
Abstract

OBJECTIVES: To adapt the LittlEARS® Auditory Questionnaire into Persian and evaluate the psychometric properties of the Persian version of the questionnaire for children with normal hearing. METHODS: A "back-translation" method was used to translate and adapt the LittlEARS Auditory Questionnaire into Persian. The translated version was first evaluated by means of an expert-appraisal method. After having improved the Persian version of LittlEARS with the results obtained from that evaluation, various psychometric analyses were carried out to determine the validity and reliability. A group of 240 Persian speaking parents of children below 24 months of age with normal hearing completed the LittlEARS® Auditory Questionnaire. Various psychometric analyses (scale analysis and item analysis) were conducted. RESULTS: In the current study, the following scale and item characteristics were investigated: Corrected item-total correlations ranged from 0.14 to 0.74; Cronbach's alpha coefficient value was 0.960; the split-half reliability r was 0.734; predictive accuracy Guttman's lambda was 0.965; the correlation between the overall score and age of the children was 0.808 (p < 0.001). The regression curve, which reflects the age-dependence of auditory behavior, was produced. The regression analysis that was conducted to obtain normative data showed that 80% of the variance in the total scores could be explained by age. CONCLUSION: The data obtained from psychometric analysis support the use of the Persian version of the LittlEARS Auditory Questionnaire as a reliable and valid tool to assess the development of auditory behavior in Persian speaking children who are 24 months old or younger.


Abstract

OBJECTIVES: Combined electric-acoustic stimulation (EAS) is a well-accepted therapeutic treatment for cochlear implant (CI) users with residual hearing in the low frequencies but severe to profound hearing loss in the high frequencies. The recently introduced SONNETeas audio processor offers different microphone directionality (MD) settings and wind noise reduction (WNR) as front-end processing. The aim of this study was to compare speech perception in quiet and noise between two EAS audio processors DUET 2 and SONNETeas, to assess the impact of MD and WNR on speech perception in EAS users in the absence of wind. Furthermore, subjective rating of hearing performance was registered. METHOD:
Speech perception and subjective rating with SONNETeas or DUET 2 audio processor were assessed in 10 experienced EAS users. Speech perception was measured in quiet and in a diffuse noise setup (MSNF). The SONNETeas processor was tested with three MD settings omnidirectional/natural/adaptive and with different intensities of WNR. Subjective rating of auditory benefit and sound quality was rated using two questionnaires. RESULTS: There was no significant difference between DUET 2 and SONNETeas processor using the omnidirectional microphone in quiet and in noise. There was a significant improvement in SRT with MD settings natural (2.2 dB) and adaptive (3.6 dB). No detrimental effect of the WNR algorithm on speech perception was found in the absence of wind. Sound quality was rated as "moderate" for both audio processors. CONCLUSIONS: The different MD settings of the SONNETeas can provide EAS users with better speech perception compared to an omnidirectional microphone. Concerning speech perception in quiet and quality of life, the performance of the DUET 2 and SONNETeas audio processors was comparable.


Abstract

OBJECTIVE: Hearing preservation after cochlear implantation allows for fitting of acoustic and cochlear implant technologies in the same ear, known as Electric-Acoustic Stimulation (EAS). Cochlear implant recipients with EAS who experience an internal device failure face the additional risk of residual hearing loss during reimplantation. This report reviews the case of an EAS recipient with long-term hearing preservation and significant benefit who experienced a device failure and underwent cochlear reimplantation. PATIENT: Case study who presented with an internal device failure after nearly 10 years of hearing preservation and significant benefit with an EAS device. INTERVENTION: Reimplantation with hearing preservation electrode array. MAIN OUTCOME MEASURES: Unaided residual hearing and aided speech perception with an EAS device using CNC words in quiet and CUNY sentences in noise. RESULTS: Low-frequency thresholds were similar when comparing residual hearing pre- and post-reimplantation. The patient does not use the acoustic portion of the EAS device due to normal low-frequency hearing sensitivity—even after two cochlear implantation procedures. At the 3-month follow-up interval, the patient demonstrated restoration of aided speech perception performance with the EAS device. CONCLUSIONS: Hearing preservation can be maintained with long-term use of EAS devices. Those with preserved low-frequency hearing who experience a device failure may maintain hearing preservation after reimplantation. Normal low-frequency hearing thresholds were maintained in the present case, and the patient continued to listen with the EAS device without the acoustic component. EAS recipients may experience rapid restoration in speech perception after reimplantation in the presence of hearing preservation.

Abstract

OBJECTIVES: To investigate the long-term outcomes of cochlear implantation in individuals with single-sided deafness (SSD) in terms of speech perception, subjective hearing performance, and sound localization. METHODS: Thirty-four subjects with SSD were recruited across two large cochlear implant (CI) centers (Antwerp, Belgium and Perth, Australia). The long-term hearing outcomes (between 4 and 10 years of CI use) were evaluated using speech in noise tests, a subjective hearing performance questionnaire (Speech, Spatial and Qualities Questionnaire [SSQ12]), and sound localization tests. RESULTS: Statistically significant improvements were observed in speech perception in noise and sound localization results postoperatively with the use of a CI in comparison to preoperative measurements. Subjective hearing abilities also significantly improved after long-term CI use. CONCLUSION: Access to binaural hearing is important for subjects with SSD. CI users with SSD experience long-term benefits in speech understanding, sound localization, and quality of life.


Abstract

OBJECTIVE: While cochlear implant (CI) provision for adults with single-sided deafness (SSD) is now an accepted treatment option, auditory training programs specific to this group of CI users have not been described. This paper details the auditory training protocol and critical factors required to rehabilitate CI users with post-lingual SSD. OUTCOMES AND RESULTS: Several key factors are integral to the success of the rehabilitation program; these include 1) CI users with SSD require a map that is balanced as closely as possible to their normal hearing ear and has optimal mapping levels; 2) the auditory training program needs to be stimulating, rewarding, and directly stimulate the implanted ear via Direct Auditory Input (DAI); 3) CI users need to achieve some success in the early post-implantation stages to maintain or increase their motivation; 3) CI users need to be fully committed to the auditory training; and 5) a well-defined structured auditory training program with immediate feedback and markers of success helps ensure optimal communication outcomes. As an indication of success, from the foundation of the program in 2008 until the present all adults with SSD who have received a CI at our clinic (N = 114) only 5 have elected to stop using their device. CONCLUSION: The auditory training program described herein has been developed to optimize hearing and quality of life outcomes for adult CI users with SSD.


Abstract
PURPOSE: A recent clinical trial has shown the feasibility of robotic cochlear implantation. The electrode was inserted through the robotically drilled tunnel and an additional access through the external auditory canal was created to provide for means of visualization and manipulation. To obviate the need for this additional access, the utilization of multiple robotically drilled tunnels targeting the round window has been proposed. The objective of this study was to assess the feasibility of electrode insertion through a robotic multiport approach. METHODS: In four ex vivo human head specimens (left side), four trajectories through the facial recess (2x) and the retrofacial and suprameatal region were planned and robotically drilled. Optimal three-port configurations were determined for each specimen by analyzing combinations of three of the four trajectories, where the three trajectories were used for the electrode, endoscopic visualization and manipulative assistance. Finally, electrode insertions were conducted through the optimal configurations. RESULTS: The electrodes could successfully be inserted, and the procedure sufficiently visualized through the facial recess drill tunnels in all specimens. Effective manipulative assistance for sealing the round window could be provided through the retrofacial tunnel. CONCLUSIONS: Electrode insertion through a robotic three-port approach is feasible. Drill tunnels through the facial recess for the electrode and endoscope allow for optimized insertion angles and sufficient visualization. Through a retrofacial tunnel effective manipulation for sealing is possible.


Abstract

BACKGROUND: Remote programming for adult cochlear implant (CI) users is feasible, safe, and effective. Limited evidence, however, exists on if remote CI programming can also be productively done with pediatric CI users. AIMS/OBJECTIVES: To assess the safety and feasibility of remote CI programming in CI users for all ages. MATERIALS AND METHODS: Forty-six (25 children, 21 adults) experienced CI users were fit locally and remotely. The results of these two fitting sessions were compared in terms of safety, Impedance Field Telemetry (IFT), Maximum Comfortable Levels (MCL), Threshold Levels (THR), audiometry, fitting duration, and speech understanding. RESULTS: The subjects' safety was not compromised during any of the fitting procedures. No significant difference was found for IFT, MCL, THR, audiometry, or speech understanding for either remote or local fitting. Remote fittings took slightly longer than local fittings when only the fitting time itself was measured. CONCLUSIONS AND SIGNIFICANCE: Remote follow-up fitting is as safe, feasible, and effective as local fitting for CI users of all ages. A more extensive adoption of remote fitting may allow many CI users greater access to clinics and therefore increased benefit from CI use.

OBJECTIVE:
To investigate the feasibility of using the LittlEARS® Auditory Questionnaire (LEAQ®) as part of the infant hearing screening programme in Germany. DESIGN: LEAQ®s were distributed to 47 paediatric practices and were completed by the parents/guardians of the infants (aged between 9-14 months) involved in the study (= LEAQ® screening). The infants who failed the LEAQ® screening were invited to a LEAQ rescreening. Infants who failed the LEAQ® rescreening were sent to a paediatric ENT specialist. After 3 years, a follow-up was performed on two groups: the first group comprised infants who failed the LEAQ screening; the second group (control group) comprised 200 infants who passed the LEAQ screening. STUDY SAMPLE: 5316 questionnaires were returned. RESULTS: Six infants with permanent hearing loss were identified using the LEAQ® as a screening tool. CONCLUSIONS: An infant hearing screening using the LEAQ® is easily implementable in paediatric practices and may be a good alternative in countries where no objective screening instruments are available. The LEAQ® was suitable for monitoring hearing development in infants in general and could help to identify a late-onset or progressive hearing loss in infants.


Abstract

Neuroprostheses designed to interface with the nervous system to replace injured or missing senses can significantly improve a patient's quality of life. The challenge remains to provide implants that operate optimally over several decades. Changes in the implant-tissue interface may precede performance problems. Tools to identify and characterize such changes using existing clinical measures would be highly valuable. Modern cochlear implant (CI) systems allow easy and regular measurements of electrode impedance (EI). This measure is routinely performed as a hardware integrity test, but it also allows a level of insight into the immune-mediated response to the implant, which is associated with performance outcomes. This study is a 5-year retrospective investigation of MED-EL CI users at the University of Southampton Auditory Implant Service including 176 adult ears (18-91) and 74 pediatric ears (1-17). The trend in EI in adults showed a decrease at apical electrodes. An increase was seen at the basal electrodes which are closest to the surgery site. The trend in the pediatric cohort was increasing EI over time for nearly all electrode positions, although this group showed greater variability and had a smaller sample size. We applied an outlier-labeling rule to statistically identify individuals that exhibit raised impedance. This highlighted 14 adult ears (8%) and 3 pediatric ears (5%) with impedance levels that deviated from the group distribution. The slow development of EI suggests intra-cochlear fibrosis and/or osteogenesis as the underlying mechanism. The usual clinical intervention for extreme impedance readings is to deactivate the relevant electrode. Our findings highlight some interesting clinical contradictions: some cases with raised (but not extreme) impedance had not prompted an electrode deactivation; and many cases of electrode deactivation had been informed by subjective patient reports. This
emphasizes the need for improved objective evidence to inform electrode deactivations in borderline cases, for which our outlier-labeling approach is a promising candidate. A data extraction and analysis protocol that allows ongoing and automated statistical analysis of routinely collected data could benefit both the CI and wider neuroprosthetics communities. Our approach provides new tools to inform practice and to improve the function and longevity of neuroprosthetic devices.


Abstract

PURPOSE: Bilateral cochlear implant (CI) provision is now widely regarded as the most beneficial hearing intervention for acceptable candidates. This study sought to determine if a number of well-regarded hearing professionals at highly reputable clinics shared similar practices and beliefs regarding bilateral CI provision, use, and rehabilitation in children and adults. METHODS: An 11-question online questionnaire was created and distributed to all 27 clinics in the HEARRING group. Questions 1-5 asked for facts; questions 6-11 asked for opinions. RESULTS: 20 completed questionnaires were returned. All 20 respondents reported that their clinics perform bilateral cochlear implantation in children; 18 do so in adults. Regarding the fact-based questions, bilateral CI provision is more commonly performed and more likely to be reimbursed in children than in adults. Children are also much more likely to be implanted simultaneously than are adults. Regarding the opinion-based questions, respondents gave broadly similar answers. Communication between the CIs and speech coding strategies specifically developed for bilateral CI users were regarded as the two future technologies that would most enhance the benefit of bilateral CI use. CONCLUSIONS: Most clinics in the HEARRING group are very familiar with bilateral CI provision and hold similar opinions on its results and benefits. Hopefully the results described herein will lead to a greater acceptance and regular reimbursement of bilateral CI provision, especially in adults.


Abstract

BACKGROUND: Hearing preservation is thought to be achievable following atraumatic surgery with thin cochlear implant electrodes; therefore, the surgical approach and implant electrode design are crucial considerations. OBJECTIVE: To assess the feasibility of hearing preservation with long electrodes for patients meeting the criteria for conventional cochlear implantation. METHODS: One hundred and two patients (132 ears) who underwent cochlear implant surgery were analyzed. Inclusion criteria included measurable residual hearing in the low frequency before implantation and not meeting the criteria for electric acoustic stimulation (EAS). RESULTS: Of the 18 patients with residual hearing in the low frequency enrolled, 17
subjects (94.4%) retained low frequency hearing. A younger age at surgery tended to contribute to better hearing preservation than that observed in older patients. There was no clear trend regarding the influence of insertion depth angle of the electrode on hearing preservation. CONCLUSION: It is possible to achieve hearing preservation in the lower frequency by the use of longer electrodes. This study underscores the importance of atraumatic surgery, even for patients with only limited residual hearing, and longer electrodes should be adopted for EAS.


Abstract

OBJECTIVES/HYPOTHESIS: Evaluation of the clinical, electrophysiologic findings, the management plans of the misplaced cochlear implant electrode array and the possible causes of misplacement. Also to provide recommendations to prevent a repeat of cochlear implant electrode misplacement into abnormal sites. STUDY DESIGN: Retrospective study. METHODS: Pediatric cochlear implant recipients implanted from January 2012 till January 2018 whose electrode arrays were misplaced outside the cochlea into the surrounding structures. RESULTS: Eight pediatric cochlear implant recipients, were identified to have a misplaced cochlear implant electrode array. Different sites of improper placement included one case in the eustachian tube, another one in the vestibule, one electrode array was found to be in the petrous apex lateral to the internal carotid canal, and another one in the internal auditory canal (IAC), and in three cases the electrode arrays were packed in the hypotympanum, and lastly an electrode array recoiled after perfect insertion and was found to be in the facial recess. Six cases were initially identified immediate because of their poor intraoperative implant testing which prompted imaging while in two cases, the one found in the petrous apex and the other one in the internal auditory canal (IAC) were diagnosed several months after surgery due to unsatisfactory auditory skills development or absent behavioral responses following implantation. CONCLUSIONS: Electrode array misplacement may be due to either failure to identify the anatomical landmarks during surgery specially the infracochlear air cell track or unidentified inner ear malformation. The routine use of intraoperative electrophysiologic testing and postoperative imaging should help to avoid such complications. Misplacement is a rare but still correctable complication after cochlear implant surgery. The diagnosis of misplacement can be delayed for years and in this occasion, it is suspected when benefit from the implant is limited or absent. Once misplacement is diagnosed revision surgery has to be done.


Abstract
Many users of bilateral cochlear implants (BiCIs) localize sound sources less accurately than do people with normal hearing. This may be partly due to using two independently functioning CIs with fixed compression, which distorts and/or reduces interaural level differences (ILDs). Here, we investigate the potential benefits of using binaurally coupled, dynamic compression inspired by the medial olivocochlear reflex; an approach termed “the MOC strategy” (Lopez-Poveda et al., 2016, Ear Hear 37:e138-e148). Twelve BiCI users were asked to localize wideband (125-6000 Hz) noise tokens in a virtual horizontal plane. Stimuli were processed through a standard (STD) sound processing strategy (i.e., involving two independently functioning sound processors with fixed compression) and three different implementations of the MOC strategy: one with fast (MOC1) and two with slower contralateral control of compression (MOC2 and MOC3). The MOC1 and MOC2 strategies had effectively greater inhibition in the higher than in the lower frequency channels, while the MOC3 strategy had slightly greater inhibition in the lower than in the higher frequency channels. Localization was most accurate with the MOC1 strategy, presumably because it provided the largest and less ambiguous ILDs. The angle error improved slightly from 25.3° with the STD strategy to 22.7° with the MOC1 strategy. The improvement in localization ability over the STD strategy disappeared when the contralateral control of compression was made slower, presumably because stimuli were too short (200 ms) for the slower contralateral inhibition to enhance ILDs. Results suggest that some MOC implementations hold promise for improving not only speech-in-noise intelligibility, as shown elsewhere, but also sound source lateralization.


Abstract

OBJECTIVE: Aim of this study was to evaluate the method of partial insertion of flexible lateral wall electrodes in patients with residual hearing and potential electric-acoustic stimulation (EAS) users. PATIENTS AND INTERVENTION: N=6 patients with a high-frequency hearing loss were treated with a partial insertion using atraumatic lateral wall electrodes. In three cases, an electrode of 24 mm length was inserted with the aim to achieve a 16 mm insertion depth and in three cases an electrode of 28 mm length to achieve a 20 mm insertion depth. MAIN OUTCOME MEASURE: Differences between the pre- and postoperative unaided air-conducted pure tone thresholds in low frequencies (125 Hz-1.5 kHz) were analyzed. Freiburg monosyllables (FBM) at 65 dB and Hochmair-Desoyer sentence test in noise (10 dB SNR) were performed. The pre- and postoperative cochlea images were analyzed. RESULTS: Residual hearing could be preserved in all patients (n=6) and is stable up to 6 months follow-up. All patients could use EAS with an average speech understanding score of 65% in monosyllables (FBM) and 76% in sentences in noise. All patients benefit significantly compared to the preoperative best aided situation. CONCLUSION: First results of patients treated with partially inserted atraumatic lateral wall electrodes show good hearing preservation rates and very good speech perception results in EAS. Partial insertion appears to be a method for an individualized cochlea implantation. In case of postoperative hearing loss, the electrode can be
further inserted, so the patients can benefit from deeper insertion using electric stimulation only equivalent to larger electrodes.


Abstract

The auditory system can theoretically encode frequencies by either the rate or place of stimulation within the cochlea. Previous work with cochlear implants has demonstrated that both changes in timing and place can be described as pitch changes but are perceptually orthogonal. Using multidimensional scaling, the present experiment extends the previous findings that timing and place changes are perceptually orthogonal into the cochlear apex using long 31-mm electrode arrays. However, temporal cues seem to be more reliable across subjects at the apex while place cues seem to be more reliable at the middle of the cochlea.


Abstract

OBJECTIVES: Many studies examining early bilingualism in migrant populations focus on the development of the first language. As language acquisition is closely related to the hearing development, there is a critical need to investigate language development in hearing-impaired children being raised bilingually who were fitted with cochlear implants and/or hearing aids. Therefore, this research project aimed to study the linguistic development of hearing-impaired children being raised with German as a second language who were provided with hearing aids or cochlear implants. Further, the language development of these children is compared with that of hearing-impaired children being raised in a monolingual environment and with normal-hearing children being raised bilingually. METHODS: In this prospective study, we analyzed data from 95 typically developing children with hearing loss (43 bilingual and 52 monolingual) aged 3:0 to 10:11 (years; months) on four language measures in German: receptive vocabulary, productive vocabulary, receptive grammar, productive grammar (sentence repetition). Additionally, 30 bilingual children with normal hearing were included in this study. RESULTS: 44 children were provided with hearing aids in both ears; 34 used cochlear implants bilaterally and 17 were fitted bimodally. Statistical analysis showed that bilingual hearing-impaired children scored significantly poorer than monolingual hearing-impaired children. CONCLUSION: Hearing-impaired children being raised bilingually should have speech and language examinations on a regular basis. An examination of both languages would be desirable in order to be able to fully assess speech and language acquisition.

environment: Part II: Measuring the hearing performance and evaluating the listening effort of individuals with a hearing implant. Cochlear Implants Int. 20(4):165-175.

Abstract

Objectives: The controlled clinical test environment is very different from real-life listening situations, where the presence of additional speakers and variations in background noise signals can affect listening performances. The primary objective of this study is to reduce the gap between clinical results and real-life performances that are reported for many hearing implant users. Methods: Similar to Part I of this study, hearing performance and sound perception are evaluated using the following tests: (i) the Roving Level Test, (ii) the Just Understanding Speech Test, (iii) the Performance Perceptual Test, (iv) the Visual Analogue Scale to evaluate the perceived listening effort required for a range of background noise levels, and (v) the Hearing Implant Sound Quality questionnaire. All subjects recruited for this study used MED-EL hearing implant systems. Results: Results show that, similar to normal hearing listeners, hearing implant users tend to accurately estimate their hearing abilities, and both listening effort and speech recognition thresholds tend to increase with increasing noise. Discussion: The proposed test battery for evaluating speech understanding and listening effort were suitable for use in this study as all of the implant users were able to complete the tests. This test battery can be used to provide audiologists with further information relating to real-life listening performances. Conclusion: Evaluating the self-estimated and verified performance measurements of hearing implant users in real-life listening situations are essential for providing information regarding the discrepancies observed between the objective and subjective reports of hearing difficulties.


Abstract

OBJECTIVE: Controlled clinical test environments are very different from real-life listening situations in which speaker and background noise level variations can hinder a person's ability to hear and follow conversations. This study was performed to evaluate the ability of people with normal hearing to follow a single speaker in the presence of background noise, and to explore relations between those measures and the listeners' subjective assessments, listening effort, and sound quality judgements. METHODS: A group of adults with normal hearing were evaluated using the following battery of tests: (i) Roving Level Test, (ii) the Just Understanding Speech Test, (iii) Performance Perceptual Test, (iv) the Visual Analogue Scale to evaluate listening effort, and (iv) with a sound quality questionnaire. RESULTS: The results show that people with normal hearing tend to accurately estimate their hearing abilities, and both the listening effort required and speech recognition thresholds tend to increase with increasing background noise. DISCUSSION: Implementing a battery of tests that evaluate speech-in-noise listening abilities, listening effort, and subjective hearing perception might provide greater
insight into hearing performance than traditional measures. Additionally, the data generated in this study can be used for comparison with measures obtained from hearing impaired and hearing device listeners, and as such, has the potential to guide counselling and rehabilitation to a range of clinical populations. CONCLUSION: The examination of both the self-estimated and verified performance measurements in simulated real-life listening situations can provide audiologists with a comprehensive and realistic profile of a person's hearing performance.


Abstract

OBJECTIVES: Electrically evoked compound action potentials (eCAP) recordings are widely used in functional evaluation and fitting of cochlear implants (CI) in clinics. We compared the results from two eCAP recording approaches (StandardART and FineGrain, MED-EL, Austria). The FineGrain method is more advanced than the Auditory Nerve Response Telemetry (StandardART) method in terms of the stimulation and algorithm for the eCAP threshold detection. To understand the benefits of these alterations, we compared the two methods on a larger scale in pediatric CI users alongside evoked auditory brainstem responses (eABR).

MATERIALS AND METHODS: We collected the eCAP recordings obtained with both methods from a population of pediatric subjects with CI, either intra- or post-operatively. The eABR recordings were only collected post-operatively. For comparability reasons, we used the same stimulation rate and similar amplitude levels for all three approaches.

RESULTS: Our results demonstrate that, although the success rates are similar, the FineGrain method outperforms traditional StandardART in terms of robustness and measurement duration. The eCAP recordings in general outperform the eABR in terms of speed.

CONCLUSION: We conclude that the eCAP recordings are the method of choice for measuring the auditory neural activity, and FineGrain outperforms StandardART. From the three investigated approaches, we conclude that FineGrain performed best and should be the first-choice method in pediatric patients.


Abstract

Auditory brainstem implantation (ABI) is a recent technique in children's hearing restoration. Up till now the focus in the literature has mainly been the perceptual outcomes after implantation, whereas the effect of ABI on spoken language is still an almost unexplored area of research. This study presents a one-year follow-up of the volubility of two children with ABI. The volubility of signed and oral productions is investigated and oral productions are examined in more detail. Results show clear developmental trends in both children, indicating a beneficial effect of ABI on spoken language development.

Abstract

OBJECTIVE:
To determine the effect of cochlear coverage on audiological and speech parameters in patients with cochlear implants. Previous work has investigated the effect of tailoring electrode size to a cochlear implant recipient's individual cochlear duct length (CDL). However, no clear relationship has been found between speech development and the extent of electrode insertion, and the benefits of apical stimulation are not yet clear. METHODOLOGY: In this retrospective study, we assessed the effect of cochlear coverage on audiological and speech performance. Participants were prelingually deaf children who received cochlear implants between June 2013 and December 2014 under the care of a single cochlear implant surgeon. Cochlear coverage was estimated for each ear according to electrode type, depth of insertion, and the number of active electrodes. Electrode type and length were determined by the individual's CDL, measured by computed tomography (CT), and full insertion was documented intraoperatively. The number of active electrodes was recorded using intraoperative audiological response telemetry. Audiological assessments were obtained 6 months and 1 year postoperatively. Results of the categories of auditory performance-II and speech intelligibility rating scales were obtained after 3 years. Patients were divided into two groups based on their cochlear coverage and their audiological and speech outcomes were compared. RESULTS: Of the 97 children recruited, 47 were girls. Temporal bone CT scans showed the right and left mean CDLs among girls were 27.7 and 27.9 mm, respectively, and 29.2 mm for both ears in boys. For each sex, the right and left CDLs did not differ significantly (p = 0.07). Twenty patients were lost to follow-up, leaving 77 patients (120 ears), which were divided into groups according to cochlear coverage (complete vs. incomplete). Significant between-group differences were not found in assessments of audiology, categories of auditory performances, or speech intelligibility ratings after 3 years. CONCLUSION: Audiological parameters do not differ according to the degree of cochlear coverage, specifically for low-frequency tones. Speech parameters are also comparable. Therefore, complete cochlear coverage does not appear to provide significant benefit over incomplete coverage for prelingually deaf cochlear implant recipients.


Abstract

BACKGROUND: When cochlear implant (CI) listeners use a directional microphone or beamformer system to improve speech understanding in noise, the gain in understanding for speech presented from the front of the listener coexists with a decrease in speech
understanding from the back. One way to maximize the usefulness of these systems is to keep a microphone in the omnidirectional mode in low noise and then switch to directional mode in high noise. PURPOSE: The purpose of this experiment was to assess the levels of speech understanding in noise allowed by a new signal processing algorithm for MED EL CIs, AutoAdaptive, which operates in the manner described previously. RESEARCH DESIGN: Seven listeners fit with bilateral CIs were tested in a simulation of a crowded restaurant with speech presented from the front and from the back at three noise levels, 45, 55, and 65 dB SPL. DATA COLLECTION AND ANALYSIS: The listeners were seated in the middle of an array of eight loudspeakers. Sentences from the AzBio sentence lists were presented from loudspeakers at 0 or 180° azimuth. Restaurant noise at 45, 55, and 65 dB SPL was presented from all eight loudspeakers. The speech understanding scores (words correct) were subjected to a two-factor (speaker location and noise level), repeated measures, analysis of variance with posttests. RESULTS: The analysis of variance showed a main effect for level and location and a significant interaction. Posttests showed that speech understanding scores from front and back loudspeakers did not differ significantly at the 45- and 55-dB noise levels but did differ significantly at the 65-dB noise level—with increased scores for signals from the front and decreased scores for signals from the back. CONCLUSIONS: The AutoAdaptive feature provides omnidirectional benefit at low noise levels, i.e., similar levels of speech understanding for talkers in front of, and in back of, a listener and beamformer benefit at higher noise levels, i.e., increased speech understanding for signals from in front. The automatic switching feature will be of value to the many patients who prefer not to manually switch programs on their CIs.


Abstract

The objective of this study is to determine the variations in size and shape of the most widely recognized cochlear malformation types using three-dimensional (3D) visualization. Using 3D slicer freeware, the complete inner-ear structures were segmented from 46 anonymized high-resolution computed tomography (HRCT) image datasets. Cochlear height, internal auditory canal height, and width were measured from the axial plane. Cochlear basal turn diameter was measured from the oblique coronal plane. Number of cochlear turns was measured from the 3D images and the corresponding cochlear duct length (CDL) was estimated using the CDL equations given in Alexiades et al. [Otol Neurotol 36 (2015) 904-907]. Out of 46 preoperative HRCT image datasets of human temporal bone, cochlear anatomy types including normal anatomy (4), enlarged vestibular aqueduct syndrome (3), cochlear aplasia (2), incomplete partition Types I (8), II (Mondini’s deformity) (3), and III (X-linked) (4), cochlear hypoplasia (CH) (17), and common cavity (CC) (5) were identified. Majority of CH cases had cochlear height shorter than 4 mm whereas the CC cases measured cochlear height above 6 mm. For all the other malformation types, cochlear height was between 4 and 6 mm. In terms of “A” value, majority of CH cases showed shorter "A" value of <7.5 mm, which is in the lower end in comparison to the rest of the malformation types reported in this study. 3D-visualization shows the size and shape variations of all the structures of inner ear and also improves the clinicians’
ability to visualize cochlear anatomy and nearby structures much easier than from the 2D image slices.


Abstract

During robotic cochlear implantation a drill trajectory often passes at submillimeter distances from the facial nerve due to close lying critical anatomy of the temporal bone. Additional intraoperative safety mechanisms are thus required to ensure preservation of this vital structure in case of unexpected navigation system error. Electromyography based nerve monitoring is widely used to aid surgeons in localizing vital nerve structures at risk of injury during surgery. However, state of the art neuromonitoring systems, are unable to discriminate facial nerve proximity within submillimeter ranges. Previous work demonstrated the feasibility of utilizing combinations of monopolar and bipolar stimulation threshold measurements to discretize facial nerve proximity with greater sensitivity and specificity, enabling discrimination between safe (> 0.4 mm) and unsafe (< 0.1 mm) trajectories during robotic cochlear implantation (in vivo animal model). Herein, initial clinical validation of the determined stimulation protocol and nerve proximity analysis integrated into an image guided system for safety measurement is presented. Stimulation thresholds and corresponding nerve proximity values previously determined from an animal model have been validated in a first-in-man clinical trial of robotic cochlear implantation. Measurements performed automatically at preoperatively defined distances from the facial nerve were used to determine safety of the drill trajectory intraoperatively. The presented system and automated analysis correctly determined sufficient safety distance margins (> 0.4 mm) to the facial nerve in all cases.


Abstract

OBJECTIVE: To evaluate cognitive change in severely hearing-impaired older adults after cochlear implantation. STUDY DESIGN: Prospective, longitudinal cohort study with assessments before, and at 6 and 12 months after implantation. PATIENTS: Twenty older adults (median age: 71.5 yr). MAIN OUTCOME MEASURES: Change in the Repeatable Battery for the Assessment of Neuropsychological Status for Hearing-impaired individuals (RBANS-H) total score and subdomain scores were used to assess cognitive evolution. In addition, change in best-aided speech audiometry in quiet (monosyllabic words) and in noise (Leuven Intelligibility Sentences Test [LIST]) was examined, as well as patient-reported measures of health-related quality of life (Nijmegen Cochlear Implant Questionnaire [NCIQ]),
self-perceived hearing disability (Speech, Spatial, and Qualities of hearing Scale-12 [SSQ12]), sound quality (Hearing Implant Sound Quality Index-19 [HISQUI19]), and states of anxiety and depression (Hospital Anxiety and Depression Scale [HADS]). RESULTS: The RBANS-H total scores improved significantly after 12 months cochlear implant (CI) usage ($p < 0.001$). At subdomain level, significant improvements were observed in the immediate and delayed memory domain ($p = 0.005$ and $p = 0.002$, respectively), and to a lesser extent also in the attention domain ($p = 0.047$). Furthermore, speech perception in quiet and in noise improved significantly after 6 months and remained stable after 12 months. Similarly, a significant improvement was observed on all patient-reported measures after 6 months of CI usage. These results remained stable after 12 months, except for the HADS. CONCLUSIONS: A significant improvement in overall cognition after 12 months of CI usage was established. However, future research is imperative to further disentangle possible practice effects from the effects of the cochlear implantation. The significant, positive effect of cochlear implantation on speech perception and patient-reported measures was confirmed.


Abstract

INTRODUCTION: Cochlear nerve aplasia or hypoplasia is found in up to a half of patients with unilateral or bilateral hearing loss. There is an ongoing discussion regarding the indication of cochlear implants for hearing rehabilitation in cases with radiologically-defined aplasia or hypoplasia of the cochlear nerve in those patients, especially in children. At present there is conflicting evidence whether the audiological outcomes of those children with a CI are comparable to those of children with a CI and a radiologically-normal cochlear nerve. The primary aim of this study was to assess the audiological abilities before and after CI provision in children with cochlear nerve hypoplasia or aplasia. Additionally, we aimed to determine if audiological outcomes differed in children with aplasia from those with hypoplasia. Such data should be helpful in determining if CI provision is appropriate for such children. METHODS: This retrospective study presents 7 children who were diagnosed with cochlear nerve aplasia or hypoplasia and received a CI. The pre- and postoperative audiological performance and the hearing and speech development of the children were examined. RESULTS: 4 children were unilateral CI users and 3 were bilateral CI users. Hearing reactions could be detected in all children. Already at first fitting, prompt responses and reactions to songs were observed. The aided thresholds in free field in children with hypoplasia were between 30 and 60 dB. Even in children with aplasia, the results in free field with CI averaged between 30 and 70 dB. Therefore, the aided thresholds in children with hypoplasia and in children with aplasia of the CN are similar. It could be demonstrated that hearing reactions improve with the long-term use of the implant. Improvement in general development could be observed in all children despite the very heterogeneous conditions and the accompanying handicaps. CONCLUSION: The results of this study support the hypothesis that children with radiologically-defined CN hypoplasia or aplasia and detectable responses to electrical or acoustical stimuli can improve their sound detection thresholds and their awareness of sound when provided with a CI.

Abstract

OBJECTIVES: Cochlear implants (CIs) have been shown to benefit patients with single-sided deafness (SSD) in terms of tinnitus reduction, localization, speech understanding, and quality of life (QoL). While previous studies have shown cochlear implantation may benefit SSD patients, it is unclear which point of comparison is most relevant: baseline performance before implantation versus performance with normal-hearing (NH) ear after implantation. In this study, CI outcomes were assessed in SSD patients before and up to 6 mo postactivation. Benefits of cochlear implantation were assessed relative to binaural performance before implantation or relative to performance with the NH ear alone after implantation. DESIGN: Here, we report data for 10 patients who completed a longitudinal, prospective, Food and Drug Administration-approved study of cochlear implantation for SSD patients. All subjects had severe to profound unilateral hearing loss in one ear and normal hearing in the other ear. All patients were implanted with the MED-EL CONCERTO Flex 28 device. Speech understanding in quiet and in noise, localization, and tinnitus severity (with the CI on or off) were measured before implantation (baseline) and at 1, 3, 6 mo postactivation of the CI processor. Performance was measured with both ears (binaural), the CI ear alone, and the NH ear alone (the CI ear was plugged and muffed). Tinnitus severity, dizziness severity, and QoL were measured using questionnaires administered before implantation and 6 mo postactivation. RESULTS: Significant CI benefits were observed for tinnitus severity, localization, speech understanding, and QoL. The degree and time course of CI benefit depended on the outcome measure and the reference point. Relative to binaural baseline performance, significant and immediate (1 mo postactivation) CI benefits were observed for tinnitus severity and speech performance in noise, but localization did not significantly improve until 6 mo postactivation; questionnaire data showed significant improvement in QoL 6 mo postactivation. Relative to NH-only performance after implantation, significant and immediate benefits were observed for tinnitus severity and localization; binaural speech understanding in noise did not significantly improve during the 6-mo study period, due to variability in NH-only performance. There were no correlations between behavioral and questionnaire data, except between tinnitus visual analog scale scores at 6 mo postactivation and Tinnitus Functional Index scores at 6 mo postactivation. CONCLUSIONS: The present behavioral and subjective data suggest that SSD patients greatly benefit from cochlear implantation. However, to fully understand the degree and time course of CI benefit, the outcome measure and point of comparison should be considered. From a clinical perspective, binaural baseline performance is a relevant point of comparison. The lack of correlation between behavioral and questionnaire data suggest that represent independent measures of CI benefit for SSD patients. This is an open access article distributed under the Creative Commons Attribution License 4.0 (CCBY), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract

OBJECTIVE: This study reviewed outcomes of hearing preservation (HP) surgery depending on the angle of insertion (AOI) in a cochlear implant (CI) patient population who used electric stimulation (ES) or combined electric-acoustic stimulation (EAS). STUDY DESIGN: Retrospective case review. SETTING: Tertiary referral university hospital. PATIENTS: Ninety-one patients with different degrees of preoperative low-frequency residual hearing who underwent HP surgery with a free-fitting lateral-wall electrode array (MED-EL Flex) with lengths ranging from 20.0 to 31.5 mm. INTERVENTION: Cochlear implantation using HP surgery technique and subsequent fitting with CI speech processor for ES, or combined CI and hearing aid speech processor for EAS. MAIN OUTCOME MEASURES: Individual AOI were estimated using modified Stenvers' projection. Freiburg monosyllable test in quiet (free-field presentation at 65 dB SPL) and pure-tone averages for low frequencies (125, 250, and 500 Hz; PTAlow) were evaluated during a follow-up period of 12 months after implantation. RESULTS: Estimated AOIs showed bimodal distribution: shallow insertion (SI) with mean AOI of 377 degrees and deep insertion (DI) with mean AOI of 608 degrees. Speech test scores after 12 months were comparable between AOI groups, however, they were significantly different between stimulation types with better scores for EAS. Only ES showed a positive correlation (r = 0.293) between speech test score and AOI. When HP was possible, both SI and DI showed significant postoperative PTAlow shifts with mean of 17.8 and 21.6 dB, respectively. These were comparable between AOI groups and no significant shifts were observed in follow-up intervals. Audiometric indication for HP and subsequent EAS is proposed up to 65 dB HL at 500 Hz, and up to 87 dB HL for HP. CONCLUSIONS: CI candidates can benefit from HP surgery with deep insertion when only using ES due to insufficient residual hearing. Conversely, candidates with preoperative threshold up to 65 dB HL at 500 Hz could perform significantly better with EAS which requires shallow insertion.


Abstract

OBJECTIVE: To examine inter-aural hearing preservation results in children undergoing simultaneous bilateral cochlear implantation (CI). METHODS: Retrospective case review in tertiary referral centre. All children undergoing simultaneous bilateral CI between January 2013 and June 2014 (18 months). Patients eligible for inclusion in the study had pre-operative hearing thresholds of <90 dB at 250 Hz and ≥100 dB at 500 Hz. Patients with anatomical cochlear anomalies or missing data were excluded. Seven patients were included, 1 male, 6 female, mean age of 12 years 11 months at the time of surgery. All patients had simultaneous bilateral cochlear implant surgery, using the same implant and technique. All patients had pre-
and post-operative unaided pure tone audiometry. Inter-aural hearing preservation results were compared in each patient. RESULTS: The achieved hearing preservation for 14 ears was complete in 5, partial in 7, and minimal in 2. Measurable hearing preservation was achieved in 86% overall. Inter-aural analysis revealed that only 2 (subjects 1 and 4) of the 7 patients had preservation results within the same preservation group (complete/partial/minimal). The mean inter-aural preservation difference was 30.7% with a range from 12.4% to 65.2%.

CONCLUSIONS: Several factors and techniques have already been identified in the wider literature to explain differences in hearing preservation results in CI. However, despite controlling for known factors, we demonstrate variable inter-aural results. This suggests that there may be more factors beyond the surgeon’s control influencing our ability to provide consistent results.


Abstract

OBJECTIVES: The study aimed to determine the effect of interimplant interval and onset of profound deafness on sound localization in children with bilateral cochlear implants, controlling for cochlear implant manufacturer, age, and time since second implant. DESIGN: The authors conducted a retrospective, observational study using routinely collected clinical data. Participants were 127 bilaterally implanted children aged 4 years or older, tested at least 12 mo post-second implant. Children used implants made by one of three manufacturers. Sixty-five children were simultaneously implanted, of whom 43% were congenitally, bilaterally profoundly deaf at 2 and 4 kHz and 57% had acquired or progressive hearing loss. Sixty-two were implanted sequentially (median interimplant interval = 58 mo, range 3-143 mo) of whom 77% had congenital and 23% acquired or progressive bilateral profound deafness at 2 and 4 kHz. Children participated in a sound-source localization test with stimuli presented in a random order from five loudspeakers at -60, -30, 0, +30, and +60 degrees azimuth. Stimuli were prerecorded female voices at randomly roved levels from 65 to 75 dB(A). Root mean square (RMS) errors were calculated. Localization data were analyzed via multivariable linear regression models, one applied to the whole group and the other to just the simultaneously implanted children. RESULTS: Mean RMS error was 25.4 degrees (SD = 12.5 degrees) with results ranging from perfect accuracy to chance level (0-62.7 degrees RMS error). Compared with simultaneous implantation, an interimplant interval was associated with worse localization by 1.7 degrees RMS error per year (p < 0.001). Compared with congenital deafness, each year with hearing thresholds better than 90 dB HL at 2 and 4 kHz bilaterally before implantation led to more accurate localization by 1.3 degrees RMS error (p < 0.005). Every year post-second implant led to better accuracy by 1.6 degrees RMS error (p < 0.05). Med-El was associated with more accurate localization than Cochlear by 5.8 degrees RMS error (p < 0.01) and with more accurate localization than Advanced Bionics by 9.2 degrees RMS error (p < 0.05). CONCLUSIONS: Interimplant interval and congenital profound hearing loss both led to worse accuracy in sound-source localization for children using bilateral cochlear implants. Interimplant delay should therefore be minimized for children with bilateral profound hearing loss.
loss. Children presenting with acquired or progressive hearing loss can be expected to localize better via bilateral cochlear implants than their congenitally deaf peers.


Abstract

BACKGROUND: Studies have shown that cochlear implants improve deaf patients' hearing-related quality of life (hrQoL), but the degree of improvement varies considerably between patients. This study investigated whether personality factors contribute to hrQoL outcome after cochlear implantation. METHOD: Fifty adult patients with postlingual hearing loss who received a unilateral cochlear implant were administered the Neuroticism-Extraversion-Openness Five-Factor Inventory (NEO-FFI; a personality inventory) and the Nijmegen Cochlear Implant Questionnaire (NCIQ; a hrQoL questionnaire). The NEO-FFI was administered only before implantation; the NCIQ was administered before implantation and 12 months after implant activation. A linear regression analysis was computed to detect whether NCIQ scores at 12 months were predicted by the NEO-FFI personality factors (i.e., Extraversion, Neuroticism, Openness to Experience, Agreeableness, and Conscientiousness) assessed before implantation. RESULTS: HrQoL scores had significantly improved 12 months after cochlear implantation in all subdomains of the NCIQ. Of the five personality factors, solely Neuroticism was negatively associated to the NCIQ subdomain self-esteem (β = -0.34; p = 0.013) at 12 months after cochlear implantation. CONCLUSIONS: While significant improvement of hrQoL was seen 12 months after implant activation, this improvement was barely predicted by the Big-Five personality traits measured before implantation. Only Neuroticism was found to moderately influence postimplantation hrQoL in our patients, in the way that higher degrees of Neuroticism tend to go along with lower degrees of self-esteem (as conceptualized by the NCIQ). The failure to detect personality effects on hrQoL could partly be due to the low levels of Extraversion and Openness to Experience observed in our sample of patients with hearing loss.


Abstract

OBJECTIVES: To develop a reliable and objective fitting method for use with young children with an auditory brainstem implant (ABI). MATERIALS AND METHODS: Subjects were 17 young children implanted with an ABI with the mean age 2 years and 4 months (8-64 months). Evoked auditory brainstem response (eABR) measurements were performed intraoperatively and at activation in order to record the auditory response and non-auditory side effects. Each child was tested to observe any subjective responses to the electric stimuli and non-auditory side effects. All children were fitted based on the postoperative eABR. The minimum follow-up
time was 12 months. RESULTS: Intraoperatively an eABR could be obtained in all children. The responses were recordable from 75-100% of all electrodes. At initial stimulation eABR were recordable in all children. The eABR was obtained in 79.7% of all electrodes (25-100%) with a mean eABR threshold of 22.3 nC. eABR without any non-auditory stimulation was recorded on all electrodes in 11 children. Mixed eABR and non-auditory responses were recorded on 2-6 electrodes in 6 children. The subjective auditory responses for at least 1 electrode were noted in 15 children. In the 2 remaining cases the auditory response was obtained only when the device was activated. In all children the subjective responses were within the estimated dynamic range for each electrode. Each child was able to accept up to 100% of volume of the created map. The non-auditory response was observed only on children and electrodes with mixed eABR and non-auditory responses. The mean CAP score at 6 months after the activation was 2.4 (1-4). CONCLUSIONS: eABR seems to be a reliable tool to judge ABI electrode placement and a reliable method for fitting of young children with an ABI. The data suggest that eABR-based fitting helps children to more quickly achieve auditory perception and development.


Abstract

OBJECTIVES: Patients with single-sided deafness (SSD) have great difficulties in listening situations which rely on binaural auditory processing. The purpose of this study was to examine to which extent a cochlear implant (CI) can improve speech perception outcomes in various noisy listening environments. Additionally, the ability to use interaural level differences for sound localization and subjective benefit with the CI were assessed. METHODS: Ten single-sided deaf patients with CI were tested in different loudspeaker configurations with and without the CI. A multi-source noise field (MSNF) with uncorrelated noise from four different directions was used in addition to a setup with the signal from the CI side and noise from the normal-hearing side (SCINNH, azimuth of ±45 degrees). Ten normal-hearing subjects were used as a control for the setup. Speech understanding was measured by an adaptive sentence test (Oldenburg Sentence Test, OLSA) in stationary speech shaped noise and temporally modulated noise to assess the benefit in each listening situation. Sensitivity to interaural level differences was measured in a lateralization experiment. Furthermore, patients completed the Bern Benefit in Single-Sided Deafness (BBSS) questionnaire to assess subjective benefit with the CI. RESULTS: An overall average benefit in speech reception threshold (SRT) of 1.6 dB (±0.6 dB standard error of the mean [SEM]) was observed in the binaural listening condition (with CI) in all conditions. In the MSNF setup thresholds improved by 0.4 dB (±0.5 dB SEM) and in the SCINNH configuration by 2.7 dB (±0.7 dB SEM). The choice of masking noise effect also had a significant effect on the SRT outcome. The lateralization performance of the SSD users was on a par with the normal hearing group. BBSS scores reflect the overall benefit with the CI apparent in the speech test results. CONCLUSION: Patients with single-sided deafness do benefit from a CI in difficult listening environments and are able to localize sound based on
interaural level differences. Considering these outcomes, cochlear implantation represents a promising treatment option for patients with single-sided deafness.


Abstract

BACKGROUND: Cochlear implantation in patients with functional residual low-frequency hearing is performed according to an established hearing-preserving surgical technique in order to cause minimal trauma of inner ear structures. Due to the increasing number of cochlear implants in children, the preservation of residual hearing is becoming increasingly important in this patient collective. OBJECTIVES: Short- and mid-term hearing preservation outcome in pediatric patients is investigated. MATERIALS AND METHODS: A group of 9 children (12 ears) between 5 and 12 years of age were examined after hearing-assisted cochlear implantation with respect to the pure tone audiometric thresholds. Retrospectively, short-term hearing preservation (up to 3 months after surgery) was examined. In a subgroup of 5 children, mid-term hearing preservation (7.5 to 16 months after surgery) was also analyzed. The mean values of hearing preserved (HL%) and hearing loss (HL) due to electrode insertion were calculated as measured values. RESULTS: In the whole group, the mean values of the preoperative PTAlow were 29.8 dB and the short-term postoperative PTAlow 42.6 dB. The mean value of the HL% was 73.6%, corresponding to an HL of 9.4 dB. In the subgroup, the mean PTAlow postoperatively was 46.0 dB in the mid-term and the HL% at 80.7% with a HL of 6.6 dB. CONCLUSIONS: The results in children are consistent with the results in adults. Electric-acoustic stimulation (EAS) should be used in the treatment of children with existing low-frequency residual hearing, as good residual hearing preservation can also be achieved in children after implantation.


Abstract


Abstract

INTRODUCTION: Paediatric Auditory Brainstem Implantation (ABI) is indicated for children with congenital cochlear aplasia, absent/hypoplastic vestibulocochlear nerve, for whom cochlear implantation is not possible. Knowledge of the anatomical landmarks and variants in anatomy of the brainstem is vital for ABI surgery. METHOD: Study was done at Auditory implant centre in Madras ENT research foundation, which includes 24 children who had undergone ABI surgery and are being followed up for 1 year, post operatively. Aims were to study the anatomical variants and the outcomes of ABI implantation. To determine if different anatomical variants effect placement of ABI electrode. To assess the patient outcomes by Categories of auditory Performance (CAP) scores and Speech Intelligibility Ratings (SIR) scores. RESULTS: All the candidates showed gradual improvement in audiological and verbal outcomes after the ABI. The mean CAP and SIR scores after 6 months of AVHT were 2.07 and 1.37 respectively. After 1 year of auditory verbal rehabilitation therapy CAP was 3.42 and SIR was 2.33. Flocculus of the cerebellum can be of different grades. Though, there was difficulty in insertion of the electrode in subjects with anatomical variants, the outcomes were comparable with other subjects. CONCLUSION: ABI surgery involves frequent anatomical variations surrounding the lateral recess which makes the positioning of the auditory prosthesis difficult. Variants during the surgery can make the placement of ABI electrodes difficult, but promising results were seen in all the implantees.


Abstract
HYPOTHESIS: Methods for cochlear coverage determination vary in their accuracy and are hence not equally reliable. BACKGROUND: The audiological outcome after cochlear implantation is known to depend on several factors. One factor shown to positively correlate with speech perception is the insertion angle. This parameter is one of the ways to describe the fraction of the cochlea spiral exposed to electric stimulation after implantation, also known as cochlear coverage, which itself is dependent on the length and type of electrode array as well as the size and shape of the implanted cochlea. While the assessment of cochlear coverage as the insertion angle is quick and uncomplicated, the accuracy of representing the relative fraction of the cochlea exposed to electric stimulation by this single measurement value remains unknown. METHODS: Both the cochlea spiral and implanted electrode array of N=10 cochlear implant patients were traced within clinical imaging data and processed to derive the respective cochlear coverage values. These values were compared to ones derived with alternative measures like the insertion angle as well as other methods to yield the accuracy and reliability of these approaches. RESULTS: The insertion angle as well as two novel approaches were found to be superior to all other analyzed assessment options and well suited for clinical cochlear coverage evaluations. CONCLUSION: Insertion angle measurements are well suited for cochlear coverage determination, especially regarding retrospective analyses. Prospective studies independent of anatomical irregularities should be performed with the newly proposed approaches.


Abstract

The main impairment associated with single-sided deafness (SSD) is the loss of binaural hearing. Currently, the most effective treatment to compensate for this deficit is to supply patients suffering from SSD with a cochlear implant (CI) in the deaf ear. With this approach binaural hearing abilities can be restored to a certain extent, which is expressed in an improvement in such patients with regard to sound source localization and speech comprehension in noise after receipt of a CI. However, binaural performance of these listeners does not reach the level of normal-hearing listeners. One of the reasons for this might be that the electrical stimulation via CI and the physiological stimulation via the intact ear are not synchronized: the CI transmits the information to the auditory nerve with different timing than does the intact inner ear. As a result, there is a timing mismatch of the information transfer between the left and the right side, which may account for the limited binaural performance. The effective mismatch in timing depends on the CI system because of different stimulation strategies implemented in devices from different manufacturers. For the particular CI device used in this study (MED-EL Mi1000/Mi1200) electrical stimulation led to faster activation of the auditory nerve than natural for a wide frequency range. In particular, electrical stimulation was about 1 to up to 2 ms ahead of time for frequencies above 1.5 kHz. Hence, it was hypothesized that information transfer between the left and the right ear can be tuned by delaying the CI signal. The goal of the present study was to investigate whether such a delay in the CI signal affects binaural performance of CI users with SSD. For this purpose, sound source localization
and speech perception in noise were tested in a sample of 12 CI users with SSD (mean age 51 ± 12 years). The tests were performed for four different delay times of the CI signal applied spontaneously (0.5, 1, 2 and 4 ms) and for the base line condition "no delay" in the CI signal (i.e. everyday use). It was found that delaying the signal had a significant impact on sound source localization. Speech perception in noise was affected, but less pronounced than was sound localization. Regarding sound source localization, a signal delay of 1 ms applied to this particular CI device produced the best performance in our patients. It is concluded that improving the synchronisation between the CI-transferred signal and the naturally transferred signal could increase binaural hearing performance in CI users with SSD.


Abstract

OBJECTIVE: To evaluate the usefulness and reliability of a research software application for the estimation of an individual's cochlear duct length as a basis for electrode selection.

METHODS: In this prospective cohort study, 21 consecutive patients (23 ears) implanted with a cochlear electrode were investigated. The study comprised 19 children (2 bilateral) and 2 adults.

RESULTS: The measured 'A' distances (the largest distance from the round window to the contralateral wall) corresponded to cochlear duct lengths of 28.5-36.4 mm. The mean cochlear duct length was 34.05 ± 1.72 mm (33.60 ± 2.27 mm in females and 34.35 ± 1.27 mm in males). Full insertion was achieved in all but two cases. No misplaced electrode array or electrode fold-over was detected. In all but three ears, the electrode was chosen based on the research software application's indication.

CONCLUSION: The results show a good correlation between the pre-operatively predicted insertion depths using the software application and those post-operatively measured using X-ray. The insertion length predicted by the software was always longer than that measured via X-ray.


Abstract

Hearing loss affects 30 million people in the United States, and a subset of these patients have normal low-frequency hearing and ski-sloped high-frequency hearing loss. For these patients, hearing aids alone may not provide adequate benefit. Cochlear implantation alone has been utilized to improve speech perception. The addition of high-frequency electric hearing to low-frequency acoustic hearing in these patients is beneficial. Technical improvements have allowed preservation of low-frequency hearing in cochlear implant recipients, allowing for electric and acoustic stimulation in the same ear with significant improvements in speech perception, sound localization, music appreciation, and quality of life.

Abstract

OBJECTIVE: To determine the time needed to remotely perform a set of intraoperative measurements during cochlear implantation surgery and to compare it to the time needed to perform the same measurements in theatre. DESIGN: Prospective two-arm study comparing a local with a remote measurement setting. Three intraoperative measurements (Impedance Field Telemetry (IFT), evoked compound action potential (ECAP) and evoked stapedius reflex test (eSRT)) were performed with the audiologist present in the operating theatre (i.e. locally) or with the audiologist in his/her office (i.e. remotely). The time needed to complete the measurements, in total and individually, were measured and compared. STUDY SAMPLE: Fifty cochlear implant recipients, aged 0.7-48 years Results: IFT, ECAP and eSRT were performed successfully in all participants. Comparing locally and remotely performed measurements, IFT did not differ significantly, ECAP threshold or slope did not differ significantly different in any single channel and eSRT measurements did not differ significantly except for in one of six channels. Remote measurements took 8.6 min less to perform than did local measurements (10.04 vs. 18.64 min); a significant difference (p < 0.001).

CONCLUSIONS: Using a remote network connection for intraoperative objective measurements is an efficient and safe way to perform measurements during cochlear implantation surgery.


Abstract

BACKGROUND: The cochlear implant has become the standard of care for severe or worse losses in hearing and indeed has produced the first substantial restoration of a lost or absent human sense using a medical intervention. However, the devices are not perfect and many efforts to narrow the remaining gaps between prosthetic and normal hearing are underway. OBJECTIVE: To assess the present status of cochlear implants and to describe possibilities for improving them. RESULTS: The present-day devices work well in quiet conditions for the great majority of users. However, not all users have high levels of speech reception in quiet and nearly all users struggle with speech reception in typically noisy acoustic environments. In addition, perception of sounds more complex than speech, such as most music, is generally poor unless residual hearing at low frequencies can be stimulated acoustically in conjunction with the electrical stimuli provided by the implant. Possibilities for improving the present devices include increasing the spatial specificity of neural excitation by reducing masking effects or with new stimulus modes; prudent pruning of interfering or otherwise detrimental electrodes from the stimulation map; a further relaxation in the criteria for implant candidacy, based on recent evidence from persons with high levels of residual hearing and to allow many
more people to benefit from cochlear implants; and "top down" or "brain centric" approaches to implant designs and applications. CONCLUSIONS: Progress in the development of the cochlear implant and related treatments has been remarkable but room remains for improvements. The future looks bright as there are multiple promising possibilities for improvements and many talented teams are pursuing them.


Abstract

Objectives To assess the use of cortical auditory evoked potentials (CAEPs) to verify, and if necessary, optimize the cochlear implant (CI) fitting of adult CI users with postlingual single-sided deafness (SSD). Methods Sound field cortical responses to the speech tokens /m/, /g/, /t/, and /s/ were recorded from input to the CI while the normal hearing ear was masked. Responses were evaluated by visual inspection and classified as presence or absence of the CAEPs components P1, N1, P2. In case of an absence fitting was adjusted accordingly. After fitting, subjects were asked to use their new setting for 2±3 weeks for acclimatization purposes and then return for retesting. At retesting, new CAEP recordings were performed to objectively ensure that the new fitting maps effectively activated the auditory cortex. Results In 14/19 subjects, as per visual inspection, clear CAEPs were recorded by each speech token and were, therefore, not refit. In the other 5 subjects, CAEPs could not be evoked for at least one speech token. The fitting maps in these subjects were adjusted until clear CAEPs were evoked for all 4 speech tokens. Conclusions CAEP can be used to quickly and objectively verify the suitability of CI fitting in experienced adult CI users with SSD. If used in the early post-implantation stage, this method could help CI users derive greater benefit for CI use and, therefore, be more committed to auditory training.


Abstract

Objective To determine the impact of the fixed and adaptive beamforming technology of the new MED-EL SONNET cochlear implant audio processor on speech perception in noise. Methods The study cohort comprises 18 postlingually deafened adult cochlear implant recipients with at least six months of experience. Speech reception thresholds were measured with the Oldenburg Sentence Test in continuous, speech-shaped noise. Target sentences were presented in front of the listener, with noise sources placed at -135Ê and 135Ê, respectively. Outcome measures were the differences in speech reception threshold using omnidirectional, fixed and adaptive beamformer microphone settings. Results The use of directional microphones significantly improved speech reception thresholds: fixed beamformer
vs. omnidirectional: 4.3 dB (95%-CI [3.1; 5.5]), p<0.0001; adaptive beamformer vs. omnidirectional: 6.1 dB (95%-CI [4.9; 7.3]), p<0.0001; and adaptive beamformer vs. fixed beamformer: 1.8 dB (95%-CI [0.7; 3.0]), p = 0.001. Conclusion This study confirms the previously reported improvements in speech perception in noise of the fixed beamformer microphone setting and is the first to report significant improvements in speech perception in noise when applying the adaptive beamformer microphone settings of the SONNET audio processor. Cochlear implant users may be able to benefit from improved hearing performance especially in difficult listening situations.


Abstract

Background: A prospective clinical study was conducted to assess different regimens of steroid therapy and preservation of hearing following cochlear implantation. Material/Methods: Study participants were ≥18 years-of-age, with a cochlear duct length ≥27.1 mm measured by computed tomography (CT), with hearing sound levels in the range of 10–120 decibels (dB) and sound frequencies of 125–250 hertz (Hz); sound levels of 35–120 dB and frequencies of 500–1,000 Hz; sound levels of 75–120 dB and frequencies of 2,000–8,000 Hz. Study exclusion criteria included diseases with contraindications for steroid therapy or medications that increased the effects of steroids. Patients had cochlear implantation and were divided into three treatment groups: intravenous (IV) steroid therapy (standard steroid therapy); combined oral and IV steroid therapy (prolonged steroid therapy); and a control group (cochlear implantation without steroid therapy). Hearing preservation was established by pure tone audiometry based on the pre-operative and postoperative average hearing thresholds according to the formula developed by the HEARRING Network. Results: There were 36 patients included in the study. In all cases, the cochlear implant electrode was inserted via the round window approach with a straight electrode length of 28 mm. Patients with combined oral and IV steroid therapy (prolonged steroid therapy) had better results when compared with patients with intravenous (IV) steroid therapy (standard steroid therapy) and the control group. Conclusions: Prolonged steroid therapy using combined oral and IV steroids stabilized hearing thresholds and preserved hearing in adult patients following cochlear implantation.


Abstract

Objective: Within the field of cochlear implantation (CIs), the role of utilizing patient-specific cochlear anatomy for choosing the optimal implant electrode is becoming increasingly important. Unfortunately, performing detailed anatomical measurements of a cochlea using clinical imaging data is rather time consuming and hence difficult to implement into the clinical...
routine. In order to accelerate clinical cochlear anatomy evaluations, previously developed mathematical models can be adjusted to the patient-specific anatomy by measuring just a few overall cochlear dimensions. However, the accuracy of model-based cochlear anatomy estimations is unclear, and incorrect evaluations may lead to false conclusions regarding the suitability of specific implant electrodes. Methods: Based on 10 cochleae, an error evaluation of various commonly used curve fitting approaches for cochlear shape and duct length approximation was conducted. Spline tracings of the cochlear contours were used as reference values for the various approximations. Results: Parameterized average cochlear helix models and two of five analytical approaches were found to be suitable for reconstructing the cochlear helical shape and estimating its length. Discussion: Spline curve reconstructions are the most accurate and reliable method for assessing patient-specific cochlear geometry, especially in the case of anatomical irregularities. The most accurate results within the group of model-based evaluations still resulted in mean overall cochlear length deviations of approximately 5%. Conclusion: Spline curve reconstructions appear to be the best option for anatomical diagnostics in clinical practice. Retrospective studies can be performed to further evaluate model-based evaluations.


Abstract

Objective: To demonstrate the safety and effectiveness of the MED-EL Electric-Acoustic Stimulation (EAS) System, for adults with residual low-frequency hearing and severe-to-profound hearing loss in the mid to high frequencies. Study Design: Prospective, repeated measures. Setting: Multicenter, hospital. Patients: Seventy-three subjects implanted with PULSAR or SONATA cochlear implants with FLEX24 electrode arrays. Intervention: Subjects were fit postoperatively with an audio processor, combining electric stimulation and acoustic amplification. Main Outcome Measures: Unaided thresholds were measured preoperatively and at 3, 6, and 12 months post activation. Speech perception was assessed at these intervals using City University of New York sentences in noise and consonant–nucleus–consonant words in quiet. Subjective benefit was assessed at these intervals via the Abbreviated Profile of Hearing Aid Benefit and Hearing Device Satisfaction Scale questionnaires. Results: Sixty-seven of 73 subjects (92%) completed outcome measures for all study intervals. Of those 67 subjects, 79% experienced less than a 30 dB HL low-frequency puretone average (250–1000 Hz) shift, and 97% were able to use the acoustic unit at 12 months post activation. In the EAS condition, 94% of subjects performed similarly to or better than their preoperative performance on City University of New York sentences in noise at 12 months post activation, with 85% demonstrating improvement. Ninety-seven percent of subjects performed similarly or better on consonant–nucleus–consonant words in quiet, with 84% demonstrating improvement. Conclusion: The MED-EL EAS System is a safe and effective treatment option for adults with
normal hearing to moderate sensorineural hearing loss in the low frequencies and severe-to-profound sensorineural hearing loss in the high frequencies who do not benefit from traditional amplification.


Abstract

Background: A suggested solution to suppress tinnitus is to restore the normal sensory input. This is based on the auditory deprivation hypothesis. It is known that hearing aids can provide sufficient activation of the auditory nervous system and reduce tinnitus in subjects with mild to moderate hearing loss and that cochlear implantation can reduce tinnitus in subjects with severe to profound hearing loss. This applies to subjects with single-sided deafness (SSD) or bilateral hearing loss. Aim: To investigate if electric-acoustic stimulation (EAS) can reduce severe tinnitus in a subject with residual hearing in the ipsilateral ear and contralateral normal hearing (high-frequency SSD) by restoring the auditory input. Methods: Tinnitus reduction was investigated for 1 year after implantation in a subject with high-frequency SSD, who uses EAS, and was compared to 11 subjects with a cochlear implant (CI) with SSD. The Visual Analogue Scale (VAS) and the Tinnitus Questionnaire (TQ) were administered pre-operatively and at 1, 3, 6, and 12 months after implantation. Results: Significant tinnitus reduction was observed 1 month after implantation on the VAS in the subjects with SSD using a CI. Tinnitus reduction was also observed in the subject with high-frequency SSD using EAS. A further decrease was observed 3 months after implantation. The TQ and VAS scores remained stable up to 1 year after implantation. Conclusion: A CI can significantly reduce ipsilateral severe tinnitus in a subject with SSD. Ipsilateral severe tinnitus can also be reduced using EAS in subjects with high-frequency SSD.


Abstract

Objectives: To determine whether preoperative steroids can improve hearing outcomes in cochlear implantation (CI). Methods: This is a randomized controlled trial involving 30 postlingual deaf CI patients. Subjects had preoperative thresholds of better than or equal to 80 dB at 125 and 250 Hz, and better than or equal to 90 dB at 500 and 1,000 Hz. The subjects were randomized to a control group, an oral steroid group (receiving 1 mg/kg/day of prednisolone for 6 days prior to surgery), or a transtympanic steroid group (receiving a single dose of 0.5 mL of 10 mg/mL dexamethasone at 24 h prior to surgery). Results: The subjects receiving transtympanic steroids had a significant decrease in the pure tone average over 3 months compared to the control and oral steroid group, which persisted over 12 months (p <
Conclusion: A single dose of preoperative transtympanic steroids prior to CI appears to have a beneficial effect, at least in the short term, with minimal effects seen in the longer term.


Abstract

Introduction: Electrically evoked compound action potentials (eCAP) and electrically evoked stapedius reflexes are the most frequently used objective measurements for programming a cochlear implant (CI) audio processor. Objective methods are particularly beneficial for children and CI users that encounter difficulties in providing feedback. In this study, we compared the threshold and the slope of the eCAP amplitude growth function with the electrically evoked stapedius reflex threshold (eSRT) in pediatric CI users. Furthermore, the duration times required to perform eCAP and eSRT recordings were compared. Methods: During a regular fitting session, 52 pediatric CI users with recordable eSRTs having MED-EL devices (MED-EL GmbH, Innsbruck, Austria) were programmed using the eSRT fitting method. The eCAP thresholds and the slopes of the amplitude growth function were measured across one apical, one medial, and one basal electrode contact. Results: There was a weak to medium correlation between eCAP thresholds and eSRTs. The eCAP threshold profile did not correlate with the eSRT profile. Typically, ECAP thresholds were at a lower stimulation charge than eSRTs with only 4/152 being higher. An eCAP threshold was found on 152/156 electrode contacts with eSRTs. On average, the eCAP measurements took 4.2 times longer to record per electrode than eSRT measurements (median durations 35 s vs. 120 s). Conclusion: eSRTs were significantly higher than eCAP thresholds and eSRT and eCAP profiles were generally different from each other reducing the clinical relevance of eCAP testing for setting MCLs across the array. Additionally, the eSRT measurements were faster to record than the eCAP threshold and slope determination measurements.


Abstract

Introduction The introduction of neonatal hearing screening and the increasingly early age at which children can receive a cochlear implant has intensified the need for a validated questionnaire to assess the speech production of children aged 0–18. Such a questionnaire has been created, the LittlEARS® Early Speech Production Questionnaire (LEESPQ). This study aimed to validate a second, revised edition of the LEESPQ. Methods and materials Questionnaires were returned for 362 children with normal hearing. Completed questionnaires were analysed to determine if the LEESPQ is reliable, prognostically accurate, internally consistent, and if gender or multilingualism affects total scores. Results Total scores correlated positively with age. The LEESPQ is reliable, accurate, and consistent, and independent of
gender or lingual status. A norm curve was created. Discussion This second version of the LEESPQ is a valid tool to assess the speech production development of children with normal hearing, aged 0–18, regardless of their gender. As such, the LEESPQ may be a useful tool to monitor the development of paediatric hearing device users. Conclusion The second version of the LEESPQ is a valid instrument for assessing early speech production of children aged 0–18 months.


Abstract

Objective: For the increasing number of cochlear implantations in subjects with residual hearing, hearing preservation, and thus the prevention of implantation trauma, is crucial. A method for monitoring the intracochlear position of a cochlear implant (CI) and early indication of imminent cochlear trauma would help to assist the surgeon to achieve this goal. The aim of this study was to evaluate the reliability of the different electric components recorded by an intracoellear electrocochleography (ECochG) as markers for the cochleotopic position of a CI. The measurements were made directly from the CI, combining intrasurgical diagnostics with the therapeutical use of the CI, thus, turning the CI into a “theragnostic probe.” Design: Intracoellear ECochGs were measured in 10 Dunkin Hartley guinea pigs of either sex, with normal auditory brainstem response thresholds. All subjects were fully implanted (4 to 5 mm) with a custom six contact CI. The ECochG was recorded simultaneously from all six contacts with monopolar configuration (retroauricular reference electrode). The gross ECochG signal was filtered off-line to separate three of its main components: compound action potential, cochlear microphonic, and summating potential (SP). Additionally, five cochleae were harvested and histologically processed to access the spatial position of the CI contacts. Both ECochG data and histological reconstructions of the electrode position were fitted with the Greenwood function to verify the reliability of the deduced cochleotopic position of the CI. Results: SPs could be used as suitable markers for the frequency position of the recording electrode with an accuracy of ±1/4 octave in the functioning cochlea, verified by histology. Cochlear microphonics showed a dependency on electrode position but were less reliable as positional markers. Compound action potentials were not suitable for CI position information but were sensitive to “cochlear health” (e.g., insertion trauma). Conclusions: SPs directly recorded from the contacts of a CI during surgery can be used to access the intracoellear frequency position of the CI. Using SP monitoring, implantation may be stopped before penetrating functioning cochlear regions. If the technique was similarly effective in humans, it could prevent implantation trauma and increase hearing preservation during CI surgery. Diagnostic hardware and software for recording biological signals with a CI without filter limitations might be a valuable add-on to the portfolios of CI manufacturers.

Abstract

OBJECTIVE: Patients with moderate-to-profound sensorineural hearing loss in 1 ear and normal hearing in the contralateral ear, known as unilateral hearing loss (UHL) or single-sided deafness (SSD), may experience improved quality of life with the use of a cochlear implant (CI) in the affected ear. Quality of life assessment before and after implantation may reveal changes to aspects of hearing beyond those explicitly evaluated with behavioral measures.

METHODS: The present report completed 2 experiments investigating quality of life outcomes in CI recipients with UHL. The first experiment assessed quality of life during the 1st year of device use with 3 questionnaires: The Speech, Spatial, and Qualities of Hearing Scale (SSQ), the Abbreviated Profile of Hearing Aid Benefit (APHAB), and the Tinnitus Handicap Inventory. Twenty subjects were evaluated preoperatively and 1, 3, 6, 9, and 12 months post-activation. Quality of life results were compared over the study period using traditional scoring methods and the SSQ pragmatic subscales. Subscales specific to localization and speech perception in noise were compared to behavioral measures at the preoperative and 12-month intervals. The 2nd experiment evaluated quality of life preoperatively and at the 12-month interval for CI recipients with UHL and CI recipients with bilateral hearing loss, including conventional CI users and those listening with electric-acoustic stimulation (EAS). The 3 cohorts differed in CI candidacy criteria, including the amount of residual hearing in the contralateral ear. RESULTS: For subjects with moderate-to-profound UHL, receipt of a CI significantly improved quality of life, with benefits noted as early as 1 month after initial activation. The UHL cohort reported less perceived difficulty at the pre- and postoperative intervals than the conventional CI and EAS cohorts, which may be due to the presence of the normal-hearing ear. Each group experienced a significant benefit in quality of life on the APHAB with CI use. CONCLUSIONS: Cochlear implantation in cases of substantial UHL may offer significant improvements in quality of life. Quality of life measures revealed a reduction in perceived tinnitus severity and subjective improvements in speech perception in noise, spatial hearing, and listening effort. While self-report of difficulties was lower for the UHL cohort than the conventional CI and EAS cohorts, subjects in all 3 groups reported an improvement in quality of life with CI use.


Abstract

Purpose Postoperative cognitive dysfunction (PCD) is a subtle, prolonged deterioration in cognition after surgery. This complication has been frequently investigated, mainly after major (cardiac) surgery. However, the incidence after cochlear implantation is unknown. Therefore, the aim of the study was to investigate the incidence and possible risk factors of PCD in severely hearing-impaired older adults after cochlear implantation. Methods In a prospective
cohort study, 26 older participants (age: M = 70, SD = 8 years), scheduled for cochlear implantation, were assessed prior to and 1 week after implantation by means of the Montreal Cognitive Assessment (MoCA). The incidence of PCD was calculated. In addition, the following possible risk factors were recorded: age, sex, education, duration of hearing impairment, preoperative signs of depression and anxiety, duration of anesthesia, anesthetic and surgical events and postoperative complications. Results The incidence of PCD was 11.5%, defined by a Z score of change in MoCA scores ≥ 1.96 (i.e., a decrease of ≥ 4 points). The incidence of PCD was corrected for practice effects by incorporating data from a reference group. Besides an effect of age on the postoperative cognitive performance, no significant risk factors were identified. Conclusions The incidence of PCD after cochlear implantation is lower than after major surgeries, but higher than after other minor surgeries. Routine cognitive screening before and after cochlear implantation is recommended to identify patients with PCD and to provide additional care for these patients.


Abstract

OBJECTIVE: A design comparison of current perimodiolar and lateral wall electrode arrays of the cochlear implant (CI) is provided. The focus is on functional features such as acoustic frequency coverage and tonotopic mapping, battery consumption and dynamic range. A traumacity of their insertion is also evaluated. METHODS: Review of up-to-date literature. RESULTS: Perimodiolar electrode arrays are positioned in the basal turn of the cochlea near the modiolus. They are designed to initiate the action potential in the proximity to the neural soma located in spiral ganglion. On the other hand, lateral wall electrode arrays can be inserted deeper inside the cochlea, as they are located along the lateral wall and such insertion trajectory is less traumatic. This class of arrays targets primarily surviving neural peripheral processes. Due to their larger insertion depth, lateral wall arrays can deliver lower acoustic frequencies in manner better corresponding to cochlear tonotopicity. In fact, spiral ganglion sections containing auditory nerve fibres tuned to low acoustic frequencies are located deeper than 1 and half turn inside the cochlea. For this reason, a significant frequency mismatch might be occurring for apical electrodes in perimodiolar arrays, detrimental to speech perception. Tonal languages such as Mandarin might be therefore better treated with lateral wall arrays. On the other hand, closer proximity to target tissue results in lower psychophysical threshold levels for perimodiolar arrays. However, the maximal comfort level is also lower, paradoxically resulting in narrower dynamic range than that of lateral wall arrays. Battery consumption is comparable for both types of arrays. CONCLUSIONS: Lateral wall arrays are less likely to cause trauma to cochlear structures. As the current trend in cochlear implantation is the maximal protection of residual acoustic hearing, the lateral wall arrays seem more suitable for hearing preservation CI surgeries. Future development could focus on combining the advantages of both types: perimodiolar location in the basal turn extended to lateral wall location for higher turn locations.

Abstract

Objective: A cochlear implant (CI) is an auditory prosthesis restoring profound hearing loss. However, CI-transmitted sounds are degraded compared to normal acoustic hearing. We investigated cortical responses related to CI-degraded against acoustic listening. Methods: Event-related potentials (ERPs) were recorded from eight single-sided deaf CI users who performed a three-stimulus oddball task, separately with their normal hearing ear and CI ear. The oddball tones were occasionally intermitted by novel sounds. ERP responses were compared between electric and acoustic listening for the auditory (N1) and auditory-cognitive (Novelty P3, Target-P3) ERP components. Results: CI-degraded listening was associated with attenuated sensory processing (N1) and with attenuated early cortical responses to acoustic novelty whereas the late cortical responses to acoustic novelty and the target-P3 did not differ between NH and CI ears. Conclusion: The present study replicates the CI-attenuation of Novelty-P3 amplitudes in a withinsubject comparison. Further, we show that the CI-attenuation of Novelty-P3 amplitudes extends to early cortical responses to acoustic novelty, but not to late novelty responses. Significance: The dissociation into CI-attenuated P3 early Novelty-P3 amplitudes and CI-unaffected late Novelty-P3 amplitudes represents a cortical fingerprint of CI-degraded listening. It further contributes to general claims of distinct auditory Novelty-P3 sub-components.