Acoustic Cue-Weighting in Lexical Tone and Speech Intonation Recognition in Children with Cochlear Implants and with Normal Hearing

Introduction: It was reported that English sentences spoken as questions or statements will carry the domain cues (F0, duration, and intensity patterns) in the last word for the contrast. Acoustic analyses showed F0 contour is the primary cue for the question-statement contrast; intensity and duration changes convey important but less reliable information. On the basis of these reports, the study is aimed to examine and compare the perceptual weighting of prosodic cues in question-statement identification on Mandarin-speaking children with normal hearing and cochlear implants systematically manipulated.

Methods: 28 CI and 11 NH children participated in the study. One four tone recognition task and two question-statement identification tasks were administered. In task 1, Mandarin four tone recognition was used to test the participants' tonal perception. In Task 2, 120 naturally uttered question or statement sentences were used for identification. In Task 3, the same participants' perceptual cue weighting in question-statement identification was assessed with resynthesized single-word stimuli. Three acoustic parameters were systematically manipulated.

Results: The statistic results showed that the perceptual correctness of Task 1 and Task 2 were highly correlated. Of the three acoustic cue parameters in Task 3, normal hearing children tended to use F0 as the primary
cue instead of duration and intensity. However, cochlear implanted users took duration and intensity cues to perceive questions or statements instead of F0 changes.

**Conclusion:** The findings here are quite identical with the previous research on English-speaking CI users. Cochlear implants are still limited in acoustic cue integration.
Introduction: Preservation of residual hearing in cochlear implantation is a main concern for patients and otologists. New electrode arrays as well as development of minimally invasive technique have allowed the expansion of indication criteria for cochlear implantation. The loss of residual low-frequency hearing is thought to be the result of many factors. Controversy exists in regards with the electrodes array characteristics, the surgical implantation technique and the pharmacological therapy used. The aim of this research is to analyze the available information pertaining to hearing preservation with cochlear implantation.

Methods: A systematic review was conducted. Original studies and analysis reporting on hearing preservation with cochlear implantation were included. The level of evidence and risk of bias were assessed. Studies with a moderate or high level of evidence and a low or moderate risk of bias were included for analysis.

Results: Both cochleostomy and round window approaches are adequate, but should rely on the anatomic position of the round window membrane. No electrode design had a higher rate of hearing preservation, either a standard or shorter length was used, or a straight or contoured array. The speed of insertion has a significant impact on hearing preservation and vestibular function. A slow insertion should be used for all cochlear implant insertion, hearing preservation or not. However, the optimal speed of insertion is still unclear. Moreover, the use of steroids regardless of the route or the timing, along with intraoperative topical steroids had a positive impact on hearing preservation.

Conclusion: Classic atraumatic insertion maneuver, very slow and delicate insertion and the use of intraoperative corticosteroids improve hearing outcomes. Whichever the surgeon’s preferences, all surgical modifications meet the same goal: protection of the delicate intracochlear structures with preservation of residual low-frequency hearing to improve speech perception abilities.
Introduction: A retrospective case review of patients with active or inactive chronic otitis media (COM) and mastoid cavity that underwent cochlear implantation and ear obliteration in a single-stage procedure was conducted. The objectives of this retrospective review were to assess complication rates, postoperative infections and to evaluate post-implantation audiologic performance.

Methods: All patients with COM and mastoid cavity, presenting or not active disease, that underwent cochlear implantation and obliteration of the ear as a single-stage procedure, from November 2004 to April 2013, were included. All per- and perioperative complications were recorded. Open-set sentence scores were used to evaluate the audiologic gain after implantation.

Results: Twenty-seven patients were included in our review: ten with active COM and seventeen with inactive COM. Overall, nine patients (9/27) presented postoperative complications (7/9 were minor): three were active COM patients (30.0%) and six, inactive COM patients (35.0%). Patients in the ladder group presented two major complications. A mean gain of 55.9% on open-set sentence scores was obtained after cochlear implantation. We found that patients with COM had higher complication rates if they had the one-stage cochlear implantation, compared to the global implant population (19.9%). However, most complications were considered minor and there was no statistical difference between active and inactive COM. In addition, patients with COM had similar audiologic scores to those found in patients with normal temporal bone anatomy.

Conclusion: Cochlear implantation performed as a one-stage procedure in patients with active and inactive COM could be considered as a treatment option to avoid staging. These patients presented with good post-implantation audiologic scores and require regular follow-up.
**Abstract Body:**

**Introduction:** One common complaint of patients in the post-operative of cochlear implants procedures are depressions in the mastoid bone of the cortical region where the retro auricular surgical approach was carried out. These depressions sometimes result in discomfort in the use of the CI and aesthetic problems. Soft tissue cans ingrowth into the mastoid cavity and blocks the natural aeration increasing the possibility of future otitis media.

**Objective:** Describe the surgical technique of mastoid cortex plastic using a pediculate osseous flap and its aesthetical and clinical significance in cochlear implant surgery.

**Study Design:** Prospective.

**Setting:** Tertiary medical center.

**Methods:** 20 patients from 1 to 70 years old were operated, with normal mastoid CT scan. After the retro auricular incision for CI approach, a “U” periosteal flap with the programed size of the mastoidectomy opening was created. A 3 mm thick cortical bone was drilled using a 2.5 mm burr bellow the flap is drilled and elevated with chisel and hammer adhered in the periosteum flap creating a unique osseous and periosteum flap pediculate and folded anteriorly. After the procedure the mastoid cortex defect was covered with the folded flap and the cavity is closed. The border periosteum is sutured to it’s original position.

**Patients and Main Outcome Measures:** Mastoid cortex plastic was included in the first-stage operation in 20 patients who underwent CI surgery. CT scan was used to identify high sigmoid sinus and exclude the patient from the study.
**Results:** In all patients, mastoid cortex was reconstructed completely, and the post-operative aspects after 3 months is like a normal cortex. Post op CT scan showed no soft tissue ingrowth into the mastoid cavity in all cases. No infections or other complications occurred.

**Conclusion:** Osteoplastic pediculate flap is a simple and rapid procedure for preventing postoperative deformity of the mastoid process and it’s valuable for mastoid cavity function.
Abstract Body:

Introduction: In order to achieve residual hearing or remaining inner ear structure preservation, scala translocation should be avoided during array insertion. Therefore, optimal insertion axis in the basal turn should be aimed for at the beginning of each array insertion. The goal of this study was to compare standard surgical techniques and assisted techniques with navigation or robotic guidance to achieve a better alignment of array insertion axis with the scala tympani centerline in the basal turn.

Methods: Two ENT surgeons were evaluated on four temporal cadaveric bones. A surgical approach was performed to show the round window region and a cone beam CT was obtained in all specimens. The optimal insertion axis was defined on preoperative imaging as the closest axis to the scala tympani center line that would avoid the third portion of the facial nerve. A neuronavigation system (Digipointeur®, Collin, Bagneux, France), RobOtol (Robot-based assistance arm prototype developed in our laboratory), and SmartOtol (a software allowing a semi-automatic alignment to the Robotol) were used as surgical devices to perform alignment of the insertion axis. Four procedures were performed to assess reproducibility of the insertion axis: manual, manual navigation-assisted, robot based navigation-assisted and robot-based semi-automated. The angle between the optimal insertion axis planned on preoperative imaging and the insertion tool axis in the experimental setup was measured and compared according to each of the four techniques.

Results: The average error was 8.5+/−4.4° for the manual, 9.6+/−3.8° for the manual navigation-assisted, 3.3+/−2.5° for the robot navigation-assisted (n=24 for the first three procedures), and 2.8+/−1.5° for the robot-based semi-automated procedures (n=12). A
better accuracy was observed on semi-automatized procedure than manual (p<0.01), robot navigation-assisted (p<0.01) (Kruskal Wallis post-test). There was no difference between the robot navigation-assisted and the robot semi-automated procedures.

**Conclusion:** The manual alignment is a complex gesture and cannot be improved by the navigation systems due to current displays that are non-user-friendly. A robotic device made easier, but not reproducible the alignment of the insertion axis. A semi-automated procedure could improve the precision and reproducibility of a pre-planned insertion axis of temporal bone.
Introduction: There is little information in literature regarding outcomes of cochlear implantation (CI) in patients completely deafened after head trauma. The aim of this study was to evaluate CI outcomes in this group of patients.

Methods: Completely deafened patients after head injury, CI implanted for auditory rehabilitation. Functional hearing, evaluated using Bamford-Kowal-Bench (BKB) sentences. Average age and length of deafness for implantation, preimplantation and postimplantation speech perception outcomes have been measured. Length of hearing loss, residual hearing, implant type, speech processor strategy, number of active electrodes inserted have been studied too.

Results: 5 patients have received cochlear implants (Sonata - 2, Concerto - 2, Combi40+ split - 1). Average age for implantation was 35 years (standard deviation, 8 years). Average length of deafness before implantation was from 5 month age to 2 years. There was 1 patient at the age of 33 who had meningitis and cochlea obliteration, caused by head injury. The operation was made in term of 4 months after meningitis. In this case we used implant with dual Split-electrode by Medel. Two patients had a one-sided fracture of cochlea. Adult patients had frequency scaling to determine subjective frequency of stimulus. According to its data, electrodes programming was made in a definite order. Preimplantation BKB score in silence - 0%. Average postimplantation BKB score in silence was 68% (range, 30%-100%) and in noise was 59% (range, 24%-94%). There was a moderately negative correlation between outcome and age under implantation ($r = -0.41$, $p<0.05$) and between outcome and length of deafness ($r = -0.52$, $p<0.05$). In a year after CI, one patient with Split-electrode implant had increasing resistance on 6 channels up to 12-20 kOhm. Probably, it happened because of the growth of connective tissue around the electrode in cochlea. This patient had the greatest difficulties in speech recognition.

Conclusion: Cochlear implantation is an effective method for hearing rehabilitation in completely deafened patients after head injury. However, negative factors, such as significant injury of central auditory canal, basal turn obliteration, length of deafness should be considered in the preoperative estimation of these patients.
Abstract Body:

**Introduction:** Soft-tissue reduction surgery in bone conduction hearing implants (BCHI) is being abandoned. Currently, the preferred technique is the soft-tissue preservation technique as established by Hultcrantz, which has been shown to be superior in terms of peri-abutment dermatitis rate, aesthetics and preservation of sensibility. To further improve BCHI outcomes, surgeons are employing even less invasive surgical techniques, by performing the installation through a single circular incision. However there are some potential pitfalls to consider including; structural bone damage through insufficient cooling, adjacent soft-tissue damage and loss of surgical control during surgery. Recently, a new standardized surgical technique for BCHI placement, the minimally invasive Ponto surgery (MIPS) technique, was developed by Oticon Medical AB (Askim Sweden) to address these pitfalls and minimize soft-tissue trauma by using a novel specially designed surgical instrumentation kit.

**Objective:** The primary objective of this study is to compare the incidence of peri-abutment dermatitis after 3 months between the MIPS technique and Hultcrantz technique. Other objectives included surgical results such as, surgery time, wound healing, pain, loss of sensibility, extrusion rate, stability measurements, dehiscence and esthetic result. Additionally, this study is set-up to gain further understanding of factors that influence the rate of peri-abutment dermatitis, such as skin movements, bacterial colonization and immune responses.

**Methods:** A multi-center prospective randomized controlled trial in the Netherlands was designed to compare the MIPS technique to the Hultcrantz technique, with the primary investigation center in Maastricht. A total of 62 subjects will be included with a two year follow-up period. In this trial new objective measures have been introduced to objectively quantify factors as loss of sensibility, dehiscence, skin overgrowth and cosmetic result. To gain further
understanding of peri-abutment dermatitis, the bacterial profile is evaluated using molecular techniques, changes in cytokine expression profiles post-implantation are quantified and skin position changes are objectively measured at several time points.

Results: Our current experience indicates that the MIPS technique is a clear, simple and fast procedure with good cosmetic results. Surgery times have been reduced to 4 to 6 minutes using this new procedure. Additionally, this technique seems quite suitable for local anesthesia. Preliminary results will be available in the spring of 2016.

Conclusion: The new MIPS procedure for BCHI surgery is compared to the current golden standard in BCHI surgery in a multi-center prospective trial with good initial results. If this new surgical technique proves to be effective, the MIPS technique could become an attractive alternative to the current techniques. Furthermore, this trial will improve our understanding in factors contributing to peri-abutment dermatitis.
Informational masking in patients with single-sided deafness after cochlear implantation

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Introduction: Individuals with single-sided deafness (SSD) have difficulties in localizing sounds, understanding speech in background noise and following conversations with several competing talkers (Wie et al., 2010). Studies showed that providing the contralateral ear with a cochlear implant (CI) in patients with SSD led to improved localization abilities and enhanced speech recognition in noise (Arndt et al., 2011).

The aim of the present study is to investigate the benefit of a CI when explicitly speech is used as a disturbing noise signal. In a communication situation with competing talkers, at least two forms of masking occur: energetic masking (EM) and informational masking (IM). Whereas EM describes the spectral and temporal overlap of target and masker signals at the periphery, IM relates more to central auditory effects and is associated with the amount of irrelevant information given by the competing talker(s) (Leek et al, 1991).

Methods: Based on the German Oldenburg sentence test (OlSa) (Wagener, Brand & Kollmeier, 1999a) target and masker sentences were generated. The fundamental frequency of the target talker was 100 Hz. The voice of the speech masker was either the same as the target talker (100 Hz) or modified generating a fundamental frequency of 180 Hz. Additionally, a noise masker was imbedded to compare the results to those from the speech maskers and distinguish between energetic and informational masking. Target and masking signals were presented from different locations (0°, 90°, 270° azimuth). The participants were tested in the unilateral non-aided Situation with their normal hearing ear (NH) only and in combination with the contralateral CI.

Results: Speech recognition differed depending on the type of masker. A detailed analysis of errors was used to dissociate energetic and
informational masking effects. The analysis showed rather a release from energetic than from informational masking.

**Conclusion:**
Noise interferers which are mostly used in daily clinical practice to test patients’ performance in everyday life is not sufficient to reflect difficulties experienced in a situation with competing talkers. Furthermore, it is shown in which situations speech recognition is improved due to the contralateral cochlear implant.
Auditory Brainstem Implants

Utility of Mapping Electrode in Auditory Brain Stem Implantation

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Introduction: Auditory brainstem implantation has revolutionized the hearing rehabilitation of patients with NF-2. Implantation. Distortion of the brainstem anatomy after removal of large tumors can make optimal implantation difficult. Electro physiologic mapping using a test electrode can optimize placement of the device.

Methods: Adult patient with NF 2 underwent placement of a Med El ABI after resection of a 3.5 cm acoustic neuroma. Prior to placement of the device the brainstem was mapped using a test device which allowed evaluation of the eABR across all the electrode array. Identification of the anatomic position in which the maximal amount of electrodes demonstrated generation of an eABR without stimulation of surrounding cranial nerves was used to place the permanent electrode array.

Results: Careful mapping of the brainstem allowed placement of electrode arrays in which all 12 electrodes produced auditory percept when activated.

Conclusion: Use of a test electrode to map the brainstem can improve placement of ABI electrodes resulting in auditory percept in the maximum electrode number.
Control Number:
2016-A-167-ACI

Session Number:
POS02

Session Title:
Poster Session B

Poster Board Number:
26-B

Topic 1:
04g-Patterns of Early Social-emotional Development in Young Children with Cochlear Implants

Publishing Title:
The Comparison of Social Adjustment in Hearing and Cochlear Implanted Children with Normal Performance Intelligence Quotient

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Abstract Body:

Introduction: Hearing loss is one of the most common deficiency in human being. Before the introduction of cochlear implantation (CI) in 1980, hearing aids were the only means by which profoundly deaf children had access to auditory stimulus. Nowadays Cochlear implantation is established as effective way to help deaf children be independent and improved in speech, language and social interaction. However, much of the studies about cochlear implant tend to be from professional perspective and have concentrated on different aspects of speech perception and production. So, the main aim of this study is to evaluate the level of social adjustment of cochlear implanted children in comparison with normal hearing children.

Methods: This experimental study compares social adjustment of 60 normal hearing with cochlear implanted children. Before selection of cochlear implanted children, the RAVEN test was done to be sure of normal intelligence quotient of this group. Then the samples were chosen randomly and distributed in case and control groups. The social adjustment of the groups was evaluated by Vineland adoptive behavior scale. After gathering the data, statistical analysis was done through SPSS software version 19.

Results: Based on Raven test results the intelligence quotient of cochlear implanted children was in normal range (90-110). In addition, no significant difference in the level of social adjustment of 2 groups was seen (P>0.05). As the cases had finished rehabilitation program after surgery, it can be said that rehabilitation is the main factor in improvement of social adjustment of cochlear implanted children.

Conclusion: According to the present study, after cochlear implantation and its rehabilitation program especially in younger children (below 3 years old) with normal intelligence quotient, the level of social adjustment and communication of cochlear implanted and normal hearing children will approximately be equal.
Sequential Bilateral Cochlear Implantation in Adults: The Effects on Speech Recognition in Noise and Quality of Life

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Introduction: A growing number of adult unilateral cochlear-implant recipients worldwide are being implanted also in their other ear to provide bilateral auditory stimulation, and ultimately, access to binaural hearing. The benefits of bilateral stimulation are well documented in the literature, including improvements in speech recognition in noisy environments and more accurate sound localization over unilateral stimulation. These and other subjective benefits have been reported for patients implanted simultaneously in a single surgery of both ears, as well as for patients implanted sequentially after a time delay between the first and the second implant (CI1 and CI2, respectively). There is, however, considerable variation in the outcomes, and the factors contributing to auditory performance in sequential bilateral cochlear implantation are not yet well understood. Thus, more data are needed for a better understanding of the expected bilateral outcome in sequential implantation. The aim of this prospective study was to assess the benefits of sequential bilateral cochlear implantation using a speech-in-noise test and questionnaires for a consecutive sample of working-age adult cochlear-implant recipients.

Methods: Speech recognition threshold in noise (SRTN) was assessed in a sound-proof listening room via an adaptive procedure prior to the surgery of CI2 in the best-aided condition (CI1 and a potential hearing aid), and after 1, 3, 6 and 12 months from the switch-on of CI2. At each assessment after receiving CI2, SRTNs were measured for five different conditions: unilaterally with either CI1 or CI2 and bilaterally with both CI1 and CI2 with speech (S) and noise (N) emanating from the frontal direction (S0N0), and bilaterally with speech from the front and noise either from the side of CI1 or CI2 (S0N±90). The presentation order of the conditions was counterbalanced across recipients and the overall presentation level was 65 dB SPL. In addition, the Glasgow Benefit and Health Status Inventories (GBI and GHSI) and the 15D health status questionnaires were administered prior to and 12 months after receiving CI2. Adult patients under the age of 65 years, who needed a second implant due to work, studies or similar activity, were included in the study. At present, 29 consecutive patients have received their CI2, of whom 26 have participated in the 1-month and five in the 12-month postoperative follow-up assessments. The time between CI1 and CI2 for these patients varied from 1 to 17 years.
Results: The initial results show improvement in bilateral over preoperative unilateral SRTN already at 1 month after the switch-on of CI2. For the majority of the patients, SRTN for CI2 was at the level of CI1 between 3 and 6 months from the switch-on. Moving the noise source from the front to either side improved the SRTN on the order of a few dB SNR. Subjective benefits via the questionnaires and colloquial feedback from the patients suggested additional bilateral improvements. Based on the data collected so far, time between the surgeries of CI1 and CI2 exhibits the best, albeit weak, correlation with the speech recognition data in noise.

Conclusion: There are evident bilateral improvements for sequentially implanted adult cochlear-implant patients, irrespective of relatively large differences in the patient demographics. Time course for the development of SRNT for CI2 is in agreement with other recently published data.
The Benefits of Microphone Directionality in Speech Recognition in Noise for Three Commercial Cochlear Implant Systems

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Abstract Body:

Introduction: Difficulties in understanding speech in noisy conditions is one of the most common complaints of the hard of hearing and the users of hearing aids and cochlear implants. To alleviate the difficulties, directional microphone technology has been available in these devices for over two decades. Directional microphones have been investigated in a number of different listening configurations and their benefits are well established in the literature, especially in situations where the speech and noise signals are spatially separated and relatively close to the listener. Today, all major cochlear-implant (CI) manufacturers provide their sound processors with directional microphone technology. Typically, directionality is achieved with two omnidirectional microphones and digital signal processing. Akin to modern hearing aids, the directional pattern may be adaptive according to the location of the noise source and directionality may be applied only when needed, e.g., when the background noise level exceeds a given threshold. However, there are relatively few data on comparing the audiological benefits of directional microphones of different CI systems within a single study. The aim of the present study was to assess directional microphones via the improvement in speech recognition threshold in noise (SRTN) using a newly developed matrix-type speech-in-noise sentence test in Finnish. The acute effects of different directional patterns in three CI systems were compared with each user serving as their own control.

Methods: SRTN was assessed for adult cochlear-implant recipients in four different configurations: 1) in the omnidirectional mode with speech (S) and noise (N) from the front (S0N0), and with the noise from the side of the CI sound processor (S0NCI) in the 2) omnidirectional, 3) fixed directionality and 4) adaptive directionality modes. The overall presentation level was 65 dB SPL and the level of the speech signal was varied in an adaptive procedure to converge to the 50 % correct point. The presentation order of the four configurations was balanced across participants for each CI system. All assessments were performed unilaterally.

Results: The initial results suggest that over 10 dB SNR improvements in SRTN may be achieved with directional microphone technology in unilateral CI listening. At present, the data are still too few to compare the results across CI systems.
Conclusion: In optimal conditions of spatially separated speech and steady noise, marked improvements in speech recognition in noise are evident. Comparisons of directional benefits between CI systems will be presented at the meeting.
Introduction: The Cochlear Baha Attract system is a bone conduction hearing system designed to leave the skin intact. It uses a magnetic connection to attract the sound processor to the implant, sending sound to the inner ear without anything breaking the skin. This system is used for patients with conductive hearing loss, mixed hearing loss or single-sided deafness. The main aim of the study was to present six months experience with 14 adult patients implanted with Cochlear Baha Attract system.

Methods: The evaluated group was implanted and followed up in World Hearing Centre in Kajetany. To present the results there were pre- and post-operative examinations of audiological evaluation, including pure tone audiometry, free field audiometry, speech audiometry in free field. The subjective benefit was assessed with two questionnaires: APHAB and SSQ. The follow up period of healing and recovery after surgery was also documented for each patient.

Results: The comparison of pre- and postoperative results shows that hearing threshold was stable and patients have better results in speech understanding, both in silence and in the noise. Furthermore, the results obtained by means of a questionnaire APHAB and SSQ show a decrease in daily communication problems and increase the ability to cope with adverse communication conditions. Data obtained from the medical history and the patient's post-operative monitoring, indicates a low amount of postoperative complications alike in short and long term after surgery.

Conclusion: Data obtained from the medical history and the patient's postoperative monitoring indicates a low amount of postoperative complications. Our data shows that adults with single-side deafness, mixed and conductive hearing loss obtained benefit from implantation of the Cochlear Baha Attract system.
Introduction: Soft tissue preservation using a hydroxyapatite-coated abutment may lead to a reduction in complications in percutaneous bone conduction hearing implant surgery.

Objective
To assess the occurrence of a wide range of possible complications and benefits of this new intervention on the short and long term compared to the conventional treatment. The present abstract presents the clinical outcomes after one year of follow-up.

Methods: In this sponsor-initiated, open multi-center, randomized (1:1), controlled clinical trial (ClinicalTrials.gov NCT01796236), eligible subjects were randomly assigned to receive the conventional intervention, a titanium abutment (Cochlear™ Baha® BA300 Abutment) with soft tissue reduction (control), or a new intervention, a hydroxyapatite-coated abutment(Cochlear Baha BA400 Abutment) with soft tissue preservation (test). The primary outcome was a combined endpoint which included the secondary outcome measures pain, numbness, peri-abutment dermatitis and skin thickening/overgrowth.

Results: 106 subjects were randomized to one of the treatment groups. The Intention-to-treat (ITT) population consisted of 52 control subjects and 51 test subjects. The difference between the groups after one year of follow-up as measured by the primary efficacy variable was not statistically significant (p = 0.12) in the ITT population (n=103), but was statistically significant (p = 0.03) in the Per-protocol population (n=96). It showed an advantage for the test group, with over twice as many subjects (29%) with none of these important medical events during the first year compared to the control group (13%). Secondary outcome measures, such as surgical time (15 vs. 25 minutes, p<0.0001), numbness (90% vs. 69% of subjects experienced no numbness at one year, p<0.01), neuropathic pain (mean score at 3 months, 1.06±0.25 vs. 1.70±1.53, p=0.015) and the overall opinion of the esthetic outcome (as measured by the observer with the POSAS scale after 3 months, p<0.01) were favourable for the test group. Five abutments with
tissue overgrowth had to be changed in the control group versus one in the test group. No significant differences existed in the occurrence of peri-abutment dermatitis (Holgers index). One implant extrusion was recorded in each group.

**Conclusion:** Soft tissue preservation with a hydroxyapatite-coated abutment leads to a statistically significant and clinically meaningful reduction in numbness, neuropathic pain and surgical time, and improves cosmetic outcomes in comparison to soft tissue reduction surgery with a titanium abutment.
Electrophysiologic Assessment of Pediatric Patients with Sequential Bilateral Cochlear Implants

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Abstract Body:

Introduction: Selection of the ear to implant first in sequential bilateral cochlear implants may have long-lasting effects on binaural performance in deaf pediatric recipients within critical auditory development period (Sharma et al., *Hearing Research*. 2004;203(1-2):134-143). Historically, implantation of the worse hearing ear was favored in an effort to spare the remaining acoustic hearing (Blamey et al., *Ear Hear*. 2015; 36:408-416.). More recently, implanting the better hearing ear first has been found to be predictive of better ipsilateral and binaural speech perception outcomes (Laszig et al., *Otol Neurotol*. 2004;25:958-968). Reliable methods for selecting the “better ear” for implantation would therefore be valuable. Here we compare the ability of electrocochleography (ECochG) and the audiogram to identify the better ear in terms of speech perception outcomes. The objective of this study is to compare reliability of audiogram and ECochG in predicting the ear with better speech perception performance in pediatric bilateral cochlear implant candidates.

Methods: The pure tone average (PTA) was obtained from preoperative audiogram thresholds for 500 Hz, 1 kHz and 2 kHz. The round window ECochG response to tone bursts of different frequencies (0.25-4kHz, 90dB nHL) was recorded during CI surgery. The sum of significant response peaks was defined as the total response (ECochG-TR). Regardless of the ear that was actually implanted first, a better ear was determined for PTA if the scores were at least 6 dB nHL apart, and for ECochG-TR if the values differed by 6 dB re:1µV.

Side specific PB-k speech perception performance scores were obtained after at least 1 year of CI on each side. Subjects’ outcomes were compared using the earliest reliable PB-k score that could be matched to a contralateral score by the duration of CI use. A ‘better ear for outcomes’ was identified when the PB-k scores from the two sides were at least 10% apart.

Results: Nineteen pediatric subjects (0.9-17 years old) who underwent sequential bilateral CI procedures. A better ear for PTA was found in 10 cases (52.6 %), and for ECochG in 11 cases (57.9%). In 3 cases both modalities identified a side with expected ‘better ear outcome’; their results agreed in 2 of these cases. So far 11 cases have reached at least one year of use with both devices and have PB-k test scores. Of these, there was a ‘better ear outcome’ in 4 cases and
symmetric level of speech perception in 7 cases. PTA correctly picked the better ear outcome in 0 of 5 cases, in 1 case it predicted the wrong ear, and in 6 cases it did not identify a side with the ‘better ear for outcomes’.

EcochG-TR correctly picked the better ear outcome in 2 of 6 cases, in 0 cases it predicted the wrong ears, and in 5 cases it did not identify a side with the ‘better ear for outcomes’.

**Conclusion:** Use of ECochG is potentially superior to the audiogram alone as a means to indicate the “better ear outcome” in a planned, sequential bilateral implant candidate.
Control Number:
2016-A-203-ACI

Session Number:
POS02

Session Title:
Poster Session B

Poster Board Number:
156-B

Topic 1:
02k-Borderline Cases

Publishing Title:
Electrically Evoked Auditory Brainstem Response Over Round Window

Author Block:
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Abstract Body:

Introduction: Electrically Evoked Auditory Brainstem Responses (EABRs) over round window (RW) stimulation are recordings of the auditory pathway neural activity generated by electric stimulation of the cochlea. They are meant to be an objective measure of the ability to activate electrically the auditory pathway through the auditory nerve (AN) in case of cochlear damage. Nevertheless, this procedure is poorly used in clinical practice because of the artifacts generated by the electric stimulation and false negative outcomes. However, there has been increased interest in this diagnosis procedure due to cases of Aplasia/hypoplasia of the AN. We believe that EABR over RW are necessary in order to select potential candidates for cochlear implantation.

Methods: The study took place at "Hospital Universitari y Politecnic la Fe de Valencia". All patients underwent surgery between the years 2008 and 2013. It was carried out the brain stem stimulation through a bipolar electrode placed over the round window (RW) connected to a device called "stimulator box" that provides stimulus as a cochlear implant. The study was first performed in control group without AN malformations to validate the technique, and after in a group with aplasia / hypoplasia of the AN.
To assess the reliability of the responses recorded during the RW stimulation, it was compared with the wave V obtained after 3 months of cochlear implantation.

Results: 50 patients were included in the control group with an average age of 34 ± 21.9 (2-73); 31 men, 19 women. The common features of the measurements were: stability in responses, identification of the wave V between 3 and 5.5 msec and the absence of other waves. The mean latencies registered according to the electric charge used, confirm that as we increase the electric load the mean latencies decrease. The comparison of the stimulation conditions provides more reliable and reproducible records keeping constant amplitudes with variations in the phase duration, finding statistically significant difference (p = 0.024). The use of bipolar stimulation in contrast to monopolar one provides greater percentage of positive responses, finding statistically significant differences (p<0.001). The use of muscle relaxants during registration removes a plausible masking of the responses by myogenic...
potentials.
In the pathological group, 15 stimulations were performed in 9 patients. 4 had no response to electrical stimulation (1 was implanted). Patients with questionable electrical response (2) or with positive electrical response (3) were implanted. The hearing performance was measured after cochlear implantation. Of the 6 patients with CI, 2 had a poor outcome, 1 a fair result, 2 a good outcome and 1 a very good outcome.

**Conclusion:** Extracochlear electrical stimulation with a bipolar probe provides reliable and reproducible results, obtaining 100% positive results in the control group.
In patients with AN malformations, EABRs are critical to assess cochlear implantation. Patients with positive or weak responses are candidates for CI.
Introduction: Meniere’s disease is a disorder of the inner ear, which is characterized by recurrent attacks of vertigo. Currently it remains difficult to differentiate between different causes of dizziness. Cone Beam CT or MRI enhanced by invasive contrast agents such as gadolinium are nowadays investigated as a possible diagnostic for Meniere’s disease. Here, an alternative approach is investigated using readily available and conventional MRI scans. Lately, the evidence is increasing that with new imaging processing and analysis techniques, more information can be gathered from standard imaging modalities. This so called radiomics approach does not necessarily rely on features perceptually visible by the (neuro)radiologist, but it instead relies on the extraction and analysis of quantitative image features.

Objective: To investigate whether a quantitative image analysis of the labyrinth in conventional MRI scans using a radiomics approach showed differences between patients with Meniere’s disease and the control group.

Methods: MRI scans of the affected labyrinths of 25 patients with Meniere’s disease were compared to the MRI scans of labyrinths of 29 patients with an asymmetrical sensorineural hearing loss (best hearing side). The 1.5T and 3T MRI scans had been previously made in a clinical setting, without contrast enhancement. 3D Slicer 4.4 (http://slicer.org) was used to extract several substructures of the labyrinth from the original MRI scans. A quantitative analysis of the normalized radiomic image features was performed in Mathematica 10 (Wolfram Research). The image features of the two groups were statistically compared.

Results: In numerous image features, a statistically significant difference between the Meniere’s disease group and the control group was found. These differences were localized in all substructures of the labyrinth (the cochlea, the vestibule and the semicircular canals).

Conclusion: A quantitative analysis of the labyrinth on conventional MRI scans showed statistically significant differences between patients with Meniere’s disease and the control group. This demonstrates a difference between the two groups in the distribution of the intensities on MRI, and it might imply that Meniere’s disease could be detected in conventional MRI scans.
Introduction: The most usually used approach to auditory brain stem implant in children and adults is retrosigmoid. This approach have some disavantages as retraction of cerebellum and a craniectomy with post operative reports of cronic headache and longer hospitalization.

Methods: 67 cases was operated using this method. 35 children and 32 adults. A retrolabirynthine (RLA) or infralabyrintine approach was performed in all cases and was modified to expose the anatomical landmarks for the electrode implantation with a minimum exposition of the facial nerve and vestibule.

Results: The RLA used for ABI implantation in children is smaller than the one used in the removal of the schwannoma vestibular. The semicircular canals and the vestibule remain intact and there is no need to expose the dura of the internal acoustic meatus. The jugular bulb must be totally exposed in order to allow enough view of the IX cranial nerve and cerebellar flocculus. We had no postoperative complications in the 67 cases performed.

Conclusion: The data will be presented with the audiological results. The RLA can be done safely for ABI implantation in adults and children.
Introduction: Intracochlear schwannomas are rare tumors, first described by Mayer in 1917 (fewer than 100 cases in the literature). Schwann cells are also present in the modiolus, near the spiral ganglia and a schwannoma may begin primarily within labyrinth.

Asymmetric sensorineural hearing loss is almost invariably present in patients with intracochlear schwannoma. Complaints of tinnitus, ear fullness and vertigo are also common. Diagnosis of intracochlear schwannoma is difficult and often delayed because these presenting symptoms are shared with other otologic diseases, particularly Meniere’s disease.

Hearing preservation has not been reported in patients undergoing resection of intracochlear schwannomas. Anacusis often occurs as a result of the natural history of the tumor or after surgical removal. The objective of our study is to describe an minimal invasive procedure to intracochlear schwannoma removal which allows the possibility of simultaneous cochlear implantation.

Methods: Mastoidectomy with posterior tympanotomy, incus and tensor timpani muscle removal for exposition of the cochlea apice. With a diamond burr the cochlea wall was burred and a small window was opened in the apical turn and the membranous labyrinth exposed. The opening was enlarged with a delicate curette and the tumor was identified and totally removed pulling with a delicate hook. Cochlea was sealed with bone wax.
Results: Simultaneously, cochlear implantation was performed inserting the electrode by the round window. Intraoperative neurotelemetry showed normal and strong neural responses.

Conclusion: IT’S POSSIBLE TO REMOVE INTRACOCHLEAR TUMORS AND INSERT COCHLEAR IMPLANT WITH GOOD RESULTS
Hearing in Noise Benefit Using the Cochlear™ Mini Microphone 2+ with Nucleus®6 Sound Processors

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Abstract Body:

Introduction: The CP900 series sound processor has a new processor chip inside (NEO-chip), allowing wireless audio-connection, relieving recipients of the use of cables during certain communications. Traditionally, cochlear implant recipients’ access to assistive technology has involved connecting an Audio cable or using an intermediary device such as an FM receiver to the sound processor. Although assistive technology can provide increased SNR benefit to the patient, they have drawbacks outside of their financial cost. With FM systems, an ear-level or bodyworn receiver is necessary for routing the signal to the patient’s hearing instruments. For children especially, this can create problems due to increased size of the hearing aid with the ear-level receiver, as well as the inconvenience of having a second device to wear. The Cochlear™ Wireless Mini Microphone 2+ is a clip on microphone that transmits sound directly to the CP900 sound processor. Designed for one on one communication in difficult listening situation, and may also be connected directly to MP3 players. It is also compatible with GN Resound hearing aids. FM receivers are also able to be connected to the Mini Microphone 2+.

The study evaluates the hearing performance benefit obtained using the Cochlear™ Mini Microphone 2+ accessory with Nucleus 6® sound processor users.

Methods:
Eighteen experienced Nucleus® 6 recipients were recruited. Speech performance testing in fixed classroom noise was conducted, comparing the CP900 sound processor(s) and GN Resound hearing aid (bimodal subjects) with and without the Mini Microphone 2+, and Phonak’s Mylink FM & Roger FM systems.

Results:
The speech performance results in fixed classroom noise show that the Cochlear™ Mini Microphone 2+ provides significant and similar benefit to the Mylink & Roger FM systems, when compared to the Baseline (CP910 processor(s)/hearing aid alone condition). Full details will be presented.
Conclusion:
The Cochlear™ Mini Microphone 2+ is a convenient, easy to use accessory that provides the Nucleus® 6 user with increased hearing performance in difficult listening situations.
Control Number:
2016-A-255-ACI

Session Number:
POS02

Session Title:
Poster Session B

Poster Board Number:
140-B

Topic 1:
02f-Complications

Publishing Title:
Seven Cases Major Complications in Cochlear Implants and their Management

Author Block:
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Abstract Body:

Introduction: Cochlear implantation is a safe and effective therapy for severe to profound sensorineural hearing loss. However, some severe complications still occur.

Methods: A retrospective review of the data of cochlear implant patients performed by authors from March, 2010 to August, 2015 at our hospital was conducted and seven cases of major complications were reported. The complications were classified into early ( <1 week ) and late ( >1 week) and the reasons and management were discussed.

Results: The overall rate of complications was 10.6 % (61 of 575), with minor 54 cases (9.4%) which were resolved spontaneously or by medical treatment and major 7 cases (1.2%) which needed operations to correct them. The major early complication was an epidural hematoma in a boy who recovered completely without any neurological deficits and also with the cochlear implant device successfully survived following immediate evacuation. The major late complications were those needed to undergo reimplantation surgery. The reimplantation rate was 1.0 % (6 of 575). The reasons for reimplantation were hard failure in 2 cases, device broken following head trauma in 2 cases, flap infection and necrosis after 3 years of primary implantation in 1 case, postauricular abscess caused by acute suppurative otitis media after 6 month of primary implantation in 1 case. The reimplantation surgeries were problematic but complete electrode insertion was achieved.

Conclusion: Cochlear implantation is a relatively safe procedure with a low complication rate. But, some rare and life threatening complication may occur and certain reimplantation surgeries are inevitable. Specific attention and immediate intervention can help surgeons to prevent or correct them properly.
Introduction: Cochlear implantation (CI) is currently the treatment of choice for patients with severe to profound hearing loss. However, the outcomes with CI vary significantly among recipients.

Methods: The data of total 575 cases implanted by authors from March, 2010 to August, 2015 in our hospital were retrospectively reviewed. The cross-sectional questionnaire evaluation was conducted based on CAP (categories of auditory performance) and SIR (speech intelligibility rating) in prelingual normal inner ear patients among 3 age groups at implant and different duration of implant use. Also the performance of 21 cases malformed inner ear patients with CI trained in the same rehabilitation school were assessed by speech perception scores and speech age, as well as CAP and SIR with the standardized procedures conducted by China national CI program at the intervals pre and 6m, 12m post operation, and compared with matched normal inner ear controls.

Results: The score of CAP and SIR improved with the duration of implant use in all 3 age groups after CI, and were significantly different in <3 years old group among different using periods (p<0.01). At the earlier post-operation time, the score was higher in >6 years old group (p<0.05), which was in accordance with the proportion and duration of hearing aid use pre-implantation. But after 2 years of implant use, the score was higher in <3 years old group (p<0.01). The speech perception scores and speech age, as well as CAP and SIR in Common cavity cases were significantly lower than control pre and 6m, 12m post implants (p<0.01).

Conclusion: These results suggest that the auditory and speech performance is improved with the duration of implant use and faster and better in children younger than 3 years old at the time of CI. The duration of hearing aid use before surgery is related to the early performance post implant. Severe inner ear malformation affects the CI outcomes.
Cochlear Implant Surgery in Long-Term Single-Sided Deafness

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Abstract Body:

Introduction: Till today the cochlear implant (CI) surgery in adults with a long-term single-sided deafness (SSD) takes a special position. Adults with a very long-term or even congenital unilateral deafness have only recently gained access to a binaural hearing. Because of the extremely asymmetric experience in binaural hearing and the intense one-sided embossing of the central auditory pathway success in binaural hearing after cochlear implant surgery can be only poorly predicted. It raised the question whether this group of patients could benefit from a CI.

Methods: In the period of 2011-2015 CI surgery was performed in 27 patients with SSD. Five of them (2 female, 3 male) suffered from a long-term single sided deafness. At the time of CI surgery the patients were 52.4 ± 15.2 years old. The average duration of deafness was 38.6 ± 13.4 years. Because the term "SSD" must be always set in relation to age, a minimum duration of deafness of 25 years was assumed. In 2014 we carried out the first evaluation of the auditory results of 5 patients. These patients were particularly well observed in the past two years and we would now like to present the follow up results. All patients are in continuous care in Cochlear Implant Rehabilitation Centre Saxony-Anhalt. Overall, the duration and intensity of rehabilitation and the methodological approach for these patients had to be modified. To compare the objective results in all patients sound threshold audiogramm, a speech audiogram and the localisation ability were measured. To compare the subjective perception the changes in Bern Benefit in Single Sided Deafness Questionnaire (BBSS) and the Abbreviated Profile of Hearing Aid Benefit (APHAB) have been used as in previous years.

Results: It could be demonstrated that especially in unilateral SSD longer wearing time of CI speech processor and the great rehabilitative effort is worthwhile. An objective improvement of binaural hearing performance, a medialisation of hearing, the localization ability and a better understanding of language could be achieved. Subjectively all patients describe more security in everyday life and in difficult hearing situations and the CI enables them to experience a significant increase in quality of life.

Conclusion: This special group of potential CI patients remains up to today a major challenge and it requires an intensive
preoperative diagnosis, a detailed patient education about the possibilities but also limitations of the CI-supply and a much more complex rehabilitation after CI surgery. Only well-informed and motivated SSD patients may benefit from a cochlear implant.
Bilateral Use of Active Middle Ear Implants: Speech Discrimination Results in Noise

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Introduction:
Binaural sound reception has advantages over unilateral perception. Up to now, most active middle ear implant (AMEI) users have been unilaterally implanted, but patient demand for an implant on the other side is increasing.

Methods:
The Oldenburg sentence test was used to measure speech reception thresholds in noise. The subject’s signal-to-noise ratio (SNR) at a speech reception score of 50% was calculated for different noise conditions. (including squelch effect and summation effect)

Results:
Patients demonstrated improvement with bilateral AMEIs compared to right or left AMEI. Statistical significance was found in the S0N0 condition to favor usage of bilateral AMI versus either the right or left side only.

Conclusion:
Bilateral implantation can help to reduce problems in background noise and restore directional hearing.
**Introduction:** Throughout our experience and practice during the last 8 years in kids cochlear implantation, we would like to share the main observed complications, determine its incidence, the right therapeutic approach for future cases and to conclude the behavioral impact on the kids and their parents.

**Methods:** This is a prospective and retrospective study on a series of implanted patients between November 2007 and May 2015. The number of implanted patient was 232, amongst them 12 adult-adolescents and 220 kids whom age varied between 16 month and 6 years.

Classical implantation technique: retro auricular way, minimal/mastoidectomy/facial nerve approach and tympanic cord by posterior tympanotomy / round window approach or cochleostomy. Unilateral implantation in all the cases (financial incidence) - Two types of implants were used: Cochlear and Oticon (Neurelec).

- Report the different local complications directly linked with the anatomy, the ear surgery and the implant. We classified them as minor or major complication, peri or post surgical, near or late.

**Results:** We noticed 18 complications, representing 8% of our 220 patient series. No complications in the adults.
Half of them had local problems (9): - local infections, 2 cases treated - 2 facial paresis that regressed - 3 temporo-parietal hematoma cases without complications - 1 cheloid scar - 1 posterior retraction sac.
The other half (9 cases) - in relation with the implant: 4 failures without an apparent cause which needed a homolateral reimplantation and 1 contralateral - 1 failure due to a secondary extrusion because of a skin fragility reimplanted after 8 months in the contralateral side and 1 by late infection - 3 post-traumatic explanations which were reimplemented too.

**Conclusion:** We defined and presented different therapeutic approaches adapted to these main complications in order to reduce their number in the future and better preserve hearing and quality of life.
Introduction: To present a particular otologic pathology: the necrotizing external otitis of the external acoustic meatus, and to highlight its serious evolution towards a cartilaginous damage.

Methods: In this study we report the case of an immunodeficient infant, which was caused by a pseudomonas aeruginosa germ. The clinical exam showed a partial necrosis of the tragus cartilage and a stenosis of the external auditory canal. This particular external otitis has to be differentiated from the infectious pathologies and from the congenital cystic malformations of the posterior parotid region.

Results: A medical treatment has been conducted causing an ulceration in the cutaneous part of the external auditory canal and an expected necrosis due to the pseudomonas aeruginosa abscess location.

Conclusion: There was a good evolution, which required a rigorous follow-up to calibrate well the canal by a drain after the scarring to avoid the auditory meatus stenosis.
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 in cochlear implantees led to the assumption that an estimation of the intracochlear electrode position could be possible. The aim of the study was to evaluate the assessment of the ipsilaterally scalar position of cochlear implant electrodes by MRI sequences at 1.5 T.

Methods: In a retrospective study we evaluated in 8 implantees with the postoperative need for an MRI scan the intrascalar electrode position in an axial position with a T2 weighted sequence at 1.5 T. We compared the evaluated intracochlear position with the routinely postoperative performed flat panel tomography and intraoperative NRT-ratio observed position.

Results: In all cases the MRT estimated scalar position corresponded with flat panel tomography and NRT-ratio estimated position. In six cases a scala tympani position was observed. In two cases a scalar change from scala tympani to scala vestibuli was found.

Conclusion: An estimation of the intracochlear position of cochlear implant electrodes by MRI is possible.
Introduction: Beside a multistep surgical cartilage reconstruction for cosmetic ear rehabilitation in patients with ear anomalies and hearing loss the combination of an hearing implant with an epithetical solution is a possible treatment option. It was the aim of the study to present our experiences in terms of surgical steps and cosmetic results with a combination of hearing implant and epithetical solution.

Methods: In 5 patients a combination of hearing implant and epithetical anchoring was performed (Cochlear Implant, Vibrant Soundbridge, BAHA Attrac 2 times und Vibrant Bonebridge). We chose a sequential surgical procedure where we combined firstly the hearing implant surgery with the fixture placement. The abutment fitting was performed in a second step as an outpatient treatment.

Results: Beside the successful hearing rehabilitation all patients pronounced a high degree of satisfaction with the cosmetically result. Complications like a local abutment inflammation are possible.

Discussion: The combined treatment of hearing loss and outer ear anomalies by an hearing implant with an epithetical solution is an alternative way to a cartilage based ear reconstruction and a hearing implant. The pros and cons of the different solutions need to be discussed with parents and children.
Abstract Body:

**Introduction:**
The indication criteria for cochlear implantation have changed over the past decades to patients with residual hearing. To preserve residual hearing, the electrode design has been refined and an atraumatic insertion of the cochlear electrode has become one aspect of cochlear implant research. The aim of our study was to observe intracochlear pressure changes due to different cochlear implant electrodes in a cochlear model.

**Methods:**
The experiments were performed in an artificial cochlear model. A micro fibre pressure sensor was placed in the helicotrema area to monitor pressure changes. We compared 4 different electrode types (Advanced Bionics IJ, Helix, HFMS and LW 23) in terms of insertion speed, insertion time, tip size effects, electrode concept and electrode volume effects by means of hydostatic pressure, peak frequency and peak amplitudes.

**Results:**
We observed significant effects of electrode volume, electrode tip size, electrode insertion technique (lateral wall vs. midmodiolar) on hydostatic pressure, peak frequency and pressure amplitudes.

**Conclusion:**
In our model experiments electrodes characteristics have a significant influence on the intracochlear pressure changes in terms of mean maximum value, frequency and amplitude of peaks.
Abstract Body:
Introduction: Living Well tool uses pictures on cards to help hearing impaired patients to identify what is most important to their quality of life and can come up with strategies to deal with communication challenges in the daily lives. It also enables patients to identify the communication situations in their daily lives that are most important to them. By learning where patient’s priorities lie, we can keep the conversation relevant and focus treatment plan for improved outcomes. This makes it easy for the clinician to recommend communication strategies and appropriate hearing equipment to the patient. Living Well’s flexible design makes it possible for us to personalize care. Using the tool’s pictures of everyday communication situations, we can help jog the patient’s memory. Together, we can set goals to improve everyday communication and formulate a plan for achieving those goals. It is also useful as a teaching tool. By role playing scenarios, students and professionals can practice patient-centered counseling skills. The tool is based on the principles of WHO’s International Classification of Functioning and Disability.

Methods: In our study, this tool is employed to 10 cochlear implanted adults with different age, duration of deafness, and standard of living.

Results: The outcome after using this tool was evaluated, and recommendation was addressed to customize the tool for cochlear implanted adult patients.
Introduction:
To investigate hearing rehabilitation results of implanted children with narrow internal auditory canal (IAC), and analyze whether the degree of IAC stenosis will influence auditory performance.

Methods:
8 implanted children who were diagnosed with IAC were retrospectively analyzed from July 2012 to January 2013 in our hospital, which included 5 males and 3 females, aged 1-7 years old. The cochlear nerve canal (CNC) and IAC diameter were measured on high-resolution computed tomography (HRCT), and the width of the cochlear nerve (CN) and the facial nerve (FN) were measured respectively on magnetic resonance imaging (MRI). It was diagnosed as stenosis IAC if the width of CNC was<1.8mm, or the width of IAC was<3mm, or the diameter ratio of CN / FN was <1. The control group chose 10 similar condition patients with normal CN who received CIs in our center. The CAP, SIR, and hearing threshold after CI between CND group and without CND group at post 1 year were compared, and the correlation between the ratio of CN/FN and the CI auditory and speech performances was studied with Spearman test.
Results:
1. Most (6/8) patients didn't develop favorable CI outcomes and showed CAP scores lower than 5 after 1 years in use. 2. Except one child has no response to the sound, the others CAP score showed obviously higher post CI 1 year comparing with that pre-operative, but these scores were significantly worse than those without CND who were implanted in the ear. 3. All of the patients showed SIR scores lower than 3 after 1 year in use. 4. Comparing with normal CI patients, those patients have lower speech development and poorer speech articulation, and most of them started to form speech at about 1 year after CI. 5. Hearing threshold with CI of CND patients were significant higher than that of normal CI patients. 6. Few CND patient's hearing threshold with CI could achieve 20-30dB HL, most of them could achieve 40-50dB HL after 1 year in use. 7. For the 8 patients, there was no significant correlation between auditory rehabilitation and the ratio of CN / FN.

Conclusion:
The outcome of cochlear implantation in patients with CND are poorer than those with normal CN patients. The ratio of CN/FN by MRI scan could not predict the short term outcome of the CND patients with CI.
Multichannel cochlear implants have been a viable treatment option for severe to profound hearing loss for over 30 years. In that time period, enormous advances have been made in sound encoding strategies, sound processor technology, and internal device architecture. As the treatment modality has matured, recipient performance has improved. Advances in the industry have been accompanied by marked accrued benefit to implant recipients as a group. Can this trend be expected to continue indefinitely? Many factors may be converging that should prompt an exploration of individual performance as well as group trends. Recipient performance continues to be highly variable for reasons that are not fully understood. The brain development of pediatric recipients is being shaped by today’s technology with no way to predict where technology will take the industry in the child’s lifetime. Incremental benefit from each product advancement cycle may have slowed. Today’s legacy recipient was at one time a new recipient on whose shoulders we now stand. In light of these and other factors, considerations regarding the industry’s ethical obligation to all implant recipients, not just the majority, will be explored in hopes of encouraging discussion.
Introduction:

Inner ear malformations comprise about 20% in profound to severe sensorineural hearing loss. Incomplete partition (IP) type I is described as “cochleo-vestibular malformation” and is not common in candidate for the cochlear implantation (CI). The aim of this study is to investigate the outcomes of these patients after CI.

Methods:

Medical records retrospectively reviewed in 26 patients (3 %) of IP type I among 842 CI between Jan 2000 and Jun 2013 by one surgeon in Asan Medical Center, Seoul, Korea. The mean age at the CI was 10.1 years (SD, 12.4, range; 0.9 - 47.4). The mean duration of follow-up was 5.2 years (SD, 3.6; range, 1.1 - 12.0). The widening of fundus and the size of cochlear nerve were measured using preoperative high resolution temporal bone (HRTB) CT and MRI. The speech perception test scores were included in the data analysis.

Results:

Contralateral lesions were found mostly IP type I in 19 ears (73.1 %), cochlear aplasia in 3 ears, common cavity in two ears, and IP type III in one ear. HRTB CT showed widening of the fundus in 11 ears; however six ears were showed cerebrospinal gush out during the cochleostomy. Among six, one patient underwent revision surgery due to CSF leakage. The cochlear nerve was evaluated in 20 patients and the cochlear nerve aplasia was found in 10 ears (50%), cochlear nerve hypoplasia in five ears (25 %), and normal in 6 ears. The outcome after CI was evaluated by categories of auditory performance (CAP) score, The CAP scores were 7 in six ears (23 %) at 7.7 years postoperatively, CAP 5 in five ears (19%) at 3.4 years after CI, CAP 4 in eight ears (30.1 %), and less than CAP 3 in five ears.

Conclusion:
The IP type I was comprised 3% among 842 of CI. The cochlear nerve aplasia or hypoplasia was found in 75% of IP type I patients. CAP score reached 7 in 23% of patients at 7.7 years long term follow up. Regardless of the extent of inner ear anomalies, a CI with careful treatment planning is a valid option for the IP type I inner ear malformation.
Abstract Body:

Introduction: The Bonebridge is a new transcutaneous bone conduction hearing implant used for patients with mixed and conductive hearing losses. A frequently described advantage of this hearing implant is that the skin above the implant remains intact. So far no reports are available showing successful implantation of the Bonebridge after failed treatment with the BAHA system. We wanted to show, if the Bonebridge could also be used for unsatisfied patients due to infected BAHA-screws.

Methods: We present the case of a 50 year-old female patient, who suffered from conductive hearing loss. After BAHA implantation bilateral recurrent infections of the skin surrounding the screw appeared mostly on one side. Despite careful local treatment the skin problems could not be solved. Due to these infections, the BAHA was explanted and a Bonebridge bone conduction implantation was performed. Audiological outcome of both implant systems were compared and subjective satisfaction was evaluated by hearing device satisfactory scale. The peri- and postoperative period were observed.

Results: No peri- or postoperative problems occurred. The audiological outcome with the two different devices was nearly the same. An improvement in the patient’s subjective satisfaction with the Bonebridge could be found.

Conclusion: The transcutaneous bone conduction hearing implant Bonebridge is an alternative option for patients suffering from local skin reactions with BAHA.
Influence of the Recording Electrode on the ECAP Threshold

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Introduction: Measuring the electrically evoked compound action potential (ECAP) has become an important tool for verifying the electrode-nerve interface as well as establishing a basis for a map to program the speech processor. In a Standard clinical setup, ECAPs are recorded via an electrode being proximate to the stimulation electrode and the threshold of the ECAP response is determined.

Methods: We investigated the influence of the distance between the stimulation and recording electrode on the ECAP threshold in 35 cochlear implant (CI) users (39 implants, all MED-EL devices). For each of the 12 contacts of the electrode array, amplitude growth functions (AGF) were recorded using all 11 unstimulated electrode contacts until the loudest acceptable presentation level (LAPL), resulting in 132 AGFs per CI. The so called fine-grain recording paradigm was used where the stimulation intensity is increased in quasi-continuous steps and each current level is measured as an individual single trace. These single traces are being combined with a moving average filter improving the signal to noise ratio without the need to repeat and later average recordings with identical stimulation levels. However, as AGFs usually show the shape of a sigmoidal curve, we decided to use this a-priori knowledge and alternatively fitted sigmoidal functions to all individual data points obtained from the subjects instead of using the moving average approach as a noise reduction method. The intention here is to get rid of the smearing effects being introduced by the moving average filter and at the same time get a snug fit by using the more realistic sigmoidal fitting function resulting in a highly probable AGF estimation. The high resolution of the carrier of the measured AGF, i.e. in the neighborhood of the ECAP threshold, allowed for a derivation of the ECAP threshold directly from the fitting sigmoidal parameters.

Results: We observed a decrease of the maximal ECAP amplitude with increasing distance between the stimulation and recording electrode, with a detectable ECAP being normally present even at a distance of 11 electrode contacts. Analyzing AGFs where the LAPL was above the ECAP threshold we could not find any significant effect of the distance between the stimulation and recording electrode on the ECAP threshold determined from the sigmoidal model.
Conclusion: Our findings indicate that the determination of the ECAP threshold is invariant of the choice of the recording electrode in cases where the AGF can be recorded well above the ECAP threshold.
Abstract Body:

**Introduction:**
In literature 0.5 to 0.83 of 1000 children have unilateral hearing loss (UHL). This type of hearing loss is defined as normal hearing in one ear and hearing impairment in the other ear of at least 20 dB. Single sided deafness (SSD) is an extreme version of unilateral hearing loss (UHL), with severe to profound hearing loss in the respective ear. The consequences of UHL in children and young adults are often extenuated. Parents experience good hearing performance in their children, and language acquisition mostly starts normal at the end of the first year of life. Moreover, professionals like ENT doctors and pediatric audiologists underestimate the problems of UHL for speech development, social skills, school and academic achievements. However, limitations in these domains are well documented for children with SSD.

**Methods:**
In the paedaudiological ambulance of the University hospital all parents of children with SSD are routinely informed about the possibility of cochlear implantation. After an insufficient trial with hearing aid, three of these SSD children were implanted with a cochlear implant (CI) and received an audio-verbal therapy. We aimed to explore the hearing outcome in the implanted SSD children. The three SSD children were tested in respect of the hearing thresholds and the speech understanding in the implanted ear.

**Results:**
All children wear their speech processors daily, show success in therapy and benefit from the CI in everyday life.

Conclusion:

In children with SSD, cochlear implantation in the deaf ear should be considered if a hearing aid is not sufficient. The correct time of implantation is not yet well known. However, in consideration of maturation aspects, implantation in the first years of life are expected to lead to the best results.
Utilising Intraoperative Electrocochleography to Assess the Preservation of Cochlear Function During and After Cochlear Implant Insertion

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Abstract Body:

Introduction:
Introduction and objective: There are different types of electrode array available for cochlear implant (CI) surgery, Choice of array may influence the likelihood of hearing preservation. The objective was to evaluate which arrays were the least harmful during insertion using electrocochleography

Methods:
The recording electrode was placed above the stapes through the attic and the transducer was placed in the ear canal. Recordings, using click or tone pip stimuli, were obtained on drilling the surface of the cochlea, opening the cochlea either through the round window or through a cochleostomy, and at different stages during the insertion of the cochlear implant. Previous studies when the basilar membrane was pierced during Meniere’s surgery showed that the electrocochleogram could take about 1-2 minutes before loss of the potentials. It was necessary therefore to wait at each stage for at least one minute before proceeding with the insertion.

Results:
Results: The changes in action potential (AP) thresholds which occurred at each step of the surgery are summarised for 39 different surgeries. The results for the insertion of Cochlear™ straight (CI24REST, CI422) and contoured arrays (CI24RCA, CI24RECA) and a Med-El™ 31mm flexisoft electrode are presented. It was found that stiffer electrodes could damage the basal membrane on reaching the first cochlear turn with loss of the compound action potential (CAP). The Cochlear™ contoured electrodes were particularly prone to cause damage. The Cochlear™ straight arrays were less damaging. The CI422 could cause AP loss on deeper insertion. The Med-El electrode was inserted without any loss of the potentials recorded 10 minutes after insertion.

Conclusion:
Contributors influencing hearing preservation are complex and is thought to involve both intraoperative and post-operative factors. Intra-operative electrocochleography enables intraoperative analysis of thresholds and can show loss of intra-operative CAP. Analysis using intra-operative electrocochleography shows flexible, and finer arrays are associated with better preservation of CAP and less intra-cochlear damage during CI insertion.

Introduction:
Fitting is a key step for successful implant outcomes. A proper fitting process is mandatory to provide good access to sound spectrum, for reaching an appropriate level of speech discrimination, for acceptable sound quality in different listening situations.

Methods:
The goal of our ENT Department is to treat young children with severe to profound hearing loss, in their critical sensitive period of central auditory system maturation. Lowering the age, assessment of MCL and THR can be a challenge.
The aim of this paper is to compare, retrospectively, the objective measurement of ECAPs in 27 selected patients from those implanted in our ENT Department between 2008-2015. The clinical application of ART test is to validate the working status of the implant through evaluation of auditory nerve response, to assist programming the speech processor in patients with unreliable behavioral responses.

Results:
The study group included 4 adults and 23 children, 6 postlingually deafened, with at least 6 months experience in implant use. The auditory nerve responses were recorded with reliable data in 78% of the patients. Correlations between ECAP thresholds and behavioral established MCL levels were mild, with slightly stronger correlations in the apical region comparing with those from the basal sites. We found a better correlation between ECAP thresholds and MCL levels in postlingually implanted patients, mainly in apical electrodes.
Conclusion:

Recording this synchronous response from electrically stimulated auditory nerve fibers, via intracochlear electrodes of the implant, we may add valuable information to assist programming CI speech processor. The correlations between ECAP thresholds and behavioral levels didn’t prove to be strong enough to allow us to use ECAP measures as a sole method for fitting maps estimation. At this level, the stimulus should be audible enough to begin conditioning a child to respond behaviorally, but a strong reliance on ECAP thresholds has yet not been achieved.
Introduction
To assess phonological proficiency and speech intelligibility of a group of 36 prelingually-deafened children with more than 2 years of CIs use using newly developed paragraph-reading sample tools.

Methods
Twelve reading passages (4 for lower, middle and higher grade of elementary school) of this phonological proficiency and speech intelligibility assessment material were developed and validated, which include all vowels, consonants and tones in Mandarin. 36 children (14 boys and 22 girls) with CIs aged from 7 to 15 years old (mean=10.8±2.0), (age at implantation: 2.8±1.1 yrs; duration of implant use: 8.0±2.3) were recruited from the cochlear implant centre of Chang Gung Memorial Hospital and assessed with this newly developed tools. This tool is used to assess the children’s articulation (including phoneme production and tone), word and sentence intelligibility, voice, fluency, speech rate and subjective auditory-perceptual evaluation. Three speech therapists listened to the passage-reading recordings in a single-blind setting, making correct % scores for phonemes and intelligibility. The severity of each other items (fluency, speech rate) is given a score of 100% (normal), 75% (mild), 50% (moderate), 25% (severe) and 0% (profound).

A six-point scale was used for auditory-perceptual evaluation.
The scores given by the three speech therapists were averaged for analysis. The subjects sex, ages at implantation and their duration of implant use are used for predictive factors for unfavorable outcomes.

Results
The results of average correct rate of consonant production are 92.6%±13.1%, of vowel production are 99.1%±1.7% and tone discrimination, 93.3%±9.4%. The overall word intelligibility (90.1%) in all children is much better than sentence intelligibility (55.7%). 52.8% of our children have normal speech intelligibility, 88.9% have normal speech rate, 86.1% are fluent speaker. Subjectively, The auditory-perceptual evaluation showed that 33.3% of children have abnormal voice, which include monotone, 44.4%, abnormal
loudness 19.4 %, abnormal pitch 30.6 % and abnormal resonance 19.4 %. Binary logistic regression analysis showed that our independent predictors - sex, age at implantation and duration of implant use was not independent predictors of unfavorable articulation and voice quality outcomes.

Conclusion
Our long term data showed phonological proficiency and speech intelligibility of Mandarin-speaking prelingually deafened children with CIs is good. However, the predictive factors related with these abilities still need to be explored.
Introduction: Congenital malformations are associated with significant aesthetic and functional problems. Although there are new types of implantable hearing devices available, there are limited evidence on the application of these devices in patients with atresia and microtia problems. Especially, if this deformation are connected with genetics syndrome. Despite the gradual improvement of surgical techniques reconstruction, the surgery still remains associated with very limited short-term and mainly long-term functional outcomes. Therefore, the priority treatment in modern otosurgery becomes implantable devices such as Baha, Ponto, Bonebridge and active middle ear implants.

Methods: The group of 15 patients was evaluated by collecting the data from their medical history, audiological tests and radiological tests. Audiological assessment including pre and post operation pure tone audiometry, free field audiometry and speech audiometry in free field. Radiological analysis included assessment of the structures of the middle ear and the degree of malformation.

Results: Radiological consideration showed that degree of middle ear malformation has influence on audiological benefits alike among children and adults with congenital malformation of middle and outer ear implanted with Vibrant Soundbridge.

Conclusion: In recent years there has been an increase in the number of available implantable devices, which can be used in this type of defects. The selection of appropriate implantable hearing devices should be based on various factors, including radiological findings, audiological benefits, and possible surgical complications after device implantation and patient preferences. Only proper correlation of all this factors allows to optimal hearing treatment outcomes.
Control Number: 2016-A-413-ACI

Session Number: POS02

Session Title: Poster Session B

Poster Board Number: 61-B

Topic 1: 03c-Outcomes

Publishing Title: Results After Sequential Bilateral Auditory Brainstem Implantation

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Abstract Body:

Introduction: Patients with neurofibromatosis type 2 (NF2) considered for auditory brainstem implantation usually have bilateral vestibular schwannoma, which often results in deafness. Most of these patients receive one auditory implant system (ABI) and obtain various levels of functional benefit although not achieving significant open set speech recognition. Four out of five our NF2 patients with ABIs have open-set speech recognition with their one device alone. One patients received bilateral ABIs sequentially.

Methods: In 2006, after surgical removal of the tumour on the right side, 27-year-old man with NF2 was implanted with C40+ ABI system, manufactured by Med-El, Innsbruck, Austria. The vestibular schwannoma on the left side was removed and the second C40+ was implanted on March 28, 2008. Perceptual and speech comprehension performance was assessed by free-field audiometric testing, Sound Effects Recognition Test (SERT), the monosyllabic word test and a visual analog scale (VAS). All tests were administered under 3 conditions: sound on right side only, sound on left side only, and bilateral sound stimulation.

Results: The free-field audiograms showed the same sensitivity to sounds for both sides. The SERT score for the right side and bilateral condition was 100%, and that for the left side was 80%. Bilaterally, the word recognition scores were 80% and 35% in quiet and in noise respectively Right ABI scores were 70% and 30% in quiet and in noise respectively. Lack of open-set speech recognition in response to electric stimulation of the left ABI alone was most probably due to the side effects problem. Subjective sound-quality assessment rankings were 6 points, 1 point, and 9 points for the right side, left side, and bilaterally, respectively.

Conclusion: The benefit from bilateral stimulation was proved on
Results of the current study demonstrated that bilateral electrical stimulation from ABIs provide at least the same or better sound perception benefit as that provided by unilateral stimulation.
Introduction: The initial fitting of a speech processor for cochlear implants (CI) is usually done two to six weeks after surgery (Vaerenberg et al., The Scientific World Journal 2014:501738). The question arises why it is important to wait such long time. Arguments in favour of early switch-on are to evidence the hearing success immediately after implantation. Also the growth of connective tissue may be reduced by electrical stimulation (Newbold et al., J Neural Eng 2011;8:036029), keeping impedances low, and improving battery life. On the other hand wound healing may be impaired by wearing the behind-the-ear processor in the vicinity of the suture. The magnet strength in the headpiece of the processor may be overestimated due to swollen tissue after surgery, leading to problems after some weeks.

Methods: Early Switch-on is supported by intraoperatively measured thresholds of the electrically evoked compound action potentials. It was shown that there is a moderate to good correlation of these thresholds with the comfortable levels, needed to program the speech processor. We are reporting on our first cases of early activation in regards of acceptance, benefit and disadvantages. The impedances have been measured in patients with and without early switch-on and were compared at different times.

Results: Preliminary analysis comprises 33 patients with early switch-on from three different manufactures. In this group impedances were about 0.5 kOhm lower compared to patients without early activation. The difference was not significant. Early switch-on was generally accepted by the patients. Programming parameters after five weeks were quite similar. Only the volume had to be increased. In some cases the magnet strength of the coil had to be diminished.

Conclusion: Early switch-on was feasible in most of our patients. They were satisfied with the quick approach of CI surgery and direct activation, which had an encouraging effect. Especially in cases of contralateral implantation and re-implantation the Prior experience was very advantageous.
Introduction: In the last years new cochlear implant (CI) electrodes were developed which aim to preserve the residual hearing during implantation which succeeds in most of the cases. However, it is desirable to monitor the status of the residual hearing during insertion. The aim of the monitoring is to identify critical steps during the insertion as well as an immediate modification of the ongoing insertion if necessary.

Methods: Within the project cochlear microphonics (CMs) are measured intraoperatively in case of significant residual hearing. The recording took place at different insertion steps. With up to now 28 patients CMs were recorded extracochlear using a cotton wick electrode. With up to now 3 patients the “theragnostic probe” was used. This CI electrode (Flex20, Company MedEl) has got three additional recording contacts at the tip whose were used for measuring CMs intracochlear. The stimulation was done acoustically using different tone bursts (250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz) presented by insert earphones.

Results: With extracochlear recordings the according spectra showed peaks up to 0.5 uV at maximum stimulation level. Intracochlear the measured peaks had an amplitude of up to 20 uV to some extent.

Conclusion: The measurement of CMs during CI insertion is possible. With intracochlear recordings the measured amplitudes are by far higher than with extracochlear recordings. For a more specified evidence more data has to be obtained.
Abstract Body:

Introduction: Patients with single side deafness and bone conduction implant are a small group in comparison to the rest of patients qualified to be implanted. It is commonly known that research reliability grows with the number of participants. Since targeted group is so small, another approach is to conduct many independent tests on smaller groups. The same high reliability score can be provided when many independent tests will give the same or similar results. The aim of this study was to independently measure improvement in ability to localize the source of the sound as well as speech understanding in noise as well as to provide reference point for similar studies conducted by other research facilities.

Methods: So far eleven adult subjects with single side deafness and bone conduction implant have been enrolled into this study. Eight of them are using Bonebridge, two Baha Atract and one Baha Connect device. To evaluate their improvements we have been using audiological tests and both ABHAB and SSQ tests. Questionnaires were filled by patients before surgery and 3 months after. To perform localization and hearing in noise tests, we used insulated room with five active loudspeakers. They have been distributed on 0°±45°±90° angles to create half circle shape. The distance between the patient and loudspeakers was approximately 1 meter.

Results: As far as ability to localize sound is concerned, patients with left sided implantation were reported to improve their results in contrast to those with right sided implantation who reported worsening of their condition. In time, significant improvement in speech recognition in noise were observed in implanted patients.

Conclusion: According to ABHAB questionnaire, patients rated their hearing ability in different situations as two times better than before surgery. The same participants in SSQ test evaluated theirs spatial and speech hearing ability as significantly better.
Effect of the Oticon Crystalis Intensity Mapping System on Binaural Hearing in Bilaterally Implanted Subjects

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Abstract Body:

Introduction: Signal processing in the Oticon Medical cochlear implant aims to present a large input dynamic range without typical distortions introduced by a fast acting automatic gain compression (AGC) by capitalizing on the instantaneous compression in the current-mapping stage. Preliminary company tests showed improvements for speech understanding in quiet (+12%) and in noise (+27%). The objective of the study is to test the effect of the signal processing without fast acting AGC on binaural processing by relating measures of speech understanding with spatially separated sources and measures of localization to just-noticeable differences for inter-aural time differences.

Methods: Three adult subjects with a hearing loss due to DFNA9 simultaneously received the Oticon Oticon Neuro Zti Evo implant in both ears. All used the Neuro One processor in both ears. Speech understanding will be tested using the closed-set Matrix test with speech from the front and noise from front, left and right. Localization will be tested measuring the head orientation towards one of 125 speakers placed in a sphere arrangement of 140 degrees in azimuth and 120 in elevation. Different intensities and frequency content will be used for this task. JND for ITD will be measured via direct audio input.

Results: Results will be presented.

Conclusion: As this is work in progress, no conclusion can be drawn yet.
Introduction:
Insertion of the electrode into the cochlea usually causes a certain degree of trauma to delicate cochlear structure (electrode insertion trauma - EIT), which may activate several mechanisms of ganglion cell death, including necrosis and apoptosis. It is generally assumed that the amount of EIT correlates significantly with the level of postoperative hearing preservation. Thus the extent of hearing preservation is believed to serve as a good indicator of the magnitude of EIT. However it is not known how affects cochlear mechanics and function beyond that which is revealed by the audiogram. Direct intracochlear recordings of the acoustically evoked potentials (AEP) from the implanted cochlea will help us to identify the electrophysiological markers of cochlear health. The aim of the study was to assess the feasibility of this approach by investigating the prevalence of recorded potentials in relation to the audiometric thresholds and place of recording in the cochlea.

Methods:
Sixty patients with preserved various levels of low frequency hearing after cochlear implantation were recruited for the study. The acoustical stimuli (500 Hz, 1000 Hz, 2000 Hz and 4000 Hz tones) were presented via inserts placed in the ear canal of the subject in implanted ear. The personal computer with Synergy system was used for controlling and providing acoustical stimulation. Near field responses were recorded from multichannel intracochlear electrode array using Research Interface Box II system.

Results:
The prevalence varies from 94% for 500 Hz tones to 82% for 4000 Hz tones. Recordings were possible for all apical medial and basal locations in 37 out of 60 patients. The lack of responses were encounters in cases with thresholds excided 115 dB.
Conclusion:

Results showed that recordings of acoustic evoked potentials directly from the different places of cochlea are possible after cochlear implantation in majority of patients with preserved hearing. The work was supported by Polish National Science Centre, decision no. DEC-2013/09/B/ST7/04213
Impact on Word Recognition and Directional Hearing in Patients Using Bilateral Bone Conduction Hearing Implants

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Introduction:
Patients with a conductive or mixed hearing loss due to aural atresia or with radical cavities after cholesteatoma surgery often need bone conduction hearing aids for a better word recognition. A bone anchored hearing aid could be an alternative to a conventional hearing aid solution. We tried to find out which effects a bilateral stimulation of the ipsi and contralateral cochlea with bone anchored hearing aids would have on the ability of sound localisation and word recognition in noisy surroundings.

Methods:
Two patients with a conductive hearing loss were implanted bilateral with the semiimplantable bone anchored hearing aid Bone Bridge. Word recognition was tested with the Freiburger monosyllabic test and the OLSA sentence test comparing bone conduction hearing aids and the Bone Bridge. Directional hearing was tested with the ISVR 5 Speaker Localisation test.

Conclusion:
There is a great benefit in word recognition and directional hearing with bilateral bone conduction hearing aids. This effect could be increased by using bilateral Bone Bridge implants.
Abstract Body:

Introduction: Profound mixed hearing losses are still a great challenge in modern audiology and otosurgery. Available treatment does not provide expected results in many cases. Both surgical (inc. stapedotomy, middle ear implants, bone conduction implants), and non-invasive (conventional hearing aids) approaches are inefficient or even impossible to apply in many cases. A new partially implantable middle ear prosthesis - Cochlear CODACS - may be in the future a prospective alternative for the current solutions.

Methods: Material consists of 5 patients implanted unilaterally with a Cochlear CODACS device, in 2012. The surgeries were conducted as a part of a multicenter clinical study sponsored by the Cochlear company. Impedance audiometry was basic audiology test. The Polish monosyllabic speech tests in noise and in quiet conditions, and the adaptive sentence test were also applied as well as PTA (free field). Additionally to the multicenter study we extend test with results of acoustical loudness scaling in free field, using narrowband noise and 50-points loudness scale measured in CODACS only condition are presented. The frequencies measured ranged from 500Hz to 6300Hz and intensity levels ranged from 40 to 90 dB SPL.

Results: Hearing and functional structures of the ear were preserved in a 100% of cases. While 4 out of 5 cases of patients with CODACS devices showed a statistically significant improvement of speech recognition scores, yet SRT was achieved by lower the SNR in comparison to preoperative results in conventional hearing aids. The authors also observed lower postoperative PTA thresholds in free field conditions with Cochlear CODACS devices, than with hearing aids worn before surgery.

Conclusion: Obtained long-term results allow us to state that the implantable Cochlear CODACS system may be an alternative for other treatment methods applied in cases of profound mixed hearing loss.
Introduction: Tissue preservation surgery, either with a linear incision or a single circular incision approach, has quickly become the preferred method for installing bone anchored hearing systems (BAHS), with superior outcome in terms of aesthetics and preservation of sensibility. However, the surgical instrumentation currently used was not developed with these surgical techniques in mind. To improve patient outcomes and to reduce the invasiveness of the procedure further, a standardised surgical procedure was developed to allow a safe installation through a 5mm circular incision. For this purpose, a novel surgical instrumentation kit was developed, the minimally invasive Ponto surgery (MIPS) technique. We report here the experience from 50 centres and approximately 200 patients using MIPS. Objective: To evaluate a new minimally invasive surgical technique (MIPS), and to collect short-term follow-up data. Study design: Multi-centre case series.

Methods: Employing a monitored introduction and continuous assessment across different centres and surgeons, has allowed us to optimise the usability and safety of the MIPS system. A broad evaluation of the MIPS technique is ongoing in approximately 50 separate centres in Europe and North America. Patients suitable for single stage BAHS surgery are included in a consecutive design and followed according to local clinical practice during a minimum of two follow-up visits. Data recorded includes intra- and post-operative complications, surgical time, and skin healing after surgery and Holgers’ scores.

Results: The evaluations of the system is encouraging with few intra-operative complications, quick healing and good short-term skin tolerability. Intra-operative and post-operative results from approximately 200 patients will be available in the spring of 2016.

Conclusion: The minimally invasive approach of MIPS is made possible by a complete new set of tailor-made surgical components. The outcome, in terms of operating time, reduced need for general anesthesia, cosmetics, pain and numbness, as well as possible consequences for future patient counselling will be discussed.
Cochlear Implant in Post-Lingual Patients: Clinical Aspects Regarding Side Decision

**Introduction:** Asymmetry of the hearing loss in post-lingual patients candidates to cochlear implant (CI) reflects the choice of implanted ear in order to obtain the best results. The cochlear implant in the ear with best cochlear reserve, that represents a greater number of neurons in the spiral ganglion, could receive better stimulus from implanted electrodes. To provide binaural hearing with a bimodal stimulus the choice of the side of worse auditory residue for the internal device CI surgery have been considered to provide a binaural stimulation, using hearing aid device on the other side.

**Methods:**
Retrospective longitudinal to assess the best auditive response evaluation, after two years postoperatively, comparing audiological results of patients older than 18 years with unilateral CI in the ear with better cochlear reserve with CI in the worse ear. Reviewed medical records of the post-lingual patients submitted to CI surgery in 2004 to 2014. The variables were the age at the time of CI, sex, years of hearing loss, time of stimulation of each ear with hearing aids (exclusion time) and the audiological characteristics of each patient in the pre and post CI. Patients included were unilateral cochlear implant users with at least 1 full year of use of the speech processor, severe to profound hearing loss post-lingual and greater age equal to 18 years. Excluded the users of bilateral cochlear implant, patients with severe to profound hearing loss, with pre-lingual hearing loss, age up to 18 years, with no neurological
or psychomotor development conditions or with the etiology of meningitis, with impairment of the central nervous system. Group A composed by patients implanted on the best side, with less time of exclusion, auditory thresholds, on tonal audiometry in 500 Hz greater or equal to 10 dB in relation to the contralateral side and who reported better hearing on this side and group B, patients that received CI in the worst side, with more time of exclusion, tonal threshold audiometry thresholds in 500 Hz up to 10 dB in relation to the contralateral side, referring worse hearing on the implanted side

Results: Group A was composed with 11 patients, mean age of 45 years, 6 men and 5 women and average time of beginning of hearing loss of 21 years. Group B was composed with 17 patients, mean age of 50 years, threshold in 500 Hz and in the averages of 500, 1000, 2000, 3000 and 4000 Hz pre and post CI. In the speech perception tests pre CI we verified a better percentage 7 men and 10 women and average time of beginning of hearing loss of 24 years. The average time of group A sound deprivation was 9 years and in group B was of 10 years. There was no statistical difference in the tonal in the speech perception in Group B, which remained in the postoperative period

Conclusion:
For this study group, the CI in the ear with worse auditory residue and sound deprivation favors a bimodal hearing, which would allow the binaural summation, without compromising the improvement of audiometric threshold and speech perception
Abstract Body:

Introduction:
We describe the clinical presentation of an unusual and dramatic clinical entity of the middle and the inner ear in a child who underwent cochlear implantation.

Methods:
Retrospective chart review of a 21 month’s old toddler with undiagnosed invasive disease of middle and inner ear, leptomenigitis, acute neuritis of VIII cranial nerve (VIII CN) with cofosis.

Results:
A previously health 16 month old boy was treated for recurrent right otorrhea with several oral antibiotics, during 5 month. At 21 month old, CT revealed large destruction of cochlea, petrous bone and a complete filling of middle ear; brainstem auditory evoked potentials (BAEP) were normal in the left ear and showed cofosis in the right ear. Granulomatosis disease (mycobacteria infection, Wegener granulomatosis, histiocytosis), fungal infection and tumor cells were excluded. All immunologic studies were also negative. After one year of treatment with antibiotics and steroid, the child developed leptomenigitis, left VI cranial nerve.
paralysis and left cofosis (110 dB waves on BAEP with no otoacoustic emission) with contrast enhancement of the VIII CE, on MRI. A total recovery of the left VI cranial nerve was achieved with high doses of steroids but left deafness remained although MRI showed normal VIII cranial nerve and cochlea. The disease was controlled but not cured with systemic steroid, cyclophosphamide and mofetil micofenolate. At age 5, the child was submitted to left cochlear implant. Some grade of fibrosis was find and in spite of incomplete electrode insertion the audiometric results are satisfactory with gradual improvement of speech recognition.

Conclusion:

This undiagnosed destructive disease has been a challenge. Permanent deafness caused by acute neuritis of the VIII CN in the context of leptomeningsitis is a rare indication for cochlear implantation.
Introduction:
The Supported Hearing in Elderly Citizens (SHiEC) project aims at developing eHealth tools to support senior cochlear implant (CI) recipients in using their hearing implants more effectively, hence allowing them to remain more active in their everyday lives. As part of this SHiEC project, a survey gathered information on the use of modern IT technology among 266 CI recipients and three focus groups concerning the CI journey were held with 24 senior CI recipients. Based on questions and needs that were put forward in the IT survey and the focus groups, a recipient portal was developed.

This recipient portal is a secure web portal providing the information that is classically delivered through user manuals and the in-clinic counseling by the audiologist in a more convenient and easily accessible form.

Methods:
A pretest-posttest study was conducted among 28 senior CI recipients. They had 6 weeks access to the recipient portal. To investigate predictors of recipient portal usage, a questionnaire prior to portal access assessed socio-demographics, internet and computer use, hearing loss and CI characteristics. To investigate the impact of the recipient portal, 15 Likert type questions on CI knowledge (e.g., Do you know whether you can have an MRI with your CI?) and CI actions (e.g., Do you know how to use disposable batteries with your CI?) were posed prior and post portal use. Furthermore, to assess use and satisfaction, several questions were added to the posttest, including (1) The Dutch System Usability Scale (SUS, Digital Equipment Co Ltd., Reading, UK), (2) use, frequency and encountered problems, (3) perceived ease of use, usefulness and completeness of the portal. Also questions were posed concerning self-perceived impact of the recipient portal. These questions asked the CI recipients directly if they felt that the web portal caused any changes in their CI journey. Finally, the participants could share their thoughts about improvements for future versions of the recipient portal.
Results:
So far, data of 20 senior CI users (10 male, 10 female, mean age 61y) have been analyzed. On average, the recipient portal received a System Usability Scale score of 73% (SD 7.53 and range 58%-85%). After having access to the portal, results showed that senior CI users’ CI knowledge increased with 17%. If they wanted to seek help concerning their CI prior to having access to the portal, they would read their paper manual (30%) or contact their audiologist (25%). After having access to the portal, 74% indicated they would visit the recipient portal in order to get an answer on their CI related questions.

Conclusion:
The growing need, the budget constraints, the labor shortage and the desire for more patient responsibility all point to the need for change in the delivery of hearing implant care. This recipient portal aims at offering senior CI recipients access to CI information on a more convenient way and has the potential to empower them in their CI journey. Furthermore, making use of an eHealth system might free up capacity for the CI audiologists.
Abstract Body:

Introduction: Cone beam computed tomography (CBCT) offers the potential to predict the patient-specific cochlear duct length prior to implantation. In addition, CBCT imaging can be used to postoperatively assess insertion outcomes. The value of a mobile CBCT for both applications was investigated in an ex vivo study with Thiel and Formalin fixed human temporal bones.

Methods: Eight Thiel fixed and 8 Formalin fixed specimens were implanted with free-fitting cochlear implant electrode arrays (28 mm array length). Preoperative CBCT images were used to estimate the size of the cochlea in each specimen. A logarithmic equation found from previous studies was applied to predict the linear insertion depth for an aimed insertion of 1.5 turns (540°). The electrode arrays were marked at the specified length and inserted through the round window by 2 ENT surgeons. The arrays were inserted until the first point of resistance, or if possible, until the marks reached the round window. Postoperative CBCT imaging was performed to assess the angular insertion depth, the implanted scala, and the array course.

Results: In all specimens it was possible to identify the position of the electrode arrays in the scala tympani (n=16). The average estimated linear insertion depth was 26 mm (range 23 to 28 mm). A mean angular insertion depth of 538° (Thiel fixed) and 409° (Formalin fixed) was achieved. The arrays inserted into the Thiel specimens showed a smooth array course, whereas in 4 Formalin specimens bending in the hook region occurred. A minor problem was the visualization of the insertion depth marks on the arrays at the round window through the microscope during insertion.

Conclusion: Preoperative CBCT imaging can be used to estimate the required array length for a specific angular insertion depth, however, the results have to be repeated in a clinical setting. Placement of marks during the manufacturing process could support the surgeons in the estimation of the insertion depth. The insertion outcomes further indicate that Thiel fixed specimens are more suitable models for deep electrode array insertion experiments.
Introduction: During last years we can observe significant development in middle ear implants area. There are several attempts and still no consensus when exactly which implant should be applied.

Methods: Our material consists of 3 cases implanted in 2014. Patients were suffering from mixed hearing loss with PTA at level 35-50 dB SPL. Surgical access to the body of incus was achieved via atticotomy. Before the operation patients tried numerous other solutions and none of them met their expectations.

Results: After the operation their quality of life has improved. Initial audiological outcomes are satisfactory.

Conclusion: MET device can be used in the group of patients with pure SNHL and MHL. The amplification is better than with VSB, but often the access via posterior tympanotomy is more difficult. Anatomical features can be a contraindication for this kind of surgery. Patients have better results than with conventional hearing aids (10 dB). To make more statements we have to continue the research.
Introduction:

Electro acoustic stimulation (EAS) cochlear implants are getting widespread due to their success of filling the gap between conventional cochlear implants and hearing aids. Soft surgery techniques and short atraumatic electrode arrays are developed to support the combined stimulation. Many studies have focused on effects of frequency overlap and temporal effects of the different stimulus modalities. Little has been reported about consequences of electrode implantation on the cochlear mechanics. In this study, we investigate the effect on cochlear mechanics when introducing an electrode into the cochlear.

Methods:

The behaviour of the travelling wave in the presence of a cochlear implant electrode is investigated by a mechanical finite element model. The cochlea is modelled as a tapered box of which the wider and narrower ends represent the base and the apex respectively. The scala tympani and scala vestibuli are modelled as two fluid compartments separated by an orthotropic
elastic solid accounting for the basilar membrane. The fluid compartments are conjoined by the helicotrema at the apical end of the box. The oval window is represented at the basal face of the scala vestibuli compartment and stapes velocity is applied to this surface to drive the simulations. The round window is mimicked by a pressure release boundary condition at the basal surface of the scala tympani. The electrode array is modelled as a conical object located inside the volume of the scala tympani.

Results:

The place and amplitude of the travelling wave peak is investigated with respect to the distance between electrode and basilar membrane. First simulations indicate a suppression of the travelling wave amplitude after electrode insertion. Furthermore, simulations suggest that the peak of the travelling wave envelope (the place of excitation in the cochlear) remains unchanged as long as the stimulus frequency corresponds to a location apical to the tip of the electrode. On the other hand, the peak shifts towards the apex when the electrode is present at the cochlear location corresponding to the place of maximum excitation in the non-implanted cochlear. This peak shift becomes more prominent as the distance between the electrode and the basilar membrane is reduced.

Conclusion:

Utilization of the developed mechanical finite element model can support electro-acoustic cochlear implant development by characterising the acoustic excitation of an implanted cochlea. Suggestions for sound processing strategy of the hearing aid part of the device can also be deducted with the aid of the model for various types of used electrodes.
Introduction: The aim of this work is to illustrate the hearing threshold results of adult patients with the Treacher-Collins syndrome implanted with a Bonebridge (BB) hearing implant after two years follow-up.

Methods: The authors report their experience of first BB implantation in Croatia in conductive hearing loss in Treacher-Collins syndrome. The Bone Conduction Implant (BCI) is positioned completely under the intact skin and contains a magnet that holds the audio processor in place above the implant by means of magnetic attraction. The sound is transmitted to the inner ear via bone conduction in temporal bone. Functional hearing gain was analyzed via pure-tone audiometry (PTA) and speech audiometry (SA) with VBS off and on in quiet and in noise.

Results: Preoperatively, air-bone gap (ABG) was between 10 dB and 60 dB and the score for monosyllables at 65 dB was 10%. One month after the surgery, the score for monosyllables was 80%, and two years after surgery was 95%.

Conclusion: This study demonstrated that Bonebridge implantation allows good speech performances in Treacher-Collins syndrome with conductive hearing loss.
Introduction: There is strong evidence demonstrating that cochlear implant (CI) is the only treatment option that may provide the benefits of binaural hearing in unilateral deafness (UD) and treat tinnitus, if present. Compared to other treatment modalities, CI shows superior performance in speech understanding in noise scores and localization ability. One of the challenges for the clinician providing auditory rehabilitation for patients with UD is to ensure that the sound processor is set to provide the best outcome possible. Relying only on patients’ subjective feedback may lead to imbalanced input from both ears and consequently unpleasant or insufficient sound.

Objective: This study aimed to investigate whether the measurement of cortical auditory evoked potentials (CAEPs) in response to sounds that span the speech frequency spectrum could represent a valuable tool for clinician to verify audibility in unilaterally deafened CI users.

Methods: The participants had pure tone average at 0.5, 1, 2, and 4 kHz ≤ 30dB in the good hearing ear. The subjects used their speech processors on a full-time basis. They had stable map and had 3 to 36 months experience with their CI at the time of data collection. Sound field cortical responses to four speech tokens /m/, /g/, /t/, /s/ were recorded. The stimuli were presented at 55 dB SPL. Each subject performed the ACA testing with CI activated and the contralateral normal hearing ear masked with 70 dB HL of broad-band noise presented through insert-phones.

Results: Fifteen adult subjects with postlingual unilaterally deafened CI participated in this study. ACA responses showed that 4 out 15 patients would benefit from optimization of their map parameters. They all had their map modified based to the results of ACA and the measures were obtained either on the same day or within 2 weeks post map adjustments. No difficulties to adapt to the
new map were encountered.

Conclusions: ACA showed an effective and reliable tool to assess if UDCI users have access to the speech spectrum with their CI configuration. Optimization of mapping is possible at very early stage post-CI activation using the ACA measures.
Abstract Body:

Introduction
Language ability is important for academic performance in school-aged children. It can be achieved by intensive rehabilitation through early cochlear implantations (CI) in children. The purposes of the present study were to analyze the change in auditory performance and the educational placement according to the age of CI and to estimate the possibility of integration of children with early CI into the general society.

Methods
We enrolled 77 children who had CI at our department in the age less than 10 years old and who are now in the school age or already graduated from the school. Among these children, 21 had bilateral CI and 16 had additional disabilities. We classified the children into two groups according to the age of implantation, and defined children who had CI under 5 years old as ‘the early group’ (n=48) and who had CI over 5 years old as ‘the late group’ (n=29). The mean age of implantations and the period of the CI use were 2 years 7 months, and 9 years 6 months in the early group and 7 years 2 months and 11 years 5 months in the late group. We compared both groups with the auditory performance (CAP, monosyllabic and bisyllabic word and sentence scores) and with the proportion of the educational placement. We also tested a standardized peer relationship test (KIPR: Korean Inventory of Peer Relationships) in 25 children with early CI. The test consists of 64 questions with 8 subscales (domineering, vindictive, cold, socially avoidant, nonassertive, exploitable, overly nurturant, intrusive).

Results
The early group showed lower auditory performance than the late group until 2 years after CI, however, over 2 years of CI use, auditory performance were higher in the early group rather than the late group. There was no significant difference in the proportion of regular school attendance between the early and late groups showing 93.8% and 98.7%, respectively. But, the early
group (68.9%) showed higher proportion of full-time mainstream schooling than the late group (44.4%). The presence of additional disabilities affected the full-time mainstream school attendance even in the early group. In cases of children with additional disabilities, the use of spoken language was the important factor in attending regular schools. According to the peer relationship of children with early CI, 16% needed ‘close observation and help’, while 8% children required ‘counseling, intervention and care’. The children with CI had high tendency of socially avoidant, nonassertive, and overly nurturant. There was no correlation of any audiological factors with the degree of peer relationship.

Conclusion
CI gives positive effects for deaf children to educate in regular schools, but 24% of the children with early CI still have difficulty in peer relationship in regular schools. There is a need for specialized group therapy and psychological counseling services to improve communicating skills and psychosocial activities.
Using Vocal Production to Measure Cochlear Implant Patients’ Perception

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Abstract Body:

**Introduction:** For some cochlear implant populations, such as pediatric patients, it is difficult to obtain reliable subjective judgments needed to accurately fit the cochlear implant. Previous research has found that when an altered version of a normal hearing listener’s pitch or loudness is played back to that participant in real time, they automatically adjust their own production to compensate. This automatic adjustment provides a potential objective measure of what the participant perceives. The goal of this study was to determine whether cochlear implant patients also adjust their vocal pitch and loudness in response to brief alterations in real-time versions of their own production presented back to the participant.

**Methods:** Cochlear implant users were asked to produce the sound “ah.” During their vocal production, their own voice was presented back to the participants. At random periods during their production, brief shifts in pitch or amplitude were introduced into the signal presented back to the participants and changes in their vocal production were measured.

**Results:** Cochlear implant patients’ production was influenced by changes in the signal presented back to them, indicating that their vocal production was influenced by their perception.

**Conclusion:** These results suggest that it is possible to use cochlear implant users’ vocal production to gain insight into what patients are perceiving. This could provide a useful method for fitting populations, such as pediatric patients, for whom subjective judgments are unreliable or difficult to obtain.
 Predictive Role of Imaging in Cochlear Implant Patients with Cochlear Nerve Deficiency

Abstract Body:

Introduction: Cochlear nerve deficiency (CND) is defined by an absent or a small cochlear branch of the vestibulocochlear nerve (cochlear nerve). High-resolution computed tomography (HRCT) and 3-dimensional magnetic resonance imaging (3D MRI) are two common imaging methods that are used to diagnose CND. Previous studies showed that congenitally deaf children with CND had relatively poor auditory performance using CI than children without CND. Aplasia or hypoplasia of cochlear nerve has been proposed to account for the auditory performance of CI children with CND. However, because of the existence of mixed nerves, it is difficult to distinguish aplasia from hypoplasia. CND patients generally had two nerve points or less in the internal auditory canal (IAC) based on 3D MRI data and various diameters of IAC based on the HRCT data. The relationship between these measures is not clear. Also, it is not clear whether auditory performance of CI children is related to the diameters of IAC based on the HRCT data and/or number of nerve points based on the 3D MRI data.

Methods: A retrospective study was conducted in 43 CI children who were diagnosed with CND and underwent cochlear implantation surgeries in our center during January 2007 to August 2015. These patients were all required to wear hearing aids and perform the language training for at least six months before the CI surgery to determine the response of cochlear nerves to the incoming sounds. Postoperative auditory performance of the CI children was assessed by Auditory Performance (CAP), Speech Intelligibility Rating (SIR), Meaningful Use of Speech Scale (MUSS) and meaningful auditory integration scale/infant-toddler meaningful auditory integration scale (MAIS/IT-MAIS). The patients underwent HRCT to determine the diameters of IAC and 3D MRI to measure the number of nerve points. The data from the CND group were also those from the age-matched control group.

Results: The data showed that the diameters of the CN within the IAC of patients who have only one nerve point (the diameter of IAC is 2.99±0.89mm) is slightly thinner than those are two points (the diameter of IAC is 3.15±1.39mm). However, there is no significant difference in the diameter of IAC and auditory performance between these two groups. The diameters of the CN for the
control group is 5.04±1.02mm, which is significantly thicker than the CND group (p<0.001). Multiple linear regression analysis showed that the diameters of IAC are moderate predictor of MAIS score and MUSS scores (p<0.05). However, none of auditory performance is correlated to the age of implantation or implant use. There was no significant difference of auditory performance between the CND group and control group.

**Conclusion:** There are no clear relationship between auditory performance and the number of nerve points based on 3D MRI data as well as the demographical data (the age of implantation and the implant use) in CI patients with CND. However, the diameters of IAC based on HRCT data may be a moderate predictor of auditory performance for CI patients with CND.
Introduction: This presentation is a personal experience of the aural rehabilitation that is needed for a cochlear implant for single sided deafness.

Methods: Aural rehabilitation was presented using recorded voice through direct audio input cable, and making use of apps and downloadable programmes for a pc

Results: BKB sentences and CRM tests show improvements in speech perception. Personal perspective on improvements in social situations and quality of life

Conclusion: A personal view that aural rehabilitation with a cochlear implant has been a successful treatment for single sided deafness
Effects of Loudness Matching on Binaural Hearing in Different Groups of Bimodally Fitted Patients

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Introduction:
Binaural hearing is necessary for optimal auditory functioning and is the goal of hearing revalidation. It requires that the input of both auditory pathways is matched in frequency response and intensity sensitivity for a wide dynamic range of auditory signals. Depending on the type and hearing loss different technological hearing supporting systems are available that often results in bimodal fitting, i.e. with different aids applied to contralateral ears. Differing systems imply differences in frequency characteristics, threshold sensitivity, compression methods, etc. This produces ambiguous binaural phase and intensity cues and makes achievement of binaural hearing non trivial. The present study was designed to evaluate the effects of loudness matching on binaurality in different groups of bimodally fitted patients.

Methods:
The study was performed in four groups of patients. Group 1 comprised 10 experienced subjects with a unilateral cochlear implant and normal contralateral hearing. Group 2 included 10 subjects after bilateral cochlear implantation. Group 3 consisted of 10 subjects with a unilateral cochlear implant and a contralateral hearing aid. Group 4 contained 20 subjects with normal hearing (thresholds better than 30dBHL). During the tests all subjects kept their optimal setting of their
hearing support devices.
The alternate binaural loudness balance (ABLB) test was used to assess the subjective loudness matching at different sound intensities delivered to each ear/aid/implant via headphones. Binaural hearing was assessed by horizontal localization test performed in a setup of 9 plus 2 loudspeakers (-90 to 90 degrees plus 2 non-active speakers at -135 and 135 degrees). Two levels of loudness of the signal were used for localization testing: 1.) 20dB above the threshold of the worse side and 2.) intensity of the best match in the ABLB test. The International Speech Test Signal (ISTS, Oldenburg, Germany) was used for all the tests in order to prevent that the hearing aids/implants activate their noise cancelling circuits. The ISTS signals were used in two conditions (LP filtered at 500Hz and HP at 2kHz) in order to separately evaluate the intensity and phase cues for horizontal localization.

Results: Results of horizontal localization tests without and with loudness matching will be shown for each test condition for each of the study groups.

Conclusion: At time of submission this study was ongoing.
Abstract Body:

Introduction: Music enjoyment in Cochlear Implant (CI) users is still limited. Although CI users can detect simple musical structures like rhythm, more complex structures such as melody, timbre and pitch recognition are challenging. Bilateral CI users might be able to combine musical cues from both ears resulting in possibly improved music perception. This study investigates the ability of CI users to differentiate between mono and stereo music presentations as well as the influence of the stereo effect on the enjoyment of music for CI users.

Methods: 10 normal hearing (NH) listeners and 20 bilateral CI users participated in the study. All of them underwent three different experiments. In a psychoacoustical summing localization task two-channel noise and music signals were presented with a gain or delay between channels to the subjects, who indicated the perceived position of the virtual sound source. Stereo detection was tested by presentation of 25 difference music samples as stereo and mono version, of which the subjects had to identify the stereo sample. For the rating of music enjoyment for the stereo and mono versions the same music samples were presented and scored by the study participant. All experiments were conducted in free-field and with direct audio presentation, i.e., headphones for NH or DirectConnect or ComPilot respectively for CI users.

Results: Results showed that summing localization with level differences was possible for CI users, but not for delay differences. In free-field the stereo music piece could be identified in 66% of the cases, presentation with DirectConnect resulted in 86%. For the ComPilot group stereo identification increased from 46% correct in free-field to 86% with ComPilot. NH as well as CI users rated the enjoyment of stereo better than mono music. CI users showed increased music enjoyment for the stereo compared to the mono version when listening to music with direct audio, i.e., with the ComPilot or DirectConnect.

Conclusion: The results indicate that only gain differences between channels contribute to the perception of the stereo effect in CI users. Furthermore, the perception of the stereo effect was easier with direct audio input than in free-field, and contributed to music enjoyment.
Introduction:
Following operations at the inner ear canal, craniocerebral injuries or toxic hearing loss due to inflammatory processes of the inner ear for example it is not clear if the hearing nerve function remains stable to provide patients successful with a cochlear implant. Aim of this project is to identify if there is a possibility to measure and predict hearing nerve function with E-BERA potentials.

Methods: E-BERA was performed both on patients intraoperatively and postoperatively provided with a cochlear implant system. On the one hand we tested patients intraoperatively shortly after insertion of the electrode array. In this group we compared the results from E-CAP measurements, stapedius-reflex thresholds with the received E-BERA potentials. Data were analysed to identify if there is an influence on the latency depending from the chosen electrode and stimulation energy. As reference we select a group of patients who has been used to the implant with speech processor longer than 6 months. This group was able to give a safe feedback during the stimulation. The maximum level of stimulation was the energy, which generated a comfortable sound for the patient. The measurement started at this level. The stimulation energy has been reduced as long as we received answers at the E-BERA.

Results: First results have shown that the latency of the detected potentials seems to be a stable factor in this set up. In 9 out of 9 patients were able to find intraoperative save potentials. Results from these intraoperative measurements showed no correlation between E-CAP, stapedius-reflex and E-BERA. The influence of the stimulation level and location of chosen electrode appears without any significance so far comparing to the speech test results. In 1 case of bad responders we found no substantial potentials.

Conclusion: We predominant tested patients who are hearing with their cochlea implant systems. As no tendency regarding the level of performance due to the existing E-BERA potentials have been found the next step will be to measure more patients who are using implants without intelligibility. In expectation to find a correlation with the E-BERA we hope to find a tool for intraoperative testing of hearing nerve function in the future with a routine set up.
Introduction: This study was conducted in order to determine whether the SSQ12 is a valid assessment tool when translated into Spanish and completed by Spanish speaking individuals. Researchers hypothesize that results of the translated questionnaire will be similar to that of the English questionnaire when completed by individuals with hearing thresholds in the mild to moderate hearing range (30-55dBHL). The department sees many hearing impaired adults, many of who are Spanish speaking individuals. English questionnaires cannot be used to effectively assess the difficulties of Spanish speaking hearing impaired adults. By validating the use of the questionnaire in Spanish, we create another way of accessing these patient's needs.

Methods: Participating subjects were Spanish speaking patients of the North Shore LIJ Hearing and Speech Center and LIJ ENT department, with hearing thresholds in the mild to moderate hearing range (30-55dBHL).

Results: Subjects filled out the SSQ12 questionnaire, which consists of 12 questions that assess an individual's listening ability in various daily situations. The subjects were asked to fill out the questionnaire to the best of their ability based on their personal experiences. A statistical analysis is done in order to compare the scores of the English and Spanish versions of the questionnaire, and determine whether they yield
similar results.

**Conclusion:** The study looks at the validity of the questionnaire when translated into Spanish so that it may be used as an appropriate assessment tool for future patients.
Abstract Body:

Introduction
Cochlear implant has been recently indicated to more and more people with increasing amount of residual hearing. In an attempt to mimic the auditory system and preserve the residual hearing, efforts have been directed to develop cochlear systems in different electrode lengths, thickness and types, as well soft surgery principles and drugs that reduce the insertion trauma. In this regard, it seems essential to include the cochlear size and the insertion angle depth in the patient’s evaluation, since it may impact performance and psychoacoustic parameters.

In fact, some studies have demonstrated that the insertion angle seem to be related to the speech perception performance while other studies haven’t found any significant correlation. Regarding to the CI422 electrode, the insertion depth angle and linear insertion depth has been estimated, but no correlation with the hearing performance have been done. For this reason, our study has the objective to evaluate the influnce of the insertion angle depth of the CI422 electrode (Cochlear ™) on hearing performance and psychoacoustic parameters in cochlear implant users.

Methods
Ten severe to profound hearing impaired adults patients were evaluated and subjected to cochlear implant with the CI422 electrode array. Only patients with normal inner ear anatomy were included. Patients underwent an audiologic evaluation including unaided thresholds, pre and postoperatively at 1- and 3-month follow-up intervals. Intraoperative neural response telemetry thresholds and stimulation levels at the same intervals were collected. Computed tomography was obtained before and after the surgery to assess the anatomy of inner ear and to measure the insertion angle depth using “cochlear view” according to the consensus panel.

Results
The measured insertion depth angle ranged from 361.5° to 490.5° (mean 446°). Taking into account the insertion depth angle and gender, we noticed that for female the measured insertion angle ranged from 361.5° to 488.5° (mean 441°) and for male from 421.5° to 490.5° (mean 454°). Related to linear insertion depth, nine patients had 25mm insertion depth, whereas in one patient the electrode array couldn’t be placed entirely into the cochlea (linear insertion depth = 23mm). We will present the 3-month follow-up
interval psychoacoustic and electrophysiologic results and correlate the insertion depth angle to the hearing performance.

Conclusion
This study intends to investigate the correlation between the insertion depth angle measurement and the speech performance postoperatively. Furthermore, this measurement could help to predict how deep the surgeon can insert the electrode when a reduced insertion deep angle is intended in patients with low-frequency residual hearing in order to decrease the risk of hearing loss.
Initial Experience with the NaidaCI EAS Processor

Introduction:
Since the publication of v.Ilberg et al. in 1999 it is well known that cochlear implant subjects with residual hearing benefit from electric-acoustic stimulation (EAS) in terms of speech understanding and localization. However, this was always evaluated with subjects who used EAS processors from their first fitting on. The new EAS processor Q90 by Advanced Bionics offers the possibility to upgrade previous implanted subjects with residual hearing and to evaluate their benefit in speech understanding with EAS. An interesting aspect in these cases is also whether such subjects after longer periods of electrical stimulation only are able to benefit from an EAS mode.

Methods:
Ten subjects with residual hearing have been upgraded from their regular Naida Q70 processor to the new NAIDA Q90 EAS processor. The low frequency PTA (mean across 125, 250 and 500 Hz) ranged from 38 to 95 dB HL with a mean of 65 dB. Subjects were measured with the adaptive sentence test OLSA with 2 lists per condition. A stationary speech shaped noise signal was played at 65 dB (A). Level of the target signal was adapted to find the 50% speech reception threshold (SRT). The subjects have also been asked to evaluate their Hearing sensation with the different fittings using the SSQ questionnaire. The study comprises three appointments with two chronic phases of 3-4 weeks in between. During these sessions, two different cutoff points at 85 dB and 70 dB (acoustic amplification was limited to frequencies with a hearing loss of not more than 85 dB/70 dB and the lowest frequency to be transmitted by the CI was set to the same frequency) were investigated.

Results:
Complete results of 9 subjects are collected to date. Mean SRT with the clinical map was -0.1 dB. The SRT increased by about 1 dB when tested acutely with Cutoff_85dB", probably because the subjects have to get used to the new frequency allocation table. Tested again after the chronic phase, the SRT improved again to -0.2 dB. The chronic test with “Cutoff_70dB” showed a mean improvement to -1.1 dB. Even more convincing was the subjective feedback regarding the sound quality. Eight out of nine subjects
were very satisfied and will continue to use the EAS device as their everyday speech processor which demonstrates that it is possible to upgrade subjects even after a long time with electrical stimulation only to an EAS mode.

**Conclusion:** Overall, the current results are very promising and demonstrate the potential of AB's new EAS processor, improving the mean SRT by more than 1 dB. This improvement was achieved although the residual hearing of many subjects was very limited and allowed only for acoustic amplification below 500 Hz. As the subjects preferences for the different programs was very mixed, a one-size-fits-all approach is not sufficient and it is crucial to give the audiologist full access to fitting parameters (e.g. gain, acoustic cutoff frequency and electric start frequency). The results also demonstrate that CI subjects after long use of electrical stimulation only can benefit from an EAS mode.
Abstract Body:

Introduction:

Patients with presbyacusis typically show a high-frequency hearing loss with insufficient speech understanding in noise. Usually, those patients do not benefit from hearing aids as they do not lead to an adequate improvement in speech understanding. A short FLEX16 electrode (MED-EL, Austria), which can be inserted up to 16mm into the cochlea, was developed to treat those patients with combined electric and acoustic stimulation (EAS).

Methods:

At the Hannover Medical University, n= 3 patients with a high-frequency hearing loss have been identified and implanted with FLEX16. The characteristics of the audiogram of these patients correspond to the typical age-related hearing loss of patients suffering from presbyacusis. To document hearing preservation outcomes, differences between the pre- and postoperative unaided air-conducted pure tone thresholds (PTA) in low frequencies (125Hz⋯1.5 kHz) were analyzed. Further, to evaluate hearing performance, Freiburg monosyllables at 65 dB and HSM sentence test in noise (10 dB SNR) were performed at first fitting, 3 and 6 month.
Results:

The median hearing loss at first activation was 13.8 dB for FLEX16 (n=2). The patients used their residual hearing for EAS and achieved 65 % in Freiburg monosyllables at 65 dB and 84.5 % in HSM 10 dB SNR at 6 months. Preliminary results of another, recently implanted patient, showed a temporal conductive hearing loss >30 dB three days after surgery.

Conclusion:

First results indicate that patients with high-frequency hearing loss and functional residual hearing in low frequencies can benefit from EAS and FLEX16 implantation. A test battery to further investigate the effects of cochlear implantation in patients with presbyacusis and to understand the influences of this treatment on dementia and cognition will be presented.
Introduction: Binaural hearing is essential for accurate sound localization and highly beneficial for spatial unmasking of speech in challenging acoustic environments. For bilateral CI candidates with some aidable hearing, two options for providing binaural input are the bimodal configuration (CI with contralateral hearing aid, HA) or bilateral CIs. Access to waveform fine-structure via HA or a CI processor providing waveform fine-structure encoding may also be beneficial. The study objectives were to assess, within-subjects, the effects of bimodal versus bilateral CI listening, binaural versus monaural listening, reverberation, masking noise type and fine-structure versus envelope-only strategy on speech reception in diffuse noise.

Methods: 16 adult CI candidates with bilateral severe-to-profound hearing loss but some aidable low-frequency hearing completed the adaptive-level Hearing In Noise Test (HINT) under a variety of listening conditions involving spatially diffuse noise after 6 and 12 months of bimodal listening following a first-ear CI surgery, and at a further 6 and 12 months following receipt of the second-ear CI. Participants received processors implementing both an envelope-based strategy (“ENV”) and a strategy that encoded waveform fine structure in the four lowest-frequency channels (“WFS”). All used the WFS strategy in daily life. Speech reception thresholds (SRTs, the speech signal-to-noise ratio yielding 50% correct performance) were estimated using the mean of two 20-sentence SRTs in all 16 possible combinations of: listening mode (binaural or first-CI only); environment (low or high reverberation); noise type (speech-shaped noise or multi-talker babble) and processor strategy (WFS or ENV). Tests were conducted using the ENV and WFS strategies on successive days.

Results: Between the first (bimodal) and final (bilateral) post-implant test sessions, SRTs improved by ~3 dB for ENV and by ~4 dB for WFS, averaged across listening modes, noise types, and reverberation levels. Paralleling speech-in-quiet results obtained as part of a larger study, asymptotic performance was approached more quickly with the WFS strategy (by the 12-month bimodal session) than
with ENV (only by the 6-month bilateral session). Collapsed across other factors, SRTs improved between the first (bimodal) and last (bilateral) sessions more in high reverberation (4.4 dB) than in low reverberation (2.8 dB), and similarly (~3.6 dB) for both noise types, although the babble masker yielded SRTs elevated by 3 dB overall. Collapsed across other factors, binaural listening was superior to first-CI listening only in the bilateral testing sessions.

**Conclusion:** For this patient population, only provision of a second CI (rather than the hearing aid used in bimodal sessions) improved performance over a single CI in the challenging listening environments tested. Asymptotic performance was reached more quickly with the WFS strategy that participants used in daily life.
Control Number: 2016-A-527-ACI

Session Number: POS02

Session Title: Poster Session B

Poster Board Number: 211-B

Topic 1: 05g-Sound Coding

Publishing Title: Benefit of Directional Microphones on Speech Perception in Noise of Cochlear Implant Users

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Abstract Body:

Introduction: For cochlear implant (CI) users understanding speech in noise remains a challenge. In such conditions the use of directional microphones (beamformers) improves the signal-to-noise ratio (SNR) by attenuating sounds from back and sides of the listener while maintaining signals from the front. Adaptive beamformers adapt their maximal attenuation depending on the noise source position. Advanced Bionics (AB) offers sound processors with an omni-directional microphone behind-the-ear (BTE) as well as a T-Mic. The T-Mic is a microphone placed at the opening of the user’s ear canal which is an advantage in terms of better speech understanding in noise. Furthermore an AB adaptive beamformer called UltraZoom (UZ) improves speech intelligibility for CI users in noisy listening conditions as well. The next AB sound processor will offer an additional, four-microphone binaural beamformer called StereoZoom (SZ), in which both processors receive audio data from the contralateral one in order to form a more focused beamformer and stronger attenuation of noise. This clinical study aims to compare speech intelligibility in noise with the adaptive beamformer UltraZoom as well as the binaural beamformer StereoZoom on the Naída CI sound processor to the two omni-directional microphone options: BTE microphone and T-Mic.

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

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

Conclusion:
Based on previous study results and technical measurements, UltraZoom and StereoZoom will likely result in improved speech intelligibility. Furthermore the narrower beamformer StereoZoom offers bilateral CI users to focus on a single talker for communication in a difficult noise situation.
Introduction: Infancy is a critical period for the speech development of children, and hearing intervention should be performed as early as possible to avoid oral communication impairment. Softband Ponto fixes the sound processor around the head instead of using an implanted screw which is more comfortable for the user and suitable for patients even 3 months old.

Methods: Thirty patients (age ranging from 3 months to 4 years) with bilateral aural atresia were studied. Auditory brain stem response(ABR) and the Infant-Toddler Meaning Auditory Integration Scale (IT-MAIS) was assessed to evaluate the hearing threshold and auditory development at three time levels: baseline, 3 months and 6 months. Auditory performances and speech production intelligibility were assessed using the Categories of Auditory Performance (CAP) and the Speech Intelligibility Rating (SIR) scales.

Results: The average unaided bone conduction hearing thresholds of patients is(17.5±5.9)dB nHL, and the average air conduction hearing thresholds is(72.5±9.3)dB nHL. The IT-MAIS, CAP and SIR scores are improved significantly after wearing softband Ponto and approached the level of normal hearing peers.

Conclusion: Softband Ponto is suitable for infants and toddlers with bilateral atresia. Softband Ponto should be used as a bridge for surgical implantations when the temporal bone is thick enough.
Benefit of Sound Cleaning Features on Speech Understanding andListening Comfort of Cochlear Implant Users

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Abstract Body:

Introduction: Speech understanding is still a challenge for cochlear Implant (CI) users when it comes to listening in noisy surroundings. Different strategies have been developed to reduce noise without attenuating speech. Single-channel speech enhancement algorithms can provide better long-term signal-to-noise ratios for speech in stationary or impulsive noise. Directional microphones allow the user to follow a speech signal from the front more easily as noise from the rear hemisphere is attenuated. The objective of this presentation is to show results from multiple clinical studies investigating a variety of sound cleaning features like ClearVoice, SoundRelax, UltraZoom, and StereoZoom implemented in the Naida CI sound processor.

Methods: Different test setups were used to show the effect of the beamformers UltraZoom (adaptive) and StereoZoom (binaural) on speech reception thresholds (SRT) in the adaptive matrix test. The speech signal was presented from the front, while noise was presented from multiple loudspeakers positioned around the subject. To simulate everyday listening situations the spatial distribution of the noise was either fixed or time-varying. Fluctuating noise, like restaurant noise or open-plan office noise, was used in addition to stationary speech-shaped noise. The impulsive noise canceler SoundRelax was tested in the presence of transient noise, like hammer noise or clinking cups, using a rating scale for subjective feedback on comfort. ClearVoice was added in some of the studies to evaluate its improvements in stationary noise.

Results: Significant benefits in speech understanding in open-plan office noise and restaurant noise could be shown for Freiburg numbers and monosyllables for UltraZoom compared to the omni-directional T-Mic. Speech perception could be improved by around 7 dB by the use of UltraZoom simulating moving car noise. A majority of users preferred SoundRelax over the clinical program with regards to comfort while listening to speech in the presence of hammering noise (80%) and clinking dishes (70%). Several setups showed an additional improvement of around 1 dB with ClearVoice in stationary speech shaped noise.

Conclusion: Results from a variety of clinical studies showed the benefit of sound cleaning features on either speech perception or
listening comfort in noisy hearing situations. A combination of these features results in additional improvements. The Naida CI sound processor incorporates multiple algorithms which provide improved hearing for cochlear implant users in various everyday situations.
Performance of the SONNET EAS Audio Processor in Experienced Electric-Acoustic Stimulation Users

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Abstract Body:

Introduction: Electric-acoustic stimulation (EAS) is a well-established treatment in patients with profound deafness at higher frequencies and residual hearing at low frequencies (“ski slope hearing loss”). Recently, MED-EL introduced the EAS audio processor as successor of the DUET2 processor. Some of the features of the new device are multi-channel amplification in the acoustic component and implementation of different directional sensitivities and wind noise reduction (WNR).

The aim of the study was to compare speech perception in quiet and in noise between DUET2 and SONNET EAS audio processors in experienced DUET2 users.

Methods: 10 subjects took part in the study. Monosyllable test scores were assessed in quiet at 65 dB SPL. Speech reception thresholds (SRTs) in noise were measured in a multi-source noise field with 4 decorrelated maskers. Tests were conducted in two sessions with a time interval of 3 weeks. In the first session, subjects were tested with their DUET2 audio processor. Afterwards, they were fitted with the SONNET EAS processor. In the second session, same tests were conducted with SONNET EAS processor using three different directional sensitivities: omnidirectional, natural (pinna simulation) and adaptive. Additionally, the impact of a wind noise reduction (WNR) algorithm on speech perception was determined. Patient satisfaction was assessed by means of a modified HISQUI questionnaire.

Results: Speech perception scores in quiet were comparable between both speech processors. In noise, no significant difference in SRT between DUET2 and SONNET EAS with omnidirectional sensitivity setting was found. Mean SRTs were -1.7 dB SNR (DUET2) and -2.3 dB SNR (SONNET EAS). The pinna simulating natural directional sensitivity decreased SRT by 1.6 dB, adaptive directional sensitivity improved SRT by 3 dB. WNR had no significant impact on speech perception. This result was expected, since the algorithm was designed to be only active if wind is present. There was a tendency of higher patient satisfaction with the new audio processor.

Conclusion: In quiet listening conditions, performance with SONNET EAS was comparable to the DUET 2 device. Speech perception was significantly improved in a complex noise situation by applying beamforming algorithms, which are implemented in the new device. The newly available multi-channel acoustic fitting allowed for better control of amplification to the individual hearing loss.
Do Electrodes Reported Open or with High Impedence or Absent NRTs During Intra Operative Assessment Improve Spontaneously in the Post-Operative Period in Cases with Otherwise Uneventful Surgical Procedure and Insertion?

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Introduction: Cochlear Implantation relies significantly on electrophysiological assessments to evaluate the integrity and functionality of electrodes and device and confirm complete electrode placement in the Cochlea. This is of importance both at the time of surgery and in the post-operative period - switch on and follow up. At the time of surgery, not all electrodes demonstrate ideal values in terms of impedance, and threshold of neural response telemetry responses, even in those cases where surgical report and X Ray confirm perfect placement and complete insertion. Various reasons are attributed to this such as dry field, locked air bubbles, readjustment of the inner ear environment etc. Anecdotally, most of these parameters change to expected values in the 2-3 weeks following surgery by the time the device is switched on. However, there are no objective reports that confirm this claim. As such, inferring from these intra operative tests can be tricky and non objective. The aim of this study was to track the exact status of all electrodes that were not within normal electrophysiological range (Impedance and NRT) at the time of surgery by evaluating their status at the time of switch on and in the post operative follow up period. We also wanted to investigate any correlation with device type, electrode type or surgical technique (cochleostomy / round window / extended round window). We also wanted to note the incidence of additional open / short circuit electrodes as well as those causing non-auditory perception in the post operative period, inspite of normal parameters intra-operatively.

Methods: We investigated the impedance and NRT Threshold of all electrodes outside the normal range in all our patients operated since 2009 by the Senior Author (260 patients) by looking at these values in Custom Sound / Sound Wave, at the time of surgery, switch on and last post operative follow up. We excluded all cases with neo ossification, excessive CSF leak or significant abnormal anatomy of the cochlea. We also reported all cases with non-auditory sensations and any electrode that was flagged up / switched off for any reason during
the post operative period and compared it with preoperative surgical report and electrophysiological measurements.

**Results:** The paper will discuss the latest Impedance values (last mapping session) of all electrodes that were reported to be outside normal range at the time of intra operative measurement. It will also report the status of neural response telemetry at this time for those electrodes where the same was absent at the time of intra operative assessment.

**Conclusion:** Our study will reveal the true incidence of long term electrode related issues as suggested by intra operative measurements in otherwise uncomplicated cochlear implant surgery patients. This will help the surgeon better interpret the value of current intra operative measurements.
Control Number: 2016-A-547-ACI

Session Number: POS02

Session Title: Poster Session B

Poster Board Number: 124-B

Topic 1: 02c-Hearing Preservation

Publishing Title: Hearing Preservation Evolution in Cochlear Implant Recipients

Author Block: Cristina Sierra, MD¹, Manuela Calderon, MD¹, Alexandra Tisaire, Speech therapist², Eduardo Raboso, PHD¹;
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Abstract Body:

Introduction: The main objective of cochlear implantation surgery is providing the patient with hearing communication abilities which will be socially useful for them. However, during the last years, hearing preservation has become a challenge. Its purpose is, on one hand, applying acoustic amplification into the residual hearing, and on the other hand, preserving the anatomical structures in regards to possible future therapeutic treatments.

Methods: The study was conducted in 23 adult patients with residual hearing prior to the surgery and the above mentioned candidacy guidelines. All of them underwent a surgical procedure to receive a cochlear implant between 2012 and 2015. The residual hearing was assessed after the surgery, during the whole follow-up of the patients. Every parameter which could influence on the long term preservation of the residual hearing, during the years the patients were included in the study, was studied. Among these parameters, the surgical technique and type of electrode were specially taken into account.

Results: From the total 23 patients who underwent the surgical procedure, 6 of them (26,08%) did not retain any residual hearing and 17 of them (73,91%) had some degree of hearing preservation. Among the latter, 15 (65,21%) have complete or partial hearing preservation. The 26,66% of these 15 patients were operated between 2012 and 2013, and the 73,33% between 2014 and 2015.

Conclusion: If the appropriate technique is used, preservation of residual hearing is feasible after a cochlear implant surgery. Many of our patients have residual hearing at low frequencies which is not sufficient enough to be included inside the candidacy criteria for combined electric acoustic stimulation. But it will be studied if these patients could have any benefit by using acoustic amplification at low frequencies when there is some kind of preservation of their residual hearing.
Comparing the performance of a bone anchored hearing devices pre-operatively on soft band to post-operatively on abutment.

Introduction: Bone anchored hearing instruments are a common treatment method for people with conductive and mixed hearing losses as well as single sided deafness.

Objects: A study have been conducted with focus to evaluate the efficacy of a bone anchored hearing device in terms of hearing performance and self-reported outcome with the device on abutment compared to the pre-operative test situation using the device on a softband or headband. Included in the study was evaluation of soft tissue reaction and complications in relation to the surgery. In addition health-related quality of life data was compared between the aided abutment condition and the unaided situation.

Materials and Methods: Subjects in the study underwent linear incision with tissue preservation surgery. Skin reaction using Holgers score at 15 days, 4 weeks and 10 weeks follow up was collected. For evaluation of pre-operative and post-operative condition aided sound field thresholds and Speech Recognition Thresholds in noise were measured together with Speech, Spatial and Quality questionnaire for self reported benefit. For evaluation Glasgow Health Status inventory was used for comparing health-related quality of life between unaided and post-operative condition.

Results: Preliminary results show very few adverse skin reactions and post operative complications. Improvement of hearing performance between the pre-operative and post-operative condition is found together with improvement of self-reported outcomes. Also quality of life score indicates improvement for the aided condition compare to before surgery.
Abstract Body:

**Introduction:** Transcutaneous bone conduction implants (BCIs) are playing an increasingly important role in patients with conductive or mixed hearing loss as well as in certain patients with unilateral deafness. The main advantage of transcutaneous BCIs is keeping the skin intact. Although most studies show remarkable audiological improvement following BCIs implantation, it is usually stated that the large size of the internal part of the implant (8.8 mm deep) may require dural and/or sigmoid sinus compression in order to be secured in the bony well. The aim of this study was to (1) evaluate postoperative pain following active BCIs implantation; (2) analyze the impact of surgical variables on postoperative pain; and (3) compare postoperative pain between BCIs users and other transcutaneous implant users, including cochlear implants (CIs) and middle ear implants (MEIs).

**Methods:** 25 patients with active BCIs were evaluated with 2 pain-related questionnaires postoperatively. The Headache Impact Test (HIT-6) was used to measure the degree of disability in everyday situations. Disability was quantified using 4 impact grades including none or little impact (≤49), mild (50-55), moderate (56-59), and severe (≥60). The Brief Pain Inventory (BPI) was used to assess pain intensity and function interference. Clinically meaningful pain was considered to be present if patients rated their average pain ≥3/10. The impact of the surgical approach, exposure of the dura and the sigmoid sinus on postoperative pain was analyzed. The BCIs pain results were compared with 10 MEI and 70 CI.

**Results:** Mean functional gain was 34.3±12.9 dB HL with the greatest difference occurring at 4KHz. Word recognition (SDS at 65dB) significantly improved from 14.2±24.7% preoperatively to 82.1±21.0% at 1 year postoperatively, and to 82.9±21.6% at the last follow-up. No local or general complications occurred in this series. None of the 25 patients undergoing BCIs showed significant improvement of the HIT-6 (41.5 to 42) or the BPI scores (0.5 to 1.0) following surgery. None of the mean postoperative values revealed significant pain (HIT-6 >49 or BPI>3). The analysis showed that the retrosigmoid approach, the need for dural or sinus compression, and the use of BCI lifts had no significant impact on postoperative pain following BCIs implantation. The mean...
postoperative HIT-6 pain scores for patients with BCIs, MEIs and CIs were 42, 43 and 46, respectively. Both postoperative pain severity score and pain interference scores were very similar among the three types of transcutaneous implants.

**Conclusion:**

1. BCI surgery causes no significant postoperative pain

2. The retrosigmoid approach, dura compression or sigmoid sinus compression have no significant impact on postoperative pain.

3. BCI surgery causes no more postoperative pain than other transcutaneous implants as CIs or MEIs.
A Comparison of Electric Charge Requirements, Speech Recognition, and Residual Hearing with CI422 and CI24RE(CA) Cochlear Implants

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Introduction: Average psychophysical responses, such as thresholds, comfort levels, and dynamic range of adult cochlear implant recipients with CI24RE(CA) cochlear implants has previously been evaluated. However, little is known about how these psychophysical responses compare to other electrode arrays and how that variation may impact post-operative speech recognition. With the release of the CI422 electrode array and the expansion of candidacy guidelines to include individuals with better pre-operative hearing and speech recognition scores, information about average psychophysical responses as well as pre- and post-operative speech recognition and hearing thresholds may be valuable to clinicians for management of adult cochlear implant recipients. Additionally, a comparison of these variables between the CI24RE(CA) and CI422 electrode arrays may provide useful information when counseling patients pre-operatively regarding device selection and expectations of performance.

Methods: The aims of this study were 1) to evaluate electric charge requirements and speech recognition in adult cochlear implant recipients with CI422 electrode arrays at 12 months post-activation and 2) to examine the relationship of pre- and post-operative speech recognition and hearing thresholds in adults with CI422 electrode arrays compared to a normative group of adults with CI24RE(CA) electrode arrays.
This study is a retrospective review of electric charge requirements of 32 post-lingually deafened adults with normal cochleae who received CI422 cochlear implants. Data includes threshold (T) and comfort (C) levels obtained at 12 months post-activation, converted to units of charge per phase (nC) to allow comparisons across differing pulse widths. Typical mapping parameters (strategy, pulse width, pulse rate, maxima), and number of useable electrodes are also analyzed. These data are compared to a group of 100 post-lingually deafened adults with normal cochleae who received CI24RE(CA) cochlear implants. Additionally, pre- and post-operative hearing thresholds and speech recognition, as measured by scores obtained on the Consonant-Nucleus-Consonant test, are compared across groups.

**Results:** Mean electric charge requirements, typical mapping parameters, and performance outcomes for adult CI422 cochlear implant recipients will be presented and the relationship between charge requirements, pre- and post-operative hearing thresholds, and speech recognition performance across recipients who receive CI422 and CI24RE(CA) cochlear implants will be examined.

**Conclusion:** Available data regarding average psychophysical measurements, mapping parameters, and post-operative performance across different electrode arrays is limited. This study provides mean threshold and comfort levels, as well as mean pre- and post-operative speech recognition scores and hearing thresholds for CI422 and CI24RE(CA) cochlear implant recipients. This information may aid clinicians with candidacy evaluation, device selection, counseling, and post-operative management of adult cochlear implant patients.
Case Report – Powerstapes with a Short Process of the Incus Coupler

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Introduction:
A majority of the otosclerosis patients suffer from additional sensorineural hearing loss. Despite optimal air bone gap closure these patients requiring further amplification. For selected patients stapedotomy and Vibrant Sound Bridge may be combined (powerstapes). Recently, an alternative short process of the incus (SP) coupler has been introduced. The following case report presents the combination of stapedotomy and SP coupler Vibroplasty as an alternative technique in powerstapes surgery.

Case report:
A 55 year old female patient presented with progressive hearing loss on the right ear over the past 5 years. Hearing aids had been used prior with limited audiologic success and had led to chronic external ear infections. Audiologic workup revealed slight sensorineural impairment on the left ear and a sensorineural hearing loss of 50 dB in the middle and high frequencies on the right ear with an additional air bone gap of 30 dB. Tympanometry showed a regular curve with a missing stapedius reflex. Otosclerosis of the right ear had been diagnosed. Because of recurrent external ear infections triggered by the hearing aid an informed consent for a powerstapes has been requested.

Surgical technique:
A tympanoscopy via a retroauricular incision was performed. Examination of the middle ear revealed a fixed stapes footplate.
Subsequently, the stapes supra structure was removed. A mastoidectomy and antrotomy fully revealing the short process of the incus was performed. A Virbant Sound Bridge was then implanted and connected to the short process of the incus applying an SP coupler. Finally the stapes footplate was perforated with a CO₂ Laser and a standard 4.5 x 0.6 mm stapes piston was inserted.

Discussion:
The SP Couple is a useful alternative to the standard coupling on the long process of the incus. Using the SP Coupler has several technical advantages. On the one hand the coupling of the FMT can be performed prior to the insertion of the stapes piston with a disconnected ossicular chain. Therefore, possible inner ear trauma is reduced. On the other hand, the handling of the FMT in the wide antrotomy is easier, than through a posterior tympanotomy.
**Introduction:** Despite the prevalence of children who are deaf and/or hard of hearing in North American healthcare and education systems, clinical assessment of speech perception in preschoolers and young school-age children is performed using word lists of uniform difficulty. These lists provide little information to aid in the development of aural rehabilitation management plans or to systematically track progress in speech perception abilities over time. This is problematic because as children with impaired hearing learn to listen they progress through a hierarchy of speech perception skills. The typical approach of evaluating children’s speech perception using speech materials with uniform difficulty is unlikely to provide an accurate reflection of a child’s true listening abilities. This is particularly important for school-age children with impaired hearing because this is a critical age for habilitating speech, language, and listening problems.

**Objective:** To demonstrate the feasibility and sensitivity of a four-alternative, forced-choice picture-pointing word-recognition task that employs a listening hierarchy. Target words are familiar English words and the pictures used are timeless and classic. These materials and procedures have a number of advantages for testing children with impaired hearing. The four-alternative format accommodates assessment of children with severe hearing loss and/or poor speech production, who might perform at “floor level” on an open-set task. The hierarchical listening difficulty better predicts real-world performance than testing with words of uniform difficulty and allows for systematic tracking of progress in speech perception ability over time.

**Methods:** Children age 3 - 8 years with impaired hearing who use auditory prosthetic devices and children with normal hearing were tested. Recorded test stimuli were played via a clinical audiometer through a loudspeaker in a sound booth at a calibrated fixed level of 60 dB SPL. Children were seated 1m (3.28 ft) facing the loudspeaker. Each child was instructed to point to the picture in the test booklet that matched the word that was heard. Responses were recorded manually.

**Results:** Preliminary data on children with hearing loss, including hearing aid and cochlear implant users shows progressively better scores that positively correlate with listening experience. The listening hierarchy is also substantiated by results from children with
normal hearing in that the youngest children perform perfectly on the lower levels of the hierarchy and older children perform perfectly on the entire test.

**Conclusion:** Test performance on a new progressively hierarchical pictured word identification test in English can track benchmarks in listening skills for children with hearing loss as they progress through a listening hierarchy. The test takes less than 5 minutes to administer and produces a single score that indicates the child’s hierarchical speech perception abilities.
Control Number: 2016-A-560-ACI

Session Number: POS02

Session Title: Poster Session B

Poster Board Number: 131-B

Topic 1: 02d-Alternative Surgical Approaches

Publishing Title: Low Frequency Hearing Preservation and Outcomes Following Electro-Acoustic Stimulation Cochlear Implantation with a Modified Soft Surgical Technique

Author Block: Andrew J. Redmann, MD1, Shawn M. Stevens, MD1, Ashley Altman, BS2, Lisa Houston, AuD1, Theresa Hammer, AuD1, Ravi N. Samy, MD1; 1Department of Otolaryngology: Head and Neck Surgery, Univ. of Cincinnati, Cincinnati, OH, 2University of Cincinnati Medical School, Univ. of Cincinnati, Cincinnati, OH.

Abstract Body:

Introduction:
Patients with isolated high frequency hearing loss and residual low frequency hearing are candidates for electrical-acoustic stimulus (EAS) cochlear implantation. There is debate over the optimal surgical technique for EAS implantation, including type of cochleostomy, depth of insertion, and type of the implanted electrode array. Meticulous hemostasis and avoidance of suctioning around the cochleostomy may be important to successful outcomes but poses a challenging technical hurdle. The role of perioperative steroids is unclear.

Methods: Retrospective chart review of patients undergoing EAS CI was conducted from 2011-2014. Inclusion criteria were age>18years, residual low frequency hearing (125,250,500 Hz) thresholds ≤60dB in the implanted ear, and pre-operative aided monosyllabic word scores of 10-60% in the implanted ear and ≤80% in the contralateral ear. Patients were excluded if the duration of deafness >30years and duration of follow up <6 months. Patients were provided 1 week of pre-operative oral steroids. Soft surgical technique entailed immediate intratympanic steroid injection, use of CO2 laser for meticulous mesotympanic hemostasis, round window insertion(whenever possible), and slow electrode advancement to a depth of 16-20mm depending on the array. One week of post-operative steroids were administered. Comparisons of pre-and postoperative pure tone thresholds, AZBioQ, and CNC scores were made at 3mo and ≥1 year. Usage rates of electro-acoustic stimulation were documented.

Results: Fifteen patients and nineteen ears underwent EAS implantation (53% male, 47% female). The mean age at the time of implantation was 62 years (37-86). Mean follow up was 17.3 months. Devices implanted were the Cochlear Hybrid L-24 (11), 422 (6), and 522 (2). Low frequency threshold averages declined from 40.3 dB preop to 62.6 dB at the first postop visit. At the time of first post-operative evaluation (mean 3.4 months), 15/19 (79%) patients had low frequency preservation. Eight of these have since been tested at a follow up date ≥1 year (mean 19.3 months) with a low frequency average of 59.8dB. Preoperative AZBioQ was 48.7%, compared with 55.3% postoperatively. A significant improvement in CNC was
detected pre- to postop (27.3% to 52.4%; p=0.0049). Seventy-four percent of patients in the study were still utilizing electro-acoustic stimulation at most recent follow up.

**Conclusion:** CO2 assisted soft surgery combined with use of perioperative steroids is a safe and effective means of preserving low frequency hearing after hybrid cochlear implantation. Almost 75% of patients still use the EAS condition at long term follow-up.
Abstract Body:

**Introduction:** In normal hearing subjects, the auditory system is able to perceive interaural time differences (ITD) with high precision and to use ITD for sound localization and binaural unmasking. In single sided deaf (SSD) cochlear implant (CI) users with normal hearing in the contralateral ear the treatment of the deaf ear with a CI leads to an altered neuronal representation of ITD caused by the partial replacement of the peripheral auditory system on the deaf ear's side. Compared to SSD CI users, the unilateral application of a hearing aid (HA) in bimodal CI/HA users additionally alters ITD representation in terms of an increase caused by the signal processing in front of the ear. The objective of the present study was to quantify the modifications of ITD representation by these devices to estimate the need for central auditory temporal compensation in both, SSD CI users and bimodal CI/HA users.

**Methods:** Electrically and acoustically evoked auditory brainstem responses (ABR) were recorded in seven SSD CI users provided with recent MED-EL CI systems. Based on these recordings, ABR wave V latencies were assessed for the normal hearing and the CI ear, respectively. Acoustical stimulation was performed using 0.5, 1, 2 and 4 kHz tone bursts. For electrical stimulation single biphasic current pulses were applied to intracochlear electrodes no. 3, 5, 8 and 10. Furthermore, signal processing delays present in the CI system used by the subjects and in recent hearing aids were determined.

**Results:** The SSD CI users showed shorter electrically evoked ABR wave V latencies (around 4 ms almost independent of the stimulation site) compared to acoustically evoked ABR wave V latencies (6.0 to 9.5 ms depending on the frequency). The frequency specific group delays measured in the CI system turned out to be in the right range to compensate for the difference between electrically and acoustically evoked ABR wave V latencies at 1 and 2 kHz. However, somewhat suboptimal CI group delays were found at 500 Hz and 4 kHz. In contrast to these quite low interaural timing deviations in SSD CI users compared to normal-hearing listeners, subjects provided bimodally with a HA on one and with a CI on the other side face much larger modifications of ITD representation. Group delays of up to 7 ms were found in recent hearing aids altering ITD representation considerably.
Conclusion: Especially in bimodal CI/HA users the adjustment of interaural stimulation timing may induce improved binaural hearing, reduced need for central auditory temporal compensation and increased acceptance of bimodal device use. This adjustment could be obtained by implementing an adjustable additional across-frequency delay in the CI system.
Abstract Body:

Introduction:
Every language possesses cultural and linguistic characteristics, which are both specific and inherent to it. That is the reason why every (re)habilitation tool must be based on a series of linguistic and cultural criteria which cannot be extrapolated to other languages.

Methods:
The tool compiles all the phonemes from the spoken Spanish language, and the hearing training is organised depending on its frequency of use. The lexical level is based on the frequency of use of the Spanish linguistic units. That is the reason why common words are trained before uncommon ones. For grammar and syntax, transitivity, subjectivity and frequency of use in Spanish were the characteristics used. Finally, it has been considered including training of the short time memory for increasing the difficulty of some exercises.

Results:
The tool is widely used in other languages for hearing rehabilitation of patients with both cochlear implants or hearing aids. While adapting it to Spanish, it has been checked with several patients. It has been noticed that both the tool and the methodology are really useful for patients.
Conclusion:
The main purpose of this methodological adaptation is achieving a functional hearing training for adults which comprehends all the most frequently used parameters. The rehabilitation material has been created following all the principles previously presented because there was need of a tool based on that specific methodology which had never being used before in Spanish. Finally, all Spanish-speaking patients using hearing aids and/or cochlear implants can take advantage of this tool.
Hearing and Life Quality Assessment in Patients Following Cochlear Implants

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Introduction: Hearing loss affects millions of people, and may lead those individuals to isolation and exclusion from social interaction, depression, cognitive impairment and bring a negative economic impact to society. Cochlear implants have shown advantages over other treatment alternatives, for it provides considerable hearing gains and therefore greater social interaction possibilities to the affected individuals.

Methods: Speech perception tests were performed to selected subjects prior to and following the cochlear implant using Med-EL devices; the questionnaires assessing quality of life were answered afterwards.

Results: A total 22 patients met the study’s inclusion criteria. There was an improvement in the audiometric thresholds, and the patients presented a good quality of life with cochlear implant.

Conclusion: The evaluation of these subjects permits to conclude there are improvements in hearing, and that patients perceive their quality of life to be good after being subjected to cochlear implant.
The Effect of Music Therapy on People with Hearing Impairments

Abstract Body:

Introduction: In recent years, music has been used in many intervention and rehabilitation settings. Numerous researchers show that Music Therapy can help improving language skills in patients including hearing impaired. In this study are reviewed 6 experimental studies (mixed study, multiple case study, and 2 review study about the effectiveness of Music Therapy on hearing impairment were Published since 2002 to 2015. We extracted these articles from Google scholar, Medline and science direct

Methods: Different methods of music therapy such as hearing and listening to music, singing, playing musical instruments, rhythmic move, identifying individual components of music (rhythm, pitch) and so on were applied on participants. Various scales included the Iowa music perception and appraisal Battery, musical background questionnaire, were used to assess the indexes of these studies

Results: According to these studies Music Therapy can enhance the frequency and duration of spontaneous imitation, initiation, turn-taking and synchronization of young children following cochlear implantation. Music Therapy seems to improve pitch perception ability in prelingually deafened children with CI. The duration of musical training positively correlated with the correct rate of pitch perception performance

Conclusion: As well as, research studies have shown that Music Therapy is a useful tool for speech production, development of vocabulary and sound awareness or discrimination. Furthermore, more time spent listening to music
and receiving formal training may improve accuracy on pitch discrimination, pitch pattern recognition and complex song recognition. Some aspect of music, such as it’s vibro-tactile features, wide frequency range and common pairing with lyrics, make it a useful tool for promoting language development.
Cochlear Implants in Cochlear Otosclerosis: Our Results

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Abstract Body:

Introduction: The retrofenestr al or cochlear otosclerosis represents up to 10% of cases of otosclerosis. It may be associated with antefenestral involvement. These patients usually have rapidly progressive bilateral sensorineural hearing loss. Cochlear implantation (CI) is an established option for treatment. The aim of our study is to correlate preoperative audiological thresholds with radiological findings and to analyze the implants results and complications.

Methods: We present a descriptive and analytical study of 30 patients diagnosed with cochlear otosclerosis treated with a CI between 2004 and 2015 in a tertiary hospital. Free field Audiometry (FFA), and Word Recognition Scores (WRS) were performed on all patients with hearing aids and with CI. The imaging study was performed using computed tomography (CT) and high-resolution magnetic resonance imaging (MRI).

Results: The mean age of hearing loss onset was 29.3 years, and for profound sensorineural hearing loss was 51.9 years. No correlation between tonal threshold and radiological stage was evident. The mean age at implantation was 59.2 years. We had good results in patients with cochlear otosclerosis and with profound sensorineural hearing loss by an average verbal discrimination with CI of 80.17% ± 15.68%. No statistically significant relations were observed between age at implantation and implant performance. We found a statistically significant relation between shorter auditory deprivation and free field disyllabic discrimination (p <0.05) with the CI. There were no further complications during surgery. The electrode insertion was complete in all cases. Only 2 patients (6.66%) had extracochlear stimulation with facial symptoms that were solved by means of deactivation of the electrodes.
Conclusion: The cochlear implant is an effective treatment in patients with profound sensorineural hearing loss and cochlear otosclerosis and shows good postoperative results. The radiological and auditory stages did not show any correlation in our study. The most important preimplantation predictor was auditory deprivation time.
Effects of Transient Noise Reduction and Near-Stationary Noise Reduction in Cochlear Implant Users

Gertjan Dingemanse, MSc, André Goedegebure, PhD; Otorhinolaryngology, Erasmus Med. Ctr., Rotterdam, Netherlands.

Introduction: Most current CI processors have the possibility to apply a noise reduction algorithm which can improve speech performance in noisy situations. Single-microphone algorithms are mainly effective in reducing stationary background noises. However, many environmental noises are transient. Recently, transient noise reduction became available as an extra processing option in Cochlear Implant sound processing. The objective of this study is to investigate if a combined application of transient noise reduction (TNR) and a single-microphone noise reduction algorithm (NRA) results in a cumulated improvement for CI-users in terms of noise tolerance, speech intelligibility and preference in noisy backgrounds that contain disturbing transient sounds.

Methods: In this prospective efficacy study a randomized within-subjects repeated-measures design was used where each subject served as his/her own control. Each combination of TNC on/off and NRA on/off was tested, which resulted in four conditions per subject. For each condition the Acceptable Noise Level (ANL) and the Speech Reception Threshold (SRT) at 50% correct repeated words of unrelated sentences (Versfeld et al. 2000) were measured. The noise in both tests was a combination of near-stationary noise and transient noises from real-life situations. We used paired-comparison rating to measure noise annoyance and overall preference. Prior to the experiment we investigated if the TNC was activated by the transients in the noise. Furthermore, the conditions were compared in a paired comparison experiment and rated on an annoyance scale and a preference scale.

Results: Results will be presented which will show the effect of TNR alone, NRA alone and the combined effect of TNR and NRA on ANL, SRT, annoyance rates, and preference rates.

Conclusion: We will present conclusions about the efficacy of the combined application of transient noise reduction and noise reduction of near-stationary noise.
Introduction:
All HERMES is a database developed by the Auditory Implant Initiative (AII) to enable cochlear implant programs to 1) manage and organize clinical data throughout the CI candidacy period and subsequent first and second years of CI use, and 2) to pool aggregate data across participating centers for the purpose of clinical study and scientific research. The initial AII HERMES database was designed to accommodate adult patients. During the past year, we have been given the opportunity to help design the pediatric component of the database. The pediatric population is significantly different in many respects from the adult population of CI users. Additional considerations were necessary to effectively apply the use of the database to a greater clinical population now including pediatric patients. A number of new features have been added to All HERMES to address the unique needs of children receiving cochlear implants.

Methods:
The process of developing the pediatric components of the All HERMES database, and the product’s clinical application for children being considered for, and receiving, cochlear implants will be shared.

Results:
The Pediatric All HERMES database is a comprehensive tool for managing, viewing, and retrieving data across all intervals of the cochlear implant process. A two year timeline includes the documentation of: audiologic evaluation, speech perception testing, speech and language evaluation, educational information, surgical information, medical examination, and mapping. In addition to operating as a stand-alone database, All HERMES produces custom reports that can be scanned or uploaded to an EMR system. The database may address various needs faced by many cochlear implant clinics, including a systematic organizational structure for managing data associated with the cochlear implant process and
the lack of templates available for audiology and speech language pathology in most EMR systems. Cochlear implant clinics serving children, or both adults and children, can opt to participate in the AII HERMES database and may find it a beneficial means of addressing many of their organizational and research needs for this patient population.

**Conclusion:**
The pediatric component of the AII HERMES cochlear implant database is a useful and efficient tool for clinical management of children throughout the processes of candidacy evaluation, surgery, and early post-implant management, and may supplement and facilitate documentation, data tracking, and retrieval within current EMR systems.
Introduction: Over the past decade, the number of children with medical and developmental needs in addition to deafness receiving cochlear implantation (CI) has been increasing. It is now well-recognized that up to 40% of children with severe to profound hearing loss may have additional needs: for some children, these needs will be apparent at the time of CI, while for others, these needs will become apparent as children develop. There have been a number of studies which have examined outcome after CI for this group of patients, and have demonstrated benefits in sound awareness, speech and language development that are generally consistent with developmental levels. In addition, qualitative research with caregivers has indicated that there are additional benefits in sound awareness, social responsivity and engagement which are particularly important to families. However, there is limited research examining long-term follow-up: what exists suggests continued benefit in many children, although over the long-term, some patients do not appear to derive benefit and become non-users.

Objective: The objective of the present study was to conduct a study of long-term follow-up in children with CI and complex needs to determine outcome from the perspective of parents.

Methods: Qualitative interviews were conducted with parents of children who had received cochlear implants at a pediatric CI health care setting prior to 2004. The parents of 21 children who had received CIs between 7.3 and 19.0 years previously were potential candidates. This included the parents of 8 children who had participated in a qualitative study 10 years ago. Parents participated in a semi-structured interview which included questions about device use, its benefits and limitations, and their advice for other parents. Interviews were coded according to standard qualitative research methods.
**Results:** A review of use in this sample indicated that most children continued to use their device although 5 individuals were now non-users. Caregivers indicated that device use ranged from consistent, regular use, to periods of non-use. Consistent with the results from interviews conducted previously, parents continued to frame benefits of CI within the context of their child’s medical and developmental needs. Ongoing or periodic medical needs posed particular challenges which sometimes influenced device use. Most children demonstrated continued access to sound which their parents associated with benefits in social awareness and engagement, although this varied across CI recipients.

**Conclusion:** CI has become a standard option for parents of children with complex needs, but to date, there is limited information about long-term outcome. The results of this study provide information about outcome from the perspective of parents, which may be helpful for families currently considering CI to better understand the range of future outcomes.
Chinese Mandarin Tone Recognition in Patients with Bimodal Cochlear Implants

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Abstract Body:

Introduction:
For deaf individuals with residual low-frequency acoustic hearing, combined use of a cochlear implant (CI) and hearing aid (HA) typically provides better speech understanding than with either device alone. We called it bimodal when a listener has a CI in one ear and a HA in the opposite ear. Because of coarse spectral resolution, CIs do not provide fundamental frequency (F0) information that contributes to understanding of tonal languages such as Mandarin Chinese. Chinese Mandarin is a tonal language with one of four basic tones allotted per syllable. The variation in F0 of the target talker, and the amplitude envelope of the low-pass target speech, are important cues in background noise. The HA can provide good representation of F0 and, depending on the range of aided acoustic hearing, first and second formant (F1 and F2) information. However in many cases cochlear and hearing aid are not in a good fit. Many CI users do not possess enough residual hearing to show a bimodal benefit. So we want to find out how to show maximum benefit with CI and HA together.

Methods:
Twelve Mandarin-speaking bimodal patients (8 male and 4 female) participated in this study. Subjects were native speakers of Mandarin Chinese and were between the ages of 8 to 33 years old. All subjects had more than six months of experience with their device at the time of testing. Subjects were recruited from the Department of Otolaryngology, Head and Neck Surgery of Beijing TongRen Hospital (which specifically approved this study). The test material was provided by Mandarin i-CAST software developed by Qian-jie Fu professor. Closed-set identification tasks were used to measure Chinese tone recognition (16-alternative, forced-choice). The 16 choices were Ba1, Ba2, Ba3, Ba4, Bi1, Bi2, Bi3, Bi4, Bo1, Bo2, Bo3, Bo4, Bu1, Bu2, Bu3, Bu4. 1, 2, 3, 4 stand for tone 1, 2, 3, 4, respectively. The subjects were tested with CI+HA, with CI-only and with HA. A man spoke the tone in quiet, a woman speaking Ba1 as a background noise with SNR 10dB, 5dB and 0dB, and a man speaking Ba1 as a background noise as the same before. In all, the number of tests is 21=3 listening (CI, CI+HA, HA)*[quiet+2 background maskers*3 SNR (10dB, 5dB, 0dB)]. For the CI alone condition, the HA was removed and the HA ear was plugged to prevent eavesdropping. Subjects were seated directly facing a single loudspeaker 1m away. Their basic demographic and audiology information were recorded. The subjects’ pure-tone thresholds at 0.25, 0.5, 1, 2, 4, and 8 kHz were tested with CI+HA, CI alone, HA alone and naked ear of the HA side, respectively. Audiometry was conducted in sound field using warble tones in the first three modes while for the naked ear of the HA side it was
conducted using headphone.

**Results:**
No significant bimodal benefits were found in quiet conditions. But significant bimodal benefits were observed when maskers and targets have different F0 in all SNR conditions. In tone recognition, tone 3 is less affected by the background masker. In vowel recognition, Bi is less affected by background masker, however Ba is relatively more affected by masker.

**Conclusion:**
Bimodal is greatly benefit for recognition of information with different F0. Mandarin tone 3 and vowel I are more stable than the other tones and vowels for bimodal users.
**Control Number:**
2016-A-600-ACI

**Session Number:**
POS02

**Session Title:**
Poster Session B

**Poster Board Number:**
95-B

**Topic 1:**
03k-Assistive Listening Devices

**Publishing Title:**
FM Access in Bilateral Implant Users: Ideal in all Situations?

**Author Block:**
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**Abstract Body:**

**Introduction:** The common recommendation for students with bilateral cochlear implants is bilateral direct input of FM receivers. This has been suggested to provide the best access to a single talker in a noisy environment. However, reports from students, paraprofessionals, audiologists, and speech pathologists indicate that having two FM receivers may limit the bilateral cochlear implant user in access to incidental language within their environment. This is especially important when listening to a teacher AND peers in the classroom. The purpose of this study was to determine if there is a difference when students wear and two receivers 1) for teacher input and 2) for environmental access.

**Methods:** Ten students with bilateral cochlear implants will complete this study. They will be asked to listen and watch a videotaped lesson with FM direct input (with 1:1 FM ratio settings). Following the short video students will be asked content questions to ensure focus during the task. While the video is playing, short comments will be played in the room at soft and conversational levels to simulate classroom comments from peers. Following the video, the students will pick how many peer comments they heard from a list of all possibilities. This will be conducted with two versus one FM receiver. Conditions will be randomized. Students will also be asked subjective questions regarding the experience after both listening conditions have been completed.

**Results:** Anecdotal comments from students indicate a preference for FM in one ear due to better access to the environment and peers during classroom listening. Results from this test will provide additional information regarding actual performance under these two listening conditions.

**Conclusion:** Two FM receivers may not always be the best option for students with bilateral cochlear implants in a mainstream classroom environment. This may be situation dependent and this study will provide more insight into this topic.
Work Related Unilateral Severe Deafness in an Emergency Response Team Member Treated with Cochlear Implantation: A Case Report of Complete Recovery and Successful Return to Work

Jean-Michel Bourque, PGY 1, Richard Bussières, MD, Mathieu Côté, MD, Daniel Philippon, MD, Nicolas Rouleau, Audiologist, Maryse Landry, Audiologist; Laval Univ., Quebec, Canada.

Introduction: Cochlear implantation in not actually a common treatment for unilateral deafness in North America. Indication for cochlear implantation expands during the last few years and some studies demonstrate benefits of cochlear implantation for unilateral deafness.

Methods: We report the first case in our center of cochlear implantation for a severe unilateral deafness due to a perilymphatic fistula.

Results: A 43 years-old man working as an emergency response team member suffer of a work-related traumatic perilymphatic fistula. He has been treated with cochlear implantation and presents a complete recovery.

Conclusion: Cochlear implantation provide a real binaural audition and its indication expands during the lasts years. Cochlear implantation has been effective in our case to provide a normal audition and a successful return to work.
The purpose of this hands-on presentation is to provide the audience with knowledge of the electrically evoked stapedial reflex threshold (eSRT), its implementation, and application in the cochlear implant clinic. eSRT is the threshold at which the stapedial muscle contracts in response to electrical stimulation. Multiple publications have shown eSRT to be a beneficial tool to use during CI programming (e.g. Gross, 2003; Gordon, Papsin, & Harrison, 2004; Hodges et al., 1997; Stephan & Welzl-Muller, 2009), however, it has been shown that very few clinics actually utilize eSRT with their CI patients (Varenberg et. al., 2014).

One of the key components of cochlear implant programming is establishment of the electrical dynamic range. At the current time, there are two approaches used to establish the electrical dynamic range, behavioral loudness judgements and objective measures. Typically, behavioral loudness judgements are the sole contributor to establishment of the electrical dynamic range (Varenberg et. al., 2014). Unfortunately, individuals with hearing loss often have difficulty judging loudness (Wolfe & Schafer, 2010). Objective measures provide important information about the patient’s electrical dynamic range when an individual has difficulty providing reliable and/or accurate feedback during behavioral measures. Specifically, eSRT can be used to establish C/M levels during CI mapping. Even in cases where a patient provides reliable information, eSRT can help verify that C/M levels are being set at an appropriate level.

ECAP, another objective measure which has been found to be more commonly used than eSRT can provide a ballpark estimate for T and C/M levels, but eSRT has been found to provide a more focused view of where C/M levels should be (e.g., Gross, 2003; Gordon, Papsin, & Harrison, 2004; Hodges et al., 1997; Spivak, Chute, Popp, & Parisier, 1994). eSRT has been shown to strongly correlate with C/M levels measured behaviorally and provides the best estimate of comfortable loudness levels. C/M levels measured with eSRT are generally within nine clinical units of behaviorally measured C/M levels (Spivak, Chute, Popp, & Parisier, 1994). Even though the evidence shows eSRT as a strong clinical tool; eSRT is not commonly used in CI centers (Varenberg et. al., 2014). Possible causes of limited use is that ESRT measures are not seamlessly incorporated into cochlear implant programming software and limited comfort with the procedure by the cochlear implant audiologist. As such, this presentation will provide evidence to support the use of eSRT as well as hands on experience with performing and interpreting eSRT measures.
First Surgical Experience and Short Term Results on Performance and Preservation of Residual Hearing in Bilateral Cochlear Implantation with a New Cochlear Implant System and Hypo-traumatic Electrode

Emmanuel Mylanus, MD, PhD, Prof1, Wendy Huinck, MSc, PhD1, Sebastian Ausili, MSc2, Martijn Agterberg, MSc, PhD1, John van Opstal, MSc, PhD, Prof2, Lucas Mens, MSc, PhD1;
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Abstract Body:

Introduction:
Recently, a new cochlear implant system was introduced. This cochlear implant may be obtained with a standard electrode array or a hypo-traumatic electrode array which is considerably thinner and flexible. Signal processing in this cochlear implant aims to present a large input dynamic range without typical distortions introduced by a fast acting automatic gain compression (AGC) by capitalizing on the instantaneous compression in the current-mapping stage. First surgical, audiometric and bilateral performance data with this new device are of interest to cochlear implant centers.

Methods: Three adult subjects with severe sensorineural hearing loss due to DFNA9 simultaneously received the new cochlear implant in both ears. As residual hearing was significant in all three patients, the soft surgery protocol was applied in all patients. Audiometric follow-up will determine the outcome of the implantation on residual hearing. Speech understanding will be tested using the closed-set Matrix test with speech from the front and noise from front, left and right. Localization will be tested measuring the head orientation towards one of 125 speakers placed in a sphere arrangement of 140 degrees in azimuth and 120 in elevation.

Results: The surgical procedure was uneventful in all six ears. Fixation of the implant receiver with screws is straightforward. The round window approach was used to insert the hypo-traumatic electrode array and obtain a full insertion. The correct position of the electrodes was determined with postoperative CT-scans. Per-operative impedance measurements and integrity showed normal values over all active electrode contacts. Per-operative EBER measurements could show normal wave patterns on three electrodes in all cochlear implants. Three months follow-up data on residual hearing preservation, speech recognition-in-noise and localization
Conclusion:
The implantation procedure with this new cochlear implant system was straightforward and successful. The audiometric and binaural performance data of the patients will be presented.
Loudness Perception in Cochlear Implant Users

Introduction: Loudness perception plays pivotal role in speech perception. Intensity-difference limen (IDL) is the best index of loudness perception ability. This study aimed to compare loudness perception performance of subjects who wear cochlear implant and normal-hearing listeners at frequencies of 500, 1000, 2000 and 4000 Hz.

Methods: In this cross sectional study, IDL was performed on nine postlingually cochlear implanted patients with mean age of 31.77±6.6 and 17 controls with mean age of 32.76±6.5 years. Following a training period (eight sessions on the average), the cochlear implant users were re-evaluated by the same test. Data were analyzed with statistical package of SPSS (version 18) using independent and paired t-test assessments.

Results: In the initial tests, intensity-difference limens of cochlear implant users was significantly poor when compared with that of normal-hearing controls at all test frequencies (p<0.05). The mean IDL of cochlear implant users after training period, was significantly improved (p<0.05).

Conclusion: The results demonstrated that patients with cochlear implant have some ability of loudness perception that can be significantly improved through regular training.
Diagnostic Value of High Resolution Computed Tomography in Cochlear Implant Recipients

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Background: High resolution computed tomography (HRCT) is highly efficient in demonstrating the anatomy of the temporal bone. It allows a detailed presentation of anatomical features and achieves the prerequisites for selection of the various therapeutic options including cochlear implantation (CI). The purpose of this study was to determine the diagnostic value of HRCT as a preoperative imaging technique for CI candidates.

Methods: During a cross-sectional study, the HRCT findings in 41 patients who underwent cochlear implant were analyzed and compared with the surgical findings. The HRCT images were obtained in the axial and coronal planes using 0.5 mm slice thickness. HRCT findings were analyzed for diagnosis of cochlear malformations and opening of the scala tympani, and round window niche (RWN) visibility.

Results: In 38 (92.68\%) of the 41 patients, the HRCT image-based assessment of the cochlear malformations coincided with the surgical findings; revealed sensitivity of 93.7\%, and specificity of 97.4\%. Sensitivity and specificity of HRCT in detection of the opening of the scala tympani were 97.5\% and 83.1\%, respectively. RWN visibility during HRCT assessment, yielded sensitivity of 92.3\% and specificity of 79.5\%.

Conclusion: Our experience suggests HRCT is highly useful method for studying patients with a variety of temporal bone abnormalities and can be applied during clinical routine to facilitate cochlear implant candidacy process.
Introduction: Objective To explore feasibility of cochlear implantation in subjects with Auditory neuropathy (AN).

Methods: Pure-tone audiometry, Categories of Auditory Performance (CAP), Speech Intelligibility Rating (SIR), Meaningful Auditor Integration Scale (MAIS) were performed for 22 AN subjects with severe or profound hearing impairment (18 prelingual deafness and 4 postlingual deafness) after cochlear implantation. Outcomes were compared with those of 22 pair-matched subjects with non-syndromic congenital deafness. Paired student-t test was applied.

Results: Average aided hearing thresholds of AN subjects after cochlear implantation were 38.6±6.36 dB HL. Concerning to post-operated MAIS scores, no significant difference was found in sub-scores of bonding to the device and sound detection between AN and non-syndromic prelingually deafened subjects (P>0.05), and the sub-score of sound perception obtained in AN subjects was significantly lower than that of control group (P<0.05). There was no significant difference in post-operated scores of CAP, SIR between two groups (P>0.05).

Conclusion: Cochlear implant could be beneficial for both prelingually and postlingually deafened subjects with auditory neuropathy of severe or profound hearing impairment, and could be a feasible and regular intervention to patients with this disease.
Introduction: Improved access to early identification, advanced hearing technology, and early intervention has allowed children with hearing loss access to listening and spoken language as their primary mode of communication (Geers & Nicholas, 2013; Yoshihagita, 2003). Professionals in the developing world, however, rarely have the expertise to provide necessary language intervention service to this population (Wylie, McAllister, Davidson, & Marshall, 2013). Therefore, many organizations from the west have begun international training programs. Unfortunately, the strategies being taught may conflict with local language socialization practices, the processes by which children learn appropriate ways to interact with and through language (Crago, 1992; Schieffelin & Ochs, 1986). This study will compare families with and without hearing loss in Vietnam to those in Canada as an example of how language socialization practices impact parent-child communication so that speech-language pathologists may create more culturally appropriate intervention techniques.

Method: This project took a mixed methods approach. All data was collected over three days from children between 18 and 48 months old with and without hearing loss in Canada and Vietnam. Quantitative data was collected using full day digital audio recordings. Software automatically analyzed each recording to calculate an average conversational turn count as a measure of parent-child vocal interaction. Results were compared across cultural groups. Conversational turn count alone, however, does not provide a usable explanation for why differences between cultural groups may exist. Qualitative interviews regarding language socialization and language learning were therefore conducted with the children’s parents. A Thematic Analysis (Braun & Clarke, 2006) was performed to identify patterns within the interview data and the resulting themes were used to elaborate on the quantitative findings.

Results: Preliminary data indicates a statistically significant difference between the conversational turn counts of Canadian and Vietnamese children without hearing loss ($U=135, p<.001$). There was no difference between the two Vietnamese cohorts ($U=181, p=.21$). We expect that further data collection will show similar results and that Canadian children with hearing loss, for whom data remains to be collected, will participate in a similar number of turns as their typically developing Canadian peers.
Interviews are currently being transcribed and analyzed. As themes emerge, we hope to use them to further explain the quantitative results.

Conclusion: When speech-language pathology ignores cultural differences between families, a child’s language learning process can be disrupted. By adhering to a mixed methods approach, this study used new technology to describe language socialization practices. Results will benefit Vietnamese families receiving speech-language therapy and the professionals serving them around the world. It is hoped that findings from this project will begin a conversation about the importance of considering language socialization practices in intervention for children with hearing loss. Integrating culturally appropriate language socialization practices into speech-language therapy will allow more children with hearing loss to become fully participating members of their families and communities.
Abstract Body:

Introduction:

The purpose of this presentation is to reveal and discuss details of a novel behind-the-ear sound processor that fits in the super power category where sensorineural hearing levels of up to 65dB HL may be accommodated. Previous devices in this category have been in the form of a body-worn configuration that allows for significant separation of the microphone input and the transducer that produces the amplified signal. Advanced features such as noise reduction, automatic scene analysis, feedback cancellation and wireless accessory integration are now available for patients that require this level of amplification power to adequately amplify their hearing loss.

Methods:

A within-subject comparison is done between the more commonly used head worn sound processor and a novel behind-the-ear sound processor that provides amplification in the super power category. Speech recognition in both quiet with words and noise with sentence material will be discussed. Additionally, results of subject impressions are captured in a questionnaire after use of the novel behind-the-ear-device.

Results:

Speech recognition
scores show equal or better performance in both quiet and noise presentations in the test device.

**Conclusion:**

The described device creates a new category of sound processors with a behind-the-ear wearing configuration that is appropriate for patients with mixed/conductive hearing losses and in cases of single-sided-deafness with high inter-aural attenuation that require a bone anchored system. The results of this study reveal equal or superior clinical outcomes when comparing legacy head worn sound processors to this new behind-the-ear device.
Control Number:
2016-A-621-ACI

Session Number:
POS02

Session Title:
Poster Session B

Poster Board Number:
35-B

Topic 1:
03a-Fitting

Publishing Title:
Artificial Intelligence (FOX) to Improve Target Driven CI Fitting

Author Block:
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The Eargroup, Antwerp-Deurne, Belgium.

Abstract Body:

Introduction: A global survey on the current state of CI fitting has shown CI fitting is mainly driven by the comfort of the CI recipient rather than on preset measurable targets (Vaerenberg B, et al. Sci World J 2014; Article ID 501738: 1-12). This yields huge variability in all aspects of fitting. The MAPs CI recipients receive depend to a huge extend on the CI centre where the programming is performed. At the Eargroup well defined targets have been defined since many years for audiometry, speech audiometry, loudness scaling and spectral discrimination. Artificial intelligence has been developed to assist the audiologist in improving the MAPs and bringing the measured outcome closer to target.

Methods: Hybrid probabilistic algorithms have been built to modify the MAP of a CI recipient. These algorithms consist of a combination of deterministic and probabilistic logic. The deterministic logic makes use of the Intensity Coding model for Cochlear Implants (Vaerenberg, et al. Ear Hear 2014; 35(5):533-43). The probabilistic logic is a combination of Bayesian influence diagrams with different underlying canonical models. The algorithms analyse the MAP together with the outcome obtained with these MAPs (see introduction). They then generate millions of new MAPs by permutating the different MAP variables in a restricted domain of the multidimensional MAP domain and for each new MAP a Utility function calculates the possible benefit based on the predicted effect on the outcome measures. The results will be shown in six Cochlear Nucleus CP910 CI recipients whose implants were programmed by an expert audiologist assisted by FOX.

Results: For all six patients, the trajectory after switch on will be outlined. The results on free field audiometry, AÃ¢â€â€ spectral discrimination, AÃ¢â€â€ loudness scaling (250-1000-4000 Hz) and monosyllabic speech audiometry (40-55-70-85 dB SPL) will be presented before and after MAP changes with the use of FOX. The predicted outcome with the new MAPs will be compared with the observed outcomes.
Conclusion: It is possible to define preset and measurable targets for CI fitting. Applications making use of artificial intelligence may assist the audiologist in generating optimized MAPs that bring the test results closer to target.
Abstract Body:

Introduction: The objective of the study was to determine the natural progression of hearing changes over time in the contralateral ear in hearing preservation cochlear implantation (HPCI) surgery.

Study Design: Single centre retrospective review

Methods: Patients undergoing HPCI from 2008-2013 with devices from a single manufacturer were identified. Pure tone thresholds at 250Hz and 500Hz were obtained preoperatively and postoperatively for both ears. Patients with previously non-responsive contralateral ears and bilateral implants and were excluded.

Results: 150 patients who underwent HPCI surgery from 2008 to 2013 were identified. Of these, 83 had complete preoperative data for both ears, with an average follow up of 27 months. Mean preoperative thresholds at 250Hz and 500Hz on the operated side were 54 dBHL and 66 dBHL, which dropped postoperatively to 92 dBHL and 107 dBHL, respectively (p<.001). Mean preoperative thresholds at 250Hz and 500Hz on the contralateral ear were 49 dBHL and 62 dBHL, which dropped postoperatively to 56 dBHL and 70 dBHL respectively (p<.001). Overall, in the contralateral ear, this amounts to a 7dB drop in hearing thresholds at the tested frequencies. At 250Hz, no correlation between threshold shifts emerged between the ears (p=0.07,R²=0.04), whereas at 500Hz, a statistically significant correlation between threshold shifts was observed (p=.04,R²=0.05).

Conclusions: Our data shows an average 7dB drop in hearing thresholds in the contralateral ears of our patients who received HPCI surgeries from 2008-2013. This natural progression of hearing loss is important to consider when interpreting the results of HPCI surgery.
A Cross Over Trial Comparing the Fine Structure Coding Strategy FS4 High Rate to FSP in Cochlear Implants: Preliminary Results

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Abstract Body:

Introduction: New versions of coding strategies for cochlear implants have aimed at the transmission of temporal fine structure to cochlear implant recipients. FS4 is the latest development transmitting fine structure on 4 apical electrodes. In a previous study the addition of a high stimulation with FS4 has shown improved subjective sound quality and improved speech perception in an acute setting.

The aim of the present study is to compare FS4 using a high stimulation rate with the previously available fine structure strategy FSP in a clinical setting with 3 months adaptation time per strategy.

Methods: 34 adult CI patients with a minimum of 1 year cochlear implant experience are included. Patients need to have a minimum of 10 active electrodes of a long (≥ 28mm) electrode array. Each patient uses each coding strategy for 3 months in a randomized sequence. Outcome measures are the speech reception threshold of an adaptive sentence test in noise (Oldenburger Sentence test) and a monosyllables test in quiet. Formant discrimination is tested using artificial vowels with altered formant frequencies. In addition the subjective sound quality using VAS scales as well as a quality of life questionnaire is evaluated after each 3 month period.

Results: Preliminary results will be presented comparing the two coding strategies.

Conclusion: This study will evaluate the potential clinical benefit of adding a high stimulation rate with the FS4 fine structure coding strategy.
Benefits of Group Information Sessions Prior to Cochlear Implantation

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Introduction: Efficiency and efficacy of patient care is a constant challenge in a public health care system, including audiological service delivery for cochlear implant (CI) candidates. Improving the pre-operative CI candidacy process is therefore of interest to potential patients, audiologists and the general public. Adults referred for cochlear implantation often have little knowledge of CIs or exposure to experienced CI users. As a result, audiologists spend a significant amount of time educating individual patients on CIs often without the valuable insight only a seasoned CI user can provide. The purpose of this study is to improve the efficiency and efficacy of the CI candidacy process for both audiologists and patients by: decreasing the amount of time audiologists spend on individual pre-implant education, standardizing the information provided to potential CI candidates, and facilitating interaction between potential CI candidates and current CI users.

Methods: Following referral, patients are sent a letter detailing the group Information Session (IS) and the next available dates. Patients are asked to RSVP to a session and are encouraged to bring a significant other. At each IS, with support of a projected presentation and real-time captioning, an audiologist outlines basic CI function, candidacy criteria, the pre-operative process and audiological follow-up post-implantation. Two CI users are then asked to talk about their own experiences and answer questions. The IS also includes opportunities for patients to approach the audiologists and CI users individually for more information. Potential candidates who proceed with a candidacy assessment are asked to complete a survey regarding the IS they attended.

Results: To date, 36 patients have attended an IS with an average of 7 patients per session. All attendees (100%) returned for their individual candidacy assessment appointment. The average rating of overall satisfaction with the IS was 4.8 out of 5 with 5 being “excellent”. Half of all attendees reported that hearing from current CI users was the most beneficial part of the presentation. It is estimated that a minimum of 10 direct patient contact hours were saved over five sessions, leading to an estimated savings of approximately 28 minutes per patient.
Conclusion: Patient response to the information sessions has been very positive. Audiologists report that patients are retaining more information and are more actively engaged with the CI process. Although the reduction in direct patient contact time is modest, additional efficiencies will likely be revealed with further modifications and continued practice.
Japanese Auditory Test Results of CI Children in Mainstreaming School

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Abstract Body:

Introduction: In Japan, integration rate is not so high compared to foreign countries. However, integration rate in our hospital is 90% of our patients. This rate is same to foreign countries. Those children have normal score of intelligent Quotients test (WISC-IV) and normal speech production. There are many factor as follows, 1) We give appropriate speech processors fitting based on auditory tests. 2) Japanese auditory tests are a) functional threshold test, b) speech reception threshold test, c) speech discrimination test, d) SNR test. 3) We fit accurate speech processors programs. In this study, we report results of these tests.

Methods: All tests are presented under sound field. a) Functional Threshold Test b) Speech Reception Threshold Test; we use Japanese numbers. c) Speech Discrimination Test; 67-S Japanese monosyllabic list. d) Signal Noise Rate Test; noises we use are speech noise.

Results: There are results as follows, (All results are average score.) a) Functional Threshold Test Right side: 26dB, Left side: 26dB b) SRT Right side: 33dB, Left side: 33dB c) SDT Right side (Max-min): 87%-72%, Left side (Max-min): 91%-79% d) SNR +20dB: 89%, +10dB: 81%, +5dB: 71%

Conclusion: CI children who have good score can study in mainstreaming school without any problems (communication skills between other children and teachers, leaning abilities)
Executive Functions and Mental Health in 10 Children with X-Linked Malformation and Cochlear Implants: Preliminary Findings

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Introduction: X-linked malformation is a rare, genetic cause of hearing impairment or deafness that is described in the literature as being non-syndromic. There are so far very few reports describing cognitive results after cochlear implantation in groups of children with x-linked malformations.

Methods: In an ongoing study the overall aim is to explore and describe the general outcome in children with x-linked malformation who have been implanted with uni- or bilateral cochlear implants (CIs). One specific aim in the study is to examine executive functions as well as mental health factors, by using standardized questionnaires for both parents and teachers. BRIEF/BRIEF-P was used for examining executive functions and SDQ for examining mental health (Gioia et al., 2003; Goodman 1997). The median age of the current sample was 66 months (24-114) at the time of data collection. One child had prior been diagnosed with ADHD, two were under investigation and one child was suspected of having ADHD. No children in the sample had a known family history of ADHD.

Results: The results on BRIEF/BRIEF-P showed that the majority of children had specific executive functioning difficulties, especially in the domain of impulse control, working memory and attention. Interestingly, there were differences between parent and teacher reports, indicating that executive functions were manifested differently depending on type of environment. In home situations there were more reports of deficits in emotional control while there were more difficulties within the metacognitive domain (e.g. working memory) in pre-school and school settings. Parents and teachers rated the children’s SDQ in a way that indicated mental ill-health. Difficulties of the children were seen in the area of hyperactivity and conduct. The majority of children had problems with concentration and to stay still for a longer period. They were reported to often become angry and loose temper. There were differences between parent and teacher reports on current prosocial behavior. More than half of the teachers expressed difficulties in school while parents reported that their child had the strength of prosocial behavior.
**Conclusion:** The current preliminary results are the first known results demonstrating that children with x-linked malformation-caused hearing impairment seem to have specific difficulties within the domain of executive functioning and high rate with diagnosed or suspected ADHD. These two findings will be followed-up and further explored more in detail within the ongoing study as well as in a planned multi-center-study.
**Abstract Body:**

**Introduction:** Most of severe to profound hearing loss people could be beneficial to use cochlear implant. However, some implantee would discontinue usage for a period of time because of discomfort around the receiver. The processor would be reused after resolving the discomfort. But the original MAP would often be felt too loud and uncomfortable. Therefore, a new MAP was needed. In clinical, it is difficult to obtain reliable M/C level and T level for children. In addition, a long time was needed to adapt to the reprogramming MAP. Accordingly, the flow chart to reactivate the processor for people stop using CI for a period of time.

**Methods:** A retrospective analysis of 10 cases was performed for making flowchart to reactivate the processor in a comfortable way.

**Results:** According to the analysis, if the discontinue duration was less than 1 week, there is no need to change the original MAP. If the duration lasts 2 weeks, 60% of the original MAP was adopted to reactivate. If the duration lasts 3 weeks, only 40% of the original MAP could be accepted. If implantee stop using the processor for 1 month, reprogramming MAP was needed.

**Conclusion:** Discontinue duration will affect the acceptable level of the original MAP. In clinical, dealing with the case who stop using the processor, audiologist can adjust the original MAP based on the discontinue duration. Cases can adapt the "new" MAP immediately in a comfortable way.
Introduction:
The benefits of cochlear implantation (CI) in the elderly remain debatable in terms of sound and speech perception. Furthermore, results of CI may be affected by the intensity and pitch of spoken language. The present study was aimed to evaluate the outcomes and post-operative complications of CI in the elderly Korean.

Methods:
Fifty-five postlingually deafened adults who received unilateral CI participated in the study. Twenty-one patients aged 65 years or older at the time of CI were studied, and 34 CI patients aged 18-34 years served as control. Auditory functions were assessed by speech reception threshold (SRT), speech discrimination test (SDT), categories of auditory performance (CAP) scores and Glendonald auditory screening Procedure-Korean version (GASP-K).

Results:
Operation time and post-operative complications were comparable between the groups. SRT and CAP scores did not differ between the groups, while SDT and GASP-K score were significantly lower in the elderly group.

Conclusion:
The elderly patients may get appreciable benefits from CI without serious surgical complications. Nevertheless, hindrance in speech perception should be taken into consideration in the elderly with CI.
Abstract Body:

Introduction:
Infections associated with cochlear implantation are not common. However, they may cause severe morbidity, once they occur. Bacterial biofilm formation has been related to chronic intractable infections which frequently needs explantation of the device. Re-implantation is usually considered on the contralateral side due to the risk of re-infections. Here we report a case of a successful re-implantation on the same side after removal of the infected-implant.

Methods:
54-year old male received cochlear implantation. Six months after the operation sudden device site swelling occurred. Methicillin-resistant staphylococcus aureus (MRSA) was detected and antibiotics were given for a month. Swelling ceased with revision flap surgery. A month later, swelling recurred, and second revision surgery was done. Four months later, Device site swelling occurred again, and finally device removal was done. All the infection was cured after the explantation.

Results:
After a year, re-implantation was done on the same side without any complications over 2 years. Bacterial biofilm formation was noted by scanning electron microscopy.

Conclusion:
To our knowledge, this is the first report of successful re-implantation on the same side after cochlear implant removal due to refractory infection.
Abstract Body:

**Introduction:** Lightning-induced otologic injuries have been catalogued. Previously reported otologic outcomes include tympanic-membrane (TM) rupture; transient facial paralysis of delayed onset; conductive and sensorineural hearing loss (SNHL); perilymphatic fistulas (PLF); ossicular chain dislocation; hemorrhagic effusion of the mastoid air cells; dizziness and vertigo; tinnitus. In one case report, cochlear implantation was performed at 9 months post injury with post-implantation speech-perception performance substantially improved from pre-implantation. Studies are lacking on bone-anchored hearing-aid implantation (BAHA) for single-sided deafness (SSD) apparently associated with lightning strike. Study purpose: to document the sequelae of lightning strike over a 16-year period and the outcome of BAHA implantation for SSD at 11 years post implantation.

**Methods:** Retrospective case report of a young adult (early 30s) who was hiking when a finger of lightning struck her, causing loss of consciousness for 30 minutes.

**Results:** Outcomes are shown in the table below.

**Conclusion:** Long-term otologic sequelae of lightning strike may include ossicular chain disarticulation; tympanosclerosis; SSD; PLF; BPPV. BAHA implantation was efficacious. Neurologic paresthesia, of immediate onset, persisted long-term. The development of bilateral early posterior subcapsular cataracts may represent a delayed effect of the lightning strike.
Long-Term Results of Direct Acoustic Cochlear Stimulation

Introduction: A direct acoustic cochlear stimulator is a relatively new implantable hearing system which was developed for patients with severe-to-profound mixed hearing loss due to otosclerosis. The device is semi-implantable and comprises of a powerful actuator implanted in the mastoid with the active rod extending over the footplate. A conventional stapespiston is crimped onto the active rod after a conventional stapedotomy thus giving rise to a direct mechanical drive of the cochlea. Aim of this study was to evaluate the longterm stability of audiometric, functional and subjective results for patients implanted with this device.

Methods: Prospective study in a pre- and post-intervention design with multiple post intervention hearing aid measurements and patient questionnaires. Seven patients with severe to profound mixed hearing loss due to otosclerosis were implanted with the direct acoustic cochlear stimulator. The main outcome measures were unaided and aided pure tone thresholds, and speech recognition scores in quiet and in noise. Hearing disability and handicap as evaluated using the Abbreviated Profile of Hearing Aid Benefit (APHAB) and a questionnaire on daily usage were used to evaluate the subjective results. All were compared to the short term results after 3 months.

Results: The mean follow up period was 46 months. The aided and unaided thresholds showed stable values in 6 patients. In one patient the bone conduction threshold deteriorated 10 to 15 dB after 3 months follow-up. Also due to other factors his speech recognition was poor. For the other 6 patients aided speech reception and speech in noise recognition values were beneficial and did not show any significant changes during follow-up. APHAB score were equally improved from the pre-operative situation. All seven patients used their implant on a daily basis and were content with the device. No device failure or complications occurred.

Conclusion: Overall the direct acoustic cochlear stimulator provided stable longterm results during the first four years after implantation. Except for one patient, no changes in residual hearing were found. Technical or medical complications did not occur.
Post-Operative Intracochlear Electrocochleography Recorded in Cochlear Implant Patients


Abstract Body:

Introduction: The cochlear microphonic (CM), a constituent of electrocochleography (ECoG), is an evoked potential originating from the outer hair cells of the cochlea in response to an acoustic stimulus. Recent research has shown that the CM, detected prior to cochlear implantation via a round window electrode insertion, to be prognostic of postoperative speech discrimination. However, its presence after cochlear implant surgery is less well defined in terms of prognostic utility. Particularly, given the capability through research interphase, CM now can be measured and recorded via intracochlear electrodes at various time intervals of the postoperative period.

Methods: An acoustic stimulus was presented postoperatively to 12 CI patients via an insert earphone, while the most apical cochlear implant electrode was used to record the cochlear microphonics and auditory nerve neurophonics that were generated in response. The stimuli were tone bursts presented at 250, 500, 750, and 1k Hz, presented up to the patient’s most comfortable level. Patients also completed speech perception testing (AzBio in quiet and noise, CNC words) and audiometric testing. 6 months later patients returned for a second round of testing.

Results: All CI patients with residual cochlear function (i.e. detectable CM) had significant ECoG potentials to at least one frequency. The total response (TR; the sum of all significant cochlear microphonic and auditory nerve neurophonic responses) at 120 dB SPL was revealed to be negatively correlated with patients’ PTA (p=.001), and positively correlated with CNC words scores (p=.001). Patients’ TR scores at time 1 were positively correlated with their TR scores at time 2 (p<.0001). The range of magnitudes of EcoG responses across patients varied by 43.7dB, indicating varying extents of residual cochlear function.

Conclusion: Cochlear microphonic measurements in established cochlear implant users may provide further insights into residual cochlear functions not reflected in the behavioural audiogram. 6 month follow up results will also be presented.
**Introduction:** The important aspect of everyday life can be seriously impaired in individuals with hearing loss. These difficulties with communication could lead to a perceived reduction in quality of life. The hearing loss is one of the difficulties that decrease the communicative ability. The cochlear implant is an electronic device surgically inserted into the cochlea which provides direct electrical stimulation to the auditory nerve in the inner ear.

**Methods:** The free field audiometry with warble stimulus was performed with thirty people. All volunteers are one-side cochlear implant users. Was selected patients within 30 to 45 years old and who had activated the cochlear implant at least six months. All patients have hearing loss severe or profound in both ears and always using the equipment for a minimum eight hours /daily. During the evaluation, they used only the cochlear implant. STUDY: transversal retrospective Clinical by analysis.

**Results:** Before surgery, the average tonal thresholds (250 Hz, 500 kHz, 1 kHz, 2 kHz, 4 kHz, 6 kHz, and 8 kHz) was 110dBNA. In six months this average has changed to 40dBNA.

**Conclusion:** All users presented auditory gain relevant and satisfactory.
Introduction: The cochlear implant has benefited and improved the quality of life of many adults and children worldwide, allowing the auditory rehabilitation of the deaf. The age of implantation is a factor related to hearing results. Children who were implanted earlier achieve better hearing and better oral language acquisition.

Methods: A retrospective study with children implanted at a tertiary hospital from 2003 to 2010. Children were grouped according to the age of the activation of the cochlear implant, gender and etiology. The degree of oral communication and speech development using the Macarthur - Bates scale were evaluated. Statistical tests were performed using the Sigma XL program.

Results: 56 children were included. 23 activated before 3 years old and 33 after 3 years old. The average time of use of cochlear implants was 66 months with no significant difference between groups. Oral communication and the MacArthur - Bates Communicative Development were significantly better in children activated before 3 years old.
Conclusion: The performance and speech development of children implanted before 3 years old are significantly better than children implanted after 3 years old.
**Introduction:** Minimally invasive cochlear implantation (MICI) is an alternative method for accessing the cochlea requiring the drilling of a tunnel from the surface of the mastoid to the inner ear. As the drilled tunnel must pass within close proximity of the structures of the facial recess, including the facial nerve, extremely high levels of accuracy are required as well as the integration of safety features which can detect potential damage to these structures during the drilling process. In this work an in vitro study on temporal bone specimens is described with the aim of confirming the accuracy of a robotic system for MICI prior to clinical evaluation, as well as investigating the effectiveness of integrated safety features.

**Methods:** The complete MICI workflow, including fiducial screw insertion, pre-operative imaging, trajectory planning, patient to image registration, drilling and electrode insertion, was completed on a total of 16 temporal bone specimens. The drilling process was halted at 3mm above the level of the facial nerve and intra-operative cone beam CT imaging performed. Post-operative analysis was completed after the completion of drilling, the insertion of a titanium rod into the drilled tunnel and the performance of high resolution microCT. The post-operative images were registered to the pre-operative CT and the variation of the drilled tunnel from the planned path extracted.

**Results:** The clinical workflow was successfully performed in all specimens, in one case the limited size of the facial recess led to the planned destruction of a portion of the posterior wall of the external auditory canal, thereby precluding the accurate placement of the titanium rod within the tunnel and post-operative accuracy analysis. An accuracy of 0.15±0.07 mm was observed at the target on the round window in the remaining 15 specimens; accuracies of 0.08±0.04 mm and 0.12±0.05 mm were observed at the surface of the mastoid and level of the facial nerve, respectively. An angular error of 0.37±0.16 mm was observed. In one case the chorda tympani was sacrificed. No further or unplanned damage to anatomical structures was observed.
Conclusion: Highly accurate and safe minimally invasive access to the cochlea can be achieved utilizing the robotic system. The achieved results confirm those previously described utilizing the system. Work is ongoing towards the clinical evaluation of the robotic procedure, as well as the further assessment of integrated safety features such as intra-operative imaging, force-base pose estimation and integrated facial nerve monitoring.
Classification of Noise and Environmental Sounds by Auditory Impression for Cochlear Implant Users

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Introduction: In the present study, we investigated how CI users recognize the environmental sound and noise by comparing the auditory impression.

Methods:
Subjects were composed of cochlear implant (CI) group and normal hearing (NH) group. There were 8 patients with cochlear implant (4 male and 4 female, 57-86 yrs, average 68.8 yrs) in the CI group. 32 persons (18 male and 14 female 14 people, 61-83 yrs, average 67.4 yrs) of normal hearing were included in NH group. The semantic differential (SD) method was used to measure the auditory impression to each sound source by a use of 14 bipolar adjective pairs. Each examinee evaluated 14 bipolar adjective pairs for 38 sound sources at two sound intensities of 65 dB and 75 dB. Hierarchical cluster analysis by Ward method was done for the matrix of averaged score of each group composed of 38 kinds of sound source and 14 bipolar adjective pairs as row and column. Factor analysis was employed to explore the difference of structure of auditory impression for sound source.

Results:
The compositions of cluster were different between both groups. It indicated that auditory impression of CI group was different from that of NH group. There were three variables among 14 pairs of adjectives to describe the auditory impression evaluation of 38 kinds of sound source. On the other hand, there were two variables in CI group. The contribution of each variable was dependent on the sound intensity. Characteristics of factors I and II were monotonous and dynamic in time and frequency, respectively. The results indicated that CI users distinguished two different sound structure by auditory impression compared to three of NH group.

Conclusion:
Factor analysis was performed to explore the variables to explain the auditory impression. There were three factors for NH group.
These three factors were of pleasantness, sharpness and powerfulness. On the other hand, number of variable was two for CI group. A change in sound intensity effected factor loadings in each factor. Acoustic analysis showed that characteristics of factors I and II were monotonous and dynamic in time and frequency, respectively. The spectrum of stimulus could be called to be skeletonized spectrum in metaphorically speaking. This might be the reason why less variable was necessary to explain the auditory impression in CI users. It means that the temporal change is the most important to distinguish the difference.
Control Number:
2016-A-676-ACI

Session Number:
POS02

Session Title:
Poster Session B

Poster Board Number:
98-B

Topic 1:
03n-Tinnitus

Publishing Title:
Cochlear Implantation as a Treatment for Tinnitus in Subjects with Asymmetrical Hearing Loss: A Preliminary Report

Author Block:
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Abstract Body:

Introduction: Cochlear implantation has been an effective procedure for patients with severe-to-profound degree of sensorineural hearing loss. Significant reduction in severity of tinnitus could also be noted in patients with both incapacitating tinnitus and asymmetrical hearing loss after cochlear implantation.

The aim of this presentation is to share the experience of tinnitus management by using cochlear implantation in patients suffering from asymmetrical hearing loss and accompanied incapacitating tinnitus.

Methods: By using a minimal invasive procedure, cochlear implantation was done. Initial switch-on within 24 hours after the implantation was completed on a routine basis in our hospital. The impedance, Neural Response Imaging (NRI), unaided acoustic pure-tone, speech perception, visual analogous scale (VAS) for severity of tinnitus, pitch and loudness matching were obtained preoperatively, 1 day, one week, two week, one month, and three months post-operatively.

Results: Ten patients who had asymmetrical hearing loss with accompanied incapacitating tinnitus and underwent cochlear implantation were enrolled in this study. The subjects reported significant reduction in severity of tinnitus and improvement of life quality.

Conclusion: Significant reduction in severity of tinnitus was noted after the initial fitting and remained stable for months. Details will be revealed at the conference.
A Tale of Two Institutions Demographic Differences of Cochlear Implant Recipients in the United States and China

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1Otolaryngology, Univ. of Miami, Miami, FL, 2Otolaryngology, Chinese PLA Gen. Hosp., Beijing, China.

Introduction: As of December 2012, approximately 324,000 individuals have received cochlear implants (CI) worldwide. In the United States, more than 90,000 devices have been implanted, 60% of the recipients are adults. In comparison, approximately 30,000 people in China have received CI, 85% of them are children under the age of seven. However, with 20% of the world’s population, the market for CI is much larger in China. The live birth rate in the United States is 4.1 million per year, with estimated 5,700 children born with bilateral hearing loss of 40 decibels or more. There are 11 million live births per year in China, with estimated 20,000 children born with bilateral severe-to-profound hearing loss annually. Although faced with many challenges, Chinese CI programs have expanded exponentially with government support, such as national funds from the China Disabled Persons Federation. Amidst the CI boom in the last three decades, CI programs in both United States and China have experienced growth spurts and setbacks. We examine the historical development of cochlear implantation in these two countries by comparing the CI database at two tertiary care institutions with large CI volumes.

Methods: A retrospective review of more than 4000 patients who underwent cochlear implantation from 1995 to 2015 at the two institutions was performed. The medical records were analyzed for demographic information, etiology of hearing loss, co-morbidities, abnormal imaging findings, cochlear implant manufacturer and model, and surgical complications. Hearing assessment was determined by pure tone averages before and at 12 months after implantation.

Results: The proportion of pediatric CI patients in China is large and growing, thanks to government programs that have made CIs available to deaf children. There is unprecedented growth rate of CI operations at the Chinese institution, with 300 to 400 CI cases performed annually. The most common causes of bilateral hearing loss leading to cochlear implant are different at the Chinese auditory center compared to the American ear institute. Both centers are moving towards bilateral implants, however, simultaneous
implantation remains in its infancy. Pre-implantation and co-morbidities in CI recipients are comparable at these two institutions.

**Conclusion:** Major demographic differences exist in cochlear implant patients between the American ear institute and the Chinese auditory center. These differences reflect the developmental pathways of cochlear implant programs in two countries influenced by social and financial factors. With this study, we can better understand the needs and challenges of expanding CI access in developed and developing countries alike.
Control Number:
2016-A-683-ACI

Session Number:
POS02

Session Title:
Poster Session B

Poster Board Number:
116-B

Topic 1:
02b-Medical/Surgical Issues

Publishing Title:
The Prevalence Rate of Inner Ear Malformation Classification with Severe Sensorineural Hearing Loss Children in Hebei Province

Author Block:
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Abstract Body:

Introduction: Objective: To study the inner ear HRCT image with severe sensorineural hearing loss children so that to know the prevalence rate of inner ear malformation in Hebei province.

Methods: We analyzed temporal bone HRCT image materials about severe sensorineural deafness children from 0 to 14 years old retrospectively, who applied for the cochlear implantation project supported by Chinese government from 2008 to 2014 in Hebei province. The classification guideline of inner ear malformation refers to Jackler and Sennaroglu presentations.

Results: The temporal bone HRCT image data of 1482 cases (2964 ears) with severe sensorineural deafness children were analyzed uniformly, and the results were as follows: (1) malformations of the membranous labyrinth 2056 (69.36%), (2) malformations of the osseous labyrinth 855 ears (28.85%). Of the 855 ears osseous labyrinth malformations, contained all kinds of the osseous deformities from higher to lower in turn: large vestibular aqueduct syndrome 336 ears (11.34%), incomplete partition type I 334 ears (11.27%), incomplete partition type II 52 ears (1.75%), vestibule-lateral semicircular canal dysplasia 39 ears (1.32%), cochlear aplasia 26 ears (0.88%), cochlear hypoplasia 24 ears (0.81%), common cavity deformity 16 ears (0.54%), incomplete partition type III 16 ears (0.54%), Michel deformity 12 ears (0.40%). (3) Other simple malformations 53 ears (1.79%), included in merely wide internal auditory canal 32 ears (1.08%); the purely narrow internal auditory canal 11 ears (0.37%); cochlear ossification 5 ears
(0.17%); missing posterior semicircular canal 4 ears (0.14%); vestibular semicircular canal ossification 1 ear (0.03%). The lack of posterior semicircular canal is a new type of inner ear malformation.

**Conclusion:** The prevalence rates of large vestibular aqueduct syndrome and incomplete partition type II malformations were the top two types with deafness children in Hebei Province. Probably, the lack of posterior semicircular canal malformation is the new found type during the literatures in the world. Still need more surveys to identified the viewpoint, and then to enlarge the existing inner ear malformation classification guideline in future.
Introduction: The demographic change shows that more and more people above 60 years will receive a cochlear implant (CI). However it is not clarified for this population how daily life situations of hearing look like and if they are different to those of younger people. With the aid of “datalogging” a tool implemented in the processor software it is possible to get an overview of the pattern of daily life hearing situations of CI users. The aim of the study was to examen the everyday hearing situation of cochlear implant use in a group of patients older 60 years comparing to a group of younger adult users by the use of datalogging.

Methods: We investigated both 21 CI users above 60 years of age (group 1) who are retired or unemployed and 27 CI users between 18 and 60 years who are still in occupation (group 2). We analysed the duration of use of the CI per day and in which specific environment due to the hearing situation the implant was used. These data were sampled by the datalogging software, which was provided by the CI-companies.

Results: On average CI users above 60 years weared their CI 0,8 hours longer per day than the younger group. Group 2 used their CI longer in the specific speech situations like “speech in quiet” or “speech in noise”. In contrast older CI patients (group 1) used their CI more in quiet and less in noisy situations compared to
Conclusion: Datalogging could be a supporting tool to evaluate daily life of hearing of CI patients not only for the technicians but also for therapists. Thereby it is possible to adapt the therapy strategies and change the individual pattern of hearing experience of the CI users if they want to.
Programming Peculiarities of the Speech Processor for Patients with Deafness After Meningitis

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Abstract Body:

Introduction: One of the acquired deafness causes at any age may be meningitis. After meningitis some changes in the cochlea appear, that may cause problems during surgery and in the following fittings of speech processor. Purpose of the study - fitting features determination of speech processor for patients with cochlea obliteration.

Methods: 5 patients (3 adults and 2 children) aged from 3 to 34 years with deafness after bacterial meningitis were examined. There were no major neurological abnormalities and otoskopical signs of ear disease. Cochlear implantation (CI) was made in 5-6 months after meningitis. Three patients were diagnosed with cochlea obliteration, and implants with dual Split-electrode by Medel were used in these cases.

Results: In two years after CI it was revealed that two patients with cochlea obliteration had a growing resistance on three channels that was more than 20 kOhm, the channels were disconnected. In two years after CI it was revealed that two patients with cochlea obliteration had a growing resistance on three channels that was more than 20 kOhm, the channels were disconnected. Probably, it happened due to the growth of connective tissue around the electrode in the cochlea. The resistance on six channels was up to 12-20 kOhm. We increased the stimulus duration on these channels up to 70μs (standard is about 26μs) and reduced the volume of the most comfortable level. It permitted to obtain good auditory sensations. Contralateral stapedial reflex was used to determine the most comfortable level for children. Frequency scaling was used to determine stimulus frequency for adults. According to its data, electrodes programming was made in a definite order.

Conclusion: The Split-electrode usage allows to implant patients with cochlea obliteration. However, obliteration can progress and...
worsen the auditory sensations. When there is a growing resistance and absence of auditory sensations, the stimulus duration should be increased and the volume of the most comfortable level should be reduced. In case of a significant resistance growth on certain channels, electrodes need to be disconnected. Obliteration progression can lead to total cochlea ossification and nerve degeneration and cochlear implant will not cause auditory sensations. The only alternative is brainstem implantation.
A Role of Recombinant Human Insulin-like Growth Factor-1 in the Prevention of Cochlear Damage due to Electrode Insertion Using a Guinea Pig as an Animal Model

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Introduction: The advantages of using electro-acoustic stimulation (EAS) over traditional electric stimulation is, for instance, to provide better speech recognition in noise and music appreciation. A successful outcome of EAS can be achieved by preserving residual low-tone hearing while a body of evidence demonstrated quite a few patients lost their hearing slowly even with a soft surgery technique. A mechanism of the late-onset hearing loss in animal models can be immune response causing hair cell death (Eshraghi et al., 2013) and glutamate excitotoxicity by electric stimulation resulting in loss of hair cell synapses and nerve fibers (Kopelovich et al., 2014), while multiple mechanisms may be involved in such hearing loss after surgery (Reiss et al., 2015). We hypothesize that recombinant human insulin-like growth factor-1 (rIGF-1) can prevent such hair cell damage as we have identified rIGF-1 signaling pathway in the protection of hair cells in vitro (Hayashi et al., 2013; Hayashi et al., 2014). Moreover, we have performed a randomized controlled clinical trial to study the efficacy of topical rIGF-1 therapy in patients with sudden deafness refractory to systemic corticosteroid therapy and concluded that topical rIGF-1 application had a positive effect on hearing levels and caused no adverse effects (Nakagawa et al., 2014).

Methods: Four-week old Hartley guinea pigs were implanted with a dummy electrode through the round window. Auditory brainstem responses (ABRs) with a tone-burst stimulus at 1, 2, 4, 8, 16, and 32 kHz frequencies were measured before, 1, 2, 4, and 8 weeks after surgery. An experimental group was topically applied a gelatin sponge immersed with rIGF-1 adjacent to the round window just after electrode insertion while a control group was applied a gelatin sponge immersed with normal saline. Histological analyses were performed 8 weeks after surgery. The dummy electrodes for a guinea pig were kindly provided by Dr. Claude Jolly (MED-EL).
**Results:** Hair cells in the area where the electrode was inserted were damaged severely in a control group while those in rhIGF-1 treated group were comparatively preserved. A strong correlation between histology and ABRs was observed.

**Conclusion:** Topical rhIGF-1 application might prevent hair cell damage due to electrode insertion thus might contribute to better hearing outcome in patients undergoing EAS surgery.
Abstract Body:

Introduction: Nowadays, it is possible, from the literature and clinical experience, to establish a prognosis for the development of auditory skills and oral language in young children using cochlear implants. The situation is quite different for children having severe multiple disabilities. Indeed, studies often regroup those severely handicapped children with others affected with less severe disabilities; evidences of benefits are thus unclear for these specific cases. Consequently, counselling to parents becomes more arduous. Moreover, very few assessment tools are available to accurately document the daily changes often observed after cochlear implantation in these children because of the limited sensitivity of the standard evaluation tools. Scales of the Champions evaluation profile (Hermannova et al., 2009) explore a diversity of outcomes of cochlear implantation in children with severe multiple disabilities. Information is obtained from different sources, including the parents and therapists point of view at different stages of the process (from surgery to 5 years post implant). However, clinical experience shows that those scales offer an incomplete perspective on the effect of cochlear implantation in everyday life of these children. This project proposes a comparison of information collected with the Champions evaluation profile to the information obtained from other sources.

Methods: The Champions evaluation profile was completed with 5 children presenting severe multiple disabilities aged between 2:9 to 6 years old at the moment of implantation. Data were collected at 3 moments (6 months post, 1 year post, and 2 years post). Complimentary interviews were conducted with therapists after completing the scales. Additional information was finally obtained from interviews with parents.

Results: Data collected with the Champions evaluation profile show that cochlear implantation provided benefits for the majority of participants. The progress was slow, benefits required more time to emerge and were difficult to assess accurately because of important language limitations and the severity of the additional disabilities. On the other hand, data collected from the parents interviews show more clearly the impact of cochlear implantation in daily life; any slight improvement resulted in a significant
change in quality of life.

Discussion: The Champions evaluation profile is an interesting tool for assessing small progresses over time in children with additional disabilities. It gives a comprehensive and longitudinal overview on the outcomes of cochlear implant use. However, parents interviews define a better picture of changes in quality of life.

Conclusion: Combining multiple sources to collect outcomes on cochlear implantation in children presenting severe multiple disabilities (Champions evaluation profile, parents and therapists interviews) allows a better overview of the effect of CI intervention for that specific category of patients and consequently can enhance counselling to parents.
Control Number: 2016-A-703-ACI

Session Number: POS02

Session Title: Poster Session B

Poster Board Number: 46-B

Topic 1: 03b-Objective Measures

Publishing Title: Are There Objective Electrophysiological Measures that Distinguish High-Level Cochlear Implant Users?


Abstract Body:

Introduction: There remains a wide variability in cochlear implant performance. Part of this variability has been attributed to a variety of factors including age, duration of deafness and pre-implantation residual hearing and speech performance. However, there remains a lack of objective measures which can distinguish the above average cochlear implant performer. The electrically evoked compound action potential (ECAP) response measured through the implant has been shown to correlate with spiral ganglion survival and as well as provide information about the electrode-neural interface that is critical for cochlear implant performance. The aim of this study is to determine if there are objective measures that can distinguish the above average cochlear implant performer.

Methods: 30 adult cochlear implant users were divided into two groups based upon the group median CNC word score and AZBio sentence score in the implanted ear at 3 months. Low frequency pure tone average (PTA), word and sentence scores were reviewed preoperatively, then at 1 week, 1 month, 3 months, 6 months and 12 months post implant activation. At each time point, the ECAP parameters of slope, amplitude, threshold and the recovery function were assessed.

Results: There were 14 subjects in the “above average group” and 16 subjects in the “below average group”. The above average group was younger (62.4 years vs. 67.3 years) and had a shorter duration of deafness (23.4 years vs. 28.7 years) although these were not significantly different. Prior to surgery, the above average group had a significantly higher preoperative word and sentence score compared to the below average group. On serial ECAP testing, the above average group had lower ECAP mid electrode thresholds at 6 and 12 months and shorter recovery functions at 12 months (p<0.05). The above average group also had larger mid and basal amplitudes over the period of 3 to 12 months post activation (p<0.05). Over the same period, above average group trended towards decreasing ECAP thresholds whilst the below average group had the opposite effect of increasing thresholds (p=0.055).
Conclusion: The maximal amplitude of the ECAP response appears to be significantly higher in the above average group, a response which has been correlated with spiral ganglion neuronal survival. In addition, the lower ECAP thresholds in this same group suggests a closer position of the electrode to the neural interface. This study suggests that above average cochlear implant performers can be characterized by electrophysiological parameters that are measured objectively.
Control Number: 2016-A-704-ACl

Session Number: POS02

Session Title: Poster Session B

Poster Board Number: 162-B

Topic 1: 02m-Quality of Life

Publishing Title: The Role of Cochlear Implant in Tinnitus Annoyance

Author Block: Celso Dall'Igna, PhD, Leticia Rosito, PhD, Daniela Dall'Igna, MD, Felipe Huve, MD, Konrado Deutsch, MD, Adriana Silveira, audiologist, Sady S. da Costa, PhD; Hosp. de Clínicas de Porto Alegre, Porto Alegre, Brazil.

Abstract Body:

Introduction: Tinnitus is a very disturbing symptom usually associated to hearing loss. Sound amplification is the best way to treat this group of patients. Hearing aids can improve the hearing thresholds and sound discrimination and mask tinnitus with the environmental sound. However, the use of cochlear implants (CI) as treatment of tinnitus is still controversial. Our objectives are: 1) verify if CI can decrease tinnitus annoyance in patients with profound hearing loss; 2) determine if it is associated to improvement of hearing loss.

Methods: This is a prospective study with 16 patients with bilateral post-lingual profound hearing loss with indication of CI surgery. Before and after the procedure they were invited to ask questionnaires about quality of life related to tinnitus (THI) and hearing loss (HHIA). We analyzed also the hearing thresholds just before and 6 months after implant activation.

Results: The mean age at the time of surgery was 46.0(SD17.83). Patients had answered the questionnaires 18.46 (SD 7.69) months after surgery. The most frequent hearing loss etiologies were: otosclerosis (18.8%), rubeolla (12.5%) and undetermined (56.3%). The hearing loss was progressive in 68.8%. CI was unilateral in 15 patients. Pure tone average with CI was 28.33dB (SD 10.06). The THI score post-operative was lower than the pre-operative (30.5 vs 49.6, P=0.02). We did not observe differences between HHIA scores pre and post-operative (30.5 vs 31.9, P=0.12) in both social (14.6 vs 15.8, P=0.07) and emotional (16.9 vs 16.6, P= 0.18) aspects. We did not find associations between THI and 1)tonal thresholds with cochlear implant, 2) time of hearing privation and 3)time between surgery and questionnaires (r=0.55 P=0.10; r=0.07 P=0.79 and r= -0.33 P=0.23, respectively). We found a direct and strong correlation between THI and HHIA (r=0.60 P=0.01) in both social (r=0.62 P=0.01) and emotional (r=0.62 P=0.01) aspects.

Conclusion: CI can improve quality of life related to tinnitus in adults with profound bilateral hearing loss. This improvement may occur earlier than the related to audiological aspect.
Abstract Body:

Introduction
Cochlear implant recipients often have difficulty conversing on the telephone. Successful use of landline and cellular telephones can be limited because of less-than-optimal phone placement relative to the sound processor microphone, the restrictive use of phones with one ear only, and interference from background noise. With the development of new telephone accessories and advanced sound processing that allows for direct, simultaneous streaming to two cochlear implants (CIs), the telephone experience in bilaterally implanted individuals may be enhanced.

Objectives
The primary objective of this study was to assess the telephone communication benefits of two wireless telephone accessories and a proprietary binaural technology that streams full bandwidth audio signals from ear to ear wirelessly in a controlled environment. In addition, a questionnaire evaluating the sound quality, ease of use, and perceived benefit was used for each accessory/technology.

Methods
Study participants were adult recipients of bilateral Naida CI Q-series sound processors. Speech recognition in quiet and in noise was measured without and with each of two telephone accessories and the binaural streaming technology, all of which are designed to stream the telephone signal directly to both CIs. Assessments were made first unilaterally with the sound processor typically chosen for telephone use, then with both sound processors together, utilizing the bilateral streaming accessories/technology. Following formal testing, participants took each accessory/technology home for a two-week trial, after which they completed a questionnaire about their experiences.

Results
Results suggest that streaming the telephone signal to both ears simultaneously improves the ability to understand speech in quiet and in noise compared to listening in similar conditions with one processor alone.
Conclusions
Performance on the telephone can be improved for bilateral CI recipients with simultaneous streaming of the telephone signal to both ears.
Introduction:
Auditory-Verbal Therapy (AVT) is a parental training program for Deaf and Hard of Hearing children. Several of whose fundamental principles are centered on training and coaching parents in order to make them the main drivers of development of listen and spoken language in their children. This led us to have the need for a supervision work between peers and then came the obligation to create an observational script to do that - SOMPS (Script to Observe and Monitor through Parents Skills). This clinical study aims to contribute to the design of a guide for assessing the performance of parents throughout the program accordingly to AVT targets, by the selection of target behaviors required to reach by any parent involved in the program, in AIU (Auditory Implants Unit).

Methods:
6 families of children with cochlear implants followed in the AIU were videotaped during all sessions, as required in AVT. The skills observed and analyzed in parents were grouped into three complementary aspects: use of hearing and communication strategies, planning of activity and control of behavior. Five independent therapists conducted the analysis of videos.

Results:
All parents showed changes in their communicative attitudes globally. The biggest changes occurred in the use of hearing and communication strategies and their children’s behavior control. The skills of planning an activity showed more variance between subjects. From these results became possible to establish red flags in guiding and training parents.
Conclusion:
This study shows the need to create a more detailed script to evaluate parental progress throughout the program, in order to determine the type and intensity of training for parents conducted by each therapists in a AVT program. From this study came out the principal first specific lines of the script in preparation by our team.
Accuracy of iPhone® 6 Sound Level Meter Apps

Kellie Brooke, Bachelor's of Health Science, AuD Student, Sarah Grinn, Bachelor's of Arts, AuD Student, Sarah Crosson, Bachelor's of Science, AuD Student; Speech Language and Hearing Sciences, Univ. of Florida, Gainesville, FL.

Introduction: There are over 100 SLM smartphone apps available on the market today; however, systematic, peer-reviewed research has not yet examined the accuracy of these apps while exposed to high intensities, nor to complex stimuli representative of noisy recreational environments. Furthermore, current SLM app literature has not determined the accuracy of these apps while using the newest Apple iPhone® 6 device. This research examined the accuracy of five SLM apps tested at varying intensities (70 - 120 dBA and dBZ) using broadband noise and speech babble stimuli, with a Class 1 SLM as a control measure.

Methods: Sound levels were measured using a Class 1 SLM rated for 16-140 dB SPL measurements at 1 kHz. Levels measured using the Class 1 SLM served a control measure in assessing the accuracy of each iPhone® SLM app. The five iPhone® apps - dB Meter, SPL Meter, dB Volume, DB Meter Pro, and Decibel Ultra - were loaded onto a new iPhone® 6 with default settings. The Class 1 SLM and iPhone® were positioned 12 inches from a speaker in a double-walled sound attenuating chamber. BKB-SIN speech babble and broadband noise stimuli were generated. Stimuli were produced and evaluated for accuracy at intensity intervals ranging from 70 dB SPL to 120 dB SPL. The broadband stimulus was sampled once every 3 seconds until 10 measurements were collected using A-weighted and Z-weighted measurements in all five SLM apps and the Class 1 SLM. The speech babble stimulus was sampled once every 3 seconds until 20 measurements were collected using A-weighted and Z-weighted measurements in all five SLM apps and the Class 1 SLM; increased sampling was used to account for the complexity of speech babble stimulus.

Results: The OSHA standards state that a 5-dB increase in sound level reduces “safe” listening time by 50%. In contrast, the 1998 recommendations of NIOSH are more stringent, stating that only a 3-dB increase in sound level reduces “safe” listening time by 50%. In agreement with Nast et al. 2014, we contend that app measurement errors exceeding 3-5 dB of the Class 1 SLM will render the app inaccurate, as this amount of error would halve safe listening time per OSHA and NIOSH exchange rates. SPL Meter and Decibel Ultra were the only apps that were accurate within a mean difference of less than 3 dBA and dBZ from the
Class 1 SLM measurement in both broadband and speech babble stimuli, meeting our most stringent accuracy criteria (NIOSH exchange rate).

All other apps tested, including dB Meter Pro, dB Volume, and dB Meter were inaccurate exceeding a mean difference of more than 5 dBA and dBZ from the Class 1 SLM measurement in both broadband and speech babble stimuli, failing to meet even our most lenient accuracy criteria (OSHA exchange rate).

**Conclusion:** Two of the apps examined (SPL Meter and Decibel Ultra) demonstrated a mean difference within 3 dBA and dBZ of the Class 1 SLM control in both broadband and speech babble stimuli at intensities up to 120 dB. Our results suggest that these two iPhone® apps may be able to provide convenient, accurate, and reliable information to smartphones users in noisy recreational settings, leading to a more informed decision-making process regarding the use of hearing protection. All other apps tested revealed substantial inaccuracies which may lead to inadvertent auditory damage from noise exposure.
Assessing Speaker Discrimination Abilities in Cochlear Implant Recipients Using a 30 Speaker Logatome Corpus

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Introduction: Although the word and sentence recognition skills of cochlear implant (CI) users have been studied extensively, little is known about their ability to extract talker-specific information from speech.

Methods: Speech material from the Oldenburg Logatome Corpus (OLLO) was used to build a set of 120 logatome pairs spoken by 15 male and 15 female speakers. Each pair contained two different logatomes. For half of the pairs, the two logatomes were spoken by the same speaker, for the other half they were spoken by different speakers. Since the test was designed to examine speaker discrimination abilities rather than to test the ability to identify individual speakers, we used a same-different paradigm. 10 adult normal hearing listeners and 13 adult post-lingually deafened CI users were included in the study.

Results: Mean speaker discrimination score for the CI users was 74.6 % correct and for the normal hearing listeners 89.6 % correct. Significant influence of voice gender on the speaker discrimination score was found in CI users as well as in normal hearing listeners.

Conclusion: The test results of the CI users were significantly above chance level and no ceiling effect was observed, i.e., the presented set logatome pairs from the Oldenburg Logatome Corpus seem to be very well-suited to speaker discrimination experiments in cochlear implant users. CI users are able to discriminate speaker but their performance is slightly worse than that of the normal-hearing listeners.
Introduction: Due to resection of vestibular schwannoma, patients often suffer from acute deafferentiation on the affected side. The present study is a long-term follow-up study of patients who underwent vestibular schwannoma resection and as a result of the resection - have an acute deafferentiation on the operated side. Primary goal of the study is to assess central reorganization over time by use of late auditory-evoked potentials (P1, N1, P2, N2, P3) measured on the unaffected side. Secondary, audiological testing assesses the changes on speech understanding and tinnitus perception.

Methods: The present study is a long-term follow-up study assessing patients with unilateral vestibular schwannoma at pre-resection, 1 week post-, 3 months post-, 6 months post- and 12 months post-resection. The test protocol exists of audiological assessment comprising pure-tone audiometry, free field speech understanding in quiet and in noise, tinnitus assessment and questionnaires. Late auditory-evoked potentials are performed using midline electrodes. Potentials P1-N1-P2 provide information on the bottom-up processing of sounds whereas N2-P3 merely reflects the top-down processing. Late auditory evoked potentials evaluate how acute deafferentiation affects sound processing and how central reorganization develops over time.

Results: Currently, 10 patients are enrolled in this protocol of which seven are tested at 12 months post-resection and three at 6 months post resection. Prior to resection, all subjects had residual hearing with variable hearing thresholds on the affected side which disappeared after resection causing acute deafferentiation. Audiological data as well as auditory-evoked responses will be presented at the conference.

Conclusion: Preliminary data of central reorganization after acute deafferentiation will be presented at CI2016 Toronto.
Electrical ABR with Direct Round Window Stimulation by use of a Hockey-Stick Electrode: Use in Cochlear Implantation Patients Prior to Implantation

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Introduction: Prior to cochlear implantation, an extensive audiological protocol is performed in order to assess whether a subject fits the criteria for implantation as well as to express an estimate of post-implantation performance expectations. So far, no device is sufficiently accurate to provide thorough investigation of the integrity of the auditory nerve. In the past, the technique of transtympanal promontorium stimulation was abandoned due to inaccurate results. Currently, a device has been developed using a hockey-stick electrode to perform promontorium stimulation prior to cochlear implantation in order to more accurately assess a patient’s fitness for cochlear implantation.

Methods: The recording setup is similar to eABR where the positive electrode is placed on the high forehead, negative electrode on the contralateral mastoid and the ground electrode on the low forehead. In addition, two ground stimulating electrodes are placed on the zygomatic arch and angle of the mandible. After local anaesthetization incision of the tympanic membrane can be performed and the hockey-stick electrode can be placed transtympanally onto the promontory or directly onto the round window in per-operative situations.

Results: eABR recording using electrical stimulation on the promontory prior to cochlear implantation is useful to 1) test the integrity of the auditory system pre-operatively; 2) judge the auditory system in difficult CI candidates where all previous tests have failed to provide sufficient information; 3) select the appropriate ear for implantation in patients with bilateral hearing loss. This technique may also help in the counseling of clinicians and patients.

Conclusion: A clear setup and registration design will be presented at the CI2016 conference. In addition, case studies will be described using this technique.
Abstract Body:

**Introduction:** Introduction:
In difficult cases the decision to implant or not becomes a challenge.
The objective of this Study is to analyze factors that help to overcome this challenge.

**Methods:**
Methods:
HRCT & 3 Tesla MRI , EABR, ESPT and EPPT helped to make implant decision in three unique cases .
1) Wardenberg’s syndrome Child was denied Cochlear implant due to improper Scanning,
2 )Child with Double internal auditory canals but absent cochlear nerve
3 )Child with Cardiac anomaly, Laryngomalacia with Hypoplastic Cochlea and Cochlear nerve.

**Results:**
Results: Aq. 8years post-implant has developed good speech and language skills.
Sdt. with Bimodal hearing was
re-implanted three years back due to
Device failure has good speech & language skills.
Gr. Implanted 2.3 years back picked up
listening skills in consistency with her implant age and speaks in sentences. Her Tracheostomy &
feeding Gastrostomy have been closed successfully. All children are attending normal school.

Conclusion:

Careful analysis of Problematic cases along with diligent counselling
helps in decision making regarding Cochlear
implantation and getting favourable outcomes
**Abstract Body:**

**Introduction:** Patients with single-side deafness have problems with sound localization and speech recognition in noise. For the last few years such patients can be treated with cochlear implants. This possible treatment is an option for single-side deafness patients to bring their bilateral hearing abilities back. To achieve this, patients need a perceptual training. Therefore we developed the test battery for self-administration at home devoted to single-side deafness adult patients after cochlear implantation. The aim of this study was to assess the validity of the constructed test material for self-administered auditory training.

**Methods:** 10 single-side deafness adult patients after cochlear implantation were included in the study. Test materials and test manual were distributed during the visit one month after cochlear implant activation. The usefulness and feasibility of the constructed material were probed by the open and closed-end questionnaires, which were administered after 5 months after activation.

**Results:** Patients evaluated the training very well or well on the 5 grade Likert scale. More varied responses were received to the question of whether the training was useful. The effort necessary to perform the training was assessed by 60% of patients as small, 30% of patients considered the afford as large and 10% as very large.

**Conclusion:** The results after training confirm the usefulness of prepared training materials.
Introduction:
Children with profound hearing loss can be habilitated with a Cochlear Implant (CI). A condition for successful auditory stimulation is a developed cochlea and the presence of an adequate number of cochlear nerve fibers. The aim of this study was to evaluate the safety and efficacy of the Auditory Brainstem Implant (ABI) in seven children with aplasia and hypoplasia of cochlear nerve.

Methods:
This is a retrospective case review study. Six children with cochlear nerve aplasia (2-10 years of age) and one child with hypoplasia of the cochlear nerve underwent retro sigmoid approach for placement of the ABI into the lateral recess. These seven children underwent otological, audiological, neurological, psychological and cognitive evaluation pre-ABI. Six patients had radiological contraindications to CI surgery because the MRI revealed bilateral cochlear nerve aplasia and one patient had hypoplasia without results with Cochlear Implant. MRI evaluation, subjective and objective assessment was performed before the ABI indication. The correct positioning of the electrodes was monitored through the Electrical Auditory Brainstem Responses (EABR). The audiological outcomes were evaluated using the CID Speech Perception Categories, (Geers (1994) through the Latin American Protocol for Cochlear Implants, Free Field with ABI, it-MAIS and MAIS scales.
**Results:** No surgical or postoperative complications were observed. Five children use the device in a permanent way. Auditory sensations were produced in these patients with the activation of the device. They are showing variable auditory improvements in speech perception through specific tests and in it-MAIS and MAIS Scales through the parents’ opinion. Audiological outcomes, free field with ABI and speech perception tests, will be reported separately. Patients sixth and seventh will be tuned up in a few days.

**Conclusion:** This study suggests the safety of ABI in these children with the diagnosis of cochlear nerve aplasia or hiplopasia. This procedure is feasible, with variable results. Speech recognition in open set is possible. Age at implant (after sensible periods) and the presence of other handicaps produce poorer results.
A Comparative Analysis of Outcome Measures Used to Assess Unilateral Adult Cochlear Implant Recipients Fit Using Subjective and Objective Methodologies


Abstract Body:

Introduction: Current methods of cochlear implant (CI) programming involve measuring stimulation levels on all electrodes across the electrode array. A new programming methodology has been released that includes the use of objective measurements known as electrically evoked compound action potentials (ECAPs). This study evaluates the speech perception outcomes with respective to the two different programming methodologies, as well as recipient preference.

Methods: 10 unilateral CI recipients with devices from a single manufacturer were followed over a three month period following activation; at hookup, and 1, 2, and 3 months post hookup. Recipients were programmed using one of two methods: i) current standard of care at the health care centre; and ii) an objective fitting method. This objective method uses ECAPs to create recipients’ programs via a remote control on 5 electrodes. The recipient is then able to set their own stimulation levels by making adjustments via the remote control in response to live-voice stimuli. The standard of care is to program recipients using the software from the given manufacturer, by using psychophysical responses to stimuli. Recipients received 1 program using each method at each time point. Programs were randomly assigned to one of two program positions on their speech processor. Recipients were blind to the order of these positions.

Results: A repeated measures analysis of variance (ANOVA) revealed no significant differences over time in speech perception outcomes between the two fitting methodologies for consonant-nucleus-consonant (CNC) word tests (p>.35), and AzBio sentences in quiet (60dB SPL, p>.23) and in noise (+5dB SNR, p>.3). Recipients also reported improvements pre- to post-activation in the hearing subscale of the health utilities index (HUI, p<.0001), as well as the speech (p=.03) and spatial (p=.05) subscales of the speech, spatial, and qualities of hearing scale (SSQ). Recipients preferred using the standard of care program in noisy environments to the program created using the objective fitting methodology.
Conclusion: Preliminary results are suggesting that neither fitting methodology is superior with respect to speech perception outcomes. Recipient’s preferred program will be discussed with respect to their datalog as well as results from an in-house comparative questionnaire.
Influence of Electrode Design and Surgical Approach on Residual Hearing

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Otolaryngology, Univ. of Freiburg, Freiburg, Germany.

Introduction: The preservation of residual hearing is a quality measure in cochlear implant surgery. Several factors seem to influence surgical results. Aim of this study was to analyze the influence of electrode design and surgical approach in an unbiased patient group on preservation of residual hearing.

Methods: We performed a retrospective analysis of residual hearing pre- and post-surgery in n=155 adult patients receiving a cochlear implant in a single tertiary referral center. Inclusion criteria were measurable hearing thresholds between 125 Hz and 1000 Hz preoperatively. Patients were given the choice of implant and received Cochlear Contour Advance electrodes (n=25) or Slim straight electrodes (n=60), MedEl Flex28 electrodes (n=39) or Advanced Bionics Mid-Scala electrodes (n=20). Electrode insertion was performed either via cochleostomy (n=79) or round window approach (n=76). Hearing thresholds were obtained pre-operatively and up to 800 days postoperatively. A descriptive statistical analysis (n=155) and Kaplan-Meier analysis (n=145) were performed and the influence of electrode and approach on residual hearing was examined.

Results: The probability of hearing conservation was 75% for all electrodes and all approaches. There were no significant differences in preoperative hearing thresholds for different electrodes or approaches. Insertion via the round window significantly improved the rate of preservation when compared to cochleostomy insertions (80% vs. 64%, p=0.02). These results were influenced by the electrode used with a range of hearing conservation from 60% to 85% (Contour Advance electrode: 60%, MedEl Flex28 electrode: 65%, Mid-Scala electrode: 75% and Slim straight electrode: 85%). Round window approaches were performed in MedEl Flex 28, Mid-Scala and Slim straight electrodes. The preservation rate was significantly superior with the Slim straight electrode in round window approaches compared to results following cochleostomy insertions (75% vs. 92%, p=0.04).

Conclusion: The rate of preservation of residual hearing was 75% in an unbiased evaluation including all patients with preoperative measurable residual hearing, all surgeons and all electrodes. Due to the observed differences a flexible, thin electrode and a round window approach seem to positively influence the probability of preservation of residual hearing.
Abstract Body:

**Introduction:** Automatic scene analysis programs are becoming the recommended default for cochlear implant programs. This type of processing algorithm analyzes the listening environment and automatically changes noise reduction settings and directional microphone settings. This technology has been shown to be beneficial for speech reception when switching between quiet and noisy listening environments. However, anecdotal observations in the clinic and reports from patients and family members have indicated that while increased comfort and speech perception may be achieved, there is an impact on spoken language clarity and ease in communication.

**Objective:** The purpose of this study was to determine if a difference between an “unprocessed program” and a program with automatic scene analysis technology could be determined by the patient, speech therapist and/or parent/significant other during a therapy session.

**Methods:** Ten students with cochlear implants will complete this study. They will receive a program without processing and a program with processing. During the session with their speech therapist, they will work for 30 minutes with the processor in one program and then 30 minutes in the second program. They will listen in both a quiet environment and with low level babble noise present in the background. This will be repeated over two sessions with the patient, therapist, and family member blind to which program they will be using at which time. At the end of the
session, the CI user will rate the programs based on sound quality, speech
quality of other talkers, and own speech quality. The therapist and/or family members will rate
the programs based on ease of communication and spoken language quality of the
CI user. Finally, all individuals will
provide a program preference.

**Results:** Subjective ratings and program preferences will be shared
for the CI users and the therapist and/or family members. Differences between quiet and noisy
environments will be discussed.

**Conclusion:** Automatic technologies are becoming the default settings on
many cochlear implant programs due to the enhanced speech perception scores and
higher levels of comfort when background noise is present. While these benefits are fantastic, anecdotal
reports suggest that this may not always be the preferred setting for speech
production and ease of communication.
The results from this study will provide better insight into patient
preference and subjective ratings when using programs with and without this
automatic technology.
Introduction: For more than 30 years, the bone anchored implantable devices contributed to improve quality of life of the deaf patients. Problems as dimension, esthetical issues and defective implantation, as well as skin penetration of the previous generations of such devices constituted the cause for a rather small number of devices being implanted.

Methods: The authors present a clinical case of a teenager (16 years old) with the diagnosis of single sided deafness of the right ear, with multiple malformations: cochlear agenesis, enlarged vestibular duct, enlarged lateral semicircular canal and procidence of the VIIth nerve. The patient was implanted with BAHA at the age of nine. For 7 years’ time, the child wore BAHA intermittently because some problems emerged periodically: late and incomplete osteointegration of the titanium implant, repeated skin infections, imperfect screwing between the abutment and the titanium implant and esthetic/psychological/social integration problems. All the above led to the avoidance of wearing the BAHA processor.

Results: After a long wait (our hospital acquired first two Bonebridge devices in 2015), fulfilling all clinical, audiological and radiological required criteria, the patient was implanted with our first such bone conduction implant in July, 2015. Activation took place a month later. The audiological results were excellent. Likewise,
all other problems previously reported disappeared, leading to a complete acceptance of the device for the patient.

**Conclusion:** Bonebridge proved to be a valuable solution for single sided deafness, even more in this case where the patient had experienced another solution that proved finally to be unsuitable for him.
Introduction: The older a cochlear implant (CI) candidate is prior to surgery, the greater the risk of medical complications secondary to the surgical process. As a result, many older adults must weigh the increased risks involved with surgery against the potential for limited benefit from implantation. While the majority of CI recipients demonstrate significant improvement in speech perception abilities post-implantation, results are highly variable and depend on a number of different factors that are unique to this age cohort. Previous research has demonstrated significant speech perception benefit from cochlear implantation in elderly adults but few studies have compared performance between older and younger adults. The purpose of this study is to determine if there is a difference in post cochlear implantation speech perception benefit for adults implanted over 70 years of age compared to adults implanted under 70 years of age.

Methods: Seventy-three (73) post-lingually deafened, English-speaking adults who had consistently utilized their cochlear implant for at least three months post implantation were split into two groups based on age (less than 70 years and 70 years or greater). The grouping was based on an apparent drop in post-implant speech perception benefit for individuals implanted at 70 years of age or older. Pre and post-implant speech perception scores as well as overall speech perception benefit were compared between the two groups.

Results: Both groups demonstrated a significant improvement in speech perception scores post-implantation. Further analysis revealed that pre-implant speech perception abilities for the two groups was comparable but the younger group (less than 70 years old) demonstrated significantly higher speech perception scores post-implantation and gained significantly more benefit.

Conclusion: Despite having similar pre-implant speech perception performance, individuals receiving their cochlear implant under the age of 70 demonstrated significantly better speech perception outcomes post-implantation than adults over 70. While the older population still gained significant speech perception benefit, this population may require different counseling and rehabilitation than younger adults.
Influences of Deafness Duration and Etiology on the Outcome of Cochlear Implantation

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Introduction: Results of cochlear implant (CI) treatment of profoundly deaf adults remain capricious. Factors such as cognition, inner ear preservation, age at deafness and implantation, duration, genetics and infection damage are critical factors.

Methods: Retrospective study. Pre- and postoperative speech-perceptions were analyzed in 259 patients who received a CI after the age of 17. One year postoperatively, 25 patients still scored 0% in a speech perception test (monosyllabic words). These were compared to the patients (n=24) with the highest scores (>70% monosyllabic words), one year postoperatively, regarding duration of deafness and etiology.

Results: The patients who scored 0% on the monosyllabic words had a mean duration of deafness of 34.1 years (range 6-65 y), compared to 11.8 years (range 2-30 y) for the highest scoring patients. The mean age at implantation was 59.3 years with best results compared to 65.7 years in the other group. Among the patients lacking speech-perception, profound deafness since adolescence and meningitis were overrepresented, in the other group Meniere’s disease. All patients with 0% monosyllables after implantation scored even 0% monosyllables preoperatively. We also evaluated the CI-use of these patients: 3/19 were non-users, but 8/19 full-time users and 8/19 part-time users.

Conclusion: In accordance with previous research, our results suggest that there is a negative correlation between duration of deafness and CI outcome. However, the range is wide within both groups. Furthermore, it seems that certain diagnoses correlate with outcome. Although some patients did not improve post-operatively in speech perception, the majority expressed great satisfaction and use the CI. Hence, neither long duration of deafness nor these etiologies should be considered as contradictions for receiving a CI.
Introduction:
The indication criteria for cochlear implantation have changed over the past decades to patients with residual hearing. To preserve residual hearing intracochlear pressure changes have been assumed to play an important role. Pre-, intra- and post-insertional factors affect the intracochlear pressure during cochlear implantation. The aim of our study was to observe intracochlear pressure changes due to manually manipulation at the electrode cable after the insertion and sealing of the array in a cochlear model.

Methods:
The experiments were performed in an artificial cochlear model. A micro fibre pressure sensor was placed in the helicotrema area to monitor pressure changes. We evaluated electrode manipulations at the sealed cochlea and cable positioning manipulations with a fixed and non fixed extracochlear cable.

Results:
We observed significant effects of electrode manipulation by array lifting for sealing and cable positioning on the intracochlear pressure without visible electrode movements.

Conclusion:
In our model experiments postinsertional manipulations show effects similar to insertional pressure changes. Moving a fully inserted electrode has a strong impact on intracochlear volume displacement. A step by step handling of the electrode minimizes intracochlear pressure changes.
Creating a More Comfortable Programming Experience for Recipients, Parents and Clinicians Using Wireless Technology

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Abstract Body:

Introduction: Cochlear implant recipients are currently managed by audiologists using traditional cochlear implant mapping software, a programming pod and a cable. A new suite of clinical tools that can be used in multiple cochlear implant programming approaches and combined as needed has been developed, and enable programming to be done in environments convenient for both the clinician and the recipient. Wireless programming allows clinicians to adjust a recipient’s hearing profile comfortably and without cables and for recipients to adjust programs in real world listening environments. Clinical studies have shown that programs created using wireless programming are equivalent in performance to programs created using traditional CI programming software with current best practice fitting methods.

Methods: Clinicians, adult recipients, and parents or carers of paediatric recipients were recruited into the study. The recipients were programmed wirelessly. After the programming session, the recipients, parents and clinicians were asked questions about their experiences with wireless programming and these were compared to traditional programming methods.

Results: Up to 60 sessions of wireless programming were conducted. Results will be discussed in terms of the impact of these new tools on a traditional mapping session, the ease of use and the comfort experienced by the subjects. This was particularly evident in very young paediatric recipients who had difficulty sitting still while tethered to a computer for the duration of their programming session.

Conclusion: It was shown that wireless programming can provide a more comfortable and relaxing experience for recipients, parents and allow clinicians to be even more focused on their clients as a result of using wireless technologies.
Abstract Body:

Introduction: Research has documented that up to 40% of children with severe to profound hearing loss have additional medical or developmental challenges. In many jurisdictions, universal newborn hearing screening programs allow for early identification of hearing loss, and subsequent intervention to address hearing needs. However, other needs may not be apparent and may emerge as children develop. Identifying potential areas of additional need is important to facilitate diagnostic and treatment decisions, and to provide timely services to optimize children’s development and outcomes more generally. Objective: The objective of this study was to investigate screening of early development in children followed for management of hearing loss and cochlear implants (CI) or hearing aids (HA).

Method: Sixty-three preschool children who were identified with hearing loss and followed through a pediatric academic health setting, and their parents, were participants. One-third (N=19) had received cochlear implants. The Developmental Profile III (DP-III) was administered at least once as part of systematic assessment of outcome. This semi-structured interview provides a screening assessment of development in the areas of physical, adaptive, social-emotional, cognitive and communication skills. Direct assessments of children’s functioning were also obtained through the administration of standardized measures of communication and hearing.

Results: The results of the DP-III assessments indicated that, as a group, children’s development in the areas of physical and adaptive functioning were within the average range, although there was substantial variation in functioning. Development in the area of communication was significantly lower and highly correlated with direct assessment scores on the Preschool Language Scale (p’s < .001). Children’s development in the areas of socioemotional and cognitive functioning, as assessed by parent report on the DP-III, was higher than in the area of communicative functioning. However, ratings of development in these areas were also influenced by children’s language skills, as indicated by both high correlations with results from direct assessment, as well as item analyses of
Conclusion: Previous research has indicated that children with hearing loss are at risk for additional conditions which may influence outcomes, and suggest that early intervention is appropriate across all developmental domains. The results of this study suggest that screening of children’s early development, in addition to communication, can provide helpful information for identifying and facilitating treatment in these other areas, and has implications for service provision. Further research is needed to examine the influence of children’s communication on assessment of other areas, and to examine outcome after early screening.
Towards Direct Loading: Prospective Clinical Trial of Wide Diameter BAHS Implants with and without a Site-Specific Laser Ablated Surface Modification

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Abstract Body:

Introduction: Recent development in tissue preservation surgical techniques for installation of bone anchored hearing systems (BAHS), where the tissue surrounding the abutment is left intact, have led to the need of increasingly longer abutments, increasing the demand for short and long term stability of the implants. Moreover, patients are given access to sound at an earlier stage after surgery, with loading times as low as 2 weeks. The objective was to investigate the effects of early loading on implant stability development. A comparison is made between the wide Ponto implant with a machined surface and the Ponto BHX implant (Oticon Medical, Sweden) with a site-specific laser ablated surface at the root of the threads. Sound processor loading will take place at the first surgical follow-up visit as early as 5 days after surgery.

Methods: Two, consecutive multi-center prospective clinical trials of 70-80 adult patients eligible for a bone anchored hearing system with corresponding protocols have been initiated, using either the wide Ponto implant or the Ponto BHX implant. The stability of the implants was assessed using implant stability quotient (ISQ) measurements (Osstell, Sweden) with measurements taken peri-operatively, at the time of loading, as well as postoperatively. In both studies patients follow the same follow-up and sound processor loading programme for a total period of 12 months. The visit schedule is comprised of a surgical visit, a surgical follow-up visit combined with loading of the sound processor at 5-14 days post operatively, and three postoperative visits at 4-8 weeks, 6 months and 12 months postoperatively. Additional parameters included evaluation of pain, numbness and wound healing, as well as Holger’s classification. Per- and postoperative adverse events, if any, were registered.

Results: 38 patients have been enrolled in the wide Ponto implant study so far, with 12 month follow-up expected to be reached by Q2 2016. All patients were successfully loaded at the surgical follow-up visit. No implant loss has been encountered and no detrimental effects on the development of implant stability (ISQ value) has been recorded. In the Ponto BHX implant study, recruitment and inclusion is currently ongoing and no concerns with sound processor loading or implant stability have been reported.
Conclusion: We expect to have completed the 12 month follow up visit for all patients in the wide Ponto study and loaded minimum 30 patients in the Ponto BHX study at the end of Q2, 2016. The preliminary results indicate that loading as early as five days post-surgery or possibly even earlier is feasible using the wide Ponto implant as well as the Ponto BHX implant, at least in adult patients with normal bone quality. We will discuss any effects the different implants have on post-operative stability development as well as the resulting flexibility in loading time and potential implications for future follow-up schemes after Ponto surgery.
Introduction: Pfeiffer syndrome is a rare craniosynostotic disorder resulting in premature bony fusion of the skull, which can result in abnormal temporal bone and vascular anatomy and hearing loss. Cochlear implantation in these patients requires thoughtful surgical planning given the potential for limited access to the cochlea due to subcutaneous or intra-temporal vasculature. Herein, we present a patient with Pfeiffer syndrome who underwent successful cochlear implantation using pre-operative Doppler ultrasound to identify large extra-cranial venous anatomy followed by a modified trans-canal surgical approach.

Methods: An adult female patient with Pfeiffer syndrome had an imaging workup consisting of of pre-operative axial computed tomography, catheter angiography, and Doppler ultrasound. Audiometric outcomes were measured using aided thresholds and word recognition scores.

Results: Successful cochlear implantation was performed via a modified trans-canal approach with blind sac closure of the external auditory meatus. Full electrode insertion was obtained through a round window approach. No extra-cranial or intra-temporal vessels were encountered during surgery.

Conclusion: Patients with significant craniosynostoses and vascular malformations of the temporal bone can undergo successful cochlear implantation. Careful preoperative planning with high resolution CT, MRA, and MRV, and/or traditional catheter angiography can assist in determining surgical feasibility and minimizing risk. We recommend preoperative Doppler ultrasound of abnormal extra-cranial vessels to assist in safe placement of incisions and hardware.
Introduction: Chudley-McCullough Syndrome (CMS) is an autosomal recessive disorder which is characterized by profound sensorineural hearing loss and brain malformations caused by GPSM2 gene mutations. At this time, there is limited knowledge of CMS since its recent discovery in 1997. In particular, there is no research discussing spoken language outcomes of children with CMS following cochlear implantation. The purpose of this study is to determine if children with CMS experience spoken language benefits following cochlear implantation.

Methods: The spoken language skills of two young female siblings who received unilateral cochlear implants were evaluated as part of cochlear implant candidacy and annually thereafter as part of post-implantation Auditory-Verbal Therapy services. Outcomes were compared to chronological and hearing age normative values.

Results: The younger child is currently three years post cochlear implantation and demonstrates spoken language skills within the average range for her chronological and hearing age. The older child is currently seven years post cochlear implantation and demonstrates moderately-delayed spoken language skills for her chronological age. Her skills are within the normal range for her hearing age.

Conclusion: In this case study, siblings with CMS experienced significant benefits following cochlear implantation and demonstrated hearing age or chronological age-appropriate spoken language skills.
Introduction:
Waardenburg syndrome type 4 (WS4) (a.k.a. Shah-Waardenburg syndrome or Waardenburg-Hirschsprung disease) is a rare congenital condition involving hypomyelinating neuropathy characterized by aganglionosis of the bowel (Hirschsprung disease) and melanocyte migration that leads to abnormalities in pigmentation, as well as sensorineural hearing loss (Waardenburg syndrome). The literature on cochlear implants in children with this condition is limited (e.g., Cullen et al., 2006; Lesmas Navarro et al., 2011). Consideration of the clinical presentation of individuals with WS4 can provide useful information in determining implant candidacy, particularly as criteria for candidacy broadens (Campiao, Araujo & Oliveira, 2011), and as genetic etiologies of hearing loss are better understood (e.g., Vivero et al., 2010). This study adds to the current literature by examining the implications of cochlear implantation, medical management and supports of children with WS4.

Methods:
Methods included: (1) Retrospective medical chart review (N = 800) to identify all patients who had received cochlear implants and are diagnosed with WS4; (2) In-depth review of each patient with WS4 who have received cochlear implants (N = 3) (e.g., demographics, surgical outcomes, audiological evaluations, speech-language/communication assessment data); (3) Review of documented parental reports regarding perceived benefit of the implant; and (4) Review of documented behavioral, learning, and social challenges.

Results:
Patients with WS4 responded well to the surgical implantation and their audiological outcomes are good. The WS4 patients showed unique language and communication patterns not often seen in either typical language development or in children with later access to auditory information, including expressive language skills that exceed receptive abilities, parroting of linguistic information, and use of language in substantial ‘chunks.’ Additional behavioral challenges have been noted in this small cohort and are described in
Conclusion: The WS4 literature suggests that a unique behavioral phenotype may be present. Patients profiles were examined relative to the emerging understanding of the behavioral phenotype of children with WS4; commonalities and differences were noted. The positive surgical and audiological outcomes suggest that patients with WS4 be considered for implantation, particularly when other risk factors are reduced and age of implantation is optimized. Yet, expectations for functioning should align with data regarding the emerging WS4 behavioral phenotype. This study contributes to the limited literature related to WS4 outcomes, as well as the growing body of research documenting cochlear implant outcomes in medically complex children with diverse etiologies. Further, it extends consideration of “cochlear implant outcomes” beyond surgical successes and improved auditory access to include behavioral, learning, and social functioning.
Abstract Body:

Introduction:

The Bonebridge is the first active transcutaneous bone conduction implant system to be implanted in children. Objective: To report on the safety and efficacy of a new bone conduction hearing implant in patients aged 5 years and older.

Methods: German-speaking children aged 5-17 suffering from conductive or mixed hearing loss, with an upper bone conduction threshold limit of 45 dB HL at frequencies between 500 and 4000 Hz. Intervention: Implantation of a transcutaneous bone conduction hearing implant. The subjects’ audiometric thresholds and speech perception were tested preoperatively and postoperatively.

Results: Speech perception as measured by word recognition scores and SRT50% improved 3 months after implantation. Aided thresholds also improved postoperatively, showing statistical significance at all frequencies tested.

Conclusion:
Safety and efficacy of the new bone conduction implant was demonstrated in children followed up to 3 months postoperatively. The usefulness of the bone conduction implant and its value among other bone conduction systems will be discussed.
Introduction: Cochlear implant surgery in chronic ear disease such as chronic otitis media and cholesteatoma might be frustrating because of the concern about postoperative wound infection which could leading to device removal and revision surgery.

Methods: Retrospective analysis of CI in chronic ear disease and suggestion of new surgical approach for CI surgery in patient with cholesteatoma.

Results: CI in chronic ear have risk for postoperative infection and staged surgery would be more safe than single stage surgery.

Conclusion: New modified blind sac surgery would be more safe without external auditory canal closure.
Introduction: The number of cochlear implant recipients has increased dramatically over the last decade. When necessary, surgery is performed for explantation and re-implantation into the same cochlea or for new implantation into another one. Reports of large re-implantation series are needed to help surgeons share experience and findings in this growing field and to shed light on failure rates and audiologic performances after re-implantation. The device failure is one of reasons for reimplantation.

Methods: Retrospective case review from 1993 to 2015. Among 297 pediatric cochlear implantation cases performed at Tokyo Medical University Hospital from 1993 to 2015, 12 children (13 cases) had both initial implantation and RCI. Five children who were supposed to have device failure were selected for this study. Reasons for device failure and the outcome of revision surgery were evaluated.

Results: Device failure was found in five children. Two children had no clear episode of head trauma. The mean age at initial implantation was 2 years 8 months (range: 1 year to 3 years 10 months). The cause of hearing loss was congenital in all patients. The mean duration from initial implantation to RCI was 1 year 1 month (range: 5 months to 2 years 1 month). The mean age at device failure was 3 years 10 months (range: 1 year 10 months to 4 years 10 months). The main reasons for hard failure were loss of hermeticity and cracked casing following head trauma. Auditory performances after reimplantation are the same or better in most cases.

Conclusion: Management of device failure and assessment of the efficacy of revision surgeries are becoming increasingly important. Device failure might be difficult to diagnose in children with limited language skills. Failure might be difficult to diagnose in children with limited language skills. The surgical team and patients should be aware of the surgical difficulties that can be encountered, especially in cases of meningitis or initial traumatic insertion.
Compensation of Vestibular Function and Plasticity Vestibular Nucleus after Unilateral Cochleostomy

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Abstract Body:

Introduction: Cochlear implantation (CI) is a widely used surgical procedure for the restoration of hearing in patients with profound hearing loss. During surgery, access to the cochlea is necessary for electrode insertion. The cochlear and/or vestibular organ may be damaged during this procedure, leading to vestibular symptoms. Although several etiologies and risk factors have been suspected as causes of post-CI vertigo, impaired vestibular function is not always associated with vertigo symptoms; furthermore, the role of central compensatory mechanisms in post-CI vertigo symptoms remains to be elucidated.

Methods: This study used an animal model to investigate changes over time in the peripheral vestibular organ function, and in the plasticity of vestibular nucleus activity after cochleostomy.

Results: Loss of vestibular function was observed during the early stages, but function recovered partially over time. Histopathological findings demonstrated a mild decrease in vestibular hair cells numbers. Increased c-fos immunoreactivity in the vestibular nucleus, observed in the early stages after cochleostomy, decreased over time.

Conclusion: Cochleostomy is a risk factor for peripheral vestibular organ damage that can cause functional impairment in the peripheral vestibular organs. Altered vestibular nucleus activity may be associated with vestibular compensation and plasticity after unilateral cochleostomy.
Introduction: Misplacement of the electrode array is a rare complication of cochlear implant surgery. Most patients present with poor auditory skill development or absent behavioral responses following implantation. Advancement of language development and maintenance of decent hearing function over many years has not been previously described.

Methods: Case report of a female patient implanted in childhood who maintained good cochlear implant function for twenty years despite the electrode being misplaced outside the cochlea.

Results: A 26-year-old female presented with recently deteriorating left cochlear implant function and intermittent pain on stimulation following many years of good hearing function and excellent speech. CT scan showed the electrode array misplaced in the medial petrous apex, passing below the basal turn of the cochlea. The ipsilateral cochlea was partially ossified, with the opposite labyrinth completely ossified.

The patient had re-implantation of the left ear with complete insertion of the new electrode array in the cochlea. The misplaced electrode array was left in situ and can be seen on post-operative X-ray, along with the newly placed electrode. The patient had immediate improvement of hearing function following activation of the second implant.

Conclusion: Good hearing function and language development are achievable with a cochlear implant electrode misplaced outside the cochlea. The ipsilateral cochlea can be implanted after many years with excellent results.
Abstract Body:

Introduction: Candidacy criteria for cochlear implantation in the United States generally excludes individuals whose hearing sensitivity in the better ear is better than moderate to profound sensorineural and aided open speech discrimination does not exceed 60 percent. We report five atypical cases that were implanted in the poorer ear, with essentially normal hearing sensitivity on the contralateral side. In the case of all five patients, standard rehabilitation approaches for single-sided deafness prior to implantation did not provide significant improvement in speech understanding and they sought alternative approaches for management of their asymmetrical sensorineural hearing loss. We evaluated the functional benefit of unilateral cochlear implantation retrospectively in patients with unilateral severe to profound sensorineural hearing loss with essentially normal hearing sensitivity in the contralateral ear.

Methods: Five subjects with severe to profound sensorineural hearing loss and poor word recognition scores for the affected ear and normal to mild sensorineural hearing loss for the contralateral ear were evaluated for cochlear implantation. Aided sound field speech discrimination testing was completed using the AzBio and the CNC word test. The normal ear was functionally masked using an insert earphone. Subjective measures of tinnitus perception were obtained using the Tinnitus Handicap Inventory (THI) and Tinnitus Reaction Questionnaire (TRQ). Subjects were implanted in the affected ear and were activated four weeks following implantation utilizing standard clinic protocol. The tinnitus assessment battery was repeated on the first day of activation and at subsequent test intervals. Speech reception thresholds for speech in noise were measured in the CI-absent condition and binaural condition post implantation. Our pre-implant test battery was repeated for all subjects at the six-month interval.

Results: Five subjects were implanted with a mean age of 57 years. Three of the subjects were implanted with the Cochlear 422 electrode and two were implanted with the Advanced Bionics HiRes90k Mid Scala electrode. The pure-tone average prior to implantation for the implanted ear was 73.6 dBHL and the pure-tone average for the non-implanted ear was 12.8 dBHL. The mean AZ Bio Sentence score in the pre-implanted ear was 30.6%. The mean CNC word score in the pre-implanted ear was 18.5%. The tinnitus measures, TRQ and THI, yielded scores of 59 and 58 respectively. The SNR for BKB-SIN binaural was -.5dB and +7dB in the
normal hearing alone condition.
At three months post activation, the mean AZ Bio Score in the implant-only condition was 92% in quiet. The CNC word score in the implant only condition was 65%. The mean TRQ and THI scores were 6 and 3 respectively. The SNR for BKB-SIN binaural and normal hearing alone data will be reported.

**Conclusion:** The outcomes of cochlear implantation in five patients with asymmetric sensorineural hearing loss indicates a significant improvement in tinnitus perception; a significant improvement in speech understanding on the impaired side; and a significant improvement with respect to speech in noise in the binaural condition. Based on our preliminary data, cochlear implantation appears to be a viable option for sudden single-sided deafness and may also be an effective management strategy.
Spatial Release from Masking: Effects of Microphone Location and Distracter Azimuth

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Objective:
1) To evaluate the effect of microphone type/placement on spatial release from masking in adults with bilateral CIs.
2) Derive a performance-azimuth function for spatial release from masking.

Methods:
Using the Coordinate Response Measure speech corpus, a target talker was presented at 0°, while a similar distracter talker was presented from one of 11 different locations around the listener (-90° to +90° in 20° steps, including a co-located condition in which the target and distracter were both at 0°). The SNR was adaptively varied by adjusting the level of the distracter to calculate an SNR corresponding to 70.7% correct. These measures were obtained separately for the BTE mic and T-Mic.
Results:
Preliminary results show that spatial release from masking can be achieved with either a BTE mic or T-mic. However, despite previous reports of higher performance in spatial tasks with a T-mic, our results show essentially equivalent overall performance for both microphone modes (mean difference = 0.13 dB SNR). Interestingly, slightly more spatial release from masking was observed with the BTE mic (maximum = 2.6 dB) than with the T-mic (max = 1.25 dB). Maximum spatial release from masking can occur with the two talkers separated by 90 degrees, but is often found at smaller separations. Interestingly, the worst performance was not always observed when the target and distracter were co-located.

Conclusion:
The two microphone locations produced similar spatial release from masking benefits and overall performance levels, despite previous reports of an advantage for T-mics. Spatial release from masking can also be substantially reduced if the distracter talker is presented to the listener's “good ear”.
Introduction: Parents of children with significant hearing loss and clinicians working with these families often seek a 'label' or a 'cause' of deafness. Advantages of assigning a classification include understanding potential prognosis, making comparisons to other children who share the same disorder, and planning for expectations into the future. A label enables professionals to communicate efficiently as each label conveys a general idea about the child’s listening/learning characteristics, and enables parents to create/attend relevant support networks. Disadvantages of labels include inaccurate assumptions (i.e. stereotyping) from small data sets (particularly where disorders are rare). At present there are broad aetiology classifications for sensori-neural deafness, e.g. congenital vs acquired, and broad age-of-onset classifications (e.g. genetic, [syndromic and non-syndromic], prenatal, perinatal, and postnatal), but little agreed consensus on further subdivisions. Problems include a lack of plausible, scientifically robust rationales for subgroupings and no clear approach to managing categorization when a child presents with multiple aetiologies/findings. Furthermore, as existing pediatric databases did not originally set out to measure children’s additional co-morbidities, retrospective and post hoc analysis of groupings and subgroupings occurs.

Methods: This study reviews the literature and builds on systematic reviews (e.g. Morzaria et al. 2004 and Petersen et al. 2015) to categorize aetiology for 800 children using cochlear implants from 1985 to 2014.

Results: Available speech perception, speech production and language outcomes for this large cohort, cross referenced for aetiology, are discussed.

Conclusion: Advantages of this approach include the sharing of a universal set of aetiology classifications, and the ability to communicate mean, median, minimum and maximum outcomes for each aetiology. Use of the same terminology facilitates multi-
centre 'pooling' of data. These data provide clinicians with more accurate information to facilitate counselling regarding expectations.
Introduction: Hearing preservation cochlear implantation is based upon the assumption of atraumatic electrode insertion. There is known variability in the size of the human cochlea. Knowing the spatial properties of the cochlea, such as the duct length or any regions of narrowing along the scala tympani may be of clinical importance. In this study we introduce and validate a novel imaging protocol using contrast-enhanced cone-beam CT (CE-CBCT) to measure the spatial properties of the scala tympani in a cadaveric temporal bone model using high-resolution micro-CT as a reference.

Methods: Cone-beam CT (CBCT) images were obtained after injecting contrast medium through the round window via posterior tympanotomy in 7 cadaveric temporal bones. A semi-automatic segmentation algorithm was applied to obtain a 3D model of the scala tympani. Spatial measurements of the scala tympani, including duct length, were obtained using 3D modeling software. These measurements were compared to those obtained using high-resolution micro-CT (uCT) as the gold standard. Paired Student's T-test was applied to detect differences in measurements.

Results: CE-CBCT images to isolate the scala tympani was obtained the majority of the temporal bones. Cochlear duct length measurements obtained through contrast enhanced imaging were comparable to imaging using uCT. Additional metrics such as cochlear duct height and volume were measured. Scala vestibuli infiltration of contrast was also obtained in a proportion of bones due to trans-scalar migration of contrast. The factors which will affect the quality of the scans will be discussed.

Conclusion: CE-CBCT is a novel and effective imaging protocol for measuring the spatial properties of the scala tympani and has potential widespread application in the operative field during cochlear implantation.
Introduction: Speech perception in noise is difficult for cochlear implant (CI) users because of the limited frequency resolution of speech produced with CI devices. One approach to address this issue is to perform pre-processing of the noisy speech to improve speech intelligibility in the signal pipeline to benefit CI users.

Methods: In this study we propose a single channel speech enhancement algorithm to improve speech intelligibility by combining harmonic structure estimation (i.e., f0 structure) and traditional MMSE speech enhancement for a leveraged overall solution. MMSE enhancement has been shown to be effective in controlled stationary noise, but is limited for non-stationary noise such as babble noise and other time-varying environments experienced in daily life. In general, the reason for this is that the a priori SNR estimation is not accurate enough to generate a valid gain function, which in turn introduces more pronounced speech distortion versus a potential benefit during the noise reduction process. In the present study, we estimate the a priori SNR by exploiting the harmonic speech structure of the target speech. In voiced speech sections, since speech energy is sparsely carried by harmonic partials, the spectral energy located between adjacent harmonic partials can be considered as noise. In addition, most noise energy is typically distributed in a continuous manner along the available frequency range. Therefore, noise energy at harmonic locations can be estimated using noise information between neighboring harmonics. In this manner, a more accurate a priori SNR estimation is obtained. The new estimated a priori SNR is then employed in the MMSE framework for speech enhancement. Moreover, the harmonic structure estimation is based on pitch estimation which was proposed and shown to be effective in noise in our previous studies.

Results: A pilot listening test with one CI user was performed. Word recognition rate results show that the proposed algorithm can significantly improve speech intelligibility for CI users in noise (babble and speech shaped noise) at the SNRs of 10 dB, 5dB and 0dB. The results also show that the proposed algorithm is substantially better than MMSE alone in all test conditions.
Conclusion: The harmonic structure estimation combined with MMSE for speech enhancement shows promise for improving speech intelligibility for CI users in background noise. The estimated harmonic structures contribute to a more stable and accurate a priori SNR estimation, which in turn produces a more accurate gain function. A pilot listening test with one CI user shows speech intelligibility is improved by the proposed method compared to either the original noisy or MMSE alone enhanced speech.
Introduction: Cochlear implantation is an effective treatment for many profoundly deaf patients. The number of cochlear implant recipients has increased dramatically. A proportion of patients suffer postoperative complications and an increasing number of device failures are expected. Reoperation on a patient with an indwelling cochlear implant is uncommon. When necessary, surgery is performed for ex-plantation and re-implantation into same cochlea or for new implantation into another.

Reports of large re-implantation series are needed to help surgeons share experience and findings in this growing field and to shed light on failure rates and audiologic performances after re-implatation.

Methods: Seven hundred ten cases (375 adults and 335 children) were implanted and 563 cases was undergone initial implantation at the Auditory and cochlear implant center of Tokyo Medical University Hospital (ACICTMU) between 1985 and 2014. The outcomes of revision surgery including the followings were evaluated. 1: age at present, 2: sex, 3: etiology of deafness, 4: age at initial implantation, 5: type of device, 6: electrode insertion depth, 7: reason for reimplant, 8: time with device prior to reimplant, 9: speech performance (pre- and postrevision surgery, Adult: open-set sentences and word recognition, CI only and CI + vision, Child: sentences and words recognition for infant and child or IT-MAIS et al).

Results: Seventy-eight cases (11.6%) of 673 of first cochlear implant underwent RCI surgeries at our institution. Forty-seven were device related problems and thirty-three were flap and middle ear infection. Several literature reported the rates ranged about 3%-11% and the rate of RCI surgery in children was usually higher. In eighteen adults, 5 extrusion cases had been operated before 1994 and no extrusion cases after 1995. So this rate is expected to decrease as surgical technology improves. Thirty-three cases were associated with flap and/or middle ear infection and ten adult cases of them and two children had a past history of middle ear infection. This suggests that it is important to check periodically the ear for adults who had a past ear infection history and specially check for children by their parents commonly. In this study, trauma was cause of failure in nine cases, whereas trauma occurred in one adult and five children had clear episode of head trauma. Three
cases who re-implanted before 1995 ended up in failure unfortunately. But other successful cases had insertion into sufficient depth and almost cases were concluded that postoperative performance was either equal to or better than scores before failure.

**Conclusion:**
1. There is a tendency toward a decrease in failure rates with new technology.
2. Children had more serious failures than adults because of documented head traumas.
3. Cochlear re-implantation is safe and effective given that medical outcomes are generally excellent and that there is good evidence of maintained speech perception after re-implantation.
Impact of Bilateral, Single-Sided and Asymmetrical Hearing Loss on Cognitive Functions of Older Adults

**Abstract Body:**

**Introduction:** Single sided deafness (SSD) is defined as a severe-profound sensorineural hearing loss in the poorer ear, with hearing thresholds (≤30 dB HL to 4,000 Hz inclusively) in the opposite (“better-hearing”) ear (Vincent et al., 2015). SSD can result from various pathologies notably surgical resection of acoustic neuromas or other lateral skull base neoplasms, sudden sensorineural hearing loss (SNHL), head trauma, viral illness as well as congenital anomalies (Giardina et al., 2014). It is estimated that SSD afflicts approximately 60,000 individuals per year in the United States of America and 9,000 new cases per year are reported in the United Kingdom (Sinopoli, 2015). Studies using both animals and humans with SSD using AEP and fMRI have shown greater symmetry in activation of the auditory cortices upon monaural stimulation (Hanss et al., 2009). These changes may to a certain extent account for the perceptual and sound recognition difficulties faced by individuals with SSD. However, impact of neuro-pathophysiological changes associated with SSD on cognition is yet to be determined.

**Methods:** Twenty normal hearing participants (NH, M = 61.4 ±6.70), 20 bilateral severe-to profound hearing loss participants (BHL, M = 61.29 ± 15.77 years), 8 asymmetrical hearing loss participants (AHL, M = 63.00 ± 7.58) and 8 single sided deafness participants (SSD, M = 57.77 ±17.71) were recruited. The 4 PTA (average of thresholds at 500 Hz, 1 kHz, 2 kHz and 4 kHz) hearing thresholds for each participant groups as follows: NH (better ear = 13.75dB ± 4.58; poorer ear = 14.33dB ±5.17dB), BHL (better ear = 83.31dB ±19.87 dB; poorer ear = 95.03dB ± 19.88dB), AHL (better ear = 43.62dB ± 4.306 dB; poorer ear = 96.12dB ± 29.71 dB) and SSD (better ear = 14.21 dB ± 8.51dB; poorer ear = 97.62dB ± 27.02dB). All four participant groups completed a test battery comprised of speech perception tests (CNC-word, CUNY and BKB-Sin), cognitive assessment of executive function, attention switching, spatial working memory, strategy use, verbal recognition memory tasks (Cambridge Cognition, Ltd), and a depression, anxiety and stress questionnaire (DASS-21, Lovibond & Lovibond, 1995).

**Results:** Linear regression analysis was conducted to investigate the effect of hearing loss on cognitive functions of the participants. Results were adjusted for age, education level, and depression scores. Results revealed that hearing loss significantly predicted the performance in attention switching \([F(4, 47) = 3.74, P = 0.01, R = 0.49, R^2 = 0.24, \text{adj.R}^2 = 0.17]\) and spatial working memory \([F\]
Hearing loss also predicted the performance in CUNY sentence scores of the poorer ear \( F(4, 47) = 4.53, p = 0.04, R = 0.54, R^2 = 0.29, \text{ and } \text{adj.R}^2 = 0.23 \).

**Conclusion:** Results suggest that even a unilateral hearing loss could negatively impact the attention and working memory functions and sentence perception in quiet.
Introduction: Traditionally, Cochlear implantations (CI) are generally activated 3 to 6 weeks post-operatively. However, some literatures have already proved the safety and efficacy of earlier activation. The current study routinely switched on the MED-EL device within 24 hours post-implantation and we evaluate the differences of impedance between intra-operative and switch-on session which represents the status of the electrode and the change of its adjacent environment.

Methods: Patients who had been implanted MED-EL CI in our department between 2009 and 2015 were enrolled in this study. They were divided into two groups according to the two electrode arrays they received: STANDARD and FLEXSOFT group. All devices were activated within 24 hours post-operatively. The impedance level were measured and compared between intra-operatively and switch-on session.

Results: Total 114 ears who had been implanted MED-EL CI in our department were enrolled:25 subjects used STANDARD electrode and the other had FLEXSOFT electrode. Electrode impedances in both groups were higher in apical region of the cochlear (channel 1-5). In this apical region, FLEXSOFT group had higher level of impedance. Besides, no matter which electrodes, compared to intra-operatively session, the impedance in apical region were slightly higher when switch-on. No adverse events of all subjects were reported post-operatively.

Conclusion: The data in this study revealed the increasing of impedance in apical region of MED-EL device after implantation. And the change pattern of impedance in two electrode arrays were similar but not exactly the same. These differences may due to the different design, diameter, and electrode numbers of these two MEDEL devices.
Abstract Body:

Introduction: Cochlear implantation is accepted as a standard modality of treatment by the Parents of profoundly hearing impaired Children as well as the Hearing impaired adults. Many ENT surgeons have added Cochlear implantation to their armamentarium for managing severely hearing impaired patients. Revision surgeries are becoming more common either because of the technical failure of the implant or the surgeon. We are presenting our modest experience of Revision surgeries in Cochlear implantation.

Methods: Our cochlear implant programme is 13 years old and we have 400+ implants to our credit (Both paediatric and adult). We had 9 patients where we have performed Revision surgeries for various reasons like soft failure, Hard failure, infection, failure of the earlier surgeon to complete the procedure due to technical problems, Wrong positioning of the implant. These patients outcomes are analysed and presented.

Results: In five cases with soft failures as well as Hard failures we were able to do Re-implantation without any problems and these children are doing well after Re-implantation. In one case of infection we were able to salvage the implant and the child is in Main stream education and doing well. Another child with infection our attempts to save the implant have failed and it had to be explanted and the child is scheduled for Re-implantation this month. In three cases where the earlier surgeon had inserted the electrode either in the wrong place or was not able to find Round window, we were able to implant these children and got good neural responses on the table and also good post implant outcomes. With Cochlear implantation being accepted as a treatment of choice for patients with severe degree of hearing loss and more and more ENT surgeons taking up the procedure, Revision surgeries are going to rise in the near future. With Government sponsored program becoming available to more novice surgeons in our country, we feel the surgeons venturing in to Cochlear implant surgery should undergo proper training and good mentoring program before embarking on independent surgeries. The cochlear implant companies also should raise their standards of their implant reliability with meticulous and rigorous testing methods, so that the number of technical failures are kept at a minimum.
Conclusion: Revision surgery in cochlear implantation done by senior experienced CI surgeons are rewarding but proper study of the pre-operative scans, good anatomical knowledge of Vestibulo-Cochlear organ and its neighbouring structures will go a long way in reducing the number of revision surgeries in Cochlear implantation.
Introduction: The objective of the study was to evaluate the surgical outcomes, including the intra- or perioperative impressions, postoperative complications and performance outcomes, of laser-assisted cochlear implantation (LACI).

Methods: A prospective non-randomized study was conducted at academic tertiary referral center. Twelve consecutive LACI performed from March 2012 to March 2013. LACI was performed via round window approach. The CO2 laser (1.5-2.0W, single pulse) was used for fenestration of the round window membrane and the electrode of cochlear implant was inserted through the fenestrated round window membrane. Our intra- or perioperative data included the trial attempts before full electrode insertion, depth of insertion, any need for sealing, impedance and neural responses. In addition, postoperative complications classified as major and minor, and performance outcomes including CAP (Categories of Auditory Performance) and K-CID (Korean version of the Central Institute for the Deaf) scores were evaluated.

Results: For the majority of patients (83.7%), electrode insertion was achieved in a single attempt and no sealing was required. All patients had full electrode insertion and normal intraoperative impedance test results. Moreover, there were no major postoperative complications and 3 minor complications resolved over time. Median CAP and K-CID scores at 2 years of follow-up were 6.5 and 74%, respectively.

Conclusion: The LACI seems to be a reliable and safe technique with advantages in terms of success in electrode insertion and sealing. Larger studies would be necessary to verify these findings for a wider application to cochlear implantation.
Introduction: Research efforts to improve coding strategies for cochlear implants (CIs) were recently more frequently directed towards physiologically based approaches. The MP3000 strategy which utilizes psychoacoustic masking functions is one example. In our bio-inspired coding strategy, frequency decomposition of an audio signal was done by a 4th order all-pole infinite impulse response gammatone filterbank. For the stimulation pattern which is applied via an electrode array, two important neural functions were taken into account: channel interaction and refractory properties. Parameters of these properties can be characterized by electrically evoked compound action potential (ECAP) measurements. Facilitation (or summation effect) is also considered since animal model studies showed that for two subthreshold pulses with short interval a response to the second pulse may be obtained.

Methods: To assess the effect of the two filterbank variations, a melody contour test with synthetic clarinet tones in octave 3 was carried out using 3 notes with 3 different intervals from 1 semitone to 3 semitones between successive notes. A pilot experiment was carried out with 7 normal hearing (NH) and 10 CI listeners. For more specific analyses of the contribution of filterbank parameters to complex tone discrimination, the frequency mapping of both the FFT and gammatone filters was modified. Stimulation patterns of the standard ACE strategy and the physiologically based new coding strategy were compared using electroodogram analyses.

Results: The results for the melody contour test for NH subjects showed no difference between the gammatone and FFT filterbanks while for CI listeners there was a 15% improvement for 1 semitone interval, 9% for 2 semitones interval and 2% for 3 semitones interval for the gammatone filterbank. Results of additional melody contour experiments and a spectral ripple test will be presented and discussed.

Conclusion: Considering physiological properties in the coding strategy for CIs may improve spectral and temporal resolution and potentially lead to better results for complex tone discrimination or speech in noise.
When a Well Conducted Audiological Assessment is Superior to an Unfavorable Imaging

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Introduction: Should we trust the MRI that suggested an absolute hindrance to the realization of the Cochlear Implants in any of the ears, or should we trust in the skill and experience of our audiologist team that had conducted an audiological diagnosis and had observed that there were no doubts regarding the results in the Visually Reinforced Audiometry.

Methods: Case report of sequential bilateral cochlear implant in a 2-year-old child, even with Magnetic Resonance Imaging (MRI) suggesting agenesis of Bilateral Cochlear Nerve. Child without any apparent risk factor for hearing impairment only diagnosed as Deaf when she was one year and six months of age. At 1 year and 7 months we performed the indication and adaptation of Personal Sound Amplification Devices (PSAP) bilaterally, and we started the audiological rehabilitation therapy. Started to react to high intensity noises and the pronunciation of some words without meaning, to make onomatopoeic sounds and showed increased auditory awareness. After using the PSAPs for 3 months, the child showed a change in the auditory and language behaviour, but with limited access to the frequencies where the speech sounds are found. Hearing Category (Before the Cochlear Implant and using the PSAP) Category 0 - do not detect the speech, in a normal conversation, below 65dB . We chose, therefore, to indicate the cochlear implant and requested an ears’ Computed Tomography (CT) and a MRI to program the surgery. The outcome of the CT did not show any alteration. But, for our surprise, the MRI did not show any sing of the Bilateral Cochlear nerves (Suggesting agenesis of Bilateral Cochlear Nerve). We discussed the MRI results with 2 more different radiologist teams and none of them could confirm the presence of the Bilateral Cochlear nerves. We realised that the audiological outcomes and the presence of favourable results, even though it was limited with the use of the PSAPs, they were incompatible with a real case of agenesis of Cochlear nerves. We decided to trust the skills of our audiologist team and carryout with the Cochlear Implants, even with a MRI report suggesting agenesis of Bilateral Cochlear Nerve. The neural response telemetry, during the first surgery, showed adequate results for all electrodes. Two months after the activation of the Cochlear Implant in the right ear, 2 year and 2 months old, the child started to show clear auditory responses with the use of the Cochlear Implant and signs of development in the language. Hearing Category (3 months after the activation of the first Cochlear Implant) Category 2 - the child can perceive differences between words. The second Cochlear Implant, in the left ear, took place when the child was 2 years and 4 months old and the neural response telemetry, during the
surgery, showed again adequate results for all electrodes.

**Results:** Even though we all agree that carrying out the Cochlear Implants, with a MRI suggesting agenesis of Bilateral Cochlear Nerve, was a risky attitude, our team and, especially the child’s parents, are very pleased to have chosen this path.

**Conclusion:** We only risked to carry out the Implant, although the MRI was suggesting agenesis of Bilateral Cochlear Nerve, because we really trust the experience and skills of our audiologist.
**Introduction:** Cochlear implant signal processing involves mapping a wide acoustical dynamic range into a relatively narrower electrical dynamic range. To achieve this, predominantly a front-end automatic gain control system (AGC) followed by an output compression is implemented. Such traditional AGC systems have been reported to add distortion to the processed signal (Moore, 2008; Van Hoesel et al., 2002). Similarly, front-end noise reduction systems can often introduce distortion into the signal (Kokinakkis et al., 2012). In this study we evaluated a novel sound coding strategy that implements a post-spectral analysis output stage compression system, which allows for mapping the acoustic energy directly to electrical stimulation levels, therefore avoiding traditional AGC systems known to add distortion to the processed signal. Additionally, the efficacy of a single microphone Wiener filtering based output stage noise reduction system was evaluated which improves the signal-to-noise-ratio (SNR) by modifying the parts of output envelopes that are considered to be noisy.

The primary objective was to study whether implementing a post spectral analysis output stage compression system without a traditional front-end AGC system designed to enhance sound clarity could lead to an improvement in speech perception abilities in quiet and in noise. A secondary objective was to evaluate the efficacy of a single microphone noise Wiener filtering based output stage noise reduction system.

**Methods:** To evaluate any improvements in speech perception abilities, speech perception scores in quiet, at a fixed SNR of 10dB and in an adaptive noisy condition were recorded in a group of cochlear implant users with a sound processor using their regular sound coding strategy implementing a traditional AGC system as the baseline condition. Following this, their processors were programmed to incorporate both the novel sound coding strategy avoiding a traditional AGC system as well as a single microphone Wiener filter based noise reduction strategy. All other cochlear implant stimulation parameters remained the same. Participants were then allowed approximately four weeks to acclimatize to the new sound coding strategy following which their speech perception abilities were again recorded in quiet, at a fixed SNR of 10dB and in an adaptive noisy condition in a random order. This allowed evaluation of both the sound coding strategy implementing the post-spectral analysis output stage compression system without front end AGC and the Wiener filter based noise reduction technique.
**Results:** Preliminary results suggest an improvement in speech perception abilities with the new sound coding strategy implementing a post-spectra analysis output stage compression system without front end AGC and the Wiener filter based noise reduction technique. Further results will be discussed with respect to overall speech perception scores both in quiet and in noise as well as and speech reception thresholds (SRT).

**Conclusion:** Conclusions would be drawn on the efficacy of output stage compression and noise reduction systems that are designed to minimize distortions within the CI speech processing chain.
Informational Internet-Based Portal for Doctors and Patients Regarding Cochlear Implantation: Utility, Difficulties, Purposefulness - National Premiere Project

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Introduction: In Romania, the number of cochlear implants has increased from year to year, reaching about 100 implants reimbursed by the Health Insurance Fund. The need for cochlear implants remains tough only partially covered, the real need being estimated at over 300 cochlear implants per year.

Methods: Analyzing the pool of information available on the Romanian Internet regarding the cochlear implantation the authors found that there is a real lack of well-documented information. In consequences, the authors:
- Reviewed the Romanian websites: professional (individuals, state hospitals, private clinics), NGOs and mass-media web;
- Interviewed patients and doctors
- Identified blank info zones
- Analyzed and synthetized: legal points regarding cochlear implantation; epidemiological problems, etc.
- Identified need for information and the type of information needed.

Results: The information available on the Internet is fragmented, partially relevant and in different stages of updating and its source remains most of the time unknown. The portal is the ideal mean by which to communicate the correct information, integrated (medical, technical aspects reimbursement legislation, rehabilitation, social integration et all), create a real doctor-patient communication bridge, to facilitate their access to implantation and support subsequent success of the implantation procedure. The authors decided to build from the scratch a comprehensive free web-based portal (www.implantcochlear.info and www.implantcochlear.com) in order to fill the information gaps previously identified, which can be seen as well as real information depot, but also as virtual meeting place (forums, blogs, social networks, etc) between patients on one hand and between patients...
and the medical personnel involved in the field, on the other hand.

**Conclusion:** Although at very early stage, our Internet portal proved to be a success in Romania, attracting great interest from both the patients and the medical professionals. Of course, a lot of work remains to be done: further researching, founding financial sources for further development, developing a volunteer network, adding new sections and levels of interest.
Introduction: Necrosis of posterior wall of the external auditory canal and a secondary cholesteatoma could be complications of cochlear implant surgery. The posterior wall could be repair with bone substitute materials. The granules used for this patient have the main objective to the replace the missed bone one of the main characteristics of these granules is the unique feature of inhibiting bacterial growth making it an effective tool for bone cavity filling in the treatment of chronic osteitis.

Methods: We present the case of one patient which a cochlear implant that develops a secondary cholesteatoma seven years after. The cholesteatoma destroyed de posterior wall of the external auditory canal. A bone substitute was used to protect the cochlear implant and to repair the auditory canal. In the surgery to remove the cholesteatoma we used granules for bone regeneration (osteostimulation) as bone graft substitute. The granules are a slowly resorbable bioactive glass based biomaterial with the composition: 53% SiO2, 23% Na2O, 20% CaO, 4% P2O5.

Results: The patient presented 3 moths after the surgery a closed external auditory canal wall, a mastoid without signs of cholesteatoma and a functional cochlear implant.

Conclusion: The commercial granules used in this patient could be an option to close bone defects of posterior canal wall and protect the cochlear implant.
Distinct Clinical and Radiological Phenotype Associated with POU3F4

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Introduction: POU3F4 mutations (DFNX) are the most prevalent cause of hearing loss among all the X-linked loci identified to date. The aim of the present study was (i) to screen for POU3F4 mutations in a large group of hearing loss patients, (ii) analyze audiological and radiological features in patients with HL caused by POU3F4 defects and (iii) to present our experience on cochlear implantation in these patients.

Methods: Mutations in the POU3F4 gene were first analyzed in a selected group of patients with gusher or gusher-like incidence (n=26) through sequencing of the whole gene. Subsequently, the identified mutations were screened for in a large cohort of approx. two thousand males with HL. The molecular techniques used to detect POU3F4 mutations included whole exome sequencing, Sanger sequencing and real-time polymerase chain reaction. Three novel (p.Glu187*, p.Leu217*, p.Gln275*) and one known p.Ala116fs141* POU3F4 mutations were detected in the studied cohort. One of the novel mutations was revealed to be a de novo event. All probands with POU3F4 defects suffered from bilateral prelingual severe to profound HL.

Results: Morphological changes of the temporal bone in these patients presented a similar pattern, including malformations of the internal auditory canal, vestibular aqueduct, modiolus and vestibule. Two of the patients with POU3F4 mutations received cochlear implants with good outcome. In summary, extensive clinical and genetic investigations show that POU3F4 mutations frequently occur in patients with particular temporal bone malformations.

Conclusion: In this selected group of patients sequencing of the entire POU3F4 gene is necessary due to specific requirements and an increased risk of complications during otologic surgery.
Control Number:  
2016-A-811-ACI

Session Number:  
POS02

Session Title:  
Poster Session B

Poster Board Number:  
56-B

Topic 1:  
03c-Outcomes

Publishing Title:  
Age of the Patient is not a Limiting Factor for the Cochlear Implantation

Author Block:  
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Abstract Body:

Introduction:  
In the last decade the population is ageing, as prognoses by studies it is expected 40 % increases of cochlear implant users in elderly population in coming twenty years. The considerations regarding complications and benefits about cochlear implantations in elderly patients raised. Goal of our study is to expose changes in quality of life after cochlear implantation in elderly population and collects data regarding complications.

Methods: Our research based on group of seven elderly cochlear implant users, who were at the time of surgery older than 60 years. The detailed questioner regarding quality of life before and after cochlear implantation regarding hearing and social life was developed. Parallel to results of the questioner the results of speech understanding with and without lip reading before and after cochlear implantation were added. Their responses were compared by responses to the same questioner of the seven users at the age of implantation between 40 to 60 years. The hypothesis of influence of age, gender, education level, duration of deafness before surgery, daily use, bimodal stimulation difficulties with cochlear implant, expectations and quality of life after cochlear implantation. Main hypothesis was that the age of the candidates has no negative impact on quality of life after cochlear implantation. The main importance and impact on the global outcome after cochlear implantation should have general psychological and physical condition of the candidate and the duration of deafness.

Results: Our results indicate that age of the candidates for the cochlear implantation is not a contraindication for it if there is enough motivation and good general condition of the patient. The duration of deafness had statistically no impact on the quality of life after cochlear implantation but the highly improved quality of life after cochlear implantation even in elderly population indicate that we should not wait too long with cochlear implantation.

Conclusion: When the hearing of the elderly patient ensured no longer satisfactory communication, if there is motivation and good general condition the cochlear implantation should not be delayed.
Introduction: Cochlear Implant (CI) users not only suffer from restricted speech perception, but often also have a deficit in speech production. This study examined the relationship between hearing and speech intelligibility after cochlear implantation.

Methods: 43 CI users underwent additionally to the standard speech perception measurement battery (monosyllables in quiet, sentences in quiet and in noise) a single session speech production test measuring the word recognition rate (WR) using automatic speech recognition. The patients’ results were compared to a normal hearing control group of the same age range.

Results: Only for the monosyllable test in quiet a correlation was found to the WR (p = .03). The comparison of the different speech tests of the measurement battery with each other resulted in significant to highly significant correlations.

Conclusion: These findings match to our hypotheses that speech production quality is not simply a function of speech perception competence but depends on some more influences.
**Control Number:**

2016-A-814-ACI

**Session Number:**

POS02

**Session Title:**

Poster Session B

**Poster Board Number:**

59-B

**Topic 1:**

03c-Outcomes

**Publishing Title:**

First Clinical Experience with a New Super Power Bone Conduction Sound Processor

**Author Block:**

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**Abstract Body:**

**Introduction:** We will discuss the first clinical experience of fitting a super power sound processor for bone conduction hearing systems. The fitting range of the test device is advised to be bone conduction thresholds of up to 65 dB HL. To achieve the high levels of gain and output without feedback the test sound processor uses a unique design where the transducer is “split” from the behind-the-ear (BTE) component. To maximize performance three fitting options were available: (a) conventional BTE, (b) under-the-ear (UTE), or (c) on the body. The objective is to measure the patient’s performance and the hearing care professional’s experience with the first fittings of the test sound processor.

**Methods:** Fifty patients with a severe mixed hearing loss took part in the investigation from 12 clinics in five European countries. All patients were wearers of the Baha® Cordelle II Sound Processor (control). The test sound processor was the Cochlear™ Baha 5 Super Power (Cochlear Bone Anchored Solutions AB, Mölnlycke, Sweden). Evaluations were obtained during the fitting appointment and at the six week follow-up appointment. Questionnaires were used to examine patient perceptions of (a) hearing performance, (b) sound quality, and (c) loudness at fitting and follow-up. Further questions were asked to the hearing care professionals on the fitting process, the selected wearing option, feedback and fine-tuning.

**Results:** Data collection is underway and will be completed by February 2016. Data will compare the reported performance between the control and test sound processor

**Conclusion:** We will present the results of the first-head worn sound processor for people with 65 dB HL hearing loss. Important clinical data will be provided regarding the first fittings and resultant hearing experience. Focus will be on both performance and the practicalities regarding the three wearing options. Guidance for best clinical practice will also be shared.
Introduction: Recessive mutations of the TMPRSS3 gene cause non-syndromic hearing impairment (HI) but their spectrum in Caucasians is limited as yet. The purpose of the study was to identify the profile of pathogenic TMPRSS3 variants in Polish HI patients with cochlear implants.

Methods: A strategy of iterative cycles of TMPRSS3 gene sequencing (initiated by whole exome sequencing in one subject) combined with focused mutation screening was applied to ~2200 unrelated HI patients recruited among patients from the Institute of Physiology and Pathology of Hearing. Approx. 600 control subjects were also studied.

Results: Based on the data from medical records, patients with detected TMPRSS3 mutations and cochlear implants were identified. Among our HI cohort we found 43 (1.88%) probands with 14 different rare TMPRSS3 variants. Their genotype-phenotype correlation is presented. In summary, TMPRSS3 mutations are a rare but distinct cause of HI in Polish population and patients benefit from Cochlear Implants (CI).

Conclusion: This method of hearing improvement should be considered as an appropriate one in the group of patients with TMPRSS3 mutations.
Abstract Body:

**Introduction:** Hearing loss (HI) is a significant medical problem. The cause of hearing loss can be genetic or environmental. The background of genetic hearing impairment is an area of intensive research conducted by many groups. Recently worldwide intensive studies are conducted to clarify the genetic basis of hearing loss. To date, more than 60 non-syndromic deafness genes and more than 1000 deafness-causing mutations have been described. The most common variants responsible for an isolated HI with recessive type of inheritance are mutations in the GJB2 gene (in particular the deletion of guanine at position 35 (35delG)) and therefore the search for genetic basis of hearing loss for diagnostic purposes usually includes only analysis of the GJB2 gene. Mutations in the remaining genes associated with the process of hearing which can also cause hearing loss are not commonly investigated. The aim of our study was to estimate the prevalence of genetically related HI among patients with cochlear implants (CI).

**Methods:** We have analyzed more than 1000 patients diagnosed with congenital hearing loss who received CI. Search for mutations was performed with various molecular methods such as next-generation sequencing for exome analysis, direct Sanger sequencing, real-time PCR, allele-specific PCR.

**Results:** Although mutations in GJB2 and GJB6 genes are the main reason of HI, other genes also significantly contribute to the pathogenesis of hearing loss (e.g MYO10A, SLC26A4, TMPRSS3, MT-RNR1, MT-TL1 and others) in CI patients. Our results show that variants in different genes are responsible for at least 40% of cases of hearing loss among Polish patients with cochlear implants.

**Conclusion:** Considering the diversity of genes and mutations, after excluding the GJB2 and GJB6 mutations, wide genomic analysis should be performed in CI patients.
Introduction: Cochlear implant (CI) devices enable profoundly deaf individuals to identify speech with reasonable accuracy in anechoic quiet environments. However, speech understanding becomes challenging for CI recipients in noisy and/or reverberant environments. Here, speech enhancement strategies to alleviate noise and/or reverberation are of great importance. Several single- and multi-microphone techniques have been proposed towards suppressing adverse effects of noise and reverberation on speech, resulting in substantial gains in intelligibility for CI users. Despite effectiveness of speech enhancement strategies in improving the quality and/or intelligibility of noisy and/or reverberant speech for CI users, mitigating the negative effects of each type of masker requires environment-dependent treatment based on the nature of distortion (e.g., convolutive vs. additive interference). As a result, environment classification becomes an important element to adaptively provide proper speech enhancement strategies for varying listening conditions.

Methods: In this study, we propose several features for the task of environment classification. These features, mainly extracted from the simplified output of the maxima selection stage in the advanced combination encoder (ACE), are based on the average inter-stimuli intervals (ISI), stimulation length (SL), and stimulation energy (SE) of each frequency channel in the CI device. Gaussian mixture model (GMM), support vector machine (SVM), and neural network (NN) classifiers are trained based on these features computed in a variety of acoustic environments (e.g., anechoic quiet, noisy, reverberant). In order to evaluate the effectiveness of the proposed features for environment detection, speech material extracted from the IEEE corpus are used to simulate various acoustic conditions along with three RIRs with different reverberation times (T60 = 0.3, 0.6, and 0.8 s) as well as five noise types (white Gaussian noise (WGN), speech-shaped noise (SSN), multi-talker babble, car, and train), at four signal-to-noise ratio levels (SNR = -5, 0, 5, 10 dB).

Results: Clean, reverberant, noisy, and noisy-reverberant environments are classified 97.79%, 97.14%, and 95.13% of time using SVM, GMM, and NN classifiers, respectively. These very promising results are due to the robustness of ISI, SL, and SE of the N-maxima channels selected from the ACE speech coding strategy implemented in many CI devices. In another experiment, the
performance of the proposed feature set is evaluated in noisy environment classification. Here, classifiers are trained only using noisy data with different noise types. Clean, babble, SSN, car, WGN, and train noisy environments are classified correctly 95.08%, 93.40%, and 82.76% of time using SVM, GMM, and NN classifiers, respectively.

Conclusion: Novel features for environment detection and classification in CI devices were proposed. The performance of these features in capturing environment-dependent characteristics was assessed using different classifiers trained and tested on sentences from IEEE database in anechoic quiet, noisy and/or reverberant environments. All four environments were classified with over 95% accuracy using SVM, GMM, and NN classifiers. This high accuracy in environment classification was due to the efficacy of the proposed feature set in capturing characteristics of different environments and consequently training robust classifiers.
Control Number:
2016-A-827-ACI

Session Number:
POS02

Session Title:
Poster Session B

Poster Board Number:
204-B

Topic 1:
01h-Genetics

Publishing Title:
Successful Cochlear Implantation in Siblings with Otoferlin Gene Mutation and ANSD: UK’s Recent Amendments to Implant Criteria for ANSD

Author Block:
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Abstract Body:

Introduction: Auditory neuropathy spectrum disorder (ANSD) is a unique type of sensorineural hearing loss caused by dys-synchrony of neural transmission from cochlear to cortex. It is characterized by normal OAEs but abnormal or absent ABRs, where outer hair cell function is often preserved. Mutations in the OTOF gene coding for protein Otoferlin (which potentiates neural transmission at the inner hair cell level) is now frequently identified through familial genetic linkage analysis as a cause of ANSD at the cochlear level. It is a recognised cause of non-syndromic recessive deafness. The subset of patients with this genetic mutation are postulated to have better hearing and speech outcomes following cochlea implantation than their unaffected counterparts because the lesion is more predictably confined within the cochlea and the retro-cochlear pathway is preserved.

OBJECTIVE: We present the cases of successful cochlear implantation in two siblings with mutations in the OTOF gene and ANSD. We discuss their struggles in proving candidacy for cochlear implantation in the United Kingdom under the NICE TA 166 (prior to Aug 2014) and the utility of genetic testing in their case.

METHOD/CASES: Sibling A & B are otherwise well children with normal inner ear and cochlea nerves who were diagnosed with ANSD aged 4 and 2. They achieved minimal benefit from acoustic amplification, and their BKB and AB word scores (av. 4% HA only; 40% with both HAs and lip reading) remained consistently poor. Repeated submissions for funding on the basis of ‘individual and exceptional circumstance’ were rejected as their pure tone thresholds fluctuated significantly (30-85dB) and failed to meet standard implant criteria. Genetic testing that confirmed the Otoferlin gene mutation was not available until very recently.

RESULTS: In 2013, despite the frequent fluctuations in thresholds, Child B’s pure tone threshold finally dropped below 90dB (2-4kHz) and she underwent bilateral implants. It was only after further submission to the Commissioner with the proven success of his sister and the proven OTOF mutation that Child A was approved for funding (despite average threshold of 50dB). Although implanted at
ages 11 and 13, they have demonstrated remarkable improvement in behavioral testing and BKB/AB word scores (av. 60-74% with implants and no lip reading at 18 – 20 months).

**CONCLUSION:** Since these cases, NHS England - NICE TAG 166 criteria (amended in Aug 2014), now recognizes the challenges with pure tone thresholds which can fluctuate in ANSD and includes functional hearing performance as a key factor in determining implant candidacy. The role of OTOF gene mutation is yet to be clarified as a positive prognosticator for cochlea implantation in the setting of ANSD. We propose further investigations and cross-center collaboration to assess the role for routine and earlier testing for OTOF gene mutation in children with ANSD to improve its evidence base.
Control Number: 2016-A-829-ACI

Session Number: POS02

Session Title: Poster Session B

Poster Board Number: 170-B

Topic 1: 08a - Miscellaneous

Publishing Title: New Application of a Non-Implantable Bone Conduction Device for Trials in Single Sided Deaf Subjects

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Abstract Body:

Introduction: The Contact mini is a non-implantable digital bone-conducted hearing system. It consists of two isolated units, an electronic housing and a vibrator housing. The first research question focuses on whether the Contact mini can serve as an equivalent alternative manufacturer-independent test device for bone conduction device (BCD) trials in single-sided deaf (SSD) subjects. The second research question concentrates on whether it is possible to overcome the negative effect of transcranial attenuation (TA) during the trial by placing the electronic housing with the microphone at the SSD side and the vibrator housing at the mastoid of the normal hearing (NH) ear.

Methods: Currently, eighteen SSD subjects received a BCD trial of two weeks with the Contact mini on headband in cross-position, i.e. the electronic housing at the SSD ear and the bone vibrator at the NH ear. Prior to the trial, the subjects performed speech in noise tests (speech material: LIST sentences) in an unaided condition. After the trial, speech in noise tests were performed with the Contact mini in cross-position and with the Contact mini in ipsilateral position, i.e. both units at the SSD ear. Five different speech in noise configurations were used (S0°N0°; S0°Nnh; S0°Nssd; S0°N+/-90° and SssdNnh). Comparisons of speech reception thresholds (SRT) with Contact mini in cross-position to unaided SRT and to SRT with contact mini in ipsilateral position were performed using related-samples Friedman’s two-way analysis of variances by ranks and Wilcoxon signed-rank test for paired observations.

Results: Significant better SRT results were found in the Contact mini cross-position compared to the unaided condition in the SssdNnh configuration (resp. SRTmdn,CMcross=-0,33dB SNR and SRTmdn,UA=+3dB SNR; p<0,001). In the four other configurations no significant difference was observed between the Contact mini cross-position and the unaided condition. Similarly, a significant difference was found between the Contact mini cross-position and the Contact mini ipsilateral position only for the SssdNh configuration, in favour of the Contact mini cross-position (resp. SRTmdn,CMcross=-0,33dB SNR and SRTmdn,CMipsi=+1,33dB SNR; p=0,048).
Conclusion: These preliminary results suggest that the Contact mini is a good alternative as bone conduction trial device for patients with SSD, since its use results in significant better speech recognition when noise is presented to the normal hearing ear and speech to the deaf ear. As the speech recognition results are better in the cross-position, compared to the ipsilateral position, the Contact mini in cross-position might help to overcome the negative effect of TA during BCD trials.
Abstract Body:

Introduction: Preservation of residual hearing is a key objective of today’s cochlear implant surgeons. In our work, we want to overview the past development of cochlear implant surgery technique, our understanding of post-electrode insertion trauma and the multiple factors involved in the loss of residual acoustic hearing after implantation. We would like to suggest some future treatment strategies to protect residual hearing.

Methods: Our poster is based on our 30 years experience in cochlear implantation in our Institution, some new results of our research team on the protective effect of a selective MAO-B inhibitor and on the overview of current literature.

Results: In our Institution from large skin incision, round window approach through the posterior wall of the ear canal, through posterior tympanotomy and supra meatal approach with cochleostomy, nowadays we use small skin incision and soft surgery with round window approach. The loss of residual acoustic hearing during CI is affected by electrode design, surgical technique, and host responses to insertion trauma. Most of the cochlear implant manufacturers offer solutions for atraumatic insertion with flexible and slim arrays. Following the guidelines of soft surgery also contribute to postoperative hearing change and patient outcomes. The loss of hair cells and auditory neurons in response to oxidative stress in relation of electrode insertion should be avoided. Some promising results were presented in the last years for example about the Caspase pathway and signal transduction cascade, and the MAPK/JNK signal cascade involved in the apoptosis of hair cells and auditory neurons. Other promising field is the neurochemical interactions of inner hair cell (IHC)-afferent dendrite-lateral olivo-cochlear efferent (LOC) pathways. Our research team purpose to examine a selective MAO-B inhibitor’s protective effect on post-electrode insertion trauma.

Conclusion: Preservation of residual hearing requires knowledge of cochlear microanatomy and careful microsurgical techniques to limit intracochlear damage. In addition, new otoprotective therapeutic strategies may help protect residual auditory function after implantation. These should lead to improved outcomes for cochlear implant patients.
Development of Guidelines for Clinics to Advise Patients Being Upgraded or Fitted with Cochlear CP910 Processors, on which Cochlear Wireless Accessory May Be Most Appropriate for Them

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Introduction: Since Cochlear have introduced the wireless accessories which are compatible with CP910 processors, Oxford have undergone a programme of offering all patients who already have their CP910 processors and are eligible to receive a free of charge device, a choice of all three devices. Uptake of the offer has been good and over 70 accessories have been fitted to this group of patients. We have sent patients a questionnaire asking for feedback about their device of choice, whether they feel they made the right choice, and specific lifestyle questions. The aim of this is to ascertain what influences patient choice of device and to create guidelines on which wireless device is suitable for different types of people. We will present the results of this qualitative study and draft guidelines for clinics to use.

Methods: The questionnaire used will be presented.

Results: The results of the questionnaire will be presented.

Conclusion: We will present our guidelines for clinicians to use to help patients make the most appropriate choice of wireless accessory.
**Abstract Body:**

**Introduction:** Two adult users have been seen on multiple occasions years after their initial fitting phase. Dissatisfaction with sound quality and variation in performance were the main reasons for repeated visits. In an attempt to better understand the issues facing these recipients, a series of objective measures were applied. Additionally, the STARR speech test was used to assess performance.

**Methods:** The Volta objective measures software was used to make a complete assessment of both growth function and spread of excitation for the majority of each recipient’s electrode contacts. Both alternate subtraction and masker-probe methods of artefact reduction were applied. Electrode contact impedances were also recorded and graphed over time, with the cross impedances used to examine field spread within the cochlea. Finally the STARR speech test was used to deliver sentences at 50, 65 and 80 dB SPL in order to assess performance.

**Results:**
Volta delivered recording patterns showing unusual spread-of-excitation. These results were consistent with an electrode array tip fold over. Analysis of field spread showed supporting results. The first subject will shortly receive a cone-beam scan to confirm this diagnosis.

**Conclusion:** Objective measurements have been shown to be useful even in adult recipients with challenging programming issues. The results have allowed the electrode contacts enabled in programs to be optimized. Further, confidence from such measures has allowed a radiological examination to be requested. Such results indicate that difficult to program cases could benefit from an extensive objective measures examination that may reveal practical programming steps that can help manage these difficult cases.
Abstract Body:

**Introduction:** Cochlear implants (CI) allow children with profound hearing losses to achieve high levels of speech perception and production including making their speech understandable to normal hearing adult listeners. Communication outcomes are characterized by a wide range of scores. In order to determine one possible basis for this variability, this study examines the relationships between perception and production performance in children using CIs.

**Methods:** Participants: 107 children implanted before age four participated in the study. All participants were from a large cohort of children drawn from the first CI recipients (Geers and Brenner, 2003). They were tested between 8 and 9 years of age. Children were residents of 33 states in the United States and 5 Canadian provinces. Speech perception testing: The Video Game Test of Speech Pattern Contrast Perception (VIDSPAC) (Boothroyd, 1997) was used to evaluate speech perception in CI users. The VIDSPAC provided non-linguistic measures of the child’s ability to discriminate specific phoneme contrasts that were not affected by the child’s vocabulary knowledge. The task required the child to detect a change in pairs of syllables that represented the feature of a contrast. The VIDSPAC stimuli used in this study consisted of two place contrasts, daa/gaa and saa/shaa, two manner contrasts daa/zaa and saa/taa and two voicing contrasts, daa/taa and saa/zaa. Speech production testing: Each participant produced 36 McGarr sentences (McGarr, 1983). The recorded sentences were transcribed by four speech language pathologists. Transcriptions were analyzed using the Computer Aided Speech and Language Analyses (CASALA) software package (Serry et al., 1997). Reports from CASALA determined the percent correct for each consonant used in the perception experiment /d/, /g/, /s/, /sh/, /z/, /t/.

**Results:** Preliminary findings indicate significant associations between perception and production for the feature contrasts of manner (r=0.59, p<.001), place (r=0.4, p<.001) and voicing (r=0.34, p<.001). Associations between perception and production for manner contrasts were stronger than for the place and voicing contrasts.

**Conclusion:** The data from this study confirmed strong relationships between perception and production performance in children using CIs. Future studies will focus on better understanding the mechanisms of this relationship in order to inform future clinical practice.
Introduction: Advancements in cochlear implant (CI) processing, coding strategies, and configurations have allowed CI audiologists greater freedom to program each patient’s CI in a manner that contributes to optimized treatment outcomes. However, with greater programming flexibility come greater responsibility and a need for reliable objective measurements. Currently, there are few objective measures that can be utilized clinically with CI users: electrically evoked compound action potential (eCAP) and electrically evoked stapedial reflex thresholds (eSRT). Previous studies have shown that eCAP thresholds occur at a point of audibility within the electrical dynamic range (Caner et al., 2007). However, the exact point at which eCAP falls within T and C/M levels is variable across CI users. Instead, other measures, such as eSRT, can be used to better predict C/M levels (Caner et al., 2007; Abbeele et al., 2012). Previous studies have shown eSRT to be a reliable and predictive measure of C/M levels for both adults and children with a CI (Jerger et al., 1986; Polak et al., 2006; Kosaner et al., 2009; Stephan and Welzl-Muller, 2000). However, some studies have shown that eSRT is not measurable in about 30% of patients (Hodges et al., 2003). A multicenter study by Van Den Abbeele et al. (2012) demonstrated that eSRT is more successfully obtained using speech burst stimulation using four bands of electrodes at a time compared to single electrode stimulation. However, there still remains a small population with which eSRT measures cannot be obtained. Currently, there seems to be a lack of research regarding what variables may impact the presence or absence of stapedial reflex thresholds in CI users, as well as factors that may impact the stability of those measurements. Therefore, the purpose of this study was to determine what factors, if any, predict the presence or absence of eSRT and their stability after surgery for patients with a CI.

Methods: A retrospective chart review of patients seen at one CI center was completed for this study. To be included in the chart review, patients needed to be at least 12 months of age, and have been using their implant for at least six months. Demographic information, as well as details regarding the individual’s CI surgery, eSRT measures, and performance outcomes were collected from information in the chart. Specific variables included age at implantation, duration of hearing loss, pre-implant speech perception scores, surgical factors, other confirmed medical diagnoses, and pharmaceutical history. Research questions included: 1) How do eSRT levels relate to behaviorally measured C/M levels? 2) Does the relationship between eSRT level and behaviorally measured C/M levels vary as a function of a demographic variable? 3) What factors impact the stability of eSRT measures across time? Data
relevant to the review were collected from 83 patient charts.

**Results:** Preliminary analysis suggest that eSRT measured levels fall within an average of 23 units of behavioral loudness judgments. Additionally, a subset of patients who reported traumatic brain injury post cochlear implantation demonstrated variable eSRT measurements after injury, with elevated C/M levels after injury.

**Conclusion:**
**Introduction:** The conventional treatment of mixed hearing loss (HL) consists of surgical reconstruction of the middle ear in combination with an air-conduction hearing aid (HA). The implantable hearing system Codacs™ is a direct acoustic cochlear implant (DACI) that directly stimulates the inner ear via a piston prosthesis, intended for cases of severe-to-profound mixed HL. A common objection to the use of a DACI is that outcomes can be achieved by conventional therapy, assuming that the air-bone gap is closed completely, and that patients are perfectly compliant in their use of a HA. The aim of the study was to (a) test these assumptions, (b) compare Codacs outcomes with “real life” outcomes from the conventional approach, with realistic air-bone gap closure and HA compliance.

**Methods:** Audiological results after different types of tympanoplasty and stapes surgery performed between 2007 and 2015 at the Dept of Otolaryngology at Hannover Medical School (MHH) were analyzed retrospectively (N = 987 patients). A statistical analysis of audiological outcome in terms of change in bone conduction (BC) thresholds and residual air-bone-gap (ABG) was performed. In addition, the APHAB and a questionnaire assessing subjective satisfaction and HA use was sent to a subset of patients, 30% (N=144) of which answered.

**Results:** Post-op bone conduction thresholds were 20 ± 13 dB HL (mean ± standard deviation, PTA 0.5, 1, 2, 4 kHz), post-op air-bone gap was 20 ± 12 dB. Hence, a significant part of patients had a post-op air-bone gap of more than 30 dB. Required gain from a hearing aid, (estimated as ½ BC threshold + air-bone-gap), was 31 ± 14 dB, with 11% of patients needing more than 50 dB gain. Required MPO (estimated as 120 dB HL + air-bone-gap) was 141 ± 12 dB HL, with a substantial part of patients needing more than 140 dB HL MPO.

**Conclusion:** The assumption that tympanoplasty or stapes surgery will result in perfect closure of the air-bone-gap, thereby making a hearing aid as effective as in a patient with sensorineural hearing loss, is not valid. Many patients with a sensorineural hearing loss
component and real-world outcome of middle ear surgery will have audiological needs that maybe can be met by a conventional hearing aid in terms of insertion gain, but not in terms of MPO. Therefore, an alternative solution like Codacs™, which bypasses the conductive hearing loss, is a welcome addition to the set of available therapies for mixed hearing loss.
Enhancement of Music Enjoyment in CI Users with Single-Sided Deafness

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Abstract Body:

**Introduction:** Unilateral hearing loss can seriously impair a listener’s enjoyment of music, even when the perception of specific qualities (pitch, timbre) are unchanged in the normal hearing ear. Enjoyment of music is enhanced in normal hearing individuals when hearing music with two ears rather than one, even if the music signal is monaural rather than stereo. Availability of cochlear implant (CI) users with normal contralateral hearing allow us to evaluate whether such enhancement is observed when the additional ear has a cochlear implant rather than acoustic hearing. The objective of this study is to assess sound quality of music with either one or both ears, in Single-Sided Deafened (SSD) CI users and in a control group of normal hearing listeners.

**Methods:** Sound quality of music in Single-Sided Deafened (SSD) subjects with a CI was investigated using a modified version of the MUSHRA (MUltiple Stimuli with Hidden Reference and Anchor) method. Listeners rated their enjoyment of brief musical segments on a scale of 0-200, where 100 represented the sound quality an unmodified musical segment presented to the normal hearing ear and 0 represented a highly degraded version of the same musical segment, also presented to the normal hearing ear. Degradation of the musical segment to obtain the 0 reference was done by using a 6-channel noise vocoder simulating a 6.5 mm shift. Stimuli consisted of acoustic only, electric only, acoustic and electric, as well as a number of conditions with low pass filtered acoustic stimuli. Acoustic stimulation was provided by headphone to the normal ear and electric stimulation was provided by a direct connect cable to the subject’s clinical speech processor. Data will also be presented from a group of normal hearing listeners who were tested using headphones under the following conditions: unmodified musical segment (in one ear), degraded musical segment (in one ear), and unmodified musical segment (both ears).

**Results:** Combined electric and acoustic stimulation resulted in the highest sound quality ratings from SSD-CI users. These were significantly higher than for the acoustic-alone condition. Sound quality ratings for electric stimulation alone were quite poor. They were much closer to that of the degraded acoustic stimulation alone than to the unmodified musical segment. In all tested
conditions, adding electric hearing to acoustic hearing provided improvement in sound quality.

**Conclusion:** Music enjoyment from electric stimulation was extremely poor relative to a readily interpretable normal-hearing baseline. Results also suggest that even the poor quality musical signal provided by a CI may result in the same type of binaural enhancement observed in normal hearing listeners.
Abstract Body:

**Introduction:** Insertion of a cochlear implant electrode within the cochlea may cause loss of residual hearing. This loss of residual hearing may be related to direct trauma to inner ear structures or generation of molecular events that may initiate programmed cell death (PCD) and apoptosis.

**Methods:** We analyzed various surgical and physiological factors that impact preservation of residual hearing post-implantation.

**Results:** We will present data from temporal bone studies, in-vitro and in-vivo laboratory research, and clinical research outcomes in patients implanted with various cochlear implants. Additionally, the surgical techniques during electrode insertion will be discussed.

**Conclusion:** The possibility of treating the cochlea with otoprotective strategies before onset of sensory cell death will be presented.
Control Number:
2016-A-867-ACI

Session Number:
POS02

Session Title:
Poster Session B

Poster Board Number:
178-B

Topic 1:
08a - Miscellaneous

Publishing Title:
Cochlear Implantation In Malawi, Southern Africa
Implantation in Malawi, Southern Africa

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Abstract Body:

\textbf{Introduction:} Malawi is one of the world’s poorest and least developed countries. It has a population of 16 million, with over half living below the poverty line. Life expectancy is little over 50 years with 1 in 8 children dying before the age of five. The main health burden in Malawi is HIV (10% of the population are HIV positive) along with tuberculosis and malaria, which together account for 40% of hospital deaths. Common infective diseases, together with untreated ear infections, mean that the population is twice as likely as those in Europe to be born with, or develop, hearing loss. A co-author is one of only two ENT surgeons in the whole country.

The presenting author visited Malawi as part of a sabbatical in 2013 and during the visit saw the tremendous need of profoundly deaf patients in the country. This visit led to the concept of carrying out implants in Malawi and this paper outlines how, despite the poverty, two Cochlear Implants were successfully implanted in September 2014. As well as addressing the practical and ethical issues it also outlines future plans in developing both implant and otological surgery in Malawi and southern Africa.

\textbf{Methods:} The 2 implants were, to our knowledge, the first in Southern Africa outside of the RSA (Republic of South Africa). A 9 year old girl deafened two years previously by mumps and a 16 year old boy deafened three years previously due to quinine treatment for malaria. Both had avoidable aetiologies illustrating the many public health issues relating to acquired deafness in the 3rd world. The implants would not have been possible without the following ...

- Support from the manufacturer (Med-El) in providing the implants and audiological support
- The presence of audiologists working in Malawi (for charitable organisations) who had experience in implant programming
- The fact that, due to charitable support, the ENT infrastructure had developed significantly over the previous few years
- The charitable donation of two drill systems (the first otological drill system in Malawi)

\textbf{Results:} Both surgeries were undertaken without complication. Switch on took place in December 2014 and both patients have excellent speech recognition and have returned to full time education. Due to the implant surgery the ENT department in Blantyre,
Malawi has now, for the first time, equipment to carry out other ear surgery. As such further cochlear implant and otological surgery is planned for February 2016 and the updated results will be presented.

**Conclusion:** Despite significant practical difficulties it has proved possible, with the right support, to carry out cochlear implantation in one of the world’s poorest countries. There have been immediate ‘offshoot’ benefits in that the facilities are now such that future plans are in place to carry out regular weeks of otological surgery including developing a CI programme. The longer term aim is to train a Malawian otologist. The project has also raised awareness of deafness in Malawi as well as highlighting significant public health issues relating to the aetiology of deafness in 3rd world countries.
Perceptive and Linguistic Outcomes in Children Implanted with MED-EL Device

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Introduction: To review the outcomes of the pre lingual deaf children implanted with a Med-El cochlear implant (CI) device.

Methods: Between 2009 and 2014, 85/648 children were implanted with Med-El CI. The mean age at CI was 8.8 years (1-22 years). The mean follow up was X (12-60 mo). All children had at least 1 year follow up. 58% of children had profound congenital deafness (Gc), 42% had progressive deafness (Gp). The outcomes were evaluated looking to auditory perception capacity (CAP), open set sentences (OSS), intelligibility rate (SIR), lexical scores (EVIP) and speech production at 1, 2, 3, 5 years follow up. Results were analysed looking at presence of additional needs, family involvement (MPM scores), age at implantation in each group and the educational program (specialized/mainstream).

Results: At 3 years follow up, 80% of all children had CAP level of +5, SIR rate at +4. 51% had EVIP ranging from -1SD to +2SD, and 87% of the children followed mainstream schooling program. The Gp group was implanted at a later age then the Gc, and the perceptive scores were higher at ½ and 3 years follow up then in Gc. All factors are discussed and analysed.

Conclusion: The majority of the implanted children developed good listening skills and speech development. Poorer results were linked to low MPM scores, additional disabilities and restricted rehabilitation program.
Introduction: The cochlear implant is a device that allows the restoration of hearing in patients with severe to profound hearing loss that do not have benefit with the conventional hearing aids. Initially, patients with single sided deafness and a contralateral normal ear were not considered for implantation. Facing the advantages of binaural hearing for speech comprehension in noise and sound localization, patients with SSD and asymmetric hearing loss have received cochlear implants due to the fact that the alternatives-osteointegrated implants and CROS hearing aids- do not restore binaurality.

Aim: To assess auditory comprehension in patients with a cochlear implant and a contralateral normal ear.

Method: Four patients participated in the protocol for the Audity Implants Unit. The protocol consists of 5 tests: the first is the six Ling Sounds, the second one is the comprehension of twenty five words, the third one is the comprehension of ten sentences, the fourth one is the comprehension of one hundred and twenty four words in a text and the last one is a series of fifteen questions. The protocol was applied after one month of auditory training (twenty sessions). The assessment was carried out in a quiet environment and the patient had an earplug and a headset with background noise in the ear with normal hearing.

Results: The patients were able to comprehend better words (98%), then questions (92%), sentences (88%), text (85%) and the Ling Sounds (79%).

Conclusion: There is a clear benefit in fitting cochlear implants in patients with single-sided deafness because it gives them the chance to comprehend sounds, words, phrases, texts, and questions in a quiet environment, and especially in noisy environments.
Effect of Hearing Experience on Caregivers’ Pause Durations Following Questions

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The quality of parent-child interactions plays an important role in language outcomes following cochlear implantation (CI; Fagan, Bergeson, & Morris, 2014; Niparko et al., 2010). Across studies, higher quality interactions predict higher child language scores. To assess parent-child interactions, these studies have used qualitative ratings. To complement this approach, others have examined acoustic and prosodic features of caregivers’ infant-directed speech (IDS). For example, Kondaurova and Bergeson (2011) reported that some prosodic properties of caregivers’ IDS reflected infants’ hearing age rather than their chronological age. The current study is the first to examine a particular prosodic feature — pauses — during dyadic book reading. Research suggests that the dialogic reading style, which includes prompts for the child to respond to, facilitates later language (for a meta-analysis, see Mol, Bus, de Jong, & Smeets, 2008; Cruz et al., 2013). Pauses provide opportunities for infants to vocalize and participate in back-and-forth exchanges, which build critical language skills.

Our objective was to explore the role of children’s hearing experience following CI on mothers’ pause durations after asking a question during shared book-reading. We predicted that if mothers’ expectations of their child’s responsiveness increased with CI experience, then they would exhibit longer pause durations across post-CI intervals.

The sample included children implanted before 24 months, with normal hearing matches for chronological and hearing age. Families visited the lab before CI, then 3, 6, and 12 months after. Recordings of mothers’ speech were collected under a variety of conditions, such as playing with or reading to their child. In addition, mothers read the same storybook aloud without their infant present in order to measure adult-directed speech. Language skills were assessed using the Peabody Picture Vocabulary Test and Preschool Language Scales.

Only the story-book reading context was analyzed for this study. We created a picture-book that followed two creatures who found misplaced items and searched for their owner. The text included one question; using the acoustic analyses software Praat, the length of time from end of question to onset of the next maternal utterance was measured. Preliminary data for 10 children at 3 time points (prior to activation, then 3 and 6 months following) have been coded.

Analyses of the preliminary data revealed that prior to CI activation, mothers paused on average for 1.33 sec ($SD=0.94$); 3 mos after CI, pauses lasted 1.52 sec ($SD=0.93$); 6 mos post CI, they paused for 1.98 sec ($SD=0.95$). Although this increase in pause duration was not statistically significant ($F(2,6)=2.536, p=0.159$), there may not yet be sufficient power to detect an effect. In contrast, pause
durations did not consistently increase over time when caregivers read aloud alone (\(M_{\text{pre}}=1.99\ \text{sec}, SD_{\text{pre}}=1.19; M_{3\text{ mos}}=2.48\ \text{sec}, SD_{3\text{ mos}}=0.99; M_{6\text{ mos}}=2.28\ \text{sec}, SD_{6\text{ mos}}=1.65\)). Data coding for additional participants is in progress. Additional analyses will compare how pause durations change over time for normal-hearing dyads. How the pause-duration strategy relates to language outcomes will also be analyzed.

In conclusion, pauses can be a powerful tool to prompt children to contribute to social exchanges. This study is the first to investigate how caregivers modify their use of pauses over time following story-book questions to infants with cochlear implants.
**Introduction**: Selection of a properly sized electrode array may be an important element in maintaining residual hearing and/or improving hearing outcomes for cochlear implant (CI) recipients. At present, CI companies offer a finite number of choices for electrode length and little to no instruction to optimize surgical placement given individualized anatomy. Perhaps the most widely used guide is the “A” measurement—the distance from the round window (RW) through the modiolus to lateral wall of the basal turn—to predict the depth of insertion to cover 2 turns. The diameters of the cross section area of scala tympani (ST) may also be important as it limits depth of insertion.

**Methods**: 210 pre-operative CT images with 310 ears were automatically analyzed using a software package we developed for this purpose. Cochlear volume, two-turn cochlear duct length (CDL), length of the basal turn where advance off stylet (AOS) should start, and cross section of the ST at CDL = 28 mm were measured. To quantify the cross section, an ellipse was fit to the cross sectional area of the ST, and the shorter diameter was reported as the limiting factor for electrode insertion. To quantify the length of basal turn, the distance from the RW to the recommended angular depth for AOS was measured. Mean and standard deviation of the measurements between males and females were compared. Statistical significance of measurements were calculated using a two-sample t-test. A threshold of 0.0125 was selected for p values accounting for multiple comparisons.

**Results**: Statistically significant differences between male and female cochlear anatomy were identified as noted in the table below where measurements are given as mean ± standard deviation.

<table>
<thead>
<tr>
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<th>Male (n=173)</th>
<th>Female (n=137)</th>
<th>p-values</th>
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</thead>
<tbody>
<tr>
<td>Cochlear volume (mm³)</td>
<td>67.77 ± 9.81</td>
<td>60.81 ± 10.22</td>
<td>2.90e-09</td>
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<td>Male</td>
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<td>---------</td>
</tr>
<tr>
<td>Two-turn CDL (mm)</td>
<td>37.68 ± 1.73</td>
<td>36.39 ± 1.94</td>
<td>2.26e-09</td>
</tr>
<tr>
<td>AOS depth (mm)</td>
<td>6.03 ± 0.34</td>
<td>5.76 ± 0.38</td>
<td>1.89e-10</td>
</tr>
<tr>
<td>Shorter diameter at 28mm (mm)</td>
<td>1.02 ± 0.13</td>
<td>0.95 ± 0.12</td>
<td>4.15e-07</td>
</tr>
</tbody>
</table>

**Conclusion:** Our results indicate that there are statistically significant differences between male and female cochlear anatomy. Clinically, the vast majority of male and female cochleae can accommodate deep insertion up to 28mm. Use of imaging may be helpful in creating customized insertion plans, for example, specifying depth of insertion and/or when to begin AOS.
**Introduction:** Through limited feasibility studies in the US, an auditory brainstem implant (ABI) is an option for selected children and early outcomes are now being learned. The purpose of this study was to examine outcomes to date for children who have received auditory brainstem implants at one center.

**Methods:** A retrospective data review included five children who received auditory brainstem implants. Analyses included single subject studies of patient demographics, mapping parameters, electrophysiological findings, audiological outcomes and progress on speech and language measures.

**Results:** The development of useful audition is slow to emerge in this population and limited relative to typical cochlear implant recipients. Electrophysiological measures supplement behavior measures for patient management purposes. Each of the 5 children included in the study continue to wear their devices and benefit is variable.

**Conclusion:** Medical/surgical issues have been manageable and auditory brainstem implantation is safe for children. Development of audition and spoken language skills occurs slowly and communication mode should include use of a visual language system. Continued monitoring of this initial cohort of children will be important before patient recruitment is expanded.
Introduction: Introduction Enlarged vestibular aqueduct (EVA) with or without Incomplete Partition type 2(IP2) is the most common cochlear malformation in children presenting with sensorineural hearing loss. EVA can be non-syndromic but is also found in Pendred syndrome, a hereditary condition presenting with a triad of sensorineural hearing loss, hypothyroidism and vertigo. There is a large disparity of the hearing loss in this group, from mild to profound, with auditory function often fluctuating and at risk of dropping suddenly after mild head trauma. About 40% of patients with Pendred syndrome have episodes of vertigo. The common treatment for EVA/IP2 patients with severe to profound hearing loss is cochlear implantation and several studies report good outcomes for this group. Here we evaluate our experience of cochlear implantation in this group of children including postoperative vestibular function.

Methods: Method Retrospective case study in combination with a multidisciplinary team assessment. Hearing, language performance and balance was evaluated in 31 consecutive pediatric cases of LVAS with or without IP2 cochlear malformation implanted between 1991 and 2014. The results are compared to those of a control group of children with cochlear implants due to Connexin26 mutations. A review regarding radiological findings, surgical procedure and postoperative symptoms was also performed.

Results: Results. Round window insertion with a straight electrode offered good electrode position in all cases and no surgical complications were seen. All children had auditory benefit from their cochlear implant developing oral communication. An increased rate of postoperative vertigo is seen in this group as compared to other pediatric cases.

Conclusion: Conclusion Children with EVA with or without IP2 perform well after cochlear implantation and develop good hearing and speech skills but postoperative vertigo is more common in this group. Results from genetic analysis and psychosocial aspects as well as psychological assessment are pending.
Abstract Body:

Introduction
A thorough knowledge of the course of the cochlear nerve and lateral recess is essential for performing surgical approaches to this complex region. These structures create different spatial perspectives as they are approached from different surgical angles.

Objective
The dorsal and ventral cochlear nuclei (CNs) are the primary targets for insertion of auditory brainstem implants (ABI). However, the anatomical configuration of CNs is not well elucidated. In this cadaveric study, we have sought to present the surgical view of the anatomy in the lateral recess as it pertains to the insertion of ABIs. In addition, the access trajectory and area of exposure through the sub-occipital (SO) and trans-labyrinthine (TL) approaches are compared.

Methods
Six (3 bilateral) sides of embalmed latex-injected cadaveric heads were dissected under microscope via 2 sequential craniotomy approaches: suboccipital and translabyrinthine. The goal was to visualize the anatomy of the 4th ventricular lateral recess and cochlear nerve and compare the surgical view between these two surgical approaches. Digital images were captured to provide an atlas of the intraoperative view for each approach and used as basis for measurements. All measurements were calculated using Canvas 7 software (Denebra, 2000).

Results
The VIIIth nerve travels caudally from internal acoustic canal (IAC) toward the brainstem creating an average angle of 58.2 degrees with the posterior aspect of petrous bone. The ventral and dorsal CN span about 9 mm behind the inferior cerebellar peduncle at the ventral portion of lateral recess. The anterior nucleus straddles the foramen of Luschka. The nuclei follow the trajectory of cochlear nerve with slightly more cephalad direction when entering the lateral recess (165 degrees in sagittal plane). These are
oriented dorsally creating an obtuse angle of about 139 degrees with the VIIIth nerve complex in axial view. Due to the cephalo-caudal orientation of VIIIth nerve complex and its nuclei, the insertion trajectory for ABI electrode from surface of surgical corridor is from the upper part of cranial opening for both SO or TL approaches. This corridor is above the path of fallopian canal and overcomes the limitation of anterior access posed by this structure in TL approach. The Dorsal trajectory of VIIIth nerve in relation to the lateral recess and the more posterior orientation of CNs in the brainstem necessitates more retraction on the cerebellum and rotation of brainstem in the SO approach compared with the TL approach for ABI insertion.

**Conclusion**

This study describes intraoperative anatomical view of the lateral recess and quantifies the relationship between the VIIIth nerve, CNs, and the lateral recess, thus enabling the optimization of the anatomical accuracy for ABI insertion. Although CN can be exposed by both TL and SO approaches, the former provides a less off-axis view to the lateral recess. This minimizes cerebellar retraction and rotation of brain stem in order to visualize the lateral recess from the surface prior to ABI insertion.
Introduction: In the 90’s we used to switch-on the implant 6 weeks after implantation. Whereas, in 2000 we started doing it 3-4 weeks after surgery.
The reasons to wait for the switch-on were supported by two main concerns:
- The impact on the map with early electrical inestability
- Soft tissue swelling that could lead to intolerance to the use of the processor.
Soft tissue swelling could promote resistance to use the speech processor in early stages for reasons that might affect the coil attachment to the receiver/stimulator:
- Pain
- Swelling

Methods: Design: Prospective cohort study
Setting: Tertiary referral pediatric hospital
Patients: Twenty six ears in twenty patients with either unilateral or bilateral cochlear implant. Out of the total, twenty six ears underwent early switch-on between March 2014 and November 2015.
We randomly selected twenty six ears that underwent classic switch on (4 weeks) as control group (CG).
All the patients were users of Nucleus Freedom cochlear implant (Cochlear®, Sydney, Australia).
Outcome measures:
• Tolerance
• Audiological Outcomes (telemetry, mapping, speech discrimination)
• Complications
• Quality of life
• Learning’s
• School benefit’s
• Psychological aspects
•Speech develops
•Parents fillings

Results: •With a larger number of patients we still had the same findings. The patients accepted the use of the processor and tolerated it very well with the same compliance to the use of it than those who underwent traditional switch-on.
•Children and their parents were more relaxed and with less anxiety compared to what the audiologists usually experience with the traditional switch-on.
Parents are more calm and o the kid too
•Overall speech discrimination didn’t show any difference in both groups.
•Mapping didn’t need special adjustment compared to the CG.
•No complications due to this procedure were observed in any patient.
•Patients show faster social insertion
•Impedances showed a tendency to drop at switch-on for the early switch-on group. Also it seemed that the earlier the switch on was, the greater the drop. Most of the early switch-on group stabilized impedances earlier than the CG. For conclusions on that field we will expected for a larger group of patients.

Conclusion: •Gaining time of brain plasticity. It’s possible to start or restart stimulation as fast as possible which is a key thing in younger patients.
•Faster school reinsertion
•Quicker adaptation since we can reduce to only a few hours or days mute interval (either for CI or hearing aids users)
•Greater parental satisfaction. They can see right after surgery how the device works and their children reactions.
Abstract Body:

Introduction: Cochlear implants have been used in patients with bilateral severe to profound sensorineural hearing loss since the 1970s. Implantation criteria has expanded and the general population lifespan has increased. Therefore the age at which cochlear implants are placed has increased. Our purpose is to determine whether audiological outcomes, and complications are significantly different in the elderly population greater than 80 yo in comparison to patients < 80 years.

Methods: Adult patients > 80 yo that underwent cochlear implantation by any of 8 surgeons at a single institution were reviewed. 100 total patients were identified were included in our review. 50 patients were aged > 80 yo (group 1). 50 patients were selected as our control group who were < 80 years of age. All patients met criteria for cochlear implantation with bilateral severe to profound sensorineural hearing loss. All patients had pre-implant and post-implant HINT or AzBIO testing completed. Pre-implant HINT/AzBIO was compared with Post-implant HINT/AzBIO for each patient. In addition we reviewed the complication rates between our control group and group 1. Statistical analysis was performed comparing control group versus group 1.

Results: There was no significant difference in pre and post HINT/AzBIO testing in our control group and group 1. Post HINT/AzBIO testing had slightly poorer AzBIO/HINT scores compared to our control group. Additionally, there was no significant difference in complication rate between our control group and >80 yo group.

Conclusion: Although patients >80 yo tend to have more comorbidities then their < 80 cohort, their success rates indicated by their post operative HINT/AzBIO scoring, and complication rates are not significantly different than the < 80 cohort. When determining cochlear implant candidacy, age alone should not be a concern. Overall health and motivation to succeed with an implant are likely the most important factors.
Introduction: Normal hearing individuals adjust their speech production style and parameters in the presence of background noise. This phenomenon is known as Lombard effect (Lombard, 1911), which helps convey speech information more robustly between individuals in adverse noisy environments. Recent cochlear implant (CI) research (Lee et al, 2015) has suggested that Lombard effect is also present in speech of cochlear implant adults. In this research, speakers altered their vocal effort, including fundamental frequency, vocal intensity, glottal spectral tilt, and formant characteristics to ensure intelligible communication in challenging listening environments. However, no study has been performed to examine if Lombard effect influences speech perception for cochlear implant users.

Methods: A speech corpus intended for the perceptual experiments of Lombard effect was developed. Four normal hearing (NH) speakers participated, and produced read and spontaneous speech with their conversational partners in a sound recording booth. Noise samples were presented monaurally via open-air headphones worn by speakers. Speech sentences were produced under quiet and large crowd noise at three different levels (70 dB, 80 dB, and 90 dB SPL). Following data collection, perceptual experiments of Lombard speech were performed with cochlear implant users. Four post-lingually deaf users of cochlear implants participated. Cochlear implant subjects listened to original stimuli corrupted by large crowd noise at 5 dB and 10 dB SNR via loud speakers in anechoic sound chamber. Recognition scores were calculated based on the number of words correctly identified by CI users.

Results: Speech perception scores with Lombard sentences will be presented. From the results, we will investigate if there is a significant improvement in intelligibility when presented to CI users under noisy conditions. The data will be analyzed to see whether CI users demonstrate higher performance in recognition with the presence of Lombard effect when compared to the speech produced in quiet condition. We will also examine the potential change in performance from the speech produced in different listening environments (i.e., at 70 dB, 80 dB, and 90 dB SPL).
Conclusion: The present study has focused on speech produced in the presence of noise, and its impact on cochlear implant performance. Perceptual characteristics of speech under Lombard effect will be analyzed. The findings from this study will provide additional fundamental knowledge on speech perception of cochlear implant users.
Auditory Brainstem Implant Surgery in Children: An Update on the Massachusetts Eye and Ear Infirmary Experience

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Otolaryngology, Massachusetts Eye and Ear Infirmary, Boston, MA; Neurosurgery, Massachusetts Gen. Hosp., Boston, MA.

Abstract Body:

Introduction: The auditory brainstem implant (ABI) was originally developed for older children and adults with Neurofibromatosis Type 2 (NF2). Clinical outcomes internationally suggest a role for the ABI in deaf non-NF2 infants who are not candidates for the cochlear implant (CI) due to anatomic considerations. To date, the experience in the United States with the ABI in the pediatric population is limited. We sought to determine the safety and feasibility of ABI surgery in deaf infants who are not candidates for the CI.

Methods: Four infants with congenital deafness who 1) were not candidates for the CI due to cochlear or auditory nerve aplasia or 2) failed CI surgery and 3) underwent primary or revision ABI surgery (six total cases - four primary and two revision procedures) with the Nucleus 24 or Med-EL ABI were included in the study. Primary outcomes included assessment of perioperative complications, electrophysiologic and behavioral audiologic responses, and speech development.

Results: ABI surgery was performed using a retrosigmoid craniotomy approach in a series of infants with profound hearing loss associated with cochlear and auditory nerve hypoplasia. Intraoperatively, multiphasic Evoked Auditory Brainstem Responses (EABRs) were obtained. Detailed surgical, audiologic, and speech outcomes will be shared. Preliminary data suggest that 1) perioperative complications rates are low, 2) EABRs used to guide placement of the ABI electrode are variable and 3) behavioral thresholds of 30-40 dB in the ABI only condition are possible.

Conclusion: Based on our experience, primary and multiple revision ABI surgery in infants is a safe and effective means to habilitate deaf pediatric patients who are not candidates for the CI due to anatomic considerations.
Towards Patient-Centric Sound Fitting for Cochlear Implant Users

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¹Electrical Engineering, The Univ. of Texas at Dallas, Richardson, TX, ²Department of Electrical Engineering and Computer Science, Vanderbilt Univ., Nashville, TN, ³Department of Hearing and Speech Sciences, Vanderbilt Univ. Med. Ctr., Nashville, TN, ⁴Department of Otolaryngology, Vanderbilt Univ. Med. Ctr., Nashville, TN.

Abstract Body:

Introduction: The electrode-neural interface for cochlear implant (CI) recipients is generally far less than ideal. The placement of electrodes relative to the spiral ganglion not only determines the spatial specificity of neural excitation, but also the characteristic frequencies of neural clusters. Large variation in electrode insertion depths across recipients generally results in a unique frequency-place relationship for each CI user. Despite this mismatch, contemporary CI sound processors are usually programmed to assign a generic, pre-defined frequency allocation to the electrode contacts across all users, with the expectation that CI users will accommodate to the frequency-place distortion with experience. The degree of spectral mismatch and an individual’s ability to accommodate to the distorted spectral representation of the perceived sound may at least be partially responsible for degraded performance or slower accommodation to electrically-evoked hearing with CIs.

Methods: Five adult post-lingually deafened CI users participated in a semi-chronic study that lasted three months. Electrode placements were derived from patients’ CT scans, which were used to create custom frequency-analysis tables for each individual. The frequency fitting strategy aimed at minimizing frequency-place distortions by achieving a balance between frequency matching and frequency compression to provide a physiologically relevant representation of the sound signal. Patients were fitted with these experimental programs and then evaluated on various open-set and closed-set speech recognition tasks in an acute manner as well as following three months experience.

Results: Results indicated that acute performance with the custom frequency allocation scheme was significantly lower than their clinical programs; however, over the course of three months all subjects displayed improvement with the experimental program. By the end of the three-month period, the average speech recognition with the custom maps reached to the same level of performance as of their original clinical map, indicating adaptation to the customized frequency maps. By the end of the study, all participants
chose to keep the experimental program either exclusively, or with their old clinical programs.

**Conclusion:** Perceptual studies with CI suggest that performance levels continue to improve at least up to two years post-activation of new maps. The data from this study indicate that patient-centric optimization of frequency fitting may hold potential for improving implant outcomes, particularly for recipients with moderate to high degree of frequency-place mismatch. Pitch percepts elicited by cochlear implants that are aligned or not drastically different from the normal cortical acoustic map could improve the bottom-up presentation of acoustic cues that may potentially lead to overall better speech perception.
Effects of Microphone Location and Audio Mixing on Speech Understanding in Quiet and Noise: Pediatric Cochlear Implant Recipients

Adrian Taylor, Au.D., René H. Gifford, Ph.D., Linsey Sunderhaus, Au.D., Jourdan Holder, B.S.;
Hearing and Speech Sciences, Vanderbilt Univ., Nashville, TN.

Introduction: It is widely known that cochlear implant recipients experience difficulty understanding speech in diffuse noise. Previous studies have shown that omnidirectional microphone location can impact speech in noise outcomes in adults. For cochlear implant recipients, research has shown that the use of a microphone located at the ear canal (i.e. T-Mic)—as compared to the processor mic—yields significantly higher levels of speech understanding in diffuse noise.1,2 This effect, however, has not been studied exclusively in the pediatric population. Further, many school-aged children utilize personal FM systems in the classroom to improve the signal-to-noise ratio (SNR). General clinical practice is that 50/50 audio mixing is used with FM allowing for equal input from the processor mic and the FM transmitter mic. It is unclear, however, whether the addition of 50/50 audio mixing for an everyday listening program—without a connected external accessory—affects speech understanding performance in quiet and/or noise.

Methods: Sentence understanding in quiet and noise was assessed for 6 children aged 4-14 years. Sentence understanding was assessed using the Basic English Lexicon (BEL) sentences3 in quiet and at +5 dB SNR. Speech was presented at 65 dBA originating at 0° azimuth and the R-SPACE™ restaurant noise was presented from 7 speakers at 45, 90, 135, 180, 225, and 35 degrees. Three different microphone configurations were tested including microphone only (T-mic), processor microphone, and processor mic + T-Mic. The effect of input audio mixing (50/50) was assessed in both quiet and noise for T-Mic as well as processor mic configurations.

Results: Preliminary data indicated 1) the microphone located at the ear canal (T-Mic) afforded a small, yet significant (p<0.05) improvement in speech understanding in noise as compared to the processor mic, and 2) 50/50 audio mixing resulted in significantly poorer speech understanding in noise (p< 0.05) when not using an auxiliary input such as FM.
**Conclusion**: These findings hold significant clinical relevance for pediatric audiologists particularly given that the addition of 50/50 audio mixing in a child’s default program could negatively impact speech understanding without a connected FM system. Thus these data suggest that a secondary dedicated program be saved for FM use. Further, given the improvement in speech understanding with the T-Mic (as compared to processor mic), T-Mic may be the most appropriate microphone configuration for school-aged children provided that 1) regular mic checks are completed, 2) the recipient is capable of reporting concerns regarding sound quality, and 3) backup programs incorporating additional microphone configurations are available for use in case of T-Mic malfunction.

Introduction: Our Cochlear Implant Program was established over two decades ago. Since that time, many changes to candidacy criteria, technology, imaging and audiological assessments have occurred. Additionally, an increase in patient numbers and patient complexity, as well as changes to clinical processes led to challenges in providing seamless interdisciplinary care. In order to improve and facilitate CI patient care, a registered practical nurse (RPN) was assigned to the CI Program. The RPN’s main responsibilities on our team include: CI patient care (including immunizations), appointment scheduling and coordination (including imaging), CI chart maintenance and attendance at team meetings. The purpose of this study was to examine the introduction of an RPN to the CI team and its impact on patient care and team functioning.

Methods: Individual, semi-structured interviews were conducted with six members of the CI Program (surgeon, audiologists, program assistant, program coordinator and therapist) with questions designed to answer the following: (1) Has the inclusion of an RPN on the CI team affected patient care? If so, in what ways? and (2) Has the inclusion of an RPN on the CI team affected team functioning? If so, in what ways? Interviews were recorded, transcribed and analyzed according to standardized qualitative methods and themes were subsequently extracted.

Results: Overall, team members’ responses indicated that the introduction of an RPN had a positive impact on patient care and team functioning. Patient care benefits were identified through the following themes: improved tracking and compliance of CI immunizations; reduced wait times for medical appointments due to more efficient scheduling practices; enhanced patient awareness of the candidacy process; increased organization/support during CI surgeon’s clinics leading to more timely and comprehensive patient care due to improved information sharing among providers. Benefits in team functioning were identified through the following themes: stronger communication among team members resulting in improved interdisciplinary care; increased opportunities for knowledge exchange and greater clinic efficiency leading to a reduction in staffing demands and cost.
Conclusion: The results of this study indicate that the addition of a CI RPN positively affected both patient care and team functioning. According to participants, patients experienced improved knowledge of the candidacy process, better access to appointments and had greater immunization compliance. Team functioning was reportedly affected by way of improved communication, greater interdisciplinary collaboration and more efficient service provision. Future investigations focused on caregivers’ perspective would help better shape and define the role of the CI RPN.
Deafness Severity According to Etiology in Children

Leticia Rosito, PhD, Daniela Marques, masters, Daniela Dall’Igna, MD, Ricardo Kliemann, Student, Andressa Bernardi, Student, Cintia Ogliari, Student, José Lourenço, Student, Celso Dall’Igna, PhD; Hosp. de Clínicas de Porto Alegre, Porto Alegre, Brazil.

Abstract Body:

Introduction: Sensorineural hearing loss in children leads to impaired development of speech, spoken language and academic skills. To the best of our knowledge, few studies associate the severity of deafness with its etiology and this kind of investigation can be very important to define prognosis. The aim of this study is to determine the deafness etiology and to verify the hearing loss degree according to the cause.

Methods: Coorte study performed with 127 consecutive children with sensorineural hearing loss, classified as mild, moderate or severe-to-profound, aged 1 to 120 months (m= 38,5, sd= 32,1 months), evaluated at a tertiary public hospital in a developing country. They were submitted to a specific protocol looking for risk factors and etiology. They were submitted to complete audiological evaluation. Hearing loss was classified according to severity. Children with severe to profound hearing loss were candidates to cochlear implant surgery and the milder cases to hearing aids fitting.

Results: Deafness etiology were: perinatal intercurrences - anoxia, low weight, NICU treatment etc (34%), congenital infections (10,6%), genetics (3,9%) and undetermined (51,4%). Severe-to-profound hearing loss was the most prevalent degree in all groups (63% to 70%), with indication of cochlear implant surgery. Children with perinatal intercurrences showed a greater prevalence of mild hearing loss, although those with genetics cause showed a greater frequency of moderate degree (p=0,046).

Conclusion: Severe to profound hearing loss was the most prevalent degree in our children regardless the deafness etiology. Children with perinatal intercurrences are more likely to have mild hearing loss, whereas those with genetic etiology are more likely to have a moderate degree. Investigation of the hearing loss etiology is very important to define deafness severity and prognosis.
Abstract Body:

**Introduction:** Steroid administration represents another method to attempt hearing preservation during cochlear implantation (CI) in addition to atraumatic electrode technology and insertion technique. Steroids have been shown to protect hearing and reduce inflammation in CI in animal models. There is presently no consensus on steroid administration route, timing, or dose in hearing preservation CI. The objective of this study is to evaluate the effects of different doses of a systemic steroid on hearing and tissue response in a Guinea pig model of CI.

**Methods:** 24 Hartley Guinea pigs with normal hearing and a mean weight of 462 g were randomized into a control group, a “low-dose steroid group” receiving intraperitoneal dexamethasone 2 mg/kg one day prior to surgery, and a “high-dose steroid group” receiving intraperitoneal dexamethasone 100 mg/kg one day prior to surgery. A custom-designed silicone rod served as the cochlear implant electrode that was inserted in each animal’s left cochlea to an insertion depth of 5 mm via cochleostomy. Hearing was measured with auditory brainstem responses at 32 kHz, 16 kHz, and 8 kHz obtained pre-operatively and post-operatively at 1 week, 1 month, and 2 months. Cochlear histopathology was also examined 2 months post-operatively.

**Results:** In all groups, at each post-operative time point, the largest hearing threshold shift from pre-operative thresholds occurred at 8 kHz (p values < 0.05). The high-dose steroid group demonstrated the smallest threshold shift at 32 kHz at 1 week post-operatively, but their hearing threshold shifts increased across all frequencies over time and were significantly larger than the shifts of the control group at 2 months post-operatively (p values < 0.05).

**Conclusion:** Our preliminary results suggest that hearing becomes poorer at 8 kHz, and that high-dose systemic steroid administration may have deleterious effects on hearing over time in implanted Guinea pigs. Histopathology findings will also be presented.
"Ao Pé do Ouvido": Joint Storybook Reading Group for Children with Cochlear Implants

Daniela Marques, masters, Leticia Rosito, PhD, Paula Eustaquio, masters, Isabel Rossato, masters, Greice Chini, masters; Hosp. de Clínicas de Porto Alegre, Porto Alegre, Brazil.

Abstract Body:

Introduction: Development of oral language skills may be a challenge in several cases of children who use cochlear implants. Many studies pointed out that joint storybook reading groups can be a great way to learn vocabulary and develop literacy skills naturally in the environment.

Methods: Two groups of 5 children each and their parents were included in the study. Participants were selected at a public hospital in a developing country. Once a week, they participated in a joint storybook session called “Ao pé do ouvido” with a therapist. Sessions were videotaped during the storybook interactions, and, at the beginning and at the end of three months, a speech therapist, a psychologist and an educator assessed children’s skills. The mothers were encouraged to read books at home and to discuss their experiences with the therapists

Results: Results indicated that joint storybook groups were a great method to improve the auditory and oral language skills, as well as the mother’s self-efficacy perception of their children.

Conclusion: Regardless the age at implant and language development level in the first assessment and socioeconomic profile of the families, reading aloud is a great way to improve the child’s spoken language, and to introduce family literacy practices.
Title: Speech recognition differences between first and second ears in adult patients who have undergone sequential bilateral cochlear implantation.

Introduction: Sequential bilateral cochlear implantation has become increasingly prevalent among adult recipients due to the known benefits of improved sound localization and speech understanding in noisy environments. However, many patients abandon the use of a hearing aid in the non-implanted ear after receiving their first cochlear implant. This may result in a longer duration of deafness for the second implanted ear and may result in worse outcomes for that ear, particularly if there is a significant delay between the first and second cochlear implant. Patients who undergo sequential bilateral implantation provide a unique opportunity to evaluate speech recognition in its relation to duration of deafness and other associated clinical factors.

Objective: The main objective of this study was to examine the relationship between duration of profound deafness in the implanted ear and speech recognition in adults who received sequential bilateral cochlear implants. Other factors, such as hearing aid use prior to implantation, time between the first and second implant, age at implantation, and make/model of the internal device, were also investigated.

Methods: A retrospective chart review was performed at a tertiary academic medical center. Forty-seven adult patients who underwent sequential bilateral cochlear implantation were identified. These adults received their first implant between 1997 and 2014. Patients with device failure were excluded from the study. Preoperative pure tone average for each implanted ear and pre- and post-implant word and sentence recognition scores were examined.
Results: Duration between the first and second implant varied from a minimum of 5 months to a maximum of 244 months. Speech recognition scores obtained prior to and following implantation will be reported for each ear individually. Additionally, scores for the bilateral condition will also be reported. Mean scores obtained 1 year post-implant will be compared for the first and second ears, and the relationship between various clinical variables (duration of deafness, age at implant, make/model of internal device, time of hearing aid use prior to implantation, etiology of deafness, and pre-operative pure tone average) and post-implant speech recognition will be analyzed.

Conclusion: The results of this study will provide information that can be used by audiologists and surgeons when counseling adult patients about the benefits of sequential bilateral implantation.
Auditory-Motor Interactions in the Music Production of Adults with Cochlear Implants

Tara Vongpaisal, PhD, Daniela Caruso, BSc; Psychology, MacEwan Univ., Edmonton, Canada.

Introduction: Cochlear implants (CIs) constrain the perception of pitch in users, yet many continue to participate in musical activities after receiving their implants. To date, there has been no research examining the basis upon which adult CI users integrate electrical hearing input with motor skill to perform a musical instrument. To understand the mechanisms by which CI users learn to produce music, and to what extent auditory and motor systems contribute to this process, we trained adult CI users (n = 5) and hearing controls (n = 15) to learn short sequences on a piano keyboard. We examined how their performance is affected by changes in the melodic and motor sequences of the learned patterns.

Methods: We adapted a training paradigm used previously to examine the motor and melodic contributions in music production of trained pianists. Using an animated learning procedure that removes the constraints of reading standard music notation, we trained participants to perform short melodic sequences on the piano. We then examined the transfer of learning by measuring the participants’ time to perform novel sequences involving a change in the following: 1) melodic pattern only, 2) finger pattern only, 3) melodic and finger patterns, 4) no change.

Results: Hearing controls demonstrated the same pattern of difficulty in the transfer of learning across conditions as trained pianists in previous reports. That is, retaining the same melodic and finger patterns in novel sequences enabled the greatest transfer of learning, while those that altered both of these components yielded the poorest transfer of learning. Sequences involving a change in either the melodic or finger pattern yielded intermediate transfer performance. In contrast to hearing controls, there was no systematic pattern in the latency performance of CI participants across transfer conditions.

Conclusion: While CI users were able to learn piano melodies successfully under the current training paradigm, our preliminary findings indicate considerable individual differences in the transfer of learning to novel sequences. These differences likely reflect...
the influence of CI users' unique hearing histories and adaptive strategies in the integration of electrical hearing input and motor skill for music production.
**Abstract Body:**

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

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

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

**Conclusion:** All these patients even though with different levels of residual hearing preferred to use acoustic hearing, however the degree of benefit differed between the groups. So the differentiation between the groups is very important, because the groups are not equal and their goals in treatment are different. Concluding we can say that even though HP was not successful, some residual acoustic hearing might be helpful for the better performance, so we should give a chance to use acoustic sound to all CI users with residual hearing. However, when discussing the possibility of expanding the criteria for EAS CI candidacy, several unique groups need to be reviewed, each having their own special considerations.
Control Number: 2016-A-921-ACI

Session Number: POS02

Session Title: Poster Session B

Poster Board Number: 55-B

Topic 1: 03c-Outcomes

Publishing Title: Updated Outcomes Post-Cochlear Implantation in Children with Auditory Neuropathy Spectrum Disorder

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Abstract Body:

Introduction: Auditory Neuropathy Spectrum Disorder (ANSD) is a heterogeneous clinical entity for which the optimal method of auditory rehabilitation continues to be a matter of debate. The underlying pathology of auditory neuropathy may impact the inner hair cells, the synaptic connection between inner hair cells and the auditory nerve, and/or the auditory nerve. Diagnostic findings of patients with ANSD include present otoacoustic emissions (OAEs) and cochlear microphonic (CM), but abnormal findings on auditory brainstem reflex (ABR) testing. Such patients rarely receive functional benefit from auditory rehabilitation using traditional amplification. Studies have shown, however, that patients with ANSD can often benefit from cochlear implantation.

Methods: Outcome measures in this population were previously collected and analyzed at this institution approximately 5 years ago. This study includes an updated retrospective review of data from 30 patients with ANSD who received a cochlear implant from this large tertiary medical center. In this study, outcomes of children with clinically significant hearing loss secondary to ANSD will again be compared to those of a matched-pairs group of children with severe to profound cochlear hearing loss who have also undergone cochlear implantation. The two groups will be matched based on age at implantation, cochlear anatomy, and communication methodology. The speech and language outcomes following cochlear implantation in both groups of patients will be compared, and factors that might predict success following cochlear implantation in ANSD will be evaluated.

Results: All children who received a cochlear implant derived benefit from their device. Similar to the previous study, children with ANSD demonstrate wide variability in their post implantation speech perception and speech and language skills when compared to children with cochlear hearing loss. Importantly, children with ANSD without additional disorders perform comparable to children with cochlear hearing loss on the test measures.

Conclusion: Children with ANSD without associated cognitive or developmental disorders performed comparable to matched peers with cochlear hearing loss. Traditional factors associated with better post implantation outcomes, such as age of implantation,
played a role in outcomes in the ANSD group. Findings suggest cochlear implantation for children with ANSD is an effective method of treatment for hearing loss.
Introduction: From the 2000s, the popularization of neonatal hearing screenings (NHS) and nation wide health insurance policies for pediatric cochlear implantation, have led to a recent increase in the number of school age children with cochlear implant (CI) in Japan. However, against there are many reports about Japanese spoken language development at the preschool period of cochlear implanted children, however, until recently, Japanese literacy (reading and writing skills) development of school age populations has not been investigated thoroughly. Especially, predictors at a the time of entering to elementary school to Japanese reading achievement of these children at junior high school have not investigated at all. The purpose of this report was to identify the predictors on Japanese reading achievement of cochlear implanted junior high school students retrospectively.

Methods: 33 junior high school students participated in this study. Average age of them was 14.2 years old at administrated achievement test. Their 1st device was implanted at 4.4 years old (mean) and duration of using CI to this test was 9.8 years. Their CI-aided mean PTA was 26 dB and speech perception score was 85.2 % (mean). Japanese reading achievement was evaluated by using “reading” domain of “Kyoukenshiki NRT Kokugo” (NRT). This test was norm referenced achievement test for Japanese school aged children. To investigate predictor at the time of entering to elementary school for NRT reading score at junior high school period retrospectively, 1) CI-aided mean PTA, 2) Japanese speech perception score, 3) Nonverbal development quotient, 4) Picture vocabulary test (PVT) score at the time of entering to elementary school, and 5) Age at 1st implantation were used as independent variables on multiple regression analysis (MRA).

Results: Multiple regression analysis (MRA) was used to determine the independent contributions of these predictors to NRT reading score. Results of MRA showed two factors or “Nonverbal development quotient” and “Picture vocabulary test (PVT) score” at the time of entering to elementary school predicted significant independent variance, together, accounting for 48 % of the total variance in NRT reading score at junior high school period. On the contrary, “CI-aided mean PTA”, “Japanese speech perceptions score” at the time of entering to elementary school, and “Age at 1st implantation” were not selected as independent variables.
Conclusion: The results of this study indicated that the importance of nonverbal cognitive function and receptive vocabulary skills at preschool period for Japanese literacy development of junior high school students with CI. Namely, for improvement of Japanese literacy of these students at youth, not only CI-aided input, but also visual information through manual mode (ex. finger spelling, sign language) plays salvage function, which covers insufficient auditory information on these children.
A Comparison of BAHA Attract and BAHA Connect to Manage Conductive and Mixed Losses

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Introduction: Percutaneous bone conduction implants like the BAHA Connect have been viable options to manage conductive and mixed hearing losses since early 1980s. These devices are providing direct sound transmission (direct drive) to the cochlea by an extruding abutment. The BAHA Attract, however, is a passive transcutaneous device delivering the sounds through the skin (skin drive) via a magnetic coupling. Some studies have suggested that skin drive transmission reduces output of the device by 5 to 20 dB. However, the impact of this output reduction on patients subjective and objective outcomes has not been investigated. The primary aim of this study was to compare the outcome of patients with conductive and mixed hearing loss implanted with BAHA Attract and BAHA Connect to determine whether new recommendations are warranted.

Methods: In the retrospective study 10 BAHA Attract users with conductive or mixed hearing loss, age at implantation between 44-72 (M=60.8, SD=10.8) years, were recruited and compared with 30 BAHA Connect users with similar types and degree of hearing loss implanted in the same time frame; age at implantation between 14-77 (M=50.8, SD=18.2) years. Three different processors were utilised. Outcomes were measured using direct bone conduction (DBC) measured through the processor, on a test band preoperatively and loaded on implant post-operatively, CNC words and phonemes scores as well as a APHAB questionnaire were assessed at 3, 6, and 12 months post switch.

Results: CNC words and phoneme scores showed a significant difference between the pre- versus post-operatively at each time point (P<0.01). There was a statistically significant relationship between the types of processors and CNC scores (P<0.01). The results for the remaining outcome measures are still under analysis and will be reported at a later stage.

Conclusion: Passive transcutaneous bone conduction implants, such as the BAHA Attract, can be considered in rehabilitation of conductive and mixed hearing losses. However, candidacy should be carefully examined.
Control Number: 2016-A-937-ACI

Session Number: POS02

Session Title: Poster Session B

Poster Board Number: 100-B

Topic 1: 02a-New Indications

Publishing Title: The Impact of Cochlear Implantation on Speech Perception, Articulation, Language and Vocabulary in Children with Asymmetric Sensorineural Hearing Loss

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Abstract Body:

Introduction: This study aimed to determine the impact of cochlear implantation on speech recognition, speech articulation, and expressive and receptive language in pediatric patients with asymmetric sensorineural hearing loss (severe to profound sensorineural hearing loss in one ear, and better hearing contralaterally).

Methods: Children underwent cochlear implantation in the poorer ear, and maintained a hearing aid in the better ear. Developmentally appropriate speech recognition tasks were used for testing in children, including questionnaire, closed-set, and open-set measures. Speech articulation was measured when able using the Goldman-Fristoe Test of Articulation (GFTA). Expressive and receptive language and vocabulary were tested when able with Clinical Evaluation of Language Fundamentals (CELF) or Receptive-Expressive Emergent Language Test-third edition (REEL-3) battery, and with One-Word Picture Vocabulary Test. Data were collected before cochlear implantation and every 6 months after implantation.

Results: Lingual, perilingual, and postlingual losses. Children with congenital sensorineural hearing loss due to cochlear nerve deficiency and with auditory neuropathy spectrum disorder were excluded. There was a significant improvement in speech perception in the implanted ear as expected. Language, articulation, and vocabulary changed variably in the children, and individual results are described.

Conclusion: Cochlear implantation can provide significant improvement in speech and language measures in children with asymmetric sensorineural hearing losses. These children, who are not typical CI candidates, can benefit from a CI in the poorer ear, compared with a HA in the better ear alone.
Abstract Body:

Introduction: Electrocochleography (ECochG) is used clinically for the diagnosis of Ménière’s disease and for intraoperative monitoring of hair cell and auditory nerve integrity prior to cochlear implantation. Another use is to enhance the amplitude of wave I of the auditory brainstem response (ABR). This application is particularly relevant given the recent animal research indicating that the amplitude of wave I evoked with high stimulus intensities can detect noise-induced and age-related cochlear synaptopathy whereas threshold measures do not. The action potential component of the ECochG response corresponds to wave I and is further enhanced when evoked with broadband chirp stimuli as compared to traditional click stimuli.

Objective: The objectives of this study are to determine the amplitude variability of high-intensity, chirp-evoked ECochG recordings and to characterize ECochG amplitude growth patterns generated with a signal-in-noise paradigm.

Methods: ECochGs were recorded from normal-hearing adults (ages 18-30; n=17) using a tympanic membrane electrode. Amplitude variability of the responses evoked with chirps and clicks at 106 dB SPL was assessed by calculating the coefficient of variation (standard deviation/mean). ECochG amplitude growth curves for chirp stimuli at 106 dB SPL were constructed using simultaneous white noise that was high-passed in ½ octave intervals between 722 and 8944 Hz. Distortion product otoacoustic emissions (DPOAEs) were measured before and after the ECochG measures to assess cochlear outer hair cell integrity.

Results: The amplitude of ECochGs evoked with chirps was 1.6 times larger on average and varied 7% less than those evoked with clicks. The within-subject coefficient of variation for the amplitude of signal-in-noise chirp ECochGs ranged from 0.09 to 0.40 with a mean variation of 0.20, which was essentially equivalent to the mean variation (0.21) for the recordings with the chirp signal alone. ECochG amplitude growth curves showed a general pattern of increasing amplitude as the high-pass noise cutoff frequency increased. DPOAEs following the masked ECochG procedure were not significantly different than those measured before the procedure.
Conclusion: These data are consistent with previous research showing a robust ECochG response to chirp stimuli. The relatively stable amplitude of signal-in-noise ECochGs evoked with chirps suggest the potential clinical utility of the technique in localizing regions of synaptopathy within the cochlea. Clinical implementation of this signal-in-noise technique may help tailor cochlear implant mapping and, in the future, guide delivery of neuro-regenerative treatments within the cochlea.