the Hybrid device, many recipients now have normal low frequency hearing in both ears, but a sloping severe to profound hearing loss in the high frequencies. Some recipients may even have normal hearing in one ear, but demonstrate severe to profound hearing loss in the opposite ear. Although the minimum speech test battery for adult cochlear implant users attempted to standardize pre and post operative testing across implant centers, no such battery exists for implant recipients who are seeking a second cochlear implant. Additionally, insurance companies follow guidelines for determining candidacy requirements, but do not provide guidelines for recipients who wish to receive a second implant. The purpose of this study was to examine the protocol used to determine bilateral sequential adult implant candidacy.  
Methods: A retrospective study design was employed to examine the protocol followed and the candidacy considerations examined for 30 adult recipients who wished to obtain a sequential bilateral cochlear implant. The adult cochlear implant recipients in this study received their second implant between September of 2015 and September of 2017. There were 30 adults ranging from 32 to 87 years at the time of surgery. Two of the recipients received a sequential Advanced Bionics device, and 28 received a Cochlear device.  
Results: A number of reasons were cited as to why the recipients wished to pursue a second implant. In most cases, recipients were motivated to pursue a second implant because they perceived a change in their hearing acuity for their non-implanted ear, and felt their hearing aid was no longer providing adequate benefit. In all 30 cases, an unaided audiogram was obtained bilaterally, and the individual and average unaided thresholds are reported. Additionally, aided sentence scores in quiet and noise are presented; as well as word recognition scores in quiet. Binaural testing was also administered pre-operatively to capture performance in the bimodal condition. Finally, post-operative speech perception data at 3, 6 and 12 months is also presented.  
Conclusion: Currently, a standardized protocol does not exist to aid clinicians in determining who might benefit from a sequential implant, and who is demonstrating adequate performance in a bimodal condition. This study examined the protocol that has been employed to determine bilateral sequential implant candidacy.
Title: Cochlear Implantation for Single Sided Deafness: Case Study of a Patient with a Left Temporal Bone Fracture

Category: Audiology


Abstract:

Introduction: Cochlear implantation (CI) for patients with single sided deafness (SSD) is an area of clinical practice that continues to evolve. Currently, CI in cases of SSD is considered an off-label procedure. Several studies have shown greater benefits with cochlear implantation versus BAHA for sound localization, hearing in noise and tinnitus reduction. There continues to be concern for simultaneous binaural integration of acoustic and electric auditory signals in the case of CI for SSD with normal to near normal hearing in the contralateral ear. This case study reviews CI for SSD in an adult patient who sustained a left temporal bone fracture resulting from a fall. Imaging revealed a transverse fracture through the left temporal bone traversing the posterior and lateral semicircular canal, the basal cochlear turn and jugular foramen. This patient had normal hearing in the contralateral ear. He underwent cochlear implantation in the left ear 8.5 months after his fall. The case study will review center candidacy criteria used for CI in SSD. Outcome measures for speech perception, tinnitus management, and hearing handicap will be discussed. Longitudinal data for evaluation intervals through 5-month post-CI activation will be presented.

Methods: Candidacy evaluation followed center’s established SSD protocol. The patient underwent SSD evaluation with the CROS and Baha devices after unilateral anacusis persisted for 6 months after his accident. Baha assessment using QuickSIN testing was completed. The patient was then counseled regarding CI for SSD. Hearing Handicap Inventory for Adults (HHI), depression screen (PHQ-9) and Tinnitus Handicap Inventory (THI) were distributed pre-operatively and post-operatively. Pre-operative speech perception testing included speech in noise testing of the normal hearing ear, but could not be completed in the affected ear due to anacusis. Post-operatively, sound field thresholds, CNC words and AzBio sentences in quiet are obtained at 1 month post initial stimulation (IS), 3 months and 5 months post IS. Masking was presented to the normal hearing contralateral ear during post-operative testing.

Results: Pre-operative QuickSIN testing revealed minimal to no benefit from the Baha. Post-operatively, patient obtained soundfield thresholds ranging from 15-30 dBHL from 250-4kHz at 1-month post IS. CNC word testing yielded scores of 16% words correct and 33% phonemes correct. AzBio sentences in quiet yielded a score of 14% correct. Gradual improvement in performance was noted over the 5 months post IS. PHQ-9, HHI and THI questionnaires all revealed subjective improvement compared to pre-operative results.

Conclusions: Data presented support existing research that CI offers greater overall hearing benefit than Baha for appropriate SSD candidates. CI for SSD patients is a viable beneficial treatment alternative to existing hearing rehabilitation options.
**Abstract:**

**Introduction:** Determination of cochlear implant candidacy of Infants and children has become increasingly complex. Today, young children are being considered for a cochlear implant if they present with asymmetric hearing loss, single sided deafness, if traditional amplification provides them with limited access to sound, if their unaided thresholds fall outside current FDA indications, or if it appears that their hearing loss will eventually progress to a level of CI candidacy. In such cases, traditional test methodologies lack the sensitivity needed to identify the functional struggles that such children with hearing loss face. Thus, existing test protocols are frequently modified to obtain a more accurate picture of how children perform in difficult listening situations and to determine if a recommendation for a cochlear implant should be made. Historically, such children would be excluded from receiving a cochlear implant if candidacy decisions were based upon results obtained using more traditional measures, such as single word testing in quiet.

**Methods:** This study examined the pre- and post-operative performance characteristics of 30 children who participated in a modified, more difficult test protocol to evaluate candidacy for a cochlear implant. This included children who met FDA criteria when tests were administered in noise and those who failed to meet FDA criteria when tested in noise but received an implant “off label” after obtaining preauthorization from the child’s insurer. Recommendations to provide implants to these children were made following a detailed review of the child’s medical records and careful consideration and discussion by our cochlear implant team.

**Results:** Data will be presented that includes preoperative factors considered in the implant recommendation process, including audiometric thresholds, speech recognition, and speech and language skills. Additionally, post-operative performance data will be described, including speech perception improvements in bimodal hearing, improvements in the ear that was implanted, and improvements in receptive and expressive language skills. Factors known to contribute to success with a cochlear implant were relevant for this group of children, including age at time of implant, presence/absence of other health-related issues, consistency of device use, and mode of communication. As a group, children in this study demonstrated post-operative improvements in both speech perception and expressive and receptive language skills, justifying the decision for cochlear implantation.

**Conclusion:** The outcomes of this study demonstrate that use of a more sensitive test protocol is appropriate for use with many children who do not meet current FDA criteria for a cochlear implant when tested using traditional measures.
Title: Evidence-based Guidelines for Recommending Cochlear Implantation for Post-lingually Deafened Adults

Category: Audiology

Authors:
Jaime Leigh, PhD 1, Michelle Moran, MAud 1, Rodney Hollow, MAud 1, Richard Dowell, PhD 2, Robert Briggs, FRACS 1; 1Cochlear Implant Clinic, Royal Victorian Eye and Ear Hosp., East Melbourne, Australia, 2Audiology and Speech Pathology, Univ. of Melbourne, Carlton, Australia.

Abstract:

Introduction: Selection criteria for cochlear implantation have been developed based on analysis of the post-operative performance of a large group of post-lingually deafened adults. The original criteria published in 2004 were reviewed and amended to reflect the outcomes currently being achieved by cochlear implant recipients.

Methods: Retrospective review of post-operative speech perception performance of 382 post-lingually hearing impaired adults using either a straight or perimodiolar electrode array. Assessments were performed 12 months after implantation.

Results: Revised guidelines suggest that adults with post-lingual hearing loss can now be considered cochlear implant candidates where performance in monosyllabic word testing in quiet for the ear to be implanted is up to 26% scored for words, or up to 55% scored for phonemes. The functional benefit that the implant will provide may vary depending on the recipients’ contralateral hearing.

Conclusion: The findings of this study support the provision of cochlear implants to candidates with significant residual hearing when at least one ear meets the criterion outlined above. Patient-specific counselling is required to ensure that the potential to benefit, predicted by the current model, is acceptable to the individual patient and their family. Counselling regarding the functional benefit must take into consideration the hearing in the contralateral ear.
Title: Using Word Recognition under Earphones (WRearphones) in Cochlear Implant Candidacy Evaluations

Authors:
Anna McCraney, AuD 1, Michael Spearman, BS Biology 2; 1Audiology, Ototronix, St. Paul, MN, 2Ototronix, St. Paul, MN.

Abstract:

Introduction: The proliferation of treatment options for sensorineural hearing loss brings significant overlap in the indications for each. As such, objective measures are needed to help better differentiate between candidates for each technology to ensure patients receive the most appropriate treatment for their loss. Speech Perception Gap measures that compare aided performance against cochlear potential have proven an effective way to distinguish between patients with limited cochlear potential and those who only have limited aided benefit, thereby informing treatment recommendations.

Methods: A retrospective cohort study was performed in a single otologic clinic. Cochlear implant evaluations were performed on 321 ears, in 172 adult patients (120 female; average age 74.7 years). 102 patients underwent surgery with a cochlear implant.

Results: 321 ears had HA CNC WRS and WR<sub>earphones</sub> data. 35% (114/321) of all ears tested for CI candidacy had WR<sub>earphones</sub> ≥50%. 27.5% (70/255) of ears that qualified for a CI also met MEI indications with WR<sub>earphones</sub> ≥50%. For ears with WR<sub>earphones</sub> <50%, average CI CNC was 49.2%, a 39.2% improvement over HAs (p < 0.001), and 32.2% better than WR<sub>earphones</sub> (p < 0.001). For ears with WR<sub>earphones</sub> ≥50%, average CI CNC was 33.5%, a 21.5% improvement over HAs (p < 0.001), but 26.8% worse than WR<sub>earphones</sub> (p < 0.001).

Conclusion: A large percentage of patients undergoing CI candidacy evaluations have significant SP Gaps and, while they qualify for a CI, also qualify for a middle ear implant (MEI) with a WR<sub>earphones</sub> ≥50%. For patients who qualify for CI candidacy, patients with WR<sub>earphones</sub> <50% have a high probability to have CI CNC outcomes better than WR<sub>earphones</sub>, whereas patients with WR<sub>earphones</sub> ≥50% have a significant risk to have CI CNC outcomes worse than WR<sub>earphones</sub>. Therefore, WR<sub>earphones</sub> measurements should be used to help clinicians counsel patients on their choice of hearing treatment technology, especially for those patients with WR<sub>earphones</sub> ≥50% who may be candidates for both a CI and MEI.
Title: Measurement and Experience: The Relationship between Standard Audiological Evaluation Tools and Communication Capacity

Abstract:
Introduction: There is an interwoven relationship between hearing, communication and wellbeing across the life course. Despite increasing evidence supporting this knowledge, a significant disconnect exists between traditional audiological measures and the pervasive expression of the impact of hearing impairment on communication and health domains for an individual. Rapidly developing technology has led to standard audiological measures being limited by a ceiling effect, affecting their usefulness in capturing intervention benefits. In parallel, despite permitting the reach of ceiling scores on routine clinical tests, technology has yet not led to replacing normal hearing for social communication purposes. These siloed standard measurements ultimately do not represent the true experience and communication capacity of the individual. This has pervasive implications extending to the health infrastructure as funding bodies globally are required to rationalise funding decisions to meet individual’s needs. If interventions to assist hearing loss are to attract and retain funding, improved measures of benefit are required not only to highlight the impact of the initial deficit to direct intervention but must also be representative of function post-intervention. This literature review aimed to identify existing and developing tools that assess holistic deficits and perceptual experience of hearing impairment and its impact on social communication and wellbeing.

Methods: A systematic review of published and grey literature was conducted to identify the state of development and potential for clinical usefulness of existing psychosocial tools that address social communication and well-being, for adults with hearing impairment.

Results: A number of questionnaires and quality of life measures exists to address listening and communication abilities within a listening for communication purpose. However, their applicability, validity and sensitivity has not been examined in the context of routine clinical assessments.

Conclusion: Development of future clinical tools to assess hearing impairment would benefit from being representative and sensitive to lived interactional experience. This could be achieved by comparing and integrating them within routine practice to provide a matrix that fully represents an individual’s communication capacity.
**Title:** Congenital Zika Infection and Hearing Loss  
**Category:** Audiology  

**Abstract:**  
**Introduction:** It's now well known that congenital infection with congenital Zika syndrome (CZS) causes not only microcephaly and brain abnormalities but a lot of others organs damages such as visual impairment, orthopedic malformations and hearing loss. A previous report by the authors had already shown the association between congenital infection with Zika virus (ZikV) and congenital hearing loss with a prevalence of 5.8%, which is similar to that seen in association with other congenital viral infections.  
**Methods:** In the present report 139 children with laboratorial confirmation of ZikV infection, positive Zika virus-specific immunoglobulin M (IgM) capture enzyme-linked immuno- sorbent assay (ELISA) performed on cerebrospinal fluid (9), were tested with measurement of the short latency auditory brainstem response (ABR) to click stimuli, and was considered to be normal when wave V (the fifth and most prominent and consistent wave) was identified in two consecutive averaged waveforms at 35 decibels normal hearing level (dB nHL). If the first screening test was not normal, it was repeated approximately 1 month later. If the second test also indicated hearing loss, a diagnostic confirmatory frequency-specific ABR was conducted, in which the stimuli were tone bursts at frequencies of 500 and 2,000 Hz. The diagnosis of hearing loss was confirmed if hearing thresholds exceeded 25 dB nHL. A behavioral auditory testing with musical instruments in open field was also performed.  
**Results:** From 139 newborns with confirmed CZS, seven had diagnosis of SNHL. One of these children was excluded because she was exposed to ototoxic drug before the first screening test, resulting in an incidence of 6/138 (4.3%). From these six affected children, four had been tested with a second FS-ABR conducted after 11 to 16 months after the first diagnosis. In all of them, the second test confirmed the result of the first one. The mean head circumference size in the group with SNHL was (27.3) smaller than those without SNHL (29.1) and this difference was significant (p=0.04), but otherwise there were no significant differences in characteristics or medical history between the two groups.  
**Conclusion:** Congenital infection with Zika virus should be considered a risk factor for hearing loss. Children with evidence of congenital Zika virus infection who have normal initial screening tests should receive regular follow-up, because onset of hearing loss associated with other congenital viral infections can be delayed and the loss can be progressive.
Title: Cochlear Implant in a Child with Microcephaly for Congenital Zika Virus Infection

Abstract:

Introduction: In this case report we show the first case of cochlear implantation in a child with microcephaly due to congenital zika virus syndrome (CZS). He was diagnosed with CZS in the first months of life with positive Zika virus-specific immunoglobulin M (IgM) capture enzyme-linked immunosorbent assay (ELISA) performed on cerebrospinal fluid and computerized tomography revealing diffuse bilateral reduction of cerebral parenchyma, ventriculomegaly, malformation of cortical development, with simplified gyral pattern and multiple cerebral calcifications predominantly in the basal ganglia and cortical-subcortical regions. At that moment audiological evaluation with transient otoacoustic emissions and auditory brainstem response (ABR) to click stimuli at 35 decibels normal hearing level (dB nHL) were performed with absent results in both of them.

Methods: Further sensorineural hearing loss was confirmed by the measurement of frequency-specific ABR, in which the stimuli were tone bursts at frequencies of 500 and 2.000 Hz and revealed response only at 85 dB nHL for the frequency of 2.000Hz in the right ear. Behavioral auditory evaluation was done using instruments of known frequency range at 60cm from the pinna. The cochleopalpebral reflex was absent and there was no response to voice stimulus at 100dB. There was no response even for high intensity stimulus.

Results: At the age of 6 months he received hearing aids and the cochlear implantation was performed 18 months later in the right ear with standard electrodes inserted trough the round window without any complications. Intra-operatory neurotelemetry showed normal impedancy for all electrodes and device’s activation showed immediate response of attention to the sound.

Conclusion: Cochlear implant is a treatment option for sensorineural hearing loss in cases of microcephaly with congenital zika syndrome.
Title: Melodic Contour Identification and Sentence Recognition by Prelingually-deafened Child Cochlear Implant Users: A Preliminary Report Using Sung Speech

Category: Audiology

Authors: Yingjiu Nie, Ph.D. 1, Stephanie Moody-Antonio, M.D. 2, Debora Hatch, Au.D. 2, Harley Wheeler, B.S. 1; 1Communication Sciences and Disorders, James Madison Univ., Harrisonburg, VA, 2Otolaryngology, Eastern Virginia Med. Sch., Norfolk, VA.

Abstract: Melodic pitch perception of postlingually-deafened cochlear implant (CI) users has been shown to be negatively affected by the increase of complexity of speech timbre. Conversely, speech timbre processing (e.g., sentence recognition) has been shown to be affected by the naturalness of utterance pitch contours (Crew et al., 2015) This is attributed to the reduced spectral and temporal details transmitted through CI devices, rendering cues for pitch and timbre encoded through common pathways. Prelingually-deafened CI users have limited to no experience of acoustic pitch information. In other words, their auditory system develops in the context that pitch and timbre are represented by common cues to a large degree. Thus, it is of interest how the manipulations of the complexity of pitch contour and speech timbre affect the perception of the other in this population. The goal of the current study was to investigate this question in prelingually-deafened child CI users. In addition, the effects of selected neurocognitive skills on pitch contour and speech processing were also studied.

Methods: Prelingually deafened children at 9-16 years of age were tested. The Sung Speech Module of Angel Sound was used as described in Crew et al (2015). Both sentence identification and melodic contour identification (MCI) were tested. For the sentence identification, participants identified five random words (50 possible options) presented in a sentence with a syntax structure of name-verb-number-color-clothing with either normal speaking style or singing style with flat or varying pitch contours. For the MCI, participants identified the pitch contour of a given sequence while its five elements varied amongst being piano notes, the same word, or randomly selected words. Each condition contained 27 trials. Scores were calculated by percent correct for both total sentences and for word order in sentence trials. Three neurocognitive skills (receptive vocabulary, nonverbal IQ, and auditory working memory) were measured and their effects on MCI and speech recognition were assessed.

Results: Preliminary observation showed that for sentence identification, listeners scored highest when the sentences were naturally spoken. Sentence recognition scores were found to correlate with receptive vocabulary positively while age was controlled for, but not with nonverbal IQ or auditory working memory. For the MCI task, 9-year-olds performed at chance level, consistent with the inability to process pitch contours. Variations of complexity of speech timbre did not show an effect on pitch contour identification. When age effect was controlled for, auditory working memory was found to positively correlate with the MCI performance.

Conclusion: Overall, the preliminary data suggest that, like postlingually-deafened CI users, the naturalness of pitch contour may affect speech identification in prelingually-deafened child CI users. Different from postlingually-deafened CI users, the MCI was not affected by the complexity of speech timbre in prelingually-deafened child CI users. While prelingually-deafened child CI users lagged in the development of pitch contour processing, this processing may also be limited by the capacity of auditory working memory. Crew JD, Galvin JJ, Fu Q-J (2015) Melodic contour identification and sentence recognition using sung speech. The Journal of the Acoustical Society of America 138:EL347-EL351.
Title: Electrocochleography Estimates Residual Hearing in Cochlear Implant Recipients: A Multi-Center Study

Category: Audiology

Authors:
Jourdan T. Holder, AuD 1, Kanthaiah Koka, PhD 2, Robert Dwyer, AuD 1, William J. Riggs, AuD 3, Michael S. Harris, MD 4, Brendan O’Connell, MD 5, Amanda Ortmann, PhD 6, Craig Buchman, MD 6, Oliver F. Adunka, MD 3, Leo Litvak, PhD 7, Robert F. Labadie, MD, PhD 1; 1Hearing and Speech Sciences, Vanderbilt Univ. Med. Ctr., Nashville, TN; 2Advanced Bionics, Valencia, CA; 3Ohio State Med. Ctr., Columbus, OH; 4Med. Coll. of Wisconsin, Milwaukee, WI; 5Univ. of North Carolina, Chapel Hill, NC; 6Washington Univ. Sch. of Med., St. Louis, MO; 7Advanced Bionics, Valencia, TN.

Abstract:
Introduction: In cochlear implant (CI) patients with preserved residual hearing, the CI electrode can be used to record close-proximity electrocochleography (ECochG) responses to an acoustic pure-tone stimulus. The objective of the present multi-center study was to determine if thresholds estimated based on cochlear microphonic magnitude (“CM thresholds”) can be used to accurately predict pure-tone post-operative audiometric thresholds in CI recipients with residual hearing.

Methods: Seventy (mean age = 52 years, SD = 14) adult patients with a HiRes90k cochlear implant and a HiFocus mid-scala electrode array participated in this study. Behavioral pure-tone thresholds for warble tones were measured using insert ear phones for 125 to 4000 Hz post-operatively. ECochG waveforms were recorded on the most apical electrode of the implant array in response to calibrated pure tones and were used to estimate the CM thresholds. The frequencies with behavioral “No Responses” were replaced with 5 dB above audiometric tested stimulus levels.

Results: CM thresholds and behavioral audiometric thresholds could be measured for 63 subjects. Seven subjects showed neither behavioral nor ECochG responses. A strong correlation (r^2 = 0.85, p < 0.001) was observed between CM thresholds and the behavioral audiometric thresholds. The mean absolute difference between the ECochG responses and audiometric thresholds was 9 dB (STD=10.0).

Conclusion: CM thresholds collected post-operatively from the CI electrode may be used as a more time efficient way to routinely measure and monitor residual hearing in CI recipients.
**Title:** Perceptual Identification of Declarative and Interrogative Utterances in Mandarin-Speaking Cochlear Implanted Children

**Category:** Audiology

**Authors:**
Wentao Gu, PhD, Yao Zhu, BA; Nanjing Normal Univ., Nanjing, China.

**Abstract:**

**Introduction:** Most previous studies on intonation perception in cochlear-implanted children were conducted for those speaking non-tone languages in which the fundamental frequency ($F_0$) of speech is mainly used for sentential intonation, with little role in distinguishing word meaning. In tone languages like Mandarin, however, the $F_0$ of speech conveys both sentential intonation and lexical tones, which interact in a complex manner. It has been well known that the lexical tone of the sentence-final syllable affects the perception of sentential intonation in Mandarin. The present study aimed to investigate Mandarin-speaking implanted children’s perceptual accuracy in identifying declarative and interrogative utterances sharing the same linguistic information in all contexts of the sentence-final tone.

**Methods:** The perceptual experiment recruited two groups of children at the age of 4-5 years, i.e., the normal hearing (NH) group, and the cochlear-implanted group who were tested in both unimodal condition (CI) and bimodal condition (CIHA). We used a set of 5-syllable sentences, of which the first two, the third, and the last two syllables correspond to the noun subject, the verb, and the noun object, respectively. While the sentence-final syllable varies with four tones (T1-T4), other four syllables are all in T1. By ending with period and question mark, respectively, declarative and interrogative sentences were formed. Because speech rate is also an acoustic cue distinguishing declarative and interrogative utterances, we used both natural and time-normalized synthetic speech as the stimuli for experiment. In the experiment, a card showing a question mark indicated ‘Question’, while a card showing a cross covering the question mark indicated ‘Not question’. All utterances were presented in a random order. For each utterance, the pictures of the subject and the object were both shown on the screen, and after the utterance was played back, each child was asked to identify whether it was a question or not by selecting the appropriate card.

**Results:** CI showed significantly lower accuracy than NH ($p < 0.05$) and CIHA ($p < 0.05$), while there is no significant difference between NH and CIHA. This finding coincides with the fact that cochlear implants do not provide direct coding of $F_0$ through their aided ears with residual hearing. In addition, the sentence-final tone showed a significant effect on perceptual accuracies in NH and CIHA. In a comparison between the tests on natural speech and time-normalized speech, CI showed no significant difference in the accuracy, whereas CIHA and NH showed lower accuracies on time-normalized speech than on natural speech. This suggests that the coordination between pitch and duration information is important for perceptual identification of declarative and interrogative utterances.

**Conclusion:** For CI children speaking Mandarin, bimodal technology is helpful for improving their perception of sentential intonation in Mandarin speech, in spite of the interaction between tone and intonation.
Title: Analysis of Electrically Evoked Compound Action Potential of the Auditory Nerve in Children with Bilateral Cochlear Implants

Category: Audiology

Authors:
Fernanda Caldas, AUDIOLOGIST, Carolina Cardoso, AUDIOLOGIST, Fayez Bahmad Jr, DOCTOR;AUDIOLOGIST, IBORL, BRASILIA, Brazil.

Abstract:
Introduction: The cochlear implant device has the capacity to measure the electrically evoked compound action potential of the auditory nerve. The neural response telemetry is used in order to measure the electrically evoked compound action potential of the auditory nerve.

Methods: This is an analytical, prospective, longitudinal, historical cohort study. Six children, aged 1-4 years, with bilateral cochlear implant were assessed at five different intervals during their first year of cochlear implant use.

Results: There were significant differences in follow-up time (p=0.0082) and electrode position (p=0.0019) in the T-NRT measure. There was a significant difference in the interaction between time of follow-up and electrode position (p=0.0143) when measuring the N1-P1 wave amplitude between the three electrodes at each time of follow-up.

Conclusion: The electrically evoked compound action potential measurement using neural response telemetry in children with bilateral cochlear implants during the first year of follow-up was effective in demonstrating the synchronized bilateral development of the peripheral auditory pathways in the studied population.
CI2018 DC Poster Abstracts

Poster Number: 72
Abstract ID: 360
Title: Bilateral Cochlear Implants: Outcomes in Children
Category: Audiology
Authors:
Gabriela Lazarini, Master Student, Marcela Ferrari, Master, Lucas Costa, PhD, Orozimbo Costa, PhD, Ana Claudia Martinho-Carvalho, PhD;Univ. of Sao Paulo, Sao Paulo, Brazil.

Abstract:
Introduction: Cochlear implants (CI) revolutionized the way in which individuals with profound hearing loss interact with other individuals and with the environment, since a significant improvement in speech perception has been described in all age groups. The use of bilateral CI may be able to promote symmetrical development of the central auditory pathways, in order to benefit the development of hearing and oral language skills in the pediatric population and to improve speech perception in competitive noise situations. Studies have shown that bilateral CI improves the performance of sound localization and speech perception in silence and noise in adults and children, regardless of the time between the two surgeries and the age of the patient. The objective of this study was to evaluate auditory development in children with sequential bilateral cochlear implants.

Methods: A cross-sectional clinical study, approved by the Research Ethics Committee of the institution and carried out in a group of 16 children between 4 and 16 years of age, who received a surgical indication for sequential bilateral Cochlear Implant (CI) as a form of intervention in the auditory habilitation process. Speech perception was evaluated through lists of sentences constructed in the Brazilian Portuguese. The sentences were presented in two situations: in silence, as a fixed intensity of 60 dBHL and in competitive noise, with a signal to noise ratio of 15 dB. The evaluation was performed under the following conditions: unilateral condition with the first CI activated; unilateral condition with the second CI activated and also bilateral condition.

Results: The results of the speech perception tests showed better performance in both silence and noise for the bilateral CI condition, when compared to the 1st and 2nd CIs separately. The use of hearing aids in the contralateral ear to the 2nd CI seemed to benefit the speech perception results of the 2nd CI in both silence and noise. No correlation was found between surgical age and surgeries interval and speech perception performance for all conditions.

Conclusion: The results of the speech perception tests showed better performance in both silence and noise for the bilateral CI condition, when compared to the 1st and 2nd CIs separately. The use of hearing aids in the contralateral ear to the 2nd CI seemed to benefit the speech perception results of the 2nd CI in both silence and noise. No correlation was found between surgical age and surgeries interval and speech perception performance for all conditions.
Title: The Relationship between Lexical Tone and Melodic Contour Identification of Taiwanese Adult Cochlear Implant User

Category: Audiology

Authors:
Pao-Hsiang Chi, ph.D 1, Yi-Lin Fu, Master 1, Pei-Yi Wang, Master 2; 1Special Education, Natl. Taipei Univ. of Ed., Taipei, Taiwan, 2Division of Ear, Nose & Throat, Mackay Mem. Hosp., Taipei, Taiwan.

Abstract:

Introduction: The main purpose of the current study was to investigate the correlation between perceptual abilities of lexical tone and melodic pitch in Taiwanese CI adults. Besides, Mandarin tone production skill was also investigated in order to examine the relationship between tone perception and production in Taiwanese adult CI users.

Method: 30 CI recipients participated in this study. Lexical tone recognition task and melodic contour identification (MCI) task were conducted to all subjects. Lexical tone recognition task was measured for four Mandarin tonal patterns. 30 tone tokens were recorded from each of the subjects as production data, and evaluated by native speakers of Mandarin Chinese. As for the melodic contour identification, 6 distinct melodic patterns were used in the MCI test. Each contour was composed of 5 notes with equal duration, and the interval between successive notes was 5 semitones.

Results: It was found that lexical tone-recognition performance of the CI users was 78.86% correct on average. MCI performance of the CI users was 36.48% correct. The Pearson correlation coefficients between CI subjects’ performance in lexical tone recognition and MCI task were approximately 0.52. In addition, for CI subjects, Tone 4 was the easiest one to be perceived and produced, and Tone 2 was found to be the hardest one in both recognition and production task. Tone 2 was more often to be misperceived and produced as Tone 1.

Conclusion: Adult CI users’ performance in lexical tone recognition and MCI test are moderately correlated, and this result implies that perception of melodic pitch and lexical pitch might share similar perceptual properties in Mandarin Chinese spoken in Taiwan. Key words: cochlear implant, lexical tone recognition, tone production, melodic contour identification
Title: Investigating the Role of Working Memory in Speech-in-noise Understanding for Young and Older Adult Listeners with Normal Hearing

Abstract: With the arrival of cognitive hearing science, increased attention has been given to individual differences in cognitive functioning and their power to explain inter-listener variability in understanding speech in noise. The psychological construct that has received most interest is working memory (WM), representing the ability to simultaneously store and process information. Previous research has confirmed the association between WM capacity and speech in noise identification in older hearing-impaired listeners (Lunner 2003; Foo et al. 2007; Lunner and Sundewall-Thorén 2007; Arehart et al. 2013; Füllgrabe and Rosen, 2017). Less is known about whether or not WM capacity also plays a role in understanding speech in noise in young and older normal hearing adults. To assess if aged related differences in WM capacity accounts for differences in speech in noise understanding in the absence of peripheral hearing loss, we investigated the relationship between a WM capacity and speech understanding in noise in a group of young and a group of older adults with age-appropriate hearing.

Methods: Thirty-three older adults (mean age: 71 years; range: 60.4 - 82.7 years) and 27 young volunteers (mean age: 21.7 years; range: 19.1 - 25 years) participated in the study. All participants were native speakers of Dutch. They all had age-appropriate normal hearing and no history of central nervous system dysfunction. WM capacity was investigated using the Dutch version of the reading span test (RST) and recognition of sentences in the presence of a stationary speech-shaped noise was measured using a Dutch sentence test (LIST).

Results: The RST results demonstrated that the older adults have significantly worse working memory capacity scores compared to the younger adults. The same was found when analyzing the results of the LIST test, indicating that older adults are significantly worse in understanding speech in noise. Results also show that WM capacity (as measured by the Reading-Span test) is a reliable and strong predictor of speech understanding in noise in older listeners with age-appropriate hearing, a correlation that cannot be found in young normal hearing listeners.

Conclusion: The current results caution against the assumption that WM necessarily supports speech in noise identification independently of the age and hearing status of the listener.
**Title:** Expanded Indications for Cochlear Implantation: Unilateral Hearing Loss  
**Category:** Surgery/Medical  
**Authors:** Harold Pillsbury, MD 1, Margaret Dillon, AuD 1, Emily Buss, PhD 1, Meredith Rooth, AuD 1, English King, AuD 2, Kevin Brown, MD, PhD 1; 1Otolaryngology/Head and Neck Surgery, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC,  2Audiology, UNC HealthCare, Chapel Hill, NC.

**Abstract:**

**Introduction:** Patients with substantial unilateral hearing loss (UHL) or Single-Sided Deafness (SSD) experience poor speech perception in noise and limited localization as compared to normal-hearers. Unfortunately, approved treatment options for UHL and SSD do not provide significant improvements in speech perception in challenging listening conditions and localization. These treatment options route the signal from the affected ear to the normal hearing ear, limiting access to binaural cues. Cochlear implantation has been explored as a potential treatment option for cases of UHL and SSD. The cochlear implant stimulates the affected auditory pathway, and may offer improvements in speech perception in noise and localization. The present report reviews the preoperative and post-initial activation speech perception and localization of CI recipients with UHL to assess its effectiveness as a treatment option.

**Methods:** Twenty (20) subjects with UHL 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 (normal hearing ear alone, NH-alone) and with a bone-conduction hearing aid (BCHA+NH). Subjects were assessed in the NH-alone condition and with the cochlear implant plus the NH ear (CI+NH) 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. Speech perception was assessed using AzBio sentences in a 10-talker babble at 0 dB SNR. Localization was evaluated using noise bursts presented randomly across 11 speakers at varying intensity levels.

**Results:** Preoperatively, speech perception in noise was similar or poorer in the BCHA+NH condition as compared to the NH-alone condition. Localization was significantly worse in the BCHA+NH condition as compared to the NH-alone condition. Subjects demonstrated a significant improvement on speech perception in noise and localization with the CI+NH over the NH-alone condition as early as the 1-month follow-up interval. Performance on both tasks continued to improve through the 12-month interval with the CI+NH.

**Conclusion:** Subjects with UHL experienced a significant improvement with the CI+NH on measures of speech perception in noise and localization that were evident as early as one month of listening experience. Performance with the CI+NH exceeded that of the BCHA+NH condition. These results support the idea of expanding cochlear implantation candidacy criteria to include those with UHL and SSD.
**Introduction:** A slim pre-curved perimodiolar electrode (CI532) was recently developed by Cochlear Ltd (Sydney) that allows closer placement to the modiolus due to the elimination of the internal stylet and surrounding silicone rubber which reduces the electrode volume by 60% when compared with the perimodiolar CI512 device. The goal of this work is to compare the surgical reliability and performance outcomes between the CI512 and CI532 devices.

**Method:** In this retrospective review two groups of 28 subjects each (13 paediatric and 15 adults) who received the CI512 device and the CI532 device were compared considering electrode array tip fold-over, NRT thresholds, hearing preservation, power efficiency and CI performance outcome (BKB sentences) at 3 and 6 months post activation.

**Results:** Preliminary data from these groups reveals better low frequency hearing preservation in the CI532 group. No significant difference was seen between the groups in terms of NRT thresholds, power efficiency and CI performance. No significant difference was seen in electrode array tip fold-over between the groups and tip fold-over was only observed in one case in the CI532 group.

**Conclusion:** Our preliminary results with the CI532 implant indicate that it may be possible to use this electrode for better hearing preservation due to reduced insertion trauma when compared to the CI512 electrode however; further studies are required to determine its definitive advantage over other electrode designs.
INTRODUCTION: Over the last several years, cochlear implants have been used for a wide variety of indications. However, in the past few years new indications and novel techniques have been described in literature according to individual characteristics. Those new indications for cochlear implant insertion include patients with cholesteatoma, tinnitus, sudden sensorineural hearing loss, unilateral hearing loss, and long-term hearing loss. This poster illustrates the case of a patient whose indication for a cochlear implant has been recently describe.

METHOD: A review of the patient's medical record was performed and the benefits of a cochlear implant were described.

RESULTS: A 66-year-old male with previous acoustic trauma at 14 years of age that resulted in left tympanic membrane perforation, hearing loss and infection, was treated with left stapedectomy at age 25, followed by worsening of his hearing loss. He presented with progressive right hearing loss of 2 years duration, treated with conventional hearing aid. Additionally, he complained of severe, constant, disabling left tinnitus managed with benzodiazepines. Audiologic test revealed left cofosis, and right ear with moderate to severe sensorineural hearing loss, PTA 51 dB, speech discrimination 100% at 100 dB. Temporal bone scan with image suggesting left cholesteatoma at the hypotympanum. The case was discussed at an ENT surgical decision-making meeting after which cochlear implant was recommended to treat tinnitus. He underwent left radical mastoidectomy with canal obliteration and cochlear implantation. During surgery, cholesteatoma was found in the middle ear without erosion of the ossicles or scutum, although the ossicles were fixed. At follow-up, he presented with a retroauricular seroma which was drained without further complications, and is currently being evaluated with tinnitus handicap inventory.

CONCLUSION: New indications for the use of cochlear implants may be beneficial after appropriate patient selection. The presence of cholesteatoma is not a contraindication for surgery. Mastoid obliteration must be considered in patients that were previously deemed inoperable. Further research is needed on the identification of additional potential benefits of cochlear implants based on patient individualization.
Title: Cochlear Implantation in Elderly Patients Under Local Anaesthesia - A Case Report

Category: Surgery/Medical

Authors:
Nora Kecskemeti, MD, Magdolna Szönyi, MD, PhD, Marianna Küstel, MD, PhD, Anita Gaborjan, MD, PhD, Laszlo Tamas, Professor, Gabor Repassy, Professor; Department of Otorhinolaryngology, Head- and Neck Surgery, Semmelweis Univ., Budapest, Hungary.

Abstract:
Introduction: Average life-expectancy increases and a sufficient hearing rehabilitation for elderly patients becomes more important. Cochlear implantation is a relatively safe surgical procedure also for elderly patients, the higher risk is caused by general anaesthesia. We report about a patient who underwent cochlear implantation in local anaesthesia.

Methods: After detailed preoperative examinations (audiological tests, imaging, genetic tests (GJB2 sequence analysis), evaluation of motivation and compliance of the patient) an 81 year old male patient with severe to profound mixed hearing loss caused by progressive bilateral profound otosclerosis was selected for cochlear implantation in local anaesthesia. For the electrode insertion we used the postero-suprameatal approach technique. Pre- and postoperative pure tone audiometry and speech-perception tests were conducted to prove the success of the procedure.

Results: The mentioned technique was applied, the length of the operation was 48 minutes. The intraoperative measurements showed normal impedance and normal neuronal response telemetry and the patient had sound experience during the intraoperative examination of the engineer. No complications were observed in the postoperative period. The postoperative audiological tests showed a significant increase in the hearing perception.

Conclusion: Cochlear implantation under local anaesthesia is a safe and fast procedure for patients, which can also be applied in the elderly. The intraoperative sound experience can give an extra motivation in the postoperative rehabilitation. Our results prove that by carefully selected elderly patients cochlear implantation can assure a significant increase in speech perception. We can establish that the new postero-suprameatal approach technique combined with local anaesthesia presents a viable future option for those patients who were inoperable beforehand because of high risks due to general anaesthesia.
**Abstract:** Cochlear Implantation (CI) is a well-known procedure for treatment of deafness. Also in cases of single sided deafness (SSD) it shows a benefit in speech understanding especially in noisy environment. Anomalies and malformations of the inner ear and the inner ear canal are potential contraindications for a CI supply. We report about results of two children born with SSD and equipped with a CI at the age of 8 and 15. Due to a nationwide screening of hearing disorders for newborn children in Germany single sided deafness is detected more frequently. Anomalies of the inner ear and the inner ear canal are quite common in these cases. A causal therapy of deafness consists in a Cochlear Implantation. This is also an attempt for children born with single sided deafness. In case of a narrow inner ear canal and absence of cochlear nerve in MRI a cochlear implantation should be considered critically.

**Methods:** Indications for a cochlear implantation and results afterwards are reported in two cases of children with narrow inner ear canal and single sided deafness. Concerning anatomical malformation an indication for CI supply was given rather late.

**Results:** A boy who underwent CI surgery at the age of 8 showed neural responses (NRI) intraoperatively. At time of first fitting (appr. 4 weeks postoperatively) he recognized acoustical sensations. In the following rehabilitation he began to differentiate words with different syllables. The second case, a 15 year old girl, have had a positive promontory test during diagnostic investigations before CI surgery. At the time of first fitting she recognized only beeps after activating the CI. Half a year after surgery she starts to detect words of a closed list.

**Conclusion:** A narrow inner ear canal is a possible contraindication for CI supply especially in cases of unilateral deafness. The reported two cases of children with narrow inner ear canal and single sided deafness are an example for a hearing rehabilitation with cochlear implants better than with conventional hearing aids or brainstem implants. In individual cases of narrow inner ear canal and single sided deafness a CI supply can be considered after appropriate information about possible postoperative problems.
Poster Number: 80
Abstract ID: 78
Title: Evaluation of the Results of Cochlear Implant among Prematures and Fullterms with Perinatal or Postnatal Hypoxia
Category: Surgery/Medical
Authors:
Ahmed Mehanna, PhD, Otolaryngology, Alexandria School of Medicine, Alexandria, Egypt.
Abstract:
Objective: Preoperative evaluation of the type of deafness before cochlear implant for all deaf children with severe bilateral sensorineural hearing loss with history of perinatal hypoxia in order to assess the mechanism of deafness among prematures and full term with a history of perinatal hypoxia.
Study Design: A longitudinal study of all pediatric cochlear implant patients referred to Sydney Cochlear Implant Centre who had history of perinatal or postnatal hypoxia or asphyxia. Electrophysiological data were collected retrospectively and prospectively and analyzed. Some oto-acoustic emissions (OAE) data was collected during the neonatal period prior to referral for cochlear implant. All subjects were tested using round window electrocochleography (RWEcochG), auditory brainstem responses (ABR), and implant-evoked electric auditory brainstem responses (EABR). The tested group consisted of 53 profoundly deaf child who experienced hypoxia or asphyxia in their perinatal period is further divided into two subgroups, prematures (their gestational age is below 31w) and fullterms (born after 31 weeks of gestation). Cochlear implantation was done for all studied cases and evaluation of the results was done using electric ABR and numerical interpretation was done in the monopolar, bipolar mode and compared to the behavioral responses.
Institution: Alexandria School of Medicine, Alexandria, Egypt
Keywords: Auditory neuropathy, otoacoustic emissions, round window electrocochleography, electric auditory brainstem potentials.
Title: Cochlear Implants in the Middle East. The Start in 1983.
Category: Surgery/Medical
Authors: Abdelaziz Belal, MD 1, Selvia Khalil, MBA 2; 1ORL, ALEXANDRIA medical school, Alexandria, Egypt, 2Audiology, ALEXANDRIA ear hospital, Alexandria, Egypt.

Abstract:
Introduction: A cochlear implant program was started in Egypt and Saudi Arabia in 1983. The stages and difficulties met during progression of the program are discussed after 35 years in which 1500 implants were done are discussed. The guidelines for starting a program in the developing countries are presented.

Methods: Will be presented
Results: Will be presented
Conclusion: Guidelines for starting cochlear implant programs are presented.
Title: Surgical Outcome of Cochlear Implantation in Patients with Chronic Otitis Media

Category: Surgery/Medical

Authors:

Abstract:
Introduction: This study evaluated the surgical outcomes of cochlear implantation in patients with chronic otitis media (COM).

Methods: The clinical data of 13 cases of cochlear implantation in presence of COM was analyzed retrospectively. Rates of postoperative infections, complications and post-implant speech performance were analyzed.

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

Conclusion: Cochlear implantation is a safe and effective treatment for patients with severe to profound hearing loss secondary to COM.
Title: Cochleostomy and Facial Recess Packing Alter Cochlear Implant Electrode Location in a Human Cochlea Model

Abstract:

Introduction: Variations exist in surgical techniques for packing the cochleostomy and facial recess during cochlear implantation which may influence electrode location. We seek to determine the effect of cochleostomy and facial recess packing on cochlear implant electrode distance from the modiolus using a model of the human cochlea.

Methods: Two otolaryngology residents (PGY5 and PGY6) and one attending ear surgeon participated in this study. Using a model of the human cochlea, each subject performed electrode insertions using a perimodiolar electrode (Cochlear ® Slim Modiolar 532 ™, CI532) and a lateral wall electrode (Cochlear ® Slim Straight 522 ™, CI522) via a cochleostomy site. Packing material was simulated using cotton and placed into the cochleostomy and facial recess after insertion under the following conditions: 1) inferior to the electrode, 2) superior to the electrode, 3) both inferior and superior, and 4) no packing. Outcome measurements included mean distance of the electrode from the modiolus at the proximal, middle, and distal basal turn of the cochlea, as measured by analysis of photomicrographs taken with the model.

Results: For the CI532, packing of the cochleostomy and facial recess superior to the electrode resulted in a statistically significant decrease in distance from the modiolus at both the middle and distal basal turn regions compared to the inferior, and inferior and superior conditions. The difference in modiolar proximity when specifically comparing superior to inferior packing was considerable in the middle basal turn region (0.25 mm vs. 1.92 mm, respectively, p<0.001). For the CI522, packing superior to the electrode array similarly resulted in a significantly decreased distance to the modiolus when compared to the inferior, and inferior and superior packing conditions, at both middle and distal basal turn regions. When examining modiolar proximity at the middle basal turn, differences in superior vs inferior conditions (1.25 vs. 1.75 mm, respectively, p=0.002) were less pronounced than those observed for CI532 insertions.

Conclusion: Packing of the cochleostomy site and facial recess has a significant effect on electrode distance from the modiolus in the middle and distal basal turn using a model of a human cochlea. Effects were more pronounced when using a perimodiolar (CI532) electrode.
Utility of Intraoperative Computed Tomography for Cochlear Implantation in Patients with Difficult Anatomy

Abstract:
Introduction: As cochlear implantation is being increasingly performed on patients with abnormal ear anatomy, surgeons are challenged with navigating through difficult-to-identify or sometimes unidentifiable anatomical landmarks to successfully place the electrode in its precise position and depth into the cochlea without complications. Intraoperative imaging has been shown to be useful in achieving this goal, and several different modalities have been described.

Methods: This case report describes our experience with intraoperative high-resolution computed tomography (HRCT) in cases of cochlear implantation in patients with abnormal and difficult ear anatomy, illustrating its utility in such cases.

Results: A 2-year-old male with congenital X-linked stapes gusher syndrome and a 2-year-old female with enlarged vestibular aqueduct underwent successful cochlear implantation with the help of intraoperative CT. In the latter case, the initial intraoperative C-arm X-ray suggested malposition of the electrode, however, was not able to provide details for adjustments. In both cases, intraoperative CT changed the insertion technique of the operating surgeon and allowed for improved electrode positioning. A 47-year-old female with polyostotic fibrous dysplasia and a 55-year-old male with postmeningitis near-total cochlear obliteration underwent successful cochlear implantation with confirmation of electrode position with intraoperative CT. In the former case, image-guided navigation system was also implemented. Finally, a 72-year-old female underwent cochlear implantation during which intraoperative C-arm X-ray suggested intra-cochlear insertion. However, postoperative CT showed the electrode extending into the IAC, illustrating the limitations of C-arm X-ray.

Conclusion: When faced with challenging temporal bone anatomy, intraoperative CT provides critical details of the patient’s microanatomy that allows for improved localization of the electrode and adjustments in operative techniques for successful cochlear implantation. The three-dimensional HRCT images are advantageous over C-arm X-ray, and thus should be considered a valuable tool.
Poster Number: 85
Abstract ID: 80
Title: Insertion Depth of the Cochlear Implant Electrode Implanted through the Round Window versus Classic Facial Recess Approach - A Temporal Bone Study
Category: Surgery/Medical
Authors:
Ahmed Mehanna, phdOtolaryngology, Alexandria school of medicine Egyp, Alexandria, Egypt.
Abstract:
Objective: Compare the insertion depth and scalar location of cochlear implant (CI) electrode implanted through round window membrane (RWM) versus cochleostomy approach, using multislice computed tomography (CT).
Materials and Methods: The study was conducted on twenty fresh human temporal bones. Ten were implanted through RWM approach and the other ten through cochleostomy using standard dummy CI electrode. The CI electrodes were advanced till the point of first resistance then assessed using multislice CT.
Results: The study showed no significant differences in insertion depths whether angular or linear in the two study groups. However the RWM approach was associated with statistically significant higher incidence of scala tympani (ST) placement compared to scala vestibuli (SV) placement. Also ST placements were associated with statistically significant lower insertion depth compared to SV placement.
Conclusion: The present study suggests that, for hearing preservation cochlear implantation, advancing the CI electrode through the RWM till the point of first resistance is the recommend first choice whenever the anatomical orientation of the RWM allows.
Introduction: During preparation for and during rehabilitation after cochlear implantation patients can be confronted with the diagnosis of a malignant tumor. It is to be assumed that the diagnosis has influence on the course of the rehabilitation of deafness. In rare cases the deafness even occurs after radiation of a malignant epipharyngeal tumor. This work investigates how often the diagnosis of a malignant disease has been made as a coincidence during the preparation for cochlear implantation, the effects of this on the procedures, and whether specific measures for rehabilitation are derived from this.

Methods: The files of all patients who have been implanted or have been diagnosed for implantation in Halberstadt since 1998 were retrospectively reviewed to determine whether a malignant tumor (no vestibular schwannoma or meningioma) was diagnosed in connection with the preparation or during rehabilitation by means of the specific investigations. Patients with known treatment for malignant diseases were screened for specific complications.

Results: The detection of a malignant disease as a random finding in the context of CI is a rare occurrence. One single renal cell carcinoma and one colorectal carcinoma were diagnosed this way. During rehabilitation, two basal cell carcinomas occurred. One single patient had been implanted after becoming deaf relating to a radiation of a nasopharyngeal carcinoma. In this case a cholesteatoma of the outer ear canal or disturbance of epithelialization occurred 12 months after CI and had to be operated again.

Conclusion: Cochlear Implantation can help to reduce the consequences of therapy of malignant tumors as nasopharyngeal carcinoma. Regular ENT-contacts during rehabilitation should be used to do a complete ENT-examination. While many older CI candidates have already malignant diseases in their history, random diagnoses are rare in the course of preparation for the CI. Complaints made by patients during the rehabilitation must, however, be strictly taken seriously and clarified by a physician. Operations in a pre-irradiated area are expected to result in wound healing disorders.
Poster Number: 87  
Abstract ID: 349  
Title: Intraoperative Electrocochleography and Electrode Tip Fold-Over in Pediatric Patients  
Category: Surgery/Medical  
Authors:  
W. Jason Riggs, AuD, Jameson K. Mattingly, MD, Yusif Haciyev, MD, Prashant S. Malhotra, MD, Oliver F. Adunka, MD; Otolaryngology-Head and Neck Surgery, Nationwide Children's Hosp. & The Ohio State Univ., Columbus, OH.  
Abstract:  
Introduction: Tip fold-over is a rare but serious complication that can occur during cochlear implant (CI) surgery. The current method of detection is the use of intraoperative imaging. However, identifying a real-time electrophysiologic method of detecting tip fold-over could be of great benefit to patients. The purpose of this study was to evaluate whether the use of acoustically evoked cochlear potentials in patients with substantial amount of hair cells (auditory neuropathy spectrum disorder and enlarged vestibular aqueduct) could be used to identify differences in responses between patients with and without electrode tip fold-over.  
Methods: Eight pediatric patients undergoing CI surgery were evaluated using electrocochleography (ECochG) intraoperatively before and after electrode array insertion near the round window (RW). Tone bursts varying in frequency (.25-4 kHz) were presented at loud levels. Patients were divided into two groups, those with a confirmed tip fold-over (n=3) and hearing loss etiology-matched implant recipients without a fold-over (n=5). Cochlear microphonic response magnitudes as measured by ECochG-Total Response (TR), as well as starting phase were analyzed from pre- to post-insertion.  
Results: The average change in ECochG-TR magnitude for the fold-over group was -1.18 dB from pre- to post-insertion whereas the mean change for the group without a tip folder-over was -7.45 dB. Change in the starting phase (180 degree inversion) of the ECochG response was observed in one patient of the fold-over group while no participants in the group without fold-over exhibited this characteristic. The group without a fold-over consistently had a decrease in ECochG magnitude from pre- to post-insertion accompanied with no changes in phase, whereas the group with a fold-over typically exhibited an increase in magnitude or a change in phase.  
Conclusion: Acoustically evoked cochlear responses recorded near the RW prior to and immediately following insertion of the CI array could potentially be useful in helping to detect tip fold-over. The current data indicates that when the ECochG signal does not decrease in magnitude from pre- to post-insertion and does not have a change in starting phase, the possibility for tip fold-over of the electrode should be investigated.
**Title:** Use of Intra-cochlear Cochlear Microphonic Measurement to Assess Trauma to the Inner Ear Structures due to Cochlear Implant Surgery

**Category:** Surgery/Medical

**Authors:**
Scott Shapiro, MD 1, Adam Cassis, MD 1, Levi Stevens, MD 1, Brian Kellermeyer, MD 1, Kanthaiah Koka, PhD 2, Aniket Saoji, PhD, CCC-A 1; 1Otolaryngology - Head and Neck Surgery, West Virginia Univ., Morgantown, WV,  2Department of Research & Technology, Advanced Bionics LLC, Valencia, CA.

**Abstract:**

**Introduction:** Intracochlear electrocochleography or more specifically cochlear microphonics (CMs) measurement is being increasingly used to assess trauma to the inner ear structures due to cochlear implant electrode insertion.

**Methods:** In the present study, CMs were measured for multiple pure tone frequencies as a function of the cochlear implant electrode array to differentiate between (1) trauma to the inner ear due to cochlear implant electrode insertion and (2) influence of recording electrode on the measured CM amplitude.

**Results:** The results show changes in CM amplitude as function of the stimulus frequency and the intra-cochlear recording electrode.

**Conclusion:** Use of multi—frequency CM measurement as a function of the intra-cochlear electrodes can help differentiate inner ear trauma from systematic changes in CM amplitude across the cochlear space.
Title: Loss of Neural Function Secondary to Otitis Media after Cochlear Implantation and Improvement Following Contralateral Cochlear Implantation

Category: Surgery/Medical

Authors:
Zainab Farzal, MD, Elizabeth D. Stephenson, BA, Rounak B. Rawal, MD, Carlton J. Zdanski, MD; Otolaryngology/Head & Neck Surgery, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC.

Abstract:
Introduction: Despite appropriate vaccinations, post-cochlear implant otitis media and associated complications can occur. Follow-up to optimize hearing in these patients can pose a challenge for practitioners. Presently, few reports in the literature exist highlighting the evaluation and management of children who develop post-cochlear implant (CI) otitis media with complications many years after implantation. We report a case of a patient who developed otitis media and meningitis 6 years after cochlear implantation with loss of neural function in the CI ear and who subsequently underwent contralateral implantation with improvement in hearing outcomes on long-term follow-up.

Methods: Case Report

Results: A 7-year-old male with past medical history of GJB2 related hearing loss who underwent left sided cochlear implantation at 14 months of age presented with a 1-week history of lethargy, emesis, fever to 103.5 F, and grey colored drainage from the left ear. His parents reported declining speech perception beginning a few days prior to presentation. Temporal bone CT showed fluid filling the mastoid bowl and middle ear cavity. The patient was started on intravenous ceftriaxone and vancomycin for presumed meningitis and was taken to the operating room for urgent pressure equalization tube placement. He improved clinically and was discharged after 1 week and and completed 3 weeks of intravenous antibiotics. He had a complete loss of sound perception in the implanted ear. In weekly follow-up, he had no improvement in speech perception and underwent contralateral cochlear implantation at 6 weeks after his initial presentation. At 3-year follow-up, he had excellent binaural speech recognition (96% words, 99% phonemes) with his right ear remaining dominant (right: 100% words, 100% phonemes, left: 20% words, 48% phonemes).

Conclusion: Children who do not recover neural function with appropriate antibiotic treatment following post-cochlear implant otitis media should have close follow-up and early contralateral cochlear implantation to ensure adequate speech perception. The role of adjuvant treatment, such as systemic or local steroids, is unknown. We report a case of successful contralateral implantation with improved hearing outcomes.
Title: A Stepwise Algorithm for the Management of Cerebrospinal Fluid Gusher during Cochlear implantation

Category: Surgery/Medical

Authors: Ahmed Mehanna, phd Otolaryngology, Alexandria school of medicine Egypt, Alexandria, Egypt.

Abstract:

Introduction: The incidence of cerebrospinal fluid (CSF) perilymphatic gusher has been reported to be around 1% among patients undergoing cochlear implant surgery. Various techniques have been used to create a tight seal around the cochlear implant array. As more cochlear implantations are being considered for children with cochlear malformation, the increased risk of persistent CSF leak and with subsequent meningitis emphasizes the importance of obtaining an adequate seal around the cochlear implant array. The aim of this study was to assess the incidence of CSF gusher during cochlear implantation in children with and without congenital inner-ear malformation and to establish a simple stepwise algorithm for managing CSF gusher at the time of cochleostomy.

Materials and Methods: A total of 54 congenitally deaf children were included in a retrospective study between January 2011 and December 2012. Nine patients developed gusher at the time of cochleostomy. Among the nine cases, only one child did not show any preoperative radiologic evidence of any bony cochleovestibular malformation, whereas the remaining eight cases had different congenital inner-ear malformations with known risk for intraoperative gusher during surgery.

Conclusion: We concluded that CSF gusher is a surgical difficulty or an intraoperative challenge rather than a bad prognostic determinate for the postoperative audiologic performance, and in cases of congenital cochleovestibular malformation that develop gusher, a high degree of congenital anomaly of the cochlea, and not the degree or the amount of gusher, is correlated to poor patient performance. Finally, we were able to achieve a simple stepwise algorithm for the management of gusher during cochlear implantation.

Keywords: cerebrospinal fluid gusher, cochlear implantation, common cavity malformation, large vestibular aqueduct syndrome, wide internal auditory meatus
**Poster Number:** 91  
**Abstract ID:** 155  
**Title:** Re-implantation Surgery in Cochlear Implants by VERIA Technique- Our Experience  
**Category:** Surgery/Medical  
**Authors:**  
Jitendra M. Hans, MBBS, MS ENTENT & COCHLEAR IMPLANT, DR HANS CENTER FOR ENT HEARING CARE AND VERTIGO, NEW DELHI, India.

**Abstract:**

**Introduction:** Transcanal-minimally invasive technique for cochlear implant surgery is an organ preserving non-mastoidectomy technique providing wide access to the cochlea, this technique was first started in Veria, Greece. As a cochlear implant surgeon there is a need to understand the surgical aspects of re implantation. The re-implantation procedure has to be performed with minimal trauma to extra-cochlear and intra-cochlear structures and achieve a smooth insertion of electrode. Transcanal technique enables re-implantation with minimal bony work thereby reducing the intra-operative time.

**Methods:** From 1999 to 2017, 2152 cases have been implanted. 32 cases required re implantation. 17 cases had implant failure/loss of implant integrity, 15 cases had implant trauma. All cases were previously operated by transcanal VERIA technique. They were re-implanted with minimal bony drilling in the implant bed site. All the electrodes were passed through the pre-existing transcanal tunnel and inserted into the cochlea.

**Results:** 32 cases required re-implantation out of which 17 cases were due to implant failure/loss of implant integrity. 15 cases had implant trauma leading to hematoma in 8 cases and structural damage of implant in 7 cases. All cases were re-implanted in the same surgical sitting with minimal bony work/trauma to the extra-cochlear and intra-cochlear structures.

**Conclusion:** Transcanal minimally invasive technique provides wide access to the pre-existing implant for removal and re-implantation with limited bony work and minimal trauma to the extra-cochlear and intra-cochlear structures.
**Poster Number:** 92  
**Abstract ID:** 105  
**Title:** Surgical Outcomes of Cochlear Reimplantation and Revision Surgery in Children  
**Category:** Surgery/Medical  
**Authors:**  
Fan Zhang, Master of Otology, Sujuan Li, Master of Otology, Xing Lu, Doctor of Medicine, Zhaobing Qin, Medical Doctor, PhD; Otology, The First Affiliated Hosp. of Zhengzhou Univ., zhengzhou, China.  
**Abstract:**  
**Introduction:** To report the results of sixteen cases pediatric cochlear reimplantation and revision surgery and discuss the causes, prevention strategies, surgical findings and functional outcomes.  
**Methods:** A retrospective review of 705 cochlear implantation children recipients’ data from 2010 to 2017 in our department was performed and sixteen cases of reimplantation and revision surgical records, as well as audiologic results were reported. The time of following up was ranged from 3 months to 7 years. Functional outcomes before and after revision surgery were assessed.  
**Results:** During the study period, sixteen patients (2.27%) experienced reimplantation and revision surgeries. The reasons for reimplantation were device broken following head trauma in 6 cases, hard failure in 4 cases, flap necrosis in 2 cases, postauricular abscess caused by acute suppurative otitis media after 6 month of primary implantation in 1 case. Three patients underwent revision surgery to correct the electrode position because of the electrode misplaced into vestibular labyrinth and hypotympanic air cell, as well as the electrode reversed and aberrant respectively. Surgical difficulties might be due to fibrogenesis and neo-osteogenesis encountered during reimplantation. Complete electrode insertion was achieved and no complications were observed. Post-reimplantation and revision the rehabilitation outcomes were the same or better than preoperative levels in all cases.  
**Conclusion:** Head trauma is the most common reason to cause the device failure after cochlear implantation and parents should pay more attention to their kids. Both reimplantation and revision surgery require extra care and the rehabilitation outcomes after reimplantation and revision surgery are the same or better in most cases.
**Poster Number:** 93  
**Abstract ID:** 226  
**Title:** 3T High Resolution MRI Based Estimation of Scalar Cochlear Implant Electrode Position  
**Category:** Surgery/Medical  
**Authors:**  
Ingo Todt, Associate professor, Ercan Boga, MD, Lars Uwe Scholtz, MD, H. Gehl, Professor, Holger Sudhoff, Professor; Klinikum Bielefeld, Bielefeld, Germany.  
**Abstract:**  
**Introduction:** The scalar position of the cochlear implant electrode is of high importance for the clinical outcome after CI surgery. Common techniques to evaluate the intracochlear electrode position include ionized radiation by MSCT, DVT or flat panel tomography. Recent advantages in the knowledge about handling MRI artifacts and pain free performance of MRI scans in cochlear implantees showed that an estimation of the intracochlear electrode position is possible at 1.5 T with perimodiolar or midmodiolar arrays. The aim of the study was to evaluate the assessment of the ipsilaterally scalar position of cochlear implant electrodes by MRI sequences at 3 T with lateral wall electrodes.  
**Methods:** In a prospective study we evaluated in 10 implantees the intrascalar electrode position in an axial position with a T2 weighted sequence at 3 T and a resolution of 0.8 mm. We compared the evaluated intracochlear position with the routinely postoperative performed MSCT scan observed position.  
**Results:** In all cases the MRT estimated scalar position corresponded with CT scan estimated position. In 9 cases a scala tympani position was observed. In one case a scalar change from scala tympani to scala vestibuli was found.  
**Conclusion:** An estimation of the intracochlear position of cochlear implant electrodes by a 3 T MRI scan is possible.
**Title:** Intraoperative Use of Multi-Slice Computed Tomography During Difficult Pediatric Cochlear Implantation: How to Minimize the Radiation Risk

**Category:** Surgery/Medical

**Authors:** Christine S. Kim, MD 1, David Foyt, MD 1, Robert Rapoport, MD 2; 1Division of Otolaryngology, Albany Med. Ctr., Albany, NY, 2Department of Medical Imaging, St. Peter’s Hosp., Albany, NY.

**Abstract:**

**Introduction:** Cochlear implant devices have become an effective and widely accepted method of management for people with severe or profound sensorineural hearing loss. As cochlear implantation is being increasingly performed on patients with abnormal ear anatomy, surgeons are challenged with navigating through difficult-to-identify or sometimes unidentifiable anatomical landmarks to correctly place the electrode without complications. At our institution, intraoperative multi-slice computed tomography (MSCT) has been utilized to assist in such cases with successful results. However, this raises the concern of ionizing radiation exposure, especially for pediatric patients. Therefore, the purpose of this study was to estimate the effective dose of radiation from CT scans of the temporal bone, and to identify ways to reduce it for intraoperative use.

**Methods:** Thirty consecutive pediatric patients (age ≤ 10 years) who underwent cochlear implantation were included. Their routine preoperative CT scans of the temporal bone were evaluated to obtain the following parameters: tube voltage, tube current-exposure time product, dose-length product (DLP), and number of slices. Then, based on these settings, the minimal number of slices and the minimal DLP needed to adequately visualize just the inner ear structures were calculated. The minimal DLP was converted to effective dose of radiation, using conversion factors for pediatric patients computed on the basis of the International Commission on Radiological Protection (ICRP) publication 103 recommendations.

**Results:** All CT scans of the temporal bone were obtained without intravenous contrast, using 0.625mm slice thickness on a 16-slice CT scanner. The scans were acquired using the tube voltage of 100 kVp (n=6), 120 kVp (n=10), and 140 kVp (n=14). The tube current-exposure time product ranged from 40 mAs to 610 mAs, with median of 210 mAs. Mean DLP was 291.38 mGy-cm, which converted to effective dose of 1.37 mSv. The total number of slices ranged from 59 to 134, with mean of 85. Therefore, mean DLP per slice was 3.51 mGy-cm. The minimal number of slices needed to assess just the inner ear structures ranged from 19 to 26, with mean of 23. This yielded mean minimal DLP of 83.65, which converted to effective dose of 0.39 mSv.

**Conclusion:** By limiting the number of slices to image just the inner ear structures, this study reported a markedly reduced effective dose of radiation from MSCT, much lower than the annual natural background radiation in the U.S. The effective dose can be further reduced by implementing a low-dose pediatric protocol, which lowers the tube voltage and the tube current-exposure time product, complying with the Image Gently campaign. Although MSCT may require higher radiation exposure compared to other imaging modalities, such as fluoroscopy and cone beam CT (CBCT), the difference appears to be small based on prior literature. Considering the value of higher resolution images and the importance of a properly placed electrode array, we believe the risk-benefit ratio still favors the MSCT, when employed in appropriate settings.
Title: VHIT Testing in Cochlear Implant Patients

Abstract:
The clinical incidence of vestibular complaints after cochlear implants is generally low. Studies designed to assess the incidence of vestibular hypofunction post implantation generally report caloric testing results as the main outcome measure. There is a wide range of vestibular dysfunction reported across many studies, ranging from normal postoperative function to very high rates of vestibular hypofunction. Caloric testing can be heavily impacted by surgical alterations, like mastoidectomy, and the patients’ ability to be tasked during testing. Mastoidectomy alters the bony anatomy of the mastoid, which has a strong impact on heat distribution during caloric exams. Patients are also required to be tasked during testing to prevent suppression of the response secondary to reduced alertness. Mental tasking can be difficult due to the severity of the hearing loss coupled with testing in a vision denied condition. vHIT measures vestibular function independent of mastoid anatomy, is performed with a fixation target, and is quick to administer. Moreover, vHIT evaluates vestibular function using a physiologic stimulus at velocities encountered in daily activities. For these reasons, we sought to investigate vHIT testing, as compared to calorics, in patients who have undergone cochlear implantation.

Methods:
15 patients were enrolled in the current study. vHIT and caloric testing was performed prior to cochlear implantation with MedEl Flex28 electrodes and again at their 3-month postoperative visit. The vHIT measurements obtained were gain in the lateral plane and the presence of overt and covert saccades. We also measured bilateral maximal slow phase velocity for warm and cold calorics and percentage unilateral weakness. Dizziness handicap inventory scores were collected at each visit.

Results:
There was no significant difference in vHIT gain between preoperative testing and 3 months postoperative testing with mean values of 0.9175 preop and 0.9125 postop. There was no significant difference in presence of overt or covert saccades between the two time periods. 3 month postoperative calorics were not significantly different for both warm and cool calorics bilaterally. No significant difference in mean %UW was observed. Mean %UW during preoperative testing was 20 and during postoperative testing was 18.2. Mean DHI score preoperatively was 11 (range: 0 to 48) and postoperatively was 12 (range: 0 to 28). There was no significant difference in DHI score.

Conclusion:
vHIT is a safe and reliable measure of vestibular function in patients receiving cochlear implants, and can be easily administered to a hearing-impaired population. Unlike caloric testing, vHIT testing is independent of changes in bony anatomy. It also does not rely on tasking the patient during testing and provides a response in a normal physiologic range.
Title: Self-Reported Benefits after Implantation in a Group of Hybrid Implant Recipients

Category: Economics, Public Policy and Practice Management

Authors:
David Kelsall, MD
Rocky Mountain Ear Ctr., Englewood, CO.

Abstract:

Introduction: The benefits of electric plus acoustic stimulation in patients with ski-slope sensorineural hearing loss are well established and include improved speech understanding in quiet and in noise, more natural sound quality, and better localization ability. This population was previously left untreated until the indication to treat those with such residual hearing profiles was expanded. That is, hearing aids were unable to provide appropriate amplification in the high-frequency region to aid in speech understanding, leaving users largely dissatisfied. In recent years there has been increased demand by regulatory agencies, professional academies, and payers to provide data on patient-reported outcomes, including health utility scores, in addition to the traditional objective measures such as audiometric profiles and speech perception data to validate the use of cochlear implant technology. Such information has been and continues to be collected in hybrid implant users with interim data reported herein.

Methods: The Health Utility Index (HUI) (Furlong, W., Feeny, D., Torrance, G.W., Barr, R.D., 2001) is a validated, 15-item population-based health utility instrument that postulates the domains of health as hearing, vision, speech, emotion, pain, ambulation, dexterity, cognition, and self-care. Participants in a multi-center prospective clinical study evaluating the long-term safety and effectiveness of a cochlear implant array designed for those with ski-slope sensorineural hearing loss completed the HUI3 questionnaire pre-operatively and at 6 and 12 months postoperatively.

Results: Patients reported significant improvement in the hearing and multi-attribute domains of the HUI3 at 6 months post-implantation that remained stable after 12 months. Given that data collection is ongoing the most up to date results on these and other measured domains will be provided.

Conclusion: The Health Utility Index Scale is sensitive to changes in patient-reported health-related domains following implantation in patients with a hybrid cochlear implant. These data support the use implantable technology for those who meet the expanded indication.
Evidence-based Approaches for Efficient Programming of Adult Cochlear Implant Users Over Time

**Abstract:**

**Introduction:** Cochlear implants have provided restoration of hearing for hundreds of thousands of people worldwide. To ensure stimulation levels are adequate for the recipient over time, programming sessions are currently provided throughout the recipient’s lifetime. The median increase in caseload for a clinic is reported to be 62 implant users per year; however, with an aging population, this number is expected to rise. Given the significant reliance on hospital resources for ongoing management of implants, more efficient approaches for programming is necessary to ensure that resources are adequately distributed amongst current and future users. The primary aim of this study was therefore to provide evidence-based approaches for programming implants. This was achieved by integrating recently published findings on the changes in electrical stimulation levels in the early post-implantation period and changes in levels over the first decade post-implantation for a large group of adult implant users. Significant associations of demographic characteristics with changes in levels and the number of sessions attended over time were also investigated.

**Methods:** 680 participants using implants with a consistent stimulation mode and rate were included. For each participant, changes in stimulation levels were investigated as a function of dynamic range over 2 years post-implantation. For the 128 of these participants who had adequate long-term data, the amount of change in current levels over the first 10 years was determined using regression coefficients. To investigate the effects of electrode array segment, analyses were conducted separately for the apical, medial, upper-basal, and lower-basal segments. Etiology was classified into 6 pathological groups.

**Results:** Stability in electrical stimulation levels was evident after the first 3 to 6 months for more than 75% of the participants. A significantly greater degree of change in levels was evident for the basal segments, however, significant segmental differences were not evident in the long term. A significantly greater degree of change was evident in the early post-implantation period for participants with Otosclerosis, and those with prelingual onset of deafness, however, this was not evident in the long term. For all participants, regardless of demographic characteristics, the mean amount of change over 10 years post-implantation was less than 11 current levels (standard deviation of < 10 current levels). The number of sessions attended was most variable in the first 3 months post-implantation, but was otherwise reflective of the number of sessions outlined in the hospital's protocol for programming.

**Conclusion:** There is strong evidence that particular factors are associated with significantly greater degree of change in levels in the early post-implantation period. Interestingly, once levels stabilize, little change in levels should be expected over the first decade of implant use. The findings suggests that implant users are likely to be attending sessions as requested by the clinician rather than due to programming needs. The integration of these findings from a large group provided sufficient evidence to develop an evidence-based schedule and approaches to programming adult implant users. Clinical application of the proposed evidence-based approaches will enable more efficient programming services to be provided to current and future implant users over time, without compromising patient care.
Title: Establishing Cochlear Implants as the Standard of Care for Treatment of Patients with Severe to Profound Sensorineural Hearing Loss

Category: Economics, Public Policy and Practice Management

Authors:

Abstract:

Introduction: The benefits of implantable technology for treatment of severe to profound sensorineural hearing loss are well established. The use of electric stimulation with or without acoustic information in the ipsilateral or contralateral ear provides audibility across the speech spectrum, enabling detection, discrimination, identification, and comprehension of sounds at varying degrees for a given individual. Current estimates suggest that there are over 360 million people worldwide with disabling hearing loss. Of those, an estimated 55 million would benefit from treatment with hearing aids and 1,000,000 hearing aid users could benefit from a cochlear implant. Government agencies such as the U.S. Food and Drug Administration and the World Health Organization have recognized that hearing loss is a significant public health issue and efforts are underway to make hearing technology more accessible. In order to keep up with the increasing demand for treatment it is clear that a new standard of care must be developed.

Methods: The authors looked at a 4 pillared approach to changing the standard of care as follows: 1) Establish the reason behind the importance of hearing loss 2) Develop a consensus statement from an international panel of experts regarding the proper diagnosis and treatment of severe-profound hearing loss 3) Expand the use of data analytics to pursue updates to health economics, market access, and regulatory approval 4) Redesign the clinic delivery model to utilize technology such as remote care, connected health, and other technologies

Results: The crucial importance of creating the standard of care for the diagnosis and treatment of severe to profound hearing loss will be highlighted. Utilizing available data analytics, the creation of consensus statements and practice guidelines, redesign of the delivery model, and demonstrating the link with other serious medical conditions all play vital roles.

Conclusion: Modifying current clinical practice to make it scalable is of critical importance in order to make a standard of care model. A review of the multifactorial approach to create the standard of care for cochlear implantation will be presented.
Title: Improving Access to Cochlear Implantation in a Large academic Medical Center

Category: Economics, Public Policy and Practice Management

Authors: Sarah Sydlowski, AuD, PhD, Erika Woodson, MD, Karen Petter, AuD, Katie Hahn, AuD; Hearing Implant Program, Cleveland Clinic, Cleveland, OH.

Abstract:

Introduction: Much of the focus on improving access to cochlear implantation (CI) starts with recognition of candidacy, but the process from initial evaluation to surgery also has several points of inefficiency which hinder patient access to care. Following a focused team initiative to increase internal referrals for CI evaluation, novel methods of efficiently identifying candidates were needed to manage increases in volume with the same resource availability (e.g., time and personnel). Shared medical appointments (SMA), wherein multiple patients are seen by one or more providers in one coordinated visit, have been successfully implemented in many other settings, but have not been utilized for determining cochlear implant candidacy.

Methods: Potential adult CI candidates with a recent audiogram (completed within 6 months) who currently use at least one hearing aid are preferentially scheduled for an SMA as the first step of their CI evaluation. The SMA accommodates up to six candidates (and at least one family member) in one 120 minute session. Patients have access to both a surgeon and audiologist during the session, as well as the unique opportunity to interface with other potential candidates. Each session consists of medical intake and evaluation, aided speech recognition screening with patient hearing aids and programmed and verified clinic hearing aids, education on the anatomy and physiology of hearing (naturally and with hearing devices), medical aspects of CI, expectations following CI, and possible outcomes of the screening appointment. Subjective questionnaires are also completed and inform the screening process. Patients leave the appointment with orders for imaging, vestibular testing, additional aided testing, and other medical follow-up as needed. Appointments are scheduled before departure.

Results: The newly introduced SMA format has increased efficiency of patient scheduling and progress through the CI candidacy process. In particular, surgeon access has been improved and patients are ready for team evaluation and approval in a more coordinated fashion, both expediting and simplifying the candidacy process. Provider time is optimized by accommodating more patients in a shorter, but more effective timeframe. Patient feedback has also been positive.

Conclusion: The current climate of healthcare demands that providers introduce creative and innovative approaches to maximize the efficacy and efficiency of patient care. Using the SMA format as part of a CI candidacy evaluation has offered our large CI program an opportunity to improve access for patients while providing more upfront education that enhances the patient experience. Group visits offer a viable solution for improving productivity while enhancing quality in a busy academic medical center setting.
Title: Reorganization Cortical in Deaf Children Cochlear Implant Users

Category: Miscellaneous

Authors:
Lidia E. Charroo Ruiz, MD 1, Sandra Bermejo-Guerra, MD 2, Beatriz Bermejo-Guerra, MD 3, Antonio Paz-Cordovés, MD 4, Manuel Sevilla-Salas, MD 4, Yesy Martínez-García, Lic 2; 1NEUROPHYSIOLOGY CLINICAL, NEUROSCIENCE CENTER OF CUBA, HABANA, Cuba, 2Audiology, Hosp. Marfán, HABANA, Cuba, 3Audiology, La Pradera Intl. Ctr., HABANA, Cuba, 4Otology - Surgery, Hernamos Ameijeiras Hosp., HABANA, Cuba.

Abstract:

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: We studied deaf children (n=10) by electroencephalographic (EEG) and quantitative EEG spectral (qEEG) during eyes-closed resting state. The function of quadratic coherence was calculated as the cross-spectrum, normalized by the power spectra. Four measures were considered: Inter-hemispheric Coherence, Intra-hemispheric Long-Range, Transverse Intra-hemispheric, and Intra-hemispheric Short-Range.

Results: Significant reductions were found for the absolute power spectral density for alfa bands (absolute and normalized) before CI. Regarding our coherence results, in deaf children tended to show lower coherence values in the left and right hemispheres before CI for alfa and beta bands. However, after CI, deaf children clearly showed a tendency to present higher values of the coherence both, Intra-hemispheric Long-Range and Transverse Intra-hemispheric. These findings were correlated with the outcomes audiological unless there are pathologies associated with deafness. As result of the effects of cross-modal-plasticity in deaf children might explain our results before CI, while suggesting a new brain reorganization after electrical stimulation of the auditory pathways with CI.

Conclusion: Our study allowed us to find that measures of functional connectivity cortical can help to objectively evaluate changes cerebral in deaf children. Our findings show that cochlear implantation is a change significant in deaf children cochlear implant users that correlate with progress in auditory rehabilitation. Electrophysiological test may contribute in CI candidacy and determining how beneficial are implantation.
Title: Intra-Word Variability in Bilingual Cochlear Implant Users and Their Peers with Normal Hearing: A Longitudinal Study

Category: Basic Research

Authors:
Ferenc Bunta, PhD 1, Samantha Noel, BA 2, Anna Sosa, PhD 3; 1Communication Sciences and Disorders, Univ. of Houston, Manvel, TX, 2Univ. of Iowa, Iowa City, IA, 3Communication Sciences and Disorders, Northern Arizona Univ., Flagstaff, AZ.

Abstract:

Introduction: Parental engagement in supporting language development in pediatric cochlear implant users is especially critical for bilingual children (Bunta & Douglas, 2013; Bunta et al. 2016). It is imperative to have a better understanding of how speech develops in bilingual cochlear implant users for whom parental involvement using the home language is encouraged and how that development compares to their peers with normal hearing. This study analyzes intra-word variability of bilingual children with cochlear implants and their peers with normal hearing over time.

Methods: The study included ten English- and Spanish- speaking bilingual participants: 5 participants with normal hearing and 5 participants with cochlear implants whose parents were encouraged to use the home language. The participants were between the ages of 5;3 and 7;5 and were sampled at two time points approximately nine months apart. A repeated measures ANOVA with language (English versus Spanish) and time (Time 1 versus Time 2), cochlear implant versus normal hearing as a between-subjects factor, and time between sessions as a covariate was conducted with intra-word variability as the dependent measure.

Results: There was a statistically significant effect of language (F (1, 7) = 5.696 at p = 0.048 with an effect size of partial η² = 0.449). There was also a statistically significant main effect for cochlear implant versus normal hearing (F (1, 7) = 7.694 at p = 0.028 with an effect size of partial η² = 0.524). Time between sessions also had a statistically significant effect on variability (F (1, 7) = 6.361 at p = 0.040 with an effect size of partial η² = 0.476). The main effect for time (Time 1 versus Time 2) was not statistically significant. None of the interaction effects were statistically significant. Overall, the results indicate that whole-word variability in bilingual children is affected by the language spoken and whether or not they use a cochlear implant or have normal hearing.

Conclusion: Intra-word variability is present in the speech of young bilinguals with both NH and CIs, but it is notably higher for CI users. Spanish productions were less variable than English productions at Time 1 and Time 2. The time elapsed between Time 1 and Time 2 had an effect, but there was no statistically significant difference in Time 1 versus Time 2 scores.
Poster Number: 104
Abstract ID: 145
Title: Single-sided Cochlear Implantation in a Young Adult: Comparing Performance with a Hearing Twin
Category: Basic Research
Authors:
Mary K. Fagan, PhD
Communication Sciences & Disorders, Chapman Univ., Irvine, CA.
Abstract:
Introduction: As cochlear implant candidacy expands, questions remain regarding the benefits and limitations of implantation in late adolescence or young adulthood. This study examined multiple measures of functioning before and after single-sided cochlear implantation in a young adult in comparison with his hearing twin. The measures included assessments of communication, interpersonal functioning, and quality of life for both participants.
Methods: Participants were identical twins, one with normal hearing, the other with profound hearing loss in one ear and moderate to severe hearing loss in the other. Both participants were tested at 17 years of age, before the twin with hearing loss received a cochlear implant, and at 22 years of age, one year after cochlear implant activation for the twin with hearing loss. Measures included vocabulary comprehension, speech understanding, and measures of social functioning and satisfaction.
Results: Results indicated improved speech perception and improved satisfaction with social functioning. Receptive vocabulary scores were equivalent in both participants before and after cochlear implantation, showing how well the cochlear implant recipient understood spoken vocabulary words even before cochlear implantation, but also that the benefits of cochlear implantation in young adulthood can be measured in ways beyond word learning alone.
Conclusion: Single-sided cochlear implantation in young adulthood provided measurable benefits for speech perception, communication, and social functioning.
Title: A formant-based Approach for Channel Selection in 'n-of-m' Sound Coding Strategies for Cochlear Implants

Category: Basic Research

Authors:
Juliana N. Saba, BS, Hussnain Ali, MS, PhD, John H. L. Hansen, MS, PhD; Electrical Engineering, Univ. of Texas at Dallas, Richardson, TX.

Abstract:
Introduction: Advanced Combined Encoder (ACE) sound coding strategy is a popular signal processing scheme used in clinical cochlear implant (CI) processors. The premise of this ‘n-of-m’ strategy is to select ‘n’ information-rich frequency bands out of ‘m’ available stimulation sites in each stimulation cycle related to the highest spectral content. Although such schemes are able to encode speech signal fairly well in quiet environments, they are inherently susceptible to the negative effects of noise and reverberation in adverse listening conditions (at which normal hearing individuals can understand speech at ceiling levels). Formant frequencies, or resonances in voiced speech, are considered to be fundamental in speech perception and have traditionally served as the backbone of early generations of sound coding strategies. The second formant frequency in particular can provide useful acoustic cues for speech understanding in noise and is normally masked (and hence not selected) in the conventional ‘n-of-m’ approach.

Methods: A channel selection algorithm was developed to accurately detect the location of the second formant (F2) and enforce selection within each stimulation cycle within the ‘n-maxima’ criteria of ACE processing. Prior work by the authors demonstrated improved performance of CI users in reverberation and noise using a computationally-expensive, formant-prioritization for the first three formants, called FACE (Ali et al. (2014) IEEE ICASSP, Florence, Italy, pp. 905-909). Speech intelligibility was measured from CI users with IEEE and AzBio sentences presented in quiet, 10 dB, and 5 dB SNR speech shaped noise as well as babble noise. Subjective and two-forced-choice tasks were performed to quantify preference of either strategy, both in quiet and in noise. Sentence tokens were processed offline using MATLAB (MathWorks Inc.) and stimulated to the implanted electrode array using the CCI-MOBILE Research Platform (Ali et al., (2016) CI2016, Toronto, Canada).

Results: CI performance with the F2-priority-selection algorithm showed comparable performance to ACE and FACE (F1, F2, F3-priority selection), indicating an improvement in overall speech recognition in noisy environments. Quantitative and subjective results will be presented at the conference.

Conclusion: Computational cost of the sound coding strategy was significantly reduced without significant loss in performance providing rationale to transition the algorithm into a real-time strategy. These results may serve as: (1) potential improvement on the existing framework of clinical sound processing strategies and (2) easy integration in commercial sound processors using ACE.
Title: In Vitro and In Vivo Models to Test the Effects of Electrical Stimulation on the Inner Ear

Category: Basic Research

Authors:
Adrien Eshraghi, MD, MSc 1, Christopher O'Toole, PhD 1, Jorge Bohorquez, PhD 1, Emre Ocak, MD 1, Jeenu Mittal, MSc 1, Carolyn Garnham, MSc 2, Rahul Mittal, PhD 1; 1Hearing Research Laboratory, Univ. of Miami, MIAMI, FL, 2Med-El Limited, INNSBRUCK, Austria.

Abstract:

Introduction: While there is a trend to implant patients with residual hearing, we know that cochlear implantation may cause some loss of this residual hearing. The direct effect of implantation of the electrode in macroscopic structures of the inner ear is well described, however, the effect of the electrical field generated by the implant has not been investigated to date. Some recent data suggests that the electrical stimulation can have a negative effect on the auditory system. However, the role of such stimulation on sensory cells in vitro and on hearing ability in vivo is not well established. The objective of this study was to determine the effect of electrical stimulation on auditory system employing in vitro and in vivo models.

Methods: A custom stimulator circuit that allows to study several parameters, including stimulation amplitude, pulse width, and total stimulation duration was designed. For the in vitro work, organs of Corti explant cultures from P3 rats were used. For in vivo work, the adult guinea pigs were implanted with a cochlear implant and subjected to a number of periods of electrical stimulation via constant activation of the implant. Stimulation was applied with varying parameters to determine the effects of the stimulation on the survival of hair cells. Survival was quantified by counting hair cells in organ of Corti explants using confocal microscopy. Auditory Brainstem Recordings were performed to determine hearing thresholds in the guinea pig model.

Results: In the present study, a compact and easily-adjustable stimulator circuit was developed. It has sufficient flexibility to imitate a wide range of cochlear implant settings. By varying the amplitude, pulse width, and time parameters, we are able to achieve the simulation required for the electrical effects similar to a cochlear implant. There was a decrease in hair cell count in the explants exposed to higher duration of stimulation. In vivo testing revealed the possibility of testing the effects of changing various stimulation parameters on hair cell survival, oxidative stress and inflammation in the cochlea.

Conclusion: The electrical stimulator developed in this study helps to better understand the effect of electrical field on inner ear sensory cells. The models developed in this study using electrical stimulation can be used as a powerful tool to screen otoprotective drugs for the preservation of residual hearing post-cochlear implantation.
**Poster Number:** 107  
**Abstract ID:** 26  
**Title:** Early Experience with the Nucleus 7 Sound Processor  
**Category:** Technology  
**Authors:**  
Dian Liu, PhD 1, Philip A. Segel, Master's degree audiology 2, Marcella Bertrand, MS 1, Herbert Mauch, Dipl.-Ing. 1; 1Cochlear AG, Basel, Switzerland, 2Cochlear Americas, Denver, CO.  

**Abstract:**  
**Introduction:** The Cochlear™ Nucleus® 7 is a behind-the-ear (BTE) sound processing unit. It offers enhanced mobile connectivity, which enables direct audio streaming, control and monitoring of the sound processor when used with a compatible mobile device. The complementary Nucleus Smart App is an app on the mobile device for control and monitoring purposes. Prior to its release, a First Experience Programme (FEP) of the Nucleus 7 was undertaken to determine its impact on clinical practice.  

**Methods:** 50 clinics in 10 European and African countries were recruited to participate in the FEP of the Nucleus 7 Sound Processor after CE mark was obtained. Clinicians completed surveys regarding their training, counselling and fitting experiences (initial activations and upgrades= over a period of three months.  

**Results:** Counselling (N=170): Those candidates, who chose the Nucleus 7 over the off-the-ear Kanso™ Sound Processor, primarily did so because of the cosmetics that come along with the BTE option (57%), followed by battery options (38%) and direct audio streaming from a mobile device (Made for iPhone) (33%). For small children, the ability to listen to the microphone was of key importance (44%), highlighting the demand of parents for monitoring capabilities. Clinicians discussed the mobile connectivity of Nucleus 7 in 60% of the sessions, taking 6 minutes on average. General fitting (N=266): In terms of the configuration of the Nucleus 7, the Hugfit was the most chosen retention option (32%). Battery life estimates were in excellent agreement with previously published values. The majority of initial activation sessions took a similar amount of time compared to fitting other Nucleus Sound Processors. 14% reported the session to be longer, mostly due to the additional time required for explaining the benefits of mobile connectivity. 60% of the recipients in this FEP did not own a compatible mobile device. In 38% of fittings involving mobile connectivity, recipients successfully downloaded and logged into the Nucleus Smart App before prior to their first fitting. If a recipient was not successful in this onboarding process, it was mostly because he forgot to do this or was not confident enough. When a recipient tried to resolve their onboarding issues prior to the fitting, he most often contacted the clinic (71%) for troubleshooting. Overall, 91% of the clinicians agreed that the Nucleus 7 was easy to fit. Final feedback (N=42): Evaluating their past months of Nucleus 7 experiences, clinicians identified a few knowledge gaps around mobile connectivity due to a lack of familiarity that had to be yet established after training. A trend was seen in a change of clinical practice (19%). This was mainly noted in the area of scheduling longer counselling and fitting sessions due to the increased number of features they needed to cover, e.g. mobile connectivity, wireless accessories etc.  

**Conclusion:** The early clinical experiences indicated that fitting the Nucleus 7 Sound Processor was easy and not a significantly different experience than with previous processors. Clinics experienced a steep learning curve on how to optimize their counselling and fitting practice, as they found themselves in an increasingly connected environment with an increasing number of auxiliary devices to handle. With appropriate training and support, mobile connectivity becomes a game changer for all stakeholders involved, and as a means for remote care, has the potential to deliver efficient clinical services.
Title: Upgrading Electric-Acoustic Stimulation External Technology: Speech Perception Outcomes

Introduction: Electric-Acoustic Stimulation (EAS) monaurally combines cochlear implant and hearing aid technologies for CI recipients with preserved low-to-mid frequency hearing. The EAS clinical trial enrolled subjects with mild-to-moderate hearing loss in the low-to-mid frequency range, who were fit postoperatively with an audio processor that combined electric and acoustic modalities. Subjects demonstrated a significant improvement in speech perception abilities with EAS as compared to conventional hearing aids or with either stimulation modality alone. Recently, EAS subjects were upgraded to a new external audio processor, which offers multiple acoustic frequency bands. The present report compared acute speech perception when the acoustic settings were fit with the manufacturer recommended settings, or adjusted to meet NAL-NL1 and NAL-NL2 prescriptive targets. The objective of this study was to investigate acute speech perception of EAS recipients when programmed with the new audio processor using different acoustic fitting methods.

Methods: Thirty-one (31) EAS recipients who participated in the EAS clinical trial were enrolled. All subjects had greater than 2 years of listening experience with the previous generation EAS processor. Subjects were fit with the new audio processor using behavioral mapping methods. The acoustic component was programmed based on the unaided audiogram using real-ear and/or test box measures. The test battery included assessment of residual hearing and aided speech perception. Speech perception measures included recorded CNC words in quiet and AzBio sentences in a 10-talker babble (+10 dB SNR). Subjects were evaluated on the day of the fitting and 1 month post-fitting.

Results: Acute speech perception assessment did not demonstrate a significant difference in quiet or noise between the fitting methods. Subjects varied in their preferred acoustic settings based on sound quality. Subjects showed a trend for better performance with their preferred acoustic settings at the 1-month follow-up interval.

Conclusion: Subjects demonstrated variability in scores between conditions and preference for sound quality. Results may influence clinical decision making regarding the optimal fitting of the acoustic component in combined devices. Understanding of optimal mapping methods and associated speech perception outcomes is needed as hearing preservation procedures become more widespread and expand to the pediatric population.