**Abstract Body:**

**SAMBA Audio Processor Upgrade Study**

**Abstract**

**Introduction:**

With the SAMBA VIBRANT MED-EL introduces a new generation of audio processors for the Vibrant Soundbridge and the Bonebridge. Consequently the question arises to what extent an upgrade from the current audio processor Amadé to the SAMBA improves the users’ hearing performance. The aim of this study was to evaluate the user’s benefits of the new sound processing features in the SAMBA in terms of speech understanding in quiet, in noise and furthermore to assess subjective benefits.

**Method:**

Experienced Vibrant Soundbridge Amadé users were included in this study. Initially the unaided performance without the audio processor was tested using free field warble tone thresholds, the Freiburger monosyllables word test (65dB) and the Oldenburger Satztest (OLSA) in two different conditions (S0N180, S180 N0). User Satisfaction was evaluated with the APHAB and HDSS questionnaires. Subsequently users have been fitted with the new SAMBA audio processor on the first day of testing. After two weeks of permanent use of the new audio processor the above mentioned tests were repeated with the Amadé and the SAMBA audio processor in order to compare performance. Additionally subjective benefit with the SAMBA was assessed again via the APHAB and HDSS.

**Conclusion:**

Improved signal processing in the SAMBA audio processor leads to improved audiological results in challenging environments. User satisfaction after a two weeks’ SAMBA trial was high.
Introduction: A systematic review of available literature to study the prognostic value of the promontory and round window stimulations tests (PST and RWST respectively) in cochlear implantation in patients with bilateral severe to profound hearing loss.

Methods: The PubMed, Scopus, Cochrane Library and CINAHL databases were searched from their inception to 6 July 2015 for promontory stimulation test or round window stimulation test and cochlear implantation and their synonyms.

Results: The search of the databases yielded 348 articles and cross-referencing yielded another 2 articles. Of these, 12 articles were eligible for critical appraisal. Critical appraisal showed that 4 articles carried a high risk of bias and thus, we proceeded to extract data from the remaining 8 articles.

There was no standardization across the articles in the performance of the PST or PWST, cochlear implantation, auditory outcome measures and follow-up. As such, we could not pool the data in a meta-analysis and proceeded to summarize the data of the included studies.

Conclusion: This systematic review has shown that the available literature on the prognostic value of PST and RWST in cochlear implantation is scarce and not of high quality. However, most of the included articles suggest that these tests have a correlation with the post-implantation auditory outcomes. As the outcome of cochlear implantation is generally favorable, to be more useful clinically, these tests should be standardized and applied in a select group of patients. Further studies should be strongly considered.
Electrophysiological Measurement of Pitch Perception in Cochlear Implant Users

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Introduction: Pitch is one of the primary auditory percepts. Variation of pitch is associated with the perception of melodies. Thus, perception of pitch is important for music and language perception as well as for segregating the sources of concurrent sounds. In CI users the transfer of spectral components and temporal fine structure is limited and the perception of pitch and timbre still difficult. Auditory pitch detection relies on cochlear and central regularity detection. There are two main concepts of pitch perception, the place code (tonotopy) and the time code (periodotopy). To investigate these components separately stimulus presentation in CI users can be used.

Methods: We examined iterated rippled noise (IRN) perception in normal hearing listeners and CI users with their everyday fitting and a fitting with just one active electrode. In IRN white noise is delayed and added on its original. The frequency of the perceived tonal component is determined by the reciprocal of the delay time and its strength by the amount of added iterations. Difference limens for IRN iterations were determined psychoacoustically before measuring auditory evoked potentials with 32-channel EEG recordings.

Results: Pitch onset response (POR) was found for IRN in both groups. With increasing pitch strength the POR amplitude grows and the latency becomes shorter. Even when presenting the IRN on one single cochlear electrode a pitch perception is reported and in single subjects a POR can be measured.

Conclusion: Pitch perception in CI users can be evaluated objectively and could be used with non-cooperative patients for monitoring of ongoing audio-verbal therapy after CI surgery.
Introduction: A previous unpublished review of preoperative pediatric cochlear implant (CI) patients between 2002-2007 at our tertiary institution revealed 67% of patients were not up-to-date at the time of their surgery. In 2008, a Vaccine Infectious Disease Specialist joined the Cochlear Implant Team in order to address this serious health concern. The objectives of this current study were to review the vaccination status of CI patients implanted between 2010 and 2014 in order to explore whether barriers to child vaccination compliance post-surgery continue to exist.

Methods: Retrospective chart review and a telephone survey. Medical records of 116 patients implanted between 2010 and 2014 were reviewed for demographics, focused clinical history, CI surgery details and vaccination status. 28 patients had been identified as requiring additional vaccines after their CI and a telephone survey was conducted to obtain the current vaccination status of these patients and, if applicable, reasons for non-compliance.

Results: Between 2010-2014, 93% of patients were up-to-date at the time of surgery, compared to 67% up-to-date at the time of surgery between 2002-2007 (a 39% increase). 20 (out of 28) patients completed the telephone survey with 45% (9/20) found to have failed to receive the necessary vaccinations post-surgery. Pneumovax-23, a vaccine specifically for high-risk patients (such as CI candidates), was missed in all 9 cases. The main reason for non-compliance was because parents were unaware that their children required this vaccine by being “high-risk”.

Conclusion: Pre-operative cochlear implant vaccination successfully improved with the addition of a Vaccine Specialist to the CI Team, however 7% of pediatric CI recipients were still not appropriately vaccinated at the time of their surgery. More alarmingly, a large proportion of patients requiring vaccinations after surgery (9/20, 45%) did not receive them. A communication gap continues to exist between the CI team, parents of CI patients, primary care physicians and public health vaccination clinics. Possible solutions to bridge this communication gap include providing families with updated high risk vaccination schedules post-surgery, sending
reminder notifications to families, reminding primary care physicians of this population and notifying public health of high risk status.
Introduction: The objective of this research is to find out the benefits that cochlear implants, using fine structure strategy, give in relation with the perception of music.

Methods: The answers to the Munich Music Questionnaire have been analyzed. This questionnaire made it possible to compare the patients’ musical habits and preferences, before losing their hearing and after being implanted. This questionnaire was administered to fourteen patients, with postlingual hearing loss, users of fine structure strategy. The average age was 54,7 years old (rank: 30 to 76 years old).

Results: The musical parameters these patients have access to, such melody and rhythm, are also described in this research. As regard the way music is perceived through the implant, the most patients have described it is natural, pleasant and clear.

Conclusion: It was then proved that, following the implant activation and after having used this device uninterruptedly for a year, the patients recovered their habits and preferences as regards their perception of music.
Abstract Body:

Introduction:
Since adequate exposure of the round window requires a facial recess approach, facial nerve variation and anomalies could potentially alter the surgical approach significantly. We reported here our experience with retrofacial approach as alternative approach of cochlear implantation.

Methods: Retrofacial approach to access the posterior mesotympanum and visualize the round window. 7 ears in 5 children with bilateral profound sensorineural hearing loss who were cochlear implant candidates. Two patients had bilateral simultaneous cochlear implantations.

Results:
We implanted 7 ears in 5 patients with and without inner ear malformations with an aberrant facial nerve or a posterior displaced round window niche. The standard facial recess approach did not allow visualization of the round window in 2 cases the other 1 case we anticipate easy surgeries with retrofacial surgery pre-operatively in 2 cases we predict by CT scan difficulty of posterior tympanotomy with reasonable access retrofacially. We were able to expose the round window in all cases and proceeded with round window full insertion. Non of our patients required cochleostomy or extended round window technique. We were able to complete the surgery with full insertion of the implant and no complications such as facial nerve injury.

Conclusion:
In cases with an aberrant facial nerve or inaccessible round window through the facial recess, the retrofacial approach is a good alternative but requires a certain level of expertise and familiarity with temporal bone anatomy. The decision to use an unconventional approach should be considered before surgery, but the ultimate decision may require intra-operative assessment.
**Introduction:** Wegener’s granulomatosis (WG) is an inflammatory autoimmune process that affects multiple organs and causes sensorineuronal and conductive hearing losses. The mucosa of the middle ear cleft is characteristically inflamed with fluid accumulation. Profound hearing loss can be caused by WG necessitating a cochlear implantation. Patients with chronic suppurative otitis media often undergo subtotal petrosectomy with a blind sac of the external auditory canal to control infection before cochlear implantation because of the risk of implant infection. It is not known whether surgical treatment before cochlear implantation to control inflammation in patients with WG is needed as in chronic otitis media.

**Methods:** A case report and a review of the literature are presented.

**Results:** A 71 year old lady with bilateral profound hearing loss with WG and nasal, lung and heart manifestations was assessed for candidacy. Treatment with prednisone and methotrexate prior to surgery controlled the middle ear and nasal inflammation. A cochlear implantation in a posterior facial recess approach was performed with no complications. The speech reception threshold was 25dBHL and the monosyllabic word discrimination score was 65% one year after surgery. Three other cases of patients with WG that were implanted have been reported in the literature. Subtotal petrosectomy was not used.

**Conclusion:** Based on the little information available inflammation due to WG can be controlled medically with immunosuppressive medication and a subtotal petrosectomy is not needed as in chronic suppurative otitis media. Significant improvement of hearing can be expected.
Introduction: criteria for pediatric cochlear implant candidacy continue to evolve. The combination of deafness and developmental delay has become more common as increasing numbers of children survive extremely premature birth complications of prematurity often include both cognitive delays and deafness. These children are not routinely excluded. The aim of this study is to evaluate the progress of children with developmental delay after cochlear implantation.

Methods: The study is a retrospective case series analysis of 9 children aged between 2,5 and 6 years at the time of implantation. One child had a severe developmental delay and 8 children had a mild developmental delay. With a good social and emotional interaction development (interactive), the etiology of the handicap was variable essentially: prematurity, prenatal infection, acute fetal distress. The evaluation varies from 1 to 3 years after switch on. Progress in speech perception and speech intelligibility was monitored using the category of auditory perception scale (CAP) and speech intelligibility rating (SIR) but we focused our evaluation in 4 criteria: wearing the device, perception and differentiation between sounds, comprehension and finally speech production.
Results: 4 of the 9 children wore actively their device.
8 of the 9 children perceived and differentiated between the different sounds, understood the meaning of some words like their names, or a simple order.
The production was poor: only 4 children developed speech and vocabulary it was limited to some intelligible words.

Conclusion: If children with low or mild developmental delay in motivated families are implanted earlier they could improve significantly their language.
Improvement of Comprehension by Using Sound Localization Training in an Implanted Single Side Deafness

Introduction: Entering relapsing polychondritis by dizziness and left sudden hearing loss, Mrs P. had her left cochlea implanted even if her right hearing loss was not profound (20 dB). According to the MRI, a left ossifying labyrinthitis was beginning. Auditory rehabilitation in a single side implanted ear, preserving a good hearing on the opposite side, is a challenge because auditory information through the implant of a unique impaired ear is not treated by the cerebral cortex as if both ear were impaired. Usually, audiologists use an active masking in the best ear when training the implanted one. This kind of work requests an enormous effort from the recipient and leads to acute his tiredness. This is also emphasized by the polychondritis itself that can weaken the patient. We propose a new specific sound localization training in order to decrease the number of training sessions and to stimulate the brain in a new way, considering that the work done on sound localization will have an influence on speech comprehension.

Methods: We first ask to do no fitting between the first and the final evaluation in order to avoid any bias. First and final evaluation are similar, including both speech comprehension tests in silence and noise (LAFON words list and HINT phrases). The Sound/Noise (S/N) ratio is 0, +5 and +10 dB for each 40db and 50 dB cocktail party noise. We then add a sound localization test using 8 speakers, 45° from each other, the first one is in front at the patient. They are on a one meter diameter circle around the recipient who is in the center.

Training: Five one hour training sessions are proposed weekly using noise, music and speech. The recipient can easily move and is invited to as she can go to each speaker trying to learn where from the stimulus is coming. At the fifth session, she usually localizes the stimulus without moving anymore and can tell what kind of sound she hears (noise, music, speech). This discrimination and sounds comparison training helps to increase the natural sound localization reflex.

A final evaluation is performed one week after the end of the training.

Results: The recipient describes a more comfortable hearing. Her motivation and confidence in her cochlear implant are enhanced without stressing on the speech comprehension part itself.

Scores in speech comprehension and sound localization are improved between the first and the final evaluation.
Even if audiologists are trying to train the worst ear, no official consensus on the way to do it has been described in the literature as one side impaired and implanted ear is not part of classical cochlear implantation indications. We propose here a stressless and playful way of providing auditory rehabilitation in these particular recipients.

**Conclusion:** Sound localization work is interesting by itself but also permits to increase the speech comprehension in silence and noise. It can also be used in bimodal stimulated recipients or even in recipients with classical hearing devices or bilateral cochlear implants.
Objective: To examine the information obtained by Trans Tympanic Electrically evoked Auditory Brainstem Response (TTEABR) in candidacy, ear selection and compare with outcomes.

Patients: 37 patients were split into two groups. First group consisted of 15 patients with auditory neuropathy/Auditory Dysnchrony (ANAD) spectrum disorder and second group of 22 patients with hypoplastic auditory nerve with or without cochlear malformation.

Method: The stimulus was delivered through transtympanic golf club electrode placed on/around the round window niche. The electrically evoked auditory brainstem responses were recorded using GSI Audera. The presence and absence of Peak V was examined in these cases. The presence of Peak V indicates that the auditory nerve is capable of eliciting synchronous firing which is important for sound perception. The waveform morphology and latencies of TTEABR were considered in ear selection for cochlear implantation. Outcomes were recorded routinely through CAP, LIP, SIR, IT-MAIS, MAIS and aided audiogram.

Results and Conclusions: TTEABR was obtained in at least one ear in 15 out of 22 patients with hypoplastic auditory nerve with/without cochlear malformation and in 13 out of 15 patients in the ANAD group. In patients with responses in both ears, the ear with better morphology and early latency was recommended for cochlear implantation. The outcome measures show variation in both the groups. Hence TTEABR is a useful tool in the test battery in identifying if cochlear implantation would provide sound perception and help in making a decision on ear selection.
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2016-A-54-ACI

Session Number:
POS01

Session Title:
Poster Session A

Poster Board Number:
137-A

Topic 1:
02e-Inner Ear Malformation

Publishing Title:
Cochlear Implantation in Malformed Inner Ear with High Cerebrospinal Fluid Gusher Risk

Author Block:

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Abstract Body:

Introduction: Inner ear malformations constitute about 20% of congenital sensorineural hearing loss (SNHL). 20% - 35% of patients with profound congenital SNHL have radiographic evidence of anatomic inner ear abnormalities. Cochlear implantation surgery for inner ear malformations carries with it the risk of cerebrospinal fluid (CSF) gusher during cochleostomy, which may persist post-operatively; and the difficulty in placement of the electrodes. Finally meningitis which may occur with and without cochlear implantation in this special group of patients is emphasized.

Methods: Between 2007 and 2015, we performed 427 cochlear implantations. 59 patients had inner ear malformations; They were classified as isolated enlargement of the vestibular aqueduct (EVA), incomplete partitions (IP) (IP I, IP II, and IP III), common cavity (CC) and variable canal and vestibular malformations (VSCC). 36 patients had CSF gusher risk (EVA = 13; CC = 2; IP I = 7; IP II = 11 and IP III = 3); for this category we applied a hyerosmolar therapy protocol for all patients.
Results: Mean follow up was 4.7 years (11 month - 8 years). Per operative observations were collected for all patients with an empiric method of evaluation of the leakage, a grading using five steps ranged from Grade 0 (no leak) to Grade 4 (gusher). Important per operative leak was observed (Grade 4 = gusher) in 33% cases (12/36). Grade 4 was seen in 36% cases of IP II (4/11). Grade 4 was seen in 21% cases of EVA (3/13). Grade 4 was observed in 100% case in CC (2/2). Grade 4 was observed in 100% case in IP III (3/3). Grade 4 was observed in 0% case in IP I (0/7). Severe complications were misplacement of the electrode in one case of IP III, persistent leakage in one case and meningitis in one case. With the hyperosmolar protocol we were able to manage all CSF leakage cases even grade 4, and no necessity to perform middle ear and mastoid obliteration only in one case. Lumbar drain is very rarely necessary. Vaccination is essential. Osmotherapy is known to be effective for cerebral oedema and regularly used in neurosurgery. In inner ear malformation, gusher at surgery is directly related to the intra-cerebral pressure. According to our otoneurology and skull base surgery practice, the most important part of the protocol is the hyperosmolar treatment, to reduce the intra-cerebral pressure the time of the surgery and few days after surgery. Our results suggest that this treatment is effective for a better control of leakage at cochleostomy on IP III which is the most severe malformation regarding to CSF leakage. No severe complication related to surgery was seen. Its good tolerance could allow its use in most patients with inner ear malformation.

Conclusion: Hyperosmolar protocol has good tolerance and allows its use in most patients with major inner ear malformation even IP III. CSF leakage can be encountered in cochlear malformations and in cochleas without apparent malformation. Successful implantation without short-term or long-term complications is expected with the hyperosmolar protocol.
Abstract Body:

**Introduction:** Image-guided surgery (IGS) has become a helpful tool for surgeons to accomplish surgical objectives with improved accuracy and safety, particularly in the surgical fields of paranasal sinus and skull base. However, IGS in routine otologic surgery, such as cochlear implantation, is less popular although this region shares the same property with paranasal sinus and skull base, that the surgical field is concealed in the bone and that the small and undetected error in orientation may lead to serious surgical complications. Otologic IGS requires two competing factors. First, otologic surgery only allows noninvasive registration methods because surgery in shallow region in the temporal bone is relatively noninvasive in nature. Second, small anatomical structures in middle and inner ear require submillimetric accuracy of the IGS. The difficulty in developing a system for otologic IGS lies in balancing the noninvasiveness and accuracy. There are a few custom-made navigation systems, including ours, which fulfill both factors to be used in otologic surgery. However, technologies and techniques used in these systems are applicable only in limited devices and not for commercially available navigation systems. Thus, we started a research project to bring the lessons we have learned during developing our IGS for temporal bone surgery to broadly available navigation systems.

**Methods:** We selected the recommended procedures to prepare image-guided otologic surgery using a commercially available electromagnetically-tracked surgical navigation system. In IGS of temporal bone, a reference frame to compensate patient’s movement plays a crucial role. We describe a reference frame that can be secured in a noninvasive manner. Next, a strategic and asymmetrical registration using both ears improves the accuracy by bringing the registration centroid near the operating area. Third, a CT dataset of the temporal bone often includes a set of low-resolution data of the whole head and a pair of high-resolution data of magnified temporal bones of both sides. The registration must be performed using the CT dataset of the whole head, but then can be replaced by a high-resolution dataset so that the intraoperative view in the navigation screen can be improved.

**Results:** We confirmed the theoretical background in experimental temporal bone model study, and then evaluated a commercially available navigation system in actual otologic surgeries under the above-mentioned strategy. The accuracy with our registration protocol was acceptable both in experimental (<0.7mm) and clinical (<1.5mm) settings, but interface on the monitor during surgery
may need refinements.

**Conclusion:** Commercially available surgical navigation systems still have room for improvements, but can be used in better accuracy by performing strategic registration protocol.
Abstract Body:

Introduction:
Many children with congenital malformation of inner ear have undergone cochlear implant surgery. The results for cochlear implant surgery in these children are very encouraging and provide a ray of hope for these patients

Methods:
We report a case of two year old child suffering with Mondini,s deformity who underwent CI with minimal incision cochlear implantation. MICI has been developed with the aims of reducing the impact of surgery on the patient without any preoperative shaving of hairs

Results:
Patient after surgery with MICI showed better looking postauricular scar, low post operative morbidity in comparison to conventional wider access approach and hence earliest switch on of device (1 st post operative day).

Conclusion:
We are of opinion that MICI is safe and successful in Mondini,s deformity
Introduction: The aim of this case report is to present audiological management and results of cochlear implantation of a 15 year old child with Zellweger Syndrome (ZS). ZS, a rare spectrum disorder, is one of a group of related diseases called peroxisome biogenesis disorders (PBD) that have overlapping signs and symptoms and affect many parts of the body. The diseases are caused by defects in any one of 13 genes, termed PEX genes, required for the normal formation and function of peroxisomes. Children with ZS develop life-threatening problems in other organs and tissues, such as the liver, heart, and kidneys. ZS is also characterized by weak muscle tone (hypotonia), feeding problems, seizures, and vision and hearing loss. In cases of severe to profound sensorineural hearing loss, cochlear implantation may be a possible treatment option.

Methods: The present case report describes the results of unilateral cochlear implantation in a 15 year old male with ZS and profound sensorineural hearing loss. Diagnosed with hearing loss at 2 years of age, he utilized hearing aids until he received a cochlear implant at 15 years. Due to effects of ZS such as vision loss, unconventional test methods have been used to obtain information on performance with his cochlear implant. His audiological characteristics and parent-reported benefits are discussed in the report. Video evidence of testing performance is also provided.

Results: Cochlear implantation is an appropriate option of treatment of sensorineural hearing loss in children with ZS. Outcomes with cochlear implantation in ZS are not well reported in the literature. While it is still unclear how successful he or others with ZS will be with developing spoken language, it is shown with this case report that cochlear implantation can provide good access to
audibility of spoken language.

Conclusion: Early identification and treatment of this disease and the subsequent hearing loss is of great importance to rehabilitate the patient to better meet communication needs.
Introduction: Intraoperative testing of cochlear implant device impedances and evoked compound action potential (ECAP) measurements are extremely important to assess the device integrity and response of the auditory nerve. Unfortunately, it is not widely performed due to the inconvenience of requiring an audiologist on site for testing. Surgical times are unpredictable and require the audiologist to be available for far longer periods of time than required for the actual device check. While tele-health and remote procedures are now commonly used for a variety of health-care based procedures, they have not been widely embraced for audiological service provision and generally not used for intraoperative monitoring of cochlear implant surgery. Little information is available from programs that are using this technology in order to allow other centers guidance in implementing this technology. We are documenting our recently implemented remote cochlear implant device operative monitoring of Med-El, Cochlear Americas and Advanced Bionic implants using a System Center Configuration Management (SCCM) System.

Methods: Methods: 1. We included the operating computers in our list of networked computers for each of the three manufacturer software programs used at our center. 2. We selected a readily available remote desktop application that was allowed within our hospital environment (System Center Configuration Management). 3. We obtained programming hardware for each manufacturer that was dedicated to remain in the operating room area. 4. We trained our operating room staff on the appropriate hardware setup and placement for each of the three manufacturer devices used in our facility. 5. We generated a protocol that the Audiologist assigned to assist would be notified approximately 10 minutes before surgical support is needed so that they can log into the OR computer and be on standby to assist. 6. We perform real-time monitoring from a remote location.

Results: Results: Thus far, we have completed over 20 surgeries using remote intraoperative monitoring techniques. In each case, programming times have been significantly reduced. Implementing this technology has allowed us to obtain this critical information in a far more cost-effective and timesaving manner. Surgical support times for bilateral surgeries have been reduced from 3 hours to 20 minutes per patient. Testing has been reliable for all cases. Also, in one of the cases, intraoperative monitoring revealed a faulty
implant which required the insertion of the back-up device.

**Conclusion:** Remote intraoperative monitoring is extremely important and easily implemented using readily available remote desktop technology such as SCCM. Use of this technology allows for our audiologists to see additional patients in the clinic resulting in more billable services while still being available to provide surgical support. As it is easily feasible and reliable, we believe that this should be a standard recommendation for all cochlear implant centers that do not have an audiologist on site to perform intraoperative device monitoring.
Control Number:
2016-A-66-ACI

Session Number:
POS01

Session Title:
Poster Session A

Poster Board Number:
157-A

Topic 1:
02l-Difficult or atypical patients

Publishing Title:
The Role of Subtotal Petrosectomy in Cochlear Implant Surgery: Report of 61 Cases and Review of Indications

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Abstract Body:

Introduction:
SP in association to CI was first described for cases with chronic otitis media or in the presence of a previous radical cavity It has also been used in cases of cochlear malformations and as a salvage procedure for repeating meningitis

Methods:
Retrospective case review undertaken in a terciary referral skull base from 2004 to 2013 we treated 61 patients

Results:
Indications for /
In five cases complications were encountered one subcutaneous cerebrospinal fluid collection two array extrusions one temporal lobe abscess and one abdominal fat infection

Conclusion:
SP combined with CI is a procedure required in specific situations and lowers the risk of repetitive ear infections
Improving Localization and Speech Reception in Noise in Bilateral Cochlear Implant Recipients with Linked Automatic Gain Control

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Abstract Body:

Introduction: Bilateral cochlear implants (CI) have proven advantageous over unilateral to localize sounds and enhance speech understanding in noise, but there are still opportunities to improve binaural cues with two CIs. Bilateral CI recipients primarily rely on interaural level difference (ILD) cues to localize sounds. In order to preserve ILD cues, it is important to address distortions from independent signal processing in the two ears. One possible distortion is automatic gain control (AGC). For example, when loud sounds are at one side, the AGC compresses the signal in the near ear differently than the far ear, distorting ILDs. In this study, we demonstrate benefits of synchronizing gain information across sides.

Methods: We examined localization accuracy and speech reception in noise of bilateral CI recipients in independent AGC and linked AGC conditions. In addition, subjective information was collected about independent vs. linked AGC conditions during a take-home trial.

Localization: Conditions: 1) independent AGCs at 60 dB SPL for baseline, 2) independent AGCs at 75 dB SPL, and 3) bilaterally-linked AGCs at 75 dB SPL. Using the Iowa Environmental Sounds with an 8 speaker array spaced 20 degrees apart (-70 to +70), subjects reported the speaker number of the perceived location of environmental sound (alarm, bell, glass shattering, etc.) The RMS error was measured in each condition.

Speech Reception Threshold (SRT) in Noise: Conditions: 1) independent AGCs vs. linked AGCs in intermittent noise, 2) independent AGCs with automatic sensitivity control (ASC) vs. linked AGC with ASC in continuous noise. BKB sentences (Bench et al., 1979) were presented in sound field with target talker at 65 dB SPL at +10 degrees and four-talker babble at -70 degrees. Level of the talker was adapted to find signal-to-noise ratio (SNR) in dB providing 50% intelligibility.

Take-Home: The Speech, Spatial and Qualities of Hearing Scale (Gatehouse and Noble, 2004) was administered at the beginning of the study to rate level of performance with current map settings. Subjects kept a diary of their experiences. After completion of take-home, the SSQ12C was administered to compare the linked AGC to the independent AGC.
**Results:** Localization: Average of 8 degree improvement* with linked AGC at 75 dB SPL was found for all speaker locations. Every subject showed improved localization with link. The “worst speaker” (largest ILDs due to head-shadow and asymmetries in room acoustics) showed 20 degree improvement*.

SRT in Noise: Average of 2.5 dB improvement in SRT* was found in linked AGC condition when ASC was not enabled. However, with ASC on in continuous babble there was no difference in performance.

Take-Home: Performance with linked AGC was rated positively in SSQ12C* and in subject diary*. Localization and speech in noise were specifically revealed as improved with linked AGC.

(*two-tailed t-test, p<0.05)

**Conclusion:** Linking the AGCs preserves ILD cues, which improves localization. Subjective reports supported lab test results and functional benefits in difficult listening conditions were revealed. ASC can produce similar benefits as linked AGC for speech in noise in certain situations, such as continuous noise due to ASC’s reduction of input level to below AGC kneepoints. ASC won’t deliver this effect in changing noise conditions, however. Both methods are needed to maintain appropriate ILD cues.
Introduction: The number of elderly people who would benefit from cochlear implantation is steadily increasing. Although cochlear implantation is a relatively safe procedure, there is some reticence to subject elderly people, especially those with significant co-morbidity, to the risks of general anesthesia. The most common post anesthesia complications in elderly patients are delirium and postoperative cognitive dysfunction, which both may impair memory, psychomotor speed, and information processing and thus may substantially delay or even impair the rehabilitation process with CIs. The objective of the study was to explore the feasibility of cochlear implant surgery under local anesthesia and sedation via a modified suprameatal approach in elderly patients.

Methods: Seven elderly (≥ 70 years) subjects with severe or severe-to-profound sensorineural hearing impairment and significant co-morbidities underwent unilateral cochlear implant surgery under local anesthesia and sedation. All subjects had been initially reluctant to undergo cochlear implant surgery due to their concerns about general anesthesia until offered surgery under local anesthesia. The subjects were implanted with 24 mm straight electrode array devices through a modified suprameatal approach (see Figure 1). Pain and discomfort was monitored intra- and postoperatively with the Numeric Pain Rating Scale 11. Clinically relevant aspects were reviewed.

Results: Cochlear implantation under local anesthesia and sedation was successful and well tolerated in all subjects. Intraoperative pain could be easily controlled. No intra- or postoperative complications occurred. Recovery was quick and all subjects were discharged on the first postoperative day. All subjects would opt again for the procedure under local anesthesia.

Conclusion: Cochlear implantation under local anesthesia and sedation was found to be feasible. The modified suprameatal approach lends itself for procedures under local anesthesia, because only minimal drilling is required. The application of this technique provides a safe and efficient alternative especially for the elderly with significant co-morbidity and increased risks for general anesthesia.
Introduction: Evaluation of electrode placement is usually performed after cochlear implant surgery, leading to a revision surgery in case of incorrect placement of the electrode array. An intraoperative imaging based on skull x-ray performed in Stenver’s incidence is possible, but can miss a misplaced electrode, such as an electrode positioned in a semicircular canal. Moreover, interpretation of electrode position on plain radiography can be difficult in case of abnormal cochlear anatomy and complex middle ear deformity. The O-arm® imaging system (Medtronic) is a mobile Cone-Beam computed tomography (CBCT) which can be used in the operation room.

Methods: Electrode placement has been intraoperatively assessed using CBCT in 30 adult patients aged 54 ± 17.6 [31-87] implanted with the four brands of cochlear implant (Cochlear n=19, Medel n=7, Advanced Bionics n=3, Oticon n=1). One patient had a major middle ear malformation due to an external ear aplasia. In one case, the CBCT was performed during a revision surgery for a device migration to verify the absence of electrode displacement.

Results: CBCT imaging using O-Arm® required that the patient was operated on a radiolucent carbon-fiber surgical table in a dedicated operation room adapted against radiation. Fluoroscopy has to be done before 3D acquisitions in order to verify the good positioning of the head patient into the gantry. A training was required for the first six CBCT; the scanners were then performed by the surgeon in all cases. For the last ten patients, the total duration of the procedure including the installation of the gantry and reconstruction was less than 6 minutes. The radiation dose ranged from 0.7 to 1.5 mGy for fluoroscopy and 12.41 mGy for 3D scan that is lower than radiation dose for a CT scan. The assessment of electrode position within the cochlea was possible for the four brands of cochlear devices, even in case of malformation. The resolution was lower compared to a CT scan or conventional CBCT and was not sufficient to visualize the exact position of the electrode array into the cochlea and a scalar translocation.

Conclusion: Intraoperative CBCT using O-Arm® device is a safe, rapid and easy procedure to assess the electrode position within the cochlea. O-Arm® is particularly helpful in case of anatomical problems or in revision surgery and simplify cochlear implantation in one-day surgery.
**Introduction:** The Naida CI Q90 EAS System is a new sound processor which integrates both acoustic and electric sound processing within one device to meet the needs of the cochlear implant (CI) recipients with residual acoustic hearing. The objective of this project was to evaluate the usability of the Naida CI Q90 processor with EAS functionality and related accessories for both CI users and professionals.

**Methods:** Questionnaires were handed over to CI users and professionals. CI users were asked to use the new processor between four and eight weeks before completing the questionnaire. The latter contained subjective questions about ease of use and sound quality as well as objective data about fitting, listening configuration and user performance. Both new users and upgraded users from a previous sound processor or hearing aid could participate. In parallel, professionals were asked to provide feedback about practicality and ease of use of the new EAS system and related accessories.

**Results:** Studies conducted so far showed positive feedback on sound quality as well as improvements in speech understanding. However, users’ feedback and electro-acoustic parameters vary largely from user to user. Data collection is still ongoing; results from the preliminary experience with the Naida CI Q90 EAS System collected through these questionnaires will be presented.

**Conclusion:** Although only preliminary outcomes are available so far, the Naida CI Q90 EAS System provides hearing improvements to CI users with residual hearing. Having access to various fitting parameters of electro-acoustic stimulation seems important in order to optimally meet each user’s needs. At project completion the results will provide more insight on these aspects from a larger group of CI users and professionals.
Introduction: It is recognised that access to cochlear implantation (CI) for adults, especially older adults, is well below expectation. Trying to understand some of the reasons for this, despite that CI surgery is a mature service, are still centred on lack of awareness. This can be at the patient / public level but also it is perceived that there is a general lack of knowledge about indications for referral in health care professionals. However, even when some patients have been identified, as been suitable candidates, they have not wished to participate for fear of surgery. Deafness is associated with various medical ailments, including mental and societal problems. Implantation is aimed to reduce cognitive decline but similarly postoperative cognitive dysfunction (POCD) is recognised factor following general anaesthesia (GA). CI under local anaesthesia (LA) should be considered as an option for patients.

Methods: The methodology of this study was in two phases. First, was to audit the knowledge base within healthcare professionals and act accordingly and re-audit. The second was to evaluate the response and outcomes of CI in adults, especially the elderly. Clinical scenarios, which included aetiology of hearing loss, specimen audiograms, mode of communication, age and health were formulated and circulated to various health professionals using ‘survey monkey’ questionnaire in 2012. These were sent to ENT surgeons and audiologists. The second phase was prospective monitoring of the service demand and outcomes of patient assessments were conducted over the last 3 years. This included suitability, and if suitable the uptake of the CI surgery. In addition the uptake of CI under LA was evaluated.

Results: 136 ENT surgeons and 53 local audiologists responded to the survey. Appropriate responses from surgeons ranged from 50% - 80% correct; audiologist 22% - 68%. Not all ENT surgeons who responded were Otologists. As all patients would be seen by an audiologist training seminars were held and the process re-audited showing a significant improvement in understanding. As a result referrals doubled to an average of 112 adults / year. Paediatric referral also rose slightly. The proportion of adults not meeting strict inclusion criteria remained the same. Of the remainder offered surgery 18% initially did not want to have surgery but the uptake increased when LA surgery was offered.
Conclusion: Improved training of audiologists has significantly increased referrals and number of CI implantations in adults. More elderly referrals were received but the proportion not suitable for CI remained the same. Following assessment of those found to be suitable, initially 18% declined because of the surgical aspect of treatment. When offered under LA the uptake improved. We have found that such surgery was very well tolerated and as a result in the last couple of years have offered LA for all elderly patients and those past their 1st trimester of pregnancy. We are monitoring the impact of dementia in those not suitable for surgery and those that have received CIs.
Introduction: Chronic demyelinating inflammatory polyneuropathy (CDIP) is considered a chronic form of Guillain-Barre disease and has been rarely associated with cochleovestibular dysfunction.

Objective: describe a case of CDIP which presented with bilateral sudden sensorineural hearing loss and has subsequently benefited from unilateral cochlear implantation.

Methods: case history review and review of the literature for the terms CDIP, hearing loss, cochleovestibular dysfunction, and cochlear implantation.

Results: 49 year-old woman presented with bilateral rapidly progressive SNHL 1 month after a upper respiratory tract infection. Hearing loss was not responsive to high-dose steroids and there were no other laboratory abnormalities or physical findings. Within 1 month, she then developed ascending motor palsy requiring long-term ventilator support. This neurologic condition was diagnosed as CDIP and she was successfully treated with plasmapheresis and IVIG. Her hearing never recovered. At the time of cochlear implant evaluation she had no response at the limits of the audiometer and obtained 0% on AzBio testing. No ABR could be recorded preoperatively. She underwent uneventful cochleapheresis with a perimodular electrode. Three months after activation she had 21% on AzBio testing and a pure tone average (PTA) of 35dB. One year after activation she had a PTA of 20dB and 40% on AzBio sentence testing. Her eABR demonstrates a neuropathy pattern and tracings will be presented. Only 2 other cases of CDIP associated with dysfunction of the 8th nerve have been described, neither had documented profound hearing loss.

Conclusions: severe SNHL associated with CDIP is very rare. Although this patient has good access to sound, speech discrimination is poor at one-year post implantation. This outcome is possibly due to incomplete recovery of myelination of the 8th nerve after.
treatment for CDIP. Other possibilities include loss of peripheral nerve fibers due to the initial viral URI which may lead to less neural substrate to stimulate.
Introduction: Benefit from cochlear implants is no longer questioned; however, many recipients still experience difficulty when using the phone (Adams et al 2004; Clinkard et al. 2011). A relationship between phone use and quality of life has been demonstrated (Rumeau et al. 2014). The aim of this study was to evaluate the benefit provided by a hands-free connection to the sound processor using the Cochlear™ Wireless Phone Clip.

Methods: Nine cochlear implant recipients (mean age 47yrs, range 9-87yrs) participated in the study. All recipients were fit with a Nucleus CP900 Series Sound Processor allowing for a hands-free phone connection with the Phone Clip. Speech understanding was accessed as well as Quality of Life using the Kepler questionnaire. Speech understanding was tested under four conditions: in quiet and in noise, both with use of the Phone Clip and without (phone positioned close to the processor microphone input). HINT lists (Hearing In Noise Test), which were previously recorded as a message on the answering machine of the cell phone, were played back via cell phone to assess speech understanding. Cocktail party noise was presented at 65 dB SPL from a speaker positioned 1 meter in front of the recipient. The Kepler questionnaire (Kepler, Terry & Sweetman, 1992) was administered twice, with the Phone Clip and without. The questionnaire was administered before and after experience with the Phone Clip.

Results: Speech understanding scores were better with the Phone Clip in both quiet (p=0.001) and noise (p=0.001) conditions; cf. Fig. 1. Overall, Kepler scores were better with use of the Phone Clip, with 2 questions (Q16 & 19) showing significant improvement (p=0.02 and 0.06 respectively); cf. Fig. 2.

Conclusion: The Phone Clip, which provides a wireless hands-free connection between the phone and sound processor, enables better understanding in noise and quiet. Speech understanding results were confirmed subjectively with the Quality of Life Questionnaire (Kepler) showing significant improvements in specific contexts. Although preliminary, these results suggest improved resistance to noise with this type of hands-free accessory.
Comparison of Electrode Discrimination Abilities in CI Carriers Using Cochlear Straight and Perimodiolar Electrode Arrays

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Abstract Body:

Introduction:
Multichannel electrode array design has evolved into two major categories: straight and perimodiolar electrodes. When implanted, the first category of arrays lies along the outer wall of the scala tympani. However, animal experiments and computer modelling studies have indicated that the preferable position of an electrode array is close to the modiolus. However, their advantage for pitch discrimination has not been conclusively stated.

Methods:
An in-house psychophysical platform was used to conduct this experiment under a NIC licence agreement with Cochlear LTD. It allows customization of electrical pulse parameters, measurement of threshold and comfort levels, loudness balancing and alternative forced choice experiments to determine electrode discrimination in Nucleus (c) users. Using this tool, The ability to discriminate electrical pulses from adjacent and near-adjacent electrodes at low intensity level (matching 25% of the DR of electrode 11) for patients carrying straight (422 cochlear) and perimodiolar (Cochlear CA (RE)) arrays was investigated.
Results:
Preliminary results suggest a connection between electrode placement, threshold levels and electrode discrimination. The results are ongoing and final data will be presented at the conference.

Conclusion: Electrode array geometry and placement within the cochlea appear to have an effect on electrode discrimination ability and on electrical hearing thresholds. This study further evaluates the use of perimodiolar guides as a way to improve performance in CI recipients.
Control Number:
2016-A-88-ACI

Session Number:
POS01

Session Title:
Poster Session A

Poster Board Number:
197-A

Topic 1:
01c-Anatomy

Publishing Title:
Model Adaptation for Mesh Generation of Patient Cochlears from CT Scan Images

Author Block:
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Abstract Body:

Introduction: The generation of 3D meshes of biological structure images for simulating pathologies, prosthesis and behavior of different organs presents a great challenge when little information is available. In this case, a compromise is required between emitted radiation, exposure time and desired image quality. Moreover if we use high radiation and long exposure time, there can be no guarantees that sufficient data will be collected.

Methods: The key of this method consists on deforming the mesh of a generic cochlea in order to obtain a mesh of a specific one. The input data are both the mesh of the generic cochlea and the data collected by Computerised Tomography (CT) scan, Magnetic Resonance Imaging (MRI), etc. This technique involves genetic algorithms for adjusting the nodes of the input mesh to the collected points, Radial Basis Functions to deform the input mesh, and optimization of the final mesh.

Results: We propose a technique to generate cochlear models when a given set of images with sparse data is given. This technique involves genetic algorithms for adjusting the nodes of the input mesh to the collected points. Radial
Basis Functions for deforming the input mesh, and mesh optimization.

**Conclusion:** A critical point is the selection of handle points. Future research will involve the improvement of the method adopted for this selection, e.g. using landmarks. A proper handle point choice has positive effect in the fitting of the acquired data to mesh.
Abstract Body:

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

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

Results: We noted a discrete masculine predominance, the sex ratio is of 1,04 boy for a girl.
Middle Age is of 3 years 9 month, a standard deviation of 19 months, with an extreme of 19 month minimal and maximum age of 7 years
41% had similar cases in the family.
21% of the implanted children had two deaf cases in the family, 14% had three cases, two implanted children had four profound deafness in the family, and one had seven deaf cases in the family.
We noted the presence of two cases deaf in the siblings in 18% of the established children, and three deaf persons or more in the family in 6,98% of the implanted children.
We noted the concept of fever in the personal antecedents at 23, 26%, two cases of meningitis were announced, and persistence of arterial channel among two patients, 04 children had hyperpyretic convulsions.
18,60% of these children had an otitis associated with deafness at the time with the diagnosis, taken drugs during the pregnancy was noted at 27% of the cases.
The radiology finds a pathological cochlea in 16% of the patients, cochlea deformity in 14%, cochlear ossification in 2%, a dilation of the vestibular aqueduct in 7% of the children, procidence of the facial nerve in one patient, and procidence of the side sine in 12% of the children.
The congenital causes of deafness was noted in 95.35%, 53.49% are genetic syndromic, and 32.56 are genetic nongene-syndromic, other share the type acquired in 4.6% which are post-meningeal.

The choice of the operated ear: was made according to several parameters: dexterity, residual hearing, and the disorders vestibular. We placed a Medel implant to date in 51%, Cochlear implant in 49%, the insertion of the implant by the round window at 83% and by

the opening of the cochleostomy in 16.28%, the geyzer was seen in 9.30%.

we carried out an audiometric evaluation in free field and orthophonie of our patients, the consanguinity is a determining factor in hearing perception the production of the language, the

relation is significant the P is equal to 0.05, the second factor is the age of implantation, we obtained better results among patients operated at early age, a 0-2 years, and 2-4 years in comparison with the children operated with age more than 4 years.

**Conclusion:** The study of the associated factors with deep deafness in the child allows to understand the hearing evolution of the deaf patients, and to reinforce an orthophonie reeducation in a more rigorous way in order to improve these results.
Control Number:
2016-A-92-ACI

Session Number:
POS01

Session Title:
Poster Session A

Poster Board Number:
153-A

Topic 1:
02i-Radiology/Imaging

Publishing Title:
Selecting the Appropriate Cochlear Electrode Array Using a Specifically Developed Research Software Application

Author Block:
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Abstract Body:

Introduction: Cochlea size varies among people. For an individualized cochlear implant (CI) solution, it is helpful to know each individual’s cochlear duct length (CDL). In order to quickly assess an individual’s CDL, a research software application was developed. Clinicians can use this information to select the cochlear electrode array size that is individually suited to each CI recipient. Further, the research software application allows users to post-operatively determine the percent of cochlear coverage, the insertion depth of individual electrode contacts, and the insertion angle of individual electrode contacts. This information allows users to more easily conduct fittings or deactivate electrode contacts that are stimulating dead regions or are, in the case of incomplete insertion, outside the cochlea.

Methods: Before surgery, the maximum basal turn diameter (value “A”) was measured on a coronal section of high-resolution computed tomography (CT) of the temporal bone. Based on “A”, the research software application calculated the CDL, and either a long electrode or a shorter electrode was chosen for implantation. After implantation, the results of 4 patients obtained using the research software application were compared to their postoperative X-ray of the cochlea and to the intraoperative notes made by the surgeon.

Results: The research software application was used in 21 patients (23 ears). The A distance measured on CT scans varied from 7.8mm to 9.7mm with a mean value of 9.14mm (9.03mm in women and 9.21mm in men). The measured “A” distances correspond to CDLs varying from 28.5mm to 36.4mm. The mean CDL was 34.05mm (33.60mm in women and 34.35mm in men). The cochlear coverage was over 80% in all cases. Full insertion was achieved in all but 2 cases. X rays were performed for 2 long electrodes and 2 shorter electrodes. In all 4 cases, the electrode was chosen based on the research software application. For both shorter electrodes, the calculated insertion depth using the research software application was 27mm. In both cases, full insertion was achieved. For both long electrodes, the research software application suggested an insertion depth of 30.5mm and it was 30.4 and 28.2mm according to the X-ray. Again, full insertion was achieved in both cases.
Conclusion: The results suggest a good correlation between the insertion depths predicted preoperatively using the research software application and the insertion depth calculated postoperatively using the X-ray.

Acknowledgements: Special thanks to Ursula Lehner-Mayrhofer who provided expertise in writing this paper.
Introduction: Cochlear implantation is an effective procedure for restoring hearing capacity to individuals with severe-to-profound hearing impairment. Since the development of cochlear implantation in the 1960s, both the surgical technique and the implant design have been modified to reduce complication and allow better functional results. The classical technique for placing cochlear implant (CI) involves mastoidectomy and posterior tympanotomy. However, only few alternatives to this classic approach have been described in the literature. The suprameatal approach was developed by Kronenberger et al. in 1999. This method is a simple and safe surgical procedure that does not endanger the facial nerve and the chorda tympani.

Methods: The purpose of the present paper is to report
the results of our study of anatomical variation and relations of the middle ear on the large collection of the temporal bones. Attention was paid to the structures and landmarks which are important for CI.

Results: In the mastoid region we examined and precisely defined: the type of pneumatization, the position of the sigmoid sinus, the course of the mastoid segment of the facial nerve and the facial recess. We noted great variability in the course of the facial nerve through its mastoid segment. The nerve bifurcation distal to the second genu was found in two cases. Dehiscence in the bony covering of the facial nerve were observed adjacent to the facial recess. Variations in the location of the chorda tympani nerve were also described. In the area of the attic we described the morphological variations of the medial and lateral compartment and their communication with the other middle ear spaces. The compartment of the attic varies in shape and dimensions, depending upon the position of the auditory ossicles (the body of the incus and the head of the malleus) in relation to the attic walls, the degree of prominence of lateral semicircular canal and the direction of the course of the tympanic segment of the facial canal.

Conclusion: Knowledge of the morphological relations and variations is important for classical and alternative surgical method for cochlear implantation.
Control Number: 2016-A-99-ACI

Session Number: POS01

Session Title: Poster Session A

Poster Board Number: 9-A

Topic 1: 04b-Rehabilitation

Publishing Title: Cochlear Implantation in Cases of Single-Sided Deafness: Auditory Rehabilitation Outcomes

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Abstract Body:

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

Methods: All subjects participated in two aural rehabilitation sessions. Sessions were completed at the initial activation and 1-month post-initial activation of the external speech processor. Each participant was tested using the designed test protocol to quantify outcomes of adults with single sided deafness. Progress will be reported in percentages.

Results: All subjects reported an improvement in speech
perception, localization and/or quality of life within the initial three months of listening experience.

**Conclusion:** Overall, adults with single-sided deafness who receive a cochlear implant show benefit regarding restoration of auditory skills in their implanted ears.
Introduction: The Chinese language is a tonal language and change of lexical tones will change the meaning of a word. The introduction of cochlear implant in rehabilitation of deafness allows an opportunity to study the pattern of language recognition and development in a specific population. This study aims to review the outcomes of cochlear implant in Chinese patients with reference to the language characteristics.

Methods: A critical appraisal of the topic was undertaken by the authors with literature search from 1996 to 2015 through systemic searching of the Medline, reference texts, and Chinese publication database. Selection was based on relevance of the publication in relation to Chinese language perception. Studies and reports were classified according to the time of publications, age of subjects, etiology/ duration of deafness and types of Chinese languages. Stratification was undertaken when it was feasible to do so according to preset criteria. Summary tables with pooled analysis were reported.

Results: Research undertaken in the past two decades in Hong Kong and China has demonstrated the successful acquisition of tones in adults and children undergoing cochlear implant surgery. The correlation of tonal language development and perception was found to be with the implanting age in children and it is also a major factor in determining the speech and language outcomes in adults and children.
Conclusion: It is feasible to target tone perception as a specific cochlear implant system for Chinese speakers.
Introduction: Recently there has been an increase in the numbers of congenitally deafened adults seeking a referral for cochlear implantation. These 'non-traditional' candidates fall within NICE criteria for unilateral implantation in adults in the UK. However, many of them are unable to complete the outcome measures typically used in cochlear implant recipients due to limited receptive speech and language. Therefore it is not possible to measure actual benefits obtained from cochlear implantation in this patient group as traditional outcome measures are inappropriate. This means that currently UK practice is to offer these patients an implant, without any convincing method of measuring their perceived benefits. Instead, they are typically referred to as "poor performers".

The key question of the Focus Group was to determine the differences having a cochlear implant has made to their lives.

Methods: We ran a series of focus groups with born deaf and prelingually deafened adult cochlear implant recipients asking about the actual benefits they receive to determine aspects of cochlear implantation that are important to this group. An adaptive focus group approach was adopted using British Sign Language (BSL), BSL interpreters were used to assist in the identification of themes, the groups were videoed.

The focus group looked at three key aspects:
Functional hearing, social interaction and emotional effects
using an adapted focus group method for use with British Sign language (BSL) users. Data from the focus groups was transcribed and will form the basis of a future grant application to develop a robust tool for measuring outcomes and addressing patient expectations in this challenging group of patients.

Results: Systematic analysis were conducted to establish the key differences a cochlear has made to these prelingual cochlear implant users in terms of outcomes, quality of life, with both positive and negative factors.

Results suggested that having a cochlear implant did not change their self perception; they considered themselves deaf individuals, however the described increased confidence, in social situations, and felt less frustration with their deafness. Some of the negative
aspects were initial surprise at unexpected and unfamiliar sounds, Frustration because of poor localisation requiring the input from a hearing person to help locate and identify new sounds.

**Conclusion:** These focus groups demonstrated that prelingually deafened adults gained benefit from cochlear, however it became apparent than their assessment and rehab requirements are different from post long deaf adults. It is therefore recommended that a rehab programme specific to this group becomes a routine part of clinical practice.
Publication Title: Active Bone Conduction Implant: Clinical Results of our First 20 Patients

Author Block: Carlos De Paula, MD, PhD, Nabil Atrache Al Attrache, MD, Abel Guzman, MD, Laura Cavalle, MD, Constantino Morera, MD, PhD; ENT, UNIVERSITY HOSPITAL LA FE VALENCIA, Valencia, Spain.

Abstract Body:

Introduction: The active bone conduction implant improves hearing by providing acoustic information to the inner ear via transcutaneous/bone conduction. The objective of this study is to compare functional hearing levels in patients with hearing loss before and after implantation.

Methods: Audiometric tests were performed on 20 patients (mean age: 44 years, ranging from 12 to 67 years): 15 patients diagnosed with conductive or mixed hearing loss (CMHL) with bone conduction thresholds above 45 dB and 5 diagnosed with single sided deafness (SSD). The hearing level comparison was performed using the Pure Tone Audiometry average (PTAa) from 500 Hz to 4000 Hz and also the auditory thresholds at each of those frequencies in every single patient, which were measured before and after implantation with conventional audiometry and free field tests. Additionally word recognition scores were measured and compared before and after implantation.

Results: PTAa improved considerably after implantation in all patients when comparing auditory thresholds before and after surgery: From 73 dB to 39 dB in CMHL (p<0.001) and from 109 dB to 30 dB in SSD (p<0.01). Word recognition scores (at 65 dB) in patients with CMHL improved from 49% unaided to 84% with the implant (p<0.01) and in patients with SSD improved from 10% unaided to 78% after implantation. (p=0.04) The APHAB (Abbreviated Profile of Hearing Aid Benefit) questionnaire yielded encouraging results regarding the percentage of difficulties in implanted patients. Neither intraoperative nor postoperative complications were reported, as well as for skin infections in the implant zone.

Conclusion: The active bone conduction implant provides significant functional gains and improves word recognition for conductive and mixed hearing loss as well as for single sided deafness. Subjective patient scores and evaluations are also shown to be very positive.
Abstract Body:

Introduction
Cochlear implants (CI) have proven very useful in restoring hearing in severe to profound hearing loss. In some countries, unilateral CI in unilateral deaf patients can be provided if indicated.

Objective
To quantify the potential benefit of a CI in asymmetrical hearing loss for the purpose to better counsel potential candidates and to provide arguments regarding the reimbursement bodies.

Methods
47 patients with asymmetrical hearing loss who received a cochlear implant on their severe to profound hearing impaired side were included in this study. Of these, 12 had unaided hearing on the better side, 37 had a hearing aid. We performed monosyllable and sentence speech testing in quiet and noise, directional hearing tests and used the APHAB questionnaire.

Results
The mean score in the Freiburg monosyllable testing at 65 dB was 55% in the monaural and 84% in the binaural situation in quiet. In the adaptive Oldenburger sentence test at 65 dB noise level, the mean signal to noise ratio was 6.6 dB in the monaural and -0.2 dB in the binaural test situation. In the Göttinger sentence test, the mean score in the monaural condition in quiet was 53 dB while in the binaural condition 47 dB. In noise, the monaural mean score was 74% while in the binaural testing 67%. In the directional hearing testing, the average of correctly identified sound sources was 14% in the monaural and 28% in the binaural situation. In the APHAB testing, the scores for “background noise”, “reverberation” and “ease of communication” did improve, while the “aversiveness”-score got worse.
Conclusion
Patients with asymmetrical hearing loss can benefit significantly from a CI in terms of speech discrimination in quiet and noise. Also, the sound localization gets better. All but one category of the APHAB-score did improve. While it seems to be mostly beneficial for those patients, careful counseling and further evaluation is needed.
Introduction: Participant is a 7-year-old child with an auditory brainstem implant (ABI). She underwent sequential cochlear implantation (CI) at 10 and 13 months of age. Minimal progress in speech development following CI was attributed to bilateral Cochlear Nerve Deficiency. Participant underwent Auditory Brainstem Implantation (ABI) around her 5th birthday in her right ear after explanting the CI in that ear. In terms of auditory skills, participant is able to detect and discriminate some early vocabulary words, environmental sounds, syllable patterns, voiced and voiceless phonemes with the ABI, but used very few words spontaneously. With total communication used at her school, she primarily used signs to communicate with her family and friends. Following activation of the ABI, she received one year of weekly Auditory-Verbal Therapy that used multisensory cues in addition to auditory-only rehabilitation procedures. Sign was the dominant language used at home. The purpose of this study was to document speech production development by comparing speech samples collected before and after ABI.

Methods: Digital audio recordings were carried out in a quiet room using a Yeti cardoid, unidirectional, USB microphone. Speech samples were recorded at a sampling rate of 44,100 Hz and 16-bit quantization using the Wavesurfer program. Participant produced very few utterances spontaneously during the two pre-ABI sessions and therefore samples included only imitative production of isolated vowels and words. During the three post-ABI sessions, each scheduled 6 months apart, both imitative and spontaneous speech samples were collected. A total of 508 vowels from the pre-ABI sessions and 623 vowels from the post-ABI sessions were analyzed to estimate vowel formant frequencies (F1, F2), vowel durations and vowel fundamental frequency using a custom MATLAB program. These parameters were compared across pre-ABI and post-ABI sessions to assess speech production development following ABI.

Results: Vowel F1 X F2 plots revealed a substantial overlap in vowel categories for samples from the pre-ABI sessions. The vowels produced during the post-ABI sessions revealed a slightly expanded and differentiated vowel space. Additionally, vowel durations decreased significantly from the pre-ABI samples to post-ABI samples. Vowel fundamental frequency continued to remain high and
did not show any differences between pre- and post-ABI samples.

**Conclusion:** Acoustic analyses revealed progress in terms of growth and differentiation of vowel space and change in vowel durations toward more age-appropriate values. Findings will be (1) discussed in reference to information provided by the ABI device and (2) discussed in terms of the role of auditory feedback in speech production.
Introduction:
Research has shown the benefits of explicit instruction and shared literacy interactions at home on a young child’s developing spoken language, reading, and writing skills. In an attempt to “bridge” observed gaps in literacy and language skills between deaf and hard of hearing children from low SES bilingual (Spanish-English) households and typically hearing children, we have implemented an intensive 3-week summer intervention program rooted in a balanced literacy model. The program provides children, parents, and teachers with explicit training and experiences designed to build and strengthen foundational literacy knowledge and skills.

Objectives:
1) To assess the stability and growth in language, reading and writing skills in children who have participated in a 3-week literacy intervention for more than one summer.
2) To compare early language, reading and writing skills in children who participated for more than one summer to those participating in the 3-week intervention for the first time.

Methods:
Seventeen children between the ages of 4½ and 8 years were enrolled in the 3-week intervention during summer 2014. Ten of these children returned for the 2015 summer session, along with nine additional children attending for the first time. Each summer session followed the same format. Children received 36 hours of explicit literacy instruction. Instruction focused on early literacy skills, including print-concepts knowledge, phonological awareness, and writing skills. Children were placed in 4 groups on the basis of age, communicative competence, and literacy skills. Pre- and post-assessments were conducted on targeted skills, including language and literacy measures. Parents also received instruction in literacy strategies during the course of the summer
Results:
Children returning for a second year in the summer intervention demonstrated improved expressive language scores in English at 2015 program entry compared to those they demonstrated immediately following the 2014 intervention (median raw score, CASL syntax construction = 13.0 vs 5.0 respectively). Moreover at 2015 program entry, expressive language scores were higher for these returning children than for those children participating in the program for the first time (median raw score, CASL syntax construction = 3.0), even though age at enrollment was roughly equivalent for the two groups (median age: returning children = 5.72 yrs; new children = 5.85 yrs).

Children returning for a third year (after participating in 2013 and 2014) showed similar gains in expressive language as those with one year of previous experience. In addition, both groups of returning children demonstrated steady gains in written language skills between the 2014 and 2015 sessions.

Conclusions:
Children who participated in consecutive years of explicit literacy intervention showed gains in spoken and written language over the course of one to two years. We suspect that this reflects not only the child’s participation in the summer intervention, but reinforcement of foundational skills through shared literacy interactions and experiences at home.
 outcome Measures After the Controlled Market Entry of the Incus-LP-Coupler, the Incus-SP-Coupler, and the RW-Soft-Coupler

Author Block:

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Abstract Body:

Introduction: In 2014, the Incus-LP-Coupler, the Incus-SP-Coupler, and the RW-Soft-Coupler were introduced by Med-El as coupling options for the Floating Mass Transducer of the Vibrant Soundbridge. The Incus-SP-coupler is connected to the short process of the incus, the Incus-LP-coupler to the long process of the incus, and the RW-Soft-coupler with a silicone tip to the round window membrane.

Methods: In a retrospective European multicenter analysis the functional results after implantation were compared with the audiological results before implantation. As the new SAMBA sound processor was introduced shortly after the new couplers, only patients using the AMADE sound processor were included. Sound field thresholds, the functional gain, word recognition in quiet and the vibrogram were measured. The bone-conduction pure-tone threshold shift was analyzed as safety parameter. Preoperative baseline measures were compared with outcome at the initial fitting of the sound processor (6-8 weeks after surgery), and the follow-up outcome 5-7 and 9-13 months after surgery.

Results: So far, 8 patients with the RW-Soft-coupler, 6 patients with the Incus-SP-coupler, and 2 patients with the Incus-LP-coupler could be included. The results show a clear improvement of word recognition in quiet which was best for the Incus-SP and Incus-LP-couplers. Surgery was safe as the bone-conduction thresholds did not shift. The vibrogram thresholds were increased compared to the bone-conduction thresholds but with no difference between the couplers.

Conclusion: All couplers used in this comparison can be used for coupling the FMT of the Vibrant Soundbridge to the structures of the middle ear or the round window.
Parents' View on Auditory Verbal Therapy in a Nordic Country

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Abstract Body:

Title
Parents’ View on Auditory Verbal Therapy in a Nordic country

Introduction
The Danish patient organisation, Decibel, established a research unit in August 2013 funded by the Ministry of Social Affairs. A current project “Age equivalent language for children with hearing impairment, HI” aims at investigating intervention approaches for a randomized group of children with HI. It is a primary focus to study the auditory verbal, AV, approach and to evaluate the relevance of this approach for children with HI and their families in Denmark. Evaluation focuses both on outcomes for children and on the parents’ evaluation. Preliminary data from the parental evaluation of AVT is presented.

Methods
The AV approach is an intervention targeting families with children in need of all kinds of hearing technology, hence 60 children with CI/BAHA/HA and their families are included. Twenty percent of children have additional disability. Families from Sweden, Norway and the Faroe Islands are included. Families have to sponsor own transport and time away from work. The families attend sessions every other week, monthly or 2-3 monthly. Parental questionnaires and interviews are carried out on a yearly basis covering aspects such as; the understanding of the goals and activities, the carry-over of AVT to everyday life, possible stress factor of attending AVT, the reason for choosing the AV approach. Demographic related variables, i.e. SES, place of living, ethnicity and bilingualism are gathered in order to study possible associations between parents’ perception and the variables.
Results
Preliminary results of parental perception of the AV-approach are presented. The vast majority of parents (95%) choose the AV approach, because they wish for their child to develop listening and spoken language. Parents do experience feelings of stress and guilt about not practising listening and language activities enough at home with their child. Carry-over of activities and understanding of both long and short term goals do not present significant problems for the parents.

Conclusion
The majority of parents in Denmark are both working outside the home. Despite the intense involvement from parents required in an AV programme the parents still assess the AV intervention as a feasible way of working with their child with HI.
Abstract Body:

Introduction: According to FDA, cochlear implants are designed to help severely to profoundly deaf persons who get little or no benefit from hearing aids in both ears. As bilateral implantation is now often considered as a standard clinical practice, issue can be raised on implantation of individuals presenting an asymmetrical hearing deficit, with good aided results in the better ear. In order to address this question, the Quebec Cochlear Implant Program initiated in 2013 a clinical project where unilateral implantation is proposed to candidates with an asymmetric bilateral hearing loss. These candidates present 1) in the better ear, a generally severe hearing loss associated with good auditory skills, 2) in the ear to be implanted, a generally profound hearing loss and/or very limited auditory skills with a well-fitted hearing aid.

Methods: A retrospective file review is undertaken for participants implanted between February 2013 and December 2015. Auditory performance data on speech perception tests are retrieved for the aided and the implanted ears in teenagers and adults at 3 months and 1 year post-implantation. Complementary information on duration of deafness, age at implantation and history of hearing aid use are also retrieved.

Results: Preliminary results with 17 users show that the majority of subjects develops auditory skills on the implant side that appear similar or better than those observed with hearing aids before implantation. Some show a a bimodal gain for speech recognition in silence and in noise. Final results will be presented and discussed.

Conclusion: Unilateral implantation of candidates with asymmetric bilateral hearing loss is a promising avenue. The duration of deafness in the implanted ear, considering the chronological age, and the history of hearing aid use appear to be the major determinants of prognosis.
Abstract Body:

Introduction: A case study is presented identifying the effect of otitis media with effusion (OME) on evoked potential test results.

Methods: Two sets of evoked potential test results were performed under general anaesthetic on one child. The first tests were performed in the presence of OME; the second evoked potential tests were performed after grommet insertion and four months after the first test session. The evoked potential tests were performed to national recommended guidelines.

Results: From the results of the case study OME can prevent the recording of a cochlear microphonic (CM). At the first test session the child had absent CMs in the presence of OME, at the second test session, performed after grommet insertion, a CM was recorded in one ear.

Conclusion: OME can prevent the recording of a CM. This is clinically relevant as children are diagnosed with auditory neuropathy spectrum disorder (ANSD) or a severe to profound sensorineural hearing loss (SNHL) on the basis of the presence or absence of CMs. Not recording a CM in the presence of middle ear dysfunction could result in incorrect diagnosis and management of these children. Children with a SNHL or ANSD are managed differently; children with ANSD may require no intervention, hearing aid management or cochlear implantation. Children with a severe to profound SNHL are recommended to be referred for a cochlear implant assessment. This has implications for the cochlear assessment process. This has implications on management for children whose evoked potential tests are performed in the presence of OME.
Remote Programming of Cochlear Implants: Users and Health Professionals in Nova Scotia Report Their Experiences

Authors
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Introduction: In order to derive maximum benefit from their cochlear implant (CI), users must have their device periodically reprogrammed either in face-to-face or remote sessions. This study assesses the acceptability of remote programming (RP) to CI users and medical professionals at a clinic in Halifax, Nova Scotia, Canada.

Methods: CI users, local hosts, and remote experts participated in RP sessions and assessed their responses to the RP experience via a questionnaire.

Results: 100% of subjects (n=30) were satisfied and would be willing to participate in further RP sessions. Minor technical problems were encountered but were easily solved. 4/10 CI users commented that RP would be helpful in reducing travel time.

Conclusions: Remote programming of CIs, while not a substitute for face-to-face programming, was highly acceptable to the adult CI users and the audiological professionals who served them.
Abstract Body:

**Introduction:** Conclude a safe scala tympani approach for cochlear implantation by a thorough review the anatomy of the round window niche and the adjacent cochlear promontory and via human temporal bone insertion studies.

**Methods:** Review of historical and more recent anatomical data and human temporal bone studies utilizing various scala tympani openings and electrode insertion techniques.

**Results:** Anatomically, the round window niche and the round window itself are subject to great variations. This pertains not only to the size but also to the positioning of the round window with respect to adjacent structures of the temporal bone. Moreover, these relationships may change over time especially during infancy. Data from human temporal bone insertion studies confirm the mostly non-traumatic nature of round window insertions. Further, cochleostomies inferior to the window appear atraumatic.

**Conclusion:** The current review confirms the potential for non-traumatic scala tympani insertions as long as correct round window related cochleostomies are chosen.
Increased Body Mass Index (BMI) Leads to Longer Total Operating Room Time

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Introduction:
The rising incidence of obesity in United States is associated with increased healthcare expenditures and resource allocation. In orthopedic literature obesity is associated with prolonged operating times during total knee replacements. The objective of this study is to compare body mass index (BMI) to length of surgery during cochlear implantation, and to analyze other factors on cochlear implant operation times.

Methods: A retrospective case control study from a tertiary academic referral center was performed. Patients included were adults (18+) who underwent primary, single-sided cochlear implants with documented BMI and operating room (OR) times from January 2009 to July 2015. The following data were collected: BMI, total operating room time, total surgical time, ASA status, device manufacturer, age, gender, and ethnicity.

Results:
Two-hundred forty-five (n-245) patients were included. They were further stratified into obese (BMI >30) and non-obese (BMI<30) categories. Statistical analysis using independent sample t-test and multivariate linear regression analysis was performed comparing total OR time against the obesity category along with other variables. Independent samples t-test demonstrated that obesity increases total OR time by 11.9 minutes (p=0.01) compared to the non-obese group. There was no significant difference in total
surgical time. Further, there is no statistically significant impact according to multivariate linear regression analysis of device type, gender, ethnicity, or ASA status on operating or surgical time.

**Conclusion:**

Conclusion: Obesity leads to longer total OR times but not total surgical time during primary cochlear implant surgery. Given the lack of statistically significant difference between surgical time between non-obese vs. obese, increased total OR time is likely attributed to perioperative factors such patient transportation and/or induction or emergence from general anesthesia. These data have implications with utilization of operating room resources.

**Control Number:**

2016-A-128-ACI

**Session Number:**

POS01

**Session Title:**

Poster Session A

**Poster Board Number:**

147-A

**Topic 1:**

02i-Radiology/Imaging

**Publishing Title:**

Magnetic Resonance Imaging Artifacts in a CI System with a Removable Magnet

**Author Block:**

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**Abstract Body:**

**Introduction:** Cochlear implants (CIs) are the standard treatment for severe-to-profound sensorineural hearing loss. This human cadaver study evaluated the diagnostic usefulness, image quality and artifacts in 1.5 T and 3 T magnetic resonance (MR) brain scans
of CI systems with a removable magnet.

**Methods:** The diagnostic usefulness, the image quality, and artifacts were assessed at 1.5 T and 3 T in 5 cadaver heads with implanted CIs. The brain MR scans were performed with and without the magnet. The criteria were analyzed by 2 blinded neuroradiologists.

**Results:** The MR images with the magnet in situ were all compromised by artifacts caused by the CI. After removal of the magnet, the MR scans showed significant artifact reduction, improving the image quality and diagnostic usefulness, both at 1.5 T and 3 T. The visibility of the brain stem, cerebellopontine angle, and parieto-occipital lobe ipsilateral to the CI increased significantly after magnet removal.

**Conclusion:** This study indicates the possible advantages for 1.5 T and 3 T MR scanning of the brain in CI systems with removable magnets. Our findings support the use of CIs with removable magnets, especially in patients with chronic intracranial pathologies.
Abstract Body:

**Introduction:** Until now several studies proved that scala tympani positioning of the electrode gives the better results in terms of speech recognition score in CI, whereas other studies found no difference in speech recognition; moreover a relationship between translocation and hearing preservation was reported.

**Methods:** Twenty-seven patients, mean age 56 years [range 28-81] were included (29 ears). Auditory speech scores in quiet (monosyllabic words) were tested at 6 and 12 months after activation. The Abbreviated Profile of Hearing Aid Benefit inventory (APHAB) was also evaluated at 6 and 12 months after the activation. The patients were successively evaluated in noise (Matrix® adaptive test, SRT 50%). Electrode-modiolus distance for the electrodes at 180° and 360°, the angle of insertion and the electrode array scalar translocation were studied in post-operative cone beam CT scan reconstructions.

**Results:** all the electrodes array were fully inserted (mean angle 404° ± 38). No correlation was found between the depth of insertion and auditory performance. Twenty-two electrodes arrays were entirely positioned in the scala tympani, and 6 partially or totally inserted in the scala vestibuli. One patient, simultaneously bilateral implanted, had an ossification of the tympanic basal turn, thus the vestibular scala was directly implanted via cochleostomy. A second patient was affected by intracochlear vestibular schwannoma; in this case the array translocation occurred in the region corresponding to the localization of the tumor. Four arrays translocated from the tympanic to the vestibular ramp without any known reason. The distance between the electrode at 180° and the modiolus was correlated to speech scores in quiet at 6 months (Spearman r = -0.704, p<0.01). Scalar traslocation did not influence the speech performance in quiet both at 6 months and at 1 year. The APHAB questionnaire showed better hearing quality in patients having the array completely in scala tympani in 2 out 4 tested categories (ease of communication, background noise, p < 0.05, Mann-Whitney U test). Influence of scalar translocation on performance in noise (adaptive test) will be also presented.
Conclusion: the CI422 array had a low rate of scalar translocation (13%), the distance to the modiolus was correlated to hearing performance in quiet at short time (6-months). The scalar translocation did not influence the speech score in quiet, while better subjective quality of hearing was found among patients with a complete scala tympani insertion.
**Abstract Body:**

**Introduction:** In the horizontal plane two different kinds of cues, interaural level differences (ILD) and interaural time differences (ITD), are used for sound localization by normal hearing listeners. ILDs are more effective in the higher frequency range and ITDs in the lower range. With the most common coding strategies (e.g. CIS) Cochlea implant (CI) users have access to ILDs and ITDs in the signal envelope, but not to detailed information of the ongoing fine structure (FS). With the introduction of fine structure coding strategies new low frequency cues are presented to the CI user, which could help to improve the ITD perception. The aim of this study is to evaluate the ITD coding effectiveness with a standard CIS coding strategy and a fine structure coding strategy, as well as making a comparison between the two.

**Methods:** In a lateralization task the bilateral implanted subjects should distinguish between two binaural stimuli and vote for the stimulus that comes from the left side. For that task both processors are directly connected to a soundcard of a computer which generates the signals. As test signals sinusoids and pink noise are used. The method of constant stimuli is used, so that seven fixed ITDs in the range of 50 to 600µs are repeatedly presented. Conditions with one, four and ten active apical electrode pairs were measured to investigate the effect crosstalk the intra-cochlear electrode contacts.

**Results:** So far, six subjects have been included into the study (aim: n=10). Three of the six subjects were sensitive to ITDs. They showed good results with the fine structure strategy in the sinusoids condition. With the CIS strategy however, they only reached ITDs in the range of chance level. With the much broader pink noise signal even with the CIS strategy a moderate ITD perception was observed, probably caused by ITD cues in the envelope of the processed signal. However the performance with the fine structure strategy was better than with CIS in most of the cases. We also observed that in general the ITD sensitivity decreased with an increasing number of active electrodes.
Conclusion: In those patients, who were able to perceive ITD cues (<600µs) results with the fine structure strategy were superior compared to the CIS strategy. However, our preliminary results also suggest that channel interaction between intra cochlear electrodes might hamper ITD perception in CI subjects.
Introduction:

The signal change of the inner ear in the radiologic representation can point to an emergency situation as in meningitis, petrosal bone fracture or an acute labyrinthitis. It can also occur in silent, chronic processes as ossification in far advanced otosclerosis, chronic labyrinthitis or cochlear tumor e.g. schwannoma.

Methods:

We present four cases with such problems and the following therapy solutions. The first patient has a sudden hearing loss after meningitis. CT and MRI exams showed eminent sclerosis, a cochlear implant on both ears was performed. The second patient has a deaf ear after a fracture of the skull. The fracture line goes through the cochlea and in the MRI T2 sequence is the fluid signal diminished. The third person has a possible M. Meniere with deafness on the same ear, in the MRI exam we could observe a cochlear sclerosis. The fourth patient presented with an unilateral hearing loss. The MRI exam showed a cochlear schwannoma, not progressive over the years.
Results:

The first patient received immediately two implants with 70% speech understanding in quiet, even showing sound orientation after few weeks. To the second patient seemed an operation too risky and he refused the cochlear implant. He has a CROS hearing aid and is so fare content; 60% speech understanding. With the third patient we discussed the possibility of operation abort or cochlear instrumental dilatation intraoperatively. We prepared several electrode arrays in different lengths and materials. She was fully implanted successfully but has poor speech understanding with the implant, 35% word understanding at dBopt with the implant alone. In the fourth case we could insert the implant after instrumental dilatation and a 28 flex electrode array was fully inserted. The patient is very happy with his implant and shows good speech understanding 80% in quiet with the implant alone and sound orientation.

Conclusion:

Signal change in radiologic representation must be analyzed and discussed individually regarding implantation success and speech results. Operative and postoperative impediments can be expected, but a cochlear implantation is possible, the risks are minimal and the results can be of great benefit.
Control Number:
2016-A-136-ACI

Session Number:
POS01

Session Title:
Poster Session A

Poster Board Number:
146-A

Topic 1:
02i-Radiology/Imaging

Publishing Title:
The Use of Cone Beam Computed Tomography in Assessing Insertion Dept of Bone Conduction Hearing Implants

Author Block:
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Abstract Body:

Introduction: Nowadays, new minimally invasive punch-only surgical techniques are used to implant the bone conduction hearing implant (BCHI) which rely more on a tactile instead of a visual cue for full and straight insertion. Incomplete insertion might result in higher implant loss rates which raises an important concern for the development of such techniques in practice and to provide valid objective feedback of full insertion to the individual surgeon in absence of direct visual confirmation. Cone Beam CT imaging (CBCT), which features low radiation dosage, reduced sensitivity to scattering artefacts and high resolution, is considered a good candidate for such evaluation.

Objective: Here it is investigated if CBCT can be used to evaluate implant seating in vitro and in vivo. In parallel, the value of the Ostell implant stability quotient (ISQ) is investigated for the same research question using CBCT as a gold standard.

Methods: CBCT measurements were compared to direct manual caliper measurements. BCHIs was completely (4.5 rotations) and partially (3.5 rotations) inserted in artificial bone blocks of different density (Sawbones, USA). The blocks were subsequently scanned with the I-CAT scanner (Hatfield, Pennsylvania, United States of America) in 0.125mm isometric resolution. CBCT measurements and 3D models were obtained by image processing using Slicer3D 4.3.1 (http://slicer.org) and Mathematica (Wolfram Research, Oxfordshire). ISQ measurements were established for all implants mounted consecutively with 9mm, 12mm and 14mm abutments. ISQ measurements were compared to CBCT measurements, referred to as “the gold standard” for implant position. Finally, CBCT scans were made to evaluate BCHI seating in patients.

Results: The average difference between the CBCT measurements and caliper measurements was 0.24mm with a standard error of...
0.11mm. Partially inserted implants and completely inserted implants could be distinguished with a sensitivity and specificity of 100% in vitro. Evaluation of the in vitro 3D models allowed for a highly detailed qualitative assessment of the implant, the artificial bone and the implant-bone interface as well as implant insertion and angulation. Qualitative evaluation of in vivo 3D models showed high detail of the implant, skull and soft tissue, allowing visual assessment of implant seating and angulation in vivo. Average ISQ values decreased with partial insertion, low density sawbone and longer abutment lengths in vitro.

**Conclusion:** Processed CBCT scans are able to distinguish partial insertion from complete insertion with high accuracy in vitro. This technique can be applied in clinical practice as shown here.
Control Number:
2016-A-138-ACI

Session Number:
POS01

Session Title:
Poster Session A

Poster Board Number:
99-A

Topic 1:
02a-New Indications

Publishing Title:
Ipsilateral Cochlear Implantation in Patients after Cochlear Nerve Preserving Vestibular Schwannoma Surgery

Author Block:
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Abstract Body:

Introduction: Patients with Vestibular Schwannoma (VS) in the only hearing ear or Neurofibromatosis type 2 (NF2) patients with bilateral vestibular schwannomes are challenging cases that its treatment eventually leads to profound deafness in many cases, optimal preservation of hearing is one of the priorities in the management of such cases. Hearing preservation surgery is not always possible and hearing rehabilitation with an Auditory Brainstem Implant (ABI) usually do not allow open set speech discrimination. Recently vestibular schwannoma resection with preservation of the cochlear nerve and ipsilateral cochlear implantation has emerged as a reasonable therapeutic option in this situation.

Methods: A restrospective review in a tertiary skull base surgery and NF2 referral center was conducted to evaluate 7 NF2 patients with bilateral vestibular schwannomes and 1 patient with a vestibular schwannoma in the only hearing ear, who underwent resection of the vestibular schwannoma with preservation of the cochlear nerve and ipsilateral cochlear implantation. For assessment of the cochlear nerve functional integrity an intracochlear test electrode was place d via round window before tumor removal. In other 2 cases the cochlear nerve preservation was attempted but contralateral cochlear implantation was performed.

Results: 7 patients were implanted unilaterally while 1 was bilaterally implanted. 9 cochlear implants were included in the study, 8 cases implanted simultaneously and in 1 patient the implantation was sequentially performed 2 months after the vestibular schwannoma removal. Follow up ranged from 3 to 132 months, with an average of 42 months. The auditory outcomes were assessed with speech discrimination tests using the cochlear implant in open field and quite, pure tone audiometry in open field to assess the hearing thresholds. Postoperatively the average bisyllable open set word recognition score was 77% and pure tone average (PTA) was 37dB.
**Conclusion:** Cochlear implantation after vestibular schwannoma resection can be successful, achieving better auditory performance than the traditional approach with auditory brainstem implantation.
**Control Number:**
2016-A-142-ACI

**Session Number:**
POS01

**Session Title:**
Poster Session A

**Poster Board Number:**
97-A

**Topic 1:**
03m-Auditory Neuropathy

**Publishing Title:**
Auditory Neuropathy in Children: Considerations for Cochlear Implantation

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

**Introduction:** ANSD is a spectrum of auditory dysfunctions that are observed on audiological testing as the presence of normal otoacoustic emissions (OAEs) and/or cochlear microphonics (CM), with absent or severely abnormal auditory brainstem response (ABR). Therefore, is a disorder due to a dysfunction of the inner hair cells (IHC), the synapse of the IHC and auditory nerve (AN), and/or the AN itself. ANSD causes are diverse in the literature. However, it does not explain the great disparity of the results in the reported cases series regarding the etiology and treatment.

**Methods:** From a total of 48 patients with ANSD, 45.8% were children. The design is a retrospective study of 25 children with ANSD studied and treated during a period of 11 years. Patients had a complete study with genetic, radiological, and audiological tests. All children started with early intervention with auditory component and only the cases with behavioral HL on audiological tests were fitted with HA. If patient does not make the expected progress in auditory skills and spoken language development the children was cochlear implanted (CI). In the cases with ANSD due to cochlear nerve deficiency (CND), electrically evoked ABR was performed before CI.

**Results:** Etiology of ANSD in children was genetic in 60% of the cases and acquired in 40%. The most frequent cause of ANSD was genetic due to OTOF gene mutations. Second cause of ANSD was acquired due to prematurity with hypoxia and infections. Other causes were malformations. Syndromic ANSD in children was very rare in 1 case with Dandy Walker syndrome. All cases had congenital/prelingual hearing loss of various degrees. Genetic isolated and syndromic ANSD presented with permanent profound HL and all cases were treated with CIs. CI results in OTOF gene mutations depended on the age at CI with very good outcomes. The child with Dandy Walker syndrome had poorer results than the genetic isolated cases. Hearing loss degree varied in acquired ANSD and was treated with CI and HA. Post-treatment results in acquired cases were good except in the children with CND that had poor outcome. Three children with ANSD due to prematurity recovered hearing over the 17 months of life.
**Conclusion:** In our sample 60% of the causes of ANSD in children are genetic, and non syndromic genetic causes predominate (93%). Genetic and Acquired due to CND presented with permanent profound hearing loss. Acquired in premature children presented with variable degrees of hearing loss and hearing can improve with age (delayed development). CI is the treatment of choice in ANSD with permanent profound hearing loss. CI results could depend on the etiology and site of the lesion: In OTOF gene mutations the lesion is in the synapse IHC-AN with good CI outcome. The case with syndromic ANSD presented the lesion in the AN and central nervous system with poor CI result. Cases due to hypoxia (prematurity) the lesion is in the IHC (Sawada 2001) with good CI outcomes and in children with CND the lesion was in the AN with very poor CI outcome.
Abstract Body:

Introduction
The human brain has the remarkable ability to localize spatially separated sound sources in complex acoustic scenarios. This is done by exploiting interaural time- and level differences (ITDs / ILDs). In the past decades, two different families of psychoacoustic models emerged: the coincidence or excitation-excitation (EE) family based on Jeffress [1] and the excitation-inhibition (EI) model based on Durlach [2]. A third class of models, which are based on spiking neurons, has emerged only recently, e.g. [3]. They process neuronal spike responses of the auditory nerve (ANF) and replicate the properties of neurons in the lateral- and medial superior olives (LSO and MSO), which provide the basis to transfer lateralization cues into a rate code.

Methods
ANF spike responses were calculated using a model from Zilany et al. [4] for normal hearing listeners and for cochlear implant listeners using a model from Nicoletti et al. [5]. With ANF spike trains as a common physical quantity it is now possible to compare NH and CI localization abilities with different CI coding strategies.

We compared the performance of the EE-Model by Lindemann [6] - modified to work with neuronal spike inputs - with the MSO model regarding to their spatial accuracy and localization thresholds both in clean conditions and with uncorrelated background noise present. We also compared modeled NH localization with spike trains predicted by different CI coding strategies.

Results
For NH listeners, both models predicted localization thresholds of -10dB SNR, for CI users about 0dB SNR. Inside the natural occurring ITD limit of <660µs, the FS4 strategy from MEDEL resolved seven spatial positions. The CIS strategy failed to convey fine-structure ITD cues.
Conclusions

Although the two models are of different nature, both predict similar results ITD thresholds in noise. These thresholds are evaluated with listening experiments with CI users in the next step.
Introduction
With current Cochlear Implants (CIs), CI-recipients achieve good speech perception in quiet. However, speech understanding in auditory complex, real life environments remains difficult. Also sound quality perception with CIs often remains poor. It is a challenge to program CIs for such environments in a clinic. Recently a remote control is introduced that enables CI recipients to alter their upper stimulation levels of their own user programs by themselves. In this concept of remote assistant fitting (RAF), a Bass and Treble control can be adjusted. By changing the Bass and Treble controls a tilt is applied with an emphasis at mainly the low frequency or high frequency levels, respectively. This concept of self-programming can possibly overcome limitations associated with fine-tuning the CI sound processor in a clinic. The aim of this study was to investigate if experienced CI recipients would use the possibility to alter their programs and maybe even improve their auditory functioning.

Methods
22 experienced (implant use > 12 months) adult CI-recipients participated in this prospective clinical study with a within-subject repeated measures design. All participants had phoneme scores of ≥ 70% at 65 dBdBSPL in quiet and had a Cochlear Nucleus CP810 sound processor. The auditory performance was tested by a speech in quiet test, a speech in noise test, an acceptable noise level-test and a questionnaire about their perceived auditory functioning (speech, spatial and quality questionnaire). During a first session, they were tested with their own CI program as a baseline. Afterwards, they were instructed in using RAF the next three weeks at home. After these three weeks they returned to the clinic for auditory functioning tests with their new self-adjusted program.

Results
More than half of the participants changed their upper stimulation profile more than 5 current units. The way in which this profile changed, differed among the subjects. Some made a tilt to the high frequencies; others did so with a tilt to the low frequencies. Another group of subjects changed the high and low frequencies in the same manner. Also some subjects mainly used the overall
volume to change their settings. Several parts of the SSQ questionnaire scores show an improvement in perceived auditory functioning after using RAF by the subjects. No significant change was found on the auditory functioning tests for speech in quiet, speech in noise and the ANL.

Conclusion
Although the subjects in this study were experienced CI users and accustomed to their own user program, the majority of them changed the settings of their programs. After altering their programs they experienced improved sound quality without compromising on auditory performance. Therefore it can be concluded that home-made adjustments to the CI settings are a useful and clinically applicable tool that may help CI recipients to improve perceived sound quality in the normal daily life situation.
Abstract Body:

**Introduction:** The measurement of Electrically Evoked Compound Action Potentials (ECAP) is a well-known method to assess cochlear implant function as an objective method. It provides confidence that electrical stimulation leads to action potentials therefore hearing sensations. Resulting this additional information helpful for fitting, especially in difficult cases, children and offers a possibility to glean information about the placement of electrodes in the cochlea. In this study, the ECAP performance of MED-EL cochlear implants was investigated using the auditory nerve response telemetry (ART).

**Objective:** To examine the underlying physiological background of neural responses from different regions of the cochlea.

**Methods:** Two different ECAP measurements were recorded to 28 subjects in a multicentric study between Covoes and La Paz hospitals. To assess different parameters of the neural response: A) Amplitude growth recordings by stimulating the apical electrode 2, the middle electrode 5 and the basal electrode 10, was used, as well as B) Recovery sequences stimulating the same respective electrodes. To study the placement of the electrode array.

**Results:** An analysis of ECAP amplitudes and slope of the amplitude growth functions from 3 different regions will be presented.

**Conclusions:** The results show that there were significant differences between the apical and the basal electrode region on ECAP amplitude, being the ECAP amplitude higher in the apical region than to the basal region. Therefore we conclude that all regions are able to work with the information delivered by electrical stimulation and provide a highly valuable information.

**Key words:** ECAP, neural response, electrode position
Introduction: Patients with single-sided deafness (SSD), defined as one poor ear and one normal hearing ear, experience reduced speech perception in noise when compared to normal hearers. Approved treatment options for SSD do not offer enhanced speech perception in noise. It is hypothesized that listeners are unable to utilize binaural cues since the signal from the affected side is routed to the normal hearing ear. Cochlear implantation of the affected ear may provide the listener with access to binaural cues, potentially improving speech perception in noise. The objective of this study was to assess speech perception with a cochlear implant as compared to a bone-conduction device or unaided listening conditions.

Methods: Twenty (20) subjects with SSD underwent cochlear implantation as part of a clinical trial. The test battery included CNC words in quiet, AzBio sentences in noise, and BKB-SIN. Recorded materials were presented from the front and in spatially separated noise. Subjects completed a speech perception measures preoperatively, and at 1, 3, 6, 9 and 12 months postoperatively. Subjects were evaluated with a bone-conduction device and an unaided listening condition preoperatively, and with the cochlear implant plus the normal hearing ear postoperatively.

Results: Subjects experienced an improvement in speech perception with the cochlear implant, as compared to the bone-conduction device and unaided listening conditions. Speech perception results were either maintained or continued to improve through the 12-month follow-up interval.

Conclusion: Subjects experienced an improvement in speech perception with the cochlear implant as compared to current treatment options. Cochlear implantation may be a viable treatment option for patients with SSD.
Implantation of the Auditory Nerve Via the Middle Ear Cavity in Rats with Partial Hearing

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Abstract Body:

Introduction:
In a previous study we showed the feasibility of transmodiolar implantation of the auditory nerve via middle ear cavities in human. The aim of this study was to study the possibility of hearing preservation and to investigate histologic cochlear lesions after the transmodiolar implantation in rats.

Methods:
Nine adult Whistar rats were implanted. The bulla was exposed. Cochlear apex was visualized and a titanium rod (1.55 mm) covered by parylen was inserted in the apex in the direction of the modiolus. The cochlear opening was sealed by a muscle fragment. Auditory brainstem evoked responses (ABR) were recorded before surgery and at postoperative days 0, 2, 15 and 30. Thirty days after surgery, rats were euthanized and cochleae were sampled for histology.

Results:
The rod was inside modiolus in 4, and partly or totally outside modiolus in 4 animals. A residual hearing was present in all cases. The average threshold shift in cochleas with modiolar implant was 39 ± 11.2, 54 ± 9.7, 48 ± 20.3, 43 ± 21.3 dB SPL at postoperative days 0, 2, 15 and 30 respectively.

Conclusion:
This study demonstrated the feasibility of hearing preservation after auditory nerve implantation via middle ear cavities in rats. The hearing improvement with time suggested an acute inflammatory reaction which regressed progressively.
Abstract Body:

Introduction: Although it has been previously shown that changes in temporal coding produce changes in pitch in all cochlear regions, research has suggested that temporal coding might be best encoded in relatively apical locations. We hypothesized that although temporal coding may provide usable information at any cochlear location, low rates of stimulation might provide better sound quality in apical regions that are more likely to encode temporal information in the normal ear. In the present study, sound qualities of single electrode pulse trains were scaled to provide insight into the combined effects of cochlear location and stimulation rate on sound quality.

Methods: Ten long term users of MED-EL cochlear implants with 31 mm electrode arrays (Standard or FLEX\textsuperscript{SOFT}) were asked to scale the sound quality of single electrode pulse trains in terms of how “Clean”, “Noisy”, “High”, and “Annoying” they sounded. Pulse trains were presented on most electrodes between 1 and 12 representing the entire range of the long electrode array at stimulation rates of 100, 150, 200, 400, or 1500 pulses per second.

Results: While high rates of stimulation are scaled as having a “Clean” sound quality across the entire array, only the most apical electrodes (typically 1 through 3) were considered “Clean” at low rates. Low rates on electrodes 6 through 12 were not rated as “Clean” while the low rate quality of electrodes 4 and 5 were typically in between. Scaling of ”Noisy” responses provided an approximately inverse pattern as “Clean” responses. “High” responses show the trade-off between rate and place of stimulation on pitch. Because “High” responses did not correlate with “Clean” responses, subjects were not rating sound quality based on pitch.

Conclusion: If explicit temporal coding is to be provided in a cochlear implant, it is likely to sound better when provided apically.
Additionally, the finding that low rates sound clean only at apical places of stimulation is consistent with previous findings that a change in rate of stimulation corresponds to an equivalent change in perceived pitch at apical locations. Collectively, the data strongly suggests that temporal coding with a cochlear implant is optimally provided by electrodes placed well into the second cochlear turn.
Introduction:
Prelingually deaf adults (PDAs) who are implanted during adulthood remain a preoccupation for professionals in clinical settings. Despite the clinicians’ efforts to adjust expectations, many of these adults experience disappointment and frustration (although recent data suggest that auditory performance can improve after cochlear implantation during adulthood). Research have suggested that the involvement of communication partners/significant others in the rehabilitation of individuals with a hearing loss may result in mutual advantages. However, we still know very little on the perceptions of the benefits of cochlear implantation of the PDAs’ significant others. The purpose of this qualitative study was to explore the perceived everyday life benefits of cochlear implantation in prelingually deaf adults and their close communication partners/significant others, and to investigate the congruence of the perceptions of benefits between the cochlear implant user and his/her significant other.

Methods:
Seven (7) PDAs and a close communication partner/significant other (n=6) participated in the study. Two different interviewers (trained psychologists) conducted in-depth semi-structured interviews. Analyses of the two sets of interview transcripts
adopted a phenomenological methodology. We performed a thematic analysis with the QSR NVivo 10 software.

Results:

The following congruent themes emerged from independent analyses of the two sets of interviews:
1. Both PDAs and their significant others reported an improved detection and recognition of environmental sounds: the discovery of environmental sounds can be an enjoyment for both the implant user and the significant other (who then plays the role of a guide);
2. Overall, PDAs expressed an improvement in their self-confidence during communicative interactions with their close relatives, whereas significant others noted increased self-esteem and autonomy, and better interpersonal relationships in their deaf partner. We found convergent themes suggesting that relatively subtle gains (e.g. improved environmental sounds detection and recognition) can have a significant impact on the lives of PDAs. In general, significant others feel that the implant improved the life of their deaf partner, and they usually remain realistic about the possibilities of the implant.

Conclusion:

There is a need for assessing outcomes differently in adults with prelingual deafness, beyond speech recognition performance. The perspective of communication partners/significant others is also of significant interest: professionals should include them in the candidacy process as well as during the rehabilitation process, in order to better help these candidates to establish appropriate expectations toward cochlear implantation. Significant others can be our allies in making cochlear implantation a positive experience for prelingually deaf adults.
Evaluation of Scala Location and Modiolar Proximity of the Slim Modiolar Electrode Array

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Introduction:
Proximity of electrodes to the modiolus may allow for reduced current spread, greater neural specificity and improved performance whilst reducing stimulation power requirements. These potential benefits have resulted in the development and commercialisation of several perimodiolar electrode arrays in the past two decades. The most recent of these, the Slim Modiolar electrode array, has been specifically designed to achieve even closer proximity to the modiolus for both electrical stimulation efficiency and performance.

Methods:
Modiolar proximity of the electrodes was evaluated in subjects implanted with the Slim Modiolar electrode array. Using well-defined anatomical landmarks individual’s non-implanted CT image voxel space was optimized for anatomical detail with their post-implant CT image space optimized for resolution of the electrode. The electrode lead wires and contacts are identified, segmented from the post-implant image data, and copied into the non-implanted image space to provide a composite image of electrode placement within an individual’s cochlea.
Relative measurements of the lateral wall length and the length along the electrode trajectory within individuals was used to determine a measure of medio-lateral position of the electrode array or Wrapping
Factor (WF) to provide a metric of how tightly or loosely wrapped an electrode array is relative to the modiolar wall (i.e. perimodiolar position). As such the Wrapping Factor metric becomes smaller when the array is wrapped more tightly relative to the modiolar wall.
The Wrapping Factor obtained for subjects implanted with the Slim Modiolar electrode array was then compared to the Wrapping Factor for previous generations of perimodiolar electrodes to evaluate whether closer proximity to the modiolus has been achieved.

Results:
The Wrapping Factor of subjects implanted with the Slim Modiolar electrode array was lower (The WF metric becomes smaller when the array is wrapped more tightly relative to the modiolar wall) than that of previous generation perimodiolar array evaluated using equivalent methods. The potential implications of the relative difference in Wrapping Factor in terms of reduced current spread, greater neural specificity, reduced stimulation power and improved performance will be discussed.

Conclusion:
The results of this study indicate that the Slim Modiolar electrode array typically occupies a position in scala tympani such that the electrodes are in closer proximity to the modiolus.
Improved Speech Reception in Noisy Environments Using Cochlear Implant Audio Processors with Directional Microphones

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Introduction: Speech understanding in noisy environments remains a major challenge for hearing impaired in general and for cochlear implant (CI) patients in particular. Modern hearing aids often feature directional microphones to successfully address this issue. One approach is to apply beamforming techniques cancelling out noise from less important directions, while keeping sound from the front unaffected. With the current generation of audio processors directional microphones have become available for CI patients as well. The purpose of the study was to investigate the effect of different microphone directivity settings on speech reception in noise with cochlear implants.

Methods: 17 adult CI patients with a minimum of 6 months of implant experience were included in the study. Speech reception thresholds (SRT) were measured with an adaptive speech test (Oldenburger Sentence Test) in continuously present, speech shaped noise. Target sentences were presented in front of the listener, noise sources were placed at -135° and 135°, respectively. Outcome measures were the differences in SRT with microphone settings: omnidirectional, fixed beamformer, and adaptive beamformer.

Results: A preliminary analysis (N = 14) revealed that the use of directional microphones improved SRTs as follows: omnidirectional vs. fixed beamformer: 3.3 dB (SD = 2.59 dB), omnidirectional vs. adaptive beamformer: 5.01 dB (SD = 3.74 dB), and adaptive beamformer vs. fixed beamformer: 1.71 dB (SD = 2.25 dB).

Conclusion: Audio processors featuring directional microphones can offer a substantial benefit in speech reception in noise to CI patients.
Control Number: 2016-A-170-ACI

Session Number: POS01

Session Title: Poster Session A

Poster Board Number: 142-A

Topic 1: 02g: Revision Surgery, Re-Implantation

Publishing Title: Detectability of the Cochlear Implant Electrode Fixation Clip by Means of Cone Beam Computed Tomography

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Abstract Body:

Introduction: With the objective of preserving delicate structures, atraumatic electrodes are finding increasing use in cochlear implantation. However, electrodes have occasionally been found to migrate postoperatively. For this reason, a new titanium fixation clip is used to provide additional fixation of the electrode lead on the bony bridge to prevent migration. The question arises whether cone beam computed tomography (CBCT) is able to detect this clip postoperatively.

Methods: A total of 14 patients were included in this retrospective study. Seven of them were fitted with a fixation clip and the other seven had no such clip. Routinely performed postoperative (CBCT) imaging was evaluated by a neuroradiologist in a blind procedure to investigate the detectability of the clip.

Results: DVT images of 13 patients were evaluated. The clip was correctly detected in five of six patients. A false negative was produced in one case. All patients without clips were correctly identified using CBCT imaging.

Conclusion: Despite its small size, the fixation clip can be radiologically identified with high sensitivity, which is an important aspect for postoperative monitoring, especially in cases of revision surgery. The CBCT imaging thus contributes to the safety of the operative procedure.
Introduction: The study investigates the usability of Laser-Doppler-vibrometry and Outer Ear Canal Sound Pressure Level (OEC-SPL) as equivalent objective intraoperative measurements to determine the functionality of the transcutaneous bone conduction implant (TBCI) Bonebridge (MED-EL). Additionally, the origin of the measured sound in the ear canal was explored.

Methods: Here we compared vibration of the bone close to the implant measured intraoperatively by Laser-Doppler-vibrometer (LDV, Polytec Inc.) to OEC-SPL measurements. Twelve single sided deafness (SSD) patients with contralateral functional ossicular chains and eight bilateral conductive hearing loss (CHL) patients were included. All patients were implanted with the TBCI, but the transmission pathway on the contralateral side between the cochlea and the tympanic membrane was different in both groups. SSD patients had an ABG of $0.4 \pm 0.4 \text{ dB} (0.5, 1, 2, 4 \text{ kHz mean value (MV) \pm standard deviation (SD)})$ whereas CHL patients had an impaired middle ear with a large ABG of $47.2 \pm 6.6 \text{ dB}$. The bone vibration was recorded on the adjacent bone close to the implant (ipsilateral) while the OEC-SPL was measured in the ipsi- (implanted) and contralateral ear of all patients using a probe microphone (ER7C, Etymotic Research, Inc.).

Results: The results showed a strong correlation between the average displacement and OEC-SPL in the CHL ($r^2=0.85$) and SSD ($r^2=0.75$) groups. When comparing results in OEC-SPL from CHL and SSD patients no significant differences (t-test, $p<0.05$) were found at frequencies between 0.5 and 8 kHz. The transcranial attenuation (TA) measured previously by promontory acceleration of human skulls in response to stimulation by a bone-anchored hearing aid transducer and from another study using OEC-SPL in normal hearing subjects with stimulation by a bone conduction transducer on a headband showed less than 5 dB differences to our average OEC-SPL TA results.
Conclusion: High correlation among the displacement amplitude measured by LDV and OEC-SPL showed that these measurements can be reliably used for intraoperative testing with sufficient signal-to-noise ratio (>12 dB). Further, OEC-SPL provides an easy, affordable and quantitative measurement tool to monitor the functionality of these implants, also postoperatively where the LDV measurement is not applicable. The lack of significant differences in OEC-SPL between CHL and SSD patients implies that the part of the measured sound pressure at frequencies between 0.5 and 8 kHz in the ear canal originating from the cochlea and emitted by the tympanic is not dominant and OEC-SPL is mainly due to emissions by the external ear-canal walls.
Multimedia Cabin for CI Testing

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Introduction: Technological progress in cochlear implantation in particular and hearing prosthesis in general have enhanced the auditory perception of their users in ever more complex listening situations. These hearing devices can be currently programmed and adapted to listen to the spoken word in relative quietness, but also in multiple noisy environments, windy scenarios, music perception, etc. Audiometric tests to assess the performance of auditory implants and prostheses are generally performed in audiometry soundproof booths. The spoken material is usually presented in quiet or masked with noise. Even though this information is very useful, it does not reflect what the patient hears in real life, where there are multiple sound scenarios. Besides, it does not measure realistically new contributions from recent technological developments added to hearing devices, so it is difficult to obtain the right feedback in order to adjust programming and optimize performance. The objectives of this project are: Establish an examination method to assess outcomes obtained by cochlear implant users in certain listening conditions simulating real life situations and through this examination method, collect information to optimize cochlear implant programming based on the audiometric outcomes recorded.

Methods: The multimedia booth has a software that runs on a desktop computer (desktop), with 2 sound cards. The cabin has an area of 8m², has been soundbuffered, and has 8 Genelec 8010A speakers distributed among 360° around the patient. It also has a 3D television screen, so the patient may have a visual support related to the different noise scenarios described below. This
contributes to a more realistic assessment stage where sound and visual information usually coexist.

A population of normal hearing subjects and patients implanted with the Nucleus 6 System (Smart Sound technology) will be studied. Smart sound technology will be reviewed to understand how it actuates in the context of audiometric booth and testing protocol. Then, Audiometric tests will be performed in an audiometric booth recreating 5 visual-acoustic scenarios: 1. Relative Silence. 2. Noise. 3. Intense noise environment. 4. Loudness Discomfort Level. 5. Localization

**Results:** At the present time, validation of a new protocol to assess outcomes obtained by cochlear implant users in virtual reality situations in order to optimize the programming of these implantable devices is in progress. Results will be shown in the congress.

**Conclusion:** It has been developed a method of audiometric exploration that allows to assess hearing ability in healthy and poor hearing people in existing listening conditions simulating different real life situations with variable intensity signal. From the information obtained, it is possible to optimize the programming of hearing aids in order to improve their performance.
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2016-A-178-ACI

Session Number:
POS01

Session Title:
Poster Session A

Poster Board Number:
180-A

Topic 1:
08a - Miscellaneous

Publishing Title:
Exploring Skin Integration in Hydroxyapatite-Coated Abutments of Bone Conduction Hearing Implants

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*
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Abstract Body:

Introduction: Percutaneous implants such as bone conduction hearing implants suffer from complications which include inflammation of the surrounding skin. A sealed skin-abutment interface should prevent bacterial colonization and reduce peri-abutment dermatitis. A hydroxyapatite (HA) coated abutment was introduced which was previously shown to enable integration with the adjacent skin when used in combination with soft tissue preservation surgery. Research has shown that such integration is not achieved with titanium, which is the abutment material used since the origin of bone conduction hearing implants. HA is a mineral which is a major constituent of teeth which establishes a seal (junctional epithelium) to prevent the invasion of oral bacteria and therefore infection. However, to date it is not known how skin attaches to the HA-coated abutment.

ObjectiveTo explore the types of cells and the method of attachment employed by cells attaching to clinically retrieved HA abutments.

Methods: After being in situ for at least 3 months, HA-coated abutments (Cochlear Baha® BA400) were retrieved from subjects with a bone conduction hearing implant. These samples were investigated using excitation fluorescence microscopy (Leica TCS SP5, Leica Microsystems GmbH, Wetzlar, Germany) fresh and/or after being fixed in formalin and stored in phosphate buffered saline. After fixation, cells were labelled for nuclei, collagen and α6 integrin. Different parts of the abutment were visualized and analysed.

Results: HA-coated abutments showed attachment of cells as evident from DAPI staining. The thickness of the layer of cells attaching to the abutment differed between and within abutments. Multiple types of cells and extra-cellular matrix were present. These could be distinguished by their morphology, autofluorescence and specific immunostaining. Cells expressed hemidesmosome components (Integrin α6) in the neighborhood of the HA-coating. This connection can be used by cells to achieve cell-to-extracellular matrix attachment. It also has been implicated before in making implant-to-host connections possible.
Conclusion: These results confirm that cells can attach to the HA-coated abutment. Research is ongoing to determine the phenotype of the different cell types found in the neighborhood of the HA-coating.
Introduction
Research has shown that bimodal use generally allows for better speech recognition, sound quality, and localization when compared to performance in the unilateral cochlear implant condition. Contemporary cochlear implant sound processors and hearing aids feature sophisticated noise management technologies such as adaptive directional microphones and digital noise reduction (DNR). There are no published research studies examining the interaction between advanced signal processing technologies available in modern hearing aids and cochlear implant sound processors.

Methods
Fourteen cochlear implant recipients were fitted with a commercially available cochlear implant sound processor equipped with an acoustic scene classifier, an adaptive directional microphone system, and a DNR algorithm. On their non-implanted ear, they used a hearing aid which possessed an adaptive directional microphone system and DNR. The sound processor and hearing aid were each loaded with two programs, one with adaptive noise management technologies enabled and another with adaptive noise management technologies disabled. The participants were asked to alternate between the two programs in realistic situations and record in a journal their preference for each program across a variety of situations. The participants’ objective and subjective hearing performance were evaluated after a four-week field trial with the two programs. Sentence recognition was evaluated with AzBio sentences. This assessment was completed using a six-loudspeaker array (0, 45, 135, 180, 225, and 315 degrees in the horizontal azimuth). Sentence recognition was assessed in quiet was completed across all test conditions. To initiate the assessment of sentence recognition in classroom noise, all noise management technologies were disabled for the hearing aid and the cochlear implant sound processor, and the signal-to-noise ratio (SNR) was varied to determine a SNR that resulted in performance in the 40-60% correct range. The remainder of sentence recognition in noise was completed at this SNR. Assessment was completed in the following conditions:
1) Cochlear Implant (CI) (Adaptive Directional + DNR) and Hearing Aid (HA) (Noise Management Technologies Disabled),
2)
Results
The results of this study indicated a statistically significant improvement in speech recognition in noise with use of the adaptive noise management technologies. Use of the adaptive directional microphone systems provided the largest improvement in sentence recognition in noise, particularly when used with the cochlear implant. Several interactive effects were observed with use of the various noise management technologies.

Conclusion
Use of adaptive noise management technologies improves speech recognition in noise with little to no detriment.
The Bonebridge Bone Conduction Hearing Implant: Individual Computer Assisted 3D Planning for Surgical Device Placement and Audiological Outcome in Adults and Children

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Abstract Body:

Introduction: The Bonebridge is a semi-implantable bone conduction implant system indicated in conductive or - to some extent - mixed hearing loss and in single-sided deafness. The bone conduction floating mass transducer (BC-FMT) should be placed in the mastoid in the sinus-dura-angle or retrosigmoidal without compromising the dura or the sigmoid sinus. This could be a challenge especially in children with a small mastoid, in malformations or after multiple ear surgery.

Methods: Since July 2012 the Bonebridge was implanted in 21 patients, including 7 children < 16 years old (mean = 34.2 y ± 23.4 SD; min. 5, max. 76 y) in our department. In each case, the audiological testing was performed preoperative, and 1 month and 3 months after implantation. Based on high resolution CT-scans of the temporal bone, a preoperative planning method was developed which allowed a fusion of the Bonebridge implant model with the respective AMIRA software based 3D-model of the skull and to freely adjust them. This allowed us to detect the optimal implant position and to transfer it to the intraoperative situation using distances to anatomical landmarks in a virtual surgery approach.

Results: The Bonebridge implant could be accurately placed in the determined positions. In two cases a simultaneous planning of the Bonebridge implant and bone anchors for ear prosthesis was performed. It also occurred that during the preoperative planning an inadequate bone thickness of the mastoid was revealed. In that few cases, no Bonebridge implantation was carried out. Audiological data showed 3 months after implantation a significant improvement in speech recognition as well as in hearing in noise and a benefit in directional hearing and sound localization.

Conclusion: Individual preoperative planning is generally useful and especially recommendable in small, poorly pneumatized mastoids, in malformations, in reduced bone volume after canal wall down mastoidectomy and in cases of simultaneous
implantations of bone anchors for ear prosthesis. Audiological results were comparable to those reported in other studies about bone anchored hearing systems.
Introduction: Currently, the number of deaf children with multiple disabilities receiving cochlear implants has gradually increased. Our curiosity drives us to ask several questions on the social and family behavior as well as the language's evolution of these children compared to deaf children with no other disability.

Methods: A three year longitudinal study of the effects of cochlear implantation on language and behavioral outcomes in children with and without additional disabilities has been conducted. The study cohort consisted of 40 deaf children. 75% of the sample (n=30) had a single diagnosis of severe to profound hearing loss and 25% (n=10) had an additional disability. Oral language and behavioral outcomes were jointly evaluated by the same otorhinolaryngologist and speech therapist using the same language development scales.

Results: Results indicated that children with multiple disabilities made slower progress. These linguistic and behavioral changes vary according to the handicapping condition and also depending on the age at which the implantation has occurred.

Conclusion: The positive linguistic and behavioral changes in children implanted with multiple disabilities should encourage us to expand the indications in order to facilitate a better social integration with less of a burden, being the elimination of one disability.
Introduction
The benefits of utilizing low-frequency acoustic hearing in combination with high-frequency electric stimulation through the provision of an integrated electric-acoustic (EAS) sound processor fitted for adult cochlear implant recipients have been well documented within the peer-reviewed literature. In contrast, there is no consensus amongst cochlear implant clinicians and researchers regarding the determination of optimal allocation of acoustic and electrical stimulation.

Methods
Fifteen adult participants (age 18 and older) who presented with functional low-frequency residual hearing after cochlear implantation were fitted with an integrated EAS sound processor. An attempt was made to match the output of the participant’s acoustic component to the NAL-NL2 prescriptive target. The output of the acoustic component was decreased below the participants’ threshold in frequency ranges with a cochlear dead region as identified by the Threshold Equalizing Noise (TEN). Next, the high-pass cut-off for electrical stimulation was set to each of four alternatives:
1) Wideband (188 Hz),
2) The lowest frequency at which the participant’s air conduction threshold exceeded 70 dB HL (Cochlear default),
3) 438 Hz (comprehensive inclusion of F1),
4) The highest air conduction frequency at which sufficient audibility was provided by the acoustic component (defined as the highest frequency at which the NAL-NL2 target was met or the highest frequency without a cochlear dead region) (the “meet approach”),
5) One octave above the highest air conduction frequency at which sufficient audibility was provided by the acoustic component (the “gap approach”).
Hearing performance was evaluated at each of the five aforementioned programs following three wear intervals of two weeks. For one of the two-week wear intervals, the participants were asked to switch between the two programs with the lowest high-pass cut-off frequencies for allocation of electrical stimulation. For another two-week interval, the participants were asked to switch between two programs with the highest high-pass cut-off frequencies. Finally, for a third two-week interval, the participants were asked to use the program with the electrical high-pass cut-off frequency that was not evaluated during the first two intervals. The order in which these wear intervals was evaluated was counter-balanced across participants.

After each two-week interval, hearing performance was evaluated with the program(s) the subjects had trialed using the following metrics:

1) CNC words presented at a presentation level of 50 dBA,
2) AzBio Sentences at 0, +5 dB, and +10 dB SNR,
3) Speech Intelligibility Rating (SIR) Test, and
4) The Speech, Spatial and Sound Qualities of Hearing Questionnaire (SSQ) and the APHAB questionnaire.

**Results**

Results indicate statistically significant changes in hearing performance as a function of the high-pass cut-off frequency for electrical stimulation.

**Conclusion**

Adult EAS recipients' hearing performance is significantly influenced by the high-pass cut-off frequency for electrical stimulation.
Abstract Body:

Introduction: Sudden sensorineural hearing loss (SSNHL) affects approximately 4000 people in the US annually (Stachler, et al., 2012) with 10% experiencing bilateral SSNHL (www.nidcd.nih.gov). In January 2014, a 63 year old female presented to our clinic with sudden bilateral SSNHL and constant vertigo. An audiogram at the time of the initial diagnosis revealed no measurable hearing in the left ear and severe sensorineural hearing loss in the right ear, which quickly decreased to a profound loss. Vestibular testing revealed a significant bilateral peripheral weakness. CT and MRI scans were unremarkable. The patient was treated with aggressive medical therapy without response and ultimately underwent cochlear implantation to the left ear.

Methods: This is a case study.

Results: The patient received an Advanced Bionics 90k mid-scala implant in her left ear July 2014. The surgeon reported full insertion with no complications; however, NRI testing at the time of surgery revealed no neural responses on any electrode. Through aggressive mapping (M levels in the 600 CUs), the patient's soundfield thresholds have consistently been in the 25 - 40 dB HL range. Patient has not been able to correctly identify any speech materials, presented monitored live voice or recorded, since implantation.

Conclusion: Despite having good sound detection and awareness, the patient continues to struggle with speech perception. She also continues to have debilitating vertigo and is unable to resume normal activities such as working or driving.
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Abstract Body:

Introduction:
Initial activation of a cochlear implant prompts the need to decide between various feature options. One decision is the selection of a signal coding strategy among the multiple possibilities. Most studies report similarities in speech perception between signal coding strategies available currently. These investigations typically include subjects with a wide range of age at implantation. Map features, such as stimulation rate, are often manipulated when mapping an older adult. There are limited investigations as to whether the selection of a specific signal coding strategy at initial activation may influence speech perception outcomes in the older adult population.

Methods:
Speech perception outcomes between coding strategies were reviewed for younger and older adults.

Results:
All subjects experienced an improvement in speech perception outcomes as compared to preoperative performance. There was no difference between the signal coding strategies during the first six months post-initial activation of the external speech processor. There was also no effect of age at implantation for speech perception performance over time.

Conclusion:
The evaluation of signal coding strategies on postoperative outcomes should include assessment of not only speech perception, but also more complex listening tasks. Review of long-term listening experience is needed to assess how perception abilities change over time.
Simulating Pinna Effect by Use of the Real Ear Sound Algorithm in Advanced Bionics CI Recipients

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Introduction:
In acoustic hearing, listeners use pinna cues to aid in sound localization ability and to spatially separate speech signals from competing noise sources. Hearing impaired listeners lose these pinna cues due to the traditional placement of BTE hearing instrument microphones (i.e., atop the pinna). Phonak’s Real Ear Sound (RES) algorithm has proven effective in reducing front-back localization confusions in BTE hearing aid listeners. In this study, we applied the Real Ear Sound algorithm to the Advanced Bions Naida CI sound processor and compared performance of this algorithm on localization and speech in noise tasks to performance with an omnidirectional microphone as well as the T-Mic™2 microphone to determine whether the pinna effect could be simulated with this algorithm in CI recipients.

Methods:
Subjects were 17 adult Advanced Bions cochlear implant users; 10 bilaterally implanted and 7 unilaterally implanted. Localization ability was assessed utilizing six speakers, three in the front hemifield (-45°, 0° and 45°) and three in the back hemifield (135°, 180° and 225°). A stimulus (train of 4 pink noise bursts, each of 170 ms duration, 10 ms rise/fall time, 50 ms inter-burst interval) was presented at 50 dB SPL (+/-5 dB roving to remove level cues) with subjects indicating the speaker location from which they perceived the sound had originated. Speech perception in noise was measured at 60 dB SPL. The speech signal was presented
at 0° azimuth; R-SPACE restaurant noise was presented from speakers surrounding the subject (90°, 135°, 180°, 225° and 270°), but never from the same speaker from which the speech signal was presented, and the signal-to-noise ratio (SNR) was adjusted to achieve ~ 50% score relative to the score obtained with the patient’s clinical program in a quiet listening condition. Two TIMIT sentence lists were presented for each test condition.

**Results:**
Performance with the omnidirectional microphone setting was significantly worse than performance with the T-Mic 2 and RES for speech understanding in noise evaluations and sound localization tasks.

**Conclusion:**
Results suggest that use of the T-Mic 2 placing the microphone at the entrance to the ear canal allows listeners to utilize natural pinna cues for localization and speech perception in noise. The RES algorithm may lack the usability benefits of the T-Mic 2; however, it may provide similar pinna cues and allow CI recipients to achieve improvement in performance relative to the omnidirectional microphone condition.
Introduction: Over the past few years, most cochlear implant (CI) developments that aimed at enhancing speech recognition have focused on signal-processing strategies and electrode design. However, considerable improvements may also be reached by employing front-end processing. The SONNET audio processor provides users of a CI with two front-end processing features: Microphone Directionality (MD) and Wind Noise Reduction (WNR). The aim of the study was to assess speech perception outcomes with different combinations of MD and WNR implemented in the SONNET audio processor compared to the OPUS2 audio processor.

Methods: Adult unilateral cochlear implant users with a minimum of 6 months experience with their prior audio processor were upgraded to the SONNET. Three test visits were conducted, visit 1 at upgrade, visit 2 3 weeks and visit 3 6 weeks after the upgrade. During the study, subjects only used the SONNET. At each visit the subjects were tested with their prior Audio Processor (OPUS2) and with the SONNET programmed with different combinations of MD (omnidirectional, natural and adaptive) and WNR (off, mild and strong) modes. At visit 1 subjects were tested using the Oldenburg adaptive sentence test (OLSA) with the speech signal presented from the front and background noise presented continuously from 90°, 180° and 270°. At visit 2 subjects were tested using the OLSA with wind blowing to the audio processor from an angle of 45° at a speed of approximately 7 km/h with no additional background noise. At visit 3 subjects were tested in quiet using the Freiburger monosyllabic test.

Results: Speech perception outcomes of 20 subjects (out of 30) who completed the study tests were analyzed. The results of speech tests in both speech-shaped and babble noise with the SONNET in its default setting show significant benefit for speech perception in noisy conditions comparing to the OPUS2. Comparing the results of speech tests with all 9 combinations of MD and WNR in wind show that in windy conditions speech perception is always better with WNR turned on compared to WNR “Off”. The results of the Freiburger monosyllabic test in quite show that speech perception with the SONNET was better than with the OPUS 2.
**Conclusion:** Employing front end processing in CI audio processors improves speech recognition in difficult hearing conditions. The two new features, microphone directionality and wind noise reduction in the SONNET in its default mode gives CI users significant benefit for speech perception in noisy and windy conditions.
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Topic 1: 04e-Children and Recommended Rehabilitation

Publishing Title: Rehabilitation Model For Bilateral Cochlear Implant Users

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Abstract Body:

Introduction: Bilateral cochlear implantation is recognized worldwide as a beneficial procedure for the severe to profound hearing impaired; the main benefits appear mainly related to sound localisation and speech perception in noise (Bond et al 2009). However, no guidelines have been developed on rehabilitation techniques that should be used to obtain such benefits.

Objectives: The project targets the elaboration of a rehabilitation model for bilateral CI users, including 1) an assessment protocol and 2) the appropriate rehabilitation services and techniques needed to optimize the binaural benefits.

Methods: Three sources of evidence were considered in the design of the rehabilitation model: 1) international survey among experts in CI rehabilitation, 2) health technology assessment, 3) detailed analysis of the current practice in an experienced CI center.

Results: Phase 1: Scant information could be retrieved from the survey since few experts could cover all questions. Nevertheless, it seems that all responders conduct some sort of specific auditory assessment or training with the second CI alone, including tailored activities to integrate binaural perception for half of them. The same proportion requests patients to wear the second CI alone for different time periods. Frequency and duration of therapies are heterogeneous.

Phase 2: The health technology assessment revealed an important lack of evidence. Nevertheless, some trends were identified: 1) an intensive rehabilitation period would be essential to obtain optimal benefits in sound localisation and speech perception in noise, 2) benefits from the second CI take time to emerge, 3) it is desirable that users get the same level of auditory abilities in both ears, 4) considering the risk that patient stop using the second CI, follow-up after rehabilitation is emphasized, 5) tailored individual training should be done, including intervention at home/school, 6) the proposition of home based program with exercises on a computer are common for adult users, but compliance is very low.

Phase 3: The detailed analysis of the current practice in an experienced CI center revealed a consensus among professionals on assessment protocols. In terms of performance, it appears that patients with a minimum use of 5 hours per day of the second
implant achieved better benefits. Most patients had similar auditory abilities in quiet in each ear after a 3 months rehabilitation period. However, variable needs in training for speech in noise or localization were reported. From these sources, an integrated model of care was generated. This model is based on the objective of achieving similar auditory abilities in both implanted ears. It incorporates a) a proposition to wear the second CI alone at least 5 hours each day for toddlers and the majority of daytime hours for others, b) the implementation of intensive rehabilitation periods provided by a multidisciplinary team, c) rehabilitation activities targeting speech in noise and localization training.

**Conclusion:** An integrated model of care for bilateral CI users was developed using multiple sources of evidence. Actualisation of this model will be monitored and validated.
The Effect of Clipping Level and Rate Changes on Subjective Sound Quality for Advanced Bionics Cochlear Implant Recipients

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Introduction:
Cochlear implant programs in which stimulation levels exceed voltage compliance limit on one or more electrodes may lead to compromised speech perception abilities, inadequate loudness growth and diminished sound quality. Today’s commercial cochlear implant programming software provide visual indicators or automatic program adjustments in attempts to avoid exceeding compliance levels in a patient program. When compliance limits are approached, the pulse width will typically be increased to provide adequate headroom. However, this results in lower program stimulation rates and potentially introduces a change in sound quality for the listener. In this study, we aimed to gain a better understanding of the negative impact on subjective sound quality for programs operating with one or more channels above compliance limits compared with programs running at slower stimulation rates.

Methods:
Using a MUSHRA (MUltiple Stimuli with Hidden Reference and Anchor) methodology and sets of 8 sentences taken from the AzBio Sentence lists, adult Advanced Bionics recipients compared the sound quality of their commercial sound processing strategy (i.e., the “Reference” program) with programs utilizing incrementally slower rates (e.g., 1.5K, 1K, 750, 500 pps) and programs with maximum stimulation level clipped below M level on one or multiple channels located adjacent to one another within the same portion of the electrode array or spread across non-adjacent electrode contacts. A program with clipping applied
30% below M level to all active channels was used as the “Anchor” program condition for all subjects.

**Results:**
Subjective sound quality ratings were reduced for programs with clipping applied to channels located in the apical portion of the electrode array compared to medial or basal locations. Programs with clipping applied to multiple adjacent channels were typically rated as poorer in quality than those where clipped channels were spaced across the electrode array. Clipping applied to four or 7 channels spaced across the electrode array showed little effect on sound quality compared to subjects’ reference programs. Sound quality ratings were reduced for program rates of 750 and 500 pps compared to those at rates of 1000 pps and above. Programs with clipping applied to several apical channels were rated poorer in quality than the 750 pps rate programs but equivalent in sound quality to the 500 pps rate programs.

**Conclusion:**
Using clipping to simulate out-of-compliance operation, results suggest that the number of clipped channels and their location within the electrode array most affect the perceived reduction in sound quality. When widening the pulse width to avoid exceeding compliance limits, results further suggest that cochlear implant recipients may tolerate reductions in rate with minimal sound quality detriment for programs with rates of 750 pps and above.
Introduction: Cochlear implant (CI) recipients face dynamic and challenging listening situations everyday. Although omnidirectional microphones are effective in quiet, dual-microphone beamformers can greatly enhance face-to-face speech understanding in noise. In order to facilitate usage of such effective technologies in dynamic listening environments, automatic switching between microphone modes is required. The Naida CI Q90 sound processor is capable of using an automatic scene classifier that analyzes the listening environment and determines when to automatically activate the omni-directional or beamforming microphone options. It uses continuous processing of 46 parameters of the sound environment (e.g., overall noise level, signal-to-noise ratio, modulation) to determine the probability for each auditory scene and the relationship of speech to noise. When it is a quiet or noise-only environment, the default omnidirectional microphone is used. When there is a high probability that speech is embedded in noise, the beamformer is enabled.

The objective of this study was (1) to examine whether the automatic beamformer activating algorithm selects the correct microphone mode in quiet and in noise and (2) to evaluate its effect on speech understanding in quiet and in noise as compared to manually enabling the microphone options.

Methods: Speech understanding in quiet and in noise was evaluated in 20 CI recipients. AzBio sentences were presented from 0° in quiet and in cantina noise presented from +90, -90, and 180 degrees. Subjects were tested in three microphone mode programs randomly: manual in-the ear omnidirectional microphone, manual beamformer, and automatic beamformer activator. ClearVoice (medium) was active in all programs.

Results: The automatic beamformer activating algorithm classified the speech-in-noise environment accurately and switched the microphone mode to enable optimal speech perception in quiet and in noise. Speech scores in quiet with the automatic beamformer were not significantly different from the manual omnidirectional mic scores. Speech scores in noise with automatic beamformer were not significantly different from the manual beamformer.

Conclusion: The new automatic beamformer activating algorithm makes communication easier and more effective in dynamic listening situations.
**Introduction:** The purpose of the study is to investigate whether round window approach of cochlear implantation may provide better preservation of residual hearing than cochleostomy approach.

**Study Design**
Case control study

**Methods:** We designed a case-control study consisting of 40 implantee underwent cochlear implantation (Medel co.) surgeries in a tertiary referral center. From Nov 2013 to Jul 2014, we prospectively enrolled 20 subjects for the cochlear implantation with round window approach insertion. We retrospectively collected data from 20 age and sex-matched patients who had undergone cochlear implantation with cochleostomy approach insertion between January 2008 and Oct 2013. The residual hearing of the operated ear was measured before and after surgery. Variables analyzed were pure-tone average threshold at 250, 500, and 1000 Hz and residual hearing at frequencies from 250 to 8000 Hz. Residual hearing was considered as preserved when audiometric changes were less than 10 dB HL in each variable. The audiological results of the two groups were compared.

**Results:** No statistically significant difference was found in the preservation of residual hearing between the two groups (P > 0.05 in all variables)

**Conclusion:** Round window and cochleostomy approaches of cochlear implant surgery may both provide preservation of residual hearing at similar rates across frequencies.
**Abstract Body:**

**Introduction:** We proposed a piezoelectric artificial basilar membrane (ABM) composed of a microelectromechanical system cantilever array.

**Methods:** The ABM mimics the tonotopy of the cochlea: frequency selectivity and mechanoelectric transduction. The fabricated ABM exhibits a clear tonotopy in an audible frequency range (2.92-12.6 kHz). Also, an animal model was used to verify the characteristics of the ABM as a front end for potential cochlear implant applications. For this, a signal processor was used to convert the piezoelectric output from the ABM to an electrical stimulus for auditory neurons. The electrical stimulus for auditory neurons was delivered through an implanted intra-cochlear electrode array.

**Results:** The amplitude of the electrical stimulus was modulated in the range of 0.15 to 3.5 V with incoming sound pressure levels (SPL) of 70.1 to 94.8 dB SPL. The electrical stimulus was used to elicit an electrically evoked auditory brainstem response (EABR) from deafened guinea pigs. EABRs were successfully measured and their magnitude increased upon application of acoustic stimuli from 75 to 95 dB SPL. The frequency selectivity of the ABM was estimated by measuring the magnitude of EABRs while applying sound pressure at the resonance and off-resonance frequencies of the corresponding cantilever of the selected channel.

**Conclusion:** In this study, we demonstrated a novel piezoelectric ABM and verified its characteristics by measuring EABRs.
Introduction: This study aimed to develop and validate “Ecomas”, a new scale for evaluate the oral communication of hearing-impaired adults.

Methods: A 8-domains scale that explores the communication abilities, both in daily life and in complex situations, was developed in French language. Each domain is rated from 0 (poor abilities) to 4 (strong abilities). External and internal validations were measured on 300 adults presenting a severe to profound hearing loss, candidates to cochlear implantation. The sensitivity to change (responsiveness) between pre-implant and 6/9 months post-implant scores was calculated on 32 patients. The inter-rater agreement (reproducibility) concerned 37 patients examined both, by their local speech & language pathologists (SLP) and those in the Referral Center.

Results: The internal validity was confirmed by Cronbach coefficient (0.92). The correlations between Ecomas total score and each domain (rho between 0.69 and 0.79 with p <0.05) and between Ecomas and "Category of Auditory Performance" (CAP) scale (rho = 0.59, p <0.05) show a strong internal consistency and a good external validity. Sensitivity to change was shown by a size effect of 1.03. There is a strong correlation between ratings of the same patient by two different SLP (rho = 0.84, p <0.05) but the percentage of strict similarity is poor (22%).

Conclusion: Ecomas is a simple, valid, reliable, and highly sensitive scale that allows a new quantification of communication skills of the adult cochlear-implanted patients. The inter-rater agreement between SLP requires additional studies but Ecomas could be from now easily translated in several languages.
Multicentric Study About the Bonebridge Implant in France and Belgium

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Abstract Body:

Introduction: The objective of the study is to evaluate the safety and efficacy of a new transcutaneous bone conduction implant (BCI BB) in patients with conductive and mixed hearing loss or with single-sided deafness (SSD), one year after surgical implantation.

Methods: Multicentric prospective, intra-subject measurements. Each subject is his/her own control.

Setting: 9 university hospitals: 7 French and 2 Belgian.

Patients: 16 subjects with conductive or mixed hearing loss with bone conduction hearing thresholds under the upper limit of 45 dB HL for each frequency from 500 Hz to 4000 Hz, and 12 subjects with SSD (contralateral hearing within normal range). All subjects were older than 18 years.

Results: Skin safety was rated as good or very good. For the mixed or conductive hearing loss group, the average functional gain (at 500 Hz, 1 kHz, 2 kHz, 4 kHz) was 26.1 dB HL (SD=13.7), and mean percentage of speech recognition in quiet at 65dB was 95% (vs 74% unaided). In 5/6 SSD subjects, values of SRT in noise were lower with BB. Questionnaires revealed patient benefit and satisfaction.

Conclusion: The transcutaneous BCI is very well tolerated at 1 year follow up, improves audiometric thresholds and intelligibility for speech in quiet and noise, and gives satisfaction to both patients with mixed and conductive hearing loss and patients with SSD.
Introduction: Bone conduction implants are the best option for those patients with several types and degrees of hearing loss that, due to related pathologies, are not able to use (or will not perform well with) traditional hearing aids. Where assistance costs are concerned, we must consider not only the costs associated with the hearing implant product, but also those indirect costs related to the subsequent medical revisions after the device implantation. The total time of medical assistance to the patient is the factor which most influences the cost-effectiveness rate of these devices.

Methods: A review of all active bone conduction implant recipients from the main public reference hospital in the Balearic Islands for the implantation of hearing devices was carried out. A comparison has been established between percutaneous and transcutaneous active bone conduction implants regarding the following key points: average surgical implantation time for each device, postoperative complications, weeks until the first fitting of the audio processor, and number of medical revisions needed after the surgery.
Results:

Results: From the total of 83 active bone conduction implants, 75 are percutaneous and 8 are transcutaneous. Average surgical time is 45 minutes for percutaneous implants, and 90 minutes for transcutaneous ones. No postoperative complications appeared with transcutaneous implants, and the first fitting of the audio processor is done 3 weeks after the surgery. With percutaneous implants, skin infections (granuloma) and wound healing complications may occur, thereby delaying the first fitting after the initially scheduled 4 weeks. The average number of postoperative medical check-ups prior to the first fitting is 5 (4-6) for percutaneous implants, and only 1 for transcutaneous ones (to remove stitches). After the first fitting of the audio processor, patients implanted with transcutaneous devices did not request medical revisions related with the implant, but for percutaneous devices there are several possible long-term complications, such as screw extrusions and skin reinfections.

Conclusion:

Conclusion: When comparing active bone conduction implants, the total time of medical assistance is lower in transcutaneous devices than in percutaneous ones. This is due to the fact that transcutaneous devices have fewer related medical complications, while maintaining the same hearing performance. This reduction in medical assistance time is especially important in our hospital, because patients may travel from distant islands, which considerably raises the transportation costs for our public health system.
Abstract Body:

Introduction:
Hearing impairment is one of the most important factors that cause delays in speech and language development and other aspects of the communications. Perceptive and expressive language skills development of hearing impaired children after cochlear implant depends on using appropriate educational rehabilitation methods. This study aims to investigate the effectiveness of Auditory-Verbal Therapy (AVT) on aforementioned skills in hearing impaired children in contrast, other methods of communication.

Methods:
In this quasi-experimental study, 30 hearing impaired children with cochlear implant, aged under 3 years were assigned to two groups (15 children in each group). The expressive and perceptive language skills of these children were evaluated via The Newsha Developmental Scale.

Results:
The difference between the scores of both control and treatment groups through Test of U Mann - Whitney revealed that there is a statistically significant difference in expressive language skills (p= 0.008) and perceptive language skills (p= 0.007) of the children who participated in this study. In other words, the findings suggest that AVT have a significant impact on improvement of aforementioned skills in hearing impaired children In contrast, other methods of communication.

Conclusion:
Hearing-impaired children have problems with language and social interactions. Therefore, So be sure we have the best rehabilitation program to improve these children's language. According to the results of the study, AV Approach Should be in the
child’s daily schedule generally be considered to improve the perceptive and expressive language. After sessions of AVT, these children could make significant improvements in language acquisition and speech production.
**Introduction:** The aim of this study was to assess the communication performances in auditory, visual, and audiovisual modalities, by 13 adults implanted with auditory brainstem implant (ABI).

**Methods:** Thirteen post-lingually deaf adults (5 women, 8 men), with a mean age of 43±15 years old (SD [min-max, 26-67]), and a post-implant delay of 74±66 months [3-168] have been evaluated. Etiologies were predominantly the Type 2 neurofibromatosis (NF2, n=10), but also meningitis (n=2), and neuropathy (n=1). Two patients were bilaterally implanted, and 9 unilaterally, with no residual hearing in the contralateral ear. The audiometric thresholds were measured at 250, 500, 1000, 2000, 4000, and 6000 Hertz. A reproduction of six rhythmic sequences (Stamback), and a discrimination test of seven pairs of phonemes (ASSE®), presented in free field at 70 dB SPL, were performed. In addition, repetition of 10 vowels, 16 consonants, 10 dissyllabic words (Fournier), and 15 sentences (MBAA) were proposed in three conditions: visual only (lipreading), auditory only (ABI), and audiovisual (ABI and lipreading).

**Results:** After cochlear implantation, the tonal thresholds at 250, 500, 1000, 2000, 4000 and 6000 Hz were 52±15 dB [30-75], 42±12 dB [25-60], 42±13 dB [25-60], 34±13 dB [20-60], 38±11 dB [25-60], and 48±25 dB [20-70], respectively. The rhythmic sequences were correctly achieved in 97% of cases. The scores for the phonemes discrimination test (ASSE®) were 71%±16 [43-100]. A significant improvement of dissyllabic words (27%±20), and sentence recognition (21%±22) in "audiovisual" as compared to "visual only" conditions. By contrast, vowels and consonants recognition were not improved by the auditory cues provided by the ABI. The study of correlations between auditory tests and audiological data show only a correlation for the vowel recognition and the number of
activated electrodes (rho: $\rho = 0.62; p<0.05$).

**Conclusion:** This study demonstrates a clear contribution of the ABI in audiovisual modality as compared to the visual modality alone, for the recognition of disyllabic words and sentences. This improvement may be related to the involvement of cognitive abilities activated by the verbal content. Besides, auditory perception with ABI seems more efficient for analytic verbal perception such as phonemes. Therefore, speech therapy with ABI patients can have a double objective: to decrease the communication handicap by enhancing performances in audiovisual condition and optimizing cognitive skills, and to develop the auditory perception with an analytic approach based on rhythm, discrimination, and phonemic identification tasks.
**Introduction:** The objective of this study is to determine the correlation between wave V (eV) threshold in electric auditory brainstem response (E-ABR) in cochlear implant patients and free-field pure tone audiometry threshold.

**Methods:** 10 patients implanted with MED EL cochlear implant (SONATA and SYNCHRONY) were tested audiological both objective and subjective. E-ABR recording was performed in all subjects for two channels, one basal (1) and one apical (11) at decreasing intensities in order to obtain eV wave threshold. All patients were tested as well with free-field pure tone audiometry (PTA).

**Results:** EABR waves were obtained in all ten subjects, with better responses on apical channel 1 than on the basal one (channel 11). There was a large intra- and inter-subject variability regarding eV threshold for the two different channels and a poor correlation between behavioural and objective threshold.

**Conclusion:** E-ABR is a useful objective method for evaluation of the auditory system in cochlear implanted patients, but not a reliable tool for first fitting in very small children.
Introduction: In the modern otologic era, surgical complications of cochlear implantation which necessitate reimplantation are quite rare. However hard and soft implant failures mostly because of device life are in rise. Reimplantation surgery has specific difficulties for each particular case.

Methods: Two thousand one hundred eighty four patients (n: 2184) who have been implanted at Bozyaka Teaching and Research Hospital Cochlear Implant Center between 1998-2015. Ninety seven (n: 97) of these patients required a reimplantation procedure for various reasons. Records of reimplanted patients were evaluated retrospectively and possible causes, problems encountered during reimplantations and implant performance after reimplantations were analyzed.

Results: Sixty nine of the patients reimplanted either because of a hard failure or a soft failure. In other 28 patients, early or late surgical complications or problems led to reimplantations. Fifty nine of the cases were children. Most important risk factor was bony labyrinth abnormality for children and previous ear surgery for adults.

Conclusion: In this study, experience gathered from 97 reimplanted cases were presented and risk factors leading to reimplantation as well problems, hints and important aspects of this procedure are discussed. Our findings indicate that otologic surgeons who are...
encountered with cochlear implants are needed to be prepared for further reimplantation possibilities and aware of strategies that have to be used when the case is complicated in the early and late postoperative period.
Introduction
The use of image guidance for spinal, orthopedic, sinonasal and skull base surgery has been well characterized but there is limited information on the use of these systems in cochlear implant and ear surgery. The aim of this study is to evaluate the use of image guidance systems to facilitate cochlear implant surgery.

Methods and Materials:
There were 10 patients who underwent cochlear implant under the assistance of a navigation system in our department. Data collected and analyzed, where parameters like age, gender, indication of surgery determine and anatomic regions explored with navigation were also explored.

Results and discussion:
10 patients – 5 males, 5 females - underwent imaged guided cochlear implant between January and March 2013, and were included in this study. Navigation system has been used to identify facial recess, facial nerve, and to locate round window in malformed cochlea as well as to locate appropriate bone thickness to create the well. The value of a navigation system lies in its ability to allow the surgeon to accurately determine the boundaries of the surgical field and the location of surrounding vital structures. This facilitates safer surgery, particularly in cases of malformed cochlea. The navigation system allows more precise and confident identification of specific anatomic sites during cochlear implant.

Conclusion:
Performing cochlear implant with the assistance of navigation system is a safe way to treat patients with normal or malformed cochlea.
Effects of Electrode Array Length on Frequency-Place Mismatch and Speech Perception with Cochlear Implants

Abstract Body:

**Introduction**: Frequency-place mismatch often occurs after cochlear implantation, yet its effect on speech perception outcome remains unclear. In this article, we propose a method, based on cochlea imaging, to determine the cochlear place-frequency map.

**Methods**: We evaluated the effect of frequency-place mismatch on speech perception outcome in subjects implanted with 3 different lengths of electrode arrays.

**Results**: A deeper insertion was responsible for a larger frequency-place mismatch and a decreased and delayed speech perception improvement by comparison with a shallower insertion, for which a similar but slighter effect was noticed.

**Conclusion**: Our results support the notion that selecting an electrode array length adapted to each individual’s cochlear anatomy may reduce frequency-place mismatch and thus improve speech perception outcome.
The Effects of Cognitive Aging on Speech Recognition for Adults with Cochlear Implants

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Introduction: With the growth of society’s aging population, an increasing number of adult, postlingually deaf patients are receiving cochlear implants (CIs). There is amassing evidence that for many older CI users, cognitive aging contributes to poorer average speech recognition outcomes relative to their younger counterparts. This study had two primary objectives: (1) To investigate the effects of cognitive aging on speech recognition in adult CI listeners using three different types of sentence materials; and (2) To examine the effects of aging on one particular cognitive construct - working memory - which is believed to underlie robust spoken language understanding.

Methods: A group of adult, postlingually deaf, experienced CI listeners and an age- and gender-matched group of normal-hearing (NH) peers were tested using three measures of speech recognition in quiet and in speech-shaped noise - short and highly meaningful sentences, long and syntactically complex sentences, and nonsense sentences (word strings). Participants also completed several tasks of verbal working memory - forward digit span, backward digit span, and a task of serial recall of monosyllabic words.

Results: As expected, between-groups analyses revealed poorer scores on all speech recognition measures for CI users than for NH listeners. However, scores were generally not poorer for CI users on the tasks of verbal working memory. Working memory scores correlated with sentence recognition scores for CI users, especially on recognition of long, complex sentences; this relationship was not seen for NH listeners. Interestingly, older age was significantly associated with poorer working memory and poorer speech recognition for the CI group; again, this relationship was not seen for NH listeners. These associations of age, working memory, and speech recognition in CI users could not be explained by duration of deafness.

Conclusion: Findings from this study provide further evidence that cognitive aging contributes to poorer speech recognition outcomes in adults with CIs, and that this effect is not simply a result of longer duration of deafness. Moreover, the cognitive
The construct of verbal working memory appears to play a role in speech recognition for this patient population, especially for more complex sentence materials.
Introduction: During last years the importance of hearing preservation (HP) in cochlear implantation is increasing. Out of a big protocols or scientific papers, is it relevant in the practice? The aim is evaluate the use of HP technique in a heterogeneous population.

Methods: 48 patients were implanted (2014/15). HP technique used in all patients. Straight electrodes, steroids and soft surgery were the rule. Functional and structural HP was used. Functional HP in patients with some audiometric thresholds, specially in low frequencies, while structural HP (same technique) in patients without audiometric thresholds.

Results: HP technique was used in all patients except in 3 with cochlear ossification (2 meningitis and otosclerosis) where structural HP was impossible to do. Children with cochlear implants (under 3 yo) were excluded due to variable thresholds. 41,1% of serie presented residual hearing, and 12 patients have some HP after surgery reaching 85% of partial preservation. The inner ear approach was in 93% round window and 6% through cochleostomy. The use of intraoperative intratympanic and local steroids was done.

Conclusion: the respect for the inner ear structure and the possibility of hearing preservation is the most important advance in the cochlear implant surgery. This is the reason to do HP technique in all patients inclusive in those without residual hearing.
Introduction: Congenital aural atresia (CAA) is usually a challenging situation for otologist, and there is a wide array of treatment options. This have not always been satisfactory. Thus we have that the surgery for the atresia is complicated from a technical standpoint. Also has a high rate of complications. Active middle ear implants (AMEI) and active bone conduction implants (BCI) are indicated in CAA. The aim of study is to compare both devices regarding to functional gain, surgical complexity and intra and post operative complications.

Methods: 16 patients were presented. 8 patients used AMEI and 8 were implanted with active BCI. AMEI works in contact with any mobile structures in the middle ear (stapes or round window). Active BCI were placed in mastoid or retrosigmoid approach.

Results: These two prosthesis obtained similar results reaching more than 40 db of functional gain in free field. AMEI has a better result in high frequencies. Active BCI has a easier surgery than AMEI. Finally both prosthesis have a low complications rate but is mild frequent with AMEI.

Conclusion: AMEI and active BCI are very good options to improve hearing in CAA. Complications are very low but is less frequent with active BCI.
Abstract Body:

Introduction:
Objective fitting methods are preferred especially for children and CI users challenged in providing feedback. For a fitting method to be effective it needs to provide: the maximum comfort level (MCL) profile; a close approximation of MCL charge requirement; information about which if any, electrodes need deactivating; be relatively easy and quick to apply and be extensively applicable. The electrically elicited stapedius reflex threshold (eSRT) fitting method, where MCL is set at or around eSRT level, fulfils these requirements and as such is an extensively used fitting method, especially in children.

The objective of this study is to compare Auditory Response Telemetry (ART) thresholds (THR’s) with MCL set by eSRT in pediatric CI users and investigate ART THR profile, percentage of present ART THR’s and time to collect ART THR’s.

Methods:

During a regular fitting session 50 pediatric CI users were programmed using the eSRT fitting method. MCL’s were set at eSRT. ART THR was then measured on 1 apical, 1 medial and 1 basal electrode. Maximum output for ART measures was set close to MCL, on the relevant electrode, and then increased beyond MCL until an ART THR was recorded or the user showed signs of loudness discomfort. Time taken to record ESRT’s
and ART THR’s was recorded. Statistical analysis: The relationship between the two threshold profiles was assessed using the Spearman’s rho. For the number of individuals who exhibited ESRT and ART THR’s at all electrode placements, THR values were compared using the Wilcoxon signed rank test. The frequency at which a good match was achieved between the ART and ESRT THR’s, and the frequency of absent ART THR’s in the presence of eSRT was determined.

Results:
There was a weak to medium correlation between ART THR and eSRT set MCL. The ART THR did not faithfully follow the eSRT set MCL profile. This was reflected in statistical analysis. ART THR could not be found on electrodes with eSRT’s approximately 30% of the time. ART measures on 3 electrodes took significantly longer to measure than eSRT’s on all electrodes (usually 12).

Conclusion:
To make eSRT measures a tympanometer is required and the child needs to passively cooperate by wearing a probe and sitting fairly still. ART measures are easy to make as no extra equipment is required and the child can move around as recordings are not affected by muscle artifacts. However, unlike ESRT’s, ART THR’s do not provide the clinician with the detail necessary to generate an accurate program for a CI user.
Abstract Body:

Introduction:

Programming of pre-lingual ABI users is extremely challenging. Whenever, possible objective measures need to be used to allow evidence based programming and to evaluate appropriateness of provided programs. The objective of this case report is to demonstrate use and effectiveness of electrically elicited auditory brain stem measures (eABR), eSRT fitting method and Aided Cortical Assessment (ACA) in management of pediatric ABI users.

Methods:

A male with no apparent co-morbidities, aged 2 years 3 months, was implanted with an ABI to right side. Initial Stimulation was completed four weeks after surgery under anesthesia in an OR. eABR measures were made on all electrodes. eABR thresholds (THR’s) were used to formulate initial MCL and THR levels. One day later at switch on of the device, the ABI user was closely observed for non auditory side effects, while these MCL’s were approached. Device benefit was checked immediately after switch on through ACA. This child was re-programmed 6 times within 7 months of ABI use. From second fit onwards MCL’s were set at eSRT level and only E’s with eSR’s were
included in the program. Resultant programs were validated using ACA.

Results:

At initial stimulation with eABR, P2 waves were recorded on all electrodes (E’s) except for E’s 10, 11 and 12. The initial MCL and THR levels formulated from this data for E’s 1 -9 were appropriate as the ABI user had immediate P1 responses to speech tokens /M/, /G/ and /T/ presented at 65 dBSPL and wanted to wear his audio processor from first day onwards. Repeatable eSRT’s were initially found on E’s 7,5,4,2 and 1. 3 months after switch on eSRT’s were also found on E’s 12, 10 and 9. E’s 10 and 12 initially deactivated were later activated. E’s 3, 6 and 8 initially activated were later deactivated. Over a period of 5 months this ABI users’ P1 latencies to /M/, /G/ and /T/ presented at 55 dBSPL shortened significantly. P1 latencies to /M/ and /T/ entered the reference range for hearing peers. Latency of P1 to /G/ shortened to 129ms.

Conclusion:

eABR data can effectively guide programming decisions, initially. Measuring eSRT’s allows electrodes providing ‘loud’ auditory percepts to be chosen for activation and E’s not providing ‘loud’ auditory percepts to be deactivated, ensuring sound is only sent to effective E’s. ACA allows for objective validation of programs and monitoring of auditory maturation.
Objective: Head trauma with temporal bone fracture is one of the most common traumatic injuries that cause loss of auditory and vestibular functions. Temporal bone fractures that involve the otic capsule can cause destruction of the organ of corti, which results in sensorineural hearing loss. Even if a definitive fracture is not identified on CT scan, hearing loss can result from micro-fractures or cochlear concussion. Patients with profound bilateral hearing loss caused by temporal bone fractures may benefit from cochlear implantation if the functions of the auditory nerves and brain are intact.

Material and Methods: we report the cochlear implantation results of six cases of postlingually deafened patients presented after bilateral cochlear trauma.

Results: All patients gained useful open-set speech perception, with hearing results comparable to implanted patients with other etiologies of deafness.

Conclusion: Cochlear implantation has been demonstrated to be effective for hearing rehabilitation in patients with bilateral profound sensorineural hearing loss caused by temporal bone trauma. It remains the standard hearing rehabilitation treatment for temporal bone fractures without compromise of the cochlear nerve. Preoperative temporal bone imaging studies with both high resolution CT and MRI are necessary to make decision for the surgery and to determine the side to be implanted. Surgery could be challenging and complicated because of anatomical irregularity. Moreover, fibrosis and partial or total ossification within the cochlea may be expected.
Introduction: Osseointegrated bone conduction devices are effective treatment for conductive hearing loss. Conductive hearing loss is a common symptom in children with congenital craniofacial malformations. The aim of this study was to analyze the auditory gain, skin tolerance and acceptance of these children for a transcutaneous osseointegrated bone conduction implant.

Methods: Data were collected from 15 children (with conductive hearing loss and craniofacial malformations) who were fitted with bones anchored implants between 2011 and 2015, at a tertiary university hospital. We analysed audiological results (pure tone audiometry and disyllabic test) and/or associated complications.

Results: The patient’s age ranged from 4 to 14 years (mean age 8.5 years). All patients associated malformations of the middle ear. 26.6% of patients (4 patients) had severe agenesis or atresia of external auditory canal and mandibular deformity was associated. The Unilateral Goldenhar syndrome was the second most common syndrome (3 patients). All the patients had pure conductive hearing loss. The pure tone average (PTA) was 65 ± 11.01 dB and the bone conduction PTA was 22.85 ± 10.09 dB. The PTA with osseointegrated implant was 26.78 ± 5.06 dB and mean discrimination disyllabic was 97.69%. There was not significant difference between audiological results and the age of implantation or the different malformations. All children use the implant every day, for up to 8 hours, without skin complications.

Conclusion: Osseointegrated bone conduction devices are a useful therapeutic option in paediatric patients with craniofacial malformations. Audiological results are favourable. There was no evidence of postoperative complications or skin affectations. Both children and their parents report are pleased with the results.
Evaluation of a New Powerful Sound Processor for Bone-Anchored Hearing

Arjan J. Bosman, MSc PhD, Myrthe K. S. Hol, MD PhD, Emmanuel A. M. Mylanus, Prof.Dr., Ad F. M. Snik, Prof.Dr.;

Abstract Body:

Introduction: Patients with profound hearing loss may experience problems with air-conduction hearing aids due to tightly fitted ear moulds and/or maximum gain restrictions by acoustic feedback. In profound mixed hearing loss that consists of a moderate sensorineural loss with a large air-bone gap a powerful direct-drive bone-conduction device (BCD) is a viable alternative for a conventional hearing aid, owing to the relatively favourable bone-conduction thresholds. In essence, a BCD system consists of a percutaneous titanium implant (fixture) anchored in the temporal bone, a skin penetrating titanium abutment, and a sound processor. The sound processor converts sound into vibration. The vibrations are directly transferred through abutment and fixture to the skull bone. Until recently, the body-worn Baha Cordelle II processor was the only alternative for patients with a profound mixed hearing loss that needed a BCD. Recently, the head-worn Cochlear Baha 5 SuperPower Sound Processor was introduced, which offers more advanced signal processing and wireless capabilities that may further improve the hearing experience for this patient population. In this study we will compare the performance of both devices.

Methods: Performance of the Baha 5 SuperPower and Baha Cordelle II will be evaluated in a group of 10 experienced Baha Cordelle users. Measures comprise free-field aided thresholds and speech perception in quiet with standard Dutch CVC monosyllables and speech perception in noise with the digits-in-noise test. Additionally, loudness growth will be measured for both devices. The performance of either device in real life will be evaluated with APHAB, SSQ, and proprietary questionnaires. The efficacy of wireless sound transmission with Baha 5 SuperPower when using the telephone or watching TV will be evaluated with a proprietary questionnaire.

Results: This study is still ongoing and will finish early Spring 2016. Results will be presented at the conference.

Conclusion: As this study is still ongoing conclusions are not yet available. Conclusions of this study will be presented at the conference.
Experiences with the New Soundprocessor Generation Cochlear N6 for Nucleus22 Implant Users

Heike Bagus, Audiologist
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Abstract Body:

**Introduction:** Recently the N6-system is available for Nucleus22 users. It offers the possibility to benefit from new technology like ScanIQ and Wireless accessory combined with modern outfit. In our project we wanted to investigate the converting process, measure the benefit in speech understanding and evaluate the overall satisfaction with the new sound processor CP910/CP920.

**Methods:** More than 30 subjects were converted from ESPrit22, ESPrit3G or Freedom soundprocessors to CP910/CP920. We described the ease of the converting process, measured the benefits for the CI users (audiometric speech understanding tests in different conditions, use of Scan IQ and wireless) and discussed challenges that have to be considered (e.g. power management).

**Results:** The converting process was easy in most of the cases, nevertheless there have been some challenges concerning power level or default processing. Nearly all the subjects went for the new system. Speech understanding improved in most of the cases. Nearly all subjects used at least one of the wireless accessory options and felt comfortable with it.

**Conclusion:** Most subjects with „old“ implants (N22) benefit from „new“ external technology (sound processor N6, wireless accessory.) For the audiologists it is mostly very satisfying to be able to improve speech understanding and comfort „just“ by fitting a new external system - without surgery.
Introduction: To set the optimal parameters of stimulation of the cochlear implant (CI), periodic speech processor programming is required. It implies the determination of the stimulation levels, speech processing strategies and modifications according to the individual needs (Plant et al., 2007). With the telehealth, electronic devices such as the CI may be programmed remotely, reducing cost and patient travel to the center of origin (Zumpano et al., 2009). However, we need to ensure that remote programming, or teleprogramming, provide the same effectiveness as programming carried out in person.

Methods: We conducted a randomized controlled trial, with crossover, in which the remote intervention (distance) was compared to the live intervention. The selection criteria were: age between 18 and 59 years, of both genders; CI users of Cochlear Nucleus® devices, and at least 12 months of CI experience. The end point was the free field thresholds, speech perception tests, a questionnaire on listening preferences and VAS scale for analysis of satisfaction with the sessions. Participants performed two programming sessions on the same day: a live programming (LP) and a remote programming (RP). The same audiologists conducted the two programming sessions and the order of the sessions was randomized. The minimum (T) and maximum (C) stimulation levels of five electrodes (1, 6, 11, 16, 22) were established. Tests were performed in sound booth in randomized order in a blinded condition to the patient. Speech perception was evaluated at 65dB SPL, using tests according to the patients’ listening skills (i.e. closed-set sentences, open-set in quiet, open-set in noise with signal-to noise 0 dB and 10dB, or monosyllables). The patients were also submitted to free field audiometry from 250 to 8000Hz, visual analog scale (VAS) and the questionnaire.
after each fitting session. The results were compared using the Wilcoxon Test.

**Results:** The study included a total of 20 CI users. Statistically significant difference was found in the T levels for the electrodes 22 and 16 (p<0.05), with higher levels in RP. Statistically significant difference was found in the C levels for the electrodes 11 and 6 (p<0.05), with higher levels in LP. There were no statistically significant differences between the speech perception tests and thresholds obtained with maps of LP and RP (p > 0.05). The VAS scale showed a statistically significant difference, with the highest scores at LP (p = 0.018). In the questionnaire, there was a statistically significant difference in the questions about quality and communication during the sessions, showing that LP allowed less difficulty of understanding and better communication.

**Conclusion:** Teleprogramming is feasible and effective when compared to live programming. Although there were some differences in stimulation levels between the remote and live programming sessions, there was no difference in the results of thresholds in audiometry and speech perception tests performed in the two procedures. Nevertheless, the live programming allowed better communication and satisfaction when compared to remote programming.
MRI Investigations of Patients with Cochlear Implants

Jörg Langer, Senior physician, Wolfram Pethe, Senior physician, Uta Uhde, Coordinator, Klaus Begall, Chief; ENT, AMEOS Klinikum Halberstadt, Halberstadt, Germany.

Introduction: Cochlear Implantation have become a routine intervention for profoundly deaf people. Due to expanded indications as sensorineural hearing loss and single sided deafness as well as developed surgical techniques more and more patients receive a CI. On the other hand we can see the development of radiological investigations. MRI examinations are playing an increased role. In 2009 7.9 Million MRI scans took place in Germany. With this increasing number of MRI scans the possibilities of MRI investigation in patients equipped with one or two CIs are rising. Due to the magnet inside the CI the MRI usage is limited. There are restrictions dependent on the CI-companies. It is believed that patients with CI underwent MRI scans without knowledge of the implanting clinic.

Methods: We sent a questionnaire to 100 adult patients who received an implant between 2008 and 2009 at the ENT hospital in Halberstadt. The patients were asked about the frequency of MRI scans, special preparation, possible side effects or complications during the investigation, esp. uncomfortable acoustic perception,
pain or dislocation or demagnetization of the magnet.

**Results:**
The return rate of the questionnaire was 70 percent. 15 percent of our patients reported MRI scans. Fortunately there were no serious complications. Only 50 percent of the MRI scans took place with special preparation and protection of the CI.

**Conclusion:**
CI equipped people should be advised for possible complications in the context of MRI investigations. The rate of CI patients with MRI scans is comparable to the whole population. Despite advancements in the field of the MRI compatibility of CI systems alternative imaging methods such as CT or DVT should be contemplated.
Introduction: Due to the increased general expectation of life cochlear implantation in high grade sensorineural hearing loss is accessible for a growing group of older patients. Impact factors for a successful cochlear implantation (CI) and rehabilitation in patients >70 years of age are not well known. When counseling a cochlear implant candidate, referring to our personal experience, many ENT-colleagues often actually discourage patient only because of their age.

Methods: We performed a retrospective chart analysis (tertiary referring center) to investigate the patients provided with a cochlear implant in our clinic between 2013 and 2015 aged 70 and older (n=22). Parameters of evaluation are amongst others the duration of hospitalization, postoperative complications, signs of mental disorders, consultations of other medical disciplines and as well the audiometric results. We matched the results with a middle aged group of patients of our clinic (50-60 years, n=22) and put our results in relation to foreign publications.

Results: So far no perioperative complications were observed. Neither a significant prolonged length of stay was detected nor postoperative major complications. More postoperative restrictions due to vertigo symptoms were observed in the group of the elderly leading to an increased supporting therapy, a shorter interval of clinical appointments and mounting contacts of other medical disciplines. Furthermore a slower gain of results in audiological testing was detected.

Conclusion: High patient’s age itself with its associated comorbidities is in our opinion no solitary risk factor for a successful cochlear implant rehabilitation. Due to comorbidities an increased level of supporting therapy with higher rates of clinical appointments in addition to the rehabilitation after cochlear implant surgery is necessary to secure the successful rehabilitation process.
Abstract Body:

**Introduction:** Improvements in surgical techniques and cochlear implant electrode array design during the last two decades have enabled significant progress in the reported proportion of patients with preserved residual hearing. Several studies have investigated differences in array design and technique and their implications for hearing preservation outcomes. Factors outside of the surgeon’s control have also been suggested including; cochlear fibrosis, foreign body reactions, disruption to cochlear fluid homeostasis and host immunity. The aim of this study is to compare inter-aural hearing preservation results in paediatric patients undergoing simultaneous bilateral implantation.

**Methods:** A retrospective case note review of all paediatric simultaneously implanted patients at a single institution over an 18-month period. Patients with anatomical cochlear anomalies or incomplete data were excluded. Pre and post implant pure tone averages (PTAs) were calculated using 6 frequencies from 250Hz to 8kHz. Pre-operative inter-aural PTAs were within 20dB. Seven patients were identified who had undergone synchronous bilateral cochlear implantation. Results were assessed using the Hearing Preservation Classification System (HPCS) proposed by the HEARRING group.

**Results:** Seven children (1 male and 6 females) were identified with an age range of 6 - 18 years (mean 12 years and 11 months). The aetiology of hearing loss was congenital in 6 patients and sudden onset in one. All patients were implanted with a Med El Flex 28 via a round window approach. The hearing preservation was complete in 5 ears, partial in 7 ears and minimal in 2 ears. Inter-aural analysis revealed only 2 of the 7 patients had preservation results within the same preservation group (complete/partial/minimal).

**Conclusion:** Although limited by its retrospective design and small sample size, our study suggests there are other factors influencing hearing preservation. Inter-aural minor differences in insertion angle, rate or depth, micro anatomical variations, and the role of the host’s immune response could all be significant factors and warrant further investigation with a larger multi-centre study.
The Influence of Different Cochleostomy/Round Window Membrane Sealing Techniques on the Development of the Intracochlear Pressure After Cochlea Implant Electrode Insertation

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Introduction: During cochlea implantation, there are intracochlear pressure changes referring to the different steps of the operation. The extent of the varying pressure is an important factor for the residual hearing. Besides the opening of the cochlea and the electrode insertion through the cochleostomy or round window membrane (RWM), the used electrode sealing technique has a relevant part on the pressure development. Our study evaluated the impact of different sealing techniques of cochleostomy/RWM on intracochlear pressure changes.

Methods: Four different sealing techniques with an inserted cochlea implant electrode have been tested: 1. overlay seal, 2. overlay with stuffing of the cochleostomy/RWM, 3. annular seal with fascia, and 4. pulling the annular seal down. The intracochlear pressure changes were evaluated using an artificial cochlea model and a fiberoptical micro pressure sensor, positioned in the helicotrema.

Results: We found statistically significant differences in the intracochlear pressure maxima, depending on the sealing technique. The by far lowest pressure development was observed with condition 1., followed by 3., 4. and 2., in ascending order.

Conclusion: In our artificial cochlea model, we noticed significant pressure changes related to the performed sealing technique of the cochleostomy/RWM. Regarding the pressure-minimizing surgical concepts, the sealing procedure might be a meaningful factor.
Introduction: Transmastoid plugging of the superior semicircular canal in superior semicircular canal dehiscence (SSCD) syndrome and the posterior semicircular canal in intractable benign paroxysmal positional vertigo (BPPV) have demonstrated their effectiveness in resolving the respective characteristic symptoms. However, semicircular canal plugging has been reported to produce up to 25% of sensorineural hearing loss, albeit in cases where the middle fossa approach was used. Animal studies have also demonstrated mild to moderate hearing loss in a significant proportion after implantation of electrodes in the semicircular canals. Since many patients with bilateral vestibular areflexia present with an intact hearing, refinements in the surgical technique are relevant to enable vestibular implantation in these patients without producing a sensorineural hearing loss and therefore preserving acoustic hearing.

Our aim was to gain insight in the effect of opening and plugging the semicircular canal on postoperative hearing thresholds when using the presented surgical technique.

Methods: We performed a retrospective review on hearing outcomes of 17 cases that underwent transmastoid semicircular canal plugging by two surgeons in a tertiary referral center between October 2008 and October 2015. All patients received systemic corticosteroids during and after surgery. The relevant refinements in surgical technique will be presented. We evaluated air conduction (AC) pure-tone averages (PTA) of 0.5 kHz, 1 kHz and 2kHZ and bone conduction (BC) PTA of 1, 2 and 4 kHz before and after surgery in 14 cases with SSCD syndrome and 3 cases with intractable BPPV.

Results: When combining the SSCD and BPPV cases, median BC PTA was 11 dB preoperatively and 13 dB postoperatively. No BC PTA over 15 dB was observed in the individual patients. Median AC PTA was 22 dB preoperatively and 22 dB postoperatively.

Conclusion: The presented technique for opening (and plugging) of the semicircular canal through a transmastoid approach proves to be safe and effective in preserving hearing. These surgical refinements might be relevant when considering vestibular implantation in normal hearing patients with bilateral vestibular areflexia.
Abstract Body:

Introduction: Late auditory evoked responses can be elicited by ramped changes to stimulus frequency or intensity (Clynes, 1969; Weise et al., 2012). This paper explores the relationship between ramped and abrupt electrophysiological measures of acoustic change in adult CI recipients. This is examined in the framework of a study where N1-P2 responses were elicited with orthogonal and combined voice fundamental frequency (F0) and intensity changes, as these cues are important to speech, and particularly prosody perception.

Methods: The N1-P2 acoustic change complex was measured in a group of adult postlingually implanted CI recipients (n=10). Responses were elicited with a continuous synthetic vowel where combinations of F0 and intensity changes where ramped over 8 semitones and 8 dB, respectively. The ramps were linear transition ramps which were 400 ms in duration, and the abrupt changes were 10 ms. Behavioral discrimination thresholds for F0 and intensity were also measured with synthetic vowel tokens similar to the ramped stimuli.

Results: The ramped cortical responses were compared to responses to abrupt changes in F0 and intensity, and also behavioral discrimination thresholds. Preliminary results show that late auditory evoked potentials to continuous auditory stimuli can be recorded from CI recipients. However, attention must be paid to artefact removal during data preprocessing.

Conclusion: The clinical utility and the value of N1-P2 responses as a candidate metric of CI speech processor fidelity will be discussed.
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Session Number: POS01

Session Title: Poster Session A

Poster Board Number: 6-A

Topic 1: 04a-Quality of Life

Publishing Title: Well-Performing is Wellbeing, or not?

Author Block: Ietske Siemann, MSc1, Wendy J. Huinck, PhD2, Emmanuel A. M. Mylanus, PhD2; 1Medical Psychology, Radboudumc, Nijmegen, Netherlands, 2Radboud university medical center, department of otorhinolaryngology Head & Neck Surgery, Hearing &, Radboudumc, Nijmegen, Netherlands.

Abstract Body:

Introduction: Cochlear implantation (CI) has been demonstrated to be an effective treatment for severe sensorineural or profound hearing loss. Soon after multiple publications on performance with cochlear implants, there were publications on the subjective outcome measures of cochlear implantation. These included results of generic and specific quality of life measurements, and more recently various other questionnaires, for example concerning the measurement of social-emotional development, anxiety and self-esteem. It has been reported that cochlear implantation improves disease-specific quality of life, and in terms of self-esteem and social functioning (Kaplan et al 2003, Damen, Straatman, Huinck 2014). During the pre-implantation work-up our team identified a specific group of patients: adults with high education levels, career driven, who have acquired high societal positions and have a history of slow progressive hearing loss which has led to severe hearing loss. Once implanted, they prove to be good performers in terms of speech recognition scores. Despite their improved communicative capabilities, at work and at home they often have trouble accepting their hearing handicap. It seems that the rehabilitation phase confronts them with the restrictions of hearing loss, although partly alleviated, and leaves them with a delayed process of acceptance of the handicap.

Methods: Observational study of a specific group of adult CI-recipients.

Seven implanted adult patients with a specific profile (highly educated, career driven, socially successful adults with a history of slow progressive hearing loss) and good performance with CI were interviewed in a semi-structured manner. Furthermore, questionnaires were filled out: the Hospitality, Anxiety, Depression Scale (HADS) and the ZCL, a questionnaire focusing on helplessness and the acceptation of disease.

Results: Seven implanted adult patients with a specific profile (highly educated, career driven, socially successful adults with a history of slow progressive hearing loss) and good performance with CI were interviewed in a semi-structured manner. Furthermore, questionnaires were filled out: the Hospitality, Anxiety, Depression Scale (HADS) and the ZCL, a questionnaire focusing on helplessness and the acceptation of disease.
Conclusion: The general outcome of the semi-structured interviews is that patients with this specific profile are extremely driven individuals who work hard at achieving their goals. It appears that the slow progression of their hearing loss did not hinder them in acquiring high positions in society. Indeed, their strong career drive possibly masked their emotional struggle with progressive hearing loss. However, once the hearing loss progressed to a level where a CI was indicated and the rehabilitation phase started, problems concerning the acceptance of hearing loss and deafness emerged. Combined with characteristics like perfectionism and a high work ethic, the risk of a burn-out is high. The results of the questionnaires support these observations. While CI recipients with a specific profile may have excellent performance scores, they may experience acceptance problems during the rehabilitation phase. Early recognition of these potential problems is of importance in order to provide psychological guidance.
Abstract Body:

Introduction:
This longitudinal study investigated the literacy development of a small group of seven school-aged children who received simultaneous bilateral cochlear implants at the age of two years old or younger. The participants were ages 5.5 to 9.1 years old when the study began. All participants were mainstreamed with same aged peers, attending their local school and following the Ontario curriculum.

Methods:
Levels of achievement in reading and writing were measured through standardized assessments appropriate for school-aged children five to eight years of age respectively. Each participant was tested in their home at two points in a school year over two years. Measures were gathered from the CELF-5, WJ-III, CTOPP and the PPVT-4. Writing samples were gathered over the 2 years and assessed using the Ontario Curriculum Writing Exemplars. Qualitative data was obtained from a parent questionnaire and a semi-interview.

Results:
Preliminary results demonstrate 6 out of the 7 participants are scoring at the 50thile or higher in areas of receptive vocabulary, phonological awareness, and lexical access. In the area of writing skills, participants demonstrated achieving a level 1-3 with strengths in the use of inventive spelling and familiar words but limited vocabulary and development of ideas.

Conclusion:
The preliminary findings suggest even though overall achievements are within average percentiles the errors participants made in reading and writing are areas that are teachable and areas of development for their hearing peers.
Introduction: If patients with Ménière’s disease stay refractory to the conservative treatment a surgical approach can be indicated. In cases of decompensated vestibular deficiency and single-sided deafness the combination of destructive labyrinthine surgery and cochlear implantation (CI) seems to be a successful strategy.

Objective: To investigate the outcome of a combined occlusion of all semicircular canals and cochlear implantation in patients with single sided Ménière’s disease and functional deafness.

Methods: Five patients with single-sided Ménière’s disease and functional deafness were included in this prospective study. In all cases the patients suffered from rotational vertigo attacks. All of them have been supplied with cochlear implants combined with an occlusion of all semicircular canals in a single stage surgery. The outcome has been evaluated by the Dizziness-Handicap-Inventory (DHI) and audiological testings.

Results: Preoperatively the DHI of all patients indicated severe emotional, physical and functional deficits. Audiometric results showed functional deafness of the affected side in all cases. After a short period of increased vertigo following the combined surgery all patients reported a significant reduction of dizziness. After activation of the cochlear implant and rehabilitation regular audiometric results were observed in all cases.

Conclusion: For patients with a proven single-sided Menière’s disease and functional deafness the combination of a triple semicircular canal occlusion and cochlear implantation is an efficient technique for the treatment of vertigo as well as the rehabilitation of the auditory system. In order to minimize the risk of damaging the otolith organ an atraumatic surgical performance has to be ensured.
**Abstract Body:**

**Introduction:** Was applied in 100 cochlear implant users, the frequency and duration pattern pitch. Those patients have undergone the surgery through the cochlear implant program. The tests were carried out with the aim to correlate the period of hearing abilities in relation the activation of your equipment. The tonal pattern test descriptors and frequency, tonal tests, hearing tests and hearing ability were used to structure our research. This hearing and ability could underpin uptime professionals and establish levels of responses during the adjustment period. The professional building maps of the cochlear implant may browse through frequency and duration tests the evolution of auditory response from the patient.

**Methods:** A hundred users of cochlear implant were subjected to the tests of duration and frequency pattern at 50dBS intensity (with nomination). The sample was divided into four groups: children (pré-lingual), children (post-lingual deafness), adults (pré-lingual) and adults (post-lingual deafness).

Study: prospective clinical trial.

**Results:** The hearing ability and the frequency / duration pattern pitch, could help professionals and establish levels of responses during the adjustment period. The audiologist can building the maps of the cochlear implant may browse through frequency and duration tests the evolution of auditory response from a patient.

**Conclusion:** It has found that the cochlear implant activation time is related to hearing ability. The longer the time between activation and the tests application, better will be the hearing ability.

Keywords: auditory tests, tests of tonal frequency pattern, tonal duration tests, skill.
Clinical Findings, Surgical Solutions and Functional Results for Vibrant Soundbridge Middle Ear Implant for Patients with Congenital Aural Atresia

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Abstract Body:

Introduction: Although implantable bone conduction devices provide adequate hearing results for the patients with aural atresia, Vibrant Soundbridge middle ear implant enables physiologic direct cochlear stimulation and superior speech discrimination results. Because of different degree of malformation, surgery for such patients is often demanding. It is important to detect preoperative radiological, anatomical features and define surgical strategies, which could predict functional results.

Methods: 29 patients (aged 5 to 32, mean 11 ± 6.9) with congenital unilateral or bilateral osseous aural atresia (23 children, 6 adults) underwent implantation of the middle ear implant VBS. Follow - up ranged from 6 to 72 months (mean 32,8 ± 19). Four of those patients presented with associated craniofacial syndromes (3 Treacher-Collins and 1 Pierre Robin). The preoperative Jahrsdoerfer radiological score was 3-4 for 5 patients, 6 to 8 for 14 and 9 for 9 patients. Middle ear implantation was performed using stapes, oval or round window coupling methods. PTA and speech discrimination tests were performed every 6 months after operation.

Results: The coupling of floating mass transducer to the stapes (15 patients), rudimentary stapes (4), oval window (2), round window (5 patients, one - subfacial approach) and incus (2) was performed. One patient underwent third window procedure. The mean threshold with the activated implant in the free field tone audiometry was 23.8± 5.5 db HL. The mean functional gain was 40.35 dB. Surgical techniques and strategies of all of the patients are discussed. Hearing results were similar using different coupling methods. 82,7% of patients are using an implant at least 8 hours/ day. No major complications
occurred postoperatively. One implant was explanted 5 years after surgery because of extrusion and damage of the coil.

**Conclusion:** VBS enables satisfactory functional outcomes for patients with congenital aural atresia. The radiologic scores did not correlate to or predict outcomes. For patients with the radiologic score more than 6 points, possibilities for coupling of FMT processor are good and VBS surgery is fast, safe and enables good performance. For patients with poor preoperative radiologic score, the performance of middle ear VBS implantation could lead to satisfactory hearing results, although surgery might be challenging.
Introduction: Multi-channel cochlear implants first became commercially available in the early 1980s. Since that time, several different models of electrode arrays and sound processors have been introduced. As such advances have taken place, device manufacturers have been challenged with designing technology that is efficient and improved yet is also backwards compatible with devices used by their earliest recipients. Recently, the latest model of a new digital sound processor became available for use with the first generation multi-channel cochlear implant recipients. This study utilized a single subject design to evaluate outcomes for over 30 first generation recipients who were upgraded to a new sound processor.

Methods: Over 30 first generation multi-channel cochlear implant recipients were upgraded to the most current sound processor at three different clinics. Subject performance was evaluated via speech testing of monosyllabic words in quiet and sentences in background noise, as well as with subjective questionnaires. The studies examined performance with subjects’ current processor immediately prior to being fit with the new processor, which included a new automatic scene classifier, background noise reduction, and wind noise reduction algorithms. Subjects were tested again after a take-home trial with the new technology.

Results: Mean performance was statistically superior with the new sound processor on tests of sentence recognition presented in the presence of background noise. The majority of subjects performed equal to or better with the new technology when compared to their current device, and most reported high satisfaction levels across various hearing domains.

Conclusion: It is now possible for the first multi-channel cochlear implant recipients to utilize the most recent sound processor technology that includes advanced signal processing algorithms and wireless accessories. The performance capability of the newest sound processor exceeds that of previous models, and this upgrade provides a superior hearing experience for all generations of implant recipients.
Abstract Body:

Introduction: Several studies in vitro and in guinea pigs have shown that Dexamethasone (DEX) eluted from the intracochlear electrode array over a few weeks reduces the inflammatory response and fibrous tissue growth in the cochlea after electrode insertion. These studies support the use of DEX-elution in combination with cochlear implants.

Methods: After ethical committee approval, the in-vitro DEX elution profile was obtained by HPLC analysis. Fully functional Cochlear Implants with the Dexamethasone-Eluting Electrode were unilaterally implanted in five normal hearing M. fascicularis (RW insertion) for six months. The control group consisted of five subjects with a conventional CI. After light sedation, impedance and auditory nerve response (eCAP) were recorded through at two weeks and subsequently after each full month post-op up to six months. ABR was recorded using click and burst tone in contralateral and ipsilateral sides (1-16 kHz). Histology is currently being performed.

Results: The in vitro elution profile of DEX yielded a dose of about 16 µg of DEX over six months, resulting in an average daily elution ranging from 350 to 12 ng/day. For the amplitude growth function (AGF) eCAP at 800 cu stimulation, a significantly higher response was observed for the DEX group in comparison with the control group (at 4 months onwards). The average impedance at the electrode contacts in the DEX group was more than 50% lower than in the control group. Click tone thresholds were approx. 40 dB for both groups before implantation. Implantation caused a 40 dB hearing loss (HL) in the DEX group and an 80 dB HL in the control group but some hearing was preserved. The THR in the DEX group improved
by 20 dB while the THR in the control group increased by 40 dB over 6 months. The frequency specific tone burst THR followed the same pattern. In the control group all tone bursts remained at values greater than 120 dB for the duration of the experiment.

**Conclusion:** The results obtained with near-to-final-design DEX-eluting electrodes in *M. fascicularis* are encouraging towards development of drug-loaded CIs. DEX appears to protect the neural population which is indicated by an improved neural response, that is, less degeneration of the auditory nerve confirming findings in guinea pigs (Pfingst 2015, Ramekers 2014). Next to enhanced hearing preservation, significantly lower impedances for the DEX vs. control group are important benefits to the patient in terms of fitting dynamics and battery lifetime but will become an indispensable development e.g. for fully implantable cochlear implants in the future. Histology may demonstrate the effect of dexamethasone on tissue and bony growth post-implantation.
Abstract Body:

**Introduction:** Cochlear implant (CI) indication criteria are increasing. Recently CI is indicated in asymmetric hearing loss. Therefore, if patients with Meniere disease (MD) develop a severe-profound sensorineural hearing loss, CI is a therapeutic option. Scarce studies have analyzed hearing preservation, auditory performance and vestibular function after CI in a population with S-P SNHL.

**Methods:** A prospective study in a reference hospital is undertaken. 18 patients are included diagnosed of uni- and bilateral MD with S-P SNHL and CI users. They are divided in two groups based on surgical approach: cochleostomy (C) and round window (RW) approach. Pure tone audiometry, dysillabic discrimination at 65 dB, vestibular bedside examination, video assisted oculomotor reflex (VOR), ocular and cervical myogenic evoked potentials (o-VEMPS, c-VEMPS) before and at least 2 years after CI. Besides, auditory performance is compared to a control group with similar demographic features whose etiology is otosclerosis. A multifactorial mixed comparison is performed before and after CI. SPSS IBM statistics v 20.0 is used.

**Results:** Auditory performance: mean PTA pre- and post CI without the device is 94.4 dB y 119.6 dB in RW group, and 110.04 y 126.15 dB in group C. The difference between auditory thresholds for the RW group are 1.5 dB, 6.11 dB, 6.66 dB, 10.55 dB, 3.89 dB, 0 y
3.89 dB while in the C group differences pre-post are 2.22, 2.22, 2.78, 5.56, 2.78, 0, 0 dB for frequencies 0.25, 0.5, 1, 2, 3, 4 y 6kHz respectively. Dysillabic discrimination post-CI is 70.32% for the C group and 63.2 % for RW group; no statistical differences were observed. Besides, results do not differ from the control group.

Vestibular testing: bedside examination shows signs of vestibular hypo function on the operated ear in 95% of the cases. Mean gains for video assisted VOR on the implanted side are on the lateral plane pre- 0.69 (0.42SD) and post-surgery 0.39 (0.25SD); on the posterior plane pre- 0.49 (0.24SD) and post- 0.4 (0.16SD); on the anterior plane pre- 0.52 (0.23SD) and post- 0.39 (0.11SD). No statistical differences are seen (lateral, p=0.476, posterior, p=0.814, anterior, p=0.372). O-VEMPS post-CI shows an asymmetry of 57.63% (SD 29.41) and c-VEMPS 75.32% (SD30.32).

Conclusion: Patients with MD benefit from CI as the control group. RW approach or cochleostomy approach doesn’t seem to influence on auditory performance. Cochlear implant surgery does not provoke deterioration on vestibular function in the majority of patients.
Introduction: Hearing loss (HL) is one of the most common complaints in older adults. Demographic trends, including greater longevity and growing numbers of older adults, point to the relevance of understanding and managing hearing loss. That is why treating hearing loss is paramount, not only to restore hearing ability but also to improve social skills, cognitive ability and quality of life (QoL). Nowadays, there are treatments available for older adults with hearing loss. Hearing aids (HA) can improve hearing in mild to severe hearing loss. For severe to profound hearing loss, the cochlear implant (CI) provides an alternative hearing rehabilitee modality by stimulating the auditory nerve and central nervous system.

Methods: 131 patients older than 65 years old diagnosed with moderate to profound hearing loss were included. They are classified in two groups. A group with moderate to severe hearing loss including subjects treated with hearing aids and subjects that refused to treatment and a group with profound hearing loss including subjects treated with cochlear implant and some subjects that had not received treatment yet. Auditory function (PTA, dysillabic 65 dB in quiet) and quality of life (a battery of test so as to measure depression, anxiety, health status, hearing handicap inventory for the elderly) was measured and compared between the treated group and the corresponding untreated group.

Results: Auditory outcomes show the benefit for both the cochlear implant and hearing aid groups, with 39.7 dB and 38 dB pure tone Audiometry respectively. The percentage of disyllabic words at 65 dB is 58.21% and 82.8 % respectively. Besides auditory improvement, there is a positive effect on anxiety, depression, health
status and quality of life in the cochlear implant group vs. profound hearing loss control group.

**Conclusion:** Cochlear implantation in the elderly is safe and feasible. Older adults with hearing loss draw benefit from hearing aids or cochlear implants in terms of hearing but also anxiety, depression, health status and quality of life.
Abstract Body:

**Introduction:** The paper presents the results drawn from a national project of play and drama therapy developed in Romania during 2014-2016.

This research-action-training project applies to 3-18 years-old Romanian deaf children wearing cochlear implants or hearing aids. The project plays an important role in nowadays Romania, the more as no study upon cochlear implanted children has since been developed and the number of specialists requiring specific education in approaching these subjects is pretty low. The project frames two types of therapies which, completing the auditory-verbal therapy, ease cochlear implanted deaf children's normalization process.

**Methods:** 133 deaf and 126 normal hearing children from Bucharest and 16 counties from Romania participated in this 3-years project. The team, made of 1 coordinator and 28 professional volunteers (psychologists, speech therapists, educators and students in the play and drama therapy school) conducted 14 play therapy and 8 drama therapy groups. The therapeutic activities developed in 3 private-and-state medical centers from Bucharest, at 1 association's main office in Timisoara and in 5 national cochlear implant summer camps. The 8 drama therapy performances were attended by subjects' parents, friends, as well as by instructors, educators, speech therapists, audiologists, physicians and the press. Techniques specific to play therapy (multisensory stimulation, painting, drawing, modelling, puppets) and drama therapy (stories, music, dance, improvisation, masks, theatrical practices), adapted to subjects' age and verbal communication level have been used. Each group enjoyed 15 therapeutic sessions. The therapeutic groups included both deaf subjects with cochlear implants or hearing aids and normal hearing ones of comparative ages. There were no exclusion criteria in terms of subjects' hearing age. During the therapy, the subjects were able to access their inner feelings, use various artistic metaphors and externalize emotions through different means. The emphasis was laid on stimulating subjects' ability to express themselves and communicate through any means, thus overcoming their verbal difficulties.
Results: The results were analyzed according to the embodiment-projection-role paradigm. Illustration through shot and filmed images emphasize a series of instances captured at the beginning, during and in the end of the therapeutic process.

Conclusion: An improvement of the communication strategies of all subjects, mainly of the cochlear implanted ones, was noticed, as, by opening several communication barriers, the difficulties encountered in expression have been sensibly diminished. The cochlear implanted teenagers did finally agree to appear on the stage in front of the audience, a fact which strengthened their self-esteem and self-image. Therefore, as far as stimulation of cochlear implanted subjects' means of expression is concerned, play and drama therapy represent important complementary therapies of the auditory-verbal therapy.
Experiences with the NRT-Ratio in Slim Straight Nucleus Electrodes: A Multi-Center Study

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Abstract Body:

Introduction
The position of the cochlea electrode array within the scala tympani is essential for an optimal hearing benefit. An intraoperative NRT-ratio was established, which can provide information about the intraoperative intracochlear electrode array position for perimodiolar electrodes. The aims of this study were to verify the NRT-ratio for slim straight electrode arrays.

Materials and Methods
In a retrospective controlled study in a Tertiary Referral Center the electrophysiological data sets of 50 patients with measured intraoperative Auto-NRTs were evaluated. All patients were implanted with a Nucleus slim-straight electrode. The NRT-ratio was calculated by dividing the average Auto-NRT data from electrode 16-18 with the average from electrode 5-7. Using a flat panel tomography system/HRCT, the position of the electrode array was certified radiological.

Results
By electrophysiological evaluation 48 patients were detected with a scalar change rather improbable. In two patients, a scalar change was electrophysiologically probable. Radiological evaluation revealed seven patients with an electrode translocation into scala vestibuli.

Conclusion
The NRT-ratio can be used to evaluate the intracochlear position of the electrode array for perimodiolar electrodes. Related to a low sensitivity/specifity ratio the NRT-ratio seems to be electrode depending and not reliable for slim straight electrode arrays.
Variation of Intra Cochlear Electrode Impedance Measurements in Children During the First 24 Months of Cochlear Implant Use

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**Abstract Body:**

**Introduction:** The electrode impedance measure provides information regarding the condition of the interface between the tissue and the electrode, and if the stimulating electrode is working properly within its complacency voltage, enabling the identification of functioning anomalies of the cochlear and extra cochlear electrodes. The electrode malfunction can result in poor speech perception due to the sound quality changes or to the extra auditory stimulation. Even the normal operating electrode may present clinical impedance variation. These changes are attributed to tissue characteristics around the set of electrodes, the electrode density, hormonal changes, fibrotic tissue and the electrical stimulation. It is expected to observe a stabilization of the impedance measures with the use of the cochlear implant (CI).

**Methods:** Sixteen children with normal cochlear image study were included, age 1 to 5 years (mean = 2.68 yr) at the time of implantation, 9 were female (56.25%). All had complete perimodiolar electrodes insertion and presented at least 24 months of implantation use. Children with electrodes technical problems or no measurements at regular periods were excluded. The impedance measurements averages, exclusively on common ground mode, were analyzed and compared to intraoperative moment, activation moment, 1 month, 3 months, 6 months, 12 months, 18 months and 24 month of use. In addition, we grouped the electrodes on apical and basal regions (22-17, 16-11, 10-6, 5-1) and calculated the average of each region to observe whether there were differences in these measures at different cochlear regions. The measurements were submitted to statistical analysis.

**Results:** The overall values of the impedances (1-22) were significantly higher at the time of activation (mean = 13.73). There was a significant increase of impedance values between surgery and activation moments (p = 0.014) and a statistically significant decrease between activation and the first month of use of the Implant (p<0.001) followed by stabilization during the remaining period (p<0.001). Comparing the different cochlear regions a significant statistically difference were observed only during surgery with higher values in the 22-17 region comparing to 16-11 (p = 0.047), 10-6 (p <0.001) and 5-1 (p <0.001).
Conclusion: Most significant changes of the electrode impedance measurements occurred between intraoperative and the activation of CI, followed by a decrease and stabilization of measurements after one month of regular use. The electrodes located at basal regions have higher impedance values during the intraoperative moment.
Introduction:
Aural canaloplasty is a challenging procedure. Unfortunately, functional results after canaloplasty turned out to be limited. Since October 2009, the MedEl Vibrant Soundbridge (VSB) is CE certified for implantation in children in Germany. This active middle ear implant opens new possibilities for atresia cases, allowing individual solutions to fix the floating mass transducer. Outcomes of up to 36 months are available.

Methods:
28 children (5 to 18 years) with unilateral atresia received an implantation of the VSB using several options to fix the VSB FMT to vibrating structures of the middle ear. Word recognition, speech reception thresholds, and signal-to-noise ratios were evaluated, in addition to air and bone conduction.

Results:
According to the results of Wilcoxon-signed rank test inner ear hearing function stays stable over time. There is significant improvement from pre-operative testing to post-operative testing in speech understanding in quiet and in noise: \( p<0.001 \) to \( p=0.005 \). The performance stays stable over time.

Conclusion:
The active middle ear implant
demonstrates effective, laterally specific, direct-drive rehabilitation of conductive hearing loss in children with atresia. Currently it is the only middle ear implant approved for pediatric patients. The up to 36 months results prove that the VSB leads to a normal speech understanding for the atretic ear.
Abstract Body:

Introduction
The indication criteria for cochlear implantation have been changed over the last years. Due to new techniques the indication for cochlea implantation has evolved to patients with residual hearing. To preserve residual hearing the electrode design has changed and the atraumatic insertion of the cochlea electrode has moved into the interest of cochlea implant research. The aim of our study was to observe intracochlear pressure changes due to different openings of the round window in a cochlear model.

Material and methods
Round window openings were performed in an artifical cochlear model. Intracochlear pressure changes were measured by a micro-optical pressure sensor, which was placed in the helicotrema area. Openings of the round window membrane were performed in a dry and under water condition by a cannula and a diode laser.

Results
Statistically significant differences were seen between the different ways of the opening of the round window membrane in regard of the intracochlear pressure changes. Lowest pressure changes were seen by opening the round window membrane with the diode laser and the cannula, in that order. No significnt difference was seen between the dry and under water condition.

Conclusion
The atraumatic approach to the cochlea is assumed to be essential for the preservation of residual hearing. In our model experiments we compare objectively different ways of opening the round window membrane under different conditions. A round window opening under water does not have a positive influence on intracochlear pressure changes. The influence on intracochlear trauma needs to be considered under several more factors, e.g. electrode design, insertion depth and insertion speed.
Ambulatory Cochlear Implant Surgery: A Safe and Efficient Postoperative Approach

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Abstract Body:

Introduction: Nowadays, cochlear implantation is no more an exotic intervention. Although traditionally being considered an inpatient procedure, multiple studies in the last few years sustained its feasibility as an ambulatory surgery. However, doubt still persists among cochlear implant centres and we currently observe a great disparity of postoperative management across the world.

Methods: A retrospective chart review was performed on pediatric and adult patients who underwent cochlear implant surgery at a tertiary care center between January 2012 and February 2014. Two groups were formed: an ambulatory group and an inpatient group. Allocation of patients was quasi randomized, based on bed availability and anesthesiologist’s criteria. Follow-up visits were organized 24h and 1 month after surgery. Patients also had to fulfill a questionnaire evaluating their appreciation of the proposed postoperative management.

Results: A total of 117 patients underwent cochlear implant surgery: 56 patients as an outpatient procedure and 61 patients as an inpatient procedure. No significant early or late complications occurred in the ambulatory group. There were no readmission in the ambulatory group and only one patient had a prolonged hospital stay in the inpatient group.

Conclusion: Ambulatory cochlear implant surgery is a safe and efficient approach for the vast majority of pediatric and adult patients. Early and late complications were similar in both study groups and no readmission was necessary during the whole study period. Ambulatory surgery is now the preferred postoperative approach in our center.
Revision Surgery in Cochlear Implant Patients with Electrode Migration

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Introduction
Cochlear implantation is a safe procedure with a low risk for major complications. Migration of the electrode can be associated with vertigo and decreased speech perception, and can be observed in both straight and perimodiolar electrodes. Revision surgery is indicated if electrode migration is symptomatic and affects the patients outcome.

Materials and methods
Between January 2014 and November 2015 4 patients presented with either vertigo or performance drop several years after cochlear implantation in our institution. The patients received either perimodiolar electrode arrays (Nucleus Contour advance, Helix) or straight electrodes (Nucleus slim straight, Advanced Bionics IJ). The electrode array position was observed radiologically by the surgeon and 2 radiologists using a Flat Panel Tomograph (Philips Allura) or a high resolution CT scan. The insertion depth angle was estimated on the postoperative scans and compared with the scans performed on the day of consultation.

Results
Four patients showed electrode migration over 20°. Two patients reported recurrent vertigo after middle ear infection and two patients reported a distinct perfomance drop. Changes of impedences were seen in all patients. All patients underwent revision surgery via an enaural access to the middle ear. In all patients the electrode could be repositioned. Postoperative the correct position was verified radiological.

Conclusion
Electrode migration seems to be more common than expected and can cause several problems for the patients. Proper fixation of the electrode array is required to avoid electrode migration. The enaural revision with repositioning of the electrode and sealing of the cochleostomy is an easy way to relief the patients' symptoms and restore the ability for better speech perception.
Introduction: Hearing loss presents social and psychological impacts affecting the quality of life of hearing impaired individuals. The auditora and psychosocial benefits due to the cochlear implants (CI) use have been extensively documented, consolidating this method of rehabilitation as effective and safe, providing a significant improvement in quality of life and enabling social integration of individuals. The self-assessment questionnaires have been developed to quantify the auditory handicap perception, and have being used in the clinic routine to identify the specific treatment needs or evaluate an interventor results.

Methods: Eight adults aged 25 to 65 years old, 4 (50%) men and 4 (50%) women, with post lingual hearing loss were evaluated. All participants used the same type of CI and similar signal processing strategy and had at least 6 months of activation. The participants were submitted to the Handicap Hearing Inventory for Adults - HHIA in an interview format, to the sound field minimum threshold response test (MTR) and to the speech perception test (list of 10 sentences with 50 words), in an open set with ideal listening conditions. The HHIA overall and partial results (emotional and social subscales) were calculated. The following frequencies: 0.25kHz, 0.5kHz, 1kHz, 2kHz, 3kHz and 4kHz averages (MTR) and the speech perception test average percentages were also calculated. The HHIA classification was obtained according to the overall score. For the statistics analysis was used the Spearman Statistical Test and adopted the significance level of 5%.

Results: An HHIA overall score average of 38.35% (SD ± 16:37) was observed, 17.75% (SD ± 11.88) and 20:50% (SD ± 6.9) in emotional and social subscales, respectively, corresponding to a mild to moderate handicap. The MTR average was 33.75dB (DP6.28) and 79.25% (DP33.81) for the speech perception test. Statistically significant correlations between HHIA results and the MTR were not found. The same occured to the speech perception test and the HHIA results.
**Conclusion:** There was no correlation between the auditora handicap, sound field minimum threshold response and the speech perceptivo test in adults with post-lingual deafness and the hearing handicap was rated mild to moderate.
Abstract Body:

Introduction: The Sound Access Parent Outcomes Instrument (SAPOI) was developed in response to the frequently cited need for an instrument that captures important quality outcomes of amplification in children with severe complex needs in addition to hearing impairment. The SAPOI is a criterion-referenced instrument designed to capture within child and family changes. This paper will present the SAPOI derived from data gathered during an initial pilot study, which was presented at CI 2015 and has been accepted for publication in Cochlear Implants International. Development of the SAPOI has been aimed at providing a reliable and valid quality metric to assist clinicians in evaluation of the results of all types of amplification for this population. The SAPOI is intended as a complement to other assessments already in use, and has been designed to avoid duplication of these instruments. The SAPOI version used in the pilot was based on data gathered from families regarding the results of their child's access to sound using cochlear implants (published in CJSLPA, 2013). The pilot study described the development of the SAPOI, the test-retest reliability results and feedback from Clinical Specialists and Participants.

Methods: The SAPOI version presented today was adapted based on data from the pilot. Intra-class correlations for the pilot scales (.73 - .84) suggested strong test-retest reliability and supported the rateability of items. Clinical Specialist feedback confirmed utility and provided suggestions for rewording and some additions. All suggestions were incorporated into the current SAPOI adaptation.

Results: The adapted SAPOI contains four separate scales: a) Child's Behaviour and Emotions (7 items); b) Child's Interaction (19 items); c) Parent-Caregiver Well Being (19 items); and d) Child Device Use (11 items). This presentation will describe the adapted SAPOI in detail.

Conclusion: The SAPOI is unique in formalizing Parent-Caregiver Well Being as an outcome of amplification for children with severe complex needs. It is now available for research use through the first author. Additional research will allow stronger item analyses with the aim of reducing instrument length and confirming the ability of SAPOI to capture meaningful change. It is hoped that the SAPOI will, eventually, assist in candidacy processes.
Abstract Body:

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

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

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

Conclusion: The study of the associated factors with deep deafness in the child allows to understand the hearing evolution of the
deaf
patients, and to reinforce an orthophonic reeducation in a more rigorous way in order to improve these results.
Introduction: After initial cochlear implantation, a number of events can result in the need for re-implantation surgery such as a device failure or array migration. A decrement in speech perception performance is a common ‘warning sign’, and whilst speech perception outcomes after re-implantation cannot be guaranteed, improved prognostic precision can support the decision process. The objective of this study was to compare speech recognition performance before and after re-implantation surgery in adult cochlear implant users.

Methods: This was a retrospective cohort study that included 54 adults who underwent cochlear re-implantation surgery between 2006 and 2015. Speech perception scores obtained after re-implantation was compared to the best, as well as the last, scores measured before re-implantation. The reasons that led to the re-implantation are described as well as the most likely causes for the speech perception outcomes after re-implantation.

Results: 77% of patients obtained a speech perception score that was similar or better than the best score measured before re-implantation. A repeated-measures ANOVA followed by post-hoc pairwise comparisons suggested that the post re-implantation scores were similar to the best performance pre re-implantation, and significantly better than the last performance measured before re-implantation. Likely causes for less successful re-implantation outcomes included incomplete array re-insertion and central processing issues.

Conclusion: While the majority of adults undergoing cochlear re-implantation surgery obtain better speech perception scores when compared to their last measured score prior to surgery, a number do not regain the same level of performance they had with their initial cochlear implant. Reasons for this include events that could not be predicted before the re-implantation.
Introduction:
Currently evidence is growing that patients with auditory neuropathy experience some benefit from cochlear implantation. However, previous studies showed a large variability in outcome after implantation and the reported series in implanted adults are small. The objective of the current study was to assess the postoperative performances of post-lingually deafened implanted adults with auditory neuropathy and to evaluate a predictive factor for outcome after implantation.

Methods: In a retrospective chart review audiological data were collected from eight adults with auditory neuropathy undergoing cochlear implantation between 2002 and 2015.

Results:
The speech recognition improved in all adults with a mean score of 77% HINT sentences in quiet, 43% Consonant-Nucleus-Consonant (CNC) words, 66% CNC phonemes, 79% Central Institute for the Deaf sentences, 69% AzBio sentence test in quiet and 50% AzBio + 10dB signal-to-noise ratio. Although the vast majority of the group reached their plateau of performance within 6 months after implantation, two out of eight showed improvements in speech recognition after 1 year of implant use. During long-term follow-up, all individuals were still using their implant (mean follow-up 6 years; range 0.5-13 years).
Conclusion:
These results support the efficacy of cochlear implantation in adults with auditory neuropathy.
Paediatric Cochlear Implantation: Prognostic Factors from a Review of 43 Cases

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Introduction: Accurate case evaluation is a necessary step in effective paediatric cochlear implantation; this is dependent upon a clear understanding of potential threats to the overall outcome. This work succeeds two previous studies to identify prognostic factors in pediatric cochlear implant.

Methods: A retrospective review of 43 patient was performed at our center, this examined the possible influence of a number of variables (including age at implant, surgical complications, gender, meningitis, inner ear malformations, and consanguinity and prematurity on outcome measures: receptive, expressive, and total language, receptive and expressive vocabulary, speech articulation and categories of auditory performance at 12-24 months post-implant. Multiple regression analysis was used to identify variables related to language and vocabulary outcomes.

Results: The findings suggest that inner ear malformations, old late of establishment and consanguinity are negatively associated with receptive and expressive language and receptive vocabulary scores. There was marginal evidence to suggest that increasing age at implantation was associated with lower receptive and expressive language scores.

Conclusion: The study of the factors associate with major deafness in the child allows to include/understand the evolution auditive of the deaf patients, and to reinforce an orthoepic rehabilitation in a more rigorous Way in order to optimer these results.
The Rogers Syndrome: A Case Report.

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Introduction: The Rogers syndrome or Thiamine-responsive megaloblastic anemia syndrome is a rare autosomal recessive disorder caused by a mutation in the thiamine transporter gene SLC19A2 and characterized by a triad of diabetes mellitus, megaloblastic anaemia, and sensorineural deafness. The treatment by thiamine effectively corrects anemia, can improve diabetes but does not improve hearing loss. Our aim is to present a rare case of deafness and describe the clinical and genetics aspects of Rogers syndrome.

Methods: S.A is a 26 months-old boy with bilateral profound deafness. He received a clinical (cardiovascular, ophthalmologic, otologic....) and paraclinical examinations (hearing test, CT, MRI....) for the purpose of a cochlear implant.

Results: S.A presented typical characteristics of Rogers syndrome: diabetes mellitus, megaloblastic anaemia, and sensorineural deafness. He also had nystagmus and retinitis pigmentosa.

Conclusion: The knowledge of this syndrome allows early diagnosis, effective management and thus better prognosis.
Introduction:
To determine genetic etiology of cochlear implantation (CI) recipients and investigate the auditory performance and speech intelligibility.

Methods:
we enrolled 188 patients who received CI in Shandong provincial hospital from January 2013 to May 2014. The cohort included 110 boys and 78 girls with implantation ages of between 1 year old and 7 years old. Genomic DNA was extracted from the blood of all patients, and 9 hot mutation point of 4 national common deafness gene were screened by gene microarray. All surgeries were successful, and operations ordinarily 1 month later. Test of scores of categories of auditory performance (CAP), speech intelligibility rating (SIR), Meaningful Auditory Integration on Scale (MAINS) and average hearing threshold was done before implantation, 1 month later, 3 months later, 6 months later, including scores of MAINS was done by parents. Statistical analysis was performed using software SPSS19.0, repeated measurements General Linear Model for evaluating CAP and SIR scores, repeated measurements mixed linear model for MAINS and average hearing threshold.
Results:
1. Based on the genetic screening results, patients were divided into five groups: group A: GJB2 gene mutation (homozygous or heterozygous) 65 patients, 34.57%; group B: GJB3 gene mutated (homo or heter) 3 patients, 1.60%; group C: SLC26A4 gene mutated (homo or heter) 34 patients, 18.09%; group D: mitochondrial gene mutated 8 patients, 4.26%; group E: unknown etiology 78 patients, 41.49%.
2. Results of scores of MAINS before surgery, 1 month, 3 months, 6 months after surgery, average ± standard error were respectively 12.09 ± 10.5, 16.05 ± 8.5, 20.73 ± 9.2, 23.49 ± 13.3, p = 0.00, p < 0.05. There was significant difference. Group A, C, E were 22.2 ± 0.8, 23.69 ± 1.07, 17.52 ± 0.6, p = 0.001, p < 0.05, there was significant difference. Pairs compared, there was significant difference between Group A and Group E, Group C and Group E, there was no significant difference between Group A and Group C.
3. Results of scores of CAP before surgery, 1 month, 3 months, 6 months after surgery, average ± standard error were 2.17 ± 1.9, 2.67 ± 1.8, 3.62 ± 1.5, 4.56 ± 1.2, time difference Wald $\chi^2$ = 111.6, p = 0.00, p < 0.05; there was significant difference. Group difference Wald $\chi^2$ = 4.8, p = 0.09, p > 0.05, there was no significant difference.
4. Results of scores of SIR before surgery, 1 month, 3 months, 6 months after surgery, average ± standard error were 1.27 ± 1.4, 1.47 ± 1.2, 1.89 ± 1.2, 3.72 ± 1.5, time difference Wald $\chi^2$ = 111.6, p = 0.00, p < 0.05. There was significant difference. Group difference Wald $\chi^2$ = 2.7, p = 0.26, p > 0.05, there was no significant difference.
5. Results of hearing threshold at 1 month, 3 months, 6 months after surgery, average ± standard error were 64.40 ± 19.3, 46.66 ± 13.18, 37.65 ± 8.7, p = 0.00, p < 0.05. There was significant difference. Group A, C, E average ± standard error dB were 52.0 ± 1.4, 48.3 ± 2.0, 50.19 ± 1.3, p = 0.32, p > 0.05, there was no significant difference.

Conclusion: The most common hereditary deafness genes are GJB2 and SLC26A4 gene among pediatric cochlear implantation. CI has time-dependent effect on the auditory and speech rehabilitation outcomes. GJB2 and SLC26A4 gene mutations do not impact on the outcomes of CI in short time.
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Influence of Setting Threshold Levels on Speech Discrimination for the MED-EL Audio Processor

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Abstract Body:

Introduction: Determining minimum stimulation levels on cochlear implant electrodes might be a difficult task when programming sound processors for very young children. The programming process has been facilitating by setting threshold levels set to 0μA or 10% of the most comfortable level. Previous studies suggested that the measurement of thresholds is relatively unimportant because the threshold levels programed by the facilitated process had no significant decrement in speech understanding for Med-El processors. Following these studies, Med-El processors had been programmed without setting threshold levels when we started to manipulate them. However, compared to the children using Cochlear sound processors which had settings of threshold levels, most of the Med-El audio processor users tended to feel uncomfortableness in hearing sounds and their articulation was not so clear as that of the Cochlear sound processor users. Based on these findings, the present investigation was designed to assess whether programming threshold levels would effects speech discrimination of the Med-El audio processor users.

Methods: Subjects were eight children, aged 3 to 14, who had received the Med-El cochlear implant either both or one side of their ears. Totally thirteen processors were evaluated in this study. Two test programs were produced for each processor. One program had threshold levels estimated by ABR measurements. Another program had threshold levels set to 0μA. Sound field thresholds and speech discrimination were assessed for each program. Sound field thresholds were measured at the frequencies of 125, 250, 500, 1000, 2000, 4000, and 8000Hz. To measure speech discrimination, we used Japanese monosyllabic lists named 67-S lists. The 67-S tests were presented at an intensity of 60, 50, 40 and 30dBHL.

Results: Compared to the cases using programs with estimated threshold levels by ABR measurements, all subjects using programs without setting threshold levels (set to 0μA) had low discrimination scores as sound pressure levels decreased. The programs with estimated thresholds had no significant difference on speech discrimination scores at each sound pressure levels. However, speech
discrimination scores got lowered at the presentation levels of 40 and 30dBHL when using the programs with threshold levels set to 0 qu.

**Conclusion:** Although the program with threshold levels estimated by ABR measurements did not affect scores on sound field thresholds, it did affect speech discrimination scores. Programming threshold levels improve recipients’ monosyllabic hearing abilities at low sound pressures as 40 and 30dBHL. Based on these findings, in the cases without setting threshold levels, it lacks the signals of low sound pressures and that concerns the distortion of sounds and the users’ uncomfortableness in hearing. The clinical use of programming threshold levels has the potential to make low sounds much clear. It is critical to get low sound pressure signals for the language development of child cochlear implant recipients.
Introduction: In everyday listening situations, the presence of reverberation and background noise can make it difficult for people with hearing impairment to understand speech through their specific assistive technology (Hearing Aids or Cochlear Implant). Most CI Technologies have your microphone positioned behind the ear (BTE), on the top of the speech processor, offering a good performance in environments with controlled noise.

Advanced Bionics is the only Cochlear Implant Company to offer another extra placement for the microphone, with the patented T-Mic2 on the Naida CIQ70 Speech Processor. This technology places the microphone at the opening of the ear canal and utilizes the outer ear’s natural sound-gathering capabilities, just like normal-hearing ears. The T-Mic2 also lets recipient to use cell phones, Bluetooth devices, MP3 players and other battery-powered audio devices just like everyone else, so they can have much more natural hearing.

The goal of this study was to verify benefits of speech perception in noise based on these two different cochlear implant microphone positions.

Methods: 8 subjects from 4 to 9 years old, native Portuguese speakers, who used Advanced Bionics Cochlear Implant and Naida CIQ70 Speech Processor. All recipients were implanted for more than 6 months and uses their CI regularly with the BTE microphone activated. The programming was made based on behavioral methods. Patients were fully informed and provided written consent before participating in this study. This study was approved by the ethical committee.

The tests consisted in an audiometry with pure-tone thresholds, an speech perception test in quiet and in noise and an IT-MAIS questionnaire, used to identify hearing abilities in young children.

The speech perception test with the use of figures conducted, was based on the Pediatric Speech Intelligibility Test (PSI). It was applied in free-field soundproof booth, initially in silence and then in noise. Speech signal was fixed in 65 dB and researched the speech recognition index in silence and then in noise with 3 different level of S/N ratio (+10dB, 0dB and -10 dB).
All tests were conducted before TMic2 microphone activation and retested 60 days after activation.

**Results:** In the evaluation of tone thresholds, no statistical difference was observed when used different microphones. Regarding speech perception in noise, significant differences was observed, especially in the S/N ratio 0dB and -10dB with the use of Tmic2. The huge modification was observed in S/N ratio -10 dB. On the questionnaire, there was a significant difference after the use of T-Mic2 microphone.

**Conclusion:** The TMic2 microphone used in Advanced Bionics Naida CIQ70 shows great improvement on speech intelligibility performance in noise. This improvement was observed in speech perception tests in noise and evaluation of hearing abilities questionnaires.
Introduction: The auditory performance of the implanted patients should be evaluated in various settings to optimize the speech perception, since the degree of patient satisfaction is related to its improvement. The evaluation of Cochlear Implant (CI) can be made by speech perception tests and self-assessment questionnaires that subjectively assess hearing difficulties associated with communication problems and lifestyle. The questionnaire Hearing Implant Sound Quality Index (HISQUI19) was developed in order to self-evaluate the sound quality of CI in various listening situations.

Methods: The sample included 33 adults, 16 male and 17 female. All users of CI, unilateral or bilateral, with the device activation and at least 1 year of the interview and speech perception tests (SPT). The questionnaire HISQUI19 was applied in the form of individual interviews for which a numerical value of the sum of 19 questions ranging a punctuation between a minimum of 19 and a maximum of 133 points was obtained, showing how good or bad is the sound quality of the CI. The sentence recognition test in open settings (SPT) was conducted in a soundproof booth with speech presentation of 55dBHL and the percentage of correct answers was achieved. The results were statistically analyzed with SPSS version 12 and for each hypothesis test was given a 0.05 significance level. In addition, the statistical test Cronbach’s alpha was used to determine the degree of reliability of the studied instrument by measuring the internal consistency of the observed values.

Results: The score of the questionnaire shows that 70% of the respondents showed a result of CI sound quality between good and very good and mean score of 90.2 points. A high reliability of the questionnaire could be confirmed with internal consistency value of 0.83. No significant statistically differences were found between male and female samples (p = 0.23). In the analysis of the implantation side, the bilateral implant showed the best performance, but it was not statistically significant (p = 0.61). Independently of the respondents revealing easier communication to hear the telephone ring, situations involving understanding auditory announcements in public places and talking to strangers in noisy environment showed that nearly 40% of respondents always manage to perform the auditory tasks. For the SPT, the hit average was 89.2% and showed no statistically significant
relationship to the result of the score (p > 0.05).

**Conclusion:** The HISQUI19 instrument presented a high degree of reliability. Most respondents considered as good the quality of the CI and, almost half, reported communication facility in noisy environment. Still, it was not possible to relate the score variables of the HISQUI19 to the SPT.
Introduction: The ability of the auditory system in dealing with the identification of quick and sudden changes in an acoustic event, detecting pauses between sound stimuli is called temporal resolution. It is a necessary ability to detect phonetic variations in speech, having an impact on the perception of connected speech and the recognition of phonemes. The possibility of measure these abilities and verify their relationship will assist the treatment planning of cochlear implant users.

OBJECTIVE: To evaluate the correlation between the temporal resolution ability in a noise segment and the recognition ability of monosyllables and sentences in cochlear implant users with postlingual hearing loss.

Methods: The study included nine patients with postlingual hearing impairment, aged between 14 and 67 years (mean = 43.22 years). All wore implant at least one year and were users of similar strategies of signal processing. To measure the ability of temporal resolution we used the gaps-in-noise test (GIN) and assessed the gap detection thresholds and percentage of recognition of gaps. In addition, to evaluate speech recognition the task to verbally repeat a list of 25 monosyllables was employed with two lists of 10 sentences in which one presented in quiet and the other in the noise keeping the signal to noise positive ratio of 10 dB. It was also studied the sentence’s recognition threshold in quiet and the signal to noise ratio necessary for the individual to recognise half of the sentences presented in noise.

Results: The gap threshold mean value was 17.33 milliseconds (SD ± 8.53), and percentage of recognition gaps 30% (SD ± 17.97). In speech perception tests it was obtained mean values of monosyllabic recognition at 50.67%, of sentences in quiet 94% and sentences in noise 24.7%. The mean threshold of sentences recognition in noise was 53.25 dB and the signal to noise ratio of 12.1 dB. Negative and significant correlations between monosyllables and age were observed (p =0.031), threshold gap detection and percentage of recognition gap (p = 0.002), threshold and sentence recognition in quiet (p = 0.034), sentence recognition in noise and signal to noise ratio (p = 0.020).

Conclusion: There was no correlation between the temporal resolution ability in a noise segment and the recognition ability of monosyllables and sentences in cochlear implant users with postlingual hearing loss.
Introduction:
The Cuban Cochlear Implant Program (CCIP), with over 15 years experience, has since its inception a working protocol where priority is given deaf-blind children. Advances in Cochlear Implant (CI) have broadened the criteria for candidates giving opportunity to children with other health problems.

Methods:
This study included 30 childrens (between 2 and 16 years, mean = 8 years; 16 female) who also presented: visual impairment (n = 18), multiply disabilities (n = 11), stroke (n = 1). Neurophysiological studies: ASSR, VEP, SEP, CAEP and EEG. Postimplantation, the results electrophysiologies was analyzed considering the progress in the auditory rehabilitation.

Results:
We presented the clinical description and the electrophysiological findings of pre- and post-CI evaluation. With the ASSR was confirmed and characterized the hearing loss (severe-profound SNHL in all cases), while the VEP allowed to demonstrate commitment visual impairment associated with deafness. The post-IC study showed cortical auditory evoked response with latency that correlation with the results of hearing rehabilitation but, in general, these children had
slow progress when compared with deaf children without handicapped. Notably somatosensory cortical evoked response and analysis of the frequency components of brain electrical activity showed changes before and after implantation, reflected improved auditory perception in the somatosensory cortex changes and maturation pattern representation EEG activity of post-IC.

**Conclusion:**

Evoked Potentials and EEG may be considered to improve in a protocol of the evaluation the children candidate to IC, while offering evidence of functional status, maturational changes and/or neuroplastic changes, at cortical level by of the sensory impairment and the effects of hearing rehabilitation post-IC.
**Introduction:** The cochlear implant (CI) designed to restore some sense of hearing for children and adults who receive little or no benefit from hearing aids. It is well established that “The impact of Cochlear implantation on the deaf population has been the single most therapeutic modality in otology and has far exceeded the expectations of even the most ardent early supporter of this technology”. Cochlear implantation program is in place at PSMMC since 2009. Success of any program depend on:

- The team work overt.
- Effective collaboration.
- Leadership support.
- Higher authority support.

**Methods:** Chart review of 120 cases of Cochlear Implantation performed at PSMMC since 2009.

Inclusion criteria:
- Only those patients who had a regular follow up at PSMMC rehab unit.
- Pre lingual children.
- Minimum of six months follow up

Exclusion Criteria
- Patients undertaking rehabilitation outside our unit
- Post lingual cases.
- Patients with less than 6 months follow up.

Fifty three out of the 120 cases were found to fit the criteria.

Data was collected on:
Results: The average age group at the implant was 3.5 years and ranged between 1-9 years which is higher than other reports. Both consanguinity 36/53 and family history of deafness 24/53 was high among the patients. Idiopathic congenital deafness was the major cause, followed by prenatal and postnatal illnesses. Majority of the patients subjected to single sided CI. Complications of minor nature were recorded in around 11% of the cases, No major complications were recorded in any of the patients. Substantial improvement was recorded in both speech and auditory levels post implantation.

Conclusion: The CI program being implemented at PSMMC shows a good outcome with substantial improvement in both speech and audiology parameters. The rate of complications is also on the lower side. However early screening and detection is recommended to reduce the age at CI. Awareness and genetic studies should be created to reduce/avoid consanguinity to prevent the increase of deafness.
Abstract Body:

**Introduction:** Designing an acoustic hearing implant means to master multiple challenges. One of them is to reach sufficiently high maximum power output levels over a wide frequency range while limiting the power consumption of the device. Especially if the device is intended to treat profound hearing loss, the actuator design has to be consistent with the implantation approach such as direct acoustic cochlear stimulation. Achieving this objectives is only possible if the device is well adapted to its operating environment and if losses within the system are minimized. A holistic design methodology is required to develop corresponding design concepts.

**Methods:** The proposed design methodology consists of the following for main steps:

1. determination and analysis of the human body functions that shall be emulated by the system
2. determination of the preliminary system architecture
3. determination of the user and system requirements
4. conceptual design

This approach allows to derive the technical solution directly from main functions and the operating environments of the future device. The resulting design concept meets therefore all related requirements and serves as sound basis for the detailed design phase.
**Results:** The design of a hearing implant actuator is a good example to illustrate how the proposed design methodology influences the technical solution. The most appropriate actuation principle directly depends on the mechanical load which is given by the foreseen coupling site of the actuator. As a result, an actuator designed for direct acoustic cochlear stimulation is different from one that drives the ossicular chain. The clinical results of the Codacs direct acoustic cochlear stimulation device show that an actuator which is designed in this way is able to reach the required maximum power output to treat profound mixed hearing loss [1, 2].

**References:**
[2] Snik A et al., Are middle ear implants superior to bone-conduction devices for patients with conductive/mixed hearing loss?, CI 2014; KN2-4

**Conclusion:** The proposed holistic approach focuses on the conceptual design phase in order to maximize the overall device performance. Especially in the field of active implantable medical devices, where technology has to be joined to living tissue, the global optimum has to be searched on concept level. The possibility to influence the major performance characteristics becomes very restricted once the development has entered the detailed design phase.
Coding and Perception of Interaural Phase Differences in BiCI Users

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Introduction:
Listening with two ears enables the normal-hearing (NH) auditory system to perceive interaural phase differences (IPD) with high precision. Such ILD are important for the localization of sounds and binaural unmasking of speech. Therefore, a binaural coding strategy in bilaterally implanted cochlear implant (BiCI) users that transmits IPD effectively is highly desirable.

Methods:
In this study we compared two coding strategies in BiCI users provided with CI systems from MED-EL. The CI systems were bilaterally programmed either with the fine structure processing strategy FS4 or with the constant rate strategy HDCIS with consideration of adaptation phases of 6 to 12 weeks to each coding strategy. The impact of IPD was measured in terms of binaural intelligibility level differences (BILD). BILD were determined in NH listeners and BiCI users using their clinical speech processors.

Results:
NH subjects (n=8) showed a highly significant BILD of 7.5 ± 1.2 dB. In contrast, BiCI users (n=12) with both, HDCIS and FS4 revealed a barely significant BILD (HDCIS: 0.5 ± 2.0 dB; FS4: 0.6 ± 1.9 dB). To investigate if the included BiCI users show unusually poor IPD sensitivity, IPD thresholds were measured in them using narrow-band stimuli. The stimuli were processed by the CI processors programmed with FS4. The resulting individual IPD thresholds revealed large variations in IPD sensitivity across the included BiCI users revealing some BiCI users with considerably high IPD sensitivity. However, these BiCI users revealing high IPD sensitivity did not turn out to be the individuals with highest BILD values. No correlation between BILD and IPD thresholds was found.

Conclusion:
Significant but small amounts of binaural unmasking were found in 12 BiCI users included in the present study compared to a normal-hearing reference group. The effect was independent on the coding strategy indicating that envelope coding with HDCIS and envelope/fine structure coding with FS4 in the current implementation are leading to comparable amounts of binaural unmasking.
Motivated by these outcomes, modified versions of FS4 were also tested in the same BiCI users revealing indications of improvements.
BAHA- CROS Hyrid: A New Treatment Option in Unilateral Profound Hearing Loss

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Goal of the study:
Asymmetric hearing losses need highly individualized treatment strategies. Profound unilateral low frequency in combination with severe mid to high frequency hearing losses are hardly to fit with conventional hearing aids. A treatment with a BAHA- CROS doesn’t allow a directional orientation in this cases. Therefore, if the country specific health system allows coverage, they are implanted with a cochlea implant system.

The aim of the present study was to observe, if a BAHA- CROS hydrid solution (BAHA and hearing aid on the ipsilateral ear) offers an increase in terms of speech understanding, directional hearing and subjective benefit in comparison to a pure BAHA- CROS solution.

Methodology and type of study:
In this prospective study we evaluated 4 patients with a unilateral profound low and mid to high frequency severe hearing loss. Three were implanted with a BAHA system and 1 was observed with a rod. All measurements were performed with a BAHA BP100 and a hearing aid. Audiologically observation consisted out of monosyllabic words understanding, OLSA in quit, OLSA S0/NO (noise fixed @65dB) and a localisation test (12 speaker/ 30° distance). Subjective evaluation was performed by the SSQ questionnaires.

The evaluation of the speech understanding showed an increase for all participants with the hybrid solution in comparison to the BAHA CROS or the hearing aid solution.
Conclusion:
In BAHA CROS cases with residual hearing in the mid or high frequency region the support by a conventional hearing aid increases the speech understanding.
The Benefit of EAS in Bilateral Implanted Adults with Bilateral Residual Hearing

Abstract Body:

Introduction:

The advantage of electric-acoustical stimulation (EAS) in patients with residual hearing compared to electrical stimulation only is well described. However, current studies only observe the benefit of unilateral implanted subjects with EAS devices. A bilateral substantial preservation of residual hearing aided with a current audio processor (Naida Q90 EAS) can be assumed to offer an additional benefit in terms of hearing in noise and sound localization.

Methods:

In this study we evaluated 3 cochlear adult implantees with bilateral residual hearing. The mean age of patients was 53.6 years (range 39-62 years). The mean experience with cochlea implant was 23 months (range 4 - 45 months). The time between the first and the second implantation was in average 20.6 months (range 4 - 43 months). 5 out of 6 ears were implanted with a HiFocus Mid Scala electrode, one patient with a IJ electrode. Aidable residual hearing was supported with the EAS Naida Q90 processor (≤ 80 dB HL). Audiological comparison of the conventional Naida Q70 audio processor vs. Naida Q90 EAS processor was carried out by: sentence test in noise (Oldenburger-Satztest, S0N0) unilateral/ bilateral and a sound localization test. Subjective evaluation was performed by the SSQ - questionnaire.
Results:

Mean residual hearing (125, 250, 500, 750 Hz) was 65 dB. When comparing the conventional bilateral Naida Q70 audio processors with the bilateral Naida Q90 EAS audio processors all 3 subjects performed better with the bilateral Naida Q90 EAS system. A significant difference could be observed for speech understanding in noise and sound localization. Subjectively, all of the patients preferred the bilateral Naida Q90 EAS processors in comparison to the regular Naida Q70. Preliminary results in a localization task seem to reveal better results with the EAS processors.

Conclusion:

A bilateral EAS audio processor seem to provide an additional advantage compared to a regular audio processor in terms of speech understanding in noise, sound localization and subjective evaluation.
Cochlear Implant Program in a Developing Country: Pakistan

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Abstract Body:

Introduction:
Despite financial and other multiple barriers, cochlear implantation has become an established in many developing countries. Pakistan cochlear implant program was started in Lahore in august 2000. In this study we describe our experience, socio-demographic profile of implanted patients, etiology and pattern of surgeries since it started and complication rate.

Methods:
Retrospective date review of patients who had cochlear implantation between August 2000 and October 2015. There were total of 989 cochlear implant patients under Pakistan cochlear implant program. We studied their socio-demographic profile, age at implantation, etiology of hearing impairment, consanguinity, number of implants per year and complications including re implantations.

Results:
41 adults and 948 children received cochlear implants. Only 9 had bilateral cochlear implantation, 3 had bilateral simultaneous surgery. Congenital deafness was the main etiology and 64% of children had blood related parents. There were 12 minor and no major complications. There were 3.8% successful re implantations. As it is mainly self funded program. Numbers of cochlear implants done in a year remain static but surge in cochlear implantation in last few years mainly due to involvement of charity organizations.

Conclusions:
Cochlear implant services can be established in developing countries. Cost remains the main limiting factor. Children are the main
recipients. Consanguinity is the major factor in congenital hearing loss. Children from Urban areas had more cochlear implants due to better awareness. Very few adults choose to get cochlear implants.
**Abstract Body:**

**Introduction:** The indication for a cochlear implant has expanded to patients with some residual hearing. Shorter and thinner atraumatic electrodes have been designed to preserve the residual hearing in the implanted ear. However, the insertion of the electrode array into the cochlea, with potential mechanical trauma and the presence of this foreign body inside the cochlea, may lead to free radical formation and reduced blood perfusion of the cochlea which can result in a loss of residual hearing. In this single center, randomized, placebo-controlled, double-blind phase II clinical trial the effect of free radical scavengers and a vasodilator on the residual hearing of 140 CI-patients will be evaluated.

**Methods:** The formulation is composed of β-carotene (converted in the body to vitamin A), ascorbic acid (vitamin C), trolox (vitamin E) and the vasodilator magnesium (Mg), together named ACEMg. Medication is administered twice daily orally for approximately 3 months. The primary measure is based upon the reduction in post-operative low frequency air conduction pure tone thresholds compared to pre-operative thresholds in ACEMg treated patients compared to those of a placebo-group. Additionally, the effect of different electrode lengths (MED-EL Flex 20mm, Flex 24mm and Flex 28mm) is analyzed. Study visits are scheduled two days before surgery, at first fitting and 3, 6, 9 and 12 months after first fitting. The Primary endpoint is the air conduction Hearing loss at 500Hz 3 months after first fitting. Additionally, speech recognition tests, hearing aid benefit in the implanted ear and electrophysiological measurements of implant function are assessed.

**Results:** Up to now 51 patients are recruited and interim analysis shows that good Hearing preservation results could be achieved with all electrode lengths.

**Conclusion:** Since this is a blinded clinical trial and the recruitment is still ongoing data are continuing to accrue and we cannot yet analyses the outcome of the ACEMg treatment.
Abstract Body:

**Introduction:** The objective of cochlear implant fitting is to optimize the parameters of electric stimulation to achieve the best possible speech perception. When stimulation levels are set too low, hearing sensations are limited what pushes fitting specialists to increase delivered stimuli. But when stimulation levels are set too high, sound quality can be distorted lowering hearing benefits. The aim of the study was to assess via objective methods and questionnaires if children undergoing routine fitting could be affected by overstimulation.

**Methods:** The study group consisted of 37 children implanted with Cochlear (19 patients) and Med-El (18 patients) devices. All patients were tested after nine months after first fitting during scheduled follow-up visit. All of them had acoustically elicited stapedius muscle reflex threshold measurement performed. Questionnaires on loudness perception were distributed among children’s parents to assess subjective program loudness in everyday use and then collected during mentioned visit. To validate proposed method normal hearing group was tested. Acoustically evoked stapedius reflex threshold was assessed for each participant in this group.

**Results:** Results from surveys indicate that there is no direct correlation between acoustically evoked stapedius muscle reflex threshold and questionnaire responses, but almost 70% of children with “very loud” answers in questionnaire showed acoustically evoked stapedius muscle reflex threshold equal or lower than 70dB HL. Additionally stapedius reflex thresholds achieved by CI users was compared with ones achieved by normal hearing peers.
Conclusion: By adding new validated and reliable objective test and subjective tests as well to the standard test battery it is possible to identify children suspected of overstimulation.

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Surgical Procedure for Minimally Invasive Robotic Cochlear Implantation

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Abstract Body:

Introduction: Minimally invasive robotic cochlear implantation demands an adapted surgical procedure when compared with conventional CI surgery. During insertion, the visibility and maneuverability is limited because of the small size of the direct cochlear access tunnel (1.8 mm in diameter). Therefore, an implantation procedure with an insertion guide tube was developed and evaluated in an ex vivo study for clinical applicability.

Methods: A robotic system was used to drill DCA tunnels (1.8 mm in diameter) in 16 temporal bone specimens. The specimens were prepared by placement of 4 fiducial screws, preoperative CT imaging, trajectory planning, and attachment of a dynamic reference base. Free-fitting electrode arrays (28 mm length) were manually inserted directly from the mastoid surface through the round window with a custom-made insertion guide tube. After insertion completion, the guide tube was removed prior to fixation of the electrode lead. Postoperative cone beam CT and microCT imaging was performed to evaluate the insertion outcome.

Results: CI array insertions from the mastoid surface into the cochlea were feasible in all specimens without major difficulties. The removal of the insertion guide tube was possible without pulling back the inserted arrays. All electrode arrays (n=16) were inserted into the scala tympani, with an average angular insertion depth of 450° (Fig. 1).

Conclusion: The presented procedure fulfills the requirements of robotic minimally invasive cochlear implantation and will be applied in the first in man clinical study.
Introduction:
The auditory critical period, in which there is greater development of the cortical part of the hearing in the brain and consequently the language, occurs before 3 years of age. It is known that the cochlear implant (CI) after that age presents with worse results, especially considering spoken language. Because of the delay in diagnoses in developing countries, there is a considerable number of children undergoing CI after the critical period.

Methods:
A retrospective study based on medical records. The completion of a information protocol included the following benchmarks: Age of implantation, use of sign language, laterality of implantation, mother’s level of education, regular use of CI and satisfaction level. Hearing category gain, speech category gain and the average hearing thresholds between 0.5 and 4 kHz were considered after the implantation. The statistical analysis was performed with the Spearman correlation test, using GraphPad Prism.

Results:
65 patients with prelingual sensorineural profound hearing loss were included. The age at the time of the CI varied from 4 to 7 years (mean 5.9), of which 26 males and 39 females. The threshold means were positively correlated with Category Gains, considering both hearing (p=0.0004) and speech (p=0.034). The age of implantation, the regular use and the laterality of the CI had no
correlation with improvements with thresholds or category gain. Mother level of education had a positive correlation with speech category gain \((p=0.016)\), and Satisfaction level was high, despite of other factors.

**Conclusion:**
Once the auditory critical period is over, the late implantation does not appear to do any additional negative impact in the CI performance. In a group of children from 4 to 7 years old that underwent CI, improvements such as hearing category gain and speech category gain were correlated to higher means of auditory thresholds and mother’s level of education. Furthermore, the CI in this group of patients was associated with a high level of satisfaction. This suggests that the late CI can be beneficial.
Abstract Body:

Introduction
During the last years more and more (adult) patients with residual hearing are getting cochlear implants. They are good candidates for the use of a cochlear implant in one ear and a hearing aid in the contralateral ear, which is referred to as bimodal hearing. Bimodal fitting has shown improvements in speech recognition and localization of sounds compared to unilateral CI use alone. Although bimodal fitting is becoming regular standard clinical practice, no standardized fitting rules exist and are used for clinical bimodal fittings. International multicenter surveys showed that although almost all clinicians would advise to wear a contralateral hearing aid if indicated, no standard bimodal fitting strategies are used. It remains still unclear what gain prescription rule provides optimal performance, e.g. how to define an optimal gain characteristic for a given hearing loss. Also, the benefits of individual fine-tuning of the frequency-balance remain unclear. The objective of the study is to identify the critical factors of hearing-aid fitting that contribute to optimal auditory performance in bimodal listening. Both, the optimal frequency characteristic as the individual fine-tuning of the hearing aid based on loudness balancing (broadband and within separate frequency bands) are assessed. Also the effects of bimodal wireless options are studied.

Methods
19 experienced (implant use > 6 months) adult CI-recipients will participate in this prospective clinical study with a within-subject repeated measures design. The study will start in December 2015. All participants have phoneme scores of ≥ 60% at 65 dBSPL in quiet and had a Cochlear Nucleus CP910 sound processor. All participants are wearing a hearing aid in the contralateral ear. The auditory functioning will be evaluated by a speech in quiet test, a speech in noise test with separate noise, a sound localization test and a questionnaire about their perceived auditory functioning (speech, spatial and quality questionnaire).

The study consists of four sessions, in which three different hearing aid fittings are evaluated (NAL-NL2, Audiogram+, fine tuning of NAL-NL2 with loudness balancing in separate frequency bands). During a first session, they will be tested with their own hearing aid as a baseline. Subsequently, the participants receive the Resound Enzo hearing aid. One of the three fittings is programmed in the hearing aid and used in the normal daily life situation at home. After three weeks the auditory functioning with this fitting is evaluated in the clinic after which another fitting strategy is programmed. This strategy is also evaluated after three weeks and
subsequently the last fitting is programmed and evaluated after three weeks of use at home.

Results and conclusion
The first results of this study will be presented at the CI 2016 conference.
**Control Number:**

2016-A-387-ACI

**Session Number:**

POS01

**Session Title:**

Poster Session A

**Poster Board Number:**

37-A

**Topic 1:**

03a-Fitting

**Publishing Title:**

Does a Flat Strategy Based Fitting Map Provide Better or Equal Objective Hearing Performance as a Single Channel Fitting Map?

**Author Block:**

Griet Mertens, PhD, Paul Van de Heyning, MD, PhD; Otorhinolaryngology, Antwerp Univ. Hosp., Edegem, Belgium.

**Abstract Body:**

**Introduction:** In order to provide the best possible clinical benefit, Cochlear Implants (CI's) have to be appropriately adapted for each individual user. The periodic fitting of a CI is a time consuming process, which takes up a significant proportion of the relevant staff’s working time. To get as close as possible to an optimal map, in an efficient way in as few fitting sessions as possible, is a major wish from cochlear implant centres. This study addresses the question how performance with a flat strategy based fitting (FSBF) map compares to a traditional single channel fitted (SCF) map.

**Methods:** Post-lingually deafened unilateral MED-EL CI recipients (18 years or older) with CI-aided speech intelligibility of ≥ 45 % in a monosyllables test at 65±5 dB SPL or an SRT of ≤ 20 dB SNR in a sentence-in-noise test will be enrolled in the study. Performance with 3 different maps (1. FSBF, 2. SCF and 3. fine-tuned clinical map (FTC)) will be assessed using the following measures: Oldenburg Matrix Sentence Test; Visual Analogue Scales (VAS) to subjectively rate frequency perception. This prospective, acute, randomized, open-label study will comprise one test interval for each participating subject.

**Results:** This study will report on a comparison between the objective and subjective hearing performance with an FSBF map and an SCF map, the time needed to reach an FSBF and SCF map, the deviation parameter for both maps compared to the fine-tuned clinical (FTC) map, ART data for all active electrodes and the absolute charge levels of each map.

**Conclusion:** Although the results from the first interim analysis is presented here, the conclusive differences in objective and subjective hearing performances with an FSBF and an SCF map will be presented at CI2016.
Introduction: The candidacy evaluation for cochlear implants of the Catalonian paediatric population is carried out in the only public reference children’s and maternity hospital. The universal new born infant hearing screening was adopted in 2010. Its introduction set up an interdisciplinary intervention model between Health and Education systems for the treatment and follow-up of bilateral profound hearing loss. The hearing and language (re)habilitation of these implanted children is carried out by various highly specialized professionals: an Education Department team composed of speech therapists, audioprosthesis technicians and educational psychologists (who are in charge of the evaluation and rehabilitation with tools adapted to the Catalan language), who are coordinated with the hospital’s implant centre team.

Methods: Whole coordinated process description: Candidacy evaluation; Cochlear implants committee; Health psychoprophylaxis carried out by the “Diver” program [Child Life], which belongs to the “Hospital Amic” program, and education psychoprophylaxis, where all these activities are coordinated, and done before the surgery with both the children and their families; surgical intervention, first fitting and follow-up fittings; interdisciplinary medical-educational coordinated follow-up.

Results: Description of the whole process applied on an implanted child who came from a new born infant hearing screening and its medical-educational follow-up.

Conclusion: A joint intervention and coordinated follow-up between health and education professionals on implanted children was established in 1995. The description of this work flow includes the assessment of present and future needs, keeping in mind the cochlear implantation is carried out at very early ages. The high degree of coordination between Health and Education systems on implanted children and their families aims for a more total successful paediatric cochlear implantation.
Introduction: Vertigo of vestibular origin has a prevalence of 5%, and responds poorly to current treatments. This value rises to 38% in the elderly and increases the risk of falls and the consequent permanent disability, health costs and even death. 12-14 million people worldwide would require a vestibular implant. Current devices detect cephalic angular velocities and stimulate the semicircular canals. However they do not code vertical and horizontal accelerations, used to sense gravitational forces, keep a stand up position and restore a sense of self-position by the saccule and utricle. A new vestibular implant would be the first to emulate linear accelerations electrically in these organs. Saccule and utricle function is essential for self-reported dizziness and for postural balance in upright position and gait. This new vestibular implant would be the first system that includes the detection of linear acceleration and stimulates the maculae accordingly.

The aim of the presentation is to describe surgical approach to place a vestibular implant at the macula for both, a research model (Macaca fascicularis) and human.

Methods: An anatomical study using temporal bones for both species will be conducted. Analysis of Macaca fascicularis and human temporal bones utricule and saccule to determine best surgical approach and implant location. After the experiments, the placement of the electrode will be analyzed using CT and histological techniques. 5 Macaca fascicularis temporal bones and 5 human’s temporal bones will be used for acute experimentation with the implant prototypes dummies. Surgical approach, dimensions and fixation capacity of the electrode plate on the vestibular organ, it will be studied. CT and histological studies to the check the position and interactions with the biological structures also will be performed.

Results: Surgical approach to the vestibule is performed via a mastoidectomy. Then facial nerve and all three semicircular canals (posterior, lateral and superior) are skeletonized. Vestibule is opened in its posterior region, medial to facial nerve and in between lateral and superior semicircular canals (figure 1). Histology and radiology (CT scan) analysis will be performed and shown during
Conclusion: A novel approach to the vestibule is described. It may be feasible to approach the vestibule minimizing inner ear trauma and to place an electrode at such location.
Control Number: 2016-A-404-ACI
Session Number: POS01
Session Title: Poster Session A
Poster Board Number: 168-A
Topic 1: 08a - Miscellaneous

Publishing Title: Automatic Multimodal Registration and Fusion of 3D Human Cochlea Images

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Abstract Body:

Introduction: For more efficient Cochlear Implant (CI) surgery, knowledge of cochlea size is needed in advance. Medical image segmentation and analysis techniques can help to get this measurement. An important preprocessing step image segmentation is an accurate image registration and fusion. We propose a fully automatic registration and fusion method for human cochlea multimodal three dimensional images using hierarchical approach. We offer our cochlea images for free as a standard public dataset that can be downloaded from our XNAT server. All images in our dataset are carefully preprocessed to avoid patients privacy violence.

Methods: Two cochlea images groups of patients from different gender and age are collected. First group has CBCT scans before and after CI surgery. Second group has MRI and CT scans before CI surgery, and CBCT scans after the surgery. We registered and fused images of each patient, hence we solve an intrasubject multimodal registration and fusion problem, Figure 1. Figure 2 describes briefly our method. In first group we deal with monomodality problem so we used Mean Squared Error (MSD) instead of Mattes Mutual Information (MMI).

Results: All images are successfully automatically registered. Each patient’s images required few seconds to be registered. Results are visually approved by experts and compared to classical registration methods like Intensity Variance (IV) and Inverse Consistency Error (ICE).

Conclusion: We have described and implemented an automatic multimodal registration and fusion method for human cochlea images. Our results are approved by experts and can help further image segmentation and analysis. We also described a free and public standard human cochlea dataset which helps for future reliable researches.
Abstract Body:

Introduction:
We present ‘cHIRP’ a portable, binaural, real-time research platform for cochlear implants. The platform is capable of processing signals from 4 microphones simultaneously in real-time and producing synchronized binaural outputs capable of driving two (bilaterally implanted) cochlear implants.

Methods:
The platform consists of hardware and software parts. The hardware is responsible for: (1) digitizing the 4-channel input audio signals coming from two ear-worn microphone systems and (2) generating the final electric outputs needed to drive the two antenna coils. The software is responsible for processing the four audio signals and then generating two synchronized electrodograms from these signals. The software includes a flexible environment for the development of sound pre-processing (“speech processing”) and stimulation strategies. The interface between hardware and software is fully bi-directional via standard USB.

Results:
When the whole research platform is combined with cochlear implants, interaural electrode timing can be controlled to better
than 1 us accuracy. Hence, this new platform is particularly well-suited to performing experiments related to ITD in real-time. The platform also supports instantaneously variable stimulation rates and thereby enables investigations such as the effect of changing the stimulation rate on pitch perception. In addition, because software processing can be changed on the fly, researchers can use this platform to study perceptual changes resulting from two different processing strategies acutely.

**Conclusion:**

The ‘cHIRP’ platform, a portable, binaural, real-time research platform for cochlear implants can process signals from 4 microphones simultaneously in real-time and produce synchronized binaural outputs capable of driving two (bilaterally implanted) cochlear implants.
Long-Term Results After Cochlear Implantation (CI) in Patients with Single Sided Deafness After Resection of Tumors of the Inner Ear Canal: What Can We Expect?

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Introduction: The translabyrinthine approach to the inner ear canal is still significant to reach pathologies located in this region. However we have to accept the hearing loss on that side as a result of this procedure with corresponding limitation in quality of life. If the cochlear nerve could be anatomically preserved the possibility is given to provide the patient with a cochlear implant. Nonetheless there is still an uncertainty in the assessment of the physiologic function of the hearing nerve and the stability in long term stimulation after CI. As well we have to face the potential risk of obliteration of the cochlea. Meanwhile we overlook a time-period of 6 years in the individual treatment of these patients. We will present our long-term results and concept of treatment.

Objective: Aim of the study is to report about long-term results of patients provided with a cochlear implant suffering from single side deafness after translabyrinthine resection of tumours of the inner ear canal.

Methods: A retrospective chart analysis has been carried out for 11 patients who received an ipsilateral CI after resection of a tumour in the inner ear canal. The parameters of the evaluation were results of monosyllabic speech-test, sentence tests in noise (OLSA), neural response telemetry, promontory test, postoperative E-BERA results and stability of stimulation of the CI.

Results: Long-term outcomes are available of by now 9 patients. The observation period is in average >42 months months postoperatively. Intraoperatively we identified 10 Patient with positive neural responses due to the use of telemetry of the implant system. So far we are able to detect reproducible E-BERA responses in 5 patients postoperative. Six out of 10 implanted ears achieved a monosyllabic word understanding of more than 50%, likewise an improvement of understanding in noise of more than 2dB was found in 4 patients.
Conclusion: In conclusion referring to our experience we evaluate the possibility of a cochlea implantation positive for patients with anatomical preserved cochlear nerve after translabyrinthine approach to the inner ear canal. Indeed there still remains an uncertainty in the assessment of the physiologic function of the hearing nerve. Intraoperative measured action potentials e.g. from the E-BERA could have the future potential to provide the surgeon with better information for a cochlear implantation. Until then a positive promontory test will support the decision for a cochlear implantation but it is first possible after surgery. In counselling the patient alternative solutions like CROS systems has to be offered as well. As only the CI will restore bilateral hearing and facing a potential risk of cochlea obliteration we recommend an early counselling of the patient best before treatment of the tumour of the inner ear canal.
Abstract Body:

**Introduction:** After years of experience, paediatric cochlear implantation is done routinely in reference centres. The benefits of early implantation are widely recognised nowadays, and therefore patients are being implanted at a younger and younger age. On numerous occasions patients suffer from related pathologies, which will require periodical Magnetic Resonance Imaging control studies throughout all their lives.

**Methods:** An analysis was made of the history of implanted patients and their most relevant related pathologies which will require periodical Magnetic Resonance Imaging controls. This analysis was carried out to determine if the above pathologies make up a relevant percentage, by which the importance of compatibility with Resonance Imaging studies will be established. We present a sample of cochlear implant patients who will need imaging studies for the follow up of their concomitant pathology in order to obtain the greatest amount of information within the safety requirements.

**Results:** In the only Catalonian public reference children’s and maternity hospital, among the main related pathologies which require routine controls in implanted patients, we find: congenital abnormalities (cysts, malformations of cortical development,...), acquired pathologies (meningitis, cytomegalovirus infection,...) and others (oncological cases, prematurity...).

**Conclusion:** The analysis of paediatric patients implanted in our hospital shows that a sufficient number of pathologies exists that may require Magnetic Resonance studies throughout the patients’ lives. There are also enough patients with these pathologies, whereby we can establish that the compatibility between cochlear implants and these imaging techniques are a fundamental factor to consider. So, without this compatibility, the success of the implantation could be compromised, because its long-term continuity cannot be assured if there is a conflict with the monitoring of the related pathologies. Therefore, we can conclude that the study
advocates the real and current necessity of the compatibility between cochlear implants and Magnetic Resonance scanners in the paediatric population.
Introduction: Otosclerosis is a disease of the endochondral bone of the otic capsule. The most common localization is the fissula ante fenestram anterior to the oval window. The disease may progress and thus lead to a destruction of the bony cochlea. In profound sensorineural hearing loss due to otosclerosis cochlear implantation is the most effective method for hearing rehabilitation.

Methods: Hearing outcome of 10 cochlear implanted patients (12 ears) with otosclerosis was measured using monosyllabic and polysyllabic words test after 3, 6, 12, and 24 months (Freiburger Sprachaudiogramm) as well as a sentence test (Oldenburger Satztest) and compared to a similar group with progressive hearing loss without signs of otosclerosis. Additionally CT-morphologic grade of otosclerosis was determined and intra- and postoperative development of NRT results were compared.

Results: There were no differences in the outcome of patients with otosclerosis and the control group regarding polysyllabic and monosyllabic words after 3, 6, 12, and 24 months (monosyllables in %: 50 (23,2) vs. 53,9 (26,6); 65 (26,2) vs. 60,5 (23,1); 64,4 (24,7) vs. 66,1 (18,4); 70,6 (21,7) vs. 68,3 (17,3) polysyllables in %: 95 (10) vs. 90,1 (26,7); 96,25 (9,9) vs. 93,3 (3,1); 98,75 (3,3) vs. 98,9 (2,8); 98,75 (3,3) vs. 100 (0)). Pertaining to the Oldenburger Sentence Test, patients with otosclerosis performed worse than the control group, though not statistically significant (5,15 dB (7,4) vs. -0,8dB (3,8); -1,7 dB (1,2) vs. -3 dB (1,3); -1,8 dB (1) vs. -2,5 dB (2); -2,7 dB (1,5) vs. -5,5 dB (1,3)).

There were six ears with otosclerosis grade 3 and 3 ears with otosclerosis grade 2C. For grade 1, 2A, and 2B only one case each could be found. With regard to monosyllabic word test, patients with otosclerosis grade 3 performed worse than patients with otosclerosis grade 2C (46,25 % (31,2) vs. 67,5% (17,7); 61,25% (31,5) vs. 90% (0); 61,25% (24,9) vs. 92,5% (10,6); 73,75% (19,79 vs. 90% (7,1)), however the small number doesn’t allow a real statistic evaluation.

Conclusion: Otosclerosis usually leads to conductive hearing loss, but a small percentage suffers from profound sensorineural hearing loss. It has been previously described that patients with otosclerosis show similar results after cochlear implantation compared to patients with deafness of other etiologies. We as well saw similar results regarding monosyllabic and polysyllabic words.
though a slight difference in the sentence test. Patients with grade 3 otosclerosis seem to perform slightly worse compared to grade 2C patients.
Long-Term Results with Active Middle Ear Implants in Sensorineural Hearing Loss

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Introduction
Active middle ear implants (AMEI) are indicated for patients with sensorineural hearing loss (SNHL) who do not benefit from conventional hearing aids (HA). Previous studies reported improvements in overall sound quality and better speech recognition scores with AMEI as compared with conventional HA. Regarding to these devices, it is also mandatory to demonstrate the stability at the patient’s performance over time.

Objective
The aim is to evaluate the long-term threshold level and speech discrimination results in our patients with mild to severe down-sloping SNHL who received AMEI Vibrant SOUNDBRIDGE (VSB).

Methods
20 patients with stable SNHL fitting all the audiologic criteria were included in the study. In 3 patients VSB was sequentially implanted. Pre- and postoperative assessments of hearing thresholds and speech reception thresholds (SRT) were compared, in the unaided and the VSB-aided solution.

Results
23 VSB were implanted in 20 patients, with an average of 30 months of follow up, with a maximum of 64 months and a minimum of
11 months. Results pre and post-operative with unilateral and bilateral VSB are shown.
Pre-operative hearing threshold was 53.2 dB; average SRT pre-operative was 51.6 dB.
Post-operative hearing threshold was 33.75 dB in unilateral implants and bilateral implants presenting a post-operative hearing threshold of 32.3 dB, after both implants.
Average post-operative SRT was 33.3 dB. In unilateral implants SRT was 35.6 dB and an improvement in speech discrimination with bilateral implantation was noticed with a SRT of 30.7 dB.

Conclusion
For patients who do not benefit from HA, AMEI constitute an excellent solution. Bilateral results, although in a small number of patients, are encouraging.
**Introduction:** Loudness scaling procedure in the ASSE software implies the presentation of narrow band noise of 250 Hz, 1000 Hz and 4000 Hz at different intensities and can be used as a fitting assistant with cochlear implant (CI) users. Stimulus are presented at least twice at each presentation level, and the subject is required to indicate loudness using a seven-point visual-analogue scale, ranging from ‘inaudible’ to ‘too loud’. A loudness index is calculated for each test, which is the RMS-value (root mean square) of the score compared to the average score at the same intensity in normal hearing subjects. The average RMS in hearing listeners is 0 with a 95% confidence interval of -0.8 to +0.8 (Vaerenberg et al., 2010).

The objective of study was to analyse whether there is a correlation between the loudness scores and the thresholds (T) and/or Comfort (C) and/or dynamic range (DR) levels before and after fitting in cochlear implant users with post and pre lingual deafness.

**Methods:** Adult cochlear implant users of the same CI device with at least 12 months of CI experience were selected. Two groups were created with pre and post lingual deafness. The patients underwent loudness test with the map in use, and then a new map with the retest levels of T and C were created. Loudness scores were compared to the change in stimulation level at the correspondent electrode between the map at which the test was performed and the retest map in the same fitting session. The results were statistically analyzed with Spearman correlation.

**Results:** The analysis of 250 Hz loudness showed that all of the post (n=16) and pre (n=13) lingual deafness adult patients, except one pre-lingual, showed a negative loudness score, with no correlation with the T or C level, nor with the DR, before or after the map changes. At 1000 Hz, very few (19.2%) of the post-lingual (n=26) deafness adult patients showed a negative loudness score, with a statistical significant correlation only with the T and C level, before and after the map changes. The higher the loudness scores...
the lower the T and C levels. This fact may suggest that not only the current itself induces the loudness growth. In the group of pre-lingual deafness (n=27) there were no statistical significant correlation at 1000 Hz. At 4000 Hz, there was a statistically significant correlation only with the C level in pos-lingual group (n = 23), before and after the map changes. There was no statistical correlation in the group of pre-lingual deafness (n = 18).

**Conclusion:** Loudness scaling showed statistical correlation with T and C levels in the group of post-lingual, but not at all frequencies. In the pre-lingual group no correlation between the stimulation levels and the loudness score was found suggesting that other factors affect the loudness other than the current levels.
Abstract:

Introduction: Nowadays the conductive, sensorineural and mixed hearing loss associated with medical problems can be treated using middle ear semi-implantable prosthesis with very successful results. One of these implant systems is VIBRANT SOUNDBRIDGE. The new technology implemented in the internal parts, combined with the state-of-the-art signal processing used in the audio processor (external part), allow more surgical possibilities and better results in complicated listening conditions.

Methods: 10 subjects adults with sensorineural, conductive and mixed hearing loss implanted unilaterally with VIBRANT SOUNDBRIDGE in the poorer hearing ear are evaluated. They experienced with the older audio processor Amadé ranged from 2 to 50 months. Each subject served as his or her own control. These subjects tried the new audio processor SAMBA for a time, enough to compare between both devices. Functional gain and speech discrimination in silent and noise, using different signal to noise ratio, were tested with both audio processors, SAMBA and Amadé, also the comfortability and the easy-to-use was compared.

Results: The average of the functional gain obtained with the Amadé was 37 dB and with the SAMBA was 34 Db. The average of the speech discrimination @65dB with Amadé was 71% +/-30 and with SAMBA was 76% +/-27 . When the signal to noise ratio was 0, the Amadé obtained 50% +/-33 and SAMBA 55 +/- 33. When the signal to noise ratio was -5 the average of the results was 29% +/-27 for Amadé and 34 +/-30 for SAMBA.

Conclusion: The active middle ear implant VIBRANT SOUNDBRIDGE is an effective method of hearing restoration for sensorineural, mixed and conductive hearing loss for the majority of the subjects. The semi-implantable technology allows to update the state-of-the-art signal processing without exchanging the internal part.
Introduction: The indications for Vibrant Soundbridge include sensorineural hearing loss with normal ossicles, conductive and mixed hearing loss in cases after radical modified operations with presence of remnants of the ossicles, also in cases of chronic adhesive otitis media or even severe otosclerosis. Recently the middle ear implants has become also the alternative in the treatment of hearing impairment in congenital deformations of external and middle ears in children.

Methods: The objective of the study was to specify the indications and analyze results obtained after surgical treatment of hearing impairment with use of Vibrant Soundbridge system in children with congenital ear deformations.

Results: We selected a group of children and adolescents below 18 years of age with congenital deformations of the external and middle ears. Middle ear implant Vibrant Soundbridge was used as the method of hearing improvement. Surgical technique included posterior atticotomy. Various methods of fixation of the FMT were used but mostly the fixation of the FMT on the remnants of the ossicles without removing any of them. VSB implantation was preceded by auricle reconstruction or in some cases was the first and only surgical procedure.

Conclusion: The benefits of Vibrant Soundbridge use are significant. We did not observe serious surgical complications. Short and long-term hearing results in the cases of congenital deformations of the external and middle ears are very encouraging.
Control Number: 2016-A-438-ACI

Session Number: POS01

Session Title: Poster Session A

Poster Board Number: 114-A

Topic 1: 02b-Medical/Surgical Issues

Publishing Title: Vibrant Soundbridge: Round Window Direct Stimulation

Author Block: Henryk Skarzynski, Prof., MD, PhD, Andrzej Pastuszak, MD, Lukasz Olszewski, MSc, Marek Porowski, MD, PhD, Piotr H. Skarzynski, Ass. Prof., MD, PhD; World Hearing Center, Inst. of Physiology and Pathology of Hearing, Warsaw, Poland.

Abstract Body:

Introduction: Middle ear implant Vibrant Soundbridge was originally designed to treat patients with mild and severe sensorineural hearing loss. Round window application of vibrant soundbridge, where FMT is directly placed in the round window, is a quite new method of treatment of conductive or mixed hearing loss. Otological etiologies of patients selected for this study included complications concerning chronic otitis media, cholesteatoma, and ossicular malformation. This study was performed to investigate the effects of placing the FMT on the round window’s middle ear.

Methods: Our study refers to all cases of FMT placing on the round window. Such implantations have been performed in the Institute of Physiology and Pathology of Hearing in Kajetany in Poland since 2003. Analyzes focused on the results of the pure tone audiometry at 0.5, 1, 2 and 4kHz before and after the surgery, and the speech audiometry one month after the activation of the speech processor. Intraoperative and postoperative complications were also analyzed.

Results: Functional hearing results using the Soundbridge were improved with all patients (speech in quiet and speech in noise were compared with preoperative scores).

Conclusion: Our results show that round window direct stimulation using the FMT is a safe option for treating moderate hearing loss. It is a good alternative for patients who would not tolerate traditional hearing aids and bone hearing aids. To evaluate the long-term outcomes of this kind of FMT’s placement we have to wait, but this solution seems to be remarkable. No complications were observed.
On the Perceptual Dimensions of Pitch in Cochlear Implant Users

Wiebke Lamping, PhD student, Sébastien Santurette, Assistant Professor, Jeremy Marozeau, Associate Professor; DTU Elektro, Technical Univ. of Denmark, Kgs. Lyngby, Denmark.

Abstract Body:

Introduction: Pitch plays an important role when defining and differentiating our acoustic environment. Although human listeners perform remarkably well in discriminating and ranking pitch, this task remains difficult for cochlear implant users. Although it has been shown that a change in electrode place, pulse rate, or amplitude modulation frequency can induce a pitch-like sensation that can be ranked from low to high, multidimensional scaling experiments have indicated that these parameters are most likely perceived on different perceptual dimensions. The aim of the present study was to clarify whether and how these perceptual dimensions can be described by using verbal attributes.

Methods: The perceptual dimensions evoked by the variation of different physical parameters were investigated in cochlear implant recipients. Participants were asked to rate the sensation induced by two sets of stimuli on multiple scales delimited by opposite attributes such as low/high, soft/loud, bright/dark, simple/complex, or dull/sharp. Amplitude modulated biphasic pulse trains were presented on a single electrode. The activated electrode, the pulse rate, and the frequency of the amplitude modulation were varied across stimuli. One set of loudness balanced stimuli was created by random combinations of electrode number and pulse rate and with no amplitude modulation. A second stimulus set was created similarly for electrode number and amplitude modulation frequency with a constant pulse rate. The pulse rate was varied from 80 to 300 pulses-per-second, the electrode varied from the most apical (# 22) to the middle region (# 11), and the amplitude modulation frequency from 80 to 300 Hz. Listeners’ ratings were analyzed with principal component analysis to extract the main perceptual dimensions and their corresponding attributes.

Results: Preliminary data suggest that a change in electrode number is not necessarily correlated with a change in the low/high sensation. Ratings that varied more consistently with electrode number were found for other attribute pairs, e.g., lively/dead or simple/complex which indicates that the sensation elicited by changing the place of excitation might not be sufficiently described by pitch.
Conclusion: These results are in agreement with previous suggestions that altering the electrode place is rather perceived as a change in timbre. Describing and defining the sensations evoked by each of the physical parameters above may provide constraints to future stimulation methods aiming to improve perceptual attributes in cochlear implant users.
Introduction: For the past few years cochlear implantation has been considered a treatment option for patients with single-sided deafness to provide the benefits of binaural hearing including improved speech perception in background noise and localization abilities. However, there are a number of challenges both anticipated and unanticipated which require consideration.

Objective: To examine the challenges of cochlear implantation in pediatric patients with single-sided deafness.

Methods: To date, 12 pediatric patients with SSD have been evaluated for cochlear implant candidacy. Five patients have been implanted, four with the Nucleus device (2 Freedom CA, 2 CI512 Profile) and one patient with the Advanced Bionics device (90Kj Advantage). Age at implantation ranged from 1 year, 2 months to 9 years, 6 months. Four patients presented with normal to borderline normal hearing in the non-implanted ear and one patient presented with a mild hearing loss rising to normal hearing sloping to a severe hearing loss in the non-implanted ear. Etiologies were reported to be enlarged vestibular aqueduct with Pendred Syndrome, Connexin 26, enlarged cochlea and unknown etiology for two patients. Pre-operative testing was performed using Phonak Naida hearing aids, Phonak CROS system or BAHA soft band. A plug and muff technique was used when testing the ear to be implanted in order to limit the effects of binaural input. Post-implant testing was performed using plug and muff technique, direct-connect testing and testing via the mini mic for Nucleus patients. Four patients were denied by insurance and are undergoing an appeals process. Three patients were deemed not to be candidates for cochlear implant surgery due to hypoplastic VIII nerve findings on MRI.

Results: All patients had full insertion of the electrode arrays and there were no postoperative complications. One patient wears the device all day, three wear the processor part of the day and one has discontinued use after 1 year of inconsistent usage. For the three subjects who can perform speech perception testing, all demonstrated open-set speech perception in the implanted ear and bilateral improvement in background noise. The two youngest subjects demonstrated detection of all Ling sounds. Challenges which
have arisen in this population of cochlear implant candidates fall into a number of categories. They include 1) Pre-implant considerations: age at implantation, etiology, radiologic findings, insurance approval 2) Evaluation considerations: minimizing effects of the better hearing ear via plug and muff, direct connect or mini mic, testing in noise, parental report, localization set-up, test anxiety 3) Programming: comfort levels balanced with better hearing ear, accurate threshold levels, pitch balancing 4) Psycho-social, educational and rehabilitative: consistent device usage, speech and language delays, auditory training of implanted ear, behavioral issues in school, socialization with family and peers.

**Conclusions:** Cochlear implantation can provide improvements in open-set word and sentence recognition unilaterally and binaurally in children who present with single-sided deafness. However, these improvements do not occur without challenges which require on-going counseling, creative programming and evaluation techniques. These issues should be acknowledged and discussed with the families prior to implantation in order to avoid disappointment leading to non-usage.
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Noise Trauma and Systemic Application of a Selective Glucocorticoid Receptor Modulator

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Abstract Body:

Introduction: Even though the mechanisms of action are still poorly understood, glucocorticoids are used for the treatment of many otological disorders like sudden hearing loss or cochlear implant insertion trauma. Selective glucocorticoid receptor modulators represent a novel class of drugs with the potential to reduce side effects whilst showing a pharmacological potency similar to glucocorticoids. The objective of this study was to compare a selective glucocorticoid receptor modulator, namely compound A, to the potent glucocorticoid dexamethasone in a guinea pig model of noise trauma.

Methods: 40 pigmented guinea pigs were divided into four groups of equal size, which were intraperitoneally injected once daily for ten consecutive days. The administered treatments included compound A (1mg/kg or 3mg/kg), dexamethasone (1mg/kg) and water for injection as negative control. Animals were exposed to broadband noise (8-16kHz, 115dB) for 3 hours to cause the noise trauma. Noise exposure was performed directly after the 5\textsuperscript{th} intraperitoneal injection. Auditory brainstem responses were measured a week prior to and directly after the trauma as well as on days 1, 3, 7, 14, 21 and 28. After the last audiometry animals were sacrificed and ears were analyzed as cochlear whole-mounts or after embedding and sectioning.

Results: Compound A failed to preserve auditory thresholds after noise exposure. No statistically significant difference to the control group was found. The histological data confirmed the physiological data.

Conclusion: The presented work did not show otoprotective effects of the selective glucocorticoid receptor modulator compound A. Even though other compounds of this class merit evaluation for potential otoprotective effects, for the moment classic
glucocorticoids will stay the mainstay of pharmaceutical inner ear therapy for conditions like sudden hearing loss, noise trauma or electrode insertion trauma.
Introduction:

This presentation shows preliminary results of a prospective study on cognitive development undertaken in four groups of children (NH, moderate, severe-to-profound, profound/CI).

Methods:

The cohort was divided in one control group and three groups of children with hearing impairment: control group (CG), children with mild-to-moderate hearing loss using hearing aids (G1), children with severe-to-profound hearing loss using hearing aids (G2) and children using a cochlear implant (G3). The study consists of three major test phases: Test phase I was performed with the Bayley Scales of Infant and Toddler Development (Bayley 2006b, 2006a). Test phase II started in 2014 with data acquisition four (T4) and is continuing. The testing tool is the Kaufmann Assessment Battery for Children (K-ABC) (Kaufmann A et al. 1983). It is a test of sequential, simultaneous processing and mental processing scale (100 ± 15). The Test Battery is appropriate for the use in children who range in the age from 2 ½ and 12 ½ years. For analysis nonparametric tests and descriptive statistics with the SPSS Version 22 were used.
Results:

These preliminary results were administered in 61 children. Between phase I and phase II it turned out that seven children of the original in G2 received a cochlear implant. Therefore the group of severe-to-profound consists presently of 2 subjects. The control group consisted of 18 children (CG n=18); the mild-to-moderate group (G1) of seven (n=7); the severe-to-profound group (G2) of two (n=2) and the severe-to-profound group with CI (G3) of 34 children (n=34). The K-ABC was tested at a mean value of 67.2 months (± 7.7 SD) in CG, 69 months (± 9 SD) in G1, 65 months (± 2.8 SD) in G2 and 74.2 months (± 11.5 SD) in G3.

Sequential processing scale (SEPS)
The mean value of the SEPS in CG is 103.7 (min. 80, max. 121), in G1 95.3 (min. 82, max. 107), in G2 95.5 (min. 86, max. 105) and G3 90.6 (min. 56, max. 121).

Simultaneous processing scale (SIMPS)
The mean value of the SIMPS in CG is 105.8 (min. 80, max. 124), in G1 103.8 (min. 66, max. 119), in G2 102 (min. 100, max. 104) and G3 97.8 (min. 63, max 129).

Mental processing composite (MPC)
The mean value of MPC in CG is 104.3 (min. 80, max. 116), in G1 100.7 (min. 75, max. 109), in G2 98.5 (min. 93, max. 104) and G3 94.4 (min. 62, max 121).

Due to the heterogeneous pairs of the groups the calibration of significance at this stage is not recommended. However the descriptive data showed that 11.4 % subjects scored below the first standard deviation. The percentage of scores below the first standard deviation (≤ 85) is higher in G3 in comparison to CG and G1.

Conclusion:

The descriptive comparison between the groups indicated that the majority of the groups CG, G1 and G2 had a mental processing composite score within average. The incidence for higher risk of learning disability could occur in the group of severe-to-profound children with CI. There is a strong need of more detailed analysis including educational factors in the future.
Introduction: The objective of the study was to connect two otosurgical procedures in one - obliteration radical mastoid cavity with bioactive glass S53P4 (SiO2 53%, Na2O 23%, CaO 20%, P2O5 4%) and Bonebridge implantation.

Methods: Procedure was performed in two patients with mixed and conductive hearing loss due to cholesteatoma. Both patients had radical modified surgery performed. Surgical procedure started with the work on radical cavity and its partial obliteration. Then a Bonebridge device was implanted.

Results: There are no contraindications to perform this kind of procedure as a one stage surgery to achieve satisfactory audiological results. From audiological perspective the bone gap was closed in frequencies above 1000. In 500 the gap was less then 15 dB. There were no surgical complications. In one case there was a need for to change the magnet for the stronger one.

Conclusion: This kind of surgery is recommended in cases of patients when there is no other effective treatment that can be applied. The treatment is more effective in cases of high frequency hearing loss than low frequency hearing loss.
Hearing Implantable Technologies for Beethoven's Deafness: Could These Devices Have Improved His Music Composing?

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Introduction: Beethoven’s music has turned out to be fascinating for humanity while the origin of his deafness remains unclear in spite of the scientific information at hand. Cochlear implants and other implantable devices currently available offer a solution for most problems related with hearing, including those for the great genius.

Methods: We have done a scientific literature review to determine the most accurate possible origin for Beethoven’s deafness as well as to establish indications for the different implantable devices to assess which of these should have been the best for the composer taking into count the repercussions in his music composing.

Results: Throughout time the diagnosis for Beethoven has changed radically including conductive and sensorial deafness, having these two a solution in the present. For many scientists the greatness of his compositions is due to his hearing impairment leading us to believe that if we had intervene improving his hearing he would have never created some of the most beautiful music in the world.

Conclusion: The information that can be obtained from the result of the autopsy of Beethoven, as well as from the letters he wrote and the most recent scientific research allows us to have a diagnosis if not very certain, close to what it was. Thus, his hearing could have been improved with the present technology. However, given the little experience in the evaluation of musical perception in receiving patients for cochlear implants or other implantable devices, the repercussions of these solutions in his music composing will be impossible to determine.
Introduction: Mutations in SLC26A4 gene are believed to account for approximately 5% of all cases of recessive genetic deafness. These mutations can result in both syndromic and non-syndromic forms of deafness: the Pendred syndrome and DFNB4 hearing loss, respectively. The aim of this study was to determine the prevalence of SLC26A4 mutations in a cohort of hearing-impaired patients in Germany.

Methods: To further characterize the prevalence of these mutations in our cohort, direct sequencing of exons 6 (p.Leu236Pro), 8 (c.1001+G>A, VS8+1G>A) and 10 (p.Thr416Pro) along with the flanking introns of the SLC26A4 gene was performed for 390 hearing-impaired patients in our cochlear implant program. Patients also underwent either multidetector or cone-beam CT scanning during their clinical work up.

Results: One percent (n = 4) of patients were found to have homozygote mutant status, as well as an additional 1.3% (n = 5) who were compound heterozygotes for mutant alleles. Eleven (11) further patients (2.8%) were simple heterozygotes. As such 2.3% (n = 9) of the total cohort were revealed to have a genetic cause for the observed hearing loss. All of those with biallelic mutations displayed an enlarged ventricular aqueduct (EVA). Surprisingly, 63.6% (n = 7/11) of the simple heterozygotes were also found to have an EVA. This can be contrasted with only 4.4% (n = 15 / 344) of the homozygote wild types for whom CT scans were available. Mutations of all configurations, be it homozygotes, compound heterozygotes and also simple heterozygotes were strongly associated with the presence of an enlarged ventricular aqueduct.

Conclusion: The results of this survey show SLC26A4 to be responsible for a significant proportion of the hearing loss in our cohort, and as such support the screening of patients with early-onset sensorineural hearing loss.
**Abstract Body:**

**Introduction:** Tonotopic organization, which relates place to pitch inside the cochlea and extends to the cortex, has shown to be of great importance in auditory perception. Therefore the position of Cochlear Implant (CI) electrodes is important for the perception of pitch. It is hypothesized that when electrical stimulation more closely matches the natural tonotopic organization, this might lead to better hearing results and sound quality for CI-patients.

**Objective:**
To improve the estimation of the pitch perceived by CI recipients using accurate three dimensional (3D) image analysis of cochlear electrode position.

**Methods:** Electrode contacts of the CI were marked on a Cone-Beam CT-scan in 3D space in relation to the nearest point on the cochlear lateral wall. Distance to the base of the lateral wall was calculated and plotted against the place-pitch function for humans. An adaptive procedure was used to elicit the perceived pitch of electrically evoked stimulation by matching it with a contralateral acoustic pitch.

**Results:** The electrically evoked pitch percept matched well with the 3D imaging based frequency calculation.

**Conclusion:** We describe a method of improved image analysis which can be used to predict the pitch perception on corresponding cochlear electrode positions. This method shows the potential of 3D imaging for CI fitting optimization and could prove to be
of special interest when fitting patients with residual and binaural hearing.
Abstract Body:

**Introduction:** Dual-microphone beamformers have been shown to be effective in improving Cochlear Implant users ability to hear in noise. These beamformers use the front and rear microphones on a single sound processor to create a first order beamformer. Proprietary technology to stream audio input wirelessly between a bilateral CI listener’s two sound processors in real time allows for creation of a four-microphone (two on each sound processor) focused beamformer. The resultant third-order front facing beam is sharper and therefore, should further facilitate face-to-face conversations in challenging situations. It is important to evaluate the effectiveness of such technology in improving speech understanding when speech arrives from front and also to understand its effect on speech arriving from other directions. This will help counsel listeners regarding appropriate use cases and orientation with respect to signal of interest.

**Objective:** The specific aim of this study was to evaluate and compare speech understanding in diffuse noise with the four-microphone focused beamformer and an in-the-ear omni-directional microphone when speech is presented from the following source locations: 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315°.

**Methods:** Subjects were users of bilateral Naida CI Q90 sound processors. Speech understanding in noise was measured using sentences from the Hearing in Noise Test (HINT; Nilsson et al., 1994). Sentences were presented in adaptive fashion to find 50% correct performance for each degree of azimuth. Noise was presented from each speaker of the R-SPACE eight-speaker array at 60 dB SPL(A). Participants were tested bilaterally in two conditions: omni-directional microphone and focused beamformer.

**Results:** Results were in agreement with the polar plot of the four-microphone focused beamformer such that speech understanding in noise was significantly better when speech was located in the front.

**Conclusion:** Results have direct implications for counseling patients towards expectations and use of directional microphone technology.
Introduction: Cochlear implant (CI) surgical planning is still mostly linked to cochlear access, as intracochlear structures precise visualization is challenging with current clinical imaging techniques. Moreover, postoperative electrode-array position, with respect to scala tympani (ST) and scala vestibuli (SV), is difficult to estimate with clinical postoperative imaging.

The aim of this study is firstly to define an accurate shape model of the intracochlear anatomy with anatomical prior learned from temporal bones high-resolution images in order to infer the detailed anatomy from a clinical computed tomography (CT). A second objective is to combine this model with image processing methods to assess the position of the CI electrode-array using pre- and postoperative clinical CT image fusion.

Methods: A new parametric shape model was designed. It consists of parametric surfaces of the ST, the SV and the scala media (SM) merged, the whole included in a model of a cochlea. Special attention was paid to model realistically the cross-sections and the longitudinal component of the centerlines as a function of the insertion depth. The model was validated on nine manually segmented high-resolution micro-CT images. The parameters probability distributions were estimated from the micro-CT database, which provides a generative model. The parameters of the shape model and its position were fit to the data observable in six clinical preoperative CT with manual initialization. CI electrode was segmented in the corresponding postoperative CT using intensity-based segmentation techniques. Fusion of preoperative and postoperative CT was performed to assess the position of the electrode with respect to the intracochlear cavities and the basilar membrane.

Results: The shape model defines 22 parameters and their probability distribution. The parameters are anatomically meaningful (e.g. number of cochlear turn, logarithmic spiral pitch, centerline radial origin, longitudinal slope, amplitude of corrective term, cross-sectional parameters, etc.). The fitting error which quantifies how much the fitted model deviates from high-resolution
Segmentations is on average below 0.1 mm. Postoperative electrode-array position could be estimated from clinical CT images.

**Conclusion:** An anatomically realistic cochlear model was designed. Using shape prior and medical image processing techniques, the cochlear implant electrode-array position can be estimated relative to intracochlear anatomy. These results open doors for electrode insertion surgical planning where critical factors such as electrode-array length, insertion depth, round window or cochleostomy insertion can be optimized. Similarly, the postoperative electrode-array position can be used for post-implantation diagnosis. In future research, histological data from cadaveric studies will be used to validate this model.
Introduction: The time point of cochlea implantation is of utmost importance for the children’s intellectual and social development. Language acquisition and communication are substantially influenced by the implantation. Given the background of a mandatory inclusion of children with physical and mental deficits in Germany, we focused in this study, whether the time point of implantation and the period of deafness influence the children’s school and social career.

Methods: 180 children and adolescents who underwent uni- or bilateral cochlear implantation at the age of 1 to 17 years were included. Surgery was performed at a single German Cochlea Implant Center between 2000 and 2013. Subjective impressions of parents and teachers, as well as objective criteria like educational facilities or school performance for evaluation of the childrens’ development were analyzed by questionnaires. Reason and period of deafness were included in the plotting process.

Results: The average age of implantation was at 5.5 years (SD = 4.5), with more than 57% of children being younger than four years of age at the time of surgery. Altogether, a short period of deafness and an early and bilateral implantation had a positive impact on the childrens’ school and social career.

Conclusion: The positive influence of an early cochlea implantation on childrens’ development essentially supports their capabilities and performance and thereby allows an improved inclusion at school and in everyday life.
Abstract Body:

Introduction: Spatial coding and spectral resolution are still providing major investigations for improving coding strategies of cochlear implants (CI). Indeed, stimulation mode, pulse shape, and grounding schemes yield from moderate to important effects on spread of excitation, electrode discriminability and nerve activation focusing. Even if traditional clinical studies can be conducted, the use of clinical stimulation interfaces provides inherent limitations and, for obvious ethical reasons, it only allows to collect a limited number of data. The aim of this study is two-fold. First, it allows the presentation of a chronic animal CI model stimulated with a dedicated animal stimulation platform (ASP). Second, it presents comparative data on two different approaches to code loudness: by modulating either pulse-amplitude or pulse-duration. Those two strategies were compared by recording and quantifying the electrically evoked compound action potential (eCAP) and electrically evoked auditory brainstem responses (eABR) collected in chronically implanted guinea pigs. These physiological measurements were collected from 1 week to 4 months post-implantation.

Methods: Dedicated electrode-arrays, connectors and ASP were developed. Six tricolor guinea pigs, aged from nine months to two years, were chronically implanted with these electrode-arrays (4 electrodes inserted) and the connector was secured on the head of the animal using dental cement. After a week of recovery, eCAPs and eABRs were tested once a week on animals under isoflurane anesthesia. During each session, measurements were done for 20 increments either in pulse-amplitude and pulse-duration, which provided a large overlapped in terms of total amount of delivered current. Amplitudes and latencies of different eCAP and eABR waves were automatically analyzed. ABR were also used to quantify the hearing loss due to the implantation. Animal’s weight and scars were regularly checked to detect any infection and/or health issue.

Results: No significant health problems was detected with the implant or the electrical stimulation on these animals. It was found that amplitude and duration loudness coding strategies generated similar values of eCAP thresholds, latencies and maximum
amplitudes. On average, this was also the case for the different eABR waves. However, eCAP and eABR growth functions expressed in pulse charge shown different patterns in function of the strategy (pulse amplitude or duration variations) consistently across subjects and across time after implantation. Particularly, duration increment showed steeper eABR and eCAP growth functions than amplitude increment.

**Conclusion:** The procedure is robust and adapted for chronic studies, and the ASP provided an efficient way to measure animal’s eCAPs and eABRs and lead to a first experimental application. These results suggest that the pulse duration loudness coding is a valuable strategy to mimic a growing sound level. These data will be further discussed with regard to spread of excitation limitation, nerve recruitment efficiency and available dynamic range using pulse duration. Furthermore, the ASP will be further used for collection of eCAPs and eABRs to investigate spectral resolution by stimulating with different stimulation shape and mode and for collection of cortical responses.
Patterns of Electrophonic and Electroneural Excitation

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Abstract Body:

Introduction: Electroacoustic stimulation in subjects with residual hearing is becoming more widely used in clinical practice. However, little is known about the properties of electrically induced responses in the hearing cochlea. The present study investigated the patterns of excitation in the inferior colliculus (IC) with electrical stimulation of hearing and deafened cochleae to identify the locations where electrophonic and electroneural responses are generated.

Methods: Cochlear implantation was performed through a cochleostomy in normal hearing guinea pigs under general anesthesia. A Neuronexus double-shank 32-channel electrode array was stereotactically placed in the contralateral side of the inferior colliculus parallel to the tonotopic axis. The electric stimuli were charge-balanced biphasic electric pulses, 100µs/phase. Thresholds, firing rates and dynamic ranges were determined from unit activity recorded in the midbrain and was related to the acoustic characteristic frequency (CF) of the unit. The cochlea was subsequently deafened with the implant left in place and the stimulation was repeated in the deaf condition. The response patterns to electrical stimuli before and after deafening were compared.

Results: Cochlear implant was not acutely harmful for normal hearing. Acoustic stimulation revealed an ordered frequency representation along the shanks of the electrode arrays, covering CFs in the range of 1 - 32 kHz. In hearing cochleae, two spots of activity were observed: one at low CFs (~ 5 kHz) and one at high CFs (> 9 kHz). After deafening, the thresholds of electrical stimulation increased and the electrical dynamic range decreased significantly. Most extensive changes were observed in the low CF region. Moreover, with sinusoidal electrical stimuli, the apical excitation shifted with changing frequency of the electrical stimulus, the basal one corresponded to the place of the stimulating electrode in the cochlea.

Conclusion: The low threshold, the large dynamic range and the change with deafening suggest that the low CF response was predominantly hair-cell mediated (electrophonic). This electrophonic response appeared at the dominant frequency of the electrical stimulus. A direct neural response with higher thresholds, small dynamic range and less change after deafening was observed in the
CF region >9kHz. Consequently, electrical stimulation of a hearing cochlea results in two spatially separate regions of electrophonic and electroneural activation. Bipolar stimulation revealed that the electrophonic response is more effectively generated if the stimulating electrodes are more apical. In monopolar stimulation differences in properties of the two stimulation sites were less pronounced than in bipolar stimulation.
Within-Subjects Comparison of the Effects of Bimodal Versus Bilateral CI Listening, Binaural Versus Monaural Listening, Reverberation, and Fine-Structure Versus Envelope-Only Strategy on Speech Reception in Quiet

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Abstract Body:

Introduction: Hearing with two ears yields binaural summation benefits in quiet and is 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) or bilateral CIs. Hearing aids can provide beneficial access to waveform fine-structure, but some current CI processors also provide strategies that capture this information. The study objectives were to assess, within-subjects, the effects of bimodal versus bilateral CI listening, binaural versus monaural listening, reverberation, and fine-structure versus envelope-only strategy on speech reception in quiet.

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) in quiet under a variety of listening conditions 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 level yielding 50% correct performance) were estimated using the mean of two 20-sentence SRTs in all eight possible combinations of: listening mode (binaural or first-CI only); environment (low or high reverberation); and processor strategy WFS or ENV. Tests were conducted using the WFS and ENV strategies on successive days.

Results: Between the first (bimodal) and final (bilateral) post-implant test sessions, SRTs improved for both strategies by ~7 dB, averaged across listening modes and reverberation levels. Paralleling speech-in-noise results obtained as part of a larger study, this asymptote was reached more quickly with the WFS strategy (by the 12-month bimodal session) than with ENV (only by the 6-month bilateral session). Collapsed across strategies and listening modes, the transition from bimodal to bilateral CI use yielded a significant ~7 dB improvement in the high reverberation environment. Collapsed across processing strategies and reverberation conditions, a significant binaural benefit (binaural SRT better than first CI alone) was observed only at 12 months bilateral CI. Analyzed by
processing strategy, this binaural benefit was significant for ENV in the low reverberation condition and for WFS in the high reverberation condition.

**Conclusion:** For our patient population, bilateral CIs provided a significant benefit over bimodal listening, particularly in high reverberation. Versus first-Ci-alone, both strategies provided a binaural benefit, but only WFS provided that benefit in high reverberation. Asymptotic performance was reached more quickly with the WFS strategy that participants used in daily life.
Introduction: During the last decade it turned out that normal hearing on the contralateral side is not a contraindication for cochlear implantation and for each ear the optimum treatment has to be chosen. Concerning the ear which will be implanted, cochlear implants are required when conventional hearing aids do not allow for sufficient speech understanding. The definition of “sufficient” depends not only on the technology but on individual factors, too. Usually, extensive hearing aid trials with hearing aids of different types and quality were performed before cochlear implantation is performed. Until now, no clear criteria exist, which allows for decision whether hearing aids or cochlear implants will provide better speech understanding. Therefore, analyzing outcome data for hearing aids in subjects with different degrees of sensorineural hearing losses are necessary.

Methods: Audiometric measurements of 185 sensorineural hearing-impaired subjects were evaluated retrospectively. In particular, monosyllabic score at different levels and puretone loss were analyzed. The data were collected as a part of clinical routine for hearing aid performance assessment. All subjects had been supplied with hearing aids and had at least 3 months experience.

Results: Speech perception with hearing aids varied even for very similar puretone thresholds. With puretone thresholds above 50 dB the average recognition is worse with hearing aids than with cochlear implants.

Conclusion: By combining information from speech and puretone audiometry
hearing aid performance can be estimated. Therefore, an audiometric criterion can be derived which indicates that cochlear implantation is superior to acoustic amplification. This criterion is supported by comparing hearing related quality of life with conventional hearing aids and with cochlear implants as determined by several questionnaires (Oldenburg Inventory, Nijmegen Cochlear implant questionnaire, and Hearing Implant Sound Quality Index).
A Structured Training for Speech Understanding in Noise: Results of Experienced Cochlear Implant Users Confirm Effectiveness of Training

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Within-Subjects Comparison of the Effects of Bimodal Versus Bilateral CI Listening, Binaural Versus Monaural Listening, and Fine-Structure Versus Envelope-Only Strategy on Spatial Unmasking of Speech

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Introduction: Binaural hearing is 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) or bilateral CIs. Access to waveform fine-structure via a hearing aid or a CI processor with fine-structure encoding strategy 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, and fine-structure versus envelope-only strategy on spatial unmasking of speech (SUS).

Methods: 14 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) in the presence of speech-shaped noise under a variety of listening conditions 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 encoding 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) were estimated in all eight possible combinations of: listening mode (binaural or first-CI only); noise location (co-located with speech or separated by 90 degrees on the HA/second-CI side); and processor strategy (WFS or ENV). Speech was presented from the front, and the difference between the SRTs for co-located and spatially separated noise yielded the SUS score in dB. For 12 listeners tests were also conducted with spatially separated noise on the first-CI side with binaural or second-CI-only listening in the final two (bilateral) sessions. Tests were conducted using the WFS and ENV strategies on successive days.

Results: Across other factors, the WFS strategy yielded significantly greater SUS than did ENV (~1 dB more in bilateral-CI testing
sessions). Mean SUS actually decreased after the transition from bimodal to bilateral listening because the provision of the second CI more markedly improved SRTs for co-located noise than for separated noise. First-CI-only listening yielded lower SRTs and larger SUS than binaural/bimodal or binaural/bilateral listening until the final (bilateral-CI) testing session, for which they did not differ. This was a result of higher (worse) SRTs in binaural/separated conditions, and indicates that the ability to ignore noise on the HA/second-CI side developed gradually. In the final testing session (12 months bilateral), the reversed stimulus configuration (noise on first-CI side) yielded significantly (~1.8 dB) less SUS in binaural than in second-CI-only listening.

**Conclusion:** Bilateral CI listening yielded significantly better performance for co-located noise than did bimodal listening. Ability to disattend to noise on one side (and therefore to benefit from the better-ear effect) developed gradually for noise on the second-CI side, but more rapidly than for the noise on the first-CI side. No binaural (squelch) benefit for separated noise was observed. Overall, the WFS strategy provided more SUS than did the ENV strategy in each testing session.
Introduction: Evaluate academic attainment in a population of children over 10 years of cochlear implant use. Analyze the variables that influenced the subsequent performance.

Methods: We assessed the academic level in 50 children with pre-linguistic Hearing loss who received their Cochlear Implant (CI) between 1996 to 2004. All of them were using their CI for longer than 10 years, undergoing auditory treatment and developed Open Set performance. The evaluation method was conducted through personal interviews and questionnaires performance, age at surgery and years of use. Also the presence of associated disorders in programming language was assessed as well as if CI user was Unilateral, Bilateral or Bimodal.

Results: The analyzed sample consists of 50 children, 38 CI Unilateral, Bilateral Sequential CI 3 and 9 Bimodal (CI and contralateral hearing aid). The age at 1st CI surgery range 1 year 7 months to 11 years 2 months. Average: 6 years and 3 months. Years of using CI range 11 years to 19 years and 6 months. Mean: 15 years and 2 months. 7 children presented disorders in language processing, which included difficulty in attention, memory, in the acquisition of literacy, reading comprehension. These difficulties were overcome with specific speech therapy. The analysis of the achieved academic level was obtained by personal interviews and questionnaires about performance. All children completed Primary school. 23 children who received CI between 2 years old and 13 years old and 2 months completed Secondary level. The average age of implantation was 5 years and 10 months. The time of use of the device was between 11 years to 19 years and 6 months. Mean 15 years 3 months: All these children are Unilateral CI users. Tertiary studies were completed by 16 children. Age range to the first CI surgery: 1 year and 7 months to 11 years 2 months. Average: 4 years 7 months. Years of use of the device 11 years to 18 years 4 months. Average: 15 years 1 month. This group included 7 children who presented language associated disorders that was solved with specific treatment. 11 children of this group were
Unilateral CI users, 3 children with Sequential Bilateral CI and 2 children in Bimodal condition. University degree were obtained by 11 children. Age range at the first implantation: 3 years and 1 month to 11 years. Mean: 7 years and 1 month. Years of use of the device: 11 years 6 months to 17 years 7 months. Average: 15 years 2 months. In this group 7 children used Bimodal stimulation, and 4 children received their implant between 37 and 40 months old.

Discussion
When we compared the average age at surgery we found that for children who achieved Secondary level it was 5 years and 10 months. For those who achieved Tertiary education it was 4 years and 7 months. Whereas, those who went to University was 7 years and 1 month. The age at surgery was statistically significant only for the group of children with University degree compared with the other two groups.

Higher age at time of surgery in the latter group could be related to the presence of residual hearing and better language development before the surgery. These children are under Bimodal stimulation.

**Conclusion:** The best academic level obtained in the third group (University level) would be related to early intervention, stimulation of both auditory pathways and higher language level reached before CI surgery.

These results should be analyzed in a larger sample of patients for each group to confirm this hypothesis.
Abstract Body:

**Introduction:** Nowadays, by the expansion of selection criteria, Cochlear Implants seems to be the best solution to restore speech perception in noise, localization and tinnitus in Single Sided deafness (SSD) and Asymmetric Hearing Loss (AHL). Objectives: 1. To compare outcome rate in speech perception after cochlear implant, between patients with Single Sided Deafness, Asymmetric hearing loss and unilateral cochlear implant with bilateral hearing loss. All with similar deprivation time. 2. To investigate quality of life in both groups Single Sided Deafness and Asymmetric hearing loss.

**Methods:** In this retrospective study, we included 3 patients with Single Sided Deafness, 10 patients with Asymmetric hearing loss and 10 patients with bilateral hearing loss. All patients are between 18-50 years. We followed performance in speech perception measured with disyllabic words in open set (Latinoamerican Protocol), Quality of life was determined using two questionnaires (APHAB and SSQ). A visual analogue scale (VAS) and Tinnitus Handicap Questionnaire (THQ) were used to measure tinnitus. And for statistical analysis GraphPad Prism was applied.

**Results:** In this group of adult patients with Single Sided Deafness and Asymmetric Hearing Loss, with 12 months of cochlear implant use, speech perception abilities reach 80% in open set and diminished tinnitus perception. Quality of life improves in all cases.
Conclusion: Heterogeneity could be found in these groups of patients. But, as in lots of papers, we found that patients with Single Sided Deafness and Asymmetric Hearing Loss can achieve some benefits in speech perception, in quality of life, in perception of tinnitus and in localization. The most important variable is onset of hearing loss. In counseling must include discussion of progressive suppression of tinnitus, localization and speech perception in noise. Cochlear Implant in Single Sided Deafness and Asymmetric Hearing Loss promotes the best condition to receive auditory information. It could improve language, communication skills and workability.
Introduction: Glucocorticoids are potent anti-inflammatory agents and possess anti-apoptotic actions on numerous cells (e.g. hair cells). Therefore dexamethasone is used intra-operative to dampen inflammatory reaction due to the insertion trauma and tissue response against the electrode carrier after cochlear implantation. To prevent higher systemic concentrations of dexamethasone that might cause undesirable side effects the drug is locally applied. As a result of the fast clearance of dexamethasone from the inner ear, sustained dexamethasone applications should be more effective in suppressing tissue reaction. The embedding of dexamethasone into the cochlear implant electrode carrier and its continuous release may solve this problem. The aim of the present study was to examine how perilymph drug levels are influenced by the dexamethasone concentration in the electrode carrier at different time points.

Methods: Silicone rods were loaded with 1% and 10% concentrations of dexamethasone and were implanted into the basal turn of the scala tympani of guinea pig. After implantation, dexamethasone concentrations in perilymph were measured at 7 time points (1 day to 7 weeks) for the 10% loading while 5 time points (1 day to 7 weeks) were used for the 1% rods. Each time point consisted of 3 animals.

Results: The release kinetics showed an initial concentration-dependent burst release. The higher dexamethasone concentration in the electrode carrier resulted in a more elevated and longer lasting burst release. Following this initial burst release phase, similar dexamethasone levels were detected in scala tympani perilymph, about 75 ng/ml and 100 ng/ml for the 1% and 10% loaded rods respectively, during the rest of the observation time.

Conclusion: From these results we conclude that the loading concentration of the silicon rod influences the peak and duration of burst release. The current results so far show that an increase in concentration of dexamethasone from 1% to 10% in the silicon drug carrier leads to an approximately 25% increase in steady state perilymph drug concentration for several weeks.
Abstract Body:

**Introduction:** Preservation of residual hearing in cochlear implantation, especially in the low frequencies, reflects the degree of trauma produced during the electrode insertion into the cochlea. Numerous factors have been analysed and related to the degree of hearing preservation, which had led some authors to describe the surgical steps of “atraumatic surgery for cochlear implantation”. Its importance lies in the proved fact that patients that preserve residual hearing have better audiological results with their cochlear implant.

**Methods:** A retrospective study was conducted with the patients that underwent cochlear implantation in the Cochlear Implants Unit of the Hospital Ramón y Cajal between June 2011 and August 2014. Inclusion criteria were: age over 18, profound postlingual hearing loss and residual hearing detected in the frequencies 125, 250 and 500 Hz.

Data collection: Age, sex, aetiology of hearing loss, pure tone audiogram pre and postoperatively, type of electrode insertion (cochleostomy vs round window) and depth of insertion.

Main outcome measure: Hearing preservation was defined as complete when the change in the mean hearing threshold was less than 10dB.

**Results:** Seventeen patients met inclusion criteria. There were 10 female and 7 male. Mean age was 50 years (95% IC 43-57). Mean follow up was 8.67 months (IC 95% 4-13 months). Mean preoperative residual hearing was 73.5 dB, 82.9 dB and 93.5 dB in the frequencies of 125, 250 and 500 Hz, respectively. Overall hearing preservation rate was 66%. In five patients (29%), complete hearing preservation was achieved, whereas partial hearing preservation was obtained in 6 patients (35%).

Overall hearing preservation rate in men was 57.14% % whereas in women was 72.72% (p=0.6)

Electrode insertion was performed by cochleostomy in 22% of the cases and by the round window in 78%. Overall hearing preservation rate in the cochleostomy group was 64%, in contrast to round window insertion (75%). This difference was not statistically significant.
Regarding depth of insertion, it was 31.5 mm, 25 mm and 26 mm in 65%, 6% and 29% of the cases, respectively. Overall hearing preservation rate was 54% for long electrodes (31.5 mm) and 100% for short electrodes (26 mm). This difference was not statistically significant.

**Conclusion:** Hearing preservation is feasible in more than 50% of the patients undergoing cochlear implantation. Numerous factors such as the degree of residual hearing, cochlear approach and depth of insertion are involved in the outcome. Hearing perception with background noise and music perception is significantly better in patients with preserved residual hearing. Therefore, surgical criteria for atraumatic cochlear implantation should be implemented in all cases.
Abstract Body:

Introduction:
Congenital profound sensorineural hearing losses are determined by genetic or nongenetic factors.

Objectives:
To further evaluate more accurately congenital profound sensorineural hearing losses from etiologic point of view.

Material and Methods:
Congenital profound sensorineural hearing loss etiological assessment is a critical component in infants and children clinical and paraclinical evaluation. Nongenetic factors might be implied in about 25% of congenital hearing losses, while genetic factors (hereditary) are thought to determine more than 50% of all hearing losses. Evaluation of nongenetic and genetic factors will allow to determine a disease progression pattern and will facilitate associated clinical manifestations and complications monitoring.

Results:
Implementation of a cost-efficient etiological assessment based on genetic testing, environmental factors, maternal infections (rubella, cytomegalovirus, herpes simplex virus), prematurity, low birth weight, birth injuries, toxins including drugs and alcohol consumed by the mother during pregnancy, complications associated with the Rh factor in the blood/jaundice, maternal diabetes, toxemia during pregnancy, anoxia evaluation. Imaging studies (CT and MRI) are indicated in order to exclude inner ear malformations.
Conclusion:
In congenital profound sensorineural hearing loss etiological assessment is mandatory a multidisciplinary approach: ENT surgeon, neonatologist, pediatrician, geneticist, radiologist and other specialists, depending on each case.
Introduction: Little is known about the rate of acquisition of words of children with cochlear implants, as well as lexical categories that make up this first lexicon. This work aims to contribute to knowledge of the rate of acquisition of the first 50 words by deaf children with cochlear implant, the lexical content and the influence of implantation age.

Material and Method: Eight children of both genders, aged between 1 year and 1 month and 2 years and 6 months with profound bilateral sensorineural deafness were studied, and used the Diary of Early Language. The Student t test and One Way Anova of SPSS 20 were used for statistical analysis, with minimum significance of $p=0.05$. Results are in mean ± standard deviation.

Results:
Out of the 8 children studied, 4 were girls (50%) and 4 boys (50%). Five had bilateral cochlear implant, 4 applied in different times and one in the same day. Their mean age when produced the 50th word was 9.25±4.8 months. Boys produced the first word with 2.53±2.6 months of age and girls with 2.0±0.8 months. The difference was not significant, $p=0.3$. The first 50 words were produced by girls at 8.5±4.8 months of age and by boys at 10±4.8 months. No statistic difference were found, $p=0.6$. However, within the lexical categories of spoken words, the boys showed a significantly higher number of onomatopoeic words, 14.0±3.91 than girls, 6.75±0.95. $p=0.01$.

According to the implant age, before (N=6) or after two years and six months (N=2) it was found that children implanted before said the first 50 words with 9.7±4.2 months of age, while children with cochlear implants placed after 2 years and 6 months said it with 8.0±7.0 months. The difference was not significant, $p=0.6$. However, within the lexical categories, the articles averaged spoken by children with cochlear implant after 2 years and six months, was 1.0±0.0, significantly higher than in the others, 0.33 ± 0.5, $p=0.02$. It was registered that children with one implant (N=3) said the first 50 words with 13.0±1.0 months of age; children with 2 cochlear implants told it at 7.0±4.3 months. The difference was significant, $p=0.04$. In lexical categories and combinations of words, the mean were similar.
The most spoken words of lexical categories studied, were nouns (43%), onomatopoeic words (27%) and verbs (14%). The smallest number was: conjunctions (0%), interrogative words (0.25%) and others words without classification (0.25%). The differences between them, were statistically significant, p=0.001.

Conclusions:
1- No significant difference was found between children implanted before or after two years and six months of age, when reached the 50 words.
2 Children with bilateral cochlear implant reached the 50th word sooner than others.
3- Boys spoken a significantly higher number of onomatopoeic words in the first 50 words than girls.
4- The lexical content of first 50 words of children with cochlear implants studied is constituted mostly by nouns and onomatopoeic words.

References: ¹NOTT P. et al, 2009 (a); ²NOTT P. et al, 2009 (b)
Introduction: Since FDA approval of the Auditory Brainstem Implant (ABI) in 2000, the device has been indicated for older children and adults with Neurofibromatosis Type 2 (NF2). More recently ABIs have been used in non-NF2 congenitally deaf children who cannot benefit from a cochlear implant (CI) for reasons including absent auditory nerves and cochlear aplasia. Audiologic outcomes in these patients have been varied although, in general, speech perception outcomes are poorer when compared with those of CI users. While intraoperative Electrically Evoked Auditory Brainstem Response (EABR) testing is used routinely to aid with precise positioning of the ABI, studies examining the correlation between EABR waveforms and clinical outcome have been limited.

Objective: To examine the predictive value of intraoperative EABR in NF2 adult ABI recipients and non-NF2 pediatric ABI recipients.

Methods: All ABI recipients from 1994 to 2015, which included 34 NF2 adults and 10 non-NF2 children were included in this study. EABR was performed intraoperatively during electrode placement for all patients. In addition, EABR was also performed at initial stimulation in the pediatric population. The morphologies of the EABRs were evaluated for the number of waveforms showing a response, the number of positive peaks in those responses and the latencies of each of these peaks.

Results: 27/34 of adults and 9/10 children had EABR waveforms. 20/27 (74.0%) of the adult patients and all of the children had ABI devices that stimulated post-operatively. When comparing the waveforms between adults who stimulated and those who did not stimulate, the proportion of total number of intraoperative EABR peaks to total possible peaks was significantly higher for the adults who stimulated than for those who did not (p<0.05). Children had a significantly higher proportion of total number of peaks to total possible peaks when compared to adults who stimulated (p<0.02). Additionally, although not significant, there were more likely to be EABR responses at the initial stimulation than intraoperatively in the pediatric group. To date, no correlation exists between intraoperative EABR responses and speech perception outcomes.
Conclusions: This study shows that a higher number of total peaks on intraoperative EABR tracings may indicate a greater likelihood of device stimulation although the predictive value of intraoperative EABR for speech perception outcome requires more long-term data.
Introduction:
In Japan, CI children have difficulties to attend mainstreaming school for many reasons. 1. Consultation rate of Newborn Hearing Test is approximately 70-80%. 2. 106 Special Educational School for Hearing loss children (Traditional school for the deaf) exists and many Hospital introduce CI Children to enter these schools. 3. Few specialists who can manipulate appropriate programs of Hearing Aids and CI exist and also there are few who can offer effective AV therapies. 4. Many Japanese researchers have been pointing out the low learning abilities of CI children. By these reasons, approximately only 50-60% of CI children could enter mainstreaming school in Japan. However, the children who have the speech processors programmed at Rinku General Medical Center have not attended the schools for the deaf for 15 years. The purpose of this study was to assess the basic leaning abilities of the CI children using WISC-IV.

Methods: Objective: Eight CI children attending in mainstreaming kindergartens, primary schools and junior high schools. Method: Intelligent qualities of all the children were measured by WISC-IV. The results were analyzed by each factor (PRI, VCI, WMI, PSI).

Results: The test results of all the children were in the average range (90-110) or in the high average range (110-119) in WISC-IV. Each patient result indicate different results. However, scores between PRI and VCI have no significant difference in individuals.

Conclusion: The scores of the patients in our hospital who have been attending mainstreaming schools, resulted in average range in WISK-IV.
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Active Bone Conduction Implants as Functional Treatment in Congenital Aural Atresia

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Abstract Body:

Introduction: The Bone Conduction Hearing Aids (BCHA) allows the improvement of hearing in-patients with Congenital Aural Atresia (CAA). There are two kind of prosthesis according to the skin status, transcutaneous and percutaneous. On the other hand, there are active and passive devices related to the site of the stimulation. The aim of this study is to describe the surgery technique, the different approaches, complications and audiometric results with transcutaneous active Bone Conduction Implants. (aBCI)

Methods: 11 patients (14 prosthesis) with CAA were implanted. Three patients received bilateral implants. Trans-mastoid approach was used in 6 patients (7 devices), while in 4 patients (5 prosthesis) retrosigmoid approach was chosen. Finally one patient received aBCI in middle cranial fossa.

Results: Regarding to the approaches, trans-mastoid approach was most frequent, and the Retrosigmoid was the fastest surgery. In patients with mastoid approach we need to compress the sigmoid sinus in many patients due to the little space in this cases of malformation. Related to complications two patients with retrosigmoid approach had bleeding of emissary vein and was resolved sealing with bone wax. The main functional gain was over 35 db. in all patients.

Conclusion: aBCI are an excellent option to treat the hearing loss in CAA with a simple surgery and low rate of complications.
Objectives: Speech processor Sonnet offers several new functions. Several advantages can be expected by the Medel cochlear implant users. Speech processor Sonnet is expected to improve quality of hearing and understanding in different auditory environment using two microphones (improvement of directional hearing). There is a possibility to reduce wind noise. Special strategy FineHearing should bring rich hearing perception. To evaluate these features the comparison between the Sonnet and old processor OPUS2 (Tempo+) users has been realized.

Material and Method: In the University Department of ORL HNS in Bratislava 27 cochlear implant users have been tested to compare their old previous speech processor (OPUS2 or Tempo+) with the new Sonnet speech processor. Patients have filled the questionnaire focusing on quality of hearing and understanding. Audiologic tests (PTA in free field, speech audiometry (s/n 60/60dB), monosyllabic test (s/n 60/60dB) have been realized with old and new processor.

Results: Analyzing the questionnaire we found out that the new speech processor Sonnet brought improvement speech understanding in complicated auditory environment (shopping mall, restaurant, car, several speaking persons, and wind noise). Evaluating audiologic tests 10% improvement has been found in speech understanding and 15% improvement in monosyllabic test.

Conclusion: Subjective evaluation and audiologic tests confirmed that new features of the speech processor Sonnet are reflected in the cochlear implant users’ performance.
Introduction: Cochlear anatomical variability, in non-malformed cochleas, may affect surgical planning. In hearing preservation surgical context, this variability may affect residual postoperative acoustic hearing and outcomes. The goal of the present study is to assess whether hearing preservation in cochlear implantation using straight electrode-arrays (EAs) of medium-to-long length (24-26 mm) might be compromised by patient's dependent cochlear geometric factors, when a full insertion is achieved.

Methods: Cochlear implant candidates were included in this study as soon as they had a residual hearing below 100 dB at 250 Hz, 500 Hz, and 1 kHz. They were implanted with straight EAs of 24 to 26 mm long. All cases were implanted through the round window, with full insertion of the EA. Patients were sorted out in two groups, depending on their residual hearing after one year after surgery. Group P consisted of patients with a postoperative acoustic residual hearing below 100 dB at least on one frequency. Other patients were pooled in the group NP. Measurements of cochlear geometries and angle of insertion were achieved on CT-scans with bony window. The smallest cone that could contain the cochlea approximated its volume.

Results: Hearing preservation was achieved in 9 patients out of 18. Insertion angle was significantly smaller at 400°+/-27° in group P vs 450°+/-55° in group NP (p=0.02). The height (H) of the cochleas significantly differed between groups at 4.33+/-0.5 mm in the P group vs 3.89+/-0.34 in the NP group (p=0.04). H ≥ 4.45 mm gave a 100% specificity of hearing preservation and H< 3.55 mm a 100% sensibility. No differences in volume or in width of the basal parts of the cochlea were found between groups.

Conclusion: Hearing preservation with a full insertion of 24-26 mm straight EAs cannot be expected in cochleas with small height
(H<3.55 mm) and should be reserved for cochleas with higher height (H ≥4.45 mm). Such results suggest that electrode length has to be chosen carefully with respect to cochlea’s height in order to maximize hearing outcomes in hearing preservation surgeries. This has to be discussed with regards to the cochlear coverage of the EA, especially in case of unsuccessful hearing preservation after cochlear implantation.
Influence of Insertion Depth on Hearing Preservation and Speech Perception

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Abstract Body:

**Introduction:** Initial investigations of Electric-Acoustic Stimulation (EAS) reported postoperative hearing preservation with a shallow electrode array insertion. Postoperative hearing preservation provided the opportunity to combine cochlear implant and hearing aid technologies in an ipsilateral listening condition, resulting in improved speech perception. Studies reviewing surgical procedures in these cases have offered recommendations to increase the potential for postoperative hearing preservation using varying electrode array lengths. Insertion depth has shown to be related to speech perception within the initial months of listening experience for conventional cochlear implant recipients, where hearing preservation was not achieved. This report reviewed whether insertion depth influences postoperative hearing preservation and aided speech perception in adults.

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

**Results:** There was no significant difference between cohorts for hearing preservation, though variability was noted. A potential confounding variable was floor effects in the preoperative residual hearing for the subjects implanted with the longest electrode array. All subjects experienced an improvement in aided speech perception as compared to preoperative findings with conventional amplification. There were no differences in speech perception between cohorts at the 6 month interval.
Conclusion: Hearing preservation can be achieved with electrode arrays offering different insertion depths. Electrode array selection was not predictive of speech perception abilities postoperatively up to 6 months of listening experience.
Age-Related Variability of Speech Perception in Noise in Bilateral Cochlear Implant Patients

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Introduction: Bilaterally deafened adults who receive bilateral cochlear implants (CIs) display significant gains over unilateral CI recipients in complex tasks of auditory function such as listening in noise ability. Despite this, outcomes remain highly variable and some studies have suggested reduced abilities as a function of age. The purpose of this study was to evaluate the effect of age on speech perception in noise ability in bilateral CI recipients.

Methods: Postlingually deafened adults who were bilaterally implanted and with a minimum of 12 months experience were included for this study. Subjects were divided into young adults and elderly with an arbitrary division of 65-years old. Test battery included word recognition ability in quiet using CNCs; BKBSIN and AzBIO speech-in-noise measures; and subjective questionnaires. Any individual performing outside published norms on the MME were not included for study.

Results: Preliminary data suggests that older adults have similar performance to younger adults for speech perception in quiet; however, they display reduced performance compared to their younger cohorts on tests of speech perception in noise. Likewise, their perceived disability is greater in noisy environments than that reported by younger adults.

Conclusion: While significant gains in speech perception are observed in postlingually deafened adults who receive bilateral implants, there is an observed variability with decreased performance in the ageing adult. Specifically, older adults have reduced performance in noisy environments suggesting higher order processing changes.
Abstract Body:

**Introduction:** Bilateral cochlear implantation (CI) is widely offered to young children with no or a short inter-stage interval between two implants. However, parents of older children who received a first implant at an earlier age also request access to bilateral implantation. Even if these candidacies are carefully examined through precise guidelines, such as the Bilateral Implant Profile, predicting outcomes of bilateral CI for these children is still challenging. Considering the growing database of such cases, this project proposes a retrospective analysis of sequentially bilateral implanted children in our center who received their second CI after the age of 4, in order to assess current practices and support future decisions on implantation.

**Methods:** The target population includes all children who received their second cochlear implant after the age of 4 from our Cochlear Implant Program Center (n=73). Demographic, audiological, speech and language data were retrieved from patients’ files at three moments: before the second implantation, and then before and after the intensive 4 to 12 weeks rehabilitation program following this second implant. The one and two years post-implantation data were also analyzed when available. Pre-implantation key variables are the length of profound deafness, the interimplant interval, the daily use of the first device and the hearing aid on the second ear, the auditory capacities with the first implant and in the unimplanted ear with HA.

**Results:** Performance for perceptive tasks (close-set monosyllabic and words identification, open-set words and sentence recognition, lateralization) will be presented in details for this group of children. Expected predictors of high levels of perception skills, such as inter-implant interval and age at implantation will be specifically explored.

**Conclusion:** Scientific and clinical outcomes are expected. The cohort data analysis will help to define a better comprehensive picture of short- and medium-term performance in these children. This will highlight the benefits of sequential bilateral cochlear implants.
implantation in older children, but also the limits of this procedure. Clinically, the project will reinforce the selection process for bilateral cochlear implantation, and provide food for thought to improve the rehabilitation program proposed to those children.
Introduction: Localization ability is a binaural phenomenon, dependent upon integration of timing and level cues from both ears. Those individuals with severe to profound sensorineural hearing loss in both ears receive cochlear implants (CIs), which directly stimulate the auditory nerve allowing for binaural input. Because of this, bilateral CI users undoubtedly gain some binaural advantage over unilateral recipients. Previous studies have shown that majority of adults with bilateral CIs are better at horizontal localization with two implants compared with one, but their abilities do not reach those of normal-hearing listeners. Further, despite significant gains in speech perception studies have suggested reduced outcomes in older adults who receive CIs. Here we investigate the differences in localization ability by age group for bilateral CI users and compare performance to normal hearing adults.

Methods: Postlingually deafened adults who were bilaterally implanted and with a minimum of 12 months experience were included for study. Subjects were divided into young adults and elderly with an arbitrary division of 65-years old. Localization stimuli included a broadband signal and two 1/3 octave narrowband signals centered at 500 and 4000 Hz. Stimuli were presented using a 19 speaker array separate by 10º and spanning +/- 90º.

Results: Preliminary data suggests that both younger and older CI users gain significant benefit in localization ability in the bilateral condition over the unilateral condition, however their results to not reach that of normal hearers. Preliminary data also suggests that older adults have reduced localization ability compared to their younger cohorts.

Conclusion: While significant gains in localization are observed in postlingually deafened adults who receive bilateral implants, there is an observed variability with decreased performance in the ageing adult.
Introduction: Wireless technologies are a common recommendation and accessory provided to children with cochlear implants and families. Research has demonstrated benefits for listening in noisy environments as well as for listening to auditory inputs such as the telephone. Although this technology has the potential to improve patient access to additional auditory inputs, many questions remain, for example:

1. How often do patients and their families choose to use this technology?
2. Do they believe they are proficient in its use?
3. Do they find subjective benefit in using the devices?

The purpose of this research is to determine how common the use of wireless technologies is among patients with current wireless devices and to determine comfort/proficiency level with use.

Methods: Twenty children with cochlear implants and their families will be asked to complete a survey focusing on use of wireless technologies including device types, hours of use, and use in environments/situations. In addition, questions regarding comfort with the device, comfort with connecting to additional devices, and comfort with connecting to the sound processor will be included.

Results: Anecdotal comments from young implant users and their families suggest that while counseled on many opportunities to use wireless technologies, use may be limited. In addition, comfort with the technology may be higher among children than parents. The survey results will provide data to demonstrate current use trends and needs for support.

Conclusion: Results from this study will likely impact counseling on wireless devices with young implant users and families.
Abstract Body:

Introduction: Waardenburg syndrome (WS) comprises pigmentation abnormalities of the eyes, hair and skin and sensorineural hearing loss, predominantly bilateral. There are four clinical subtypes of the disease, mostly of autosomal dominant inheritance, with variable genetic penetrance and expression. Hypoacusis is more typical of types I and II, the most prevalent types of WS. Cochlear implantation is highly recommended in cases of severe and profound bilateral deafness when there are no functional gains with conventional hearing aids.

Methods: This is an observational retrospective study of all clinical files of children with WS that were submitted to cochlear implantation surgery, in our department, from 2004 to 2015.

Results: We studied 6 children with WS who had severe to profound bilateral deafness. All of them had absolute indication to cochlear implantation surgery, with mean implantation age of 28 months. Follow-up time with cochlear implant was of 13 to 38 months, with mean pure tone average (PTA) scores of 30 dB. Four of the six implanted children are in regular schools, and only two of these have special educational programs.

Conclusion: Children with WS correspond to 11% of the implanted children in our hospital. Despite similar PTA scores, speech improvements are different among these children.
The Ability to Evaluate Words and Phrases: Discrimination in Adults with Cochlear Implants

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Abstract Body:

Introduction: The cochlear implant represents the most important advance in the treatment of patients with severe or profound hearing loss don’t show benefits with conventional individual sound amplification device. The cochlear implant is an electronic device that plays partially the functions of sensory cells in the cochlea and directly stimulates the auditory nerve, promoting great results in the auditory discrimination skills and understanding.

Methods: Thirty adults, with hearing loss, which received the cochlear implant in post-lingual period, were rated by the speech’s discrimination using an open set phrases list. The collected data were statistically processed. study: prospective clinical trial.

Results: None of the patients before the cochlear implant could discriminate words and phrases in open set word list. The average hit on auditory discrimination was 85% words with three syllables and phrases were 82%.

Conclusion: Cochlear implant users present increase of ability to discriminate words and phrases than improving your communication. The patients reported improvement in quality of life and inclusion in society and social interaction.
Introduction
Many authors verified that the cochlear implantation age influences oral language gains and the linguistic performance in children with cochlear implants. However, they compare implanted children and normal hearing children with the same hearing age. This study aims to contribute to the knowledge of the influence of implantation age, when comparing cochlear implanted children with normal hearing children with the same chronologic age.

Material and Method
Thirty children of both genders, with profound bilateral sensorineural congenital deafness, with cochlear implant, aged between 8 years and 1 month and 10 years, were studied. All of them were implanted before 4 years old. The group was divided in two: one of 8.1-9 years, 12 children (group 1) and other of 9.1-10 years old, 18 children (group 2). Each one was divided in implanted before or after 2.5 years old. The language was evaluated using the Evaluation Language Grid - school level, GOL-E. The language structures evaluated were semantic, morphosyntax and phonology. The score of each group of implanted children was compared with the standard of children with the same age. One simple t Test of SPSS 20 was used for statistic analyze with a minimum significance of p=0.05. Data are in mean ± standard deviation.

Results
The results of the group 1 in the semantic structure was 11.92±9.70 vs 29.93±4.71, p=0.0001; in the morphosyntax 12.58±10.74 vs 42.70±4.79, p=0.0001 and in the phonology it was 21.42±12.76 vs 36.97±3.74, p=0.001.
The results of the group 2, when comparing with normal hearing children with the same age registered: in semantic 18.56±8.9 vs 31.63±4.57, p=0.0001; in morphosyntax 21.89±12.75 vs 45.30±3.15, p=0.0001; and in the phonology 23.44±8.41 vs 38.13±2.27, p=0.0001.
Comparing only the score of children implanted before 2.5 years old with the standard of the same age, we verified the follow:

In the group 1, 5 children, the semantic structure was 17.00±9.43 vs 29.93±4.71, p=0.037; in the morphosyntax 17.6±101.88 vs 42.70±4.79, p=0.009 and in the phonology it was 25.8±7.91 vs 36.97±3.74, p=0.034.

In the group 2, 13 children, the semantic structure was 20.62±8.46 vs 29.93±4.71, p=0.001; in the morphosyntax 24.85±11.58 vs 42.70±4.79, p=0.0001 and in the phonology it was 30.69±8.48 vs 36.97±3.74, p=0.01.

**Conclusion**

1- A statistically significant difference was found in linguistic gains of deaf children, with 8.1 to 10 years old, with cochlear implant, inserted before 4 years old when compared to oral language of hearing children with same age.

2- Cochlear implant performed before 2.6 years of age influences significantly the language improvement of children with profound congenital deafness, but the results remain significantly inferior from children with the same chronological age.
Introduction: There are numerous reasons why a patient who is referred for a cochlear implant may not receive one. The two main categories are that either the cochlear implant team (CIT) or the patient/family do not want to proceed.

Methods: Objectives: To review the past eight years of referrals to a Pediatric Cochlear Implant Centre and establish why patients ultimately did not receive an implant.

Methods: Medical charts of patients referred to the Pediatric Cochlear Implant Team (CIT) between April 1, 2007 and March 31, 2015 were retrospectively reviewed. Information regarding source of referral, age, gender, type and severity of hearing loss, etiology, comorbidities and family history of hearing loss were obtained. Number of patients turned down by the CIT vs. number of patients/families who refused implantation and the reasons for both were explored.

Results: 241 patients were referred to the CIT over the 8-year study period. 224 (93%) charts were reviewed. 131 were male and 113 were female. Median and mean age of referral was 33 and 62 months respectively with the majority (57%) referred by an Audiologist.

141 patients (63%) went on to implantation and 83 (37%) were not implanted. In the non implanted group, 59/83 patients were declined by the CIT: 7 were considered inappropriate referrals based on the type and severity of hearing loss, and 52 were not considered good candidates for cochlear implantation because there was significant benefit with hearing aids (14 patients), absence of bilateral cochlear nerves (11), too much residual hearing (11), length of auditory deprivation (7), age in pre-lingual patients (4), hypoplastic or unilateral cochlear nerve with good hearing on the contralateral side and/or poor verbal language development (4) and one patient was trialing hearing aids.

24/83 patients were not implanted because of patient’s or family preference; 20 declined CI assessment and 4 decided not to proceed with cochlear implantation although approved. Reasons why patient/families declined a CI assessment were preference of a hearing aid (8 patients), they felt they had “enough” residual hearing (4), family history of hearing loss and a desire to use sign language as their primary mode of communication (5), wait until the their child was 18 years of age and could make their own
decision (1) not interested in the assessment for surgery (2).
Four families/patients decided not to proceed with cochlear implantation when the 2 patients was considered a good because they considered the risk of the surgery was greater than the benefit, 1 because it was perceived the child was obtaining appropriate benefit with the use of hearing aid and 1 family refused to be implanted in our institution because they wanted a bilateral CI and we recommended one side only as there was only one cochlear nerve.

**Conclusion:** Reasons why patients at our institution did not receive an implant are diverse. The two main reasons for being rejected by the team are too much residual hearing with good benefit with hearing aids and the absence of cochlear nerves. The main reason why parents/families elected not to pursue implantation is perception of enough hearing and the desire to use hearing aids instead.
Bilateral Cochlear Implantation in a Child with Congenital Hydrocephalus: A Case Report

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Abstract Body:

Introduction: Fetal brain malformations occur in the period of early pregnancy and it may induce motor dysfunction and general developmental delay, including delay in language. Therefore, the indication of cochlear implantation should be carefully considered when the child has congenital profound hearing loss. We report a case with hydrocephalus that undertook bilateral cochlear implantation.

Methods: The patient is a 2-year-old boy who was diagnosed as congenital hydrocephalus. Ventriculoperitoneal shunt has been already administrated as a treatment for hydrocephalus. He has bilateral profound hearing loss with incomplete partition (IP) type II malformation and hearing aid was supposed to be ineffective.

Results: 1st cochlear implantation was performed on the left ear when he was 2 years and 8 months old. After activation, sound detection was observed at 30-40 dB HL in the audiological test with warble tones. The scores of Infant Meaningful Auditory Integration Scale(IT-MAIS), Meaningful Auditory Integration Scale(MAIS) and Meaningful Use of Speech Scale(MUSS) were also improved.

2nd cochlear implantation was performed on the right ear when he was 4 years and 11 months old. It was the same side of ventriculoperitoneal shunt. Special attention was paid during surgery not to interfere the ventriculoperitoneal shunt by cochlear implant.

Now, he uses both cochlear implants successfully, and his language skills are progressing steadily.

Conclusion: These results suggest that cochlear implantation is an effective intervention for children accompanied with both congenital brain malformation and congenital profound hearing loss.
Abstract Body:

Introduction: Biological, structural, and acoustical constraints faced by cochlear implant (CI) users can alter the perception of music. Bimodal fitting not only provides bilateral hearing but can also improve auditory skills. This study was conducted to assess the impact of this amplification style on the emotional perception of music among children with hearing loss (HL).

Methods: Twenty-five children with congenital severe-to-profound HL and unilateral CIs, 20 children with bimodal fitting, and 30 children with normal hearing participated in this study. Their emotional perceptions of music were measured using a method where children indicated happy or sad feelings induced by music by pointing to pictures of faces showing these emotions.

Results: Children with bimodal fitting obtained significantly higher mean scores than children with unilateral CIs for both happy and sad music items, and in overall test scores ($p < 0.001$). Both groups with HL obtained significantly lower scores than children with normal hearing ($p < 0.001$).

Conclusion: Bimodal fitting results in a better emotional perception of music compared to unilateral
CI. Given the influence of music in neurological and linguistic development and social interactions, it is important to evaluate the possible benefits of bimodal fitting prescriptions for individuals with unilateral CIs.
Proportion of Cochlear Implantation in Older Adults Over Time

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Abstract Body:

Introduction: Life expectancy is increasing worldwide and thus the population of people older than 60 years is increasing. Disabling hearing loss occurs in 33% of the world’s population over the age of 65. Cochlear implantation is found to be an effective therapy for people with severe hearing impairment leading to better speech understanding, quality of life and cognition. Over the years, a large amount of older patients with severe sensorineural hearing loss received a cochlear implant.

Methods: Analysis of data of 758 cochlear implantations in the Antwerp University Hospital between 1993 and 2014. Different categories were used to divide patients based upon their age at the moment of implantation. The correlation between age of implantation and year of implantation was calculated and the proportion of people implanted over the age of 75 years was calculated over time.

Results: No significant correlation between age at implantation and year of implantation (Spearman rho= 0.028; p = 0.449) was found. In General, 8% of patients were found to have had a cochlear implant above the age of 75 years. This percentage did not change significantly over time.

Conclusion: Cochlear implantation is a generally accepted treatment for severe sensorineural hearing loss. Notwithstanding, the life expectancy is increasing, no significant changes in number of cochlear implantations in this older population was found. The consequences of these findings will be discussed and will be subject of further research.
Abstract Body:

**Introduction:** Research on cochlear implants has traditionally been focused on speech perception. Few recent studies have examined everyday sounds perception skills in CI users. Yet, these studies have highlighted important difficulties in recognizing or identifying non-linguistic everyday sounds. However, many CI clinicians affirm that there is no need to train sound perception arguing that CI users does not report any concern on this issue since these skills are emerging spontaneously through daily experience with environmental sounds. To better understand why clinical observations diverge from scientific findings, this project proposes to compare the assessment of non-linguistic environmental sounds perception skills in CI adults in two contexts, that is, in a standard laboratory setting and in a virtual space reproducing daily sound scenes.

**Methods:** Following a cross-sectional design, the relationship between isolated sounds recognition skills and daily sound scene description capabilities is investigated. The experimental group includes 20 CI adult users while 30 hearing adults form the control group. Two auditory situations are proposed to the participants: 1) recognition of 45 isolated environmental sounds presented in an audiometric booth 2) description of 5 familiar sound scenes presented in a virtual sound space, including the recognition of 9 emerging environmental sounds in each scene. In order to investigate the relation between perception of everyday sounds and quality of life, the Nijmegen Cochlear Implant Questionnaire is also completed by CI participants.

**Results:** Results from the CI participants will be presented in details and compared to results from the control group. The relation with the quality of life perception will also be explored.

**Conclusion:** This study will highlight the influence of assessing sound perception in a setting closer to the daily experience of CI users. This will bring some insights on the divergence between the clinicians and the literature outcomes on this issue.
Long-Term Assessment of Auditoru Outcomes in Older Cochlear Implant Users

Anouk Hofkens-Van den Brandt, Bachelor in Audiology, Annes Claes, Master in Audiology, Annick Gilles, PhD Medical Science, Griet Mertens, PhD Medical Science, Paul Van de Heyning, MD, PhD; Univ. Dept. Otorhinolaryngology, Head and neck surgery, Antwerp Univ. Hosp., Edegem, Belgium.

Abstract Body:

Introduction: Multiple studies have shown an association between hearing impairment and cognitive function. It is currently under debate whether restoring hearing in severe hearing-impaired subjects by use of a cochlear implant, effectuates positive effects on cognition in elderly. Before cognition can be accurately investigated, it is necessary to assess the audiological outcomes over time in these patients. As the audiological outcomes are key to quality of life in older subjects, they indirectly influence cognition. Therefore, a thorough follow-up of auditory performance in older subjects is imperative.

Methods: Subjects of a previous study on quality of life benefit in older cochlear implant users were reevaluated after 10 years. Subjects were divided into 3 groups referring to their age at implantation: implanted under the age of 55 years, between 56 and 69 years old and older than 70 years. Audiological test battery comprised free field pure-tone audiometry with CI, speech tests in quiet (phonetically balanced monosyllabic word lists) and in noise (LIST). In addition, the Hearing Handicap Inventory for Adults and the HISQUI19 were used to evaluate patients’ quality of life after cochlear implantation.

Results: In a previous study (2005) we showed similar improvements in quality of life and speech recognition in both older and younger cochlear implant patients. The outcomes of this study will be presented at the CI congress in Toronto.

Conclusion: Conclusion will be presented at the CI congress in Toronto.
Abstract Body:

Introduction: While cochlear implants (CI's) are by now an established method of restoring the sense of hearing, the collection of outcomes data on a large scale over a longer period of time has not been the primary focus of the field. For more than one year, members of the HEARRING group, a multi-national network of comprehensive hearing clinics, register their set of minimal outcome measures (MOM) in the HEARRING registry. To use the HEARRING registry to perform a meta-analysis to investigate the benefit of cochlear implantation in different age groups.

Methods: Data of MED-EL CI candidates (18 years of age or older) of different HEARRING centres are retrieved from the uniform HEARRING registry, which has been designed according to a collectively agreed set of MOM. This prospective cohort registry collects routine observational data from the pre-operative assessment, the implantation, the implant activation and the assessment 3 months, 6 months, 12 months after activation and annually thereafter. The MOM consist of unaided and aided pure-tone audiograms, monosyllables test in quiet, sentence test in noise and the HISQUI questionnaire. Using a one way ANOVA (Bonferroni correction) differences in hearing performances will be investigated between the three different CI study groups: A. < 55 years; B. 55-70 years and C. >70 years of age.

Results: The results of the meta-analysis of the hearing performances of the different age groups, retrieved from different HEARRING centres, will be presented at CI2016.
Conclusion: The HEARRING Registry is a useful tool to collect routine observational data from CI candidates. Data from different age groups for example, could be exported very easily from the registry. The meta-analysis can provide valuable guidelines for counselling elderly CI candidates regarding post-implantation expectations.
Abstract Body:

Introduction: We describe unusual pain around the implanted area, occurring months to years after surgery and their management in our pediatric cohort.

Methods: This is a monocentric retrospective review of our cochlear implanted cohort between 1998 and 2015, complaining about unusual pain around their external receiver. Follow-up was at least one year. Patients with trauma, infection, skin extrusion, magnet extrusion, were excluded. Treatment and outcomes were reviewed, pain resolution being the most important success sought.

Results: 18 patients (19 cochlear implants) were included, representing 1.52% of implantations performed in the department. Average age was 17 [3 to 26 years old]. Delay between surgery and pain complaining ranged from 3 months to 14 years. Pain was always severe (pain scale evaluation from 5 to 10) preventing patient to use their cochlear implant. It may persist without receptor. Two groups were gathered: one with local swelling without local or systemic signs of infection (n=8), the other without any visible signs (n=11). After a first-line treatment with painkillers, anti-inflammatories, and antibiotics when swollen, five patients (26%) were relieved permanently. Three (16%) kept intermittent pain and took intermittently painkillers. In second line therapy, two patients (11%) were relieved after removal of the magnet. Nine patients (47%) had to be explanted to completely resolve pain. After explantation no macroscopic sign of infection, local reaction or equipment visible abnormality was found. Biofilms studies were achieved for two cases and found a polymorphic flora.

Conclusion: Delayed pain around the implanted area, not bound to a hardware malfunction, is a serious complication probably under diagnosed. They may require explantation and should have a systematic statement to develop standardized management.
Introduction: Speech understanding in noise is influenced by masker type (e.g. informational vs. energetic) and masker location relative to the target. Spatially separating the target and masker(s) improves understanding of the target speech, an effect referred to as spatial release from masking (SRM). Bilateral cochlear implant (CI) users receive some benefit from spatial separation; however, the magnitude of improvement can be considerably poorer than that seen in normal-hearing listeners. Poor transmission of temporal fine structure with current CI technology, which therefore prevents adequate interaural time difference (ITD) transmission, may be largely responsible for the reduced benefit from spatial separation. Similar to bilateral CI users, bimodal listeners do not have access to ITD cues; however, they do have access to fine structure information, albeit only in one ear. Access to fine structure information from the acoustic hearing ear may facilitate speech understanding in noise via glimpsing, segregation, and a better representation of F0. However, greater fine structure representation may also make bimodal listeners more susceptible to informational masking (e.g. Pyschny et al., 2014). Thus, we hypothesized that bimodal listeners would exhibit greater release from informational masking when switching from a 2-talker distracter to signal-correlated noise (SCN). Because real-world listening environments contain informational masking with various spatial separations between a target talker and background maskers, we aimed to investigate the interaction between two types of maskers (informational and energetic) and spatial release from masking in bimodal and bilateral CI users.

Methods: Speech understanding was assessed in the presence of speech (informational) and SCN (energetic) maskers. A single female or male talker presented at 60 dBA originated from 0-degrees azimuth and the distracters (two different male talkers or SCN) were positioned at either 0 degrees, 45 & 315 degrees, or 90 & 270 degrees. The background noise levels used for testing were determined by finding the signal-to-noise ratio at which listeners got approximately 50% correct with the best CI alone with noise presented from 0 degrees.

Results: Preliminary data from 12 adult participants reveal that 1) bimodal participants exhibited SRM when speech maskers originated from 45 & 315 degrees, but not 90 & 270 degrees, 2) bimodal participants showed no SRM for the SCN masking.
conditions; rather, performance declined with increasing spatial separation, 3) for a male target talker, bilateral participants showed substantial SRM when speech maskers originated from 45 & 315 and 90 & 270 degrees, and when SCN maskers originated from 90 & 270 degrees, 4) for a female target talker, bilateral participants showed no SRM for either masking condition, and 5) bilateral participants exhibited a larger release from informational masking evidenced by a substantial improvement in performance with the noise maskers (regardless of target talker gender).

**Conclusion:** In contrast to our hypothesis, preliminary data suggest that bimodal listeners may be less affected by informational masking than bilateral CI users. Thus, it is likely that mechanisms beyond the presence/absence of fine structure are underlying these trends. Alternative explanations will be discussed with respect to group differences. Results will also be discussed within the context of clinical significance.
**Abstract Body:**

**Introduction:** The benefits of bilateral hearing are associated with three primary binaural mechanisms: the head shadow effect, binaural squelch and binaural summation. As an increasing number of patients that have unilateral cochlear implantation have also residual hearing in the non-implanted ear, interest has grown in examining the advantages of bimodal stimulation.

**Methods:** We performed a retrospective study that included 12 patients with cochlear implant (CI) who still use a hearing aid (HA) in the opposite ear. The post-implant evaluation consists in free field pure tone audiometry and speech recognition tests with the cochlear implant and with the hearing aid.

**Results:** The mean speech recognition scores obtained in quiet were: 80% with CI alone and 84% with CI and HA. The mean speech recognition scores obtained in noise (10 dB SNR) were: 68% with CI alone and 78% with and CI and HA. There was deterioration of speech recognition scores of 12% with CI alone and of 6% with CI and HA.

**Conclusion:** The use of bimodal auditory stimulation can be considered as an effective treatment option in order to obtain binaural benefit especially in noisy surroundings.
Introduction: Many researchs showed different result regarding the role of age as cochlear implant predicting factor. One of main pathogenesis is retrograde deterioration of auditory pathway that may reduce the benefit of cochlear implant. In this study we evaluate the role of imaging and electrophysiology of implantees with age of implant more than 36 month as predictor of early hearing and language development.

Methods: Patient implanted at age more than 36 months were evaluated for pra implant audiological performance, imaging and intra operative electrophysiology as predicting factor for post implant result. Free field test and Categorical Auditory Performance were used as performance indicator at least 6 month post activation.

Results: All patient achieved at least 40 dB in FFT result in all frequency. Significant different were found in eABR responses between patient with good pra implant habilitation status to poor/no habilitation patient. No correlation were found between common MRI evaluation with intra operatif electrophysiology nor post implant result. Patient with better eABR responses tend to achieve better performance on post implant evaluation. Brainstem diffusion tensor imaging evaluation in 4 patient showed a better explanation on auditory pathway condition.

Conclusion: Pre-implant auditory performance may represent auditory pathway integrity and should be consider as main candidacy factor in late implant patient. Further study need to be done to use eABR and Diffusion Tensor Imaging as predictor in cochlear implant patients.
Introduction: Meningitis is one of bad prognostic in cochlear implant patient. Labirintitis ossificants may progress days, months to year after meningitis. Inflamation in cochlear scala may produce fibrous tissue and bony formation that may obstruct the cochlear canal and obscure electrode insertion. Ossification in modiolus may destroyed spiral ganglion and produced unstimulated cochlea. This report will showed the role of imaging assessment in selecting the beneficial candidates and surgical approach in post-meningitis patient.

Methods: Imaging and intra-operative objective measurement were performed in 3 patient with history of meningitis prior to sensorineural hearing loss. Imaging evaluation consist of CT and MRI evaluation for cochlear patency in Stenver and radial position also modiolus densities to determined modiolus ossification. Intraoperative eABR and post implant performance were evaluate as clinical and electrophysiological outcome.

Results: Three patient with history of meningitis were fully implanted. One patient with fibrous tissue in scala tympani. One patient with ossification on scala tympani, scala vestibule insertion was performed as expected from CT evaluation. Both patient has good benefit from cochlear implant with good CAP score. Third patient with patchy obstruction in basal and middle cochlea and increased densities in modiolus. Implant was fully inserted, but no eABR responses were recorded intraoperatively. One year evaluation showed patient could only detect sound but could not understand speech.

Conclusion: Pre operative imaging evaluation on cochlear patency and modiolus densities should always become consideration in post-meningitis patient. Patient need to be advised carefully to consider auditory brainstem implant if cochlear implant could not give any benefit.
Perceptual Training in Post-Lingually Deafened Users of Cochlear Implants and Adults with Normal Hearing: Does One Paradigm Fit All?

Matthew Fitzgerald, Ph.D.¹, Susan Waltzman, Ph.D.², Mario Svirsky, Ph.D.², Beverly Wright, Ph.D.³;

Introduction: Post-lingually deafened recipients of cochlear implants (CIs) undergo a lengthy learning process that appears to be facilitated by auditory training. Little is known, however, on how to facilitate this learning process by modifying the training regimen. In young adults with normal hearing (NH), combining periods of active practice with periods of stimulus-exposure alone can result in learning that is more rapid and of greater magnitude than learning resulting solely from active practice. Here we asked whether this combined paradigm also promotes learning in CI users. If so, it would provide a means to enhance patient performance with a reduced amount of practice. If not, it could indicate that there are differences in the mechanisms that underlie perceptual learning between NH and CI populations. Such differences would be relevant for developing optimal training regimens for the hearing impaired.

Methods: In a pilot investigation, we trained five monolingual-English-speaking CI users aged 21 to 33 years on a phonetic-categorization task using a combination of practice and stimulus-exposure alone. Participants were asked to categorize speech syllables that varied in voice-onset-time (VOT) as belonging to one of three phonetic categories: negative VOT (+25 ms). This three-way phonetic contrast in VOT is present in many languages, but English has only a two-way contrast between near-zero and positive VOTs. In each of two 60-75 minute sessions, participants completed a pre-test, a training phase, and a post-test. The pre- and post-tests consisted of the phonetic-categorization task without feedback. The training phase consisted of alternating periods of task performance with feedback and periods of exposure to the same stimuli during performance of a written task.

Results: Using this training paradigm, young adults with NH show a steepening of the non-native category boundary between the negative and near-zero VOT. In contrast, none of the five CI users showed any improvement. Analysis of the electrical stimulation patterns elicited by the stimuli suggested that the voicing information needed to make the non-native VOT contrast was confined to
a single apical electrode.

**Conclusion:** While preliminary, these results suggest the same perceptual training paradigm can have different effects on CI users compared to NH listeners. These differences may stem from a reduction in the available cues to categorize this contrast due to the CI speech processor. An alternative possibility is that deprivation from hearing loss alters perceptual-learning mechanisms.
Introduction: Inner ear malformations constitute about 20% of congenital sensorineural hearing loss; the cochlear Malformations are of special interest nowadays, as the indication for cochlear implant surgery is expanding. In a retrospective evaluation, the aim of this study was to assess the outcomes of cochlear implantation in children with inner ear malformations.

Methods: A retrospective review of 43 children who received implants from June 2008 to November 2015 was performed. Six of them had radiologic evidence of inner ear malformations. The preoperative evaluations, intraoperative findings, postoperative complications, and performance outcomes were analyzed.

Results: We noted a clear male prevalence; the sex ratio is of five boys for a girl. Among the 6 children having a cochlear malformation we noted the concept of marriage between blood relations in the parents in at only case. 16.67% of these children having cochlear malformation have a major deaf cases in the family. 16.67% of the 6 children established in our service present another case in the family. The similar cases in the siblings were seen at 16.67% of our children. The notion of fever was noted at 16.67% of the children. One patient had a bronchiolite, another had hyperpyretic convulsions, 16% of the patients having malformation of inner ear ears had a standard sero-mucous otitis. 66.66% of the children having cochlear malformation had a standard malformation mondini, the vestibular dilatation and of the vestibular aqueuduc 50%, and 16 had a common cavity was noted. The cochlear ossification minim was noted in 16% of our patients, and the procidence of facial nerve in one case. There were no serious postoperative complications. All children with Inner ear malformation achieved open-set speech perception abilities, and showed progressive improvement of their speech perception.
abilities over time. There were no statistically significant differences in performance measured by the Common Phrases test between the groups. Although the repeated-measures analysis of variance indicated that children with Inner ear malformation performed more poorly than those with a normal inner ear.

**Conclusion:** The results of the present study show that cochlear implantation can be performed relatively safely in deaf children with inner ear malformation and that they receive considerable benefit from their implants.
Introduction: Outcomes for an aggregate clinical population, longitudinal in nature, have not been reported in the peer-reviewed literature. Previous adult outcomes have been reported in the literature, however, these data were reported from research populations (e.g. Zwolan et al., 2001; Parkinson et al., 2002; Balkany et al, 2007; Baumgartner et al., 2007; Gifford et al., 2008) or cross-sections of clinical populations (e.g. Gifford et al., 2010, 2014; Holden et al., 2013). These studies are limited in that they are relatively small in scale and/or are not representative of our global adult population. Thus it could be argued that most of the results reported in the CI literature are influenced by selection bias. Here we analyzed performance for measures included in the Minimum Speech Test Battery (MSTB) for adult CI recipients at 1, 3, 6 and 12 months post-activation for all postlingually implanted adults implanted at our center. Our objective was to investigate the possibility of previous reports overstating adult outcomes due to relatively small sample sizes and/or selection bias.

Methods: The study design was both retrospective and prospective in nature. A retrospective review of postoperative speech perception performance for all postlingual, English-speaking adults implanted from 2011-2012 at our center was completed. Since 2013, data from all adult cochlear implant recipients were collected with a prospective focus under an IRB approved protocol for all adult CI patients. A total of 394 recipients [mean age = 64 years; range 20 - 93 years] were included in the analysis. Eighty-four individuals were bilateral users. Post-operative evaluations were conducted in a clinical setting and were completed in accordance with the minimum speech test battery (MTSB) protocol (MTSB, 2011).

Results: We saw a significant improvement in speech understanding with the CI alone across the first year of CI use (p < .05). The addition of a contralateral hearing aid provided the best benefit (18% - 20%) on AzBio sentence materials presented in quiet through 6 months post activation. Slightly less benefit (12%) was observed as the patient became more experienced listening with the implant. Patients performed better in noise by as much as 17% [range = 10%-17%] at +10dB SNR and 22% [range = 10%-22%] at
Conclusion: (1) Mean CNC word scores in the literature for unilateral CI performance range from 43% to 72%. At one year post-activation our postlingual adults scored 46% correct on CNC word tests. Thus, depending on the study referenced, one can reasonably expect that mean outcomes for an aggregate clinical population will be significantly poorer than outcomes previously reported in the literature with research populations potentially affected by selection bias. If we are to understand how this intervention is truly impacting the auditory-only outcomes for postlingually deafened adults, we must make a concerted effort to assess every single patient in the clinic and keep track of our outcomes. (2) As expected and demonstrated elsewhere, aiding the non-implanted ear can significantly improve outcomes, especially in difficult listening environments.
Introduction: Methods have been proposed to localize cochlear implant (CI) electrodes relative to the sites they stimulate inside the cochlea (Noble et al., 2013). With this imaging information, the electrode set can be chosen so that active electrodes are most likely to stimulate discrete neural populations leading to significant improvements in speech understanding in both quiet and in noise as well as improved spectral resolution over a standard all-on approach. Thus far, such Image Guided CI Programming (IGCIP) methods have been incompatible with paired-electrode stimulation strategies, which are commonly used and are required for the use of specialized noise reduction algorithms that are known to improve outcomes.

Methods: Six CI recipients (4 adults and 2 children) using paired stimulation strategies participated in this study. Informed consent was obtained from each participant in accordance with the study protocols approved by the local Institutional Review Board. During visit 1, baseline testing and re-programming was completed. A second visit was scheduled for ~4 weeks later where testing was repeated with the experimental program. Electrode distance vs. frequency curves (Noble et al, 2013) were used to visualize electrode distance from the modiolus and aid in electrode selection. A minimal number of electrodes were deactivated between paired channels that were located further from the modiolus and therefore more likely to have broader channel overlap. No electrodes were selected in a way that resulted in stranded electrodes.

Adult assessment of speech recognition was completed in accordance with the adult minimum speech test battery. Estimates of spectral resolution were obtained using a spectral modulation detection (SMD) task (Gifford et al., 2014). Adult participants were assessed in the electric only and bimodal conditions. Pediatric participants were evaluated with age appropriate speech materials.

Results: All 4 adult participants reported better sound quality acutely. Both pediatric participants exhibited improved speech production. At the time of writing, 3 of the 6 participants had returned for visit 2. In the electric only condition, one adult performed significantly better on AzBio in quiet (48% vs. 21%) and at +5dB SNR (17.5% vs. 0%) and better on the SMD task (82% v. 67%). In the
best-aided condition (bimodal), this individual scored significantly better on CNC (68% v. 40%), AzBio in Quiet (92% v. 64%) and AzBio at +5dB SNR (25% v. 0%). This participant kept the program, reporting that they were hearing better and that sound was more natural. A second adult participant scored significantly poorer at +5dB SNR (20% vs. 44%), and performed worse on the SMD task (52% vs. 75%). BKB-SIN in the electric only condition was significantly better (13.5 dB SNR v. 11 dB SNR), but significantly worse best-aided (4.5dB SNR vs. 7dB SNR). Consistent with these test results, the participant felt they struggled more in difficult listening environments and opted not to keep the program. The third subject was pediatric and improved to 80% (56% baseline) on the lexical neighborhood test (LNT). Improvement on BKB-SIN in quiet (63% vs. 52%) was also observed.

**Conclusion**: The paired electrode IGCIP strategy we propose can yield significant improvements in speech understanding in quiet, in noise, on measures of spectral resolution, as well as improvements in subjective sound quality. Results on our currently expanding dataset will be presented at the conference.
Comparing Cochlear Duct Length Versus Electrode Insertion Depth: Does it Really Impact Hearing Preservation?

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Introduction: A retrospective study to determine whether cochlear duct length (CDL), as estimated using CDL formula developed by Jolly et al accurately predicts cochlear implant insertion depth. We also look at these parameters to see if they are predictors of hearing preservation.

Methods: 183 individuals received either a MedEl FLEXsoft (n=105) or a MedEl FLEX28 (n=78), using a hearing preservation technique, over a 7 year interval (FLEXsoft July 2008 through December 2012; FLEX28 January 2013 through April 2015). All of the individuals had pre-operative high resolution CT imaging of the temporal bones from which retrospective measurement of CDL was estimated. Post-operative insertion angle was also measured using Stenver’s view. Hearing preservation data for both electrode types and speech performance outcomes were measured.

Results: FLEXsoft electrode insertion depths were, on average, deeper (500.9 degrees) than FLEX28 (484.1 degrees). Correlations between estimated CDL and angle of insertion a high level of correlation in both FLEXsoft and FLEX28 groups (R=0.71, R=0.589 respectively). Despite the greater physical dimensions and deeper insertion depths, the FLEXsoft electrode was associated with a greater rate of preserved hearing at 250Hz (FLEXsoft Post-op thresholds <90 dB HL = 53%; FLEX28 = 39%). Scores on open-set speech recognition measures were equivalent at 1 year post activation between the 2 electrodes for HINT Sentences in quiet, HINT Sentences in noise (+5 s/n), AzBio Sentences in quiet and CNC words. Performance on AzBio Sentences in noise (+5 s/n) was statistically higher for FLEXsoft users (mean = 69.0% vs. 58.9% for FLEX28 users, p<0.05).

Conclusion: There is strong correlation between CDL and electrode insertion depths as measured by post-operative skull x-rays. Interestingly the longer FLEXsoft electrode paradoxically had better soundfield test results despite having a deeper insertion. Also
unexpectedly, the FLEXsoft group had better hearing preservation in the lower frequencies compared to the FLEX28 group. These results warrant further investigations perhaps in an animal model in which more variables can be controlled or eliminated.
Introduction: Bone conduction devices are excellent options in many patients with mastoidectomy cavities suffering from large conductive hearing losses in which traditional ossicular reconstruction techniques are not options. The bonebridge is a bone conduction implant which is a rehabilitative option for these patients. However, given the dimensions of the device, there are some surgical challenges in successfully implanting these patients with minimal morbidities. Potential complications include infection, bleeding, and cerebrospinal fluid leak. We will be discussing optimal pre-surgical and surgical considerations to avoid these potentially dangerous complications.

Methods: At our institution between 2013 to 2015, we performed 51 bonebridge implants. Twenty of these patients were in patients with previous mastoidectomy cavities (canal wall down). Our approach is to avoid the sigmoid sinus by either placing the bone-conduction floating mass transducer (BC-FMT) well posterior or superior to it. Preoperative imaging (CT temporal bones and 3D reconstructions) and planning are paramount. Measurements from the posterior edge of the mastoidectomy cavity will assist the surgeon in determining the optimal location to avoid the sigmoid sinus. Posterior fossa dura or temporal lobe dura are always encountered so careful protection of the dura with copious use of diamond burrs and irrigation are vital in avoiding dural tears and bleeding. In some patients, the sigmoid was exposed and occasionally bleeding was encountered. However, all cases were treated with gelfoam compression and bleeding stopped without further interventions. Careful pre-operative planning on the location of the internal magnet and external device also allow the surgeon to intraoperatively modify the angle of the BC-FMT and internal magnet to align two locations.

Results: In our modest series of patients, no post-operative complications were noted. Some of our patients experienced magnet retention issues immediately post-activation but they all resolved in time. Our patients achieved excellent outcomes and subjective quality of life assessments also revealed excellent improvements once the device was activated and in use.

Conclusion: Although patients with mastoidectomy cavities can be surgically challenging, adequate pre-operative planning and intraoperative avoidance of the sigmoid sinus should lead to successful outcomes.
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Publishing Title: New Low-Trauma Electrode-Array Design: Features and First Results

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Abstract Body:

Introduction: Cochlear implants (CI) are nowadays expected to be as atraumatic as possible in order to preserve delicate internal cochlear structures. The following presentation reports surgical experience and clinical data following first implantations using a new low-trauma electrode-array (EA).

Methods: A new EA has been designed to minimize insertion trauma, with mechanical feature showing reduced diameter (0.4 to 0.5mm diameter) with 20 electrodes on a fairly long insertion length (25mm) adapted to several anatomical configurations and atraumatic surgeries. Data analysis were extracted retrospectively from surgical records following cochlear implantation.

Results: 10 implantations were performed following the same procedure with posterior tympanotomy and round window insertion. Healon has been used for lubrication. All surgeries showed full EA insertion, with smooth insertion. No complication has been observed, with postoperative images showing good electrode placement.

Conclusion: Altogether, these first data suggest that this new EA design is satisfactory. Residual hearing preservation study could now be considered as a next step.
Introduction: The benefits of bilateral cochlear implantation in children, either simultaneous or sequential, are better localization of the sound source (binaural/stereophony), improved speech understanding in background noise, diminution of tiredness, lower level of necessary concentration in comparison with unilateral implantation and minimizing the risk of implant failure. The goal of the present study is to discuss the candidacy criteria for bilateral cochlear implantation in children.

Methods: Retrospective analysis over 67 pediatric bilateral cases over a fifteen-year period.

Results: Regarding criteria of candidacy for bilateral cochlear implantation, sequential cochlear implantation is suggested for the following children. First, a child with congenital profound bilateral hearing loss, who has had a cochlear implantation in one side with good results, an implantation of the contralateral side as from one year is indicated in accordance with the child age. Second, a child presenting with congenital profound hearing loss of one side and severe hearing loss of the other side. Implanting the side with the profound hearing loss is indicated. In the event of worsening of the non-implanted side from severe hearing loss to profound hearing loss, we propose implanting contra-laterally. Third, a child who presents an auditory neuropathy as the phonetic convergence is beneficial for the child. As to the simultaneous implantation, we indicate the implantation when a child presents a risk of cochlear ossification (e.g. meningitis) or a risk of progressive visual impairment (e.g. usher syndrome). Family adaptation and their demands has to carefully be taken into consideration, as well as the child psychology and his cognitive capacities. Furthermore, we emphasize on the particularity of sequential bilateral implantation as the preparation and the collaboration with a specialized team is essential to overcome the second cochlear implant challenges (i.e. the difficulties to control the child, the acceptance and perception of the second cochlear implant). As a matter of fact, the rehabilitation period is long and necessitate an important level of concentration (i.e. adjustment of two processors instead of one, due to the convergence of auditory simulations), therefore it’s important to choose the right time for implantation in accord with the family and school dynamics.

Conclusion: Bilateral cochlear implantation in children is now in routine practice, however candidacy criteria have to be taken carefully to maximize children performance.
Abstract Body:

**Introduction:** Cochlear implantation permits to improve the primary auditory functions: noise recognition and then speech comprehension. Recipient’s global satisfaction doesn’t usually encourage the speech therapist to go on. However, some difficulties can still be present and are identified with difficulty in most situations (noise, music, telephone, …). A specific evaluation may be then proposed in order to offer a bespoke rehabilitation program. We describe here this precise evaluation.

**Methods:** Three more specific tasks are tested compared to usual evaluation: Sound localization, speech comprehension in noise and music listening. At first, a questionnaire intends to gather the recipient’s daily behavior with his device. Then his comprehension in silence, noise, music are tested to identify which difficulties remain. First part tests tasks such as physical sound’s particularities in intensity, frequency and temporality (DifraWave Discriminator). Second part tests tasks such as sound localization and the ability to identify the sound sources (speech, music and noise) using 8 speakers in a circle, 45° one from another. We then analyze the recipient’s abilities to listen to music and finally his speech comprehension in silence and noise (Lafon word’s and Hint phrases).

**Results:** Two years after beginning this evaluation, which has been tested on 30 patients, we identified remaining difficulties even if their global hearing satisfaction was good. Among the recipients that reached 80% of words comprehension at 50 dB, 92% were unable to localize the sound, 26% couldn't tolerate specific noises, 86% had difficulties in noise and 54% still didn't listen to music.

**Conclusion:** Our rehabilitation center proposes one year after surgery a specific evaluation. More than testing auditory capacities it permits to identify remaining difficulties and to set up a specific rehabilitation program adapted to each recipient.
Introduction: The aim of this study was to describe the characteristics of Danish adolescent cochlear implant users, to determine their speech perception and language outcome and to evaluate predictive variables for successful outcomes.

Methods: 45 Danish cochlear implant users between 12-19 years were assessed in a cross-sectional study. They received their first implant between 1993 and 2010. 34 (76 %) were bilaterally implanted. Speech perception in quiet and noise was evaluated by using a monosyllabic test Dantale 1. Language outcome was evaluated using a receptive language test Peabody Picture Vocabulary Test (fourth ed.) and a Danish standardized expressive language test [OK-testen]. Reading comprehension was evaluated using a standardized reading test [TL-prøverne]. Nonverbal IQ was evaluated using Raven’s Standard Progressive Matrices. Logistic regression models and odds ratio estimates were used to analyse the relationship between test results and different factors such as school type, communication mode, support and socioeconomic status.

Results: 77 % of the adolescents had high speech perception outcome scores. Almost half of the adolescents did not have age appropriate language and reading level. Factors associated with language outcome measures were previous and present school placement, communication mode and mother's education. Adolescents who went exclusively to mainstream schools were more likely to perform at or above age equivalent level in vocabulary and reading tests.

Conclusion: Approximately half of the adolescent cochlear implant users attained age appropriate language scores compared to normative results on hearing children. Adolescents who attended mainstream school settings and did not use a total communication or sign language approach had better odds of age equivalent language outcomes compared to adolescents who went to special schools and used a total communication or sign language approach.