

## MED-EL BIBLIOGRAPHY

December 2017

1. **Ihler F, Blum J, Steinmetz G, Weiss B, Zirn S, Canis M. (2017) Development of a home-based auditory training to improve speech recognition on the telephone for patients with cochlear implants: A randomised trial. Clin Otolaryngol. 42(6):1303-1310.**

### Abstract

OBJECTIVES: Speech recognition on the telephone poses a challenge for patients with cochlear implants (CIs) due to a reduced bandwidth of transmission. This trial evaluates a home-based auditory training with telephone-specific filtered speech material to improve sentence recognition. DESIGN: Randomised controlled parallel double-blind. SETTING: One tertiary referral centre. PARTICIPANTS: A total of 20 postlingually deafened patients with CIs. MAIN OUTCOME MEASURES: Primary outcome measure was sentence recognition assessed by a modified version of the Oldenburg Sentence Test filtered to the telephone bandwidth of 0.3-3.4 kHz. Additionally, pure tone thresholds, recognition of monosyllables and subjective hearing benefit were acquired at two separate visits before and after a home-based training period of 10-14 weeks. For training, patients received a CD with speech material, either unmodified for the unfiltered training group or filtered to the telephone bandwidth in the filtered group. RESULTS: Patients in the unfiltered training group achieved an average sentence recognition score of 70.0%±13.6% (mean±SD) before and 73.6%±16.5% after training. Patients in the filtered training group achieved 70.7%±13.8% and 78.9%±7.0%, a statistically significant difference ( $P=.034$ ,  $t_{10}=2.292$ ; two-way RM ANOVA/Bonferroni). An increase in the recognition of monosyllabic words was noted in both groups. The subjective benefit was positive for filtered and negative for unfiltered training. CONCLUSIONS: Auditory training with specifically filtered speech material provided an improvement in sentence recognition on the telephone compared to training with unfiltered material.

2. **Todd AE, Mertens G, Van de Heyning P, Landsberger DM. (2017) Encoding a melody using only temporal information for cochlear-implant and normal-hearing listeners. Trends in Hearing 21:1-15.**

### Abstract

One way to provide pitch information to cochlear implant users is through amplitude-modulation rate. It is currently unknown whether amplitude-modulation rate can provide cochlear implant users with pitch information adequate for perceiving melodic information. In the present study, the notes of a song were encoded via amplitude-modulation rate of pulse trains on single electrodes at the apex or middle of long electrode arrays. The melody of the song was either physically correct or modified by compression or expansion. Nine cochlear implant users rated the extent to which the song was out of tune in the different conditions. Cochlear implant users on average did not show sensitivity to melody compression or expansion regardless of place of stimulation. These results were found despite the fact that three of the cochlear implant users showed the expected sensitivity to melody compression and expansion with the same task using acoustic pure tones in a contralateral acoustic ear. Normal-hearing listeners showed an inconsistent and weak effect of melody compression and expansion when the notes of the song were encoded with acoustic pulse rate. The results suggest that amplitude-modulation rate provides insufficient access to melodic information for cochlear-implant and normal-hearing listeners.

3. **Hoth S, Spitzer P, Praetorius M. (2017) A new approach for the determination of ECAP thresholds. Cochlear implants int. doi: 10.1080/14670100.2017.1402472.**

### Abstract

**BACKGROUND:** Electrically evoked compound action potentials (ECAPs) of the auditory nerve are routinely recorded for testing the cochlear implant integrity and its functional connection to the auditory system. The response thresholds derived from ECAP recordings are widely used as a helpful guide in the fitting of the dynamic range of electric stimulation, although they may not always predict the behavioral thresholds of individuals well. Conventionally, this threshold is based on the identification of a minimum N peak and maximum P peak and linear extrapolation of the resulting amplitude growth function (AGF). As an alternative, a new procedure involving numeric signal processing and requiring less user intervention is presented here. **Data acquisition:** In 12 adults implanted with MED-EL FLEX28 electrodes, two series of ECAPs were recorded immediately after implantation: (i) a full profile involving all 12 channels across the whole stimulus range in steps of 200 current units and (ii) a high resolution section (20 records in the immediate neighborhood of the threshold) of the AGF in one selected channel. **Data treatment:** It was observed that N and P wave latencies do not depend on stimulus intensity. Fixed time windows were hence defined for stimulus plus noise and noise alone regions. In these windows, the variance of the compound signal representing response and noise is extracted, whereas the noise variance is extracted from the tail of the curve following this time window. The base line is corrected by fitting an exponential function to reduce stimulus or amplifier artifacts. The response threshold is then derived from the response to noise ratio which should exceed the limit of 6 dB. **RESULTS:** The ECAP thresholds obtained from the new procedure coincide well with those determined by the conventional linear extrapolation of the AGF and they correlate to a greater degree with psychometric thresholds than the existing approach. **CONCLUSIONS:** The new ECAP algorithm looks promising and may reduce the need for user intervention in determining thresholds.

- 4. Doge J, Baumann U, Weissgerber T, Rader T. (2017) Single-sided deafness: Impact of cochlear implantation on speech perception in complex noise and on auditory localization accuracy. *Otol Neurotol.* 38:e563-e569.**

Abstract

**OBJECTIVE:** To assess auditory localization accuracy and speech reception threshold (SRT) in complex noise conditions in adult patients with acquired single-sided deafness, after intervention with a cochlear implant (CI) in the deaf ear. **STUDY DESIGN:** Nonrandomized, open, prospective patient series. **SETTING:** Tertiary referral university hospital. **PATIENTS:** Eleven patients with late-onset single-sided deafness (SSD) and normal hearing in the unaffected ear, who received a CI. All patients were experienced CI users. **INTERVENTION:** Unilateral cochlear implantation. **MAIN OUTCOME MEASURES:** Speech perception was tested in a complex multitalker equivalent noise field consisting of multiple sound sources. Speech reception thresholds in noise were determined in aided (with CI) and unaided conditions. Localization accuracy was assessed in complete darkness. Acoustic stimuli were radiated by multiple loudspeakers distributed in the frontal horizontal plane between -60 and +60 degrees. **RESULTS:** In the aided condition, results show slightly improved speech reception scores compared with the unaided condition in most of the patients. For 8 of the 11 subjects, SRT was improved between 0.37 and 1.70 dB. Three of the 11 subjects showed deteriorations between 1.22 and 3.24 dB SRT. Median localization error decreased significantly by 12.9 degrees compared with the unaided condition. **CONCLUSION:** CI in single-sided deafness is an effective treatment to improve the auditory localization accuracy. Speech reception in complex noise conditions is improved to a lesser extent in 73% of the participating CI SSD patients. However, the absence of true binaural interaction effects (summation, squelch) impedes further improvements. The development of speech processing strategies that respect binaural interaction seems to be mandatory to advance speech perception in demanding listening situations in SSD patients.

- 5. Dhanasingh A, Jolly C. (2017) An overview of cochlear implant electrode designs. *Hearing Research.* Doi: 10.1016/j.heares.2017.10.005.**

Abstract

Cochlear implant electrode arrays are designed with specific characteristics that allow for the preservation of intra-cochlear structures during the insertion process, as well as during explantation. Straight lateral wall (LW) electrode arrays and pre-curved modiolar hugging (MH) electrode arrays are the two types that are commercially available. Although there is a third type of electrode array called the mid-scala (MS), which is positioned in the middle of the scala tympani (ST), and is usually considered as an MH type of electrode. Different lengths of straight LW electrode arrays are currently available which allow for insertion across a range of different sized cochleae; however, due to manufacturing limitations, pre-curved MH electrodes are generally only available to cover the basal turn of the cochlea, while the spiral ganglion cells are distributed in the Rosenthal's canal that extends into 1.75 turns of the cochlea. Both straight LW and pre-curved MH electrodes can cause a certain degree of intra-cochlear trauma, but pre-curved MH electrodes tend to deviate into the scala vestibuli from the scala tympani more often than the straight LW electrodes, resulting in damage to the osseous spiral lamina/spiral ligament which could initiate new bone formation and eventually affect the cochlear implant users' hearing performance. Structural damage to the cochlea could also affect the vestibular function. With pre-curved MH electrodes, higher degrees of trauma are related to the fixed curling geometry of the electrode in relation to the variable coiling pattern of individual cochleae, the orientation of the electrode contacts in relation to the modiolar wall, and how effectively the stylet was handled by the surgeon during the procedure. Wire management, metal density, and the shore hardness of the silicone elastomer all contribute to the stiffness/flexibility of the electrode. It is important to acknowledge the impact of bringing the stimulating contacts closer to the modiolar wall with an MH electrode type in terms of the resultant damage to intra-cochlear structures. The presence of malformed cochleae should be identified and appropriate electrodes should be chosen for each specific cochlea, irrespective of the cochlear implant brand. In order to utilize drug therapy, the cochlea should be free from any trauma.

6. **Hallems A, Mertens G, Van de Heyning P, Van Rompaey V. (2017) Playing music may improve the gait patterns in patients with bilateral caloric areflexia wearing a cochlear implant: Results from a pilot study. Front Neurol. 8:404.**

Abstract

**HYPOTHESIS:** Auditory information through an active cochlear implant (CI) influences gait parameters in adults with bilateral caloric areflexia and profound sensorineural hearing loss. **BACKGROUND:** Patients with bilateral caloric areflexia suffer from imbalance, resulting in an increased risk of falling. In case of simultaneous deafness, the lack of auditory feedback results in less awareness of the auditory scene. This combination might produce significant challenges while walking and navigating. Auditory cues can be restored to some extent with a CI. Electrical stimulation through a CI can also produce a vestibulocollic reflex through current spread, which can be measured as cervical vestibular-evoked myogenic potentials. **METHODS:** Adults (seven males, one female, mean age  $61 \pm 14$  years), wearing a CI to treat profound sensorineural hearing loss and presenting with bilateral caloric areflexia walked barefoot, over ground, at self-selected speed in three different conditions: with CI turned on, while listening to music and with CI turned off. Spatiotemporal and kinematic parameters of gait were calculated using the conventional gait model. **RESULTS:** Removing auditory feedback by turning off the CI decreased stride time (mean difference  $0.03 \pm 0.15$  s) and slightly increased stride length (mean difference  $0.5 \pm 1.2$  cm) compared to the control condition with the CI on. Walking while playing music positively affected gait compared to walking with the CI on but without auditory feedback. By increasing the motion of the pelvis (mean difference  $1.3^\circ \pm 0.4^\circ$ ), the knee (mean difference  $3.9^\circ \pm 0.8^\circ$ ) and the ankle (mean difference  $2.2^\circ \pm 0.2^\circ$ ), stride length increased ( $7.8 \pm 1.2$  cm), while stride time decreased ( $0.059 \pm 0.016$  s). **CONCLUSION:** Although a practice effect cannot be completely ruled out, this pilot study suggests that playing music while wearing an active CI may improve gait in patients with bilateral otovestibular loss. It remains unclear if the musical cues boost balance control or the CI might produce current spread and electrical stimulation to the vestibular afferents, thereby boosting its detection threshold, through stochastic resonance, and improving gait.

7. **Helbig S, Stover T, Burck I, Kramer S. (2017) Cranial MRI in a young child with cochlear implants after bilateral magnet removal. Int J Ped Otorhinolaryngol. 103:1-4.**

Abstract

A young bilateral cochlear implant (CI) user required magnetic resonance imaging (MRI) to determine the cause of hydrocephalus. The images obtained with the CIs in place were not diagnostically useful due to large artefacts generated by the CI magnets. We obtained useful images by bilaterally explanting the CI-magnets and replacing them with non-magnetic placeholder dummies then conducted the imaging. The artefact in the new images was greatly reduced and the images were diagnostically useful. Lastly, we explanted the dummies and reimplanted the CI-magnets. This procedure should be useful to obtain useful images in CI users.

8. **Joly CA, Pean V, Hermann R, Seldran F, Thai-Van H, Truy E. (2017) Using electrically-evoked compound action potentials to estimate perceive levels in experienced adult cochlear implant users. *Otol Neurotol.* 38(9):1278-1289.**

Abstract

**HYPOTHESIS:** The cochlear implant (CI) fitting level prediction accuracy of electrically-evoked compound action potential (ECAP) should be enhanced by the addition of demographic data in models. **INTRODUCTION:** No accurate automated fitting of CI based on ECAP has yet been proposed. **METHODS:** We recorded ECAP in 45 adults who had been using MED-EL CIs for more than 11 months and collected the most comfortable loudness level (MCL) used for CI fitting (prog-MCL), perception thresholds (meas-THR), and MCL (meas-MCL) measured with the stimulation used for ECAP recording. Linear mixed models taking into account cochlear site factors were computed to explain prog-MCL, meas-MCL, and meas-THR. **RESULTS:** Cochlear region and ECAP threshold were predictors of the three levels. In addition, significant predictors were the ECAP amplitude for the prog-MCL and the duration of deafness for the prog-MCL and the meas-THR. Estimations were more accurate for the meas-THR, then the meas-MCL, and finally the prog-MCL. **CONCLUSION:** These results show that 1) ECAP thresholds are more closely related to perception threshold than to comfort level, 2) predictions are more accurate when the inter-subject and cochlear regions variations are considered, and 3) differences between the stimulations used for ECAP recording and for CI fitting make it difficult to accurately predict the prog-MCL from the ECAP recording. Predicted prog-MCL could be used as bases for fitting but should be used with care to avoid any uncomfortable or painful stimulation.

9. **Lassaletta L, Polak M, Huesers J, Diaz-Gomez M, Calvino M, Varela-Nieto I, Gavilan J. (2017) Usefulness of electrical auditory brainstem responses to assess the functionality of the cochlear nerve using an intracochlear test electrode. *Otol Neurotol.* 38(10):e416-e420.**

Abstract

**OBJECTIVE:** To use an intracochlear test electrode to assess the integrity and the functionality of the auditory nerve in cochlear implant (CI) recipients and to compare electrical auditory brainstem responses (eABR) via the test electrode with the eABR responses with the CI. **SETTING:** Otolaryngology department, tertiary referral hospital. **PATIENTS:** Ten subjects (age at implantation 55 yr, range, 19-72) were subsequently implanted with a MED-EL CONCERTO CI on the side without any useful residual hearing. **INTERVENTIONS:** Following identification of the round window (RW), the test electrode was inserted in the cochlea previous to cochlear implantation. **MAIN OUTCOME MEASURES:** To assess the quality of an eABR waveform, scoring criteria from Walton et al. (2008) were chosen. The waveforms in each session were classified by detecting waves III and V by the algorithm and visual assessment of the waveform. Speech performance was evaluated with monosyllables, disyllables, and sentence recognition tests. **RESULTS:** It was possible to evoke electrical stimulation responses along with both the test electrode and the CI in all subjects. No significant differences in latencies or amplitudes after stimulation were found between the test electrode and the CI. All subjects obtained useful hearing with their CI and use their implants daily. **CONCLUSIONS:** The intracochlear test electrode may

be suitable to test the integrity of the auditory nerve by recording eABR signals. This allows for further research on the status of the auditory nerve after tumor removal and correlation with auditory performance.

10. **Mulwafu W, Strachan DR, Bartlett R, Caron C. (2017) Cochlear implantation in Malawi: report of the first four cases. J Laryngol Otol. 131(10):914-918.**

Abstract

OBJECTIVE: This paper reports on the first four cochlear implant cases in Malawi. CASE REPORTS: Three patients were deafened from infectious diseases and one from an unknown cause. They all had post-lingual deafness. Six months after the last implant, they are all progressing well. CONCLUSION: Despite significant practical difficulties, it has proved possible, with the right support, to carry out cochlear implantation in one of the world's poorest countries. The project has also raised awareness of deafness in Malawi and highlighted significant public health issues relating to the aetiology of deafness in developing countries.

11. **Qi B, Liu Z, Gu X, Liu B. (2017) Speech recognition outcomes in Mandarin-speaking cochlear implant users with fine structure processing. Acta Oto-Laryngologica. 137(3):286-292.**

Abstract

Conclusion: Mandarin-speaking adults can use the Fine Structure Processing (FSP) coding strategy as well as the Continuous Interleaved Sampling (CIS+) coding strategy. No loss in performance was observed after switch-over. Tone identification improves over time with the FSP coding strategy, which is of benefit to tonal-language users. After some time, fine structure was preferred. Objective: This study aimed to determine speech perception, tone perception, and the subjective preferences of Mandarin-speaking adults who received the FSP coding strategy, at upgrade from the CIS+ coding strategy. Methods: Thirteen Mandarin-speaking subjects were tested at switch-over from CIS+ to the FSP coding strategy ~1-month after switch-over, 2-months after switch-over, and 3-months after switch-over with the Mandarin Hearing in Noise Test (M-HINT), the Mandarin Tone Identification in Noise Test (MTINT), and a visual analogue scale assessing Sound and Speech Assessment (SSA). Results: There were no significant differences in the M-HINT between presentation levels (62 dB SPL vs 65 dB SPL), over time, nor when compared to the CIS+ coding strategy. Tone perception improved significantly over time with the FSP coding strategy. Subjects rated the FSP coding strategy with the OPUS 2 as significantly more 'full' and 'rich' than with the CIS+ coding strategy after 3-months.

12. **Rajan G, Tavora-Vieira D, Baumgartner WD, Godey B, Muller J, O'Driscoll M, Skarzynski H, Skarzynski P, Usami SI, Adunka O, Agrawal S, Bruce I, De Bodt M, Caversaccio M, Pilsbury H, Gavilan J, Hagen R, Hagr A, Kameswaran M, Karltorp E, Kompis M, Kuzovkov V, Lassaletta L, Yongxin L, Lorensr A, Manoj M, Martin J, Mertens G, Mlynski R, Parnese L, Pulibalarthingal S, Radeloff A, Raine CH, Rajeswaran R, Schmutzhard J, Sprinzi G, Staecker H, Stephan K, Sugarova S, Zernotti M, Zorowka P, Van de Heyning P. (2017) Hearing preservation cochlear implantation in children: The HEARRING Group consensus and practice guide. Cochlear Implants Int. 1-13.**

Abstract

OBJECTIVES: To provide multidisciplinary cochlear implant teams with a current consensus statement to support hearing preservation cochlear implantation (HPCI) in children, including those children with symptomatic partial deafness (PD) where the intention is to use electric-acoustic stimulation (EAS). The main objectives are to provide guidelines on who is a candidate, how to assess these children and when to implant if Med-El Flex electrode arrays are chosen for implantation. METHODS: The HEARRING group reviewed the current evidence and practice regarding the management of children to be considered for HPCI surgery emphasizing the assessment needed prior to implantation in order to demonstrate the benefits in these children over time. The

consensus statement addresses following three key questions: (1) Should these children be treated? (2) How to identify these children? (3) How to manage these children? SUMMARY: The HEARRING group concludes that irrespective of the degree of residual hearing present, the concepts of hearing and structure preservation should be applied in every child undergoing cochlear implantation and that HPCI is a safe and reliable treatment option. Early detection and multidisciplinary assessment are key to the identification of children with symptomatic PD, these children should undergo HPCI as early as possible.

13. **Rak K, Schraven SP, Schendzielorz P, Kurz A, Shehata-Dieler W, Hagen R, Radeloff A. (2017) Stable longitudinal performance of adult cochlear implant users for more than 10 years. Otol Neurotol. 38(9):e315-e319.**

Abstract

OBJECTIVE: To analyze the long-term performance of cochlear implant patients. STUDY DESIGN: Retrospective longitudinal study. SETTING: Tertiary referral center with a large cochlear implant program. MAIN OUTCOME MEASURE: Speech perception scores in quiet and in background noise in the short-term ( $1.12 \pm 0.15$  yr) and long-term ( $12.61 \pm 2.34$  yr) after implantation. PATIENTS: Fifty-eight implanted ears from 55 patients with a mean age of  $51.80 \pm 1.757$  years at the time of implantation were included. RESULTS: Speech perception scores were stable in the long-term for up to 20 years postimplantation. When alteration of speech perception over time was investigated in relation to the age at implantation, there was a deterioration of the scores in quiet in older patients (>60 years old at the time of surgery). In addition the speech comprehension in noise was negatively correlated with the age at the time of the test. CONCLUSION: The speech perception abilities of cochlear implant users are stable in the long-term and at the most may be affected by the age of the patients, as it is known from acoustic hearing.

14. **Seebacher J, Muigg F, Fischer N, Weichbold V, Stephan K, Zorowka P, Bliem HR, Schmutzhard J. (2017) Auditory and cognitive development in a partially deaf child with bilateral electro-acoustic stimulation: a case study. Int J Audiol. Doi: 10.1080/14992027.2017.1383633**

Abstract

OBJECTIVE: To study the long-term evolution of speech and intelligence in a child with partial deafness and normal hearing in the low frequencies after sequentially receiving cochlear implants in both ears. DESIGN: Retrospective chart review. STUDY SAMPLE: Male child aged 6 years was followed over a time period of four years. RESULTS: The paediatric patient had normal hearing up to 1 kHz and profound hearing loss at all higher frequencies symmetrical in both ears. Deprivation of high-frequency sounds resulted in retarded development of speech, language and cognitive skills. The choice for rehabilitation was cochlear implantation with the aim of preserving a considerable amount of low-frequency hearing. With natural hearing at low frequencies and electrical stimulation at high frequencies, the child was able to compensate most of his developmental deficits. Moreover, spatial hearing was almost normal. CONCLUSIONS: Electro-natural stimulation without amplification of the low frequencies (electro-natural hearing) provides access to the whole audible frequency range for children, who suffer from partial deafness in the high frequencies and are normal hearing at low frequencies. Such provision allows for regular speech development and favours the development of spatial hearing. The case report also demonstrates a strong impact on intellectual performance.

15. **Song JJ, Kim K, Sunwoo W, Mertens G, Van de Heyning P, De Ridder D, Vanneste S, Lee SY, Park KJ, Chol H, Chol JW. (2017) A quantitative electroencephalography study on cochlear implant-induced cortical changes in single-sided deafness with tinnitus. Front Hum Neurosci. 11:210.**

Abstract

The mechanism of tinnitus suppression after cochlear implantation (CI) in single-sided deafness (SSD) is not fully understood. In this regard, by comparing pre- and post-CI quantitative electroencephalography (qEEG), we explored cortical changes relevant to tinnitus improvement. In SSD patients who underwent CI, qEEG data were collected: (1) before CI, (2) 6 months post-operatively with CI-on, and (3) 30 min after CI-off and source-localized cortical activity/functional connectivity analyses were performed. Compared to the pre-operative baseline, the CI-on condition demonstrated significantly decreased activity in the right auditory- and orbitofrontal cortices (OFC) for the delta frequency band as well as decreased connectivity between the auditory cortex/posterior cingulate cortex for the delta/beta2 bands. Meanwhile, compared to the CI-off condition, the CI-on condition displayed decreased activity in the right auditory cortices/OFC for the delta band, and in bilateral auditory cortices, left inferior frontal cortex/OFC for the gamma band. However, qEEG analyses showed no significant differences between the CI-off and baseline conditions. CI induced overall decreased cortical activity and functional connectivity. However, judging from no differences between the CI-off and baseline conditions, CI-induced cortical activity and functional connectivity changes are not by cortical plastic changes, but by dynamic peripheral reafferentation.

- 16. Todt I, Tittel A, Ernst A, Mittmann P, Mutze S. (2017) Pain free 3 T MRI scans in cochlear implantees. *Otol Neurotol.* 38(10):e401-e404.**

Abstract

**OBJECTIVE:** For cochlear implant recipients, undergoing magnetic resonance imaging (MRI) scans is associated with safety risks and potential side effects. Even following safety guidelines, potential complications (e.g., pain, magnet dislocation, image artifacts) are possible during 1.5 Tesla (T) MRI scans. The stronger static magnetic field of a 3.0 T scanner is associated with further risks of complication, including implant demagnetization. These complications led to the recent development of rotatable internal receiver magnets with a diametrical magnetization. The aim of this study was to evaluate the potential occurrence of pain during 3.0 T MRI scans for cochlear implant recipients with a rotatable, diametrically magnetized implant magnet. **PATIENTS:** Five patients implanted with a cochlear implant diametrically magnetized magnet. **INTERVENTION:** MRI scanning at 3 T. **MAIN OUTCOME MEASURE:** In the prospective patient study an MRI scan was performed on five implantees and the degree of pain was evaluated by a visual analog scale. Scans were performed initially with a magnet-supporting headband, and depending on the degree of discomfort/pain, repeated without the headband. **RESULTS:** In all the patients, all the MRI scans were performed without any pain, even without the use of the supportive headband. Demagnetization was clinically not observed. **CONCLUSION:** 3.0 T MRI scanning can be performed on cochlear implant recipients with a rotatable diametrically magnetized internal magnet without risk of the most frequent cochlear-implant-related MRI complication: pain. This finding enables the expansion of MRI scanning indications up to 3.0 T without complication. Limitations in terms of MRI artifact still persist.

- 17. Wachtlin B, Turinsky Y, Herrman F, Schaefer B. (2017) Phonological awareness in German-speaking preschool children with cochlear implants – 3 case examples. *Int J Ped Otorhinolaryngol.* 100: 198-203.**

Abstract

**Objective:** The aim was to explore PA skills German-speaking preschool children with cochlea implants (CIs) and how these skills may be related to their speech and language skills. **Methods:** Three monolingual German-speaking pre-school children aged 5;04-6;01 with bilateral CIs were tested. Their cognitive, speech and language skills were assessed. Six subtests of a standardized PA test battery were administered (i.e. rhyme identification, rhyme production; phoneme identification input and -output; phoneme blending-input and -output). **Results:** All three children showed distinctive PA profiles. One boy, who had no spoken language deficits, struggled to complete the rhyme tasks but performed well on three phoneme tasks. However, he showed a discrepancy between expressive and receptive phoneme blending skills, scoring poorly on the expressive subtest. The second boy, who displayed grammar comprehension and expressive vocabulary difficulties, showed a mixed profile, with a below average performance on rhyme production. The girl who had significant speech and language deficits scored below average on all six PA subtests. **Conclusions:** PA profiles in children with CI vary considerably and

PA testing should include a range of different PA tasks. The assumed link between spoken language deficits and PA difficulties shown in children with normal hearing could be confirmed.

18. **Wang J, Sun J, Sun J, Chen J. (2017) Variations in electrode impedance during and after cochlear implantation: Round window versus extended round window insertions. *Int J Ped Otorhinolaryngol.* 102:44-48.**

Abstract

**Objectives:** To assess differences in intra- and postoperative electrode impedances following cochlear implantation between round window insertions (RWI) and extended round window insertions (ERWI). **Methods:** Fifty patients with congenital hearing loss received unilateral hearing implants (Sonata Ti100, Med-El GmbH, Innsbruck, Austria) with standard electrode arrays. The patients were divided into two groups according to the surgical technique used. Thirty-five procedures were performed with RWI (group A) and 15 with ERWI (group B). Electrode impedance was measured and analysed during the operation, and one week and one month postoperatively. **Results:** There were no statistically significant differences (i.e.,  $P > 0.05$ ) in electrode impedance between groups A and B intraoperatively, or at one week or one month postoperatively. Electrode impedance at one month postoperatively was higher than the intraoperative and postoperative one week values in group A ( $P < 0.05$ ), with similar results in group B. **Conclusion:** There was no significant difference between RWI and ERWI in operative duration or complications of cochlear implantation. Moreover, no significant differences in postoperative electrode impedance values were found between the two surgical routes.

19. **Shew M, Bertsch J, Camarata P, Staecker H. (2017) Magnetic resonance imaging in a neurofibromatosis Type 2 patient with a novel MRI-compatible auditory brainstem implant. *J Neurol Surg Rep.* 78(1):e12-e14.**

Abstract

Auditory brainstem implantation has become a key technique for the rehabilitation of hearing in patients with neurofibromatosis type 2. The nature of this devastating genetic disease requires ongoing MRI for the patient's lifespan. Today, most auditory brainstem implants require removal of the magnet that connects the internal device to the external speech processor to undergo imaging as their disease progresses. Patients have the option of having a short procedure to have the magnet taken out and replaced each time, or alternately using a headband to secure the processor over the receiver coil of the internal device. Novel magnet technology has led to the development of a freely rotating magnet that can be used inside the magnetic field of an MRI scanner without losing magnet strength and without being displaced from the body of the device. We report one of the first patients implanted with a Med-El Synchrony ABI in the United States who subsequently underwent successful imaging with MRI 1.5 tesla to follow for other existing schwannomas.

20. **Van de Heyning P, Tavora-Vieira D, Mertens G, Van Rompaey V, Rajan GP, Muller J, Hempel JM, Leander D, Polterauer D, Marx M, Usami SI, Kitoh R, Miyagawa M, Moteki H, Smilsky K, Baumgartner WD, Keintzel TG, Sprinzl GM, Wolf-Magele A, Arndt S, Wesarg T, Yirn S, Baumann U, Weissgerber T, Rader T, Hagen R, Kurz A, Rak K, Stokroos R, George E, Polo R, Medina MDM, Henkin Y, Hilly O, Ulanovski D, Rajeswaran R, Jameswaran M, Do Gregorio MF, Zernotti ME. (2016) Towards a unified testing framework for single-sided deafness studies: A consensus paper. *Audiol Neurootol.* 21(6):391-398.**

Abstract

**BACKGROUND:** While hearing aids for a contralateral routing of signals (CROS-HA) and bone conduction devices have been the traditional treatment for single-sided deafness (SSD) and asymmetric hearing loss (AHL), in recent years, cochlear implants (CIs) have increasingly become a viable treatment choice, particularly in countries where regulatory approval and reimbursement schemes are in place. Part of the reason for this shift is

that the CI is the only device capable of restoring bilateral input to the auditory system and hence of possibly reinstating binaural hearing. Although several studies have independently shown that the CI is a safe and effective treatment for SSD and AHL, clinical outcome measures in those studies and across CI centers vary greatly. Only with a consistent use of defined and agreed-upon outcome measures across centers can high-level evidence be generated to assess the safety and efficacy of CIs and alternative treatments in recipients with SSD and AHL. METHODS: This paper presents a comparative study design and minimum outcome measures for the assessment of current treatment options in patients with SSD/AHL. The protocol was developed, discussed, and eventually agreed upon by expert panels that convened at the 2015 APSCI conference in Beijing, China, and at the CI 2016 conference in Toronto, Canada. RESULTS: A longitudinal study design comparing CROS-HA, BCD, and CI treatments is proposed. The recommended outcome measures include (1) speech in noise testing, using the same set of 3 spatial configurations to compare binaural benefits such as summation, squelch, and head shadow across devices; (2) localization testing, using stimuli that rove in both level and spectral content; (3) questionnaires to collect quality of life measures and the frequency of device use; and (4) questionnaires for assessing the impact of tinnitus before and after treatment, if applicable. CONCLUSION: A protocol for the assessment of treatment options and outcomes in recipients with SSD and AHL is presented. The proposed set of minimum outcome measures aims at harmonizing assessment methods across centers and thus at generating a growing body of high-level evidence for those treatment options.

21. **Mlynski R, Ziese M, Rahne T, Muller-Deile J. (2016) Speech perception and subjective preference with fine structure coding strategies. *Otolaryngology*. 6:254.**

Abstract

This study aimed to determine differences in speech perception and subjective preference after upgrade from the FSP coding strategy to the FS4 or FS4p coding strategies. Subjects were tested at the point of upgrade (n=10), and again at 1-(n=10), 3-(n=8), 6-(n=8) and 12 months (n=8) after the upgrade to the FS4 or FS4p coding strategy. In between test intervals patients had to use the FS4 or FS4p strategy in everyday life. Primary outcome measures, chosen to best evaluate individual speech understanding, were the Freiburg Monosyllable Test in quiet, the Oldenburg Sentence Test (OLSA) in noise, and the Hochmair-Schulz-Moser (HSM) Sentence Test in noise. To measure subjective sound quality the Hearing Implant Sound Quality Index was used. Subjects with the FS4/FS4p strategy performed as well as subjects with the FSP coding strategy in the speech tests. The subjective perception of subjects showed that subjects perceived a 'moderate' or 'poor' auditory benefit with the FS4/FS4p coding strategy. Subjects with the FS4 or FS4p coding strategies perform well in everyday situations. Both coding strategies offer another tool to individualize the fitting of audio processors and grant access to satisfying sound quality and speech perception.

22. **Perez Fornos A, Cavuscens S, Ranieri M, van de Berg R, Stokroos R, Kingma H, Guyot JP, Guinand N. (2017) The vestibular implant: A probe in orbit around the human balance system. *J Vestib Res*. 27(1):51-61.**

Abstract

The primary goal of the vestibular implant is to restore the vestibular function in patients with a disabling bilateral vestibular loss for whom there is currently no available treatment. The prototype developed by our team is a hybrid system consisting of a modified cochlear implant incorporating additional vestibular electrodes. Therefore, in addition of delivering sound information it is also capable of delivering motion information to the central nervous system using electrical stimulation. To date, thirteen patients have been implanted with such vestibular implant prototypes. For ethical reasons, only deaf ears were implanted and all patients experienced a clinical benefit from the hearing rehabilitation. The recent demonstration of partial restoration of the vestibulo-ocular and the vestibulo-collic reflexes in implanted patients suggests that gaze stabilization and postural control, fundamental functions of the balance system, can be artificially restored using a vestibular implant. This allows us to glimpse a useful

clinical application in a near future. In parallel, we show how the vestibular implant provides a unique opportunity to explore the integration of the vestibular sensory input into the multisensory, multimodal balance system in humans, since it is able to selectively stimulate the vestibular system.

23. **O'Connell BP, Hunter JB, Haynes DS, Holder JT, Dedmon MM, Noble JH, Dawant BM, Wanna GB. (2017) Insertion depth impacts speech perception and hearing preservation for lateral wall electrodes. Laryngoscope, Doi: 10.1002/lary.26467.**

Abstract

**OBJECTIVES:** 1) Examine angular insertion depths (AID) and scalar location of Med-El (GmbH Innsbruck, Austria) electrodes; and 2) determine the relationship between AID and audiologic outcomes controlling for scalar position. **STUDY DESIGN:** Retrospective review. **METHODS:** Postlingually deafened adults undergoing cochlear implantation with Flex 24, Flex 28, and Standard electrode arrays (Med-El) were identified. Patients with preoperative and postoperative computed tomography scans were included so that electrode location and AID could be determined. Outcome measures were 1) speech perception in the cochlear implant (CI)-only condition, and 2) short-term hearing preservation. **RESULTS:** Forty-eight implants were included; all electrodes (48 of 48) were positioned entirely within the scala tympani. The median AID was 408° (interquartile [IQ] range 373°-449°) for Flex 24, 575° (IQ range 465°-584°) for Flex 28, and 584° (IQ range 368°-643°) for Standard electrodes (Med-El). The mean postoperative CNC score was 43.7% ± 21.9. A positive correlation was observed between greater AID and better CNC performance ( $r = 0.48$ ,  $P < 0.001$ ). Excluding patients with postoperative residual hearing, a strong correlation between AID and CNC persisted ( $r = 0.57$ ,  $P < 0.001$ ). In patients with preoperative residual hearing, mean low-frequency pure-tone average (PTA) shift was 27 dB ± 14. A correlation between AID and low-frequency PTA shift at activation was noted ( $r = 0.41$ ,  $P = 0.04$ ). **CONCLUSION:** Favorable rates of scala tympani insertion (100%) were observed. In the CI-only condition, a direct correlation between greater AID and CNC score was noted regardless of postoperative hearing status. Deeper insertions were, however, associated with worse short-term hearing preservation. When patients without postoperative residual hearing were analyzed independently, the relationship between greater insertion depth and better performance was strengthened.

24. **Obrycka A, Lorens A, Padilla Garcia JL, Piotrowska A, Skarzynski H. (2017) Validation of the LittEARS auditory questionnaire in cochlear implanted infants and toddlers. Int J Pediatr Otorhinolaryngol. 93:107-116.**

Abstract

**OBJECTIVES:** The LittEARS Auditory Questionnaire (LEAQ) has so far been validated to assess auditory development in groups of normal-hearing children in over 20 different languages. Considering the huge variability in auditory development of CI children, especially since candidacy criteria have been relaxed, additional evidence to validate the use of LEAQ scores in this particular population is needed. The aim of this study is to provide evidence for the reliability and validity of LEAQ scores for assessing the auditory development of CI infants and toddlers based on an evaluation of LEAQ's internal structure and its relation to other variables. **METHODS:** The study was prospective, with sequential enrolment and within-subject repeated measures. It included 122 children with profound bilateral sensorineural hearing loss implanted at 6-22 months of age. All children were evaluated with the Polish version of LEAQ on the first day of CI activation and at each of four follow-up visits related to sound processor fitting. The study was undertaken in the light of current psychometric thinking about how assessment instruments should be validated. The main aim of the study was to obtain evidence for the validity of interpreting LEAQ measures from CI children in terms of auditory development. First, in order to collect evidence for score reliability and validity based on LEAQ's internal structure, the psychometric properties of LEAQ scores from CI children were determined. A second step was to confirm validity by investigating the effect of concomitant variables on LEAQ scores. Correlations between LEAQ score and duration of hearing aid (HA) use, and between LEAQ score and duration of CI use, were investigated. Additionally, group differences in LEAQ scores between:

1) early and late implanted children; 2) children with long and short HA experience prior to implantation; and 3) children who showed responses over a wide frequency range from using their HAs (prior to implantation) vs those who did not. RESULTS: On each of the five administrations of LEAQ, the item difficulty indices increased (meaning the items became easier) and over the series they progressively increased with a range of: 0.01-0.62, 0.03-0.92, 0.09-1.00, 0.26-1.00, and 0.52-1.00. At the same time, item-total correlations were in the ranges: 0.09-0.77, 0.26-0.62, 0.00-0.65, 0.00-0.65, and 0.00-0.67. Cronbach's alpha values were above 0.80 for all administrations. A positive correlation between LEAQ score and duration of HA use, and subsequent duration of CI use (hearing experience) was found. When the children were stratified into groups according to age at cochlear implantation, duration of HA use before implantation, and audibility provided by HAs prior to implantation, the differences between the groups were reflected in both their rate of auditory development and their LEAQ score. CONCLUSION: The interpretation of LEAQ scores from CI children in terms of auditory development was supported by the validity evidence of internal structure and from a logical relationship to other variables. (1) Psychometric properties - item difficulty, item-total correlations, and Cronbach's alpha values - indicate that LEAQ measures are highly consistent and reliably gauge the level of a CI child's auditory development. (2) There was a positive correlation between LEAQ scores and the duration of hearing experience with HAs and a later CI; similarly, there were significant differences between groups of children stratified according to the age at cochlear implantation, duration of HA use before implantation, and audibility provided by HAs prior to implantation, all of which demonstrate the expected relation between LEAQ score and concomitant variables.

25. **Mikic B, Jotic A, Miric D, Nikolic M, Jankovic N, Arsovic N. (2016) Receptive speech in early implanted children later diagnosed with autism. Eur Ann Otorhinolaryngol Head Neck Dis. 133 Suppl 1:S36-9.**

Abstract

INTRODUCTION: Incidence of children with autism spectrum disorder (ASD) is rising through the years with estimated 1 in 68 in the US in 2014. This incidence is also rising in the population of congenitally deaf children. Favorable outcome after early cochlear implantation is expected due to plasticity and reorganization capacity of brain in infants and toddlers, but outcomes could be significantly modified in children with diagnosed ASD. Current methods of screening for autism have difficulties in establishing diagnosis in children who have both autism and other developmental delays, especially at such an early age. The aim of the study was to assess the development of auditory perception and speech intelligibility in implanted children with profound congenital hearing loss who were diagnosed with ASD comparing to those who were typically developing. MATERIAL AND METHODS: Fourteen children underwent cochlear implantation; four were later diagnosed with ASD and ten were typically developing. All children underwent intensive postoperative speech and hearing therapy. The development of auditory perception and speech intelligibility was assessed using the Categories of Auditory Performance (CAP) and the Speech Intelligibility Rating (SIR) during the 5-years follow-up. RESULTS: In children later diagnosed with ASD, auditory processing developed slowly. Depending on the individual capabilities, by the age of six they could identify environmental sounds or discriminate speech sounds. Speech Intelligibility in children with ASD was at best rated as category 2, with very little or no progress up to the age of six, despite extensive speech and language therapy. Communication skills were strongly affected by a degree of autistic features expression. CONCLUSION: Preoperative psychological assessment in congenitally deaf infants should be expanded by the use of validated instruments for early detection of autism. The possibility of developing ASD should be kept in mind by all professionals involved in programs for cochlear implantation.

26. **Kosaner J, Deniz H, Uruk D, Deniz M, Kara E, Amann E. (2017) Assessment of early language development in Turkish children with a cochlear implant using the TEDIL test. 18(3):153-161.**

Abstract

OBJECTIVES: To analyse language development of children with a cochlear implant (CI) in relation to length of CI use and age at implantation and to examine the suitability of the TEDIL as an assessment tool for measuring early

language development in Turkish children. **METHODS:** A total of 119 children implanted with a CI before 5 years of age were assessed acutely on sound field thresholds, speech recognition thresholds, open-set and closed-set monosyllabic word tests, the TEDIL, categories of auditory performance (CAP), and speech intelligibility rating (SIR). The outcome scores were analysed in relation to length of CI use (3, 4, and 5 years) and age at implantation (<24 months vs. >24 months). The TEDIL scores were compared to all other outcome measures. **RESULTS:** Scores significantly increased with CI experience. CAP and SIR were significantly higher in the younger implanted group. No significant difference was observed between the younger and older implanted group on the closed-set and open-set monosyllabic tests and the TEDIL. The TEDIL scores significantly correlated with CAP, SIR, and the closed-set and open-set word scores. The mean TEDIL standard score was close to average. **CONCLUSIONS:** Performance of CI users improves with increased CI experience. CI users implanted <24 months tend to have better auditory skills and clearer speech than CI users implanted >24 months. CI users implanted between 24 months and 60 months tend to develop language similarly to CI users implanted <24 months. The TEDIL is a suitable tool for assessing early receptive and expressive language development in Turkish children.

27. **Hajioff D. (2016) Cochlear implantation: a review of current clinical practice. Br J Hosp Med (Lond). 77(12):680-684.**

Abstract

Cochlear implants treat severe hearing loss by providing direct electrical stimulation to auditory nerve endings. This article reviews the clinical assessment, surgical procedure and outcomes, and looks at newer developments such as preservation of residual hearing and bilateral implantation.

28. **Guinard N, Van de Berg R, Cavuscens S, Stokroos R, Ranieri M, Pelizzone M, Kingma H, Guyot JP, Fornos AP. (2016) Restoring visual acuity in dynamic conditions with a vestibular implant. Front Neurosci. 10:577.**

Abstract

Vestibular implants are devices designed to rehabilitate patients with a bilateral vestibular loss (BVL). These patients lack a properly functioning vestibulo-ocular reflex (VOR), which impairs gaze stabilization abilities and results in an abnormal loss of visual acuity (VA) in dynamic situations (i.e., severely limiting the patient's ability to read signs or recognize faces while walking). We previously demonstrated that the VOR can be artificially restored in a group of BVL patients fitted with a prototype vestibular implant. This study was designed to investigate whether these promising results could be translated to a close-to-reality task, significantly improving VA abilities while walking. Six BVL patients previously implanted with a vestibular implant prototype participated in the experiments. VA was determined using Sloan letters displayed on a computer screen, in four conditions: (1) with the patient standing still without moving (static), (2) while the patient was walking on a treadmill at constant speed with the vestibular implant prototype turned off (systemOFF), (3) while the patient was walking on a treadmill at constant speed with the vestibular implant prototype turned on providing coherent motion information (systemON<sub>motion</sub>), and (4) a "placebo" condition where the patient was walking on a treadmill at constant speed with the vestibular implant prototype turned on providing reversed motion information (systemON<sub>sham</sub>). The analysis (one-way repeated measures analysis of variance) revealed a statistically significant effect of the test condition [ $F_{(3, 12)} = 30.5, p < 0.001$ ]. Significant decreases in VA were observed with the systemOFF condition when compared to the static condition (Tukey *post-hoc*  $p < 0.001$ ). When the vestibular implant was turned on, delivering pertinent motion information (systemON<sub>motion</sub>) the VA improved to close to normal values. The improvement disappeared in the placebo condition (systemON<sub>sham</sub>) and VA-values also dropped significantly in this condition (Tukey *post-hoc*  $p < 0.001$ ). These results are a significant step forward in the field, demonstrating for the first time in humans that gaze stabilization abilities can be restored with a vestibular implant prototype. The vestibular implant shows considerable promise of being the first-ever effective therapeutic alternative for patients with a BVL in the near future.

29. Dillon MT, Buss E, Anderson ML, King ER, Deres EJ, Buchman CA, Brown KD, Pillsbury HC. (2017) Cochlear implantation in cases of unilateral hearing loss: Initial localization abilities. *Ear Hear*. Doi: 10.1097/AUD.0000000000000430

Abstract

**OBJECTIVES:** The present study evaluated early auditory localization abilities of cochlear implant (CI) recipients with normal or near-normal hearing (NH) in the contralateral ear. The goal of the study was to better understand the effect of CI listening experience on localization in this population. **DESIGN:** Twenty participants with unilateral hearing loss enrolled in a prospective clinical trial assessing outcomes of cochlear implantation (ClinicalTrials.gov Identifier: [NCT02203305](#)). All participants received the MED-EL Standard electrode array, were fit with an ear-level audio processor, and listened with the FS4 coding strategy. Localization was assessed in the sound field using an 11-speaker array with speakers uniformly positioned on a horizontal, semicircular frame. Stimuli were 200-msec speech-shaped noise bursts. The intensity level (52, 62, and 72 dB SPL) and sound source were randomly interleaved across trials. Participants were tested preoperatively, and 1, 3, and 6 months after activation of the audio processor. Performance was evaluated in two conditions at each interval: (1) unaided (NH ear alone [NH-alone] condition), and (2) aided, with either a bone conduction hearing aid (preoperative interval; bone conduction hearing aid + NH condition) or a CI (postoperative intervals; CI + NH condition). Performance was evaluated by comparing root-mean-squared (RMS) error between listening conditions and between measurement intervals. **RESULTS:** Mean RMS error for the soft, medium, and loud levels were 66°, 64°, and 69° in the NH-alone condition and 72°, 66°, and 70° in the bone conduction hearing aid + NH condition. Participants experienced a significant improvement in localization in the CI + NH condition at the 1-month interval (38°, 35°, and 38°) as compared with the preoperative NH-alone condition. Localization in the CI + NH condition continued to improve through the 6-month interval. Mean RMS errors were 28°, 25°, and 28° in the CI + NH condition at the 6-month interval. **CONCLUSIONS:** Adult CI recipients with normal or near-normal hearing in the contralateral ear experienced significant improvement in localization after 1 month of device use, and continued to improve through the 6-month interval. The present results show that binaural acclimatization in CI users with unilateral hearing loss can progress rapidly, with marked improvements in performance observed after only 1 month of listening experience.

30. Caversaccio M, Gavaghan K, Wimmer W, Williamson T, Anso J, Mantokoudis G, Gerber N, Rathgeb C, Feldmann A, Wagner F, Scheidegger O, Kompis M, Weisstanner C, Yoka-Assadi M, Roesler K, Anschuetz L, Huth M, Weber S. (2017) Robotic cochlear implantation: surgical procedure and first clinical experience. *Acta Otolaryngol*. 137(4):447-454.

Abstract

**CONCLUSION:** A system for robotic cochlear implantation (rCI) has been developed and a corresponding surgical workflow has been described. The clinical feasibility was demonstrated through the conduction of a safe and effective rCI procedure. **OBJECTIVES:** To define a clinical workflow for rCI and demonstrate its feasibility, safety, and effectiveness within a clinical setting. **METHOD:** A clinical workflow for use of a previously described image guided surgical robot system for rCI was developed. Based on pre-operative images, a safe drilling tunnel targeting the round window was planned and drilled by the robotic system. Intra-operatively the drill path was assessed using imaging and sensor-based data to confirm the proximity of the facial nerve. Electrode array insertion was manually achieved under microscope visualization. Electrode array placement, structure preservation, and the accuracy of the drilling and of the safety mechanisms were assessed on post-operative CT images. **RESULTS:** Robotic drilling was conducted with an accuracy of 0.2 mm and safety mechanisms predicted proximity of the nerves to within 0.1 mm. The approach resulted in a minimal mastoidectomy and minimal incisions. Manual electrode array insertion was successfully performed through the robotically drilled tunnel. The procedure was performed without complications, and all surrounding structures were preserved.

31. **Mertens G, Desmet J, De Bodt M, Van de Heyning P. (2016) Prospective case-controlled sound localization study after cochlear implantation in adults with single-sided deafness and ipsilateral tinnitus. Clin Otolaryngol. 41(5):511-8.**

Abstract

OBJECTIVES: To analyse the sound localisation skills of subjects with profound single-sided deafness (SSD) and accompanied ipsilateral tinnitus who are using a cochlear implant (CI) for between 4 and 11 years. DESIGN: Sound localisation skills were tested using nine loudspeakers in a frontal semicircle ranging from  $-90^{\circ}$  to  $+90^{\circ}$ . Subjects were tested in the CION and the CIOFF conditions via 3 localisation stimuli: broadband noise (BB), low-pass noise (LP) and high-pass noise (HP). PARTICIPANTS: The test group consisted of 10 adult subjects with profound sensorineural SSD, ipsilateral tinnitus and a CI. Normative data of a control group of 30 normal hearing subjects were used for comparison. MAIN OUTCOME MEASURES: Sound location accuracy was analysed via the root-mean-square error (RMSE), the mean absolute error (MAE), the localisation bias ('b') and the bias-adjusted deviation ('db'). Subjective dynamic aspects of hearing were assessed via a reduced version of the Speech, Spatial and Qualities of Hearing Scale (SSQ5). RESULTS: For all 3 stimuli, the RMSE improved significantly in SSD subjects in the CION condition compared to the CIOFF condition. The localisation accuracy of subjects with SSD improved significantly for BB and HP stimuli. A significant bias-adjusted deviation 'db' was found for the BB and HP stimuli. Subjects' mean SSQ5 scores were significantly higher in the CION condition at test date than in the CIOFF condition preoperatively. CONCLUSIONS: Subjects can better locate sound in the CION condition than in the CIOFF condition.

32. **Wimmer W, Kompis M, Stieger C, Caversaccio M, Weder S. (2017) Directional microphone contralateral routing of signals in cochlear implant users: A Within-subjects comparison. Ear Hear. 38(3):367-373.**

Abstract

OBJECTIVES: For medical or financial reasons, bilateral cochlear implantation is not always possible in bilaterally deafened patients. In such cases, a contralateral routing of signals (CROS) device could complement the monaural implant. The goal of our study was to compare the benefit of three different conditions: (1) unilateral cochlear implant (CI) alone, (2) unilateral CI complemented with a directional CROS microphone, and (3) bilateral CIs. DESIGN: Twelve bilateral experienced CI users were tested. Speech reception in noise and sound localization were measured in the three above-mentioned conditions. Patients evaluated which condition they presumed to be activated and the subjective benefit on a hearing scale. RESULTS: Compared with the unilateral CI condition, the additional CROS device provided significantly better speech intelligibility in noise when speech signals came from the front or side of the CROS microphone. Only small subjective improvement was observed. Bilateral-activated CIs further improved the hearing performance. This was the only condition where sound localization was possible. Subjective evaluation showed a clear preference for the bilateral CI treatment. CONCLUSIONS: In bilateral deafened patients, bilateral implantation is the most preferable form of treatment. However, patients with one implant only could benefit from an additional directional microphone CROS device.

33. **Baumann U, Mocka M. (2017) Einfluss des Überlappungsbereichs zwischen akustischer und elektrischer Stimulation/Impact of the overlap region between acoustic and electric stimulation. Laryngorhinootologie. Doi: 10.1055/s-0041-117639. (Article in German)**

Abstract

Patients with residual hearing in the low frequencies and ski-slope hearing loss with partial deafness at medium and high frequencies receive a cochlear implant treatment with electric-acoustic stimulation (EAS, "hybrid" stimulation). In the border region between electric and acoustic stimulation a superposition of the 2 types of stimulation is expected. The area of overlap is determined by the insertion depth of the stimulating electrode and the lower starting point of signal transmission provided by the CI speech processor. The study examined the

influence of the variation of the electric-acoustic overlap area on speech perception in noise, whereby the width of the "transmission gap" between the 2 different stimulus modalities was varied by 2 different methods. The results derived from 9 experienced users of the MED-EL Duet 2 speech processor show that the electric-acoustic overlapping area and with it the crossover frequency between the acoustic part and the CI should be adjusted individually. Overall, speech reception thresholds (SRT) showed a wide variation of results in between subjects. Further studies shall investigate whether generalized procedures about the setting of the overlap between electric and acoustic stimulation are reasonable, whereby an increased number of subjects and a longer period of acclimatization prior to the conduction of hearing tests deemed necessary.

34. **Van de Heyning P, Arauz SL, Atlas M, Baumgartner WD, Caversaccio M, Chester-Browne R, Estienne P, Gavilan J, Godney B, Gstottner W, Han D, Hagen R, Kompis M, Kuzovkov V, Lassaletta L, Lefevre F, Li Y, Muller J, Parnes L, Kleine Punte A, Raine C, Rajan G, Rivas A, Rivas JA, Royle N, Sprinzi G, Stephan K, Walkowiak A, Yanov Y, Zimmermann K, Zorowka P, Sharzynski H. (2016) Electrically evoked compound action potentials are different depending on the site of cochlear stimulation. *Cochlear Implants Int.* 17(6):251-262.**

Abstract

One of the many parameters that can affect cochlear implant (CI) users' performance is the site of presentation of electrical stimulation, from the CI, to the auditory nerve. Evoked compound action potential (ECAP) measurements are commonly used to verify nerve function by stimulating one electrode contact in the cochlea and recording the resulting action potentials on the other contacts of the electrode array. The present study aimed to determine if the ECAP amplitude differs between the apical, middle, and basal region of the cochlea, if double peak potentials were more likely in the apex than the basal region of the cochlea, and if there were differences in the ECAP threshold and recovery function across the cochlea. ECAP measurements were performed in the apical, middle, and basal region of the cochlea at fixed sites of stimulation with varying recording electrodes. One hundred and forty one adult subjects with severe to profound sensorineural hearing loss fitted with a Standard or FLEX<sup>SOFT</sup> electrode were included in this study. ECAP responses were captured using MAESTRO System Software (MED-EL). The ECAP amplitude, threshold, and slope were determined using amplitude growth sequences. The 50% recovery rate was assessed using independent single sequences that have two stimulation pulses (a masker and a probe pulse) separated by a variable inter-pulse interval. For all recordings, ECAP peaks were annotated semi-automatically. ECAP amplitudes were greater upon stimulation of the apical region compared to the basal region of the cochlea. ECAP slopes were steeper in the apical region compared to the basal region of the cochlea and ECAP thresholds were lower in the middle region compared to the basal region of the cochlea. The incidence of double peaks was greater upon stimulation of the apical region compared to the basal region of the cochlea. This data indicates that the site and intensity of cochlear stimulation affect ECAP properties.

35. **Radeloff A, Neckel M, Shehata-Dieler W, Rak K, Schraven SP, Großmann W, Hagen R. (2017) 20 Jahre bilaterale Cochleaimplantation – eine Analyse seither implantierter erwachsener Patienten / 20 years of bilateral cochlear implantation – an analysis of the implanted patients. *Laryngo-Rhino-Otol.* 96(01):35-39. (Article in German)**

Abstract

OBJECTIVE: To determine the safety and feasibility of the auditory brainstem implant (ABI) in congenitally deaf children with cochlear aplasia and/or cochlear nerve deficiency. STUDY DESIGN: Phase I feasibility clinical trial of surgery in 10 children, ages 2 to 5 years, over a 3-year period. SETTING: Tertiary children's hospital and university-based pediatric speech/language/hearing center. INTERVENTION(S): ABI implantation and postsurgical programming. MAIN OUTCOME MEASURE(S): The primary outcome measure is the number and type of adverse events during ABI surgery and postsurgical follow-up, including behavioral mapping of the

device. The secondary outcome measure is access to and early integration of sound. RESULTS: To date, nine children are enrolled. Five children have successfully undergone ABI surgery and postoperative behavioral programming. Three children were screen failures, and one child is currently undergoing candidacy evaluation. Expected adverse events have been documented in three of the five children who received the ABI. One child experienced a cerebral spinal fluid leak, which resolved with lumbar drainage. One child demonstrated vestibular side effects during device programming, which resolved by deactivating one electrode. One child experienced postoperative vomiting resulting in an abdominal radiograph. Four children have completed their 1-year follow-up and have speech detection thresholds of 30 to 35 dB HL. Scores on the IT-MAIS/MAIS range from 8 to 31 (out of a total of 40), and the children are demonstrating some ability to discriminate between closed-sets words that differ by number of syllables (pattern perception). CONCLUSION: ABI surgery and device activation seem to be safe and feasible in this preliminary cohort.

36. **Wilkinson EP, Eisenberg LS, Krieger MD, Schwartz MS, Winter M, Glater JL, Martinez AS, Fisher LM, Shannon RV, Los Angeles Pediatric ABI Team (2017) Initial results of a safety and feasibility study of auditory brainstem implantation in congenitally deaf children. *Otol Neurotol.* 38(2):212-220.**

Abstract

OBJECTIVE: To determine the safety and feasibility of the auditory brainstem implant (ABI) in congenitally deaf children with cochlear aplasia and/or cochlear nerve deficiency.  
 STUDY DESIGN: Phase I feasibility clinical trial of surgery in 10 children, ages 2 to 5 years, over a 3-year period.  
 SETTING: Tertiary children's hospital and university-based pediatric speech/language/hearing center.  
 INTERVENTION(S): ABI implantation and postsurgical programming. MAIN OUTCOME MEASURE(S): The primary outcome measure is the number and type of adverse events during ABI surgery and postsurgical follow-up, including behavioral mapping of the device. The secondary outcome measure is access to and early integration of sound. RESULTS: To date, nine children are enrolled. Five children have successfully undergone ABI surgery and postoperative behavioral programming. Three children were screen failures, and one child is currently undergoing candidacy evaluation. Expected adverse events have been documented in three of the five children who received the ABI. One child experienced a cerebral spinal fluid leak, which resolved with lumbar drainage. One child demonstrated vestibular side effects during device programming, which resolved by deactivating one electrode. One child experienced postoperative vomiting resulting in an abdominal radiograph. Four children have completed their 1-year follow-up and have speech detection thresholds of 30 to 35 dB HL. Scores on the IT-MAIS/MAIS range from 8 to 31 (out of a total of 40), and the children are demonstrating some ability to discriminate between closed-sets words that differ by number of syllables (pattern perception). CONCLUSION: ABI surgery and device activation seem to be safe and feasible in this preliminary cohort.

37. **Sazert S, Thomas JP, Buchner A, Muller J, Hempel JM, Lowenheim H, Mlynski R. (2017) Off the ear with no loss in speech understanding: comparing the RONDO and the OPUS 2 cochlear implant audio processors. *Eur Arch Otorhinolaryngol.* 274(3):1391-1395.**

Abstract

The RONDO is a single-unit cochlear implant audio processor, which omits the need for a behind-the-ear (BTE) audio processor. The primary aim was to compare speech perception results in quiet and in noise with the RONDO and the OPUS 2, a BTE audio processor. Secondary aims were to determine subjects' self-assessed levels of sound quality and gather subjective feedback on RONDO use. All speech perception tests were performed with the RONDO and the OPUS 2 behind-the-ear audio processor at 3 test intervals. Subjects were required to use the RONDO between test intervals. Subjects were tested at upgrade from the OPUS 2 to the RONDO and at 1 and 6 months after upgrade. Speech perception was determined using the Freiburg Monosyllables in quiet test and the Oldenburg Sentence Test (OLSA) in noise. Subjective perception was determined using the Hearing Implant Sound Quality Index (HISQUI<sub>19</sub>), and a RONDO device-specific questionnaire. 50 subjects participated in the study. Neither speech perception scores nor self-perceived sound

quality scores were significantly different at any interval between the RONDO and the OPUS 2. Subjects reported high levels of satisfaction with the RONDO. The RONDO provides comparable speech perception to the OPUS 2 while providing users with high levels of satisfaction and comfort without increasing health risk. The RONDO is a suitable and safe alternative to traditional BTE audio processors.

- 38. Qi B, Liu Z, Gu X, Liu B (2017) Speech recognition outcomes in Mandarin-speaking cochlear implant users with fine structure processing. *Acta Otolaryngol.* 137(3):286-292.**

Abstract

CONCLUSION: Mandarin-speaking adults can use the Fine Structure Processing (FSP) coding strategy as well as the Continuous Interleaved Sampling (CIS+) coding strategy. No loss in performance was observed after switch-over. Tone identification improves over time with the FSP coding strategy, which is of benefit to tonal-language users. After some time, fine structure was preferred. OBJECTIVE: This study aimed to determine speech perception, tone perception, and the subjective preferences of Mandarin-speaking adults who received the FSP coding strategy, at upgrade from the CIS + coding strategy. METHODS: Thirteen Mandarin-speaking subjects were tested at switch-over from CIS + to the FSP coding strategy ~1-month after switch-over, 2-months after switch-over, and 3-months after switch-over with the Mandarin Hearing in Noise Test (M-HINT), the Mandarin Tone Identification in Noise Test (M-TINT), and a visual analogue scale assessing Sound and Speech Assessment (SSA). RESULTS: There were no significant differences in the M-HINT between presentation levels (62 dB SPL vs 65 dB SPL), over time, nor when compared to the CIS + coding strategy. Tone perception improved significantly over time with the FSP coding strategy. Subjects rated the FSP coding strategy with the OPUS 2 as significantly more 'full' and 'rich' than with the CIS + coding strategy after 3-months.

- 39. Mistrik P, Jolly C. (2016) Optimal electrode length to match patient specific cochlear anatomy. *Eur Ann Otorhinolaryngol Head Neck Dis.* 133 Suppl 1:S68-71.**

Abstract

Cochlear implantation (CI) has reached over years of practicing high standards of surgical outcomes. Even patients with significant residual hearing are nowadays benefiting from a cochlear implant. However, the speech perception still depends to great extent on the adequate pitch match between the frequency components delivered by an electrode array and individual cochlear tonotopic map. Compression, deletion or shift of frequency components can be tolerated by patients only to some extent. Furthermore, low frequency information delivered to the cochlear apex is particularly important for spatial hearing. It is therefore important to use the electrode array of an appropriate length for each individual cochlea. The large variability in the anatomy makes this task difficult as a single design does not fit all cochlear shapes. Fortunately, preoperative CT imaging, routinely taken in most of ENT clinics, can be exploited also for the prediction of the cochlear duct length (CDL). It turns out that a single radiological measurement, the diameter of the basal turn, is highly correlated with CDL and its measurement can be used for the informed selection of the most suitable electrode array length from the available array portfolio for each CI patient.

- 40. Wei X, Li Y, Fu QJ, Gong Y, Chen B, Chen J, Shi Y, Su Q, Cui D, Liu T (2017) Slotted labyrinthotomy approach with customized electrode for patients with common cavity deformity. *Laryngoscope.* Doi: 10.1002/lary.26627**

Abstract

OBJECTIVES/HYPOTHESIS: Cochlear implantation for patients with common cavity deformity (CCD) can be difficult, with a higher incidence of intra- and postoperative complications; outcomes with CCD patients are also

highly variable. In this study, surgical time was compared between the traditional facial recess approach (TFRA) and the transmastoid slotted labyrinthotomy approach (TSLA). Audiological outcomes and the benefit of using customized electrode arrays for CCD patients are also discussed. STUDY DESIGN: Retrospective review of 13 cochlear implant (CI) patients with CCD. METHODS: Six patients were implanted with the TFRA using traditional electrodes, and seven patients were implanted with the TSLA using customized electrodes. Intra- and postoperative complications were reviewed. Audiological outcomes were measured 3 months to 2 years after CI activation. RESULTS: The mean surgical time for TSLA group was nearly half as long as for the TRFA group ( $P < .05$ ). Although mean audiological outcomes were better for the TSLA group, there was no significant difference between groups ( $P > .05$ ). CONCLUSIONS: For CCD patients, TSLA for cochlear implantation is recommended due to shortened surgical time; customized electrode arrays may be additionally advantageous in terms of audiological outcomes.

41. Büchner A, Illg A, Majdani O, Lenarz T (2017) Investigation of the effect of cochlear implant electrode length on speech comprehension in quiet and noise compared with the results with users of electro-acoustic-stimulation, a retrospective analysis. *PLoS One*. 12(5):e0174900.

Abstract

OBJECTIVES: This investigation evaluated the effect of cochlear implant (CI) electrode length on speech comprehension in quiet and noise and compare the results with those of EAS users. METHODES: 91 adults with some degree of residual hearing were implanted with a FLEX20, FLEX24, or FLEX28 electrode. Some subjects were postoperative electric-acoustic-stimulation (EAS) users; the other subjects were in the groups of electric stimulation-only (ES-only). Speech perception was tested in quiet and noise at 3 and 6 months of ES or EAS use. Speech comprehension results were analyzed and correlated to electrode length. RESULTS: While the FLEX20 ES and FLEX24 ES groups were still in their learning phase between the 3 to 6 months interval, the FLEX28 ES group was already reaching a performance plateau at the three months appointment yielding remarkably high test scores. EAS subjects using FLEX20 or FLEX24 electrodes outscored ES-only subjects with the same short electrodes on all 3 tests at each interval, reaching significance with FLEX20 ES and FLEX24 ES subjects on all 3 tests at the 3-months interval and on 2 tests at the 6- months interval. Amongst ES-only subjects at the 3-months interval, FLEX28 ES subjects significantly outscored FLEX20 ES subjects on all 3 tests and the FLEX24 ES subjects on 2 tests. At the-6 months interval, FLEX28 ES subjects still exceeded the other ES-only subjects although the difference did not reach significance. CONCLUSIONS: Among ES-only users, the FLEX28 ES users had the best speech comprehension scores, at the 3- months appointment and tendentially at the 6 months appointment. EAS users showed significantly better speech comprehension results compared to ES-only users with the same short electrodes.

42. Lenarz T. (2017) Cochlear implant – state of the art. *Laryngorhinootologie*. 96(S 01):S123-151. (Article in German)

Abstract

Cochlear implants are the treatment of choice for the auditory rehabilitation of patients with sensory deafness. They restore the missing function of inner hair cells by transforming the acoustic signal into electrical stimuli for activation of auditory nerve fibers. Due to the very fast technology development cochlear implants provide open-set speech understanding in the majority of patients including the use of the telephone. Children can achieve a near to normal speech and language development provided their deafness is detected early after onset and implantation is performed quickly thereafter. The diagnostic procedure as well as the surgical techniques have been standardized and can be adapted to the individual anatomical and physiological needs both in children and adults. Special cases such as cochlear obliteration or malformations can be addressed. Device failures and medical complications might require special measures and reimplantation which can be done in most cases in a straight forward way. Technology upgrades count for better performance. Future developments will focus on better electrode nerve interfaces by improving electrode technology. An increased number of electrical contacts as well

as the biological treatment with regeneration of the dendrites growing onto the electrode will increase the number of electrical channels. This will give room for improved speech coding strategies in order to create the bionic ear, i. e. to restore the process of natural hearing by means of technology. The robot assisted surgery will allow for high precision surgery and reliable hearing preservation. Biological therapies will support the bionic ear. Methods are biohybrid electrodes which are coded by stem cells transplanted into the inner ear to enhance autoproductio

43. **De Seta D, Nyugen Y, Bonnard D, Ferrary E, Godey B, Bakhos D, Mondain M, Deguine O, Sterkers O, Bernardeschi D, Mosnier I (2016) The role of electrode placement in bilateral simultaneously cochlear-implanted adult patients. *Otolaryngol Head Neck Surg.* 155(3):485-93.**

Abstract

OBJECTIVE: To evaluate the influence of the electrode placement on hearing performance in adult patients who were simultaneously and bilaterally cochlear implanted. STUDY DESIGN: Case series with planned data collection. SETTING: Tertiary referral university centers. SUBJECTS AND METHODS: The postoperative computed tomography scan was studied for 19 patients who were simultaneously and bilaterally implanted with a long straight electrode array. The size of the cochlea was measured in consideration of the major cochlear diameter and cochlear height. The electrode-to-modiolus distance for the electrodes positioned at 180 and 360 degrees and the angular depth of insertion of the array were also measured. Speech perception was assessed at 1 and 5 years postimplantation with disyllabic word lists in quiet and in noise, with the speech coming from the front and a background noise (cocktail party) coming from 5 loudspeakers. RESULTS: At 1 year postimplantation, the electrode-to-modiolus distance at 180 degrees was correlated with the speech perception scores in both quiet and noise. In patients with a full electrode insertion, no correlation was found between the angular depth of insertion and hearing performance. The speech perception scores in noise gradually declined as a function of the number of inserted and active electrodes. No relationship between electrode position and speech perception scores was found at 5 years postimplantation. CONCLUSION: In adult patients who were simultaneously and bilaterally implanted, the use of a long straight array, the full electrode array insertion, and the proximity to the modiolus might be determining factors to obtain the best speech performance at 1 year, without influence on the speech perception scores after long-term use.

44. **Calvino M, Gavilan J, Sanchey-Cuadrado I, Perez-Mora RM, Munoz E, Diez-Sebastian J, Lassaletta L (2016) Using the HISQUI29 to assess the sound quality levels of Spanish adults with unilateral cochlear implants and no contralateral hearing. *Eur Arch Otorhinolaryngol.* 273(9): 2343-53.**

Abstract:

To evaluate cochlear implant (CI) users' self-reported level of sound quality and quality of life (QoL). Sound quality was self-evaluated using the hearing implant sound quality index (HISQUI29). HISQUI29 scores were further examined in three subsets. QoL was self-evaluated using the glasgow benefit inventory (GBI). GBI scores were further examined in three subsets. Possible correlations between the HISQUI29 and GBI were explored. Additional possible correlations between these scores and subjects' pure tone averages, speech perception scores, age at implantation, duration of hearing loss, duration of CI use, gender, and implant type were explored. Subjects derived a "moderate" sound quality level from their CI. Television, radio, and telephone tasks were easier in quiet than in background noise. 89 % of subjects reported their QoL benefited from having a CI. Mean total HISQUI29 score significantly correlated with all subcategories of the GBI. Age at implantation inversely correlated with the total HISQUI29 score and with television and radio understanding. Sentence in noise scores

significantly correlated with all sound perception scores. Women had a better mean score in music perception and in telephone use than did men. CI users' self-reported levels of sound quality significantly correlated with their QoL. Cochlear implantation had a beneficial impact on subjects' QoL. Understanding speech is easier in quiet than in noise. Music perception remains a challenge for many CI users. The HISQUI29 and the GBI can provide useful information about the everyday effects of future treatment modalities, rehabilitation strategies, and technical developments.

- 45. Mertens G, Desmet J, De Bolt M, Van de Heyning P (2016) Prospective case-controlled sound localization study after cochlear implantation in adults with single-sided deafness and ipsilateral tinnitus (2016) Clin Otolaryngol 41(5):511-8.**

Abstract:

**OBJECTIVES:** To analyse the sound localisation skills of subjects with profound single-sided deafness (SSD) and accompanied ipsilateral tinnitus who are using a cochlear implant (CI) for between 4 and 11 years. **DESIGN:** Sound localisation skills were tested using nine loudspeakers in a frontal semicircle ranging from -90° to +90°. Subjects were tested in the CION and the CIOFF conditions via 3 localisation stimuli: broadband noise (BB), low-pass noise (LP) and high-pass noise (HP). **PARTICIPANTS:** The test group consisted of 10 adult subjects with profound sensorineural SSD, ipsilateral tinnitus and a CI. Normative data of a control group of 30 normal hearing subjects were used for comparison. **MAIN OUTCOME MEASURES:** Sound location accuracy was analysed via the root-mean-square error (RMSE), the mean absolute error (MAE), the localisation bias ('b') and the bias-adjusted deviation ('db '). Subjective dynamic aspects of hearing were assessed via a reduced version of the Speech, Spatial and Qualities of Hearing Scale (SSQ5 ). **RESULTS:** For all 3 stimuli, the RMSE improved significantly in SSD subjects in the CION condition compared to the CIOFF condition. The localisation accuracy of subjects with SSD improved significantly for BB and HP stimuli. A significant bias-adjusted deviation 'db ' was found for the BB and HP stimuli. Subjects' mean SSQ5 scores were significantly higher in the CION condition at test date than in the CIOFF condition preoperatively. **CONCLUSIONS:** Subjects can better locate sound in the CION condition than in the CIOFF condition.

- 46. Suhling MC, Majdani O, Salcher R, Leifholz M, Büchner A, Lesinski-Schiedat A, Lenarz T (2016) The impact of electrode array length on hearing preservation in cochlear implantation. Otol Neurotol. 37(8): 1006-15.**

Abstract

**OBJECTIVE:** The aim of the study was to determine the degree of hearing preservation (HP) and its relation to electrode array length after cochlear implantation using different thin flexible electrode arrays (TFEA). **STUDY DESIGN:** Retrospective analysis. **INTERVENTION:** One hundred twenty adult patients with preoperative residual hearing received a cochlear implant with a TFEA: 46 received a TFEA20, 34 a TFEA24, and 40 a TFEA28 mm. **MAIN OUTCOME MEASURES:** Pure-tone audiometry (125-1500Hz) was performed preoperatively, at initial fitting, and at 3, 6, and 12 months postoperatively. Median hearing loss (HL) was determined for each of the three array groups. The pre- to postoperative pure-tone average difference was scaled into three groups ( $\leq 15$  dB,  $>15$  to  $\leq 30$  dB,  $>30$  dB) for array group. **RESULTS:** At initial fitting, median HL of 17.5 dB (TFEA20), 20 dB (TFEA24), and 24 dB (TFEA28) was observed. At 12 months, median HL of 15 dB (TFEA20), 19.4 dB (TFEA24), and 32.5 dB (TFEA28) was observed. At initial fitting, a HL of  $\leq 15$  dB was achieved in 45.6% TFEA20 subjects, 29.4% TFEA24 subjects, and 15.0% TFEA28 subjects; compared with 48.8% TFEA20 subjects, 50.0% TFEA24 subjects, and 15.8% TFEA28 subjects at 12 months. **CONCLUSION:** HP is possible in the majority of subjects who are implanted with a TFEA20, 24, or 28. Using shorter arrays led to greater HP and lower median HL.

- 47. Riss D, Hamzavi JS, Blineder M, Flak S, Baumgartner WD, Kaider A, Arnold C (2016) Effects of stimulation rate with the FS4 and HDCIS coding strategies in cochlear implant recipients. Otol Neurotol. 37(7):882-8.**

Abstract

**OBJECTIVE:** The aim of the present study was to evaluate the effect of stimulation rate on speech perception and sound quality for the fine structure strategy FS4 and the envelope-based strategy high definition continuous interleaved sampling (HDCIS). **STUDY DESIGN:** Randomized crossover trial with four conditions. **SETTING:** Tertiary referral. **PATIENTS:** Twenty-six postlingually deafened adult cochlear implant (CI) recipients were included. **INTERVENTION:** All subjects were equipped with four coding strategies: FS4 with high rate on the envelope channels (on average 1376 pps/ch), FS4 low rate (750 pps/ch), and HDCIS with the same high and low rates. A "flat-charge map" was used for all four strategies. Only the loudness was balanced between programs. All tests were performed acutely in a double blind manner and a randomized sequence. **MAIN OUTCOME MEASURES:** Monosyllables in quiet and subjective sound quality. **RESULTS:** Mean monosyllables scores at 65dB in quiet were 25.5% correct with HDCIS low rate, 27.2% correct with HDCIS high rate, 25.2% with FS4 low rate, and 33.1% with FS4 high rate. Performance with high stimulation rates was significantly higher than with the low rate settings. Subjective sound quality measured with visual analogue scales showed that for naturalness of speech, the improvement with a high rate version was only evident with the FS4 strategy. In both FS4 and HDCIS, higher stimulation rates elicited a higher pitch and were perceived as less dull than lower rates. **CONCLUSION:** A high rate of stimulation resulted in better speech recognition in both strategies and a favorable subjective sound quality for FS4 in all tested settings.

- 48. Tavora-Vieira D, Rajan GP (2016) Cochlear implantation in children with congenital unilateral deafness: Mid-term follow-up outcomes. Eur Ann Otorhinolaryngol Head Neck Dis. Suppl. 1: S12-4.**

Abstract

**OBJECTIVES:** Although cochlear implantation is widely used to treat unilateral deafness in adults, very little literature exists on its use and effects on the paediatric population. This report adds to the literature showing the mid-term follow-up outcomes achieved by these children. **MATERIAL AND METHODS:** Three children with congenital unilateral deafness were studied after implantation. Speech perception in noise, and sound localization ability were evaluated using age-appropriate materials. **RESULTS:** The preliminary data of our small group of 3 children with congenital unilateral profound hearing loss revealed that up to 3 years post-implantation, congenitally deaf children who received a cochlear implant after 4 years of age do not demonstrate binaural hearing benefits. **CONCLUSION:** Early intervention in the prelingual phase may be crucial for the development of binaural hearing.

- 49. Finke M, Sandmann P, Bönitz H, Kral A, Büchner A (2016) Consequences of stimulus type on higher-order processing in single-sided deaf cochlear implant users. Audiol Neurootol. 21(5): 305-315**

Abstract

Single-sided deaf subjects with a cochlear implant (CI) provide the unique opportunity to compare central auditory processing of the electrical input (CI ear) and the acoustic input (normal-hearing, NH, ear) within the same individual. In these individuals, sensory processing differs between their two ears, while cognitive abilities are the same irrespectively of the sensory input. To better understand perceptual-cognitive factors modulating speech intelligibility with a CI, this electroencephalography study examined the central-auditory processing of words, the cognitive abilities, and the speech intelligibility in 10 postlingually single-sided deaf CI users. We found lower hit rates and prolonged response times for word classification during an oddball task for the CI ear when compared with the NH ear. Also, event-related potentials reflecting sensory (N1) and higher-order processing (N2/N4) were prolonged for word classification (targets versus nontargets) with the CI ear compared with the NH ear. Our results suggest that speech processing via the CI ear and the NH ear differs both at sensory (N1) and cognitive (N2/N4) processing stages, thereby affecting the behavioral performance for speech discrimination. These results provide objective evidence for cognition to be a key factor for speech perception under adverse listening conditions, such as the degraded speech signal provided from the CI.

50. Cleas AJ, Mertens G, Gilles A, Hofkens-Van den Brandt A, Fransen E, Van Rompaey V, Van de Heyning P (2016) The repeatable battery for the assessment of neuropsychological status for hearing impaired individuals (RBANS-H) before and after cochlear implantation: A protocol for a prospective, longitudinal cohort study. *Front Neurosci.* 10:512.

Abstract

Background: Currently, an independent relationship between hearing loss and cognitive decline in older adults is suggested by large prospective studies. In general, cochlear implants improve hearing and the quality of life in severely to profoundly hearing impaired older persons. However, little is known about the effects of cochlear implantation on the cognitive evolution in this population. Aim of the study: The primary goal of this prospective, longitudinal cohort study is to explore the cognitive profile of severely to profoundly postlingually hearing impaired subjects before and after cochlear implantation. In addition, the current study aims to investigate the relationship between the cognitive function, audiometric performances, quality of life, and self-reliance in these patients. Methods: Twenty-five patients aged 55 or older, scheduled for cochlear implantation, will be enrolled in the study. They will be examined prior to implantation, at 6 and 12 months after implantation and annually thereafter. The test battery consists of (1) a cognitive examination, using the Repeatable Battery for the Assessment of Neuropsychological Status adapted for Hearing impaired persons (RBANS-H), (2) an audiological examination, including unaided and aided pure tone audiometry, speech audiometry in quiet and speech audiometry in noise, (3) the administration of four questionnaires evaluating quality of life and subjective hearing benefit and (4) a semi-structured interview about the self-reliance of the participant. Discussion: Up until now only one study has been conducted on this topic, focusing on the short-term effects of cochlear implantation on cognition in older adults. The present study is the first study to apply a comprehensive neuropsychological assessment adapted for severely to profoundly hearing impaired subjects in order to investigate the cognitive capabilities before and after cochlear implantation. Trial registration: The present protocol is retrospectively registered at Clinical Trials (ClinicalTrials.gov) on June 9th, 2016. The first participant was enrolled on June 22nd, 2015. The protocol identifier is [NCT02794350](https://clinicaltrials.gov/ct2/show/study/NCT02794350).

51. Acharya AN, Tavora-Vieira D, Rajan GP (2016) Using the implant electrode array to conduct real-time intraoperative hearing monitoring during pediatric cochlear implantation: Preliminary experiences. *Otol Neurotol.* 37(2):e148-53

Abstract

OBJECTIVES: To present the preliminary experiences and findings from a pilot study evaluating a novel technique for monitoring cochlear electrophysiological function during electrode insertion in cochlear implantation surgery. STUDY DESIGN: Prospective pilot cohort study. SETTING: Tertiary academic neuro-otology center. PATIENTS: Pediatric patients with residual hearing undergoing hearing preservation cochlear implant surgery. INTERVENTION: Monitoring of intraoperative cochlear microphonics during cochlear implant surgery. MAIN OUTCOME MEASURE: Intraoperative intracochlear microphonic measurement, preservation of these responses postoperatively and preservation of hearing as measured by audiometry. RESULTS: Intracochlear microphonics could be identified in both patients presented and were preserved during the surgical procedure and postoperatively. The preservation of intracochlear microphonics correlates with preservation of hearing. CONCLUSION: The novel approach using the electrode array to detect and measure intracochlear microphonics during cochlear implantation surgery shows promise as an instrument to alert the operating surgeon to hair cell damage during electrode insertion. Further refinement of the technique is required to better understand the measurements and correlate these with pre- and postoperative hearing and risk of hearing loss from surgery. Improvements in the software algorithm will reduce the time required for each measurement, leading to the development a more real-time monitoring technique.

52. Caporali PF, Caporali SA, Bucuvic EC, Vieira Sde S, Santos ZM, Chiari BM (2016) Cross cultural translation and adaptation to Brazilian Portuguese of the hearing implant sound quality index questionnaire – (HISQUI19). *Codas.* 28(4): 345-54

Abstract

**PURPOSE:** Translation and cross-cultural adaptation of the instrument Hearing Implant Sound Quality Index (HISQUI19), and characterization of the target population and auditory performance in Cochlear Implant (CI) users through the application of a synthesis version of this tool. **METHODS:** Evaluations of conceptual, item, semantic and operational equivalences were performed. The synthesis version was applied as a pre-test to 33 individuals, whose final results characterized the final sample and performance of the questionnaire. The results were analyzed statistically. **RESULTS:** The final translation (FT) was back-translated and compared with the original version, revealing a minimum difference between items. The changes observed between the FT and the synthesis version were characterized by the application of simplified vocabulary used on a daily basis. For the pre-test, the average score of the interviewees was 90.2, and a high level of reliability was achieved (0.83). **CONCLUSION:** The translation and cross-cultural adaptation of the HISQUI19 questionnaire showed suitability for conceptual, item, semantic and operational equivalences. For the sample characterization, the sound quality was classified as good with better performance for the categories of location and distinction of sound/voices.

**53. Bruns L, Mürbe D, Hahne A (2016) Understanding music with cochlear implants. Sci Rep. 6:32026.**

Abstract

Direct stimulation of the auditory nerve via a Cochlear Implant (CI) enables profoundly hearing-impaired people to perceive sounds. Many CI users find language comprehension satisfactory, but music perception is generally considered difficult. However, music contains different dimensions which might be accessible in different ways. We aimed to highlight three main dimensions of music processing in CI users which rely on different processing mechanisms: (1) musical discrimination abilities, (2) access to meaning in music, and (3) subjective music appreciation. All three dimensions were investigated in two CI user groups (post- and prelingually deafened CI users, all implanted as adults) and a matched normal hearing control group. The meaning of music was studied by using event-related potentials (with the N400 component as marker) during a music-word priming task while music appreciation was gathered by a questionnaire. The results reveal a double dissociation between the three dimensions of music processing. Despite impaired discrimination abilities of both CI user groups compared to the control group, appreciation was reduced only in postlingual CI users. While musical meaning processing was restorable in postlingual CI users, as shown by a N400 effect, data of prelingual CI users lack the N400 effect and indicate previous dysfunctional concept building.

**54. Rader T, Döge J, Adel Y, Weissgerber T, Baumann U (2016) Place dependent stimulation rates improve pitch perception in cochlear implantees with single-sided deafness. Hear Res. 339:94-103.**

Abstract

In normal hearing, the pitch of an acoustic tone can theoretically be encoded by either the place of stimulation in the cochlea or the corresponding rate of vibration. Thus spectral attributes and temporal fine structure of an acoustic signal are naturally correlated. Cochlear implants (CIs), neural prosthetic devices that restore hearing in the profoundly hearing impaired, currently disregard this mechanism; electrical stimulation is provided at fixed electrode positions with default place independent stimulation rate assignments. This does not account for individual cochlear encoding depending on electrode array placement, variations in insertion depth, and the proximity to nerve fibers. Encoding pitch in such manner delivers limited tonal information. Consequently, music appraisal in CI users is often rated cacophonous while speech perception in quiet is close to normal in top performers. We hypothesize that this limitation in electric stimulation is at least partially due to the mismatch between frequency and place encoding in CIs. In the present study, we determined individual electrode locations by analysis of cochlear radiographic images obtained after surgery and calculated place dependent stimulation rates according to models of the normal tonotopic function. Pitch matching in CI users with single-sided deafness shows that place dependent stimulation rates allow thus far unparalleled restoration of tonotopic pitch perception. Collapsed data of matched pitch frequencies as a function of calculated electrical stimulation rate were well fitted

by linear regression ( $R(2) = 0.878$ ). Sound processing strategies incorporating place dependent stimulation rates are expected to improve pitch perception in CI users.

55. Zirn S, Polterauner D, Keller S, Hemmert W (2016) The effect of fluctuating maskers on speech understanding of high-performing cochlear implant users. *Int J Audiol.* 55(5): 295-304.

Abstract

OBJECTIVE: The present study evaluated whether the poorer baseline performance of cochlear implant (CI) users or the technical and/or physiological properties of CI stimulation are responsible for the absence of masking release. DESIGN: This study measured speech reception thresholds (SRTs) in continuous and modulated noise as a function of signal to noise ratio (SNR). STUDY SAMPLE: A total of 24 subjects participated: 12 normal-hearing (NH) listeners and 12 subjects provided with recent MED-EL CI systems. RESULTS: The mean SRT of CI users in continuous noise was  $-3.0 \pm 1.5$  dB SNR (mean  $\pm$  SEM), while the normal-hearing group reached  $-5.9 \pm 0.8$  dB SNR. In modulated noise, the difference across groups increased considerably. For CI users, the mean SRT worsened to  $-1.4 \pm 2.3$  dB SNR, while it improved for normal-hearing listeners to  $-18.9 \pm 3.8$  dB SNR. CONCLUSIONS: The detrimental effect of fluctuating maskers on SRTs in CI users shown by prior studies was confirmed by the current study. Concluding, the absence of masking release is mainly caused by the technical and/or physiological properties of CI stimulation, not just the poorer baseline performance of many CI users compared to normal-hearing subjects. Speech understanding in modulated noise was more robust in CI users who had a relatively large electrical dynamic range.

56. Garcia Negro AS, Padilla Garcia JL, Sainz Quevedo M (2016) Production and evaluation of a Spanish version of the LittlEARS Auditory Questionnaire for the assessment of auditory development in children. *Int J Pediatr Otorhinolaryngol*, 83: 99-103.

Abstract

BACKGROUND AND AIMS: To adapt the LittlEARS(®) Auditory Questionnaire (LEAQ) into Spanish and evaluate the psychometric properties of the Spanish version of the questionnaire. METHODS: The LEAQ was translated into Spanish by a back-translation design. Following the Guidelines for Adapting Tests of the International Test Commission (ITC), for the first time with the LEAQ adaptations, two qualitative methods were used to evaluate the translated version of the LEAQ: an expert appraisal method followed by cognitive interviewing. Having improved the Spanish version of the LEAQ with these evaluations, a psychometric analysis was conducted. 215 parents of children with normal hearing aged between 1.7 and 24.0 months participated in the study. Corrected item-total correlations were calculated to analyze to what extent items distinguish levels of auditory development of assessed children. Cronbach's alpha coefficient - to evaluate internal consistency across items - was also calculated. To obtain validity evidence, correlations between item-total score and age were calculated. A non-linear regression model was also estimated to obtain normative data for expected and minimum value of total scores from the questionnaire according to age. RESULTS: Expert appraisal and cognitive interviewing pointed out some translation errors and difficulties parents had while responding to the Spanish LEAQ. Such errors and difficulties were fixed in the Spanish LEAQ version applied for psychometric analysis. Corrected item-total correlations ranged from 0.15 to 0.75. Cronbach's alpha coefficient value was 0.92, indicating that the measurements are highly reliable. The value of the correlation between total scores and age was 0.86 ( $p < 0.001$ ). The regression analysis conducted to obtain normative data shows that 79% of the variation in the total scores can be explained by age. CONCLUSIONS: The results of psychometric analyses provide evidence supporting the use of the Spanish version of the LEAQ as a valid and culturally appropriate tool to assess the development of auditory behaviour in Spanish children who are 24 months old or younger.

57. Lorens A, Skarzynski H, Rivas A, Rivas JA, Zimmermann K, Parnes L, Lassaletta L, Gavilán J, De Bodt M, Van de Heyning P, Martin J, Raine CH, Rajeswaran R, Kameswaran M, Manoj M, Pulibalathingal S (2016) Patient management for cochlear implant recipients in audiology departments: A practice review. *Cochlear Implants Int.* 17(3): 123-8.

Abstract

**OBJECTIVES:** To determine and evaluate the time clinics needed to complete the sub-processes involved in the first-fitting and follow-up fitting of people with a cochlear implant. **METHODS:** Eight HEARRING clinics completed a questionnaire recording how long it took to complete the sub-processes involved in first-fitting and follow-up fitting cochlear implant recipients. The mean times of clinics and procedures were then compared. **RESULTS:** Questionnaires on 77 patients were completed. Clinics varied widely on time spent on each sub-process in both first- and follow-up fittings. Total first-fitting times were similar across clinics. Follow-up fitting times varied more across clinics although this may have been due to differences in questionnaire interpretation. **DISCUSSION:** If a patient management plan can help increasingly busy cochlear implant clinics provide high-quality care more efficiently, essential first steps are determining which procedures are generally performed and how long their performance takes. Until reliable data are gathered, constructing a patient management plan or reaping the potential benefits of its use will remain elusive; clinics will have to find what solutions they can to meet rising workload demands. **CONCLUSION:** The variation in time spent on each sub-process may suggest that some clinics have more efficient workflow procedures. Compiling a best practice for each process could be instrumental in creating a professional process management plan that would increase efficiency without sacrificing quality of care.

58. **Stahl P, Macherey O, Meunier S, Roman S (2016) Rate discrimination at low pulse rates in normal-hearing and cochlear implant listeners: Influence of intracochlear stimulation site. J Acoustic Soc Am, 139(4): 1578-91.**

Abstract

Temporal pitch perception in cochlear implantees remains weaker than in normal hearing listeners and is usually limited to rates below about 300 pulses per second (pps). Recent studies have suggested that stimulating the apical part of the cochlea may improve the temporal coding of pitch by cochlear implants (CIs), compared to stimulating other sites. The present study focuses on rate discrimination at low pulse rates (ranging from 20 to 104 pps). Two experiments measured and compared pulse rate difference limens (DLs) at four fundamental frequencies (ranging from 20 to 104 Hz) in both CI and normal-hearing (NH) listeners. Experiment 1 measured DLs in users of the (Med-El CI, Innsbruck, Austria) device for two electrodes (one apical and one basal). In experiment 2, DLs for NH listeners were compared for unresolved harmonic complex tones filtered in two frequency regions (lower cut-off frequencies of 1200 and 3600 Hz, respectively) and for different bandwidths. Pulse rate discrimination performance was significantly better when stimulation was provided by the apical electrode in CI users and by the lower-frequency tone complexes in NH listeners. This set of data appears consistent with better temporal coding when stimulation originates from apical regions of the cochlea.

59. **Arts RAGJ, George ELJ, Janssen M, Griessner A, Zierhofer C, Stokroos RJ (2016) Tinnitus suppression by intracochlear electrical stimulation in single sided deafness – a prospective clinical trial: follow-up. PLoS One, 11(4): e0153131. doi: 10.1371/journal.pone.0153131**

Abstract

**INTRODUCTION:** Earlier studies show that a Cochlear Implant (CI), capable of providing intracochlear electrical stimulation independent of environmental sounds, appears to suppress tinnitus at least for minutes. The current main objective is to compare the long-term suppressive effects of looped (i.e. repeated) electrical stimulation (without environmental sound perception) with the standard stimulation pattern of a CI (with environmental sound perception). This could open new possibilities for the development of a "Tinnitus Implant" (TI), an intracochlear pulse generator for the suppression of tinnitus. **MATERIALS AND METHODS:** Ten patients with single sided deafness suffering from unilateral tinnitus in the deaf ear are fitted with a CI (MED-EL Corporation, Innsbruck, Austria). Stimulation patterns are optimized for each individual patient, after which they are compared using a randomized crossover design, with a follow-up of six months, followed by a 3 month period using the modality of

patient's choice. RESULTS: Results show that tinnitus can be suppressed with intracochlear electrical stimulation independent of environmental sounds, even long term. No significant difference in tinnitus suppression was found between the standard clinical CI and the TI. CONCLUSION: It can be concluded that coding of environmental sounds is no requirement for tinnitus suppression with intracochlear electrical stimulation. It is therefore plausible that tinnitus suppression by CI is not solely caused by an attention shift from the tinnitus to environmental sounds. Both the standard clinical CI and the experimental TI are potential treatment options for tinnitus. These findings offer perspectives for a successful clinical application of the TI, possibly even in patients with significant residual hearing.

60. Johnston JD, Scoffibgs D, Chung M, Baguley D, Donnelly NP, Axon PR, Gray RF, Tysome JR (2016) Computed tomography estimation of cochlear duct length can predict full insertion in cochlear implantation. *Otol Neurotol*, 37(3): 223-8.

Abstract

OBJECTIVE: To compare the rates of full insertion of electrodes and hearing outcomes obtained with 28-mm and 31-mm cochlear implant electrode arrays. To assess whether cochlear duct length (CDL) estimated by preoperative computed tomography (CT) predicts whether an electrode is fully inserted. STUDY DESIGN: A cohort study compared electrodes inserted and hearing outcomes after implantation with 28-mm or 31-mm arrays. CDL estimated from preoperative CT was compared in patients in whom full insertion of the 28-mm array was achieved compared with patients in whom at least one basal electrode was outside the cochlea. SETTING: Tertiary referral cochlear implantation center. PATIENTS: One hundred forty-eight patients implanted with 28-mm cochlear implant arrays (175 devices) and 74 patients implanted with 31-mm arrays (88 devices). INTERVENTION: Cochlear implantation with 28-mm or 31-mm array. MAIN OUTCOME MEASURES: Active electrodes at first programming, and at subsequent follow-ups. Bamford-Kowal-Bench sentence and auditory speech sound evaluation test results at 2 to 3 months in adult patients. CDL predicted by preoperative CT. RESULTS: There was no difference in full insertion between the 28-mm and 31-mm array cohorts ( $p = 0.22$ ). Early hearing outcomes at 2 to 3 months showed no difference in mean auditory speech sound evaluation ( $p = 0.19$ ) or Bamford-Kowal-Bench results ( $p = 0.853$ ) between the 28-mm and 31-mm cohorts. CDL was shorter in the 22 patients with less than full insertion of the array with a mean length of 28.7 mm compared with 29.6 mm in the 42 patients in whom full insertion was achieved ( $p = 0.046$ ).

61. Roy AT, Penninger RT, Pearl MS, Wuerfel W, Jiradejvong P, Carver C, Buechner A, Limb CJ (2016) Deeper cochlear implant electrode insertion angle improves detection of musical sound quality deterioration related to bass frequency removal. *Otol Neurotol*, 37(2): 146-51.

Abstract

BACKGROUND: Cochlear implant (CI) electrode arrays typically do not reach the most apical regions of the cochlea that intrinsically encode low frequencies. This may contribute to diminished implant-mediated musical sound quality perception. The objective of this study was to assess the effect of varying degrees of apical cochlear stimulation (measured by angular insertion depth) on musical sound quality discrimination. HYPOTHESIS: Increased apical cochlear stimulation will improve low-frequency perception and musical sound quality discrimination. METHODS: Standard (31.5 mm,  $n = 17$ ) and medium (24 mm,  $n = 8$ ) array Med-EL CI users, and normal hearing (NH) listeners ( $n = 16$ ) participated. Imaging confirmed angular insertion depth. Participants completed a musical discrimination task in which they listened to a real-world musical stimulus (labeled reference) and provided sound quality ratings to versions of the reference, which included a hidden reference and test stimuli with increasing amounts of low-frequency removal. Scores for each CI users were calculated on the basis of how much their ratings differed from NH listeners for each stimulus version. RESULTS: Medium array and standard users had significantly different insertion depths ( $389.4 \pm 64.5$  and  $583.9 \pm 78.5$  degrees, respectively;  $p < .001$ ). A significant Pearson's correlation was observed between angular insertion depth and the hidden reference scores ( $p < 0.05$ ). CONCLUSION: CI users with greater apical stimulation made sound quality discriminations that more closely resembled those of NH controls for stimuli that contained low frequencies ( $< 200$  Hz of information).

These findings suggest that increased apical cochlear stimulation improves musical low-frequency perception, which may provide a more satisfactory music listening experience for CI users.

- 62. Kuzovkov V, Sugarova S, Vanov Y (2016) The Mi1000 CONCERTO PIN cochlear implant: An evaluation of its safety and stability in adults and children. Acta Otolaryngol, 136(3): 236-40.**

Abstract

**Conclusion** The study demonstrates the medium-term stability and safety of the CONCERTO PIN cochlear implant. The use of the CONCERTO PIN proved to be suitable for the use of a surgical technique without the need for suture fixation and resulted in short surgery duration and a low medium-term complication rate. **Objective** The primary aim was to provide data on medium-term safety and stability of the CONCERTO PIN cochlear implant in adults and children, and to collect feedback on the surgical technique used, which involved no drilling and no suture fixation. The secondary aim was to analyze surgery duration. **Methods** Implantation was performed using minimally invasive surgery. During surgery, data on the surgical procedure was collected by the attending surgeons or a designee. Safety and stability of the CONCERTO PIN were assessed at first fitting (1 month after implantation) and 6 months after first fitting. **Results** Ninety-nine patients were implanted with a CONCERTO PIN implant and one patient with a CONCERTO implant. The CONCERTO PIN implants implanted during this study were immobilized by pins and a tight periosteal pocket. The mean ( $\pm$  SD) surgery duration was 27:52 ( $\pm$  9:19) min.

- 63. Kitoh R, Moteki H, Nishio S, Shinden S, Kanzaki S, Iwasaki S, Ogawa K, Usami S (2016) The effects of cochlear implantation in Japanese single-sided deaf patients: five case reports. Acta Otolaryngol, 136(5): 460-4.**

Abstract

**Conclusion** Cochlear implantation (CI) for Japanese single-sided deafness patients resulted in improved speech perception, increased sound localization accuracy, and reduced tinnitus handicap. **Objectives** This study reports results for five adult SSD cases with CI, focusing on the benefits they obtained in terms of speech recognition, sound localization, and tinnitus handicap. **Methods** Five Japanese patients meeting the eligibility criteria were included in this study. All patients were implanted with a fully inserted MED-EL Concerto FLEX28® implant (MED-EL, Innsbruck, Austria). Speech perception outcomes in noise, as well as sound localization and tinnitus disturbance, were assessed pre-surgically and at 1, 3, 6, and 12 months after CI activation. **Results** The Japanese monosyllable test score in noise improved gradually after implantation. In some cases, speech perception ability appeared unstable, particularly in the first 1-6 months after implantation. The sound localization ability showed marked improvement in all cases, with the disturbance to daily life caused by tinnitus also decreasing in all cases from the early post-operative period.

- 64. Landsberger DM, Vermeire K, Claes A, Van Rompaey V, Van de Heyning P (2016) Qualities of single electrode stimulation as a function of reate and place of stimulation with a cochlear implant. Ear Hear, 37(3): e85-90.**

Abstract

**OBJECTIVES:** Although it has been shown previously that changes in temporal coding produce changes in pitch in all cochlear regions, research has suggested that temporal coding might be best encoded in relatively apical locations. The authors hypothesized that although temporal coding may provide useable information at any cochlear location, low rates of stimulation might provide better sound quality in apical regions that are more likely to encode temporal information in the normal ear. In the present study, sound qualities of single electrode pulse trains were scaled to provide insight into the combined effects of cochlear location and stimulation rate on sound quality. **DESIGN:** Ten long-term users of MED-EL cochlear implants with 31-mm electrode arrays (Standard or FLEX) were asked to scale the sound quality of single electrode pulse trains in terms of how "Clean," "Noisy,"

"High," and "Annoying" they sounded. Pulse trains were presented on most electrodes between 1 and 12 representing the entire range of the long electrode array at stimulation rates of 100, 150, 200, 400, or 1500 pulses per second. RESULTS: Although high rates of stimulation are scaled as having a Clean sound quality across the entire array, only the most apical electrodes (typically 1 through 3) were considered Clean at low rates. Low rates on electrodes 6 through 12 were not rated as Clean, whereas the low-rate quality of electrodes 4 and 5 were typically in between. Scaling of Noisy responses provided an approximately inverse pattern as Clean responses. High responses show the trade-off between rate and place of stimulation on pitch. Because High responses did not correlate with Clean responses, subjects were not rating sound quality based on pitch. CONCLUSIONS: If explicit temporal coding is to be provided in a cochlear implant, it is likely to sound better when provided apically. In addition, the finding that low rates sound clean only at apical places of stimulation is consistent with previous findings that a change in rate of stimulation corresponds to an equivalent change in perceived pitch at apical locations. Collectively, the data strongly suggest that temporal coding with a cochlear implant is optimally provided by electrodes placed well into the second cochlear turn.

65. **Grossmann W, Brill S, Moeltner A, Mlynski R, Hagen R, Radeloff A (2016) Cochlear implantation improves spatial release from masking and restores localization abilities in single-sided deaf patients. *Otol Neurotol*, 37(6): 658-64.**

Abstract

HYPOTHESIS: Adult patients with acquired single-sided deafness (SSD) benefit from binaural hearing after cochlear implantation (CI). BACKGROUND: To spatially separate the signal of interest from noise is of utmost importance for the speech understanding in challenging listening situations. This ability, however, largely depends on binaural hearing. CI in acquired SSD restores hearing on the deaf ear. This study intended to test, if this is accompanied by a restoration of binaural functions of the auditory system. METHODS: Eleven CI users with SSD and normal hearing to mild sensorineural hearing loss in the contralateral ear participated in this study. Speech reception thresholds (SRT) were obtained using the Oldenburg Sentence Test (OLSA) sentence test in competing two talker babble noise. To evaluate spatial release from masking, seven spatial configurations of speech and noise were used in a free field setup: noise originated from 0 degree,  $\pm 45$  degrees and  $\pm 90$  degrees incidence angles, whereas speech was either presented from the front or  $\pm 90$  degrees. In addition, localization ability in the frontal horizontal plane was assessed with a 1 s Comité Consultatif International Téléphonique et Télégraphique (CCITT) noise stimulus using an array of nine equally spaced loudspeakers. All tests were conducted in acoustic normal hearing ear alone (AH) and aided conditions. RESULTS: In conditions with spatially separated signal and noise sources, significant benefit of the aided over the AH condition was observed, even when noise was presented from the AH side. Localization ability significantly improved in the aided condition. CONCLUSION: The present data demonstrates that spatial release from masking can be restored in patients with SSD using a cochlear implant.

66. **Nordfalk KF, Rasmussen K, Hopp E, Bunne M, Silvola JT, Jablonski GE (2016) Insertion depth in cochlear implantation and outcome in residual hearing and vestibular function. *Ear Hear*, 37(2): e129-37.**

Abstract

OBJECTIVES: It has long been known that cochlear implantation may cause loss of residual hearing and vestibular function. Different insertion depths may cause varying degrees of intracochlear trauma in the apical region of the cochlea. The present study investigated the correlation between the insertion depth and postoperative loss of residual hearing and vestibular function. DESIGN: Thirty-nine adults underwent unilateral cochlear implantation. One group received a Med-El +Flex electrode array (24 mm; n = 4), 1 group received a Med-El +Flex electrode array (28 mm; n = 18), and 1 group received a Med-El +Flex electrode array (31.5 mm; n = 17). Residual hearing, cervical vestibular-evoked myogenic potentials, videonystagmography, and subjective visual vertical/horizontal were explored before and after surgery. The electrode insertion depth and scalar position were examined with high-resolution rotational tomography after implantation in 29 subjects. RESULTS: There was no observed relationship between the angular insertion depth ( $405^\circ$  to  $708^\circ$ ) and loss of low-frequency pure-tone

average. Frequency-specific analysis revealed a weak relationship between the angular insertion depth and loss of hearing at 250 Hz ( $R= 0.20$ ;  $p = 0.02$ ). There was no statistically significant difference in the residual hearing and vestibular function between the +Flex and the +Flex electrode array. Eight percent of the cases had vertigo after surgery. The electrode arrays were positioned inside the scala tympani and not scala vestibuli in all subjects. In 18% of the cases, the +Flex electrode array was not fully inserted. CONCLUSIONS: The final outcome in residual hearing correlates very weakly with the angular insertion depth for depths above  $405^\circ$ . Postoperative loss of vestibular function did not correlate with the angular insertion depth or age at implantation. The surgical protocol used in this study seems to minimize the risk of postoperative vertigo symptoms.

- 67. Wimmer W, Weder S, Caversaccio M, Kompis M (2016) Speech intelligibility in noise with a pinna effect imitating cochlear implant processor. *Otol Neurotol*, 37(1): 19-23.**

Abstract

OBJECTIVE: To evaluate the speech intelligibility in noise with a new cochlear implant (CI) processor that uses a pinna effect imitating directional microphone system. STUDY DESIGN: Prospective experimental study. SETTING: Tertiary referral center. PATIENTS: Ten experienced, unilateral CI recipients with bilateral severe-to-profound hearing loss. Intervention: All participants performed speech in noise tests with the Opus 2 processor (omnidirectional microphone mode only) and the newer Sonnet processor (omnidirectional and directional microphone mode). MAIN OUTCOME MEASURE: The speech reception threshold (SRT) in noise was measured in four spatial settings. The test sentences were always presented from the front. The noise was arriving either from the front (SON0), the ipsilateral side of the CI (SONIL), the contralateral side of the CI (SONCL), or the back (SON180). RESULTS: The directional mode improved the SRTs by 3.6 dB ( $p < 0.01$ ), 2.2 dB ( $p < 0.01$ ), and 1.3 dB ( $p < 0.05$ ) in the SON180, SONIL, and SONCL situations, when compared with the Sonnet in the omnidirectional mode. There was no statistically significant difference in the SON0 situation. No differences between the Opus 2 and the Sonnet in the omnidirectional mode were observed. CONCLUSION: Speech intelligibility with the Sonnet system was statistically different to speech recognition with the Opus 2 system suggesting that CI users might profit from the pinna effect imitating directionality mode in noisy environments.

- 68. Guinand N, van de Berg R, Ranieri M, Cavuscens S, DiGiovanna J, Nguyen TAK, Micera S, Stokroos R, Kingma H, Guyot JP, Perez Fornos A (2015) Vestibular implants: hope for improving the quality of life of patients with bilateral vestibular loss. *Conf Proc IEEE Eng Med Biol Soc*. 2015:7192-5.**

Abstract

The vestibular system plays an essential role in crucial tasks such as postural control, gaze stabilization, and spatial orientation. Currently, there is no effective treatment for a bilateral loss of the vestibular function (BVL). The quality of life of affected patients is significantly impaired. During the last decade, our group has explored the potential of using electrical stimulation to artificially restore the vestibular function. Our vestibular implant prototype consists of a custom modified cochlear implant featuring one to three vestibular electrodes implanted in the proximity of the ampullary branches of the vestibular nerve; in addition to the main cochlear array. Special surgical techniques for safe implantation of these devices have been developed. In addition, we have developed stimulation strategies to generate bidirectional eye movements as well as the necessary interfaces to capture the signal from a motion sensor (e.g., gyroscope) and use it to modulate the stimulation signals delivered to the vestibular nerves. To date, 24 vestibular electrodes have been implanted in 11 BVL patients. Using a virtual motion profile to modulate the "baseline" electrical stimulation, vestibular responses could be evoked with 21 electrodes. Eye movements with mean peak eye velocities of  $32^\circ/s$  and predominantly in the plane of the stimulated canal were successfully generated. These are within the range of normal compensatory eye movements during walking and were large enough to have a significant effect on the patients' visual acuity. These results indicate that electrical stimulation of the vestibular nerve has a significant functional impact; eye movements generated this way could be sufficient to restore gaze stabilization during essential everyday tasks

such as walking. The innovative concept of the vestibular implant has the potential to restore the vestibular function and have a central role in improving the quality of life of BVL patients in the near future.

69. **Dillon MT, Buss E, Adunka OF, Buchman CA, Pillsbury HC (2015) Influence of test condition on speech perception with electric-acoustic stimulation. Am J Audiol, 24(4): 520-8.**

Abstract:

**PURPOSE:** The goal of this work was to better understand speech perception for cochlear implant (CI) users with bilateral residual hearing, including consideration of effects related to listening conditions and test measures. Of interest was the role of acoustic hearing for speech perception in a complex background, the role of listening experience for CI-alone conditions, and whether performance with electric-acoustic stimulation (EAS) was improved by a contralateral hearing aid (HA). **METHOD:** Eleven subjects provided data on Consonant-Nucleus-Consonant (CNC; Peterson & Lehiste, 1962) words in quiet, City University of New York (CUNY; Boothroyd, Hanin, & Hnath, 1985) sentences in steady noise, and Bamford-Kowal-Bench (Bench, Kowal, & Bamford, 1979) sentences in multitalker babble. Listening conditions included: CI with a full-frequency map, CI with a truncated-frequency map, EAS, and EAS+HA (EAS plus contralateral HA). Sounds were presented at 0° azimuth. **RESULTS:** For CNC words and CUNY sentences, performance was better with the truncated-frequency than the full-frequency map, and performance with EAS was better than for either CI-alone condition. For Bench-Kowal-Bamford sentences, EAS+HA was better than EAS. **CONCLUSIONS:** As demonstrated previously, performance was better in the EAS condition than either CI-alone condition. Better performance in the truncated-frequency than full-frequency CI-alone condition suggests that listening experience may be important. A contralateral HA improved performance over unilateral EAS under some conditions.

70. **Wolf-Magele A, Schnabl J, Edlinger S, Pok SM, Schoerg P, Sprinzl GM (2015) Potoperative changes in telemetry measurements after cochlear implantation and its impact on early activation. Clin Otolaryngol, 40(6): 527-34.**

Abstract

**INTRODUCTION:** Cochlear implantation is a clinically routine treatment for patients with severe sensorineural hearing loss for over 20 years. Up to now, the general recommendation for speech processor activation was 4 weeks after cochlear implantation. The aim of this study was to determine whether activation is possible at <4 weeks postop and to show the postoperative change in telemetry over time. **MATERIAL AND METHODS:** The study was retrospectively carried out at the Karl Landsteiner University Hospital St. Pölten, Austria. Patients who routinely received a CI between January and August 2013 were included in this study. Two weeks after the surgery clinical complications, the ability to wear the audio processor and the impedance values were analysed. **RESULTS:** Forty-five patients were included in this study. Forty patients were examined at the first postoperative visit, scheduled 2 weeks after the surgery. In nine cases, a mild wound-healing complication occurred; just in one patient, the activation could not carry out immediately. There were no statistically significant differences between the intraoperative, the 2- and 6-week postop impedance measurements for each channel. **DISCUSSION:** We used the minimally invasive approach and soft implantation technique in all of our patients and believe this to have been a major reason that earlier activation was possible. With this technique, you can reduce the wound-healing process, which makes it possible for the wound to heal fully and for the patient to wear the sound processor over the wound without problems. We found out that telemetry is not a predictor for the time of activation. **CONCLUSION:** Based on the results in this study, an earlier activation can be recommended. This will shorten the time the patient needs to wait following cochlear implantation, and rehabilitation can begin sooner.

71. **Távora-Vieira D, Miller S (2015) The benefits of using RONDO and an in-the-ear hearing aid in patients using a combined electric-acoustic system. Advances in Otolaryngology, <http://dx.doi.org/10.1155/2015/941230>.**

Abstract

People with residual hearing in the low frequencies and profound hearing loss in the high frequencies often do not benefit from acoustic amplification. Focus on this group of patients led to the development of the combined electric-acoustic stimulation (EAS) systems which can provide users with greater speech perception than can cochlear implant (CI) alone or acoustic hearing alone. EAS users wear a combined speech processor that incorporates a behind-the-ear audio processor that sits with an ear hook on the user's pinna and a hearing aid, which sits in the ear canal. However, with the introduction of single-unit processors, which combine the audio processor, coil, control unit, and battery pack into a single device that sits on the implant site, therefore off the ear, simultaneous electric (CI) and acoustic (hearing aid) stimulation is not currently possible with a combined processor. To achieve EAS with a single-unit processor, a CI user must also wear a hearing aid. This study seeks to determine if experienced users of combined EAS speech processors could also benefit from using a combination of a single-unit speech processor that sits off the ear and an in-the-ear hearing aid.

72. **Calvino M, Gavilán J, Sánchez-Cuadrado I, Pérey-Mora RM, Munoz E, Lassaletta L (2015) Validation of the Hearing Implant Sound Quality Index (HISQUI19) to assess Spanish-speaking cochlear implant users' auditory abilities in everyday communication situations. Acta Otolaryngol, 136(1): 48-55.**

Abstract

**CONCLUSION:** The Spanish-language HISQUI19 is a reliable and easy-to-use tool for quantifying the self-perceived level of auditory benefit that cochlear implant (CI) users experience in everyday listening situations. **OBJECTIVES:** To validate the Spanish-language version of The Hearing Implant Sound Quality Index (HISQUI19), a questionnaire for quantifying the self-perceived level of auditory benefit that CI users experience in everyday listening situations. **METHODS:** Adult Spanish-speaking subjects with a CI were asked to complete a Spanish-language version of the HISQUI19. Reliability of the questionnaire was determined using Cronbach's  $\alpha$  coefficient; exploratory factor analyses with a rotated (varimax) factor solution was applied to check construct validity; external validity was confirmed using Pearson's correlation. Test-re-test analysis was also performed. The MED-EL Assessment Database was used to assist in the administration, reporting, and data collection. **RESULTS:** Sixty-six of 77 subjects completed and returned the HISQUI19. The mean score auditory ability score (mean  $\pm$  standard deviation) of the HISQUI19 was  $79.9 \pm 24.0$ , a 'moderate' auditory benefit. An inverse relationship was found between the HISQUI19 score and age at implantation. Gender and side of implantation did not influence self-perceived functioning. The objective measures (disyllables tested without lip-reading and in quiet) were correlated with the Total Score.

73. **Schnabl J, Wolf-Magele A, Pok SM, Url C, Zorowka P, Sprinzl G. Evaluation of a minimally invasive surgical fixation technique for young children with the Concerto Pin cochlear implant system. Eur Arch Otorhinolaryngol, 272(8): 1893-8.**

Abstract

In 2011, Med-El (Innsbruck, Austria) introduced a new cochlear implant system, designed to require a minimally invasive surgical technique and allow greater positional flexibility for its fixation on the skull. The Concerto Pin implant system is a good option for patients with thinner bone, such as children and elderly. The aim of this study was to investigate the implant's stability in children using our minimally invasive surgical technique. This was a prospective, longitudinal study with a single-subject, repeated-examination design. Six children, implanted with a Concerto Pin using our minimally invasive surgical technique between October 2011 and September 2012, were assessed 1, 3 and 6 months after surgery. In each case, the implant remained in a stable position and no adverse events or problems with healing were observed at any time during the investigation. The minimally invasive technique and the method of implant fixation that bypass drilling a deep implant bed constitute a good option for patients with thinner bone, such as children. This clinical study shows the safety and stability of the Concerto Pin implant system using a minimally invasive surgical technique.

74. **Kleine Punte A, Mertens G, Cochet E, De Bodt M, Van de Heyning P (2015) Improved speech reception and sound quality with the DUET2 audio processor for electric acoustic stimulation. *Acta Otolaryngol*, 135(10): 1022-9.**

Abstract

**CONCLUSION:** The results show that the DUET2 offers users speech perception that is equivalent to or better than the DUET. Moreover, the DUET2 offers subjective benefits above those provided by the DUET. **BACKGROUND:** The DUET is a combination of hearing aid and CI in one device for electric acoustic stimulation. Since its introduction: a second generation, the DUET2, has been developed. This study aimed to investigate the benefits of the DUET2 compared to the DUET. **METHODS:** Speech reception was determined in quiet and in noise. The sound quality of speech and music was rated using a visual analogue scale. Test intervals were at upgrade and at 3 and 6 months after upgrade. **RESULTS:** Speech reception in quiet and in noise was significantly better than with the DUET after 6 months. For sentence reception in quiet, the SRT with the DUET2 did not change significantly between test intervals. Sentence reception in noise with the DUET2 improved significantly between 3 and 6 months and upgrade and 6 months. After 6 months, speech reception in quiet and in noise with the DUET2 was significantly better than with the DUET. Subjects rated the sound quality of speech and of music with the DUET2 significantly better than with the DUET.

75. **Kobler JP, Dhanasingh A, Kiran R, Jolly C, Ortmaier T (2015) Cochlear dummy electrodes for insertion training and research purposes: Fabrication, mechanical characterization, and experimental validation. *Biomed Res Int*, 2015: 574209.**

Abstract

To develop skills sufficient for hearing preservation cochlear implant surgery, surgeons need to perform several electrode insertion trials in ex vivo temporal bones, thereby consuming relatively expensive electrode carriers. The objectives of this study were to evaluate the insertion characteristics of cochlear electrodes in a plastic scala tympani model and to fabricate radio opaque polymer filament dummy electrodes of equivalent mechanical properties. In addition, this study should aid the design and development of new cochlear electrodes. Automated insertion force measurement is a new technique to reproducibly analyze and evaluate the insertion dynamics and mechanical characteristics of an electrode. Mechanical properties of MED-EL's FLEX(28), FLEX(24), and FLEX(20) electrodes were assessed with the help of an automated insertion tool. Statistical analysis of the overall mechanical behavior of the electrodes and factors influencing the insertion force are discussed. Radio opaque dummy electrodes of comparable characteristics were fabricated based on insertion force measurements. The platinum-iridium wires were replaced by polymer filament to provide sufficient stiffness to the electrodes and to eradicate the metallic artifacts in X-ray and computed tomography (CT) images. These low-cost dummy electrodes are cheap alternatives for surgical training and for in vitro, ex vivo, and in vivo research purposes.

76. **Sun CH, Hsu CJ, Chen PR, Wu HP (2015) Residual hearing preservation after cochlear implantation via round window or cochleostomy approach. *Laryngoscope*, 125(7): 1715-9.**

Abstract

**OBJECTIVES/HYPOTHESIS:** The purpose of the study was to investigate whether cochlear implantation using the round window approach provided better preservation of residual hearing than the cochleostomy approach. **STUDY DESIGN:** Case-control study. **METHODS:** We designed a case-control study including 40 patients from a tertiary referral center who underwent cochlear implantation surgeries using devices from MED-EL Co., Innsbruck, Austria. Between November 2013 and July 2014, we prospectively enrolled 20 subjects for cochlear implantation surgery using the round window insertion approach. In addition, 20 age- and sex-matched control subjects from the database of cochlear implantees treated using the cochleostomy approach between January 2008 and October 2013 were retrospectively enrolled. The residual hearing of the operated ear was measured before and after surgery. The variables analyzed were the pure-tone average threshold at 250, 500, and 1,000 Hz and the

residual hearing at frequencies of 250 to 8,000 Hz. The residual hearing was considered as preserved when the audiometric changes were <10 dB hearing loss for each variable. The audiological results of the two groups were compared. RESULTS: No statistically significant difference in the preservation of residual hearing was found in the two groups ( $P > .05$  for all of the variables). CONCLUSIONS: The round window and cochleostomy approaches for cochlear implant surgery may preserve residual hearing at similar rates across a range of frequencies.

77. **Batuecas-Caletrio A, Klumpp M, Santacruz-Ruiz S, Gonzalez FB, Sánchez EG, Arriaga M (2015) Vestibular function in cochlear implantation: correlating objectiveness and subjectiveness. *Laryngoscope*, 125(10): 2371-5.**

Abstract

OBJECTIVE: To evaluate vestibular function before and after cochlear implantation (CI) STUDY DESIGN: A prospective descriptive study. MATERIAL AND METHODS: Thirty consecutive patients with profound sensorineural hearing loss undergoing CI. Objective assessment of vestibular function was performed with the caloric test and video head impulse test (vHIT) in patients before and after CI. Dizziness Handicap Inventory (DHI) was used for subjective assessment before and after CI. RESULTS: Thirty patients received CI with 21 by round window approach and nine by anteroinferior cochleostomy. Vestibular results were categorized into four groups: no changes (20 patients), changes in the caloric test and vHIT (3 patients, all with DHI changes;  $P = 0.0001$ ), changes in vHIT gain but not in caloric test (3 patients, all with DHI changes;  $P = 0.005$ ), no changes in the caloric test and vHIT gain but only saccades appear (4 patients, all with DHI changes;  $P = 0.011$ ). CONCLUSIONS: Although CI is a safe surgery with few major complications, it is a procedure that can produce dizziness. The vHIT reveals that 30% of patients demonstrate postoperative change in vestibular function. Therefore, when examining a CI patient with postoperative symptoms of dizziness, results of the vHIT test and gain as well as the presence of saccades, along with an increase DHI score, are parameters to consider in their evaluation.

78. **Wimmer W, Caversaccio M, Kompis M (2015) Speech intelligibility in noise with a single-unit cochlear implant processor. *Otol Neurotol*, 36(7): 1197-202.**

Abstract

INTRODUCTION: The Rondo is a single-unit cochlear implant (CI) audio processor comprising the identical components as its behind-the-ear predecessor, the Opus 2. An interchange of the Opus 2 with the Rondo leads to a shift of the microphone position toward the back of the head. This study aimed to investigate the influence of the Rondo wearing position on speech intelligibility in noise. METHODS: Speech intelligibility in noise was measured in 4 spatial configurations with 12 experienced CI users using the German adaptive Oldenburg sentence test. A physical model and a numerical model were used to enable a comparison of the observations. RESULTS: No statistically significant differences of the speech intelligibility were found in the situations in which the signal came from the front and the noise came from the frontal, ipsilateral, or contralateral side. The signal-to-noise ratio (SNR) was significantly better with the Opus 2 in the case with the noise presented from the back (4.4 dB,  $p < 0.001$ ). The differences in the SNR were significantly worse with the Rondo processors placed further behind the ear than closer to the ear. CONCLUSION: The study indicates that CI users with the receiver/stimulator implanted in positions further behind the ear are expected to have higher difficulties in noisy situations when wearing the single-unit audio processor.

79. **Mertens G, De Bodt M, Van de Heyning P (2015) Cochlear implantation as a long-term treatment for ipsilateral incapacitating tinnitus in subjects with unilateral hearing loss up to 10 years. *Hear Res*: 331: 1-6.**

Abstract

**INTRODUCTION:** The authors previously demonstrated that tinnitus resulting from unilateral hearing loss (UHL) can be treated with electrical stimulation via a Cochlear Implant (CI). The study aimed to do a long-term (LT) evaluation of CI in subjects suffering from UHL and accompanied incapacitating tinnitus up to 10 years. The primary focus of the study is on LT tinnitus reduction. **SUBJECTS:** LT evaluation was derived from 23 subjects suffering from UHL and accompanied incapacitating tinnitus (Pre-operative Tinnitus Loudness Visual Analogue Scale (VAS) score >6/10). They were cochlear implanted at a median age of 55 years (22-71 yr) and had 8 years (3-10 yr) experience with their CI at the LT testing. The subjects were categorized into two groups: a Single-Sided Deaf Group (SSD) and an Asymmetric Hearing Loss Group (AHL). The SSD group comprises subjects with contralateral normal hearing (i.e. air conduction pure tone average (PTA<sub>0.5, 1, 2 and 4 kHz</sub>) ≤ 30 dB HL) and the AHL group subjects with contralateral mild to moderate hearing loss (i.e. air conduction PTA<sub>0.5, 1, 2 and 4 kHz</sub> > 30 dB HL). **METHODS:** In order to obtain a LT structural overview of the CI use in UHL subjects, a structured interview was conducted including questions about daily amount of CI use, residual inhibition of the tinnitus after switch off, tinnitus type, etc. The VAS<sub>tinnitus loudness</sub> and the Tinnitus Questionnaire were obtained pre-operatively, one, three, six, 12, and 36-months post-operatively and at the long-term test interval (8 (3-10 years) post-operative). The Hyperacusis Questionnaire was administered in the CI<sub>ON</sub> and the CI<sub>OFF</sub> condition. **RESULTS:** The structural interview revealed that all patients (23/23) still wear their CI seven days a week, eight (3-10) years after cochlear implantation. It appeared that in all subjects but one CI switch-on is the first act when rising and CI switch-off is the last act before bedtime. In the SSD group, tinnitus suppression is still the primary benefit reported (83%), whereas in the AHL the majority of the subjects (55%) report that the primary benefit shifted to improved hearing. In the majority of the subjects the tinnitus reduction starts within 1 min (in 70% of the cases) and the residual inhibition after CI switch-off is less than a minute (in 65% of the cases). The VAS and TQ scores significantly improved up to three months after the first-fitting and remain stable up to the LT test interval. The median score on the Hyperacusis Questionnaire was 17 (7-36) in the CI<sub>OFF</sub> condition and improved to 23,5 (12-39) in the CI<sub>ON</sub> condition in the SSD group. **CONCLUSION:** This is the first study to report on LT results in a large number of UHL CI users, up to 10 years. Structured interviews shows that 100% of the subjects wears their CI seven days a week. The tinnitus reduces significantly up to three months after the first-fitting and the tinnitus reduction remain stable up to the LT test interval. The SSD group report tinnitus reduction as the primary benefit, whereas the majority of the AHL group report improved hearing as the primary benefit, eight (3-10) years after implantation. In addition to the tinnitus reduction, the CI provides also a benefit regarding reported.

80. Skarzynski P, Lorens A, Dziendziel B, Skarzynski PH (2015) Expanding pediatric cochlear implant candidacy: A case study of electro-natural stimulation (ENS) in partial deafness treatment. *Int J Pediatr Otorhinolaryngol*, 79(11): 1896-900.

Abstract

**BACKGROUND:** Some adolescents have hearing impairments characterized by normal or slightly elevated thresholds in the low and mid-frequency bands (below 1500Hz) and nearly total deafness in the high frequency range. These patients often remain beyond the scope of effective hearing aid treatment. **CASE REPORT:** This study presents the case of a 16-year-old adolescent with good hearing in the range 125-1500Hz and deafness at other frequencies. An implant was used to restore hearing at high frequencies, while preserving low and mid frequency acoustic hearing in the implanted ear. This is described as electro-natural stimulation (ENS) of the inner ear. **CONCLUSIONS:** The results demonstrate that low and mid frequency hearing (up to 1500Hz) can be preserved using the round window surgical technique. A substantial improvement in speech discrimination was also observed when electrical stimulation on one side was combined with acoustic stimulation on both sides. There is scope to extend qualifying criteria for cochlear implantation to include adolescents who are suited to ENS.

81. Zeitler DM, Dorman MF, Natale SJ, Loiselle L, Yost WA, Gifford RH (2015) Sound source localization and speech understanding in complex listening environments by single-sided deaf listeners after cochlear implantation. *Otol Neurotol*, 36(9): 1467-71.

Abstract

**OBJECTIVE:** To assess improvements in sound source localization and speech understanding in complex listening environments after unilateral cochlear implantation for single-sided deafness (SSD). **STUDY DESIGN:** Nonrandomized, open, prospective case series. **SETTING:** Tertiary referral center. **PATIENTS:** Nine subjects with a unilateral cochlear implant (CI) for SSD (SSD-CI) were tested. Reference groups for the task of sound source localization included young (n=45) and older (n=12) normal-hearing (NH) subjects and 27 bilateral CI (BCI) subjects. **INTERVENTION:** Unilateral cochlear implantation. **MAIN OUTCOME MEASURES:** Sound source localization was tested with 13 loudspeakers in a 180 arc in front of the subject. Speech understanding was tested with the subject seated in an 8-loudspeaker sound system arrayed in a 360-degree pattern. Directionally appropriate noise, originally recorded in a restaurant, was played from each loudspeaker. Speech understanding in noise was tested using the Azbio sentence test and sound source localization quantified using root mean square error. **RESULTS:** All CI subjects showed poorer-than-normal sound source localization. SSD-CI subjects showed a bimodal distribution of scores: six subjects had scores near the mean of those obtained by BCI subjects, whereas three had scores just outside the 95th percentile of NH listeners. Speech understanding improved significantly in the restaurant environment when the signal was presented to the side of the CI. **CONCLUSION:** Cochlear implantation for SSD can offer improved speech understanding in complex listening environments and improved sound source localization in both children and adults. On tasks of sound source localization, SSD-CI patients typically perform as well as BCI patients and, in some cases, achieve scores at the upper boundary of normal performance.

- 82. Dillon MT, Bucker AL, Adunka MC, King ER, Adunka OF, Buchman CA, Pillsbury HA (2015) Impact of electrical stimulation on residual hearing. J Am Acad Audiol, 26(8): 732-40.**

Abstract

**BACKGROUND:** Candidacy criteria for cochlear implantation are expanding to include patients with substantial low-to-mid frequency hearing sensitivity. Postoperative hearing preservation has been achieved in cochlear implant recipients, though with variable outcomes. Previous investigations on postoperative hearing preservation outcomes have evaluated intraoperative procedures. There has been limited review as to whether electric stimulation influences hearing preservation. **PURPOSE:** The purpose of this analysis was to evaluate whether charge levels associated with electric stimulation influence postoperative hearing preservation within the first year of listening experience. **RESEARCH DESIGN:** Retrospective analysis of unaided residual hearing and charge levels. **STUDY SAMPLE:** Twenty-eight cochlear implant recipients with postoperative residual hearing in the operative ear and at least 12 mo of listening experience with electric-acoustic stimulation (EAS). **DATA COLLECTION AND ANALYSIS:** Assessment intervals included initial cochlear implant activation, initial EAS activation, and 3-, 6-, and 12-mo postinitial EAS activation. A masked low-frequency bone-conduction (BC) pure-tone average (PTA) was calculated for all participants at each assessment interval. Charge levels for each electrode were determined using the most comfortable loudness level and pulse width values. Charge levels associated with different regions of the electrode array were compared to the change in the low-frequency BC PTA between two consecutive intervals. **RESULTS:** Charge levels had little to no association with the postoperative change in low-frequency BC PTA within the first year of listening experience. **CONCLUSIONS:** Electric charge levels do not appear to be reliably related to the subsequent loss of residual low-frequency hearing in the implanted ear within the first year of EAS listening experience.

- 83. Wagner F, Wimmer W, Leidolt L, Vischer M, Weder S, Wiest R, Matokoudis G, Caversaccio MD (2015) Significant artifact reduction at 1.5T and 3T MRI by the use of a cochlear implant with removable magnet: An experimental human cadaver study. PLoS One, 10(7): e0132483.**

Abstract

**OBJECTIVE:** Cochlear implants (CIs) are standard treatment for postlingually deafened individuals and prelingually deafened children. This human cadaver study evaluated diagnostic usefulness, image quality and artifacts in 1.5T and 3T magnetic resonance (MR) brain scans after CI with a removable magnet. **METHODS:** Three criteria (diagnostic usefulness, image quality, artifacts) were assessed at 1.5T and 3T in five cadaver heads

with CI. The brain magnetic resonance scans were performed with and without the magnet in situ. The criteria were analyzed by two blinded neuroradiologists, with focus on image distortion and limitation of the diagnostic value of the acquired MR images. RESULTS: MR images with the magnet in situ were all compromised by artifacts caused by the CI. After removal of the magnet, MR scans showed an unequivocal artifact reduction with significant improvement of the image quality and diagnostic usefulness, both at 1.5T and 3T. Visibility of the brain stem, cerebellopontine angle, and parieto-occipital lobe ipsilateral to the CI increased significantly after magnet removal. CONCLUSIONS: The results indicate the possible advantages for 1.5T and 3T MR scanning of the brain in CI carriers with removable magnets. Our findings support use of CIs with removable magnets, especially in patients with chronic intracranial pathologies.

- 84. Alsanosi AA (2015) Simultaneous bilateral cochlear implantation in a five-month-old child with Usher Syndrome. J Laryngol Otol, 129(9): 919-22.**

Abstract

OBJECTIVE: To report a rare case of simultaneous bilateral cochlear implantation in a five-month-old child with Usher syndrome. METHOD: Case report. RESULTS: A five-month-old boy with Usher syndrome and congenital profound bilateral deafness underwent simultaneous bilateral cochlear implantation. The decision to perform implantation in such a young child was based on his having a supportive family and the desire to foster his audiological development before his vision deteriorated. The subject experienced easily resolvable intra- and post-operative adverse events, and was first fitted with an externally worn audio processor four weeks after implantation. At 14 months of age, his audiological development was age-appropriate. CONCLUSION: Simultaneous bilateral cochlear implantation is possible, and even advisable, in children as young as five months old when performed by an experienced implantation team.

- 85. Mertens G, Kleine Punte A, De Bodt M, Van de Heyning P (2015) Sound quality in adult cochlear implant recipients using the HISQUI19. Acta Otolaryngol, 135(11): 1138-45.**

Abstract

CONCLUSION: On average, adult CI recipients report a moderate sound quality using the Dutch version of the HISQUI19 questionnaire. These results are correlated with their age, speech perception scores, CI aided hearing thresholds, and the SSQ5 and the APHAB questionnaire. BACKGROUND: The general aim of the study was to assess sound quality in adult cochlear implant (CI) recipients and to link these findings to other patients reported outcome measures (PROM) and subject characteristics. Therefore, the Hearing Implant Sound Quality Index (HISQUI19), which was translated into Dutch, was used. This user-friendly instrument quantifies sound quality experienced by hearing implant users. METHODS: The Dutch version of the original German HISQUI19 was obtained by the process of translation and back-translation. The HISQUI19 was assessed in 65 experienced adult CI users at the Ear, Nose, and Throat (ENT) department of the Antwerp University Hospital to assess a sound quality profile of experienced adult CI recipients. Therefore, descriptive statistics were used to summarize the mean, standard deviation, and ceiling or floor effects of the total HISQUI19 scores in a CI population. Spearman correlations between the HISQUI19 scores and objective audiological measures and other PROM were investigated (APHAB and SSQ5 questionnaire). RESULTS: The mean HISQUI19 score of the Dutch version in adult CI recipients was 64.9 (SD = 20.8), which corresponds to moderate sound quality. The psychometric characters of the Dutch questionnaire are similar to the characters of the original HISQUI19 questionnaire, emphasizing good internal consistency ( $\alpha = 0.93$ ) and construct validity. Moderate correlation was found with speech perception in quiet ( $r = 0.36, p < 0.01$ ), speech perception in noise ( $r = 0.29, p < 0.05$ ), CI aided Pure Tone Average (PTA0.5, 1, 2 and 4 kHz) of the subjects ( $r = 0.34, p < 0.01$ ), and the age of the subject ( $r = 0.38, p < 0.01$ ). Gender did not influence the experienced sound quality significantly. Furthermore, the relation to other questionnaires was found to be significantly strong (SSQ5:  $r = 0.68$  and the APHAB:  $r = 0.64; p < 0.01$ ).

- 86. Zirn S, Arndt S, Aschendorff A, Wesarg T (2015) Interaural stimulation timing in single sided deaf cochlear implant users. Hear Res, 328: 148-56.**

Abstract

The interaural time difference (ITD) is an important cue for the localization of sounds. ITD changes as little as 10  $\mu$ s can be detected by the human auditory system. By provision of one ear with a cochlear implant (CI) ITD are altered due to the partial replacement of the peripheral auditory system. A hearing aid (HA), in contrast, does not replace but adds a processing delay component to the peripheral auditory system extending ITD. The aim of the present study was to quantify interaural stimulation timing between these different modalities to estimate the need for central auditory temporal compensation in single sided deaf CI users or bimodal CI/HA users. For this purpose, wave V latencies of auditory brainstem responses evoked either acoustically (ABR) or electrically via the CI (EABR) have been measured. The sum of delays consisting of CI signal processing measured in the MED-EL OPUS2 audio processor and EABR wave V latencies evoked on different intracochlear sites allowed an estimation of the entire CI channel-specific delay for MED-EL MAESTRO CI systems. We compared these values with ABR wave V latencies measured in the contralateral normal hearing or HA provided ear in different frequency bands. The results showed that EABR wave V latencies were consistently shorter than those evoked acoustically in the unaided normal hearing ear. Thus, artificial delays within the audio processor can be implemented to adjust interaural stimulation timing. The currently implemented group delays in the MED-EL CI system turned out to be reasonably similar to those of the unaided ear. For adjustment of CI and contralateral HA, in contrast, an adjustable additional across-frequency delay in the range of 1-11 ms implemented in the CI would be required. Especially for bimodal CI/HA users the adjustment of interaural stimulation timing may induce improved binaural hearing, reduced need for central auditory temporal compensation and increased acceptance of the CI/HA provision.

- 87. Hochmair I, Hochmair E, Nopp P, Waller M, Jolly C (2015) Deep electrode insertion and sound coding in cochlear implants. *Hear Res*, 322: 14-23.**

Abstract

Present-day cochlear implants demonstrate remarkable speech understanding performance despite the use of non-optimized coding strategies concerning the transmission of tonal information. Most systems rely on place pitch information despite possibly large deviations from correct tonotopic placement of stimulation sites. Low frequency information is limited as well because of the constant pulse rate stimulation generally used and, being even more restrictive, of the limited insertion depth of the electrodes. This results in a compromised perception of music and tonal languages. Newly available flexible long straight electrodes permit deep insertion reaching the apical region with little or no insertion trauma. This article discusses the potential benefits of deep insertion which are obtained using pitch-locked temporal stimulation patterns. Besides the access to low frequency information, further advantages of deeply inserted long electrodes are the possibility to better approximate the correct tonotopic location of contacts, the coverage of a wider range of cochlear locations, and the somewhat reduced channel interaction due to the wider contact separation for a given number of channels. A newly developed set of strategies has been shown to improve speech understanding in noise and to enhance sound quality by providing a more "natural" impression, which especially becomes obvious when listening to music. The benefits of deep insertion should not, however, be compromised by structural damage during insertion. The small cross section and the high flexibility of the new electrodes can help to ensure less traumatic insertions as demonstrated by patients' hearing preservation rate.

- 88. Helbig S, Helbig M, Leinung M, Stöver T, Baumann U, Rader T (2015) Hearing preservation and improved speech perception with a flexible 28-mm electrode. *Otol Neurotol*, 36(1): 34-42.**

Abstract

OBJECTIVE: The present study aimed to determine the extent of hearing preservation retrospectively after atraumatic cochlear implant (CI) surgery using a specialized surgical technique and specially designed flexible electrode to minimize cochlear trauma. STUDY DESIGN: Retrospective study. SETTING: Academic tertiary care center. PATIENTS: A consecutive series of 34 patients who had some preoperative residual hearing were

included in this study. INTERVENTION: Patients underwent CI surgery with a flexible 28-mm electrode using a round window insertion technique. MAIN OUTCOME MEASURES: All patients had at least 6 months of postoperative follow-up including audiometric testing and speech perception determined using the Freiburg monosyllable word test and the Oldenburger Sentence Test in noise. Audiometric testing served as a proxy for the evaluation of cochlear trauma and hearing preservation. RESULTS: Hearing was preserved to within 20 dB of preoperative low-frequency pure-tone audiometry (PTA) in 40.7% of patients. Hearing was preserved to within 20 dB of preoperative high-frequency PTA in 35.7% of patients. Overall, a deterioration in hearing thresholds was observed between preoperative assessment and first fitting. Speech perception improved significantly over time after surgery. CONCLUSION: Using appropriate surgical techniques, and electrodes specially designed to minimize cochlear trauma, hearing preservation can be achieved.

89. **Moteki H, Kitoh R, Tsukada K, Iwasaki S, Nishio S, Usami S (2015) The advantages of sound localization and speech perception of bilateral electric acoustic stimulation. *Acta Otolaryngol*, 135(2): 147-53.**

Abstract

CONCLUSION: Bilateral electric acoustic stimulation (EAS) effectively improved speech perception in noise and sound localization in patients with high-frequency hearing loss. OBJECTIVE: To evaluate bilateral EAS efficacy of sound localization detection and speech perception in noise in two cases of high-frequency hearing loss. METHODS: Two female patients, aged 38 and 45 years, respectively, received bilateral EAS sequentially. Pure-tone audiometry was performed preoperatively and postoperatively to evaluate the hearing preservation in the lower frequencies. Speech perception outcomes in quiet and noise and sound localization were assessed with unilateral and bilateral EAS. RESULTS: Residual hearing in the lower frequencies was well preserved after insertion of a FLEX(24) electrode (24 mm) using the round window approach. After bilateral EAS, speech perception improved in quiet and even more so in noise. In addition, the sound localization ability of both cases with bilateral EAS improved remarkably.

90. **Távora-Vieira D, De Ceulaer G, Govaerts PJ, Rajan GP (2015) Cochlear implantation improves localization ability in patients with unilateral deafness. *Ear Hear*, 36(3)e93-8.**

Abstract

OBJECTIVES: One of the major complaints of people with a single-sided deafness is the inability to localize sound sources. Evidence suggests that subjects with a hearing loss can benefit from the use of a cochlear implant (CI) in sound localization. This study aimed to determine the effect of CI use on localization ability in unilaterally deafened subjects. DESIGN: Sixteen adult subjects with postlingual unilateral deafness, fitted with a CI on the deaf side, were included in this study. The auditory speech sounds evaluation (AŞE) localization test was used to determine localization with a CI on (binaural) and a CI off (monaural). The root mean square error was used as a measure of the subject's localization performance. Stratified analyses were performed to test the influence of gender, age of implantation (<55 years and >55 years), and the duration of deafness (<10 years and >10 years) on localization ability. RESULTS: Subjects with a CI on localized significantly better than without a CI. Gender, age, and the duration of deafness had no effect on the localization ability of the subjects. CONCLUSIONS: Cochlear implantation is effective in improving localization abilities in subjects with unilateral deafness. The root mean square error dropped significantly with binaural hearing compared to monaural hearing.

91. **Hagr A, Garadat SN, Al-Momani M, Alsabellha RM, Abdulaziz FA (2015) Feasibility of one-day activation in cochlear implant recipients. *Int J Audiol*, 54(5): 323-8.**

Abstract

OBJECTIVE: To determine if cochlear implants recipients can be safely and effectively fitted with their sound processor one day after their implant surgery. DESIGN: All subjects were implanted with MED-EL Concerto cochlear implant. Subjects' electrode impedance levels, maximum comfortable levels, and threshold levels were

measured one day after surgery and compared to measurements obtained one month post implantation using the non-parametric Wilcoxon signed-rank test. STUDY SAMPLE: Twenty-nine participants in the age range of 1 to 42 years (average of 5 years). RESULTS: No adverse events were reported post-operatively. Measures after one day of surgery were significantly less than those measured one month post implantation. CONCLUSION: Early activation of the implant did not impact the healing process of the incision site, suggesting that one-day activation of the implant is feasible for some patients when medically possible. The evolution of the impedance and stimulation levels were consistent with that reported in previous studies, which indicates that early activation did not interfere with the physiological changes taking place after implantation.

- 92. Alexiades G, Dhanasingh A, Jolly C (2015) Method to estimate the complete and two-turn cochlear duct length. *Otol Neurotol*, 36(5): 904-7.**

Abstract

HYPOTHESIS: Using a linear measurement of the cochlea on a single radiographic image can reliably estimate the complete and two-turn cochlear duct length (CDL) in a normal human temporal bone. BACKGROUND: CDL is measured from the middle of the round window to the helicotrema. Histologic studies have shown the length of the organ of Corti (OC) to range from 25 to 35 mm. CDL measurements, performed either radiographically or histologically, are quite tedious and time-consuming. We propose equations that can reliably estimate both two-turn and complete CDL using a single computed tomography (CT) image. METHODS: Prior studies of CDL, measured either histologically or radiographically, were reviewed, which yielded distributions of CDL measured at the OC and the lateral wall of the cochlea. Using Escudé's third equation as a basis, we were able to extrapolate complete and two-turn CDL based on a CT scan measurement of the diameter of the basal turn (A). RESULTS: Using measurement A, the relationship of two-turn CDL measured at the OC is  $2TL(oc) = 3.65(A-1)$  and for  $2TL(i) = 3.65(A-0.7)$ . The equation for estimation of complete CDL is  $CDL(oc) = 4.16A - 4$  and for  $CDL(i) = 4.16A - 2.7$ . CONCLUSION: Using a single linear measurement from a CT scan image can reliably estimate the two-turn and complete CDLs in human temporal bones. The two-turn length represents the best compromise of cochlear coverage while minimizing intracochlear trauma for electrode insertions.

- 93. Távora-Vieira D & Rajan GP (2015) Cochlear implantation in children with congenital and noncongenital unilateral deafness: A case series. *Otol Neurotol*, 36(2): 235-9.**

Abstract

OBJECTIVES: Cochlear implantation is rapidly gaining acceptance as the most effective treatment for adult patients with unilateral deafness. The benefits for the pediatric population remain to be investigated. This study aimed to investigate the implications of cochlear implantation in children with congenital and noncongenital unilateral deafness. DESIGN: Four children, three with congenital and one with a sudden unilateral deafness, were studied after implantation. The children were aged 17 months, 4.5 years, 6.8 years, and 9 years at the time of implantation. Speech perception in noise and sound localization ability were evaluated using age-appropriate materials. RESULTS: The child with postlingual unilateral deafness rapidly integrated the normal acoustic hearing with the electrical signal from the cochlear implant and showed binaural benefits, as indicated by the localization ability and the improvement of speech perception in noise scores. The younger child with congenital unilateral deafness showed some clinical evidence of binaural integration and the two older children with congenital deafness have not yet indicated signs of binaural benefits. CONCLUSION: It seems that cochlear implantation in children with congenital unilateral deafness may provide some of the benefits of binaural hearing if implantation occurs within the critical period for bilateral auditory development.

- 94. Mertens G, Hofkens A, Kleine Punte A, De Bodt M, Van de Heyning P (2015) Hearing implant performance in single-sided deaf cochlear implant users after upgrade to a single-unit speech processor. *Otol Neurotol*, 36(1): 51-60.**

Abstract

**INTRODUCTION:** Single-sided deaf (SSD) patients report multiple benefits after cochlear implantation (CI), such as tinnitus suppression, speech perception, and sound localization. The first single-unit speech processor, the RONDO, was launched recently. Both the RONDO and the well-known behind-the-ear (BTE) speech processor work on the same audio processor platform. However, in contrast to the BTE, the microphone placement on the RONDO is different. The aim of this study was to evaluate the hearing performances using the BTE speech processor versus using the single-unit speech processor. Subjective and objective outcomes in SSD CI patients with a BTE speech processor and a single-unit speech processor, with particular focus on spatial hearing, were compared. **METHODOLOGY:** Ten adults with unilateral incapacitating tinnitus resulting from ipsilateral sensorineural deafness were enrolled in the study. The mean age at enrollment in the study was 56 (standard deviation, 13) years. The subjects were cochlear implanted at a mean age of 48 (standard deviation, 14) years and had on average 8 years' experience with their CI (range, 4-11 yr). At the first test interval (T0), testing was conducted using the subject's BTE speech processor, with which they were already familiar. Aided free-field audiometry, speech reception in noise, and sound localization testing were performed. Self-administered questionnaires on subjective evaluation consisted of HISQUI-NL, SSQ5, SHQ, and a Visual Analogue Scale to assess tinnitus loudness and disturbance. All 10 subjects were upgraded to the single-unit processor and retested after 28 days (T28) with the same fitting map. At T28, an additional single-unit questionnaire was administered to determine qualitative experiences and the effect of the position of the microphone on the new speech processor. **RESULTS:** Equal hearing outcomes were found between the single-unit speech processor: median PTA(single-unit) (0.5, 1, 2 kHz) = 40 (range, 33-48) dB HL; median Speech Reception Threshold in noise = -1.00 (range, -8.50 to +1.00) dB SNR; median Root Mean Square Error of sound localization = 45 (range, 19-139) degrees; HISQUI = 128 (range, 106-180); SHQ = 68 (range, 45-83); SSQ5 = 6 (range, 3-9) and the BTE speech processor: median PTA(BTE) (0.5, 1, 2 kHz) = 41 (range, 30-53) dB HL; median Speech Reception Threshold in noise = -0.25 (range, -7.00 to +4.00) dB SNR; median Root Mean Square Error of sound localization = 38 (range, 26-164) degrees; HISQUI = 144 (range, 120-183); SHQ = 56 (range, 47-85); SSQ5 = 6 (range, 3-9). The results in the condition with the single-unit speech processor were not significantly influenced by the position of the microphone. **CONCLUSION:** The study showed that long-term BTE speech processor SSD users are able to be upgraded to a single-unit speech processor without compromising their speech performance, aided hearing thresholds, sound localization, objective speech quality, hearing abilities, sound localization, and tinnitus reduction. Microphone position on the single-unit speech processor did not influence the outcomes measures. Moreover, after a short time of experience, 80% of the users preferred the single-unit processor.

95. **Guimaraes AC, Carvalho GM, Duarte AS, Bianchini WA, Sarasty AB, Gergorio MF, Zernotti ME, Sartorato EL, Castilho AM (2015) Hearing preservation and cochlear implants according to inner ear approach: Multicentric evaluation. Braz J Otorhinolaryngol, 81(2): 190-6.**

Abstract

**INTRODUCTION:** Electroacoustic stimulation is an excellent option for people with residual hearing in the low frequencies, who obtain insufficient benefit with hearing aids. To be effective, the subject's residual hearing should be preserved during cochlear implant surgery. **OBJECTIVES:** To evaluate the hearing preservation in patients that underwent implant placement and to compare the results in accordance with the approach to the inner ear. **METHODS:** 19 subjects underwent a soft surgical technique, and the electrode MED-EL FLEX™ EAS, designed to be atraumatic, was used. We evaluated pre- and postoperative tonal audiometric tests with an average of 18.4 months after implantation, to measure the rate of hearing preservation. **RESULTS:** 17 patients had total or partial preservation of residual hearing; 5 had total hearing preservation and two individuals had no preservation of hearing. The insertion of the electrode occurred through a cochleostomy in 3 patients, and in 2 of these there was no hearing preservation; the other 16 patients experienced electrode insertion through a round window approach. All patients benefited from the cochlear implant, even those who are only using electrical stimulation. **CONCLUSION:** The hearing preservation occurred in 89.4% of cases. There was no significant difference between the forms of inner ear approach.

96. **Távora-Vieira D, Marino R, Acharya A, Rajan G (2015) The impact of cochlear implantation on speech understanding, subjective hearing performance and tinnitus perception in patients with unilateral severe to profound hearing loss. 36(3): 430-6.**

Abstract

OBJECTIVES: This study aimed to determine the impact of cochlear implantation on speech understanding in noise, subjective perception of hearing, and tinnitus perception of adult patients with unilateral severe to profound hearing loss and to investigate whether duration of deafness and age at implantation would influence the outcomes. In addition, this article describes the auditory training protocol used for unilaterally deaf patients. DESIGN: This is a prospective study of subjects undergoing cochlear implantation for unilateral deafness with or without associated tinnitus. METHODS: Speech perception in noise was tested using the Bamford-Kowal-Bench speech-in-noise test presented at 65 dB SPL. The Speech, Spatial, and Qualities of Hearing Scale and the Abbreviated Profile of Hearing Aid Benefit were used to evaluate the subjective perception of hearing with a cochlear implant and quality of life. Tinnitus disturbance was measured using the Tinnitus Reaction Questionnaire. Data were collected before cochlear implantation and 3, 6, 12, and 24 months after implantation. RESULTS: Twenty-eight postlingual unilaterally deaf adults with or without tinnitus were implanted. There was a significant improvement in speech perception in noise across time in all spatial configurations. There was an overall significant improvement on the subjective perception of hearing and quality of life. Tinnitus disturbance reduced significantly across time. Age at implantation and duration of deafness did not influence the outcomes significantly. CONCLUSION: Cochlear implantation provided significant improvement in speech understanding in challenging situations, subjective perception of hearing performance, and quality of life. Cochlear implantation also resulted in reduced tinnitus disturbance. Age at implantation and duration of deafness did not seem to influence the outcomes.

97. **Jaiswal V, Gibbons I, Nation L, Hughes S, Joseph J, Backhouse S (2015) Paediatric vestibule-cochlear malformations and international collaboration for the U.K.'s first bilateral FORM19 electrode cochlear implantation. . Cochlear Implants Int, 16 Suppl 1: S6-8.**

Abstract

None.

98. **Verschuur C, Causon A, Green K, Bruce I, Agyemang-Prempeh A, Newman T (2015) The role of the immune system in hearing preservation after cochlear implantation. Cochlear Implants Int, 16 Suppl 1: S40-2.**

Abstract

None.

99. **Côte M, Trudel M, Philippon D, Bussièrès R (2015) Improving audiologic performance with partial inertion of a compressed array despite intracochlear retention of four electrodes during revision cochlear implant surgery: A Case report. Cochlear Implants Int, 16(1): 57-60.**

Abstract

OBJECTIVE AND IMPORTANCE: To report a case of partial extraction of the electrode array during revision cochlear implant surgery and to discuss the surgical management of this rare complication CLINICAL PRESENTATION: The safety of revision cochlear implant surgery has long been demonstrated. Only five cases of partial extraction of the electrode array with intracochlear retention have been reported in the literature. In this report, we describe the case of a 12-year-old boy with post-meningitis deafness who suffered this complication. INTERVENTION: Despite intracochlear retention of four electrodes, the surgical team was able to perform partial

insertion of a Med-El compressed array: a total of 8 electrodes out of 12 were implanted in the same scala tympani. Five months after the surgery, the patient had access for the first time to open-set speech recognition. He could recognize 77% of open-set sentences in silence compared to 14% after initial implant activation. Seven months after the surgery, the patient was implanted in his contralateral ear with a Med-El Pulsar split array and now benefits from bilateral auditory stimulation. CONCLUSION: Partial insertion of a compressed array represents a viable option when facing incomplete extraction of a cochlear implant electrode array. Indeed, our patient's audiologic performance improved significantly and the results seem to surpass those obtained with partial insertion of a conventional electrode array.

- 100. Vermeire K, Landsberger DM, Van de Heyning PH, Voormlen M, Kleine Punte A, Schatzer R, Zierhofer C (2015) Frequency-place map for electrical stimulation in cochlear implants: Change over time. *Hear Res*, 326: 8-14.**

Abstract

The relationship between the place of electrical stimulation from a cochlear implant and the corresponding perceived pitch remains uncertain. Previous studies have estimated what the pitch corresponding to a particular location should be. However, perceptual verification is difficult because a subject needs both a cochlear implant and sufficient residual hearing to reliably compare electric and acoustic pitches. Additional complications can arise from the possibility that the pitch corresponding to an electrode may change as the auditory system adapts to a sound processor. In the following experiment, five subjects with normal or near-to-normal hearing in one ear and a cochlear implant with a long electrode array in the other ear were studied. Pitch matches were made between single electrode pulse trains and acoustic tones before activation of the speech processor to gain an estimate of the pitch provided by electrical stimulation at a given insertion angle without the influence of exposure to a sound processor. The pitch matches were repeated after 1, 3, 6, and 12 months of experience with the sound processor to evaluate the effect of adaptation over time. Pre-activation pitch matches were lower than would be estimated by a spiral ganglion pitch map. Deviations were largest for stimulation below 240° degrees and smallest above 480°. With experience, pitch matches shifted towards the frequency-to-electrode allocation. However, no statistically significant pitch shifts were observed over time. The likely explanation for the lack of pitch change is that the frequency-to-electrode allocations for the long electrode arrays were already similar to the pre-activation pitch matches. Minimal place pitch shifts over time suggest a minimal amount of perceptual remapping needed for the integration of electric and acoustic stimuli, which may contribute to shorter times to asymptotic performance.

- 101. Mertens G, Kleine Punte A, De Bodt M, Van de Heyning P (2015) Binaural auditory outcomes in patients with postlingual profound unilateral hearing loss: 3 years after cochlear implantation. *Audiol Neurotol*, 20 (suppl 1): 67-72.**

Abstract

The value of cochlear implants (CI) in patients with profound unilateral hearing loss (UHL) and tinnitus has recently been investigated. The authors previously demonstrated the feasibility of CI in a 12-month outcome study in a prospective UHL cohort. The aim of this study was to investigate the binaural auditory outcomes in this cohort 36 months after CI surgery. The 36-month outcome was evaluated in 22 CI users with postlingual UHL and severe tinnitus. Twelve subjects had contralateral normal hearing (single-sided deafness - SSD group) and 10 subjects had a contralateral, mild to moderate hearing loss and used a hearing aid (asymmetric hearing loss - AHL group). Speech perception in noise was assessed in two listening conditions: the Cloff and the Clon condition. The binaural summation effect (SON0), binaural squelch effect (SONCI) and the combined head shadow effect (SCIN0) were investigated. Subjective benefit in daily life was assessed by means of the Speech, Spatial and Qualities of Hearing Scale (SSQ). At 36 months, a significant binaural summation effect was observed for the study cohort (2.00, SD 3.82 dB;  $p < 0.01$ ) and for the AHL subgroup (3.34, SD 5.31 dB;  $p < 0.05$ ). This binaural effect was not significant 12 months after CI surgery. A binaural squelch effect was significant for the AHL subgroup at 12 months (2.00, SD 4.38 dB;  $p < 0.05$ ). A significant combined head shadow and squelch effect was also noted in the spatial configuration SCIN0 for the study cohort (4.00, SD 5.89 dB;  $p < 0.01$ ) and for the AHL

subgroup (5.67, SD 6.66 dB;  $p < 0.05$ ). The SSQ data show that the perceived benefit in daily life after CI surgery remains stable up to 36 months at Clon. CI can significantly improve speech perception in noise in patients with UHL. The positive effects of Clon speech perception in noise increase over time up to 36 months after CI surgery. Improved subjective benefit in daily life was also shown to be sustained in these patients.

- 102. Usami SI, Motek H, Tsukada K, Miyagawa M, Nishhio SY, Takumi Y, Iwasaki S, Kumakawa K, Naito Y, Takahashi H, Kanda Y, Tono T (2014) Hearing preservation and clinical outcomes of 32 consecutive electric acoustic stimulation (EAS) surgeries. *Acta Oto-Laryngol*, 134(7):717-27.**

Abstract

**CONCLUSIONS:** Our results indicated that electric acoustic stimulation (EAS) is beneficial for Japanese-speaking patients, including those with less residual hearing at lower frequencies. Comparable outcomes for the patients with less residual hearing indicated that current audiological criteria for EAS could be expanded. Successful hearing preservation results, together with the progressive nature of loss of residual hearing in these patients, mean that minimally invasive full insertion of medium/long electrodes in cochlear implantation (CI) surgery is a desirable solution. The minimally invasive concepts that have been obtained through EAS surgery are, in fact, crucial for all CI patients. **OBJECTIVES:** This study was conducted to evaluate hearing preservation results and speech discrimination outcomes of hearing preservation surgeries using medium/long electrodes. **METHODS:** A total of 32 consecutive minimally invasive hearing preservation CIs (using a round window approach with deep insertion of a flexible electrode) were performed in 30 Japanese patients (two were bilateral cases), including patients with less residual hearing. Hearing preservation rates as well as speech discrimination/perception scores were investigated on a multicenter basis. **RESULTS:** Postoperative evaluation after full insertion of the flexible electrodes (24 mm, 31.5 mm) showed that residual hearing was well preserved in all 32 ears. In all patients, speech discrimination and perception scores were improved postoperatively.

- 103. Prentiss S, Staecker H, Wolford B (2014) Ipsilateral acoustic electric pitch matching: A case study of cochlear implantation in an up-sloping hearing loss with preserved hearing across multiple frequencies. *Cochlear Implants Int.*, 15(3):161-5.**

Abstract

**OBJECTIVES:** Determine ipsilateral acoustic electric pitch place match in a patient with preserved residual hearing across a broad frequency range. **METHODS:** Case report. Patient with up-sloping sensorineural hearing loss underwent implantation with a 680° insertion angle with preserved residual hearing. Pitch matching with variance of pulse rate was carried out. **RESULTS:** Electrical pitch percepts closely approximated the Greenwood map when compared to the acoustical pitch percepts and electrode position as determined by post-operative computed tomographic scan. The pitch matching results achieved from the deeply inserted electrodes, in the apical portion of the cochlea, suggest that the electrical stimulation may activate the dendritic extensions from the ganglion cell bodies that radiate from the terminal bulb. Stimulation rate influenced pitch perception in the apical turn but not in the mid- and basilar regions. **DISCUSSION:** Frequency to pitch allocation can potentially be improved by cochlear implants that access the apical third of the spiral ganglion. The ultimate goal of stimulating the apical third of the cochlea is to provide the maximum amount of spectral information to the user. We had the unique opportunity to work with a patient who presented with a severe sensorineural hearing loss rising to within normal limits and poor speech discrimination scores. Data from this study may aid our ability to give patients a broader spectrum of sound perception.

- 104. Mahhmod AF, Massa ST, Douberty SL, Montes ML, Ruckenstein MJ (2014) Safety, efficacy, and hearing preservation using an integrated electro-acoustic stimulation hearing system. *Otol Neurotol*, 35(8):1421-5.**

Abstract

**OBJECTIVE:** To determine the safety, efficacy, and potential for hearing preservation of an electroacoustic hearing system in patients with severe high-frequency and moderate low-frequency hearing loss. **PATIENTS:** Five patients were included in this study with steeply down-sloping sensorineural hearing loss. All patients had a history of hearing aid use and similar hearing in the contralateral ear. Ages ranged from 48 to 69 years. **INTERVENTION:** All participants were implanted with an electro-acoustic stimulation (EAS) device using a hearing preservation technique. This device integrates electric and acoustic stimulation into a single processor for simultaneous ipsilateral bimodal stimulation. **MAIN OUTCOME MEASURE(S):** Pure-tone audiograms (PTA) and speech reception thresholds (SRTs) during preoperative evaluation; initial cochlear implant (CI) stimulation; initial EAS stimulation; and at 3, 6, and 12 months poststimulation. Consonant-Nucleus-Consonant (CNC) monosyllables preoperatively and at 3, 6, and 12 months poststimulation. **RESULTS:** All participants showed preserved hearing in the surgical ear after implantation as measured by PTA and SRT. Significant improvement in speech recognition testing over hearing aid was observed at 3 months with EAS versus 6 months with CI-only stimulation. Facial stimulation occurred in 1 patient and resolved after reprogramming. **CONCLUSION:** There were no significant complications in this cohort of patients. Adequate hearing preservation was achieved. EAS and CI aided conditions both showed significant improvement over hearing aid with EAS condition achieving significance sooner.

- 105. Bayazit YA, Kosaner J, Cinar BC, Atac A, Tutar H, Gunduz B, Altinyay S, Gokdogan C, Ant A, Ozdek A, Goksu N. (2014) Methods and preliminary outcomes of pediatric auditory brainstem implantation. *Ann Otol Rhinol Laryngol*, 123(8):529-36.**

Abstract

**OBJECTIVE:** The objective was to provide information about methods used and preliminary outcomes for pediatric ABI (auditory brainstem implant). **STUDY DESIGN:** An analysis of outcome was performed in children who received an ABI. **METHODS:** Twelve children received a MED-EL ABI system. Progress in audition and language was monitored through parental reports, questionnaires, profiles, and closed-set tests. **RESULTS:** The median number of active electrodes was 9 of 12. Seven of 12 users consistently respond to sound, and 5 of 12 do not. Highest performers can recognize words in small sets and have begun to use some words. **CONCLUSION:** Auditory brainstem implants appear to be beneficial for some pediatric patients who cannot benefit from traditional cochlear implant surgery. Benefits in the short-term can be recognition of environmental sounds, recognition of some words and very commonly used phrases, and the beginning use of words. Although some of our ABI users demonstrate no response to sound, they do want to wear their sound processors all waking hours. The cause of lack of response may be related to the second intervention, which might have led to displacement of the electrode array, or presence of additional handicaps or syndromes. However, the results are less than optimal. The relatively short postoperative follow-up duration is a considered weakness of this study.

- 106. Landsberger DM, Mertens G, Kleine Punte A, Van De Heyning P (2014) Perceptual changes in place of stimulation with long cochlear implant electrode arrays. *J Acoust Soc Am*, 135(2): EL75-81.**

Abstract

Long (31.5 mm) electrode arrays are inserted deeper into the cochlea than the typical 1.25 turn insertion. With these electrode arrays, the apical electrodes are closer to (and possibly extend past) the end of the spiral ganglion. Using multi-dimensional scaling with patients implanted with a 31.5 mm electrode array, the perceptual space between electrodes was measured. The results suggest that deeper insertion increases the range of place pitches, but the perceptual differences between adjacent electrodes become smaller in the apex.

- 107. Mick P, Amodi H, Shipp D, Friesen L, Symons S, Lin V, Nedzelski J, Chen J (2014) Hearing preservation with full insertion of the FLEXsoft electrode. *Otol Neurotol*, 35(1):e40-4.**

Abstract

**OBJECTIVES:** Hearing preservation (HP) in the context of cochlear implantation (CI) is indicative of an atraumatic insertion, which could potentially offer a clinical advantage to performance, whether such preservation was intended for the application of electroacoustic stimulation (EAS). Our goal was to determine the degree of HP after the implantation of a full-length electrode array (MedEI FLEXsoft). **STUDY DESIGN:** Prospective, within-

subject repeated measure design. METHODS: Adult patients with residual low-frequency hearing who received a 31.5-mm FlexSoft electrode array were included. Implantation using soft surgery techniques occurred at a single tertiary referral center between 2008 and 2011. Preoperative and postoperative audiometric data were compared. RESULTS: In 36 consecutive patients at 1 year postimplantation, 6 (21%) maintained complete HP (an increase of low-frequency pure-tone average (PTA)  $\leq 10$  dB from the preoperative value), and 19 (65%) maintained partial HP (an increase in low-frequency PTA  $\leq 40$  dB from the preoperative values) throughout the follow-up period (average, 368 d). Higher preoperative hearing threshold levels (HTLs) at 1,000 Hz were associated with HP. CONCLUSION: Low-frequency HP is possible in patients implanted with the full-length FlexSoft electrode. Longer follow-up is required to determine if results are maintained over time and if such preservation is in fact advantageous to clinical outcomes.

**108. Dillon MT, Buss E, Pillsbury HC, Adunka OF, Buchman CA, Adunka MC (2014) Effects of hearing aid settings for electric-acoustic stimulation. J Am Acad Audiol, 25: 133-40.**

Abstract

BACKGROUND: Cochlear implant (CI) recipients with postoperative hearing preservation may utilize an ipsilateral bimodal listening condition known as electric-acoustic stimulation (EAS). Studies on EAS have reported significant improvements in speech perception abilities over CI-alone listening conditions. Adjustments to the hearing aid (HA) settings to match prescription targets routinely used in the programming of conventional amplification may provide additional gains in speech perception abilities. PURPOSE: Investigate the difference in users' speech perception scores when listening with the recommended HA settings for EAS patients versus HA settings adjusted to match National Acoustic Laboratories' nonlinear fitting procedure version 1 (NAL-NL1) targets. RESEARCH DESIGN: Prospective analysis of the influence of HA settings. STUDY SAMPLE: Nine EAS recipients with greater than 12 mo of listening experience with the DUET speech processor. INTERVENTION: Subjects were tested in the EAS listening condition with two different HA setting configurations. Speech perception materials included consonant-nucleus-consonant (CNC) words in quiet, AzBio sentences in 10-talker speech babble at a signal-to-noise ratio (SNR) of +10, and the Bamford-Kowal-Bench sentences in noise (BKB-SIN) test. DATA COLLECTION AND ANALYSIS: The speech perception performance on each test measure was compared between the two HA configurations. RESULTS: Subjects experienced a significant improvement in speech perception abilities with the HA settings adjusted to match NAL-NL1 targets over the recommended HA settings. CONCLUSIONS: EAS subjects have been shown to experience improvements in speech perception abilities when listening to ipsilateral combined stimulation. This population's abilities may be underestimated with current HA settings. Tailoring the HA output to the patient's individual hearing loss offers improved outcomes on speech perception measures.

**109. Buchman CA, Dillon MT, King ER, Adunka MC, Adunka OF, Pillsbury HC (2014) Influence of cochlear implant insertion depth on performance: A prospective randomized trial, Otol Neurotol, 35(10):1773-9.**

Abstract

OBJECTIVE: The purpose of the present study was to assess the influence of electrode insertion length on cochlear implant (CI) performance. STUDY DESIGN: Prospective randomized allocation of CI patients to receive either a standard (26.4 mm)- or medium (20.9 mm)-length electrode array. The processing strategy and electrode insertion number were held constant. The postoperative testing audiologist was blinded to the map details and array. SETTING: Tertiary referral center. PATIENTS: Thirteen adult CI candidates randomized to receive the standard- (n = 7) or medium-length (n = 6) electrode array. INTERVENTION(S): Unilateral CI using standard- or medium-length array from the same implant system. MAIN OUTCOME MEASURES(S): Speech perception was assessed with HINT sentences in quiet and steady-state noise (SNR, +10) and CNC words in quiet at defined intervals. Quality of life was assessed using the Hearing Device Satisfaction Survey and the Abbreviated Profile of Hearing Aid Benefit (APHAB). Music perception was assessed using the Musical Sounds In Cochlear implants (MuSIC) test. Postoperative electrode insertion angle was assessed using reconstructed computed tomographic images. RESULTS: Interim analysis necessitated discontinuation of subject enrollment by the institutional review board. There was a trend (p = 0.07) for improved speech perception performance among standard array patients. This difference was significant when the standard array group was increased retrospectively. Quality of life and music perception differences were not apparent between groups. CONCLUSION: Longer electrode insertions

(and greater insertion angles) appear to offer better speech perception performance in the early postactivation period when using the same implant system.

- 110. Kosaner J, Sonugüler, Ogut F, Kirazli, Uruk D, Örnekcı R, Amann E (2014) LittleEARS early speech production questionnaire validation in hearing Turkish infants. Cochlear Impl Int, 15 (Suppl 1): S39-42.**

Abstract

AIM: The LEESPQ validated on hearing, German infants is a standardized tool examining preverbal speech development. This study aims to validate the LEESPQ on hearing, Turkish infants. MATERIALS AND METHODS: This is a prospective, cross-sectional validation study using the LEESPQ in Turkish. The LEESPQ was filled in once for each hearing infant. Data for  $\geq 10$  infants was collected at 19 test intervals,  $\geq 0-1$ ,  $\geq 1-2$ .....,  $\geq 18-19$  months. Psychometric validation was performed through confirmatory factor analysis, item response analysis, item analysis, and analysis of reliability and validity. RESULTS: The LEESPQ was found to be gender independent, have high predictive accuracy and almost exclusively assess speech production ability. A very high correlation between total score and chronological age means score can be interpreted as child's speech production developmental age. Expected and minimum scores were defined for each monthly interval. CONCLUSION: The LEESPQ (Turkish) has clinical value to confirm typical speech production development and detect potential problems.

- 111. Lorens A, Zgoda M, Polak M, Skarzynski H (2014) FS4 for partial deafness treatment. Cochlear Impl Int, 15 (Suppl 1): S78-80.**

Abstract

No abstract available.

- 112. Pelizzone M, Pérez Fornos, Guinand N, van de Berg R, Kos I, Stokroos R, Kingma H, Guyot JP (2014) First functional rehabilitation via vestibular implants. Cochlear Impl Int, 15 (Suppl 1): S62-4.**

Abstract

No abstract available.

- 113. Bruce IA, Felton M, Lockley M, Melling C, Lloyd SK, Freeman SR, Green KMJ (2014) Hearing preservation cochlear implantation in adolescents. Otol Neurotol, 35(9):1552-9.**

Abstract

**OBJECTIVE:** This study describes our experience of cochlear implantation (CI) with hearing preservation in adolescents. Our aim was to determine if hearing preservation is successful in this population, if the preserved hearing is maintained, and what the potential benefit of preserving hearing in this population is. **PATIENTS:** Fourteen profoundly deaf adolescents with preservation of low-frequency hearing (125, 250, and 500 Hz). **INTERVENTION:** Twelve adolescents had a single-sided CI, and two had bilateral CI. All were having their first implantation, and all patients had hearing preservation surgery (soft surgery). **MAIN OUTCOME MEASURES:** Hearing preservation was measured with preoperative and postoperative pure-tone audiograms. Speech audiometry was performed before implantation and at subsequent follow-up appointments. **RESULTS:** Hearing preservation (measurable hearing thresholds) was achieved in 13 of 14 patients. Average follow-up was 2 years 10 months (range, 4 mo-4 yr 9 mo). Three of 13 patients with initial successful hearing preservation had deterioration of their hearing at subsequent follow-up. The addition of naturally preserved hearing to the cochlear implant improved speech audiometry scores compared with using the implants in isolation. **CONCLUSION:** This study demonstrates that residual hearing can be consistently preserved and maintained in adolescents during the short-/medium-term using a soft surgical technique to insert standard-length electrodes. The potential benefit of preserving residual low-frequency hearing seems to be improvement in speech discrimination in challenging hearing conditions, although larger studies are required.

- 114. Riss D, Hamzavi JS, Blineder M, Honeder C, Ehrenreich I, Kaider A, Baumgartner WD, Gstoettner W, Arnoldner A (2014) FS4, FS4-p, and FSP: A 4-month crossover study of three Fine Structure sound-coding strategies, Ear Hear, 35(6):e272-81.**

Abstract

**OBJECTIVES:** The aim of the present study was to compare two novel fine structure strategies "FS4" and "FS4-p" with the established fine structure processing (FSP) strategy. FS4 provides fine structure information on the apical four-electrode channels. With FS4-p, these electrodes may be stimulated in a parallel manner. The authors evaluated speech perception, sound quality, and subjective preference. **DESIGN:** A longitudinal crossover study was done on postlingually deafened adults (N = 33) who were using FSP as their default strategy. Each participant was fitted with FS4, FS4-p, and FSP, for 4 months in a randomized and blinded order. After each run, an Adaptive Sentence test in noise (Oldenburger Sentence Test [OLSA]) and a Monosyllable test in quiet (Freiburger Monosyllables) were performed, and subjective sound quality was determined with a Visual Analogue Scale. At the end of the study the preferred strategy was noted. **RESULTS:** Scores of the OLSA did not reveal any significant differences among the three strategies, but the Freiburger test showed a statistically significant effect ( $p = 0.03$ ) with slightly worse scores for FS4 (49.7%) compared with FSP (54.3%). Performance of FS4-p (51.8%) was comparable with the other strategies. Both audiometric tests depicted a high variability among subjects. The number of best-performing strategies for each participant individually was as follows: (a) for the OLSA: FSP, N = 10.5; FS4, N = 10.5; and FS4-p, N = 12; and (b) for the Freiburger test: FSP, N = 14; FS4, N = 9; and FS4-p, N = 10. A moderate agreement was found in the best-performing strategies of the Speech tests within the participants. For sound quality, speech in quiet, classical, and pop music were assessed. No significant effects of strategy were found for speech in quiet and classical music, but auditory impression of pop music was rated as more natural in FSP compared with FS4 ( $p = 0.04$ ). It is interesting that at the end of the study, a majority of the participants favored the new coding strategies over their previous default FSP (FSP, N = 13; FS4, N = 13; FS4-p, N = 7). **CONCLUSIONS:** In summary, FS4 and FS4-p offer new and further options in audio processor fitting, with similar levels of speech understanding in noise as FSP. This is an interesting result, given that the strategies' presentation of temporal fine structure differs from FSP. At the end of the study, 20 of 33 subjects chose either FS4 or FS4-p over their previous default strategy FSP.

- 115. Rauhamäki T, Lonka E, Lipsanen J, Laakso M (2014) Assessment of early auditory development of very young children with LittlEARS Auditory Questionnaire and McArthur Communicative Development Inventories, IJPORL, 78(12):2089-96.**

Abstract

**OBJECTIVES:** We analysed the Finnish version of the LittlEARS(®) Auditory Questionnaire as a method for assessing very young children's early auditory, pre-verbal and emerging verbal development. We also examined

whether any background factors exist that influence the results and thus the usability of this method. To determine its potential in assessment, the Finnish version of the LittlEARS(®) Auditory Questionnaire was analysed in relation to the Finnish McArthur Communicative Developmental Inventories. The latter is currently the method most commonly used together with parental interviews. However, this method is neither designed for infants younger than 8 months nor is its main emphasis on auditory development. Thus, we investigated whether the Finnish version of LittlEARS(®) Auditory Questionnaire could supplement the Finnish McArthur Communicative Developmental Inventories and thereby help in detecting children with hearing impairments. METHODS: Normative data were collected for Finnish children with normal hearing (N=318) using the LittlEARS(®) Auditory Questionnaire and an abridged version of the Finnish McArthur Communicative Developmental Inventories. In addition, background information was collected with a questionnaire designed for this study. The results of these questionnaires were analysed in relation to each other. RESULTS: Statistical analysis showed that the results gained with the Finnish version of LittlEARS(®) Auditory Questionnaire and the abridged version of the Finnish McArthur Communicative Developmental Inventories are closely related. However, the LittlEARS(®) Auditory Questionnaire manages to capture the earlier and subtler changes that occur in infancy, therefore making a good continuum with McArthur Communicative Developmental Inventories. Also, most background factors, such as parents' educational level, did not affect the results significantly, rendering the LittlEARS(®) Auditory Questionnaire a valuable method for assessment of early auditory development in very young children. CONCLUSIONS: The Finnish version of the LittlEARS(®) Auditory Questionnaire is a reliable assessment tool with no confounding background factors. It enables evaluation of the early auditory development in even the youngest of children.

- 116. Behr R, Colletti V, Matthies C, Morita A, Nakatomi H, Dominique L, Darrouzet V, Brill S, Shehata-Dieler W, Lorens A, Skarzynski H (2014) New outcomes with auditory brainstem implants in NF2 patients, *Otol Neurotol*, 35(10):1844-51.**

Abstract

OBJECTIVE: To determine factors related to high levels of speech recognition in patients with the auditory brainstem implant (ABI). STUDY DESIGN: Retrospective case review. SETTING: International multicenter data from hospitals and tertiary referral facilities. PATIENTS: Patients with neurofibromatosis type 2 (NF2) and bilateral vestibular schwannomas. INTERVENTION: ABIs were placed after the removal of vestibular schwannomas. MAIN OUTCOME MEASURES: Demographic and surgical data were collected from 26 patients with ABIs who achieved scores of better than 30% correct identification of sentences presented in quiet listening conditions and without lipreading cues. RESULTS: Scores better than 30% speech recognition of standard sentence test materials (HINT or equivalent) in quiet listening conditions were obtained in 26 of the 84 NF2 patients (31%). ABI speech recognition was correlated with surgical position, length of deafness, the number of distinct pitch electrodes, perceptual levels, and ABI stimulation rate, but not correlated with tumor size, tumor stage, the number of electrodes used, or electrophysiological recordings. This paper presents the consensus opinion from a meeting of surgeons to compare outcomes across ABI surgical centers. CONCLUSIONS: The consensus opinion was that brainstem trauma is a primary factor in the variability of outcomes in NF2 patients. The significant co-factors in outcomes implied that ABI surgery should be accomplished with great care to minimize physical and venous trauma to the brainstem. It is clear that high levels of speech recognition, including high levels of open-set speech recognition, are possible with the ABI even in patients with NF2 and large tumors.

- 117. Matthies C, Brill S, Varallyay C, Solymosi L, Gelbrich G, Roosen K, Ernestus RI, Helms J, Hagen R, Mlynski R, Shehata-Dieler W, Müller J (2014) Auditory brainstem implants in neurofibromatosis Type 2: is open speech perception feasible? *J Neurosurg*, 120(2):546-58.**

Abstract

OBJECT: Patients with bilateral auditory nerve destruction may perceive some auditory input with auditory brainstem implants (ABIs). Despite technological developments and trials in new stimulation sites, hearing is very variable and of limited quality. The goal of this study was to identify advantageous and critical factors that influence the quality of auditory function, especially speech perception. METHODS: The authors conducted a prospective study on ABI operations performed with the aid of multimodality neuromonitoring between 2005 and 2009 in 18 patients with neurofibromatosis Type 2. Outcome was evaluated by testing word recognition

(monotrochee-polysyllabic word test at auditory-only mode [MTPa]) and open speech perception (Hochmair-Schulz-Moser [HSM] sentence test), both in pure auditory mode. The primary outcome was the HSM score at 24 months. The predictive meaning of general clinical data, tumor volume, number of active electrodes, duration of deafness, and early hearing data was examined. RESULTS: In 16 successful ABI activations the average score for MTPa was 89% (SD 13%), and for HSM it was 41% (SD 32%) at 24 months. There were 2 nonresponders, 1 after radiosurgery and the other in an anatomical variant. Direct facial nerve reconstruction during the same surgery was followed by successful nerve recovery in 2 patients, with a simultaneous very good HSM result. Patients' age, tumor extension, and tumor volume were not negative predictors. There was an inverse relationship between HSM scores and deafness duration; 50% or higher HSM scores were found only in patients with ipsilateral deafness duration up to 24 months. The higher the deafness sum of both sides, the less likely that any HSM score will be achieved ( $p = 0.034$ ). In patients with total deafness duration of less than 240 months, higher numbers of active electrodes were significantly associated with better outcomes. The strongest cross-correlation was identified between early MTPa score at 3 months and 24-month HSM outcome. CONCLUSIONS: This study documents that open-set speech recognition in pure auditory mode is feasible in patients with ABIs. Large tumor volumes do not prevent good outcome. Positive preconditions are short ipsilateral and short bilateral deafness periods and high number of auditory electrodes. Early ability in pure auditory word recognition tests indicates long-term capability of open speech perception.

- 118. Schatzer R, Vermeire K, Visser D, Krenmayr A, Kals M, Voormolen M, Van de Heyning P, Zierhofer C (2014) Electric-acoustic pitch comparisons in single-sided-deaf cochlear implant users: Frequency-place functions and rate pitch. *Hearing Research*, 309:26-35.**

Abstract

Eight cochlear implant users with near-normal hearing in their non-implanted ear compared pitch percepts for pulsatile electric and acoustic pure-tone stimuli presented to the two ears. Six subjects were implanted with a 31-mm MED-EL FLEX(SOFT) electrode, and two with a 24-mm medium (M) electrode, with insertion angles of the most apical contacts ranging from 565° to 758°. In the first experiment, frequency-place functions were derived from pure-tone matches to 1500-pps unmodulated pulse trains presented to individual electrodes and compared to Greenwood's frequency position map along the organ of Corti. While the overall median downward shift of the obtained frequency-place functions (-0.16 octaves re. Greenwood) and the mean shifts in the basal (<240°; -0.33 octaves) and middle (-0.35 octaves) regions were statistically significant, the shift in the apical region (>480°; 0.26 octaves) was not. Standard deviations of frequency-place functions were approximately half an octave at electrode insertion angles below 480°, increasing to an octave at higher angular locations while individual functions were gradually leveling off. In a second experiment, subjects matched the rates of unmodulated pulse trains presented to individual electrodes in the apical half of the array to low-frequency pure tones between 100 Hz and 450 Hz. The aim was to investigate the influence of electrode place on the salience of temporal pitch cues, for coding strategies that present temporal fine structure information via rate modulations on select apical channels. Most subjects achieved reliable matches to tone frequencies from 100 Hz to 300 Hz only on electrodes at angular insertion depths beyond 360°, while rate-matches to 450-Hz tones were primarily achieved on electrodes at shallower insertion angles. Only for electrodes in the second turn the average slopes of rate-pitch functions did not differ significantly from the pure-tone references, suggesting their use for the encoding of within-channel fine frequency information via rate modulations in temporal fine structure stimulation strategies.

- 119. Franke-Triegeer A, Jolly C, Darbinjan A, Zahnert T, Mürbe D (2014) Insertion depth angles of cochlear implant arrays with varying length: A temporal bone study. *Otol Neurotol*, 35(1): 58-63.**

Abstract

HYPOTHESIS: The aim of the study is to investigate the insertion depth angles for different types of electrode arrays and its variability depending on the individual cochlear size. BACKGROUND: Preoperative estimation of the insertion depth angles for different electrode arrays can help surgeons choose the optimal electrode length, especially for low-frequency residual hearing preservation. METHODS: Four different electrode arrays varying in lengths (20, 24, 28, and 31 mm) were inserted in 10 temporal bones to quantify the insertion depth angle of each inserted electrode. High-resolution 3D radiographs provided by Flat Panel Computed Volume Tomography (FPCT) were used to determine electrode array insertion depth angle and diameter of the cochlea's basal turn. RESULTS: The high-resolution FPCT images from all electrode arrays inserted into the temporal bones allowed

reliable measurements of insertion depth angles. In particular, statistically significant different insertion depth angles between the various array types were identified. The insertion of the 20-, 24-, 28-, and 31-mm arrays yielded a mean insertion depth angle of 341 degrees (SD, 22 degrees), 477 degrees (SD, 36 degrees), 587 degrees (SD, 42 degrees), and 673 degrees (SD, 38 degrees), respectively. Furthermore, a statistically significant negative correlation between insertion depth angle and diameter of the cochlea's basal turn was found for the 20- and 31-mm arrays. CONCLUSION: The results suggest an individually adapted length of electrode arrays, which should be taken into account for an improved decision paradigm for patients scheduled for cochlear implantation. This is of particular importance for patients with low-frequency residual hearing.

- 120. AlSanosi A, Hassan SM (2014) The effect of age at cochlear implantation outcomes in Saudi children. IJPORL, 78(2): 272-6.**

Abstract

OBJECTIVES: To determine for the effect of age (late versus early age) on the cochlear implant outcomes; in terms of language development, auditory skills, speech perception, and production outcomes). METHODS: 67 children were included in the study out of 93 implanted cases in the study period. Children were classified into 2 groups according to age at time of implantation. Group 1 contained 43 children who were implanted before the age of 5 years. Group 2 contained 24 children who were implanted after the age of 5 years. All children were evaluated pre-operatively and at 3, 6, 12, 24 months device experience using the language screening test, Standardized Arabic Language test, Listening Progress Profile (LiP Test), the Monosyllabic-Trochee-polysyllabic Test (MTP), and the meaningful Auditory Integration Scale (MAIS) Test. Charts with incomplete data were excluded. RESULTS: Only 67 children had complete data out of 93 patients. The mean age (in months) for Group 1 was (43.37±8.63) and for Group 2 was (70.38±9.97) at time of implantation. Significantly higher mean values were detected for Group 2 in comparison to Group 1 in the pre-operative period. No significant difference was detected after 2 years evaluation using the test battery for language development and auditory skills. CONCLUSIONS: Children who were implanted under the 5 years of age had a better outcome in the form of better auditory skills, speech perception, and language production. Limited resources and the absence of a national hearing screening program in Saudi Arabia result in the late presentation of children for evaluation and intervention of hearing problem; this late intervention reduces the benefits the late - implanted children derive from cochlear implantation.

- 121. Astolfi L, Guaran V, Marchetti N, Olivetto E, Simoni E, Cavazzini A, Jolly C, Martini A (2014) Cochlear implants and drug delivery: In vitro evaluation of dexamethasone release. J Biomed Mater Res B Appl Biomater, 102(2): 267-73.**

Abstract

Anti-inflammatory drugs can minimize the trauma and inflammation in the inner ear caused by cochlear implantation surgery. For this reason, much effort has recently been devoted to finding the best way to administer these anti-inflammatory drugs for a prolonged time and in a personalized dosage. One solution is constructing an electrode with a dispenser filled with anti-inflammatory drugs with a dosage adapted to suit each new cochlear implant user. The purpose of this study was to measure in vitro, by high-performance liquid chromatography-mass spectrometry assay, the amount of dexamethasone released in 78 days in a physiological solution by a filled dispenser. The drug release continued for more than 2 months in three different phases: (1) during the first 1-5 days, (2) within about 2 weeks, and (3) from about 3 weeks until the end of experiment. This release trend is in accordance with the 3 main phases of damage caused by the cochlear implantation: (1) insertion trauma within the first 2 days, (2) inflammation within 2 weeks, and finally (3) an intracochlear chronic fibrosis reaction. Future animal model studies should consider using this dispenser in order to establish its effectiveness in preventing damage caused by cochlear implantation.

- 122. Alves M, Ramos D, Oliviera G, Alves H, Anderson I, Magalhaes I, Martins JH, Simoes M, Ferreira R, Fonseca R, Andrade S, Silva L, Ribeiro C, Ferreira PL (2014) European Portuguese EARS test battery adaptation. Acta Med Port, 27(1): 23-32.**

Article in Portuguese.

Abstract

**INTRODUCTION:** The use of adequate assessment tools in health care is crucial for the management of care. The lack of specific tools in Portugal for assessing the performance of children who use cochlear implants motivated the translation and adaptation of the EARS (Evaluation of Auditory Responses to Speech) test battery into European Portuguese. This test battery is today one of the most commonly used by (re)habilitation teams of deaf children who use cochlear implants worldwide. The goal to be achieved with the validation of EARS was to provide (re)habilitation teams an instrument that enables: (i) monitoring the progress of individual (re)habilitation, (ii) managing a (re)habilitation program according to objective results, comparable between different (re)habilitation teams, (iii) obtaining data that can be compared with the results of international teams, and (iv) improving engagement and motivation of the family and other professionals from local teams. **MATERIAL AND METHODS:** For the test battery translation and adaptation process, the adopted procedures were the following: (i) translation of the English version into European Portuguese by a professional translator, (ii) revision of the translation performed by an expert panel, including doctors, speech-language pathologists and audiologists, (iii) adaptation of the test stimuli by the team's speechlanguage pathologist, and (iv) further review by the expert panel. **RESULTS:** For each of the tests that belong to the EARS battery, the introduced adaptations and adjustments are presented, combining the characteristics and objectives of the original tests with the linguistic and cultural specificities of the Portuguese population. **DISCUSSION:** The difficulties that have been encountered during the translation and adaptation process and the adopted solutions are discussed. Comparisons are made with other versions of the EARS battery. **Conclusion:** We defend that the translation and the adaptation process followed for the EARS test battery into European Portuguese was correctly conducted, respecting the characteristics of the original instruments and adapting the test stimuli to the linguistic and cultural reality of the Portuguese population, thus meeting the goals that have been set.

- 123. Perez Fornos A, Guinand N, van de Berg R, Stokroos R, Micera S, Kingma H, Pelizzone, Guyot JP (2014) Artificial balance: restoration of the vestibule-ocular reflex in humans with a prototype vestibular neuroprosthesis. Front Neurol 5(66) doi: 10.3389/fneur.2014.00066.**

Abstract

The vestibular system plays a crucial role in the multisensory control of balance. When vestibular function is lost, essential tasks such as postural control, gaze stabilization, and spatial orientation are limited and the quality of life of patients is significantly impaired. Currently, there is no effective treatment for bilateral vestibular deficits. Research efforts both in animals and humans during the last decade set a solid background to the concept of using electrical stimulation to restore vestibular function. Still, the potential clinical benefit of a vestibular neuroprosthesis has to be demonstrated to pave the way for a translation into clinical trials. An important parameter for the assessment of vestibular function is the vestibulo-ocular reflex (VOR), the primary mechanism responsible for maintaining the perception of a stable visual environment while moving. Here we show that the VOR can be artificially restored in humans using motion-controlled, amplitude modulated electrical stimulation of the ampullary branches of the vestibular nerve. Three patients received a vestibular neuroprosthesis prototype, consisting of a modified cochlear implant providing vestibular electrodes. Significantly higher VOR responses were observed when the prototype was turned ON. Furthermore, VOR responses increased significantly as the intensity of the stimulation increased, reaching on average 79% of those measured in healthy volunteers in the same experimental conditions. These results constitute a fundamental milestone and allow us to envision for the first time clinically useful rehabilitation of patients with bilateral vestibular loss.

- 124. Sennaroglu L, Atay G, Bajin MD (2014) A new cochlear implant electrode with a "cork"-type stopper for inner ear malformations. Auris Nasus Larynx, 41(4): 331-6.**

Abstract

**OBJECTIVE:** Gusher in inner ear malformations is common in patients with incomplete partition type I and type III. It is also common in less severe form as oozing in incomplete partition type II and large vestibular aqueduct. It is important to prevent cerebrospinal fluid (CSF) escape around the electrode to prevent meningitis. **METHODS:** The custom-made device was produced by Med-El Company. It has a "cork"-like stopper instead of the usual silicon ring to prevent gusher. There are two types of electrodes of different lengths. The standard one is 25mm (contact space 1.7mm) and the short one is 20mm (contact space 1.3mm). It was used in 50 patients with different inner ear malformations. **RESULTS:** Thirteen patients had gusher, and 11 patients oozing during cochleostomy. One patient with initial prototype of the cork electrode had to be revised because of persistent

oozing around the electrode. Another patient had slow extrusion of the electrode most probably due to CSF pulsation and had to be revised. Both patients had no more CSF fistula. CONCLUSION: CSF fistula in inner ear malformations is a serious situation which may lead to recurrent meningitis. The new electrode with "cork" stopper looks promising in preventing the postoperative CSF leak around the electrode.

- 125. Kleine Punte A, De Bodt M, Van de Heyning P (2014) Long-term improvement of speech perception with the fine structure processing coding strategy in cochlear implants. ORL, 76(1):36-43.**

Abstract

**Aims:** To investigate the long-term effects of the fine structure processing (FSP) coding strategy on speech perception in noise and quality of life in experienced cochlear implant (CI) users. **Methods:** In a prospective comparative clinical trial, 32 experienced postlingually deafened CI recipients were upgraded from the Tempo+ to the Opus 2 audio processor, implementing FSP in one group and high-definition continuous interleaved sampling (HDCIS) coding strategy in another group with identical frequency ranges. Speech perception in noise testing and the Speech, Spatial and Qualities (SSQ) questionnaire were administered at 0, 6, 12 and 24 months after the upgrade. **Results:** FSP yielded significant long-term improvement of speech perception in noise of in total 13.2 dB from 16.2 dB SNR at the upgrade to 3.0 dB SNR after 24 months of FSP experience. No significant improvement of speech perception in noise over time was measured for the HDCIS group. With the SSQ questionnaire, a significant benefit of the FSP coding strategy was observed. **Conclusions:** The FSP coding strategy as implemented in the Med-EL Opus 2 audio processor improves speech perception in noise. This beneficial effect of FSP on speech perception in noise is not immediate but is significant after 12 months and further improves up to 24 months after implementation of FSP.

- 126. Adunka OF, Dillon MT, Adunka MC, King ER, Pillsbury HC, Buchman CA (2014) Cochleostomy versus round window insertions: Influence on functional outcomes in electric-acoustic stimulation of the auditory system. Otol Neurotol, 35: 613-8.**

Abstract

**OBJECTIVE:** To determine the safety, efficacy, and potential for hearing preservation of an electroacoustic hearing system in patients with severe high-frequency and moderate low-frequency hearing loss. **PATIENTS:** Five patients were included in this study with steeply down-sloping sensorineural hearing loss. All patients had a history of hearing aid use and similar hearing in the contralateral ear. Ages ranged from 48 to 69 years. **INTERVENTION:** All participants were implanted with an electro-acoustic stimulation (EAS) device using a hearing preservation technique. This device integrates electric and acoustic stimulation into a single processor for simultaneous ipsilateral bimodal stimulation. **MAIN OUTCOME MEASURE(S):** Pure-tone audiograms (PTA) and speech reception thresholds (SRTs) during preoperative evaluation; initial cochlear implant (CI) stimulation; initial EAS stimulation; and at 3, 6, and 12 months poststimulation. Consonant-Nucleus-Consonant (CNC) monosyllables preoperatively and at 3, 6, and 12 months poststimulation. **RESULTS:** All participants showed preserved hearing in the surgical ear after implantation as measured by PTA and SRT. Significant improvement in speech recognition testing over hearing aid was observed at 3 months with EAS versus 6 months with CI-only stimulation. Facial stimulation occurred in 1 patient and resolved after reprogramming. **CONCLUSION:** There were no significant complications in this cohort of patients. Adequate hearing preservation was achieved. EAS and CI aided conditions both showed significant improvement over hearing aid with EAS condition achieving significance sooner.

- 127. Matthies C, Brill S, Kaga K, Morita A, Kumakawa K, Skarzynski H, Claassen A, Hui Y, Chiong C, Müller J, Behr R (2013) Auditory brainstem implantation improves speech recognition in Neurofibromatosis Type II patients. ORL, 75(5): 282-95.**

Abstract

This prospective study aimed to determine speech understanding in neurofibromatosis type II (NF2) patients following implantation of a MED-EL COMBI 40+ auditory brainstem implant (ABI). Patients (n = 32) were enrolled postsurgically. Nonauditory side effects were evaluated at fitting and audiological performance was determined using the Sound Effects Recognition Test (SERT), Monosyllable-Trochee-Polysyllable (MTP) test and open-set sentence tests. Subjective benefits were determined by questionnaire. ABI activation was documented in 27

patients, 2 patients were too ill for testing and 3 patients were without any auditory perception. SERT and MTP outcomes under auditory-only conditions improved significantly between first fitting and 12-month follow-up. Open-set sentence recognition improved from 5% at first fitting to 37% after 12 months. The number of active electrodes had no significant effect on performance. All questionnaire respondents were 'satisfied' to 'very satisfied' with their ABI. An ABI is an effective treatment option in NF2 patients with the potential to provide open-set speech recognition and subjective benefits. To our knowledge, the data presented herein is exceptional in terms of the open-set speech perception achieved in NF2 patients.

- 128. Vermeire K, Landsberger DM, Schleich P, Van de Heyning P (2013) Multidimensional scaling between acoustic and electric stimuli in cochlear implant users with contralateral hearing. *Hearing Research*, 306: 29-36.**

Abstract

This study investigated the perceptual relationship between acoustic and electric stimuli presented to CI users with functional contralateral hearing. Fourteen subjects with unilateral profound deafness implanted with a MED-EL CI scaled the perceptual differences between pure tones presented to the acoustic hearing ear and electric biphasic pulse trains presented to the implanted ear. The differences were analyzed with a multidimensional scaling (MDS) analysis. Additionally, speech performance in noise was tested using sentence material presented in different spatial configurations while patients listened with both their acoustic hearing and implanted ears. Results of alternating least squares scaling (ALSCAL) analysis consistently demonstrate that a change in place of stimulation is in the same perceptual dimension as a change in acoustic frequency. However, the relative perceptual differences between the acoustic and the electric stimuli varied greatly across subjects. A degree of perceptual separation between acoustic and electric stimulation (quantified by relative dimensional weightings from an INDSCAL analysis) was hypothesized that would indicate a change in perceptual quality, but also be predictive of performance with combined acoustic and electric hearing. Perceptual separation between acoustic and electric stimuli was observed for some subjects. However, no relationship between the degree of perceptual separation and performance was found.

- 129. Skarzynski H, Van de Heyning P, Agrawal S, Arauz SL, Atlas M, Baumgartner W, Caversaccio M, De Bodt M, Gavilan J, Godey B, Green K, Gstoettner W, Hagen R, Han DM, Kameswaran M, Karltorp E, Kompis M, Kuzokov V, Lassalketta L, Levevre F, Li Y, Manikoth M, Martin J, Mlynski R, Mueller J, O'Driscoll M, Parnes L, Prentiss S, Pulibalathingal S, Raine CH, Rajan G, Rajeswaran R, Rivas JA, Rivas A, Skarzynski PH, Sprinzi G, Staecker H, Stephan K, Usami S, Yanov Y, Zernotti ME, Zimmermann K, Lorens A, Mertens G (2013) Towards a consensus on a hearing preservation classification system. *Acta Otolaryngol (Suppl 564)*: 3-13.**

Abstract

Conclusion: The comprehensive Hearing Preservation classification system presented in this paper is suitable for use for all cochlear implant users with measurable pre-operative residual hearing. If adopted as a universal reporting standard, as it was designed to be, it should prove highly beneficial by enabling future studies to quickly and easily compare the results of previous studies and meta-analyze their data. Objectives: To develop a comprehensive Hearing Preservation classification system suitable for use for all cochlear implant users with measurable pre-operative residual hearing. Methods: The HEARRING group discussed and reviewed a number of different propositions of a HP classification systems and reviewed critical appraisals to develop a qualitative system in accordance with the prerequisites. Results: The Hearing Preservation Classification System proposed herein fulfills the following necessary criteria: 1) classification is independent from users' initial hearing, 2) it is appropriate for all cochlear implant users with measurable pre-operative residual hearing, 3) it covers the whole range of pure tone average from 0 to 120 dB; 4) it is easy to use and easy to understand.

- 130. Kühn H, Schön F, Edelmann K, Brill S, Müller J (2013) The development of lateralization abilities in children with bilateral cochlear implants. *ORL*, 75: 55-67.**

Abstract

OBJECTIVES: The purpose of this study was to investigate the development of lateralization skills in children who received bilateral cochlear implants (CIs) in sequential operations. METHODS: The lateralization skills of 9

children with a mean age of 4.1 years at the first surgery and 5.5 years at the second surgery were assessed at 3 time intervals. Children were assessed with a 3-loudspeaker setup (front, left and right) at 0.9 years (interval I) and 1.6 years (interval II) after the second implantation, and after 5.3 years of bilateral implant use (interval III) with a 9-loudspeaker setup in the frontal horizontal plane between -90° and 90° azimuth. RESULTS: With bilateral implants, a significant decrease in lateralization error was noted between test interval I (45.0°) and II (23.3°), with a subsequent significant decrease at test interval III (4.7°). Unilateral performance with the CI did not improve significantly between the first 2 intervals; however, there was a bias of responses towards the unilateral side by test interval III. CONCLUSIONS: The lateralization abilities of children with bilateral CIs develop in a relatively short period of time (1-2 years) after the second implant. Children appear to be able to acquire binaural skills after bilateral cochlear implantation.

- 131. Tavora-Vieira D, Boisvert I, McMohan C, Maric V, Rajan G (2013) Successful outcomes of cochlear implantation in long-term unilateral deafness: brain plasticity? *Neuroplasticity*, 24(13): 724-9.**

Abstract

To investigate the implications of duration of deafness in the rehabilitation of unilateral deafness utilizing cochlear implantation. From the ongoing prospective cochlear implantation in unilateral deafness study, we looked at five adults who received a cochlear implant for long-term unilateral deafness. Speech perception in noise and subjective evaluation of the benefits of cochlear implantation were measured at 3, 6, and 12 months after implantation. The results were analyzed and compared with published data from normal hearing individuals and adults using cochlear implants bilaterally. Analysis of speech perception in noise showed significant improvement for three spatial configurations: speech and noise from the front (S0/N0; P=0.003), speech from the front and noise from the normal hearing ear (S0/NHE; P=0.001), speech from the implanted ear, and noise from the normal hearing ear (SCI/NHE; P<0.001). The scores obtained at 12 months after surgery improved to values similar to those obtained by individuals with normal hearing. The results of subjective measures showed significant improvement in hearing over time to the scores obtained by individuals with a bilateral cochlear implants and those with normal hearing. In this study, older adults with more than 25 years of unilateral deafness obtained scores in speech perception testing and in subjective evaluation that are similar to those attained by individuals with normal hearing and/or those with bilateral cochlear implants. Therefore, patients with postlingual unilateral deafness should not be excluded as cochlear implant candidates on the basis of a long duration of deafness.

- 132. Adunka OF, Dillon MT, Adunka MC, King ER, Pillsbury HC, Buchman CA (2013) Hearing preservation and speech perception outcomes with electric-acoustic stimulation after 12 months of listening experience. *Laryngoscope*, 123(10): 2509-15.**

Abstract

OBJECTIVES/HYPOTHESIS: To report on single-center data of an FDA-approved clinical trial on the objective benefits of cochlear implantation and subsequent ipsilateral Electric-Acoustic Stimulation (EAS). STUDY DESIGN: Single-center data from a prospective, multicenter clinical trial. METHODS: Eighteen subjects completed the 12-month EAS evaluation and were included in this evaluation. Each patient underwent cochlear implantation using a standardized hearing preservation approach. Both hearing preservation and speech perception abilities were evaluated at various intervals. Speech testing included performance measures obtained in quiet (CNC words) and noise (adaptive CUNY protocol) in three listening conditions: hearing aid (HA) alone, cochlear implant (CI) only, and combined ipsilateral EAS. RESULTS: Various levels of hearing preservation were achieved with cochleostomy and round-window surgical approaches in 17 of the 18 subjects. Mean CNC word scores at the 12-month interval were  $14.9 \pm 12.1$ ,  $45.3 \pm 15.4$ , and  $70.7 \pm 11.7\%$  correct in the HA only, CI only, and EAS conditions, respectively. Average CUNY scores at 0 dB SNR were  $14.6 \pm 17.2$ ,  $47.1 \pm 22.1$ , and  $72.2 \pm 21.5$  for the three test conditions obtained after 12 months. CONCLUSIONS: Data obtained during this clinical trial correlate well with previous reports. Hearing preservation appears successful in a high number of subjects, and combined EAS offers excellent speech perception abilities in quiet and in noise.

- 133. Wang L, Sun X, Liang W, Chen J, Zheng W (2013) Validation of the Mandarin version of the LittEARS Auditory Questionnaire. *IJPORL*, 77(8): 1350-4.**

Abstract

**OBJECTIVES:** To evaluate the psychometric properties of the Mandarin version of the LittEARS(®)Auditory Questionnaire and to compare the parameters with those of the original German version of the questionnaire. The results would indicate whether the Mandarin version of the questionnaire can be applied in Mandarin speaking children or not. **METHODS:** A "back-translation" method was used to translate and adapt the LittEARS(®) Auditory Questionnaire into Mandarin. A group of 157 Mandarin speaking parents of children below 24 months of age with normal hearing completed the LittEARS(®) Auditory Questionnaire. Various psychometric analyses (scale analysis and item analysis) were conducted and compared with the original German version. **RESULTS:** The following scale characteristics were found with the above sample: internal consistency: Cronbach's alpha = 0.945; reliability: split-half  $r = 0.914$ ; predictive accuracy: Guttman's lambda = 0.882; correlation between overall score and age of the children:  $r = 0.841$ . Several parameters (correlation between age and item score, index of difficulty, discrimination coefficient) of each item were also calculated. The regression curve, which reflects the age-dependence of auditory behavior, was produced. All parameters above had no significant differences with the corresponding ones of the original German version. Standardized values (expected and minimum values) of the Mandarin LittEARS(®) Auditory Questionnaire were provided. **CONCLUSION:** The Mandarin version of the LittEARS(®) Auditory Questionnaire is reliable and valid as a sensitive tool to assess the development of auditory behavior in Mandarin speaking children up to 24 months of age. The Mandarin standardized values are helpful for clinicians to reach a preliminary judgment in children's hearing screening or for parents to monitor the auditory development of their hearing-impaired children.

- 134. Kosaner J, Uruk D, Kilinc A, Ispir G, Amann E (2013) An investigation of the first lexicon of Turkish hearing children and children with a cochlear implant. IJPORL, 77(12): 1947-54.**

Abstract

**INTRODUCTION:** Research on early cochlear implantation and first language milestones is limited. To compare language performance in cochlear implant (CI) users and hearing children, the establishment of normative data for both groups would be of benefit. To aid the data collection for Turkish hearing children and children with CI diaries can be used. **AIMS:** This study aimed to document the first 100-word lexicon acquired by Turkish hearing children and children with a CI during the first 2 years of hearing experience, to determine the distribution of the first 100-word lexicon per word category, the rate of acquisition of words and the effects of age at implantation on language performance. **METHODS:** First word data was collected from 63 Turkish hearing children and 71 CI users implanted under 36 months of chronological age using a diary. The mean number of words recorded at each time interval was calculated. The time taken to achieve the first 100-word lexicon and the categories of the first words were documented. Performance under 18 months and over 24 months of age at first fitting was compared. **RESULTS:** By 19-21 months of hearing age both hearing and CI user's vocabularies were of similar size. CI users developed a lexicon earlier than hearing children, but once hearing children started to acquire words their acquisition rate was faster. The distribution of words acquired per category were similar. 83% of first words were shared by both groups. No significant difference in performance was found between: hearing versus: implanted children; or earlier (<18 months) versus later ( $\geq 24$  months) implanted children. **CONCLUSIONS:** The vocabulary of hearing children compared to CI users are similar in size and the category. Early access to auditory stimuli facilitates children with a hearing loss to develop vocabularies similar to hearing children in the short term.

- 135. Kosaner J, Sonuguler S, Olgun L, Amann E (2013) Young cochlear implant users' auditory development as measured and monitored by the LittEARS Auditory Questionnaire: A Turkish experience. IJPORL, 77(8): 1359-63.**

Abstract

**OBJECTIVE:** This study aims to assess the usefulness of the LittEARS(®) Auditory Questionnaire (LEAQ) in determining the audiological development of Turkish children who have received a cochlear implant. **METHODS:** 20 children received a cochlear implant before their 3rd birthday. Each child's progress was evaluated with the LittEARS(®) Auditory Questionnaire at first device fitting and then at 3-month intervals for 2 years. Scores were compared with the age-related norms established by hearing children. **RESULTS:** All children showed a significant increase in LittEARS(®) Auditory Questionnaire scores over time. Nearly all children showed a growth in auditory skills similar to that of hearing children. Children without additional needs showed more development than did children with additional needs. **CONCLUSIONS:** The LittEARS(®) Auditory Questionnaire is useful for monitoring the audiological development of young children with a cochlear implant. Confirmation that a cochlear

implant user is achieving typical auditory milestones serves to boost parental morale during a child's pre-verbal stage when parents may be anxious about their child's ability to talk. The questionnaire could also be useful as an early warning system. Poor scores likely indicate that something is impeding the child's development. This should prompt professionals to try to identify the impediment, whether technical, medical, social or educational and, possibly, eliminate/mitigate its effects while the child is still in his/her critical development stages.

- 136. Esquila Medina GN, Borel S, Nguyen Y, Ambert-Dahan E, Ferrary E, Sterkers O, Bozorg Grayeli A (2013) Is electrode-modiolus distance a prognostic factor for hearing performances after cochlear implant surgery? *Audiol Neurotol*, 18(6): 406-13.**

Abstract

The aim of this study was to evaluate electrode array position in relation to cochlear anatomy and its influence on hearing performance in cochlear implantees. Twenty-two patients (25 ears) with Med-El cochlear implants were included in this retrospective study. A negative correlation was observed between electrode-modiolus distance (EMD) at the cochlear base and monosyllabic word discrimination 6 months after implantation. We found no correlation between EMD and hearing outcome at 12 months. The insertion depth/cochlear perimeter ratio appeared to negatively influence the EMD at the base. Indeed, deep insertions in small cochleae appeared to yield smaller EMD and better hearing performance. This observation supports the idea of preplanning the surgery by adapting the electrode array to the length of the available scala tympani.

- 137. Mertens G, Kleine Punte A, Van de Heyning P (2013) Self-assessment of hearing disabilities in cochlear implant users using the SSQ and the reduced SSQ5 version. *Otol Neurotol*, 34(9): 1622-9.**

Abstract

**OBJECTIVES:** Routine clinical assessment to evaluate the hearing performance in a cochlear implant (CI) population should include individual self-assessment tools. Because of pragmatic and psychometric considerations, there's a growing need for reduced self-assessment questionnaires. The aim of the study is twofold. First, the study aims to ascertain a disability profile, using the Speech, Spatial and Qualities of Hearing Scale (SSQ), in a CI population and to compare this profile with a hearing impaired group with similar average hearing thresholds. The second aim of the study is to investigate the degree of agreement between the total SSQ scores and the total scores of the reduced 5-item version of the SSQ, namely, the SSQ5. **METHODS AND SUBJECTS:** This cross-sectional study uses the SSQ obtained from CI patients from the Ear, Nose and Throat (ENT) department of the Antwerp University Hospital. Fifty-four postlingually deaf CI patients completed the SSQ questionnaire. All subjects were implanted with a CI at an average age of 55 years. At the time they completed the questionnaire, they had, on average, 3 (SD, 3) years of CI experience. To determine the disability profile in a CI population, the following criteria were assayed: standard values, internal consistency, sensitivity, and floor (or ceiling) effects of the SSQ. These criteria were compared with those of a hearing-impaired group (n = 153) reported in the original study. Second, Spearman correlations coefficients and intraclass correlations coefficients (ICCs) were used to determine the degree of agreement between the total SSQ scores and the total SSQ5 scores. **RESULTS:** Analysis of internal consistency, sensitivity, and floor and ceiling effects showed that self-assessment using the SSQ is feasible in a CI population. The obtained disability profile presents a mean total SSQ CI group of 4:25 (SD = 1:65). When comparing item results, significant differences were found between CI users and moderate hearing-impaired patients (SSQ hearing impaired group = 5.5; SD 1:9). Intraclass correlation (ICC = 0.78; p < 0.01) and Spearman correlations coefficients (R = 0.77; p < 0.01) indicate a significantly high degree of agreement between the total SSQ scores and the total SSQ5 scores. **CONCLUSION:** This article shows the disability profile in a CI population, using SSQ. Significant differences regarding dynamic aspects of hearing between CI users and moderate hearing-impaired patients were found, to the detriment of the CI users. The static aspects of hearing represented in the Speech section, on the other hand, showed more similarities. The reduced 5-item version of the SSQ, namely, the SSQ5, is robust to effectively measure evolutions in hearing (dis)abilities in CI users.

- 138. Beltrame MA, Birman CS, Cervera Escario J, Kassouma J, Manolidis S, Pringle MB, Robinson P, Sainz Quevedo, Shanks M, Suckfüll M, Barberán MT (2013) Common cavity and custom-made electrodes: Speech perception and audiological performance of children with common cavity implanted with a custom-made MED-EL electrode. *IJPORL*, 77(8): 1237-43.**

Abstract

**OBJECTIVE:** Few studies exist on children with common cavity, fewer still on their long-term audiological development after having received a cochlear implant. Our goal was to observe and report the long-term audiological progress of children with common cavity who were implanted with a custom-made electrode. **METHODS:** In this longitudinal, multi-center study, 19 children were implanted with a MED-EL custom-made electrode via either single slit cochleostomy or double posterior labyrinthotomy. We observed their audiological development with a test battery consisting of Categories of Auditory Performance (CAP), Speech Intelligibility Rating (SIR), and Ling 6-Sounds tests. We tested the children 1 month prior to the surgery; at first fitting; at 1, 3, 6, 12, and 18 months post first-fitting; at 2 years after first-fitting; and, whenever possible, at 3, 4, and 5 years after first-fitting. **RESULTS:** Children with common cavity tend to steadily and significantly improve their audiological skills over time. This development may, however, be highly individual; probably in part due to relatively high levels of additional needs. Parents should be counseled to establish realistic post-implantation expectations. Surgically, contrary to our expectations, we cannot confirm that double posterior labyrinthotomy reduces intracochlear electrode movement or that the MED-EL custom electrode leads to fewer incidences of intra- or post-implantation complications. **CONCLUSIONS:** Cochlear implantation is a safe and effective treatment option in children with common cavity. The majority of children with CC derive significant audiological benefit from implantation. Intra- and post-surgical complications, while serious, and be dealt with effectively in most cases.

- 139. Machade de Carvalho G, Guimaraes AC, Duarte ASM, Muranaka EB, Soki MN, Martins Z, Bianchini WA, Paschoal JR, Castilho AM (2013) Hearing preservation after cochlear implantation: UNICAMP outcomes. Int J Otolaryngol, 2013:107186. doi: 10.1155/2013/107186. Epub 2013 Mar 17.**

Abstract

**Background.** Electric-acoustic stimulation (EAS) is an excellent choice for people with residual hearing in low frequencies but not high frequencies and who derive insufficient benefit from hearing aids. For EAS to be effective, subjects' residual hearing must be preserved during cochlear implant (CI) surgery. **Methods.** We implanted 6 subjects with a CI. We used a special surgical technique and an electrode designed to be atraumatic. Subjects' rates of residual hearing preservation were measured 3 times postoperatively, lastly after at least a year of implant experience. Subjects' aided speech perception was tested pre- and postoperatively with a sentence test in quiet. Subjects' subjective responses assessed after a year of EAS or CI experience. **Results.** 4 subjects had total or partial residual hearing preservation; 2 subjects had total residual hearing loss. All subjects' hearing and speech perception benefited from cochlear implantation. CI diminished or eliminated tinnitus in all 4 subjects who had it preoperatively. 5 subjects reported great satisfaction with their new device. **Conclusions.** When we have more experience with our surgical technique we are confident we will be able to report increased rates of residual hearing preservation. Hopefully, our study will raise the profile of EAS in Brazil and Latin/South America.

- 140. Chen X, Liu B, Liu S, Mo L, Li Y, Kong Y, Zheng J, Li Y, Gong S, Han D (2013) Cochlear implants with fine structure processing improve speech and tone perception in Mandarin-speaking adults. Acta Otolaryngol, 133(7): 733-8.**

Abstract

**CONCLUSION:** This study indicates that Mandarin-speaking subjects acquire significant benefit from a cochlear implant (CI) and audio processor with the fine structure processing (FSP) coding strategy. It can take adult Mandarin CI users time to become accustomed to their CI and appreciate the benefits. **OBJECTIVES:** This study aimed to determine speech perception outcomes in Mandarin-speaking adults who received the FSP coding strategy. **METHODS:** This was a prospective study. Ten adults who were implanted unilaterally with a PULSARC(100), and received an OPUS 1 or OPUS 2 speech processor, were included in this study. The mean age at implantation was 31.1 years. We determined the benefit to postlingually deafened Mandarin-speaking adults with a severe to profound hearing loss using the tests: monosyllables in quiet, sentences in quiet and the Mandarin Hearing in Noise Test (MHINT). Tone perception was evaluated using a tone perception test. A visual analog scale (VAS) was used to score sound quality and ease of listening. **RESULTS:** The results showed a significant improvement between first fitting and 6 months in all speech tests and in tone perception. The VAS scores showed a significant improvement over 6 months in sound quality and an immediate benefit in ease of listening.

- 141. May-Mederake B & Shehata-Dieler W (2013) A case study assessing the auditory and speech development of four children implanted with cochlear implants by the chronological age of 12 months. Case Rep Otolaryngol, 2013;2013:359218. doi: 10.1155/2013/359218. Epub 2013 Feb 20.**

Abstract

Children with severe hearing loss most likely receive the greatest benefit from a cochlear implant (CI) when implanted at less than 2 years of age. Children with a hearing loss may also benefit greater from binaural sensory stimulation. Four children who received their first CI under 12 months of age were included in this study. Effects on auditory development were determined using the German LittlEARS Auditory Questionnaire, closed- and open-set monosyllabic word tests, aided free-field, the Mainzer and Göttinger speech discrimination tests, Monosyllabic-Trochee-Polysyllabic (MTP), and Listening Progress Profile (LiP). Speech production and grammar development were evaluated using a German language speech development test (SETK), reception of grammar test (TROG-D) and active vocabulary test (AWST-R). The data showed that children implanted under 12 months of age reached open-set monosyllabic word discrimination at an age of 24 months. LiP results improved over time, and children recognized 100% of words in the MTP test after 12 months. All children performed as well as or better than their hearing peers in speech production and grammar development. SETK showed that the speech development of these children was in general age appropriate. The data suggests that early hearing loss intervention benefits speech and language development and supports the trend towards early cochlear implantation. Furthermore, the data emphasizes the potential benefits associated with bilateral implantation.

- 142. Tsukada K, Moteki H, Fukuoka H, Iwasaki S, Usami S (2013) Effects of EAS cochlear implantation surgery on vestibular function. Acta Otolaryngol, 133(11): 1128-32.**

Abstract

**CONCLUSIONS:** The patients who received electric acoustic stimulation (EAS) cochlear implantation had relatively good vestibular function compared with the patients who did not have residual hearing. The vestibular function was well preserved after atraumatic EAS surgery. The round window approach and soft electrode are preferred to decrease the risk of impairing vestibular function. **OBJECTIVES:** The aim of this study was to examine the characteristic features of vestibular functions before and after implantations in patients undergoing EAS. **METHODS:** Vestibular functions in patients who underwent EAS implantation were examined by caloric testing and vestibular evoked myogenic potential (VEMP) in 11 patients before and in 13 patients after implantation. **RESULTS:** Preoperative evaluation showed that of the 11 patients, most (73%) had good vestibular function. One of 11 patients (9%) had decreased response in postoperative VEMP but all of the patients had unchanged results in postoperative caloric testing.

- 143. Qadeer S, Junaid M, Sobani ZA, Nadeem N, Awan MS (2013) Cochlear implant in a patient with Mondini's deformity of the cochlea: pilot patient in Pakistan. J Pak Med Assoc, 63(7): 913-5.**

Abstract

Autosomal-recessive genes account for about 80% of the patients of non-syndromic deafness, and a major portion of those lead to cochlear pathology. Given the strong cultural practice of consanguineous marriages and the lack of awareness regarding screening modalities, a high prevalence of hereditary pre-lingual deafness is seen in Pakistan. Considering the situation, cochlear implant surgery was introduced by Aga Khan University Hospital (AKUH), Karachi, Pakistan, in 2003. Recently we decided to expand the profile and services available and conducted the first ever cochlear implant on an anatomically-challenged cochlea. The case report relates to the experience of our pilot patient who was suffering from Mondini's deformity.

- 144. Helbig S, Rajan GP, Stöver T, Lockley M, Kuthubutheen J, Green KM (2013) Hearing preservation after cochlear reimplantation. Otol Neurotol, 34(1): 61-5.**

Abstract

**OBJECTIVE:** The combination of electrical and acoustical hearing (EAS) is the aim of successful hearing preservation in patients with low-frequency residual hearing who receive a cochlear implant. With adequate surgical treatment and electrode arrays designed for hearing preservation, partial hearing preservation can nowadays be achieved in the majority of patients. Over recent years, the number of patients with EAS has

increased, and device failures within this group are a problem that will need to be addressed. It remains unclear how reliably hearing can be preserved during revision surgery. The outcome of 3 subjects requiring cochlear reimplantation after surgery for hearing preservation is presented and discussed. Our aim was to investigate the influence of electrode reinsertion on hearing preservation. PATIENTS: Three patients with measurable residual hearing were implanted with a flexible, free-fitting electrode array in 3 different centers. INTERVENTIONS: Two subjects received a 31.5-mm array inserted 24 mm into the cochlea, whereas a third was treated with a 24-mm array, which was inserted 21 mm into the cochlea. In all cases, hearing was preserved at the initial operation. All of these subjects subsequently represented with device problems, and reimplantation was performed. MAIN OUTCOME MEASURES: Hearing preservation was measured using preoperative and postoperative pure tone audiograms. In addition, speech perception with the implant was evaluated before and after reimplantation surgery. RESULTS: Reimplantation was feasible in all subjects also in cases where a slightly deeper reinsertion was performed. Speech understanding scores after reimplantation were comparable to those seen after the first intervention. CONCLUSION: Revision surgery in patients with preserved hearing after cochlear implantation does not necessarily lead to loss of natural residual hearing, and patients can continue to benefit from the combination of electric and acoustic hearing. Even deeper insertion is possible without hearing loss within residual frequencies.

**145. Jeyaraman J (2013) Practices in habilitation of pediatric recipients of cochlear implants in India: A survey. CII, 15: 7.21.**

Abstract

Introduction: Cochlear implant (CI) (re)habilitation programs are long-term processes, with many factors contributing to the overall success. The clinics in India that are working toward pediatric CI habilitation vary in their team philosophy, clinical practices, and service delivery. It is important to explore their clinical perspectives and practices to appreciate their current state and suggest directions for improvement in the future. Objective: The objective of the study was to characterize the current status and clinical practices of the pediatric CI programs in India. Methods: Twenty-two clinics involved in the pediatric CI habilitation program across India participated in the survey. The heads of the CI teams of the participant clinics completed a validated survey questionnaire containing multiple-choice and open-ended questions on the details of the CI habilitation team, assessment and therapy protocols used, and other related clinical services. The categorical data obtained were analyzed using descriptive statistical measures. Results and discussion: The interpretation of results indicated a need to focus future discussions on early identification and management of hearing impairment, funding for CIs, continuing education programs for professionals, decision processes for providing CIs for children with multiple concerns, choice of language(s) of instruction, assessment protocols used, and outreach/consultation services.

**146. Kleine Punte A, De Ridder D, Van de Heyning P (2013) On the necessity of full length electrical cochlear stimulation to suppress severe tinnitus in single-sided deafness. Hearing Research, 295: 24-9.**

Abstract

BACKGROUND: Cochlear implantation (CI) has proven in long term prospective trials to reduce significantly incapacitating tinnitus in single sided deafness (SSD). Discussion arises whether electrical stimulation near the round window (RW) is also able to reduce tinnitus. AIM: to assess whether electrical stimulation of the basal first 4 intracochlear electrodes of a CI could sufficiently reduce tinnitus and to compare these results with stimulation with all CI electrodes. MATERIAL AND METHODS: 7 patients who met the criteria of severe tinnitus due to SSD were implanted with a Med-El Sonata Ti100 with a FlexSoft™ or Flex24™ electrode. After 4 weeks only the basal electrode pair (E12) nearest to the RW was activated. Each week the following pair was activated until the 4th pair. Thereafter all electrodes were activated. Tinnitus was assessed before CI surgery and before each electrode pair was activated. When all electrodes were fitted, evaluation was done after 1, 3 and 6 months. Tinnitus was assessed with Visual Analogue Scale (VAS) for loudness, psychoacoustic tinnitus loudness comparison at 1 kHz and Tinnitus Questionnaire (TQ) for the effect on quality of life. To evaluate the natural evolution, a tightly matched control group with severe tinnitus due to SSD was followed prospectively. RESULTS: All the tinnitus outcome measures remained unchanged with 1, 2, 3 or 4 activated electrode pairs. With complete CI activation, the tinnitus decreased significantly comparable with earlier reports. Pre-implantation the tinnitus loudness was 8.2/10 on the VAS and was reduced to 4.1/10 6 months postimplantation. Psychometrically the loudness level went from 21.7 dB SL (SD: 16.02) to 7.5 dB SL (SD: 5.24) and the TQ from 60/84 to 39/84. The non-implanted group had no decrease of the tinnitus, the average VAS remained stable at 8.9/10 throughout the

follow-up period of 6 months. CONCLUSION: with the current stimulation parameters electrical stimulation in the first 8e10 mm of the basal part of the scala tympani is insufficient to reduce tinnitus. However, stimulation over the complete CI length yields immediate tinnitus reduction confirming earlier results.

- 147. Mertens G, Kleine Punte A, De Ridder D, Van de Heyning P (2013) Tinnitus in a single-sided deaf ear reduces speech reception in the nontinnitus ear. *Otol Neurotol*, 34(4): 662-6.**

Abstract

BACKGROUND: The influence of tinnitus on speech reception is under debate. A few previous studies addressed this issue and compared speech reception in groups with and without tinnitus, with tinnitus arising in both ears or in the same test ear. Recently, we demonstrated that loudness of tinnitus in single-sided deafness (SSD) could be reduced dramatically by implanting and activating a cochlear implant (CI). PURPOSE: The aim of the study was to evaluate whether changing the level of tinnitus in the SSD ear by disabling or enabling the CI changes the speech reception in noise in the non-tinnitus ear. METHODS AND PATIENTS: Fifteen CI users (MED-EL multichannel) with SSD and incapacitating tinnitus participated. They had an initial score of 6 or greater out of 10 on the Visual Analogue Scale (VAS) and an average total score of 58.05 (standard deviation [SD], 13.68) on the Tinnitus Questionnaire. The outcome measure, speech reception threshold (SRT) in noise using an adaptive procedure was measured in the nontinnitus ear using insert earphones. The measurements were performed with a high tinnitus level and a low tinnitus level in the SSD ear, realized by switching the CI off or on. Tinnitus loudness was assessed on a VAS, and tinnitus loudness was also matched using an audiometer. RESULTS: Speech reception in noise is significantly worse in case of high tinnitus loudness. The mean difference in SRT in the nontinnitus ear between the 2 conditions (SRTCI off-SRTCI on) of the 15 subjects was 1.98 dB SNR (SD, 3.01 dB SNR). The mean tinnitus loudness on the VAS was 7.2 (SD, 2.6) in the CI-off condition. In the CI-on condition, the mean VAS score significantly declined to 3.4 (SD, 2.5). Also, the tinnitus loudness match improved from 22 dB SL (SD, 14.4 dB SL) to 10 dB SL (SD, 10.1 dB SL) in the CI-on condition. CONCLUSION: Unilateral tinnitus can significantly decrease speech reception in noise in the nontinnitus ear.

- 148. Necula V, Cosgarea M, Necula SE (2013) Health-related quality of life in cochlear implanted patients in Romania. *IJPORL*, 72(2): 216-22.**

Abstract

OBJECTIVES:

Cochlear implantation is a well established treatment method in severe to profound hearing impaired people. Hearing devices do not cure hearing loss, but correct the disability, so it is important to assess the benefits not only on auditory-verbal performances but in terms of health-related quality of life. MATERIALS AND METHODS: We evaluated the health-related quality of life in a cochlear implant group (84 patients), split into two subgroups, according to the age of implantation and compared with a hearing aided group (50 patients). We used the Nijmegen cochlear implant HRQoL questionnaire which was sent to the parents. In the study group, all patients had unilateral MedEl device and at least 6 months of experience with the speech processor. RESULTS: Although there were differences between hearing aided and implanted children in all areas of quality of life, in the physical area, these differences were greater than those in the psychological and social domains. HRQoL was positively correlated with auditory performance, speech intelligibility and negatively correlated with implantation age. The correlation coefficient,  $R=0.78$ , indicates that between these three variables, implantation age, SIR and CAP and quality of life, there was a very good linear and direct proportional correlation. According to the determination coefficient ( $R^2$  adjusted=0.59), 59.5% of quality of life's variation was explained by the variation of these three parameters. CONCLUSIONS: Cochlear implant improves the auditory performance and speech production much more than hearing aids. Associated diseases have a negative effect on the evolution of cochlear implanted children but the cochlear implant may have an important impact on these children quality of life. It is well known that children implanted at a young age evolve better than older ones, but we should take into consideration that even older children can get good results, good performances if they are properly selected and well trained.

- 149. Távora-Vieira D, Marino R, Krishnaswamy J, Kuthubutheen J, Rajan GP (2013) Cochlear implantation for unilateral deafness with and without tinnitus: A case series. *Laryngoscope*, 123(5): 1251-5.**

Abstract

**OBJECTIVES/HYPOTHESIS:** To investigate cochlear implantation (CI) in patients with unilateral deafness with and without tinnitus. **STUDY DESIGN:** Prospective case series of patients undergoing cochlear implantation for unilateral deafness and tinnitus in a tertiary academic unit. **METHODS:** Nine postlingually deafened subjects with unilateral hearing loss, with and without tinnitus ipsilaterally, and functional hearing in the contralateral ear were implanted with a standard electrode. Speech perception in noise was tested using the Bamford-Kowal-Bench presented at 65 dB SPL. The Speech, Spatial, and Qualities (SSQ) of Hearing Scale was used to evaluate the subjective perception of hearing outcomes, and the Tinnitus Reaction Questionnaire assessed the effect on tinnitus. **RESULTS:** All patients were implanted with the Med-El Flex soft electrode, Innsbruck, Austria. They are regularly wearing the speech processor and find it beneficial in improving their ability to hear, particularly in noise. Decrease of tinnitus perception and an improvement of sound localization sounds were also reported by these patients. **CONCLUSION:** In our case series, CI was successful for all nine patients, with improvement of speech recognition in noise, self-perceived improvement of hearing, and for tinnitus control. Several factors such as deafness duration, age of deafness onset, the presence of residual hearing, patient motivation, and the rehabilitation intensity need to be further investigated in order to understand their impact on performance after implantation.

- 150. Song JJ, Kleine Punte A, De Ridder D, Vanneste S, Van de Heyning P (2013) Neural substrates predicting improvement of tinnitus after cochlear implantation in patients with single-sided deafness. *Hearing Research*, 299: 1-9.**

Abstract

Notwithstanding successful reduction of tinnitus after cochlear implantation (CI) in patients with single-sided deafness (SSD) in recent studies, neither the exact mechanism of suppression nor the predictors of the amount of improvement are fully understood yet. We collected quantitative electroencephalography (qEEG) data from nine SSD patients who underwent CI for tinnitus management. By correlating the degree of improvement in tinnitus intensity and tinnitus-related distress with preoperative source-localized qEEG findings and comparing qEEG findings of patients with marked improvement after CI with those with relatively slight improvement with regard to source-localized activity complimented by connectivity analysis, we attempted to find preoperative predictors of tinnitus improvement. Our results showed increased activities of the auditory cortex (AC), posterior cingulate cortex (PCC) and increased functional connectivity between the AC and PCC as negative prognostic factors for the reduction of tinnitus intensity after CI in patients with SSD. Also, relatively increased activity of the right dorsolateral prefrontal cortex and decreased connectivity between distress-related areas such as the orbitofrontal cortex/parahippocampus and sensory-perception areas such as the AC/precuneus were found in patients with relatively slight improvement in tinnitus-related distress as compared with those with marked improvement. The current study suggests that preoperative cortical oscillations can be applied to predict post-CI tinnitus reduction in patients with SSD.

- 151. Santa Maria PL, Domville-Lewis C, Sucher CM, Chester-Browne RL, Atlas MD (2013) Hearing preservation surgery for cochlear implantation: Hearing and quality of life after 2 years. *Otol Neurotol*, 34: 526-31.**

Abstract

**OBJECTIVE:** To study the benefits of hearing preservation surgery in cochlear implantation after 2 years. **STUDY DESIGN:** A retrospective cohort study. **SETTING:** Performed at a single academic institution between 2008 and 2010. **PATIENTS:** Thirteen patients (1 bilateral): 43% male and 57% female subjects. Mean age at surgery was 51 years (range, 32-72 yr). Average duration of deafness was 25 years (range, 5-62 yr). **INTERVENTION:** Hearing preservation cochlear implantation surgery performed with the Med-El FlexEAS electrode. **MAIN OUTCOME MEASURES:** Pure tone thresholds, speech perception in quiet and noise and quality of life (Abbreviated Profile of Hearing Aid Benefit [APHAB] and Glasgow Hearing Aid Benefit [GHABP Scales] up to and including 2 years after surgery. **RESULTS:** At the first postoperative audiogram, the hearing preservation rate was 100% (complete (42.9%), partial (50%), and minimal (7.1%)). After 24 months, the breakdown was complete (25%), partial (12.5%), minimal (37.5%) and complete loss (12.5%). There was a trend in improvement in all areas of APHAB) with significant improvements in the background noise and reverberation categories as well as the global scores. The GHABP scores showed high levels of use, benefit, and low levels of residual disease. **CONCLUSION:** Hearing preservation can be achieved in the short term but deteriorates with time over the medium term at a rate greater than that can be expected with the natural progression of the disease. Patients

show benefits in speech outcomes and quality of life regardless of whether hearing preservation was achieved in the medium term.

- 152. Müller J, Brill S, Hagen R, Moeltner A, Brockmeier SJ, Stark T, Helbig S, Maurer J, Zahnert T, Zierhofer C, Nopp P, Anderson I (2012) Clinical trial results with the MED-EL Fine Structure Processing coding strategy in experienced cochlear implant users. ORL, 74: 185-98.**

Abstract:

**Objectives:** To assess the subjective and objective performance of the new fine structure processing strategy (FSP) compared to the previous generation coding strategies CIS+ and HDCIS. **Methods:** Forty-six adults with a minimum of 6 months of cochlear implant experience were included. CIS+, HDCIS and FSP were compared in speech perception tests in noise, pitch scaling and questionnaires. The randomized tests were performed acutely (interval 1) and again after 3 months of FSP experience (interval 3). The subjective evaluation included questionnaire 1 at intervals 1 and 3, and questionnaire 2 at interval 2, 1 month after interval 1. **Results:** Comparison between FSP and CIS+ showed that FSP performed at least as well as CIS+ in all speech perception tests, and outperformed CIS+ in vowel and monosyllabic word discrimination. Comparison between FSP and HDCIS showed that both performed equally well in all speech perception tests. Pitch scaling showed that FSP performed at least as well as HDCIS. With FSP, sound quality was at least as good and often better than with HDCIS. **Conclusions:** Results indicate that FSP performs better than CIS+ in vowel and monosyllabic word understanding. Subjective evaluation demonstrates strong user preferences for FSP when listening to speech and music.

- 153. Kuthubutheen J, Hedne CN, Krishnaswamy J, Rajan GP (2012) A case series of paediatric hearing preservation cochlear implantation: A new treatment modality for children with drug-induced or congenital partial deafness. Audiol Neurotol, 17: 321-30.**

Abstract:

**OBJECTIVE:** To investigate the use of hearing preservation cochlear implantation in children with partial deafness. **PATIENTS AND METHODS:** Five children with either drug-induced or congenital partial deafness were enrolled in a pilot study. The patients ranged in age from 13 months to 14 years. Implantation was performed using a hearing preservation technique. A Flex EAS electrode (MED-EL, Innsbruck, Austria) was used in all insertions. **RESULTS:** Low frequency hearing was preserved in all patients with postoperative bone conduction within 10 dB of the preoperative hearing levels. These changes were preserved over the follow-up period of 12 months. There were significant improvements in speech perception. **CONCLUSION:** Hearing preservation cochlear implantation is a new effective modality in children with partial deafness.

- 154. Jayawardena J, Khuthubutheen J, Rajan G (2012) Hearing preservation and hearing improvement after reimplantation of pediatric and adult patients with partial deafness: a retrospective case series review. Otol Neurotol, 33(5):740-4.**

Abstract:

**OBJECTIVE:** To report and review the clinical experiences of patients who required reimplantation from an ongoing trial of patients with partial deafness who were treated with electroacoustic stimulation (EAS) cochlear implantation. **STUDY DESIGN:** Retrospective case series review. **SETTING:** Tertiary referral center. **PATIENTS:** Two patients with partial deafness, 1 child and 1 adult, who required reimplantation because of device failure occurring 12 to 18 months after hearing preservation cochlear implantation with a Med-El Sonata Flex-EAS electrode array. **INTERVENTION:** Reimplantation (with full insertion) of a Med-El Sonata Flex-EAS array (child) and the new complete cochlear coverage Med-El Sonata Flex-28 electrode array (adult). Surgical techniques used include round window insertion with slow insertion speed and the use of preoperative systemic steroids and preoperative, perioperative, and postimplantation intratympanic steroids. **MAIN OUTCOME MEASURE:** Preservation of residual hearing. **RESULTS:** Both patients had complete preservation of residual hearing after reimplantation. The adult patient had stable improvement in hearing from 750 to 2,000 Hz of 5 to 10 dB. Both patients reported increased benefit after reimplantation. **CONCLUSION:** We report a case series of successful pediatric and adult EAS reimplantation, in the adult hearing improvement after reimplantation with a deep insertion

electrode was observed. Reimplantation with preservation of residual hearing in patients with EAS is possible with current surgical hearing preserving techniques and atraumatic electrode arrays of variable length.

- 155. Rajan GP, Kuthubutheen J, Hedne N, Krishnaswamy J. (2012) The role of preoperative, intratympanic glucocorticoids for hearing preservation in cochlear implantation: a prospective clinical study. *Laryngoscope*, 122(1):190-5.**

Abstract:

**BACKGROUND:** Hearing Preservation is becoming increasingly important in cochlear implantation as there is growing evidence that preserving the residual hearing, especially in the low frequencies in combination with the electric stimulation can significantly improve hearing and speech outcomes in noise. Besides the ongoing development of atraumatic implant electrodes and insertion techniques, the implementation of pharmacologic hair cell protection is thought to increase hearing preservation. This study investigates the effects of preoperative intratympanic glucocorticoid application on hearing preservation rates in cochlear implantation. **STUDY DESIGN:** Prospective interventional study. **SETTING:** Tertiary neurotology referral center. **PATIENTS:** Patients undergoing cochlear implantation with measurable preoperative hearing thresholds using either a Flex soft electrode or a Flex EAS electrode depending on the degree of residual low frequency hearing. **INTERVENTION:** Preoperative intratympanic steroid application during cochlear implantation via round window insertion. **MAIN OUTCOME MEASURES:** Level of hearing preservation after cochlear implantation; electrode- and frequency-specific hearing preservation rates. **RESULTS:** Preoperative hearing thresholds were comparable in the control group and the interventional Flex soft group (70.5 db±12.5 dB vs. 73.5 dB±10.5 dB, P=.27). As per selection criteria the low-frequency hearing thresholds were significantly lower in interventional Flex EAS groups when compared to the control group. Hearing preservation was significantly better in the interventional group with no case of complete hearing loss in this group (11 dB±2.5 dB vs. 19.5 dB 3.5 dB, P<.05). The interventional group displayed a higher stability of hearing preservation after implantation (r=.8, P=.03). Level of hearing preservation was higher when a specific hearing preservation electrode was used (r=.85, P<.05). Hearing preservation in the low frequencies was significantly higher than in the high frequencies. **CONCLUSIONS:** Our study suggests that the additional preoperative use of intratympanic glucocorticoids improves and stabilizes hearing preservation rates in round window cochlear implantation for adults and children with residual hearing.

- 156. Rajan GP, Kontorinis G, Kuthubutheen J. (2013) The Effects of Insertion Speed on Inner Ear Function during Cochlear Implantation: A Comparison Study. *Audiol Neurootol*, 18(1):17-22.**

Abstract:

**Objective:** To investigate the insertion speed and its impact on electrode insertion characteristics, hearing preservation and clinical vestibular function in a prospective cohort study with a retrospective control group at a tertiary otology/neurotology centre. **Interventions:** Hearing-preserving cochlear implantation using systemic and topical steroids in conjunction with a round-window approach, a complete cochlear coverage electrode and two different electrode insertion speeds [60 mm/min (n = 18) vs. 15 mm/min (n = 22)] was performed. **Results:** The insertion speed had a significant impact on various insertion characteristics as well as hearing preservation and vestibular function. In conclusion, a slow electrode insertion speed appears to facilitate full electrode insertion, reduce the occurrence of insertion resistance as well as promote preservation of residual hearing and vestibular function after cochlear implantation.

- 157. Kosaner J, Kilinc A, Deniz M (2012) Developing a music programme for preschool children with cochlear implants. *CIL*, 13(4): 237-47.**

Abstract:

Although music perception is especially challenging for cochlear implant (CI) users, young CI users' musical perception abilities are improved by participation in structured musical activities. **Objectives:** To design, implement, evaluate, and publish a music training programme with a monitoring tool for preschool CI users, for use in family-centred habilitation programmes. **Methods:** We devised a programme of musical activities, Musical EARS®, and a curriculum-related hierarchical Evaluation Form to represent performance. The programme included sections on singing; recognizing songs, tunes, and timbre; and responding appropriately to music and rhythm. It was implemented over 18 months at Ilkses Rehabilitation Centre, with 25 paediatric MED-EL CI users

split into three groups of varying age, duration of CI use, and ability. Results: Mean total scores increased significantly for all groups. Scores increased unevenly across subscales. Participation in and enjoyment of musical activities increased for both children and parents. Significant correlations were found between scores and length of CI use. Discussion: The training programme effectively enriches child CI users' musical experience. To varying degrees, children learned to perform the Musical EARS® activities. The study allowed us to validate the lesson content and the hierarchical nature of the Evaluation Form. We conclude that prelingually deafened CI users should be systematically involved in musical activities to help them acquire skills acquired more easily by hearing peers.

- 158. Trotic R, Kostic M, Ries M, Drivis P, Ajduk J, Petrovic I (2012) Long-term functional outcomes after 10 years of bilateral cochlear implant use. Coll Antropol, 36(1): 161-5.**

Abstract:

The aims were to determine the benefit of bilateral cochlear implantation in a 20 years old patient implanted in Croatia on hearing and speech development. The male patient, after 10 years of deafness, got cochlear implants Med-EL Combi 40+ on both sides in one-stage surgery. The etiology of his deafness was posttraumatic meningitis. Auditory capacity and speech recognition tests were performed for both ears separately and together. Average hearing level on the right ear with right cochlear implant switched on started at 62 dB 1 month after the cochlear implantation and was on 55 dB after 10 years. Average hearing level on the left ear with left cochlear implant switched on started at 55 dB 1 month after the cochlear implantation and was on 32 dB after 10 years. Average hearing level on the both ears with 2 cochlear implants switched on started at 35 dB 1 month after the cochlear implantation and was on 27 dB after 10 years. Long-term functional outcomes with bilateral cochlear implantation provides advantages over unilateral implantation including improved hearing level, speech perception in noise and improved sound localization.

- 159. Erixon E, Köbler S, Rask-Anderson H (2012) Cochlear implantation and hearing preservation: Results in 21 consecutively operated patients using the round window approach. Acta Otolaryngol, 132(9): 923-31.**

Abstract:

CONCLUSION: Prevalent hearing conservation may be achieved after round window (RW) cochlear implantation using soft and flexible electrode arrays if variations of RW anatomy, topography, and facial nerve position are considered. The most favorable electrode insertion depth remains to be established. OBJECTIVES: We assessed the incidence of cochlear function after cochlear implant (CI) electrode insertion through the RW in our first 21 consecutively operated patients aimed at hearing conservation. METHODS: Eleven patients had a preoperative low frequency hearing suitable for electro-acoustic stimulation. Hearing was preserved in an additional nine patients at their request with the intention to use full frequency CI stimulation. Anatomic variations of the RW were carefully considered using our temporal bone collection of micro-dissected ears. Electrode extension was assessed on X-ray by measuring the insertion angle of the first electrode and intra-cochlear length and correlated with audiometric data. RESULTS: There was no incidence of total loss of residual hearing in any of the patients. A slight deterioration of low frequency thresholds occurred in some patients. Mean hearing loss at 125-500 Hz was 14.4 dB at 1 month following surgery and 15.6 dB after 1 year. Insertion angle (300-540°) and depth (17.5-28.5 mm) were not statistically correlated to hearing loss.

- 160. Schnabl J, Markl A, Hörmann R, Wolf-Magele A, Schartinger V, Sprinzl G (2012) Concerto Pin: A novel concept of cochlear implant fixation. Otol Neurotol, 33(9): 1525-9.**

Abstract:

OBJECTIVE: The Concerto Pin is a new cochlear implant system, designed by Med-EL to require minimally invasive surgery and to allow greater positional flexibility in its fixation on the skull. The aim of this study was to measure the load needed to displace the implant from a human skull. STUDY DESIGN: This was a laboratory investigation under controlled conditions at the Department of Anatomy, Histology und Embryology, Innsbruck Medical University. METHODS: Using the manufacturer's surgical guidelines, a Concerto Pin cochlear implant was fixed to a fresh skull from a human cadaver. Load was applied to the body of the implant at different positions and measured with a mechanical force gauge. RESULTS: The maximum load of 100N did not cause dislocation of the implant from its position or fracture of the pins. CONCLUSION: The Concerto Pin fixation method for

cochlear implants provides a secure skull attachment with a direct mechanical connection between implant and bone. It requires less drilling and no tie-down sutures; surgery should therefore be quicker and less invasive.

- 161. Lorens A, Zgosa M, Skarzynski H (2012) A new audio processor for combined electric and acoustic stimulation for the treatment of partial deafness. *Acta otolaryngol*, 132(7): 739-50.**

Abstract:

CONCLUSION: The results of this study demonstrate that a conversion from the Duet to Duet 2 audio processor greatly improved patient satisfaction and subjective benefits. OBJECTIVES: The aims of this study were to compare the DUET 2 audio processor to the DUET speech processor and to evaluate DUET 2 user satisfaction subjectively. METHODS: Ten experienced electric acoustic stimulation (EAS) users following partial deafness treatment upgraded from the MED-EL DUET to the DUET 2 were tested with the adaptive auditory speech test, Pruszwicz monosyllabic word test, visual analog scales, and Duet 2 user questionnaire. Tests were performed post-upgrade and compared simultaneously to the DUET at three test intervals over 3 months. RESULTS: Objective analyses showed that all subjects performed as well with the DUET 2 as the DUET. There was a tendency toward better results with the DUET 2. Subjective testing indicated DUET 2 user preference upon speech and musical stimuli. DUET 2 subject satisfaction was high for wearing comfort, sound quality, and for FineTuner and Private Alert features.

- 162. Qi B, Krenmayr A, Zhang N, Dong R, Chen X, Schatzer R, Zierhofer C, Liu B, Han D (2012) Effects of temporal fine structure stimulation on Mandarin speech recognition in cochlear implant users. *Acta otolaryngol*, 132(11): 1183-91.**

Abstract:

Conclusion: The investigated experimental coding strategies significantly improved tone identification as compared with the participants' everyday audio processor settings. However, this benefit could not be attributed entirely to temporal fine structure stimulation but seems to be caused by decreasing the lower corner frequency of the filter bank. The 6 week habituation period used in this study might have been too short to allow the listeners to derive additional lexical information from the unfamiliar stimulation patterns. Objectives: To evaluate a cochlear implant coding strategy that explicitly conveys temporal fine structure information in the context of the tonal language Mandarin. Methods: The study was designed as a longitudinal, monocentric, prospective, controlled, and randomized cross-over study and included 12 postlingually deafened adults, who were experienced cochlear implant users. Two experimental coding strategies, one of which explicitly presents temporal fine structure information, were compared to the participants' personal TEMPO+ speech processors, which do not convey fine structure information. Results: Both experimental coding strategies improved tone identification by approximately 11 percentage points. This improvement was significant in the female speaker test. Sentence perception, as assessed with the M-HINT test, and quality of life scores were identical with all three coding strategies.

- 163. Niedermeier K, Braun S, Fauser C, Kiefer J, Straubinger RK, Stark T (2012) A safety evaluation of dexamethasone-releasing cochlear implants: Comparative study on the risk of otogenic meningitis after implantation. *Acta Otolaryngol*, 132(12): 1252-60.**

Abstract:

Conclusion: Dexamethasone released from a cochlear implant seems not to enhance the risk for postoperative infections. Objective: Dexamethasone has a positive impact on hearing preservation for electric acoustic stimulation (EAS). Due to their antiproliferative and immunosuppressive properties, steroids may enhance the risk of postoperative infections. A comparative study was performed to evaluate the risk of pneumococcal meningitis after implantation of dexamethasone-eluting cochlear implants. Methods: Thirty guinea pigs were implanted with non-eluting (n = 15) or dexamethasone-eluting (n = 15) cochlear implant electrode dummies. After 5 weeks, animals were exposed to a virulent strain of *Streptococcus pneumoniae*. The two groups were compared based on the meningitis rate. Animals were observed for 5 days for signs of meningitis. Meningitis was verified by clinical outcome as well as by pleocytosis and presence of bacteria in cerebrospinal fluid. Results were confirmed by histological examination of brains and cochleae, clinical findings and culture. Results: There was no significant difference in meningitis risk between the two groups. In the group with non-eluting implants, 3 of 15 animals developed meningitis, while in the group with dexamethasone-eluting implants 4 of 15 showed signs of meningitis.

In this study dexamethasone-releasing implants did not significantly increase the risk of postoperative pneumococcal otogenic meningitis.

**164. May-Mederake B (2012) Early intervention and assessment of speech and language development in young children with cochlear implants. IJPORL, 76(7): 939-46.**

Abstract:

**OBJECTIVE:** Age is one of the most important determinants of the benefit achieved in the cochlear implantation of pre-lingually deafened children. Earlier age at implantation increases the exposure of children with a hearing impairment to auditory stimuli. Earlier auditory stimulation enables children to better understand spoken language and to use spoken language themselves. Furthermore, there appears to be critical period under 2 years of age during which access to spoken language is essential in order for language development to proceed appropriately. The present study aimed to assess the impact of cochlear implantation under 2 years of age on subsequent speech and language development. **METHODS:** 28 children implanted with a cochlear implant prior to 2 years of age were included in this study and the effects of age at implantation were determined using a reception of grammar test, active vocabulary test and speech development test. Demographic features were described using descriptive statistics and data were compared to the normative values (T-values) of their hearing peers by t-test or Mann-Whitney U-test. **RESULTS:** The present data indicates that overall children with a hearing impairment implanted at less than 2 years of age perform as well as or better than their hearing peers in speech and grammar development. Word Comprehension was significantly greater in children with a cochlear implant compared to their normative peers ( $p=0.003$ ), whereas Phonological Working Memory for Nonsense Words was poorer ( $p=0.031$ ). An effect of age on grammatical and speech development could be found for younger implanted children (<12 months), who reached higher scores than children implanted after 12 months of age. **CONCLUSIONS:** The data suggests that early hearing loss intervention via cochlear implantation in children benefits the speech and language development of children. A potential sensitive period exists for implantation before 12 months of age. These outcomes support the recent trend toward early cochlear implantation in pre-lingually deaf children.

**165. May-Mederake B (2012) Determining early speech development in children with cochlear implants using the ELFRA-2 parental questionnaire. IJPORL, 76(6): 797-801.**

Abstract:

**OBJECTIVES:** Increased early identification of hearing loss has led to infants younger than 24 months of age being implanted with cochlear implants. The objective of this study was to assess early speech development in children implanted with a cochlear implant before 24 months of age using the German questionnaire Elternfragebogen für Risikokinder 2 (ELFRA-2), and to compare these results to normative data of the ELFRA-2 in order to determine any performance differences. **METHODS:** Two groups of children were included in this study. The first group included 6 children with a mean age at implantation of 11 months (range: 8-14 months). These children were tested by their parents or caretakers with the ELFRA-2 at the chronological age of 24 months. The second group included 9 children with a mean age at implantation of 13 months (range: 6-20 months) who were tested with the ELFRA-2 after 24 months of cochlear implant use. **RESULTS:** Comparison analyses of children tested with the ELFRA-2 demonstrated a statistically significant difference in all ELFRA-2 scales between children with cochlear implants (CIs) at the chronological age of 24 months and the norm group (productive vocabulary:  $p=0.002$ ; syntax:  $p=0.003$ ; and morphology:  $p<0.001$ ), and no significant difference between children with CIs at 24 months of device use and the norm group in all scales (productive vocabulary:  $p=0.335$ ; syntax:  $p=0.965$ ; and morphology:  $p=0.304$ ). **CONCLUSION:** Children implanted before 24 months of age reach a speech production level after 24 months of device use that is comparable to that of their normal hearing peers.

**166. De Raeve L, Anderson I, Bammens M, Jans J, Haesevoets M, Pans R, Vandistel H, Vrolix Y (2012) The Listening Cube : A Three-dimensional auditory training program. Clinical and Experimental Otorhinolaryngology, 5(S) : S1-S5.**

Abstract:

**Objectives:** Here we present the Listening Cube, an auditory training programme for children and adults receiving cochlear implants, developed during the clinical practice at the KIDS Royal Institute for the Deaf in Belgium. We provide information on the content of the program as well as guidance as to how to use it. **Methods:** The listening

Cube is a three-dimensional auditory training model that takes the following into consideration: the sequence of auditory listening skills to be trained, the variety of material to be used, and the range of listening environments to be considered. During auditory therapy, it is important to develop training protocols and materials to provide rapid improvement over a relatively short time period. Moreover, effectiveness and the general real-life applicability of these protocols to various users should be determined. Results: Because this publication is not a research article, but comes out of good daily practice, we cannot state the main results of this study. We can only say that this auditory training model is very successful. Since the first report was published in the Dutch language on 2003, more than 200 therapists in Belgium and the Netherlands followed a training course electrode to implement to Listening Cube in their daily practice with children and adults with a hearing loss, especially in those wearing cochlear implants. Conclusion: The Listening Cube is a tool to aid in planning therapeutic sessions created to meet individual needs, which is often challenging. The three dimensions of the cube are levels of perception, practice material, and practice conditions. These dimensions can serve as a visual reminder of the task analysis and of other consideration that play a role in structuring therapy sessions.

**167. Seebens Y & Diller G (2012) Improvements in speech perception after the upgrade from the TEMPO+ to the OPUS 2 audio processor. *ORL*, 74:6-11.**

Abstract:

OBJECTIVE: To assess if speech perception improves after the upgrade from the TEMPO+ to the OPUS 2 processor. METHOD: In this retrospective study, 45 subjects (54 ears) implanted with a cochlear implant were upgraded from the TEMPO+ (continuous interleaved sampling + coding strategy) to the OPUS 2 processor (fine structure processing). Before the upgrade, patients were tested with the Freiburg monosyllable (FM) and the Hochmair-Schulz-Moser (HSM) sentence test in quiet and in noise. Four weeks after the upgrade, subjects were again assessed with the same tests. RESULTS: In quiet, mean FM results improved from 62.0% ( $\pm 21.3\%$ ) to 77.8% ( $\pm 15.2\%$ ) and HSM sentences from 69.9% ( $\pm 26.1\%$ ) to 77.9% ( $\pm 22.1\%$ ). In noise, mean FM results improved from 27.3% ( $\pm 17.1\%$ ) to 52.1% ( $\pm 18.6\%$ ) and HSM sentences from 40.4% ( $\pm 29.1\%$ ) to 58.0% ( $\pm 26.1\%$ ). The upgrade to the OPUS 2 was statistically very significant for all speech perception tests ( $p < 0.001$ ). Additionally, subjects stated that the OPUS 2 initially sounded 'awkward' but that quality and speech perception improved after a certain adaptation time. CONCLUSION: Speech understanding in quiet and noise significantly improved with the OPUS 2 in all speech perception tests.

**168. Carvalho GM, Valente JP, Duarte AS, Muranaka EB, Guimarães AC, Soki MN, Bianchini WA, Castilho AM, Paschoal JR (2012) Electro acoustic stimulation of the auditory system: UNICAMP's surgical approach. *Braz J Otorhinolaryngol*, 78(1): 43-50.**

Article in Portuguese.

Abstract:

A new era has arrived in auditory rehabilitation with the introduction of new technologies such as electroacoustic stimulation (EAS). EAS is indicated for patients with residual hearing at low frequencies and severe or profound hearing loss at high frequencies. These patients have no indication for conventional cochlear implant and have difficulties in adapting to individual sound amplification devices. Preservation of hearing is vital in this process; the surgical technique must be based on this concept. OBJECTIVES: To present the cochlear implant surgical technique with MED-EL Mand FlexEAS to preserve hearing in patients with hearing loss at high frequencies and to maintain low frequency hearing. We are the first institution to carry out this treatment in Brazil. METHODS: A case report of the surgical technique carried out in four patients; the procedure was carried out by the cochlear implant group of a specialized clinical hospital. RESULTS: The procedures were successful and uneventful. CONCLUSION: We described the technique used at our institution for implants using EAS; the surgical technique is complex and includes steps for preservation of hearing.

**169. Mandalà M, Colletti L, Tonoli G, Colletti V (2012) Electrocochleography during cochlear implantation for hearing preservation. *Otolaryngol Head Neck*, 146(5): 774-81.**

Abstract:

Objective. To determine whether intraoperative electrocochleography during cochlear implant surgery provides online feedback to modify surgical procedure, reduce trauma, and increase preservation of residual hearing.

Study Design. Prospective cohort study. Setting. Tertiary referral center, Otolaryngology Department, University of Verona. Subjects and Methods. Twenty-seven adult patients undergoing cochlear implant surgery who had low- to mid-frequency (0.25-2 kHz) auditory thresholds measured preoperatively were enrolled. Fifteen subjects had compound action potentials measured to assess cochlear function during surgery. In those patients, surgery was modified according to electrocochleographic feedback. Twelve control subjects underwent cochlear implant surgery with blinded electrocochleographic monitoring. Results. The average preoperative pure-tone audiometry thresholds (0.25-2 kHz) were  $74.3 \pm 10.2$  and  $81.5 \pm 12.7$  dB hearing level (HL) in the electrocochleographic feedback and control cohorts, respectively ( $P > .05$ ). Compound action potential recordings showed a mean maximum latency shift of  $0.63 \pm 0.36$  ms and normalized amplitude deterioration of  $59\% \pm 19\%$  during surgery. All of these changes reverted to normal after electrode insertion in all but 1 subject in the electrocochleographic feedback group. The average shifts in postoperative pure-tone average threshold (0.25-2 kHz), evaluated before activation, were  $8.7 \pm 4.3$  and  $19.2 \pm 11.4$  dB HL in the electrocochleographic feedback and control cohorts, respectively ( $P = .0051$ ). Complete hearing preservation (loss of  $\leq 10$  dB) at 1 month before activation was achieved in 85% (11/13) of electrocochleographic feedback subjects and in 33% (4/12) of control patients ( $P = .0154$ ). Conclusion. Monitoring cochlear function with electrocochleography gives real-time feedback during surgery, providing objective data that might help in modifying the surgical technique in ways that can improve the rate of hearing preservation.

**170. Esser-Leyding & Anderson I (2012) EARS (Evaluation of Auditory Responses to Speech): An internationally validated assessment tool for children provided with cochlear implants. ORL, 74: 42-51.**

Abstract:

**OBJECTIVES:** The use of cochlear implants in the rehabilitation of hearing-impaired patients is now widely established and offers great benefits for children. To evaluate these benefits, the Evaluation of Auditory Responses to Speech (EARS®) assessment tool was designed in 1995. The objectives of this study were to assess the auditory perceptual skills in a large paediatric population over time, as well as to provide standardised values. **METHODS:** An international multicentre study was conducted in 35 clinics from 1996 to 2009. During this period, 765 children were assessed with the EARS in 10 test intervals: pre-operative, first fitting and then 1, 3, 6, and 12 months after the first fitting and annually thereafter, up to a maximum period of 5 years. **RESULTS:** The auditory skills improved significantly over time for all speech perception tests and questionnaires as well as between single test intervals: pre-operative to 6 months, 6 months to 1 year and 1 year to 2 years. Standardised values of the children stratified according to their age at implantation were calculated. **CONCLUSIONS:** The auditory perceptual skills significantly improved over time. The standardised values will help professionals set therapeutic goals and counsel parents accordingly.

**171. Radeloff A, Shehata-Dieler W, Scherzed A, Rak K, Harnisch W, Hagen R, Mlynski R (2012) Intraoperative monitoring using cochlear microphonics in cochlear implant patients with residual hearing. Otol Neurotol, 33(3): 348-54.**

Abstract:

**OBJECTIVES:** To describe a technique for the intraoperative monitoring of residual hearing during a cochlear implant (CI) procedure and, thus, to identify the time of occurrence and surgical steps leading to hearing loss. **STUDY DESIGN:** Prospective audiologic analysis in a patient series. **SETTING:** Tertiary referral center. **SUBJECTS:** Patients with residual hearing subjected to cochlear implantation. **INTERVENTIONS:** During cochlear implantation, cochlear microphonics (CMs) in response to frequency-specific stimuli were recorded in patients with residual hearing. Thresholds were determined before and after opening of the cochlea, with a limited portion of the electrode array inserted, and after full insertion. **RESULTS:** Monitoring of the hearing state using CMs was quick, reliable, and capable of detecting an intracochlear trauma. In a first series of patients, thresholds were preserved in all patients after opening of the cochlea. Thresholds were preserved in 5 of 6 patients after limited insertion and half of the patients after full insertion of the electrode array. Despite threshold preservation until the end of surgery, the residual hearing was lost in patients with deep insertions 1 week postoperative. **CONCLUSION:** Intraoperative monitoring of CM thresholds may be valuable for identifying the exact point of time at which residual hearing is affected in CI patients. Opening of the cochlea itself seems to be unrelated to hearing loss. A significant proportion of patients may have hearing loss caused by secondary effects rather than a direct trauma.

- 172. Baysal E, Karatas E, Deniz M, Baglam T, Durucu C, Abidin Karatas Z, Mumbuc S, Kanlikama M (2012) Intra- and postoperative electrically evoked stapedius reflex thresholds in children with cochlear implants. IJPORL, 76: 649-52.**

Abstract:

**OBJECTIVES:** The aim of this study was to investigate whether there is a significant correlation between intra- and postoperative electrically evoked stapedius reflex thresholds (eSRTs) in children with cochlear implants. **METHODS:** Sixty-five pediatric cochlear implant users were included in this study. All patients had congenital prelingual hearing loss. The round window approach was used in all patients. The eSRTs were intraoperatively measured using the 1st, 3rd, 6th and 12th electrodes of the cochlear implant. The measurements taken during the first fitting of the device were taken again one month after surgery. We used paired-sample t-tests to determine the correlation between intra- and postoperative eSRTs. **RESULTS:** The eSRT analysis revealed a statistically significant difference between the intra- and postoperative thresholds. A correlation analysis did not reveal any correlation between intra- and postoperative eSRTs. **CONCLUSION:** Intraoperative eSRT measurements were unable to predict early postoperative eSRTs.

- 173. Trotic R, Kostic M, Ries M, Drvis P, Ajduk J, Pertovac I (2012) Long-term functional outcomes after 10 years of bilateral cochlear implant use. Coll Antropol, 36(1): 161-5.**

Abstract:

The aims were to determine the benefit of bilateral cochlear implantation in a 20 years old patient implanted in Croatia on hearing and speech development. The male patient, after 10 years of deafness, got cochlear implants MED-EL COMBI 40+ on both sides in one-stage surgery. The etiology of his deafness was posttraumatic meningitis. Auditory capacity and speech recognition tests were performed for both ears separately and together. Average hearing level on the right ear with right cochlear implant switched on started at 62 dB 1 month after cochlear implantation and was on 55 dB after 10 years. Average hearing level on the left ear with left cochlear implant switched on started at 55 dB 1 month after the cochlear implantation and was on 32 dB after 10 years. Average hearing level on the both ears with 2 cochlear implants switched on started at 35 dB after the cochlear implantation and was on 27 dB after 10 years. Long-term functional outcomes with bilateral cochlear implantation provides advantages over unilateral implantation including improved hearing levels, speech perception in noise and improved sound localization.

- 174. Bruce IA, Bates JEHM, Melling C, Mawman D, Green KMJ (2011) Hearing preservation via a cochleostomy approach and deep insertion of a standard length cochlear implant electrode. OtoNeurotol, 32:1444-7.**

Abstract:

**OBJECTIVE:** The suggestion that the depth of insertion of the electrode into the cochlea is critical to hearing preservation has led to the development of a generation of short electrodes designed to minimize intracochlear trauma and avoid contact with the apical region of the cochlea. This study aims to describe our experience of hearing preservation surgery using a deeply inserted standard length electrode array covering the region of residual hearing. **STUDY DESIGN:** A retrospective case note review was performed identifying cases of attempted hearing preservation using standard length electrodes. **SETTING:** Study based at Manchester Royal Infirmary, a tertiary referral center. **PATIENTS:** Fourteen cochlear implants in 13 patients were identified for further analysis from the Manchester Cochlear Implant Programme database. **INTERVENTION(S):** Each patient received the same design of implant using a "soft" surgical technique. **MAIN OUTCOME MEASURE:** Preoperative and postoperative air conduction thresholds were compared to assess the degree of hearing preservation. **RESULTS:** Successful hearing preservation was demonstrated in 12 of 14 cases, and the postoperative residual hearing thresholds in 3 adolescents receiving a standard length electrode array were found to have improved. Preservation of speech recognition was not measured in this study, rather hearing was tested by pure tone audiogram. Follow-up at the time of this study ranged from 1 week to 23 months. **CONCLUSION:** This study demonstrates that deep insertion of the electrode into the cochlea does not preclude successful hearing preservation. It also highlights that residual hearing can be consistently preserved using a "cochleostomy" approach.

**175. Spitzer JB & Zavala JS (2011) Development of the Spanish version of the LittEARS parental questionnaire for the use in the United States and Latin America. *Audiology Research*, 1:e31**

Abstract:

The LittEARS Auditory Questionnaire is a parent questionnaire created to assess development of age-dependant auditory behaviours of children in the pre-verbal stage. The original questionnaire was developed in Austria (in German), and is now being introduced in the United States in English. This study was designed to obtain normative data on a Spanish translation. Fifty parents or caregivers participated. Responses were obtained at their child's visit to a hospital clinic or an external ambulatory site. Children ranged in age from .5 to 21.4 months (mean = 9.5 months). Parents were either Spanish monolingual or bilingual representing 5 national origins. Analyses included correlation of age with total score, and with individual questions, index of difficulty, discrimination and selectivity indices, scale analysis, split-half reliability and internal consistency. Specifically, correlation between age and number of observed behaviours was 0.927. A measure of internal consistency was high, 0.95. Results indicated that the translated LittEARS for use with Spanish speakers is a potentially useful tool for clinicians assessing pre-verbal auditory behaviour. High correlations of total score with age suggested that the questionnaire reflects a progression of auditory skills in the 0 to 24 months age group.

**176. Harris RL, Gibson WPR, Johnson M, Brew J, Bray M, Psarros C (2011) Intra-individual assessment of speech and music perception in cochlear implant users with contralateral Cochlear and MED-EL systems. *Acta Otolaryngol*, 131: 1270-1278.**

Abstract:

Conclusion: Whilst objective testing on music perception showed no individual differences between cochlear implant (CI) devices, subjective music perception was found to be superior with the MED-EL device in the majority of cases evaluated. Objective: To compare speech and music perception through two different CI systems in the same individuals. Methods: Six post-lingually deaf patients, who had been implanted with a Cochlear(?) Nucleus(?) device in one ear and a MED-EL SONATATI(100) on the contralateral side were evaluated. One subject was excluded from group analysis because of significant differences in performance between ears. Subjects completed a questionnaire designed to assess implant users' listening habits. Subjective assessments of each subject were made for comparison of speech and music perception with each system and preferences of system. The subjects consecutively used each system with the contralateral device turned off, and were objectively assessed for specific musical skills. Speech perception in quiet and in noise was tested. Results: For all objective tests of music discrimination and speech perception in noise, there were no statistically significant differences between MED-EL and Cochlear CI systems. Subjectively, four subjects thought their MED-EL device was better than their Cochlear device for music appreciation. Four thought that music sounded more natural, less tinny and more reverberant with their MED-EL CI than with their Cochlear CI. One subject rated all these to be equal.

**177. Helbig S, Baumann U, Hey C, Helbig M (2011) Hearing preservation after complete cochlear coverage in cochlear implantation with the free-fitting FLEXSOFT electrode carrier. *Otol Neurotol*, 32(6): 973-9.**

Abstract:

OBJECTIVES: To demonstrate the possibility of atraumatic insertion with the free-fitting FLEX electrode by evaluating the degree of hearing preservation postoperatively. DESIGN: Retrospective study. SETTING: Academic tertiary care center. PARTICIPANTS: Twenty-two severely to profoundly hearing impaired subjects with measurable residual hearing preoperatively. INTERVENTION: Atraumatic implantation with the 31.5-mm-long, free-fitting, and highly flexible FLEX electrode using either the round window approach or a cochleostomy technique. MAIN OUTCOME MEASURES: Subjects were tested preoperatively in unaided condition and at varying intervals postoperatively. Preoperative and postoperative low-frequency pure-tone average (PTA) and PTA shifts were calculated. Speech perception was measured preoperatively and postoperatively using the Freiburg monosyllabic word test in quiet. RESULTS: Preoperative low-frequency hearing could be preserved to a certain degree in 77.3% of subjects (17/22) after insertion of the FLEX electrode up to the point of first resistance. Complete loss of residual hearing was observed in 22.7% of subjects (5/22). In 18.2% of the subjects (4/22), the preoperative PTA was preserved within 10 dB. Pure-tone average results between preoperative and

most recent testing showed statistically significant differences ( $p < 0.001$  to  $p = 0.031$ ) for almost all loudness levels ranging from 125 Hz to 1.5 kHz. The maximum threshold shift was 40 dB at 250 Hz for the lower frequencies up to 1 kHz. Monosyllable testing in quiet demonstrated significant improvement over time ( $p < 0.001$ ). CONCLUSION: This study showed that preservation of residual hearing is possible in a high number of subjects when a flexible electrode and atraumatic surgical techniques are used.

- 178. Von Ilberg CA, Baumann U, Kiefer J, Tillein J, Adunka OF (2011) Electric acoustic stimulation of the auditory system: A review of the first decade. *Audiol Nuerotol*, 16 (suppl 2): 1-30.**

Abstract:

Electric-acoustic stimulation (EAS) was developed for individuals with a profound hearing loss in the high frequencies and a substantial residual low-frequency hearing (LFH). For this group of candidates, conventional hearing aids often neither provided sufficient amplification nor were they considered suitable for cochlear implantation due to the possible destruction of residual hearing capabilities. With EAS, combining electric stimulation with an ipsilateral acoustic stimulation, preservation of residual LFH and the development of a new speech processor uniting both strategies became essential. Over the last years, EAS has developed further and advanced in electrode design and surgery techniques. This paper summarizes the history of EAS and acknowledges the tremendous work of the many research groups who contributed to the success of EAS.

- 179. Ibrahim HN, Helbig S, Bossard D, Truy E (2011) Surgical trauma after sequential insertion of intracochlear catheters and electrode arrays (a histological study). *Otol Neurotol*, 32(9): 1148-54.**

Abstract:

**HYPOTHESIS** To evaluate histologically the risk of trauma to intracochlear structures after sequential insertion of an intracochlear catheter and an electrode array. **BACKGROUND:** A previous computed tomographic scan-based study demonstrated that introduction of a flexible disposable intracochlear catheter for drug delivery to a distance of up to 15 mm was feasible and showed no radiologic evidence of basilar membrane trauma. **METHODS:** Fifteen fresh human temporal bones were prepared for cochlear implantation. We sequentially performed the introduction of the catheter, the injection of 15  $\mu$ l of an iodine solution into the scala tympani via the catheter, and the removal of the catheter in 14 temporal bones, and finally, 2 types of electrode array (Flex and Flex) from MED-EL, were inserted into 10 temporal bones. The bones were fixed and embedded in methylmethacrylate to cut the undecalcified temporal bones parallel to the modiolus axis with the electrode array in place, and each histologic section was photographed to document the location and extent of trauma in the cochlea. **RESULTS:** No specific damage (Grade 0 trauma) to cochlear structures occurred in 12 temporal bones, and elevation of basilar membrane (Grade 1 trauma) occurred in 2 cases. The electrode array was positioned in the scala tympani under the basilar membrane in all temporal bones, with one exception, in which the Flex electrode array deviated behind the spiral ligament and into the scala vestibuli apically (Grade 3 trauma). **CONCLUSION:** The infusion of an iodine solution within an intracochlear catheter and the subsequent insertion of an electrode array was shown to be feasible and often atraumatic.

- 180. Withers SJ, Gibson WP, Greenberg SL, Bray M (2011) Comparison of outcomes in a case of bilateral cochlear implantation using devices manufactured by two different implant companies (Cochlear Corporation and MED-EL). *CII*, 12(2): 124-126.**

Abstract:

**OBJECTIVE:** This paper reports a case of a patient who has had bilateral cochlear implants that have been manufactured by different cochlear implant companies (Cochlear Corporation and Med-El). **METHOD:** Comparison of speech perception tests following single implant insertion and bilateral insertion (3 and 12 months). The patient was also interviewed to obtain a subjective opinion on their quality of hearing. **RESULTS:** The patient reported that their Med-El implant had better sound quality than their Cochlear Corporation implant. The speech perception tests however failed to show any difference. **CONCLUSION:** Despite no difference found with the objective tests hearing is very subjective and therefore the patient's opinion on the quality of sound is important. It is only a matter of time before other patients are fitted with bilateral cochlear implants from different companies and this information should be collated to allow comparison between manufacturers.

- 181. Geal-Dor M, Jbarah R, Meilijson S, Adelman C, Levi H (2011) The Hebrew and Arabic version of the LittIEARS Auditory Questionnaire for the assessment of auditory development: Results in normal hearing children and children with cochlear implants. IJPORL, 75: 1327-32.**

Abstract:

OBJECTIVE: With more children receiving cochlear implants at an early age, there is a need for evaluation and assessment of early auditory behavior. We present the translation of the LittIEARS® Auditory Questionnaire into Hebrew and into Arabic. First the validation of the LittIEARS® Auditory Questionnaire in normal hearing children was evaluated. Second, the auditory behavior and the progress in hearing skills of a group of children with cochlear implants were assessed. METHODS: A "back-translation" method was used to translate and adapt the LittIEARS® Auditory Questionnaire into Hebrew and into Arabic. Normal hearing participants included 70 Hebrew speaking and 97 Arabic speaking parents of children from 1 to 24 months of age with normal hearing. An additional group of 42 parents of children with cochlear implants with a hearing age of up to 24 months completed the LittIEARS® Auditory Questionnaire. 27 of them completed the questionnaire more than once at intervals, so that change and development could be recorded. Scores on the LittIEARS® Auditory Questionnaire were compared to results of SIR and CAP scales and other available auditory data. RESULTS: The results of the first study show that the curves found for the Hebrew and the Arabic translations of the LittIEARS® Auditory Questionnaire are essentially similar to those previously found for other languages. These curves reflect the age dependency of auditory skills. Furthermore, in the group with cochlear implants the developmental pattern was different than that of the normal hearing group, with an initial steep increase and a later slower improvement. This trend appeared both in curves of groups and in curves of individuals (individuals whose parents completed the questionnaire at several points in time). There was a high correlation between scores on the LittIEARS® Auditory Questionnaire and results of other audiologic tests, showing validity of results with the LittIEARS® Auditory Questionnaire. CONCLUSION: Both the Hebrew and Arabic versions of the LittIEARS® Auditory Questionnaire were found to be reliable and valid tools for assessment of the development of auditory behavior in children up to the age of 24 months. Furthermore, the LittIEARS® Auditory Questionnaire in both languages is useful in monitoring the progress of children with cochlear implant.

- 182. Baumann U, Rader T, Helbig T, Helbig S, Bahmer A (2011) Pitch matching psychometrics in electric acoustic stimulation. Ear Hear, 32: 656-62.**

Abstract:

OBJECTIVE: Combined electric-acoustic stimulation (EAS) is a therapeutic option for patients with severe to profound mid- and high-frequency hearing loss while low-frequency hearing is mostly unaffected. The present study investigates bimodal pitch matching in EAS users as a function of the angular placement of electrodes. Results are compared with data obtained from previous pitch matching studies. Knowledge of electric and acoustic pitch mapping may be important for effective fitting to control the frequency range of acoustic and electric processing. DESIGN: Pitch adjustment experiments were conducted in eight subjects with residual hearing in the opposite ear as well as in the implanted ear. Four subjects received a standard 31.5-mm electrode array and four subjects received the shorter, more flexible 24-mm FLEX electrode array (PULSARCI100 or SONATATI100 stimulator, MED-EL, Innsbruck, Austria). The subjects' task was to listen to single-electrode stimuli presented at a fixed rate (800 pulses per second) via the cochlear implant and to adjust the frequency of the acoustic stimulus until the perceived pitch matched the perception of the electrically conveyed stimulus. Two to four of the most apical electrodes were tested depending on the range of the individual's residual hearing. Postoperative x rays (modified Stenver's view) were analyzed to compare individual pitch matching data in terms of the electrode arrays' insertion angle. RESULTS: The average mean frequency match for the most apical electrode 1 in EAS subjects implanted with the FLEX array was 583 Hz, while for the two subjects with a deep insertion of the 31.5-mm standard electrode array, the matches were 128 and 223 Hz. Because the residual hearing in the EAS subgroup was rather limited in the high-frequency range, a limited number of basal electrodes were assessed to determine the slope of the electric place/pitch function. A considerable variation in terms of the individual pitch function was observed. The slope of the pitch function varied to a large extent among subjects. The differences between contra- and ipsilateral adjustments were very small (mean average 14 Hz) and within the range of the variance (average SD 124 Hz). CONCLUSIONS: The application of a pitch matching procedure to assess the electric/acoustic crossover frequency is feasible. In the present study, ipsi- and contralateral pitch matches made

by EAS patients were nearly equal; therefore, a severe alteration in the excitation pattern of the basilar membrane in the implanted ear can be ruled out.

**183. Looi V, Winter P, Anderson I, Sucher C (2011) A music quality rating test battery for cochlear implant users to compare the FSP and HDCIS strategies for music appreciation. IJA, 50(8): 503-18.**

Abstract:

**OBJECTIVE:** The purpose of this study was to develop a music quality rating test battery (MQRTB) and pilot test it by comparing appraisal ratings from cochlear implant (CI) recipients using the fine-structure processing (FSP) and high-definition continuous interleaved sampling (HDCIS) speech processing strategies. **DESIGN:** The development of the MQRTB involved three stages: (1) Selection of test items for the MQRTB; (2) Verification of its length and complexity with normally-hearing individuals; and (3) Pilot testing with CI recipients. **STUDY SAMPLE:** Part 1 involved 65 adult listeners, Part 2 involved 10 normally-hearing adults, and Part 3 involved five adult MED-EL CI recipients. **RESULTS:** The MQRTB consisted of ten songs, with ratings made on scales assessing pleasantness, naturalness, richness, fullness, sharpness, and roughness. Results of the pilot study, which compared FSP and HDCIS for music, indicated that acclimatization to a strategy had a significant effect on ratings ( $p < 0.05$ ). When acclimatized to FSP, the group rated FSP as closer to 'exactly as I want it to sound' than HDCIS ( $p < 0.05$ ), and that HDCIS sounded significantly sharper and rougher than FSP. However when acclimatized to HDCIS, there were no significant differences between ratings. There was no effect of song familiarity or genre on ratings. **CONCLUSIONS:** Overall the results suggest that the use of FSP as the default strategy for MED-EL recipients would have a positive effect on music appreciation, and that the MQRTB is an effective tool for assessing music sound quality.

**184. Boyd P (2011) Potential benefits from deeply inserted cochlear implant electrodes. Ear Hear, 32(4): 411-27.**

Abstract:

**OBJECTIVES:** This review examines evidence for potential benefits of using cochlear implant electrodes that extend into the apical regions of the cochlea. Most cochlear implant systems use electrode arrays that extend 1 to 1.5 turns from the basal cochleostomy, but one manufacturer (MED-EL GmbH) uses an electrode array that is considerably longer. The fundamental rationale for using electrodes extending toward the apex of the cochlea is to provide additional low-pitched auditory percepts and thereby increase the spectral information available to the user. Several experimental long arrays have also been produced by other manufacturers to assess potential benefits of this approach. **DESIGN:** In addition to assessing the effects of deeply inserted electrodes on performance, this review examines several underlying and associated issues, including cochlear anatomy, electrode design, surgical considerations (including insertion trauma), and pitch scaling trials. Where possible, the aim is to draw conclusions regarding the potential from apical electrodes in general, rather than relating to the performance of specific and current devices. **RESULTS:** Imaging studies indicate that currently available electrode arrays rarely extend more than two turns into the cochlea, the mean insertion angle for full insertions of the MED-EL electrodes being about 630°. This is considerably shorter than the total length of the cochlea and more closely approximates the length of the spiral ganglion. Anatomical considerations, and some modelling studies, suggest that fabrication of even longer electrodes is unlikely to provide additional spectral information. The issue of potential benefit from the most apical electrodes, therefore, is whether they are able to selectively stimulate discrete and tonotopically ordered neural populations near the apex of the spiral ganglion, where the ganglion cells are closely grouped. Pitch scaling studies, using the MED-EL and experimental long arrays, suggest that this is achieved in many cases, but that a significant number of individuals show evidence of pitch confusions or reversals among the most apical electrodes, presumably reducing potential performance benefit and presenting challenges for processor programming. **CONCLUSIONS:** Benefits in terms of speech recognition and other performance measures are less clear. Several studies have indicated that deactivation of apical electrodes results in poorer speech recognition performance, but these have been mostly acute studies where the subjects have been accustomed to the full complement of electrodes, thus making interpretation difficult. Some chronic studies have suggested that apical electrodes do provide additional performance benefit, but others have shown performance improvement after deactivating some of the apical electrodes. Whether or not deeply inserted electrodes can offer performance benefits, there is evidence that currently available designs tend to produce more intracochlear trauma than shorter arrays, in terms of loss of residual acoustic hearing and reduction of the neural

substrate. This may have important long-term consequences for the user. Furthermore, as it is possible that subjects with better low-frequency residual hearing are more likely to benefit from the inclusion of apical electrodes, there may be a potential clinical dilemma as the same subjects are those most likely to benefit from bimodal electroacoustic stimulation, requiring a relatively shallow insertion.

- 185. Karatas E, Deniz M, Baglam T, Durucu C, Baysal E, Kanlikama M (2011) Intraoperative electrically evoked stapedius reflex thresholds in children undergone cochlear implantation: Round window and cochleostomy approaches. IJPORL, 75(9): 1123-6.**

Abstract:

**OBJECTIVES:** To study the best electrically stimulation in cochlear implant surgery with round window (RW) and Promontory cochleostomy approaches with electrically evoked stapedius reflex thresholds (ESRT) intraoperatively. **METHODS:** Thirty-nine children underwent CI surgery were included for this study. The surgical procedures consisted of RW and Promontory cochleostomy. ESRT for each 1st, 3rd, 6th and 12th electrodes (E) were determined. Statistical evaluation was done for the comparison of the thresholds and duration times for both groups. **RESULTS:** The duration times of ESRT for E1, E3, E6 and E12 electrodes was shorter in RW group compared with the Promontory group ( $p < 0.05$ ). The statistical evaluation of ESRT measurements of E1, E3, E6 found  $p < 0.001$  and E12 electrode  $p < 0.05$  in RW group. ESRT measurements were recorded at lower threshold in the RW group compared with the Promontory group. **CONCLUSION:** The duration of electrically stimulation thresholds were shorter in RW group. ESRT measurements were recorded at lower threshold in the RW group compared with the Promontory group. RW insertion offers best electrically stimulation relative to electrode insertion via a promontory cochleostomy.

- 186. Riss D, Hamzavi JS, Selberherr A, Kaider A, Blineder M, Starlinger V, Gstoettner W, Arnoldner W (2011) Envelope versus Fine Structure speech coding strategy: A crossover study. Otol Neurotol, 32: 1094-1101**

Abstract:

**OBJECTIVE:** The transmission of fine structure information to cochlear implant users is an expanding area of research. Previous studies comparing the fine structure processing (FSP) speech coding strategy to the envelope-based continuous interleaved sampling (CIS) strategy indicated improved speech perception when using the fine structure strategy. Those investigations were performed with an extended frequency spectrum in the low frequencies together with the fine structure strategy. The current study addresses the question whether these improvements are due to the presentation of fine structure per se or rather the extended frequency spectrum. Hence, this cross over study compares the two strategies using an identical frequency spectrum. **STUDY DESIGN:** Randomized crossover study. **PATIENTS:** 31 patients were randomly assigned to two groups. **INTERVENTIONS:** One group was fitted with a CIS map for 4 weeks, tested and subsequently fitted with a FSP map for 4 weeks. The other group followed the same pattern in reverse. **MAIN OUTCOME MEASURES:** Test material consisted of sentence tests in noise, monosyllables in quiet and melody recognition. **RESULTS:** No statistical significance was noted between the different speech coding strategies at an identical frequency spectrum. **CONCLUSION:** This study shows that there is no difference in speech perception with FSP compared to CIS at an extended frequency spectrum. Therefore, the extended frequency spectrum in the low frequencies might explain a benefit of FSP observed in previous studies.

- 187. Arnoldner C, Gstoettner W, Riss D, Wagenblast J, Honeder C, Blineder M, Hamzavi JS, Jappel A, Baumgartner WD (2011) Residual hearing preservation using the suprameatal approach for cochlear implantation. Wien Klin Wochenschr. 123(19-20): 599-602.**

Abstract:

**OBJECTIVE:** Cochlear implantation of patients with high-frequency hearing loss and residual low-frequency hearing has become a new treatment standard within the last years. The objective of this study was to evaluate the rate of hearing preservation in cochlear implantation for electric-acoustic stimulation using the suprameatal approach. **METHODS:** Five patients (mean age 48.2 years) who were supplied with Med El (Combi 40+, Pulsar) cochlear implants and various different electrodes (Custom made, Flex soft, Flex EAS) were evaluated for residual hearing preservation after a mean follow-up time of 35.6 months (range 24 to 77 months). **RESULTS:**

Three patients showed partial hearing preservation, whereas 2 patients experienced a complete loss of residual hearing. **CONCLUSION:** Although hearing preservation rates in this series of patients operated on using the suprameatal approach were inferior as compared with a series using the standard mastoidectomy approach, this study shows that it is in fact possible to preserve residual hearing using a non-mastoidectomy surgical technique for cochlear implantation. Nevertheless, more experience is necessary to answer the question whether this technique can be thoroughly recommended in cochlear implantation for electric-acoustic stimulation.

- 188. Gstoettner WK, Van de Heyning P, Fitzgerald O'Connor, Kiefer J, Morera C, Sainz M, Vermeire K, McDonald S, Cavallé L, García Valdecasas J, Adunka OF, Baumann U, Kleine-Punte A, Brockmeier H, Anderson I, Helbig S (2011) Assessment of the subjective benefit of electric acoustic stimulation with the abbreviated profile of hearing aid benefit. *ORL*, 73: 321-9.**

Abstract:

**Conclusion:** This study demonstrates that electric-acoustic stimulation (EAS) significantly decreases the subjective impairment in speech perception. **Objectives:** To assess the subjective benefit of EAS over the first 12 months after EAS fitting using the Abbreviated Profile of Hearing Aid Benefit (APHAB). **Method:** Twenty-three EAS users, implanted with either the PULSAR(CI)(100) FLEX(EAS) provided with the DUET EAS processor or the COMBI40+ Medium provided with the TEMPO+ speech processor, were included. Electric stimulation was activated about 1 month postoperatively; ipsilateral acoustic stimulation was added 2 months thereafter. EAS benefit was measured preoperatively with only a hearing aid and postoperatively at EAS fitting and then 3, 6 and 12 months after EAS fitting using the APHAB. **Results:** Subjects reported significant improvements in the global score with a mean decrease in impairment from 74% preoperatively to 45% after 3 months of EAS use. Furthermore, clinical relevance was demonstrated in multiple subscales between preoperative and first fitting reflecting a true benefit of EAS with a probability of 95%.

- 189. Van Besouw RM, Grasmeder ML (2011) From TEMPO+ to OPUS 2: What can music tests tell us about processor upgrades? *CIL*, 12(S2): S40-43.**

Abstract:

Tests for quantifying the music perception abilities of cochlear implant users are currently being developed and trialed at the South of England Cochlear Implant Centre. In addition to measures of speech perception, tests of rhythm, and pitch have been administered to MED-EL C40+ implant users before and after upgrading from the TEMPO+ processor with continuous interleaved sampling strategy to the OPUS 2 processor with fine structure processing strategy, with the aims of comparing device performance and evaluating the potential of music perception tests for informing processor upgrades and tuning. Eight experienced adult C40+ implant recipients performed tests of rhythm and pitch discrimination using the TEMPO+ processor and, after a minimum of 6 weeks acclimatization, using the OPUS 2 processor. Stimuli included piano and sine tones in two note ranges for the pitch tasks, and drum beats for the rhythm task. Rhythm, pitch, and speech perception scores were comparable for both processors. An effect of note range was observed ( $z = -2.52$ ,  $p = 0.008$  (two-tailed),  $r = -0.63$ ), which indicated that the higher range of notes used for the pitch tasks was easier for participants than the lower range. Measures of pitch discrimination in different frequency ranges further informed changes made to one participant's map, resulting in improved pitch discrimination and speech perception scores. The outcomes of this study demonstrate that music perception tests can provide important additional measures for tuning cochlear implant parameters and assessing the impact of changes to device type and processing strategy.

- 190. Proceedings of the 11<sup>th</sup> international conference on cochlear implants and other implantable auditory technologies.(2011) *CIL*, 12(Suppl 1).**

Kleine Punte A, Vermeire K, Hofkens A, De Bodt M, De Ridder D, Van de Heyning P. Cochlear implants as a durable tinnitus treatment in single-sided deafness.

Krenmayr A, Visser D, Schatzer R, Zierhofer C. The effects of fine structure on pitch perception with cochlear implants.

- 191. Kleine Punte A, Vermeire K, Hofkens A, De Bodt M, De Ridder D, Van de Heyning P (2011) Cochlear implantation as a durable tinnitus treatment in single sided deafness. *CIL*, 12(S1): S26-9.**

Abstract:

Introduction: Severe tinnitus can seriously impair patients in their activities in daily life and reduce their quality of life. The aims of this prospective clinical study were to assess the long-term effects of cochlear implantation (CI) on tinnitus in patients with single-sided deafness and ipsilateral incapacitating tinnitus, and to investigate whether CI could treat various types of tinnitus. Materials and methods: Twenty-six subjects with unilateral severe-to-profound sensorineural hearing loss received a CI. Patients suffered from severe tinnitus greater than 6/10 on a visual analogue scale (VAS) due to unilateral deafness. Assessment consisted of a tinnitus analysis including determination of tinnitus type, frequency, and loudness. A tinnitus questionnaire (TQ) measured tinnitus distress. VAS and TQ were administered pre-implantation and post-implantation. Results: All 26 patients reported a subjective benefit from CI. Tinnitus loudness reduced significantly after CI from 8.6 to 2.2 on the VAS (scale: 0–10). The TQ total score decreased significantly and the mean tinnitus degree decreased from severe to mild. No differences were observed between patients with pure-tone tinnitus, narrow band noise tinnitus, or polyphonic tinnitus. The degree of tinnitus loudness reduction remained stable after CI. Conclusions: CI can successfully be used as treatment of severe tinnitus in patients with single-sided deafness and is equally effective for pure tone, narrow band noise, and polyphonic tinnitus. Long-term results show that implantation provides durable tinnitus relief in these patients. These results support the hypothesis that physiopathological mechanisms after peripheral deafferentation are reversible when hearing is restored. Single-sided deafness accompanied by severe tinnitus is a new indication for CI.

- 192. Riss D, Hamzavi JS, Katzinger M, Baumgartner WD, Kaider A, Gstoettner W, Arnoldner C (2011) Effects of fine structure and extended low frequencies in pediatric cochlear implant recipients. IJPORL, 74(5): 573-8.**

Abstract:

OBJECTIVE: In recent years, new speech coding strategies have been developed with the aim of improving the transmission of temporal fine structure to cochlear implant recipients. This study reports on the implementation of one such strategy (fine structure processing, FSP) in children. METHODS: This was a prospective study investigating the upgrade to a new speech processor. The upgrade used a repeated measures design with an alternating order of conditions (A-B-A-B design). Twelve pre- and perilingually deaf children with MED-EL C40+ cochlear implants were enrolled in the study. Patients were upgraded from their Tempo+ speech processor, which used continuous interleaved sampling (CIS) in combination with a frequency spectrum of 200-8500 Hz, to an Opus speech processor, which used FSP with an extended frequency spectrum of 70-8500 Hz. The primary means of testing was an HSM (Hochmair, Schulz and Moser) sentence test at 65 and 80 dB in quiet. In addition, the "Mainzer Kindersprachtest" (Mainz audiometric speech test for children) was applied at 65 and 70 dB. RESULTS: When the new FSP speech processor was used together with the extended low frequency range, HSM sentence tests at 65 and 80 dB resulted in scores indicating statistically significant improvements of 7.1 and 9.9 percentage points, respectively. Scores in the "Mainzer Kindersprachtest" at 65 and 70 dB indicated statistically significant improvements of 9.3 and 6.1 percentage points, respectively. CONCLUSIONS: The present study clearly shows that children benefit from the fine structure speech coding strategy in combination with an extended frequency spectrum in the low frequencies, as is offered by the Opus speech processors. This should be taken into consideration when fitting pre- and perilingually deaf children implanted almost a decade previously.

- 193. Usami SI, Moteki H, Suzuki N, Fukuoka H, Miyagawa M, Nishio SY, Takumi Y, Iwasaki S, Jolly C (2011) Achievement of hearing preservation in the presence of an electrode covering the residual hearing region. Acta Otolaryngol, 131(4): 405-12.**

Abstract:

CONCLUSIONS: With full insertion with a long electrode, hearing preservation can be achieved even in the presence of a long electrode covering the residual hearing region. OBJECTIVES: Advances in developing new atraumatic concepts of electrode design as well as surgical technique have enabled hearing preservation after cochlear implantation surgery, and EAS (electric acoustic stimulation) accompanied with hearing preservation is a new trend for patients with residual hearing at the lower frequencies. However, full insertion with a long/medium electrode and hearing preservation is still a challenging field that calls for discussion. METHOD: In this study, round window insertion, an atraumatic electrode, and dexamethasone administration were used and atraumaticity (hearing preservation and conservation of vestibular function) was evaluated with full insertion of the electrode.

RESULTS: Postoperative evaluation after full insertion of the electrodes showed that hearing at low frequencies was well preserved in all five cases. Combined postoperative imaging with the referential tonotopic map confirmed achievement of full insertion and indicated the corresponding frequencies and the depth of the electrode. Achievement of atraumaticity of round window insertion in the present cases was confirmed from the viewpoint of the minimal drilling time as well as the preserved vestibular function.

- 194. Mueller J, Baumgartner WD, Godey B, Freijd A, Harris S, Helbig S, Quevedo MS, Mann W, Anderson I, Gstoettner W (2011) The MED-EL SONATATI<sup>100</sup> cochlear implant: An evaluation of its safety in adults and children. Acta Otolaryngol, 131(5): 504-11.**

Abstract:

Conclusions: Data from 50 patients suggest that the SONATATI(100) cochlear implant (CI) is a safe and effective device. Objective: MED-EL has developed and tested a CI with titanium housing (the SONATATI(100)), which has the same internal components as the PULSARCI(100). Implant surgery should be less traumatic, as with these CIs smaller incisions and less drilling are involved. The study aimed to assess surgical issues pertaining to the implantation of the device, patient compatibility with the titanium of the implant housing, and other patient-related issues. Methods: Fifty patients were recruited into this multicenter study. In phase 1, 30 adults and in phase 2, 20 children received a SONATATI(100) cochlear implant. An intraoperative survey was completed by the surgeons for all patients. A postoperative survey was completed by the audiologists/fitting engineers at first fitting and 3 and 6 months after the first fitting to evaluate the safety and the efficacy of the device. Results: The device was proven to be effective in that it was stable in the implant bed and that minimally invasive surgery could be carried out. The device was proven to be safe after medium-term use and no unexpected adverse events were reported.

- 195. Helbig S, Van de Heyning P, Kiefer J, Baumann U, Kleine-Punte A, Brockmeier H, Anderson I, Gstoettner W (2011) Combined electric acoustic stimulation with the PULSARCI100 implant system using the FLEXEAS electrode array. Acta Otolaryngol, 131(6): 585-95.**

Abstract:

Conclusion: This study demonstrates that electric acoustic stimulation (EAS) using the FLEX(EAS) electrode is a successful treatment method for preservation and stability of low frequency hearing, and results in significant improvements in speech perception. Objectives: Low frequency hearing preservation and stability following EAS surgery with the MED-EL PULSARCI(100) implant using the FLEX(EAS) electrode and a combined processor in a multicentre setting, and the efficacy and benefits of EAS over time were evaluated. Methods: Eighteen subjects with normal to moderate hearing loss in the low frequencies and severe to profound hearing loss in the high frequencies were implanted with the FLEX(EAS) electrode. Implantation was performed by different surgeons at three participating centres using either the cochleostomy or the round window approach. Preoperatively, hearing was measured; a battery of speech perception tests and the subjective benefit questionnaire were administered. These tests were subsequently repeated: first at EAS fitting, which was due 3 months after surgery, and then again 3, 6 and 12 months after EAS fitting. Results: Hearing could be preserved in all subjects. Speech understanding showed significant improvement in all tests over time with the EAS condition outperforming the cochlear implant-only condition at all intervals. These considerable effects were also reflected in the subjective benefit outcome.

- 196. Bagatto MP, Brown CL, Moddie ST, Scollie SD (2011) External validation of the LittlEARS Auditory Questionnaire with English-speaking families of Canadian children with normal hearing. IJPORL, 75(6): 815-7.**

Abstract:

OBJECTIVE: To examine the external validity of the United Kingdom English version of the LittlEARS(®) Auditory Questionnaire with English-speaking families of Canadian children with normal hearing. METHODS: The United Kingdom English version of the LittlEARS was administered to English-speaking families of 130 children with normal hearing in Ontario, Canada. Total scores for these children were compared to German-derived normative values. RESULTS: There was no significant difference between Canadian and German norms when using the United Kingdom English version of the LittlEARS Auditory Questionnaire. CONCLUSIONS: The United Kingdom English version of the LittlEARS Auditory Questionnaire is appropriate for use with English-speaking families of normal hearing Canadian children.

197. Majdak P, Goupell MJ, Laback B (2011) Two-dimensional localisation of virtual sound sources in cochlear-implant listeners. *Ear Hear*, 32(2): 198-208.

Abstract:

**OBJECTIVE:** : To test localization of sound sources in horizontal and vertical dimensions in cochlear-implant (CI) listeners using clinical bilateral CI systems. **DESIGN:** : Five bilateral CI subjects listened via their clinical speech processors to noises filtered with subject-specific, behind-the-ear microphones and head-related transfer functions. Subjects were immersed in a visual virtual environment presented via a head-mounted display. Subjects used a manual pointer to respond to the perceived sound location and received visual response feedback via the head-mounted display during the tests. The target positions were randomly distributed in two-dimensional space over an azimuth range of 0° to 360° and over an elevation range of -30° to +80°. In experiment 1, the signal level was roved in the range of  $\pm 2.5$  dB from trial to trial. In experiment 2, the signal level was roved in the range of  $\pm 5$  dB. **RESULTS:** : CI subjects were generally worse at sound localization than normal-hearing listeners tested in a previous study, in both the horizontal and vertical dimensions. In the horizontal plane, subjects could determine the correct side and locate the target within the side at better than chance performance. In the vertical plane, with a smaller level-roving range, subjects could determine the correct hemifield at better than chance performance but could not locate the target within the correct hemifield. The target angle and response angle were correlated as expected. The response angle and signal level range were also correlated, raising concerns that subjects were using only level cues for the task. With a larger level-roving range, the number of front-back confusions increased. The correlation between the target and response angles decreased, whereas the correlation between the level and response angle did not change, which is an indication that the subjects were relying heavily on level cues. **CONCLUSIONS:** : For the horizontal plane, the results are in agreement with previous CI studies performed in the horizontal plane with a comparable range of targets. For the vertical plane, CI listeners could discriminate front from back at better than chance performance; however, there are strong indications that the broadband level, not the spectral profile, was used as the primary localization cue. This study indicates the necessity of new CI processing strategies that encode spectral localization cues.

198. Qi B, Liu B, Krenmayr A, Liu S, Gong S, Liu H, Zhang N, Han D (2011) The contribution of apical stimulation to Mandarin speech perception in users of the MED-EL COMBI 40+ cochlear implant. *Acta Otolaryngol.* 131(1):52-8.

Abstract:

**CONCLUSION:** Not stimulating the apical cochlear region in tonal language speaking cochlear implantees significantly reduces discrimination of Mandarin vowels. The data presented here suggest that electrode arrays that allow complete cochlear coverage with stimulation pulses seem to be preferable over shorter arrays for use in cochlear implant (CI) indications. **OBJECTIVE:** To assess the contribution of electrical stimulation beyond the first cochlear turn on tonal language speech perception. **METHODS:** Twelve Mandarin-speaking users of the MED-EL COMBI 40+ cochlear implant with complete insertion of the standard COMBI 40+ electrode array participated in the study. Acute speech tests were performed in seven electrode configurations with stimulation either distributed over the whole length of the cochlea or restricted to the apical, middle or basal regions. The test battery comprised tone, consonant, and vowel identification in quiet as well as a sentence recognition task in quiet and noise. **RESULTS:** While neither tone nor consonant identification depended crucially on the placement of the active electrodes, vowel identification and sentence recognition decreased significantly when the four apical electrodes were not stimulated.

199. Krenmayr A, Qi B, Liu B, Liu H, Chen X, Han D, Schatzer R, Zierhofer C (2011) Development of a Mandarin tone identification test: Sensitivity index  $d'$  as a performance measure for individual tones. *IJA*, 50(3): 155-63.

Abstract:

**Abstract Objective:** The aim of this study was to develop comprehensive test material for Mandarin tone identification in noise for a male and a female talker. Additionally, the sensitivity index  $d'$  as a measure for the listeners' performance to identify individual tones was evaluated. **Design:** The study followed a prospective design. **Study sample:** The complete material comprises 72 loudness-balanced syllables in all 4 Mandarin tones. For a selection of 20 syllables, i.e. 80 test words, performance-versus-intensity functions were measured in spectrally matched noise for 16 normal-hearing participants. **Results:** The average speech reception thresholds in

noise were -12.9 dB for the male and -13.6 dB for the female talker recordings. The corresponding slopes were 8.6%/dB and 7.3%/dB. As a performance measure for individual tones, the proportion of correct responses to specific tones was substantially contaminated by response bias. The sensitivity index  $d'$ , calculated according to detection theory, provided reasonable and unbiased performance versus intensity functions. Conclusions: The results firstly indicate that the material is homogenous enough for use as a speech test in clinical work and research. Secondly, to assess the discrimination performance for individual tones,  $d'$  values outperform the simple proportion of correct responses.

- 200. Carmel E, Kronenberg J, Wolf M, Migirov L (2011) Telephone use among cochlear implanted children. Acta Otolaryngol. 131(2): 156-9.**

Abstract:

**CONCLUSION:** Telephone use among implanted children is significantly different from that of the normally hearing population of the same age. **OBJECTIVE:** To characterize the use of telephone in cochlear implanted children and compare it to that of age-matched normal-hearing children. **METHODS:** The study (n = 26) and control (n = 27) groups each consisted of children aged 5-17 years treated at a tertiary referral center. The study group included children who received a Med-EL multichannel cochlear implant and had used it for at least 18 months. The control group comprised generally healthy children with normal hearing and no history of chronic ear disease or otologic surgery. The main outcome measures, evaluated through a questionnaire sent by mail, were comparison of telephone use and speech comprehension over the telephone between the study and control groups. **RESULTS:** The median age of the study and control groups was 9 and 7 years, respectively (p = 0.12). There was a significant difference between the two groups in the reported rate of telephone use (mean 128 and 244 min/week, respectively, p = 0.006) and speech comprehension of familiar persons and strangers, which was highly significant among teenagers. The reported sound quality was similar for the two groups.

- 201. May-Mederake B, Kuehn H, Vogel A, Keilmann A, Bohnert A, Mueller S, Witt G, Neumann K, Hey C, Stroele A, Streitberger C, Carnio S, Zorowka P, Nekham-Heis D, Esser-Leyding B, Brachmaier, Coninx F (2010) Evaluation of auditory development in infants and toddlers who received cochlear implants under the age of 24 months with the LittLEARS auditory questionnaire. IJPORL, 74(10): 1149-55.**

Abstract:

**BACKGROUND AND AIMS:** Newborn hearing screening and early intervention for congenital hearing loss have created a need for tools assessing the hearing development of very young children. A multidisciplinary evaluation of children's development is now becoming standard in clinical practice, though not many reliable diagnostic instruments exist. For this reason, the LittLEARS Auditory Questionnaire (LEAQ) was created to assess the auditory skills of a growing population of infants and toddlers who receive hearing instruments. The LEAQ relies on parent report, which has been shown to be a reliable way of assessing child development. Results with this tool in a group of children who received very early cochlear implantation are presented. **METHODS:** The LEAQ is the first module of the LittLEARS comprehensive test battery for children under the age of two who have normal hearing (NH), cochlear implants (CIs) or hearing aids (HAs). The LEAQ is a parent questionnaire comprised of 35 "yes/no" questions which can be completed by parents in less than 10 min. Sixty-three children who received unilateral CIs at a young age were assessed longitudinally and their performance was compared to that of a NH group. **RESULTS:** All CI children reached the maximum possible score on the LEAQ on average by 22 months of hearing age, i.e. 38 months of chronological age. In comparison, the NH group reached the maximum score by 24 months of age demonstrating that auditory skills of CI children often develop quicker than those of NH children. In the two comparison groups of children aged (a) younger and older than 12 months, and (b) between 6-9 and 21-24 months at first fitting, the early implanted children reached the highest scores faster than the later implanted children. Furthermore, three children with additional needs were tested. They showed slower growth over time but also received benefits from early implantation. **CONCLUSIONS:** The LEAQ is a quick and effective tool for assessing auditory skills of very young children with or without hearing loss. In our study, the auditory skills of children with CI progressed very quickly after implantation and were comparable with those of NH peers.

- 202. Mantokoudis G, Kompis M, Vischer M, Häusler R, Caversaccio M, Senn P (2010) In-the-canal versus behind-the-ear microphones improve spatial discrimination on the side of the head in bilateral cochlear implant users. Otol & Neurotol, 32: 1-6.**

Abstract:

**OBJECTIVE:** To test whether in-the-canal (ITC) microphones have an impact on spatial discrimination and speech perception by taking advantage of auricular cues. **STUDY DESIGN:** Experimental clinical study. **SETTING:** Audiologic laboratory in a tertiary referral center. **PATIENTS:** Seven bilateral adult cochlear implant (CI) users were selected from the institution's database. **INTERVENTION:** The adaptive German Oldenburg sentence test and minimum audible angle measurements were performed binaurally with experimental ITC and behind-the-ear (BTE) microphones.

**MAIN OUTCOME MEASURES:** Spatial discrimination and speech perception scores assessed for each microphone position. **RESULTS:** Spatial discrimination on the side of the head was superior using ITC compared with BTE microphone positions; the differences on the side of the first CI were statistically significant (mean minimum audible angle  $\pm$  standard deviation,  $28.4 \pm 7.61$  degrees versus  $34.1 \pm 14.4$  degrees;  $p = 0.031$ ). Speech perception scores with ITC versus BTE microphone positions also were improved, although the differences were not statistically significant. **CONCLUSION:** ITC microphones could help to improve CI performance in the future.

- 203. Magnusson L (2010) Comparison of the fine structure processing (FSP) strategy and the CIS strategy used in the MED-EL cochlear implant system: Speech intelligibility and music sound quality. IJA, 50(4): 279-87.**

Abstract:

**Abstract Objective:** The aim of the present study was to evaluate MED-EL's Fine Structure Processing (FSP) strategy in comparison with their variations of the standard Continuous Interleaved Sampling (CIS) strategy denoted CIS+ and High Definition CIS (HDCIS). **Study Sample:** Twenty experienced adult CI users participated in the study in connection with upgrading to a new speech processor and at a two-year follow-up. **Design:** Blinded paired-comparisons between FSP and HDCIS were performed for speech intelligibility and music sound quality. Standard speech recognition tests in quiet and in noise were also accomplished to monitor the participants' actual performance and to evaluate long-term outcomes. **Results:** Overall, the paired-comparison results showed no significant differences between the strategies, however, the total numbers of significant individual preferences were: 11 FSP vs. 12 HDCIS for speech, and 4 FSP vs. 15 HDCIS for music. The average speech recognition score decreased significantly after one month with FSP, but after two years there were no significant difference compared to the initial results with CIS+. **Conclusions:** Owing to the large individual differences in subjective preference, and the fact that the FSP strategy was not superior to the CIS variations, the recipients should be given the opportunity of choosing between the strategies.

- 204. Schramm B, Bohnert A, Keilmann A (2010) Auditory, speech and language development in young children with cochlear implants compared with children with normal hearing. IJPORL, 74(7): 812-9.**

Abstract:

**OBJECTIVE:** This study had two aims: (1) to document the auditory and lexical development of children who are deaf and received the first cochlear implant (CI) by the age of 16 months and the second CI by the age of 31 months and (2) to compare these children's results with those of children with normal hearing (NH). **METHODS:** This longitudinal study included five children with NH and five with sensorineural deafness. All children of the second group were observed for 36 months after the first fitting of the device (cochlear implant). The auditory development of the CI group was documented every 3 months up to the age of two years in hearing age and chronological age and for the NH group in chronological age. The language development of each NH child was assessed at 12, 18, 24 and 36 months of chronological age. Children with CIs were examined at the same age intervals at chronological and hearing age. **RESULTS:** In both groups, children showed individual patterns of auditory and language development. The children with CIs developed differently in the amount of receptive and expressive vocabulary compared with the NH control group. Three children in the CI group needed almost 6 months to make gains in speech development that were consistent with what would be expected for their chronological age. Overall, the receptive and expressive development in all children of the implanted group increased with their hearing age. **CONCLUSION:** These results indicate that early identification and early implantation is advisable to give children with sensorineural hearing loss a realistic chance to develop satisfactory expressive and receptive vocabulary and also to develop stable phonological, morphological and syntactical skills

for school life. On the basis of these longitudinal data, we will be able to develop new diagnostic tools that enable clinicians to assess child's progress in hearing and speech development.

**205. Podskarbi-Fayette R, Pilka A, Skarzynski H (2010) Electric stimulation complements functional residual hearing in partial deafness. *Acta Otolaryngol*, 130(8): 888-96.**

Abstract:

CONCLUSION: Candidates for hearing preservation cochlear implant (CI) surgery can be divided into: those who benefit from electrical complement (EC) to remaining hearing and don't require additional amplification, those using a combined electric-acoustic stimulation (EAS) and those with the least amount of residual hearing who benefit from electric-only stimulation (ES) provided via medium length electrode. OBJECTIVES: Patients with a borderline level of residual hearing may benefit from a hybrid electric stimulation and acoustic amplification (EAS) after a cochlear implantation procedure aimed at hearing preservation. However, there is another group of individuals who possess substantial low-frequency residual hearing that is still functional. These partially deaf patients present a 'cliff-like' audiogram and have difficulty in comfortable listening, especially in noisy conditions and are deprived of the full enjoyment of music. METHODS: Eleven adults and seven children were implanted via round window with insertion depth intentionally limited to 18-22 mm. None of them could benefit from hearing aids before surgery and they were considered for EC to their residual hearing. RESULTS: Pure tone audiograms and discrimination scores show benefit from either EC to conserved natural acoustic hearing or EAS. One patient with a loss of functional residual hearing benefited from electrical stimulation (ES) and a standard CI coding strategy.

**206. Proceedings of the 9<sup>th</sup> European symposium on paediatric cochlear implantation, Warsaw, Poland 2009 (2010), *Cochl Imp Int*, 11 (suppl 1).**

- 206.1. Skarzynski H, Lorens A. Partial deafness treatment, pp 29-41.
- 206.2. Wilson BS. Partial deafness cochlear implantation (PDCI) and electric-acoustic stimulation, pp 56-66.
- 206.3. Lorens A, Zgoda M, Waskiewicz B, Lutek A, Skarzynski H. Preliminary results of Duet to Duet 2 upgrade, pp 75-8.
- 206.4. Skarzynski H, Lorens A, Kochanek K, Mrowka M. Bilateral auditory brainstem implantation in a patient with Neurofibromatosis Type II, pp 88-93.
- 206.5. Polak M, Lorens A, Helbig S, McDonald S, McLaren S, Vermeire K. Fitting of the hearing system affects partial deafness cochlear implant performance, pp 117-21.
- 206.6. Seldran F, Thai-Van H, Truy E, Berger-Vachin C, Collet L, Gallego S, Beliaeff M. Simulation of an EAS implant with a hybrid vocoder, pp 125-9.
- 206.7. Seldran F, Thai-Van H, Truy E, Berger-Vachin C, Collet L, Gallego S, Beliaeff M. A filtered speech test to better evaluate electric acoustic stimulation (EAS) candidacy, pp 130-33.
- 206.8. Brachmaier J, Schramm B. Parent observation – An effective assessment method for early speech and language development? pp 259-63.
- 206.9. Obrycka A, Pankowska A, Lorens A, Skarzynski H, Padilla JL. Translation of the LittIEARS questionnaire into Polish, pp 340-5.
- 206.10. Obrycka A, Pankowska A, Lorens A, Skarzynski H, Padilla JL. Validation of results of the Polish version of the LittIEARS questionnaire, pp 346-50.
- 206.11. Schramm B, Keilmann A, Brachmaier. Canonical babbling and early hearing and language development of normal hearing children and children with cochlear implants, pp 375-8.
- 206.12. Vrolix Y, Pans R, De Raeve L, Spaai G, De Gooijer K, Bammens M, Croux W, Tuyls L. Supporting young deaf children with cochlear implants and their families: Suggestions and tips for parents and professionals, pp 390-4.
- 206.13. Ibrahim HN, Truy E, Bossard D, Hessler R, Jolly C. Disposable drug delivery catheter for use in cochlear implantation; Radiological study in cadaver temporal bones, pp 431-33.

- 206.14.** Ibrahim HN, Truy E, Helbig S, Jolly C. Combined insertion of intracochlear catheter and electrode array: Evaluation of surgical trauma in cadaver temporal bones (a histological study), pp 434-6.
- 206.15.** Kompis M, Senn P, Schmid C, von Guntern B, Vischer M, Seifert E, Häusler R, Caversaccio M. Improvement in speech understanding and user satisfaction after upgrading from the Medel Tempo+ to the Opus 2 speech processor, pp 437-41.
- 206.16.** Lorens A, Zgoda M, Skarzynski H. Speech perception and subjective benefit in paediatric C40+ users after the upgrade to fine structure processing (FSP), pp 444-8.
- 206.17.** Walkowiak A, Lorens A, Kostek B, Skarzynski H. ESRT; ART and MCL correlations in experienced paediatric cochlear implant users, pp 482-84.
- 206.18.** Wsaowski A, Lorens A, Obrycka A, Walkowiak A, Wozniak A, Skarzynski H. Influence of non-optimal levels of electrical stimulation in cochlear implantees on hearing benefits, pp 485-8.
- 207. Kosaner J (2010) Generating speech processor programmes for children using ESRT measurements. Cochlear Implant Int, 11(suppl 2): 20-4.**

Abstract:

To optimize outcomes of early implantation accurate speech processor programmes need to be provided quickly. This usually necessitates use of objective measures. One objective method is to use electrically elicited stapedius reflex thresholds (ESRTs) to set maximum comfort level (MCL). This paper aims to outline the procedure for generating programmes from ESRT measures and demonstrate the feasibility of this fitting method through outlining a number of studies evaluating incidence and stability of ESRTs and children's acceptance of, and performance with, ESRT generated programmes. The straightforwardness of this procedure, high incidence and stability of ESRTs, ready acceptance of and satisfactory performance with ESRT generated speech processor programmes indicate this fitting technique can be used extensively with children.

- 208. Schatzer R, Krenmayr A, Au DKK Kals M, Zierhofer C (2010) Temporal fine structure in cochlear implants: Preliminary speech perception results in Cantonese-speaking implant users. Acta Otolaryngol, 130(9): 1031-9.**

Abstract:

**CONCLUSION:** Acute comparisons between continuous interleaved sampling (CIS) and a temporal fine structure (TFS) coding strategy in Cantonese-speaking cochlear implant (CI) users did not reveal any significant differences in speech perception. Performance with the unfamiliar TFS coding strategy was on a par with CIS. Benefits of extended fine structure use observed in other studies should be investigated for tonal languages. **OBJECTIVES:** CIS-based stimulation strategies lack an explicit representation of fine structure, which is crucial for tonal language speech perception. The aim of this study was to assess speech recognition with a TFS coding strategy in Cantonese-speaking CI users with no prior fine structure experience. **METHODS:** The fine structure coding strategy encodes TFS on a few apical channels, while the remaining more basal channels carry CIS stimuli. Twelve MED-EL implantees and long-term CIS users participated in a study comparing recognition for Cantonese lexical tones and CHINT sentences between CIS and fine structure stimulation. **RESULTS:** Mean tone identification scores in 12 subjects were 59.2% with CIS and 59.2% with fine structure stimulation using 4 TFS channels, mean scores of CHINT sentences in 8 subjects were 54.2% with CIS and 55.9% with TFS stimulation. Differences between the two strategies were not significant for any speech test. Two additional versions of TFS strategy and pulse rates were tested in six subjects. No significant differences between strategies were found.

- 209. Walker A, Mawman D, Brough J, O'Driscoll M, Ramsden R, Green K, Freeman S (2010) Preliminary results of electric and acoustic stimulation using the MED-EL Sonata Flex EAS electrode array. Cochlear Implant Int, 11(suppl 2): 64-8.**

Abstract:

Electric Acoustic Stimulation is the combination of acoustic stimulation (via a hearing aid) and electric stimulation (via a cochlear implant) in the implanted ear. This paper summarises the preliminary speech perception scores and hearing preservation in adult patients (n=9) implanted with the Sonata FlexEAS electrode array. Subjects were adult candidates who met the national guidelines for cochlear implantation yet had some usable low frequency

hearing. The surgical procedure aimed to preserve this residual hearing in the ear to be implanted. Patients retaining this usable hearing post operatively were issued with the DUET speech processor which provides a combination of acoustic and electric stimulation. Patients whose residual hearing was not preserved used the OPUS 2 processor in conjunction with the FlexEAS electrode array. The aim of the study was to investigate the speech perception scores of these two patient groups in comparison to patients using the standard Sonata Flex Soft electrode array. We aim to analyse whether patients whose residual hearing was not preserved perform as well as those for whom hearing preservation was not attempted. Results show that hearing preservation is possible in this patient group and the outcomes in terms of aided speech discrimination are potentially excellent. Therefore, it may be prudent to review the criteria for implant candidature in this patient group in the future.

- 210. Jolly C, Mueller J, Helbig S, Usami S (2010) New trends with cochlear implants. Otol Jpn 20(3): 239-46.**

**New trends with cochlear implant electrodes**

Abstract:

Depending on the etiology of sensory neural hearing loss and patient age, it is postulated that a significant number of cochlear implant candidates today have a rich neural substrate consisting of nondegenerated dendrites and a large number of spiral ganglion cells with associated axons. In addition, many patients have some residual hearing especially in the low frequencies, demonstrating neural survival in the apical regions. With long electrodes covering the scala tympani from base to apex, it has become feasible to improve tonotopic stimulation. Key to the long-term success of implantation is preservation of intracochlear structures during electrode insertion. Round window membrane insertion combined with free-fitting lateral wall electrode placement tends to preserve residual hearing. New coding strategies providing fine structure information in the apex can enhance patient performance. Delicate intracochlear tissues must also be preserved during the multiple explantations and reimplantations that young patients face during their 80+ year life span, otherwise some benefits will be lost over time.

- 211. Helms J, Moser L (2010) Qualität des Hörens under der Kommunikation mit unterschiedlichen Cochlea-Implantaten (Hearing quality with different cochlear implants). Laryngo-Rhino-Otol, 89(11): 660-1.**

Article in German

Abstract:

The rehabilitation of completely or profoundly deaf patients with a cochlear implant shows different results in their ability to communicate. These differences are certainly based upon the different kind and degree of the disease or damage leading to the loss of hearing. But as CI-systems are also different, an attempt was made to find out the CI-system offering the best chance for an optimal communication ability. Anonymously answered questionnaires of 45 and 193 patients in 2 series were statistically analysed. In both the 95% intervals of confidence for numbers of patients with 2 different CIs who could mainly communicate without additional optical or electronic help did not overlap. For Nucleus 62% and for MED-EL 83% of patients obtained a mainly free communication ability. The difference was statistically significant.

- 212. Vermeire K, Kleine Punte A, Van de Heyning P (2010) Better speech recognition in noise with the fine structure processing coding strategy. ORL, 72: 305-11.**

Abstract:

BACKGROUND: Recently, a new speech coding strategy named 'fine structure processing' (FSP) has been launched. METHODS: 32 subjects, all users of the MED-EL PULSARCI(100) system, have been switched over from a TEMPO+ to an OPUS 2 speech processor. In 22 subjects, the FSP strategy could be implemented (FSP group), in 10 patients not (high-definition continuous interleaved sampling, HDCIS, group). Subjects were tested with the Tempo+ (CIS+) just before switch-over and after 12 months of OPUS 2 (FSP/HDCIS) use. Performance with FSP/HDCIS was tested at switch-over, and after 1, 3, 6 and 12 months. A sentence-in-noise test and a Speech Spatial and Qualities of Hearing Scale (SSQ) questionnaire were assessed at each test interval. RESULTS: In the FSP group, the speech reception threshold shows a deterioration of 3.3 dB (n.s.) at the acute switch-over interval, but a significant improvement over time ( $p < 0.001$ ) with a final benefit of 6.5 dB after 12 months of FSP use. A significant improvement over time can also be seen on the spatial subscore of the SSQ questionnaire ( $p = 0.009$ ). No significant differences could be seen in the HDCIS group. CONCLUSION: The results show that by enhancing fine structure coding in the lower frequencies, as implemented in the FSP coding strategy, speech perception in noise can be enhanced.

- 213. Brough J, Walker A, Mawman D (2010) Speech discrimination scores using the latest generation of speech processors. *Cochl Impl Int*, 11(Suppl 2):119-24.**

Abstract:

The Manchester Cochlear Implant Programme was established in 1988 and over 1000 patients have been implanted to date. Developments and improvements in cochlear implant technology over the past 21 years have resulted in new generations of implants and speech processors becoming available for use with patients. Since 2004, our patients have been asked to choose a device, based on their own preferences. This study looks at the speech discrimination scores of adults fitted with the latest generation of speech processors, including the Freedom (n=40), the Harmony (n=3) and the Opus 2 (n=7). These scores are also compared to those of patients using earlier generations of speech processors, including the Esprit 3G (n=89), the Auria (n=9) and the Tempo+ (n=38). Speech discrimination assessments (CUNY sentences, BKB sentences (in quiet and in noise) and AB words) were undertaken at the following intervals: 1 week, 3 months, 9 months and 21 months post switch-on. Patients were grouped according to their speech processor type and speech discrimination scores compared across the 6 groups. Our findings show that patients using the newer generation of speech processors tend to have higher speech discrimination scores than those using older generations of processor.

- 214. Haumann S, Lenarz T, Büchner A (2010) Speech perception with cochlear implants as measured using a roving-level adaptive test method. *ORL*, 72: 312-8.**

Abstract:

**AIMS:** This paper uses a new method of speech testing where the hearing aid or cochlear implant (CI) users are tested in a more realistic listening situation. **METHODS:** Groups of 11 subjects matched for performance with 5 different CI systems, for a total of 55 subjects, were tested with an adaptive test regime where the presentation level of the speech signal roved by  $\pm 10$  or  $\pm 15$  dB. **RESULTS:** Speech reception thresholds varied widely between -4.8 and 17.3 dB with the  $\pm 15$  dB roving condition being more difficult than the  $\pm 10$  dB roving condition. We also found significant differences in speech reception threshold between groups using different devices. **CONCLUSION:** The test method used in our study, which attempts to test CI users in a more realistic listening situation, is sensitive to the effects of various subject-specific and technical parameters on everyday speech perception with CIs.

- 215. Lorens A, Zgoda M, Obryca A, Skarzynski H (2010) Fine structure processing improves speech perception as well as objective and subjective benefits in pediatric MED-EL COMBI 40+ users. *IJPORL*, 74(12): 1372-8.**

Abstract:

**OBJECTIVES:** Presently, there are only few studies examining the benefits of fine structure information in coding strategies. Against this background, this study aims to assess the objective and subjective performance of children experienced with the C40+ cochlear implant using the CIS+ coding strategy who were upgraded to the OPUS 2 processor using FSP and HDCIS.

**METHODS:** In this prospective study, 60 children with more than 3.5 years of experience with the C40+ cochlear implant were upgraded to the OPUS 2 processor and fit and tested with HDCIS (Interval I). After 3 months of experience with HDCIS, they were fit with the FSP coding strategy (Interval II) and tested with all strategies (FSP, HDCIS, CIS+). After an additional 3-4 months, they were assessed on all three strategies and asked to choose their take-home strategy (Interval III). The children were tested using the Adaptive Auditory Speech Test which measures speech reception threshold (SRT) in quiet and noise at each test interval. The children were also asked to rate on a Visual Analogue Scale their satisfaction and coding strategy preference when listening to speech and a pop song. However, since not all tests could be performed at one single visit, some children were not able complete all tests at all intervals.

**RESULTS:** At the study endpoint, speech in quiet showed a significant difference in SRT of 1.0 dB between FSP and HDCIS, with FSP performing better. FSP proved a better strategy compared with CIS+, showing lower SRT results of 5.2 dB. Speech in noise tests showed FSP to be significantly better than CIS+ by 0.7 dB, and HDCIS to be significantly better than CIS+ by 0.8 dB. Both satisfaction and coding strategy preference ratings also revealed that FSP and HDCIS strategies were better than CIS+ strategy when listening to speech and music. FSP was better than HDCIS when listening to speech.

CONCLUSIONS: This study demonstrates that long-term pediatric users of the COMBI 40+ are able to upgrade to a newer processor and coding strategy without compromising their listening performance and even improving their performance with FSP after a short time of experience.

- 216. Skarzynski H, Lorens A, Piotrowska A, Skarzynski PH (2010) Hearing preservation in partial deafness treatment. *Med Sci Monit*, 16(11): CR555-62.**

Abstract:

BACKGROUND: Partial deafness (PD) is a condition in which hearing loss occurs in at least 1 frequency critical to speech understanding. Current options for partial deafness treatment (PDT) rely on preoperative hearing preservation, which, along with the use of different means of acoustic and electric stimulation, enable extending the indications for various assistive hearing devices. Possible solutions include acoustic methods only, the use of hearing aids or middle ear implants, electric complementation, and a combination of electric and acoustic stimulation. MATERIAL/METHODS: A total of 95 patients (63 adults, 32 children) with different types of PD were treated using selected types of electrodes and the optimal "round window" approach to the inner ear, with at least 36 months of observation. RESULTS: The extension of PDT indications created an opportunity for patients with different hearing impairments who obtained no benefit from a hearing aid and did not qualify for standard cochlear implant application. The authors' observations are based on the findings that preservation of preoperative hearing had been achieved in 97.1% of adult patients (8 years' observation) and in 100% of children (6 years' observation). Those results send the important message that PDT is feasible and effective. CONCLUSIONS: To allow comparison of PDT results from different studies, the authors developed the Skarzynski PDT classification system, which permits the comparison of postoperative results, including the degree of hearing preservation and, more importantly, the patient's understanding of speech after treatment.

- 217. Boyd PJ (2010) Evaluation of simplified programs using the MED-EL C40+ cochlear implant. *IJA*, 49(7): 527-34.**

Abstract:

The present study evaluated the benefit possible from a cochlear implant (CI) using a simplified map (with a set of default parameters), rather than the conventional approach of producing a 'customized map' from electrode-specific psychophysical measures. Young children are sometimes initially provided with such maps and the aim was to gain an insight into what level of benefit they might provide. Maps with upper stimulation levels set equally across the array (i.e. 'flat' maps) were compared with normal 'customized' maps in established adult users of the MED-EL C40+ device. Speech discrimination was significantly poorer for the flat maps overall (mean of 72.7% for customized map, and 60.5% for flat map) and loudness balance estimates showed a range of degrees of imbalance. These results suggest that flat maps may provide paediatric CI users with useful levels of performance when psychophysical or objective measures cannot be obtained. The poorer performance with the flat map suggests that customized maps should be fit as soon as possible to provide paediatric patients with the maximum benefit of the CI device.

- 218. Plant G, Ge Y (2010) Production of Mandarin tone by adults and children with normal hearing: Significance for children with cochlear implants. *Cochl Impl Int*, 11(4): 185-202**

Abstract:

Mandarin Chinese is a tone language in which pitch variations are used to change the meanings of words. This study focused on the production of the four tones of Mandarin by adults and eight-year-old children with normal hearing, who spoke Mandarin as their first language. All speakers were recorded producing the tones in the syllable [ma]. Analysis of the speakers' productions of the four tones in [ma] showed that all of the children were able to produce the appropriate tonal contrasts. Some differences between the children and adult speakers were found in the duration of the tones. These data represent a benchmark against which the speech of children with implants can be compared.

- 219. Kleine Punte A, Vermeire K, Van de Heyning P (2010) Bilateral electric acoustic stimulation: A comparison of partial and deep cochlear electrode insertion. *Adv Otorhinolaryngol*, 67: 144-52.**

Abstract:

**BACKGROUND/AIMS:** A patient with bilateral severe, sloping, high-frequency hearing loss was treated with sequential bilateral electric acoustic stimulation (EAS) using the MED-EL Duet EAS cochlear implant. On one side, a partial 18-mm insertion of the electrode array (M-type) in the cochlea was performed. The contralateral side was implanted 39 months later with a deep 30-mm insertion of the electrode array (FLEX(soft) type). The aims were to assess whether low-frequency hearing could be preserved after deep electrode insertion, as well as to assess the benefit of bilateral EAS surgery compared to monaural EAS. **METHODS:** Hearing thresholds and speech recognition outcomes were measured preoperatively and up to 48 months postoperatively. Outcomes from the partial and deep insertion side are compared. The benefit of EAS in daily life was assessed with the Abbreviated Profile of Hearing Aid Benefit questionnaire. Benefits of bilateral EAS were calculated from speech reception thresholds measured using the LINT speech-in-noise number test. Speech was always presented from the front. Noise was either presented from the front, from the left side, or from the right side. Each condition was measured for unilateral and bilateral EAS use. **RESULTS:** Partial as well as deep insertion of the electrode array resulted in hearing preservation and significant speech recognition in this particular case. Both EAS devices provided more than 80% speech recognition in noise at a 10-dB signal-to-noise ratio. Bilateral EAS was beneficial for speech reception in noise compared to monaural EAS. A head shadow effect of 3.4 dB, binaural squelch effect of 1.2 dB and binaural summation effect of 0.5 dB were measured. **CONCLUSION:** Hearing preservation is also possible after cochlear implantation using a FLEX(soft) electrode array with a near-full insertion (30 mm) into the cochlea. Bilateral EAS was successfully implemented in this patient providing better speech recognition compared to monaural EAS.

**220. Skarzynski H, Lorens A (2010) Electric acoustic stimulation in children. Adv Otorhinolaryngol, 67: 135-43.**

Abstract:

**BACKGROUND/AIMS:** The combined electric acoustic stimulation (EAS) of one ear is a topic that has received considerable attention over the last 10 years, the technique having originally been introduced by Prof. Christoph A. von Ilberg for so-called borderline adult cochlear implant (CI) candidates. Its development has followed several parallel strands, including the modification of existing surgical approaches and the use of different CI devices (including new designs of electrode), as well as having been applied to various different groups of patients. The aim of the study described herein was to investigate the application of EAS in children with partial deafness (PD). **METHODS:** In 2002, we performed the first implantation of an adult patient with PD, in which we pioneered the technique of partial deafness cochlear implantation (PDCI). Encouraged by the outstanding results achieved by the application of EAS in adults, we have extended its application to children who have a significant amount of residual hearing in the ear selected for implantation. Between September 2004 and December 2007, 15 children with PD and 10 platinum hearing aid users were implanted with either a COMBI 40+ or a PULSAR, using the 'round window' technique to increase the probability of hearing preservation. **RESULTS:** Monosyllabic word recognition increased over a 12-month period in the platinum group, from 31 to 60% under quiet conditions and from 1 to 19% under noisy conditions. In the PDCI group, the commensurate increase was from 34 to 67% under quiet conditions and from 7 to 47% under noisy conditions. **CONCLUSION:** The application of EAS in children gives them the ability to understand speech, hence allowing the child's overall communication skills to be improved by increasing their efficiency and effectiveness.

**221. Arnoldner C, Helbig S, Wagenblast J, Baumgartner WD, Hamzavi JS, Riss D, Gstoettner W (2010) Electric acoustic stimulation in patients with postlingual severe high-frequency hearing loss: Clinical experience. Adv Otorhinolaryngol, 67: 116-24.**

Abstract:

**BACKGROUND/AIMS:** The aim of this study was to describe audiological outcomes and surgical considerations in electric acoustic stimulation for patients with severe to profound high-frequency hearing loss. **METHODS:** In this latest series of patients in our center, all patients were supplied with the new (atraumatic) Flex EAS MED-EL electrode. Eleven patients (age 7.62-71.32 years) with profound high-frequency hearing loss were implanted with this electrode, which was designed to preserve residual hearing despite the intracochlear insertion of an electrode array. All patients were operated on by the same surgeon (W.G.). **RESULTS:** The rate of complete or partial hearing preservation was 100% after a mean follow-up period of 7.85 months (range 0.95-15.65 months). **CONCLUSION:** This study proves that both refined surgical techniques and atraumatic electrodes are mandatory to preserve residual hearing after cochlear implantation. Flexible, thin, and free-fitting straight electrodes, such as

the MED-EL Flex EAS electrode used in this study, seem to most accurately meet the requirements for hearing preservation in electric acoustic stimulation.

- 222. Nopp P, Polak M (2010) From electric acoustic stimulation to improved sound coding in cochlear implants. *Adv Otorhinolaryngol*, 67: 88-95.**

Abstract:

Research into electric acoustic stimulation (EAS) indicates that performance improves when acoustic stimulation is added to electric stimulation in subjects with residual low-frequency acoustic hearing. Research further indicates that information from the voice fundamental frequency (F(0)) region accounts for the majority of the added speech perception benefit with EAS. This implies that improved frequency coding in the low frequencies could hold great potential for improving performance with cochlear implants (CIs). Results with new speech coding strategies such as fine structure processing indeed indicate that with improved low-frequency coding, at least some of the benefits of EAS can be translated to regular CI users.

- 223. Helbig S, Baumann U (2010) Acceptance and fitting of the DUET device – A combined speech processor for electric acoustic stimulation. *Adv Otorhinolaryngol*, 67: 81-7.**

Abstract:

BACKGROUND/AIMS: Subjects with sufficient residual low-frequency hearing after cochlear implantation can benefit from electric acoustic stimulation (EAS). A combined speech processor (MED-EL DUET), which incorporates a hearing aid and a speech processor in one device, was designed especially for this group of patients. The present report evaluates the influence of postoperative pure tone audiometric results on personal acceptance of the DUET system in EAS users. METHOD: Fifteen subjects underwent cochlear implantation for EAS and hearing preservation was achieved at least partially. All were fitted with the DUET EAS hearing system. Personal acceptance (measured by whether or not they were using the DUET system) in combination with audiometric results were investigated over time. RESULTS: The combined processor was accepted by the majority of the subjects. However, those who had initial or further loss of residual hearing of more than 55 dB at 125 Hz or more than 70 dB at 250 Hz and 98 dB at 500 Hz rejected the DUET device. CONCLUSION: The combined processor enables subjects with sufficient hearing preservation in the low-frequency range up to 500 Hz to benefit from EAS. Acceptance is dependent on the pure tone audiometric outcomes after surgery and can vary with hearing loss progression.

- 224. Brockmeier SJ, Peterreins M, Lorens A, Vermeire K, Helbig S, Anderson I, Skarzynski H, Van de Heyning P, Gstoettner W, Kiefer J (2010) Music perception in electric acoustic stimulation users as assessed by the Mu.S.I.C. Test. *Adv Otorhinolaryngol*, 67: 70-80.**

Abstract:

AIMS: This study compared the music perception abilities of 13 electric acoustic stimulation (EAS) users with two control groups: unilateral cochlear implant (CI) users and normal-hearing (NH) listeners. METHODS: Groups were matched according to age and musical experience before hearing loss (HL) and tested using the Musical Sounds in Cochlear Implants (Mu.S.I.C.) test. RESULTS: No difference was found on rhythm perception, chord discrimination, dissonance rating, and emotion rating subtest performance between groups. Mean frequency discrimination scores were significantly better in EAS participants than in CI participants and not significantly worse than in NH participants. However, the EAS and CI groups scored similarly (significantly worse than NH participants) on both instrument detection and identification. Results for EAS participants were not significantly worse when the hearing aid component was removed. Frequency of listening to music before HL was negatively correlated with EAS participants' frequency discrimination scores, though singing and playing an instrument appeared to have no effect. EAS participants who indicated many reasons for listening to music and who listen to many genres after implantation scored higher on instrument detection and instrument identification. Better results on these two subtests were correlated with EAS participants' better postoperative auditory thresholds at 250 and 500 Hz. CONCLUSIONS: Though EAS participants performed better on music perception testing (though not timbre-based tasks) than CI participants, their scores did not reach the level of NH participants. This indicates that acoustic hearing in the low frequencies is helpful for music perception, though not the only important factor.

- 225. Jolly C, Garnham C, Mirzadeh H, Truy E, Martini A, Kiefer J, Braun S (2010) Electrode features for hearing preservation and drug delivery strategies. *Adv Otorhinolaryngol*, 67: 28-42.**

Abstract:

BACKGROUND/AIMS: Reducing the risk of hearing loss after cochlear implantation requires optimization of the electrode array to minimize the physical trauma caused by insertion and placement. Furthermore, the electrode design must be optimized for atraumatic surgical approaches. Even greater levels of protection may be achieved by the use of a drug during and after implantation. The electrode array offers a potential vehicle for drug delivery. METHODS: This article reviews the laboratory and clinical data available thus far relating to the importance of electrode design parameters for trauma minimization, and the possibility of further reduction through pharmaceutical intervention. Candidate drugs were identified through literature review and laboratory evaluation. The most promising have been investigated in vitro and in animal models of implantation trauma. Three delivery devices are currently under development to satisfy the specific demands of different therapy regimes. The delivery profiles of each were evaluated through both modelling and bench testing and the concepts investigated in vitro and in vivo. RESULTS: Current evidence favours a thin, flexible electrode array with wires in a zigzag shape. Steroids and an apoptosis inhibitor (AM111) performed well in animal models of electrode trauma and are both good drug candidates for reduction of the risk of hearing loss after implantation. Semi-chronic dexamethasone elution, acute drug delivery by intracochlear catheter, and longer-term delivery through diffusion from a reservoir were all shown to be feasible. CONCLUSION: An extensive programme focussed on minimizing hearing loss through device optimization and the development of new technologies has yielded positive results and new concepts for further development and clinical application.

- 226. Prentiss S, Sykes K, Staecker H (2010) Partial deafness cochlear implantation at the University of Kansas: Techniques and Outcomes. *J Am Acad Audiol*, 21: 197-203.**

Abstract:

Background: One of the most significant recent advances in cochlear implantation is the implantation of patients with residual hearing. These patients have a downsloping sensorineural hearing loss with poor speech discrimination and perform poorly with standard amplification. Studies using a variety of different electrode designs have demonstrated that it is possible to implant an inner ear and preserve residual hearing. Initial studies have demonstrated that a combination of residual acoustic hearing in the low frequencies with electrical stimulation in the mid- to high frequencies resulted in superior hearing performance in background noise. Purpose: The objective of this study was to determine the effect of electrode insertion depth on hearing preservation. Study Sample: Eighteen patients with mild to severe hearing loss in the low frequencies combined with poor word recognition were recruited for the study. Intervention: Cochlear implantation. Data Collection and Analysis: Pre- and postoperative hearing test, Hearing in Noise Test, and consonant-nucleus-consonant testing. Data analysis was performed with Kruskal Wallis and Mann-Whitney testing. Results: In our study of 18 patients implanted with a Med-El PulsarCI100 we demonstrated the ability to preserve residual hearing with implant insertion depths ranging from 20 to 28 mm, giving us the possibility of near complete cochlear frequency coverage with an implant array while preserving residual hearing. These patients performed well both in quiet and in 10 dB signal-to-noise ratio conditions. Conclusion: Hearing preservation was achievable even with deep implant insertion. Patients performed well in combined acoustic and electric conditions.

- 227. Staecker H, Jolly C, Garnham C (2010) Cochlear implant: an opportunity for drug development. *Drug Discovery Today*, 15(7-8): 314-21.**

Abstract:

For many years, the fields of inner ear pharmacology and hearing devices have progressed in parallel with limited interaction. Recently, there has been a considerable advancement in our understanding of the inner ear and its pathologies. Cochlear implantation is now being adapted for patients with considerable residual hearing but minimal benefit from hearing aids. A major consequence is the recognition that devices can be implanted into the partially deaf inner ear with minimal loss of hearing. This opens the door to the concept of local drug treatment of the inner ear using implantable devices. The evolution of cochlear implantation thus presents us with an opportunity to develop a range of local pharmacologic interventions to prevent hearing degeneration.

- 228. Sprinzi G, Riechelmann H (2010) Current trends in treating hearing loss in elderly people; A review of the technology and treatment options – A mini review. Gerontology, 56(3): 351-8.**

Abstract:

BACKGROUND: According to the World Health Organization (WHO), by 2025 there will be approximately 1.2 billion people in the world over the age of 60, which marks a shift in world population to a greater proportion of older people. An estimated 70-80% of adults between 65 and 75 years of age suffer from presbycusis, or age-related, bilateral sensorineural hearing loss (HL) in the high frequencies. Presbycusis is correlated with decreased quality of life (QoL) and depression and according to WHO, is a leading cause of years lived with disability in the adult years. OBJECTIVE: The purpose of the current study was to review the body of literature on treatment options and considerations for the elderly population, as there is a variety of audio-technology available today to treat presbycusis. METHODS: A PubMed literature search was conducted using the keywords 'presbycusis/presbyacusis/geriatric AND hearing aids/cochlear implants/electric acoustic stimulation/middle ear implants' and 'elderly AND cochlear implants'. References were also mined from papers found. RESULTS: 431 articles were considered in this review of treatment options for elderly patients suffering from presbycusis. CONCLUSION: Hearing aids and cochlear implants (CIs) are the most commonly used devices for treating mild-severe presbycusis. Reported outcomes with hearing aids indicate they are an effective method for treating mild-moderate HL in cases where the patient is appropriately fitted and is willing, motivated, and able to use the device. Depending on the type and severity of the HL and the specific needs of the patient, electric-acoustic stimulation and active middle ear implants may also be appropriate solutions for treating presbycusis. Finally, very positive QoL and speech perception outcomes have been documented in treating severe-profound presbycusis with CIs. In some studies, QoL outcomes have even exceeded expectations of elderly patients.

- 229. Kals M, Schatzer R, Krenmayer A, Vermeiere K, Visser D, Bader P, Neustetter C, Zangerl M, Zierhofer C (2010) Results with a cochlear implant channel-picking strategy based on “Selected Groups”. Hear Res, 260(1-2): 63-9.**

Abstract:

A novel channel-picking strategy for cochlear implants (CIs) which considers the spatial distribution and the spectral relevance of the channels selected for stimulation is described. In the proposed strategy, the available channels are subdivided into groups, designated as "Selected Groups" (SG), and within each group, a specified number of active channels with the largest amplitudes are selected for stimulation. The hypothesis is that most of the spectral information that can be perceived by CI listeners is conveyed by taking the highest filter band outputs within a stimulation area represented by a group of neighboring channels. Two experiments were conducted in subjects with MED-EL implant systems, measuring recognition of sentences in speech-shaped noise. In experiment 1, the SG group size was varied from two to four while selecting one active channel per group and keeping the pulse phase durations constant. Results showed no significant difference in sentence recognition between continuous interleaved sampling and SG configurations up to a group size of three. In experiment 2, phase durations were doubled, using groups of two channels with one active channel each. This resulted in a reduction of pulse amplitudes by about 40%. Intelligibility of sentences in noise was unaffected, making a substantial reduction of implant supply voltages feasible. In all experiments, the stimulation frame rate was kept constant in order to avoid rate-change effects.

- 230. Bahmer A, Polak M, Baumann U (2010) Recoding of electrically evoked brainstem responses after electrical stimulation with biphasic, triphasic and precision triphasic pulses. Hear Res, 259(1-2): 75-85.**

Abstract:

Biphasic electrical pulses are the standard stimulation pulses in current cochlear implants. In auditory brainstem recordings biphasic pulses generate a significant artifact that disrupts brainstem responses, which are magnitudes smaller. Triphasic pulses may minimize artifacts by restoring the neural membrane to its resting potential faster than biphasic pulses and make auditory brainstem responses detection easier. We compared biphasic pulses with triphasic and precision triphasic pulses to evoke brainstem responses in human subjects. For this purpose, electrically evoked brainstem response audiometry was performed in 10 (11 ears) cochlear implant patients. Artifacts and brainstem responses evoked by bi- and triphasic stimulation were analyzed. Artifact amplitude and decay time were related to pulse pattern shape, but application of averaging and alternation reduced the

deterioration of electrically evoked brainstem responses independent of pulse pattern shape. Contrary to our expectations, biphasic pulses showed a higher detectability in comparison to triphasic pulse stimulation at the same stimulation amplitude.

- 231. Alvarez I, de la Torre A, Sainz M, Roldán C, Schoesser H, Spitzer P (2010) Using evoked compound action potentials to assess activation of electrodes and predict C-levels in the TEMPO+ Cochlear implant speech processor. Ear Hear, 31(1): 134-45.**

Abstract:

**OBJECTIVE:** In this study, we analyze how electrically evoked compound action potential (ECAP) responses can be used to assess whether electrodes should be activated in the map and to estimate C levels in the Med-El Tempo+ Cochlear Implant Speech Processor. **DESIGN:** ECAP thresholds were measured using the ECAP Recording System of the Pulsar CI implant. Twenty-one postlingually and 28 prelingually deafened patients participated in this study. The relationship between ECAP responses and the activation of electrodes was analyzed. Because an error in the estimation of T levels (behavioral thresholds) has less effect on hearing quality than an error in the estimation of C levels in the Tempo+ cochlear implant speech processor (maximum comfort levels), correlation and regression analyses were performed between ECAP thresholds and C levels. **RESULTS:** The observation of an evoked potential generally implied that the electrode was activated because only 3.5% of electrodes that yielded measurable evoked responses were deactivated, because of collateral stimulations or an unpleasant hearing sensation. In contrast, the absence of an evoked potential did not imply that an electrode should be deactivated, because 20% of these electrodes provided a useful auditory sensation. ECAP responses did not predict the absolute behavioral comfort levels because of the excessive error between behavioral C levels and those derived from ECAP thresholds (the mean relative error is 43.78%). However, by applying a normalization procedure, ECAP measurements allowed the C-level profile to be predicted with a mean relative error of 6%; that is, they provided useful data to determine the C level of each electrode relative to the average C level of the patient. **CONCLUSIONS:** ECAP is a reliable and an useful objective measurement that can assist in the fitting of the Tempo+ cochlear implant speech processor. From results presented in this work, a protocol is proposed for fitting this cochlear implant system. This protocol facilitates appropriate cochlear implant fitting, particularly for children or uncooperative patients.

- 232. Alvarez I, de la Torre A, Sainz M, Roldán C (2010) Reducing blanking artifact in electrically evoked compound action potentials. Comput Methods Programs Biomed, 97(3): 257-63.**

Abstract:

The main source of distortion in the recording of the electrically evoked compound action potentials is the stimulus artifact. The popular hardware blanking technique tends to reduce this artifact, but generates a blanking artifact as a consequence of the transient state in the amplifier. In this paper we propose two techniques to deal with the blanking artifact. The proposed techniques are combined with conventional and generalized alternating stimulation in order to reduce both stimulus and blanking artifacts in the recording of the evoked potentials. A comparison over 126 evoked potential recordings reveals that the proposed blanking artifact reduction methods improve the quality of electrically evoked compound action potential recordings.

- 233. Sudhoff HH, Ebmeyer J, Bernel-Sprekelsen M, Hansen S, Pytel J, Fraenzer JT, Adunka OF (2010) Felsenbeinhistopathologie nach tiefer Cochlea Implantation (Temporal bone histopathology after deep cochlear implantation). Laryngo-Rhinol-Otol, 89: 95-7.**

Article in German.

Abstract:

None available.

- 234. Brill S, Müller J, Hagen R, Möltner A, Brockmeier SJ, Stark T, Helbig S, Maurer J, Zahnert T, Zierhofer C, Nopp P, Anderson I, Strahl S. (2010) Site of cochlear stimulation and its effect on electrically evoked compound action potentials using the MED-EL standard electrode array. Biomedical engineering online, 8:40.**

Abstract:

**BACKGROUND:** The standard electrode array for the MED-EL MAESTRO cochlear implant system is 31 mm in length which allows an insertion angle of approximately 720 degrees. When fully inserted, this long electrode array is capable of stimulating the most apical region of the cochlea. No investigation has explored Electrically Evoked Compound Action Potential (ECAP) recordings in this region with a large number of subjects using a commercially available cochlear implant system. The aim of this study is to determine if certain properties of ECAP recordings vary, depending on the stimulation site in the cochlea. **METHODS:** Recordings of auditory nerve responses were conducted in 67 subjects to demonstrate the feasibility of ECAP recordings using the Auditory Nerve Response Telemetry (ART) feature of the MED-EL MAESTRO system software. These recordings were then analyzed based on the site of cochlear stimulation defined as basal, middle and apical to determine if the amplitude, threshold and slope of the amplitude growth function and the refractory time differs depending on the region of stimulation. **RESULTS:** Findings show significant differences in the ECAP recordings depending on the stimulation site. Comparing the apical with the basal region, on average higher amplitudes, lower thresholds and steeper slopes of the amplitude growth function have been observed. The refractory time shows an overall dependence on cochlear region; however post-hoc tests showed no significant effect between individual regions. **CONCLUSIONS:** Obtaining ECAP recordings is also possible in the most apical region of the cochlea. However, differences can be observed depending on the region of the cochlea stimulated. Specifically, significant higher ECAP amplitude, lower thresholds and steeper amplitude growth function slopes have been observed in the apical region. These differences could be explained by the location of the stimulating electrode with respect to the neural tissue in the cochlea, a higher density, or an increased neural survival rate of neural tissue in the apex. **TRIAL REGISTRATION:** The Clinical Investigation has the Competent Authority registration number DE/CA126/AP4/3332/18/05.

- 235. Boyd P, Euthymiades (2009) Comparison of loudness adjustments by MCL and maplaw in users of the MED-EL COMBI 40/40+ cochlear implant system. Cochlear Implants Int 10(4): 198-202.**

Abstract:

The programming of a CI speech processor involves measurement of electrical threshold and 'most comfortable loudness' (MCL) levels on each electrode. However, when the derived 'map' is activated the resultant percept is often too loud or too soft. In this situation, adjustments of MCL settings are usually made in order to achieve a comfortable percept. The present study examined the range of volume control adjustments in 24 users of the MED-EL C40/40+ device. Volume control settings varied from 36% to 126% with a mean of 84.3% (SD = 20.4%). Additionally, the output compression function ('maplaw') was adjusted to test whether this alternative manipulation could result in a comfortable percept. It was found that this could be achieved satisfactorily, with maplaw values ranging from 10 to 2000. Clinical implications of these findings are discussed.

- 236. Kosaner J, Kilinc A, Aktas S, Tokay L, Kosaner M (2009) Evaluation of the LittleEARS Diary and activities to supplement the LittleEARS Diary as a basis for early parent guidance. In Proceedings of the 7<sup>th</sup> Asia Pacific Symposium on Cochlear Implants and Related Sciences, Medimond: Bologna.**

Abstract:

The aim of this study is to evaluate the usefulness of the LittleEARS® Diary and the Activities to Supplement the Diary as a basis for early guidance of parents of children with Cochlear Implants (CIs). **Methods:** Six children with CIs and their parents participated in weekly, diary based observational parent guidance sessions. The parents and therapists shared Diary information and kept records. Therapists observed themed activities of parents with their children. Questionnaires were used to collect feedback from parents and therapists. **Results:** Diary records documented child development, therapists reported development in parent-child interaction skills and both parents and therapists gave very positive feedback. **Conclusions:** Using the Diary and the Activities help in training professionals to give family centered guidance. Outcome measures show that children and parents benefited from the program. This suggests that these tools in combination with a naturalistic and observational approach in early intervention lead to positive and more standard outcomes for families.

- 237. Iverson K, McKinnon B (2009) Cochlear implantation following renal transplantation using MED-EL Pulsar. In Proceedings of the 7<sup>th</sup> Asia Pacific Symposium on Cochlear Implants and Related Sciences, Medimond: Bologna.**

Abstract:

Cochlear implantation following renal transplantation is uncommon, and presents unique challenges with the surgical management. A retrospective review in a tertiary academic medical centre identified two patients having undergone cochlear implantation with the Med-El Pulsar ci100 following renal transplantation. Preimplantation Hearing in Noise Test (HINT) scores were 0 in both patients and improved following uneventful unilateral implantations to 100% at 13 months in the first patients and 71% by 19 months in the second. This study adds to the growing evidence that in appropriately selected renal transplant patients successful cochlear implantation can be achieved with the Med-El Pulsar. Decision making should rely on surgical candidacy, as well as assessment of surgical risk in collaboration with the transplant service.

- 238. Coninx F, Weichbold V, Tsiakpini L, Autrique E, Bescond G, Tamas L, Compagnol A, Georgescu M, Koroleva I, Le Maner-Idrissi G, Liang W, Madell J, Mikic B, Obrycka A, Pamkowska A, Pascu A, Popescu R, Radulescu L, Rauhamäki T, Rouey P, Kabativa Z, Spitzer J, Thodi Ch, Varzic F, Vischer M, Wang L, Zavala JS, Brachmaier J (2009) Validation of the LittleEARS Auditory Questionnaire in children with normal hearing. IJPORL, 73(12): 1761-8.**

Abstract:

**OBJECTIVES:** With more children receiving cochlear implants during infancy, there is a need for validated assessments of pre-verbal and early verbal auditory skills. The LittleEARS Auditory Questionnaire is presented here as the first module of the LittleEARS test battery. The LittleEARS Auditory Questionnaire was developed and piloted to assess the auditory behaviour of normal hearing children and hearing impaired children who receive a cochlear implant or hearing aid prior to 24 months of age. This paper presents results from two studies: one validating the LittleEARS Auditory Questionnaire on children with normal hearing who are German speaking and a second validating the norm curves found after adaptation and administration of the questionnaire to children with normal hearing in 15 different languages. **METHODS:** Scores from a group of 218 German and Austrian children with normal hearing between 5 days and 24 months of age were used to create a norm curve. The questionnaire was adapted from the German original into English and then 15 other languages to date. Regression curves were found based on parental responses from 3309 normal hearing infants and toddlers. Curves for each language were compared to the original German validation curve. **RESULTS:** The results of the first study were a norm curve which reflects the age-dependence of auditory behaviour, reliability and homogeneity as a measure of auditory behaviour, and calculations of expected and critical values as a function of age. Results of the second study show that the regression curves found for all the adapted languages are essentially equal to the German norm curve, as no statistically significant differences were found. **CONCLUSIONS:** The LittleEARS Auditory Questionnaire is a valid, language-independent tool for assessing the early auditory behaviour of infants and toddlers with normal hearing. The results of this study suggest that the LittleEARS Auditory Questionnaire could also be very useful for documenting children's progress with their current amplification, providing evidence of the need for implantation, or highlighting the need for follow-up in other developmental areas.

- 239. Riss D, Arnoldner C, Reiß S, Baumgartner WD, Hamzavi JS (2009) 1-year results using the Opus speech processor with the fine structure speech coding strategy. Acta Otolaryngol, 129: 988-91.**

Abstract:

**Conclusion:** In contrast to the Tempo+ the new Opus speech processor stimulates with the new fine structure programming (FSP) speech coding strategy and offers an extended frequency spectrum. A significant improvement in speech perception for sentences at 10 dB SNR (signal to noise ratio) was observable. **Objectives:** The aim of this study was to investigate the long-term effects on speech perception in quiet and in noise with the Opus speech processor using FSP. **Subjects and methods:** Eight post-lingually deaf patients implanted with Pulsar cochlear implants and fitted with Tempo+ speech processors (both MED-EL) for a minimum of 1 year were tested at baseline with Tempo+ using continuous interleaved sampling (CIS), and at 1 year follow-up with the Opus speech processor using FSP. Monosyllables and sentence tests were performed in quiet, and sentence tests (HSM) in noise with 15, 10 and 5 dB SNR. **Results:** Mean speech perception scores showed a trend towards improvement for all tests. A statistically significant ( $p < 0.05$ ) improvement was only observed for the sentence test in noise at 10 dB SNR.

- 240. Baumann U, Helbig S (2009) Hören mit kombinierter elektrischer und akustischer stimulation (Hearing with combined electric acoustic stimulation). HNO, 57(6)542-50.**

Article in German

Abstract:

After cochlear implantation, individuals with sufficient residual hearing in the lower frequency region are able to successfully combine acoustic and electrical stimulation patterns to improve speech perception, especially in noise, and to improve music appraisal as well. These improvements occur through enhanced transmission of fine structure information by more accurate mapping of the fundamental frequency contour through acoustic hearing. In current cochlear implant systems, the transfer of frequency and melodic contour is very coarse, and the correct detection of pitch contour requires large frequency differences. It is assumed that the acoustically transferred part of the signal enables the cochlear implant recipient to better segregate between speech signals and interfering sounds. The detection and following of a speech signal emitted by a single talker in a multitalker babble situation is improved when fundamental frequencies as grouping cues are present. The preservation of hearing in the implanted ear must be considered a major surgical challenge. The development of very flexible and soft electrode carriers in combination with surgical approaches that minimally traumatize the inner ear enable hearing preservation in nearly all cases.

- 241. Helbig S, Helbig M, Rader T, Mack M, Baumann U (2009) Cochlear reimplantation after surgery for electric-acoustic stimulation. ORL, 71: 172-8.**

Abstract:

BACKGROUND/AIMS: Combined electric-acoustic stimulation (EAS) of the auditory system usually results in better speech understanding than electric stimulation only, assuming low-frequency hearing can be preserved. Treatment options and outcomes for 4 subjects experiencing compromised hearing after EAS surgery are discussed. METHODS: Each subject underwent revision surgery to replace the original 21-mm electrode arrays used in EAS surgery with cochlear implants (CIs) with 31-mm arrays. Our aims were: (1) to investigate whether deeper insertion is possible, and (2) to evaluate the influence of electrode insertion angle by comparing speech perception scores before and after revision surgery. RESULTS: Deeper insertion was feasible in all subjects. Speech understanding scores after reimplantation were comparable to those seen after the first intervention. CONCLUSION: A 360-degree insertion under EAS conditions provides sufficient speech understanding, even in cases of additional hearing loss. Reimplantation with a longer electrode array is feasible in former EAS patients.

- 242. Kleinjung T, Steffens T, Strutz J, Langguth B (2009) Curing tinnitus with a cochlear implant in a patient with unilateral sudden deafness: a case report. Cases Journal, 2: 7462 doi: 10.1186/1757-1626-2-7462**

Abstract:

Cochlear implantation is a routine procedure for patients with bilateral profound sensorineural hearing loss. Some reports demonstrated a suppression of tinnitus as a side-effect after implantation. We describe the case of a 55-year-old man suffering from severe right-sided tinnitus in consequence of sudden right-sided deafness. Multiple therapeutic efforts including intravenous steroids and tympanoscopy with grafting of the round window remained unsuccessful. One year after onset of symptoms right-sided cochlear implantation was performed, which resulted in a complete abolishment of tinnitus after activating the implant. Severe unilateral tinnitus after sudden deafness might represent a new indication for cochlear implantation.

- 243. Sainz M, Garcia-Valdecasas J, Ballesteros JM (2009) Complications and pitfalls of cochlear implantation in otosclerosis: A 6-year follow-up cohort study. Otol Neurotol, 30(8): 1044-8.**

Abstract:

OBJECTIVE: To describe and discuss the midterm complications and pitfalls reported in patients with otosclerosis who received a cochlear implant. STUDY DESIGN: Prospective cohort study. SETTING: Tertiary referral center. PATIENTS: Fifteen patients who received a cochlear implant for otosclerosis, followed up for a minimum of 6 years. Onset of hearing loss occurred at a mean age (+/-standard deviation [SD]) of 32.6 +/- 8.6 years. Mean

duration (+/-SD) of hearing loss was 26.8 +/- 7.9 years, and mean age (+/-SD) at implant surgery was 58.7 +/- 9.5 years. INTERVENTIONS: Before cochlear implantation, hearing thresholds were tested, and temporal bone anatomy and otosclerotic lesions were documented by high-resolution computed tomography and magnetic resonance imaging. All patients were implanted with a Med-El Combi 40 + device and a Standard Electrode Array. MAIN OUTCOME MEASURES: The number of inserted electrodes was checked by x-ray. After cochlear implantation, hearing skills were tested, fitting parameters were recorded, and complications were noted. RESULTS: As the disease progressed, the number of electrodes decreased, and the electrical thresholds, maximum comfort levels, and electric charge increased; these changes were more evident in the middle electrodes. Although facial nerve stimulation rate was lower than previously reported (13.3%), it increased during follow-up. Two patients (13.3%) had untreatable tinnitus. Nevertheless, all speech discrimination parameters improved significantly in all patients. CONCLUSION: Despite the need for special fitting strategies and the appearance of complications, facial nerve stimulation, and tinnitus, improvements in speech discrimination tests support the use of cochlear implantation for patients with otosclerosis.

**244. Schramm B, Bohnert A, Keilmann A (2009) The prelexical development in children implanted by 16 months compared with normal hearing children. IJPORL, 73: 1673-81.**

Abstract:

OBJECTIVE: Few studies exist which document the early speech development of German-speaking children or German-speaking children who are deaf and using cochlear implants. The current study aims to: (1) document the pre-canonical and canonical speech development of German-speaking children who are deaf and receive cochlear implants by the age of 16 months and (2) compare these children's results with those of children with normal hearing. DESIGN: This longitudinal study included 5 German-speaking children with normal hearing and 5 with sensorineural deafness. All children from the deaf group received hearing amplification before cochlear implantation, received their first implant by 16 months of age, and became bilateral implant users by 31 months of age. The pre-canonical and canonical vocalisations of each child were recorded on video- and audiotapes in a semi-standardised playing situation every 4 weeks over a span of 1 year. In the cochlear implant group, the recording started 4-5 days postoperatively (first implant); in the normal hearing group it began between the ages of 4 and 5 months. The video and audio recordings were analysed using EUDICO Linguistic Annotator version 2.4 (Nijmegen, The Netherlands) and International Phonetic Alphabet transcription. RESULTS: Both groups showed individual patterns of babbling acquisition, though the groups' patterns of acquisition were similar when analysed for consonant manner and place. Some children started with plosives and others, with nasals, but all acquired fricatives and laterals next. Onset of canonical babbling for children in the cochlear implant group began 0-4 months after first fitting of the first device, while children from the normal hearing group demonstrated an onset of canonical babbling between 4 and 9 months of age. CONCLUSION: Our results show that deaf children who receive cochlear implants at an early age are capable of reaching the canonical babbling milestone in a shorter time than children with normal hearing typically do and that their consonant phoneme acquisition follows a similar sequence to normal hearing peers'. These results are consistent with the literature indicating that early identification and intervention are important for allowing children with cochlear implants the opportunity to catch up to hearing peers.

**245. Radeloff A, Unkelbach MH, Mack MG, Settevendemie C, Helbig S, Mueller J, Hagen R, Mylinski R (2009) A coated electrode carrier for cochlear implantation reduces insertion forces, Laryngoscope, 119(5): 959-63.**

Abstract:

OBJECTIVES/HYPOTHESIS: To assess the insertion forces and feasibility of insertion of a prototype electrode carrier coated with a flexible and biodegradable coating developed for lubrication and drug delivery. STUDY DESIGN: Experimental study. METHODS: Eight coated and eight uncoated electrode carriers were inserted into a scala tympani model by means of an insertion device, and forces produced during insertion were determined in near real time. The maximum insertion depths and insertion angle were determined. To test the handling and operability, five coated electrode carriers were implanted into human temporal bones. Additionally, the bones were processed undecalcified and the distribution of the coating material within the cochlea evaluated. RESULTS: Insertion forces were markedly reduced in the group of coated electrode carriers for insertion depths above 15 mm. The insertions were less fitful and led to a higher maximum insertion angle. The insertion of the coated

electrode carrier was feasible, and the coating material was evident up to the apical parts of the cochlea postimplantation. CONCLUSIONS: Coating of a cochlear implant electrode carrier may reduce insertion forces responsible for the surgical trauma. Loaded with active substances, the coating may help to deliver drugs to the apical parts of the cochlear where hair cells reside in patients with residual hearing.

- 246. Obrycka A, Padilla Garcia, Pankowska A, Lorens A, Skarzynski H (2009) Production and evaluation of a Polish version of the LittlEARS questionnaire for the assessment of auditory development in infants, IJPORL, 73(7): 1035-42.**

Abstract:

OBJECTIVE: To adapt the LittlEars questionnaire into Polish and to evaluate the psychometric properties of the Polish version of the questionnaire. METHODS: A back-translation method was used to translate the LittlEars questionnaire into Polish. The translated version was first evaluated by means of an expert-appraisal method. After having improved the Polish version of LittlEars with the results obtained from that evaluation, various psychometric analyses were conducted. Study participants included 310 parents or other caregivers of children with normal hearing whose ages ranged between 0.5 and 24.0 months. Corrected item-total correlations were calculated to evaluate the extent to which the different questions distinguish levels of auditory development of the assessed children. Cronbach's alpha coefficient--to evaluate internal consistency across items--was also calculated. To obtain estimates of validity, correlations between item/total score and age were calculated. A non-linear regression model was derived to obtain normative data for expected and minimum values of total scores from the questionnaire according to age. RESULTS: Corrected item-total correlations ranged from 0.14 to 0.84. The Cronbach's alpha coefficient was 0.95, indicating that the measurements were highly reliable. The linear correlation between total scores and age was 0.90 ( $p < .001$ ). The regression analysis conducted to obtain normative data showed that 83% of the variance in the total scores can be explained by age. CONCLUSION: The results of psychometric analyses support the use of the Polish version of the LittlEars questionnaire as a sensitive and reliable tool to assess the development of auditory behavior in Polish children between 3 and 24 months of age.

- 247. Veekmans K, Ressel L, Mueller J, Vischer M, Brockmeier SJ (2009) Comparison of music perception in bilateral and unilateral cochlear implant users and normal-hearing subjects, Audiol Neurotol, 14: 315-26.**

Abstract:

Music plays an important role in the daily life of cochlear implant (CI) users, but electrical hearing and speech processing pose challenges for enjoying music. Studies of unilateral CI (UCI) users' music perception have found that these subjects have little difficulty recognizing tempo and rhythm but great difficulty with pitch, interval and melody. The present study is an initial step towards understanding music perception in bilateral CI (BCI) users. The Munich Music Questionnaire was used to investigate music listening habits and enjoyment in 23 BCI users compared to 2 control groups: 23 UCI users and 23 normal-hearing (NH) listeners. Bilateral users appeared to have a number of advantages over unilateral users, though their enjoyment of music did not reach the level of NH listeners.

- 248. Skarzynski H, Lorens A, Piotrowska A, Podskarbi-Fayette R (2009) Results of partial deafness cochlear implantation using various electrode designs, Audiol Neurotol, 14(suppl 1): 39-45.**

Abstract:

Nineteen adults and 9 children who received a unilateral cochlear implant between 2002 and 2007 were included in the study. All subjects were preoperatively diagnosed with significant residual hearing in low frequencies, termed as 'partial deafness', and were implanted according to a 6-step round window surgical technique for partial deafness cochlear implantation. Hearing was preserved to a great extent in the partial deafness cochlear implantation (PDCI) group. After a short period following activation of the cochlear implant, highly significant improvement in the recognition of monosyllabic words was observed. With a developed round window surgical procedure and limited electrode insertion, hearing can be preserved in the majority of patients with partial deafness. PDCI is a feasible means of treating individuals who have good low-frequency hearing but severe to profound hearing loss in the mid to high frequencies.

- 249. Skarzynski H, Behr R, Lorens A, Podskarbi-Fayette R, Kochanek K (2009) Bilateral electric stimulation from auditory brainstem implants in a patient with neurofibromatosis type 2, Med Sci Mon, 15(6): CS100-4.**

Abstract:

BACKGROUND: Recent developments in the field of electronic hearing prostheses have allowed for the introduction of auditory brainstem implants in patients with neurofibromatosis type 2. CASE REPORT: Bilateral electric stimulation from 2 sequentially placed auditory brainstem implants was applied in a 27-year-old man with neurofibromatosis type 2. CONCLUSIONS: Results of the present case support further application of bilateral electric stimulation from auditory brainstem implants for patients with neurofibromatosis type 2.

- 250. Gstoettner W, Helbig S, Settevendemie C, Baumann U, Wagenblast J, Arnoldner C (2009) A new electrode for residual hearing preservation in cochlear implantation: first clinical results, Acta Otolaryngol, 129(4): 372-9.**

Abstract:

CONCLUSION: A so far unattained high rate (100%) of residual hearing preservation in cochlear implantation for electric-acoustic stimulation could be achieved using sophisticated surgical techniques in combination with the MedEI Flex EAS electrode. OBJECTIVES: This study aimed to gather first audiological and surgical results from the experience gained with the new MedEI Flex EAS electrode array. PATIENTS AND METHODS: Nine patients (aged 7.62-71.32 years) with profound high frequency hearing loss were supplied with this atraumatic electrode, which was designed to preserve residual hearing despite intracochlear insertion of an electrode array. All patients were implanted by the same surgeon. RESULTS: Hearing preservation was achieved in all patients (complete preservation 44.44%) after a mean follow-up period of 9.73 months. Mean monosyllabic test scores improved from 9% correct with the hearing aid alone to 48% with the cochlear implant and to 65% in the electric-acoustic mode.

- 251. Kosaner J, Anderson I, Turan Z, Deibl M (2009) The use of ESRT in fitting children with cochlear implants, Int Adv Otol, 5(1): 62-71.**

Abstract:

OBJECTIVES: Fitting of the cochlear implant speech processor on young children is often a challenge for the clinician. One way to obtain a reliable programme is to use an objective fitting method such as eSRT. This paper aims to demonstrate validity and reliability of using eSRT as a fitting tool, and to show outcomes through a series of small studies. SUBJECTS AND METHODS: A number of groups of children participated in a series of small eSRT studies assessing correlation to behavioural programmes, test-retest reliability, incidence, stability and measurement in the awake and sleep state. Sound field measurements and speech perception tests were conducted. RESULTS: There is a significant correlation to behavioural programmes, good test-retest reliability, high incidence, higher eSRTs measured under sedation and stable programmes over time. Sound field scores range from 37 to 33dB across the audiogram, mean closed-set monosyllable scores were 81% and GASP scores were 7.6/10. CONCLUSIONS: A series of small studies demonstrate the viability of using eSRT to programme a cochlear implant in small children.

- 252. Takanami T, Ito K, Yamasoba T, Kaga K (2009) Comparison of electroaudiometry with cochlear implant in children with inner ear anomaly, IJPORL, 73: 153-8.**

Abstract:

The promontory stimulation test (PST) using a needle electrode has been used to evaluate the sense of the auditory nerve as a preoperative examination for cochlear implant in adults. Because this is a painful test, it is not suitable for children. It has been reported that children with inner ear anomaly showed poorer outcomes of hearing after cochlear implant. Electroaudiometry developed by Med-El Corporation, which is noninvasive, is a more suitable procedure for young children. Patients were three children less than five years old with inner ear anomaly. Two patients showed common cavity, and one showed narrow IAC with hypoplastic cochlear anomaly. By using Electroaudiometry, we analyzed electro-neural hearing of these children before cochlear implant, and compared their hearing after cochlear implant. Three children seemed to have residual electro-neural hearing because the dynamic range between stimulus level (SL) and uncomfortable level (UCL) was detected by using Electroaudiometry. After cochlear implant, their pure-tone audiograms showed moderate hearing thresholds, and

their hearing detection and speech perception improved. These results suggest that Electroaudiometry is available for evaluating electro-neural hearing in young children with inner ear anomaly. It can provide useful information for a successful cochlear implant and evaluation of postoperative performances.

- 253. Mosnier I, Sterkers O, Bebear JP, Godey B, Robier A, Deguin O, Fraysse B, Bordure P, Mondain M, Bouccara D, Bozorg-Grayeli A, Borel S, Ambert-Dahan E, Ferray E (2009) Speech performance and sound localization in a complex noisy environment in bilaterally implanted adults patients, *Audiol Neurotol*, 14: 106-114.**

Abstract:

Objective: To evaluate speech performance, in quiet and noise, and localization ability in adult patients who had undergone bilateral and simultaneous implantation. Study Design: Prospective multi-center study. Methods: Twenty-seven adult patients with profound or total hearing loss were bilaterally implanted in a single-stage procedure, and simultaneously activated (Med-El, Combi 40/40+). Subjects were assessed before implantation and at 3, 6 and 12 months after switch-on. Speech perception tests in monaural and binaural conditions were performed in quiet and in noise using disyllabic words, with speech coming from the front and a cocktail party background noise coming from 5 loudspeakers. Sound localization measurements were also performed in background noise coming from 5 loudspeakers positioned from -90 degrees to +90 degrees azimuth in the horizontal plane, and using a speech stimulus. Results: There was a bilateral advantage at 12 months in quiet (77 +/- 5.0% in bilateral condition, 67 +/- 5.3% for the better ear,  $p < 0.005$ ) and in noise (signal-to-noise ratio +15 dB: 63 +/- 5.9% in bilateral condition, 55 +/- 6.9% for the better ear,  $p < 0.05$ ). Considering unilateral speech scores recorded in quiet at 12 months, subjects were categorized as 'good performers' (speech comprehension score  $\geq 60\%$  for the better ear,  $n = 19$ ) and 'poor performers' ( $n = 8$ ). Subjects were also categorized as 'asymmetrical' (difference between their 2 unilateral speech scores  $\geq 20\%$ ,  $n = 11$ ) or 'symmetrical' ( $n = 16$ ). The largest advantage (bilateral compared to the better ear) was obtained in poor performers: +19% compared to +7% in good performers ( $p < 0.05$ ). In the group of good performers, there was a bilateral advantage only in cases of symmetrical results between the 2 ears ( $n = 10$ ). In the group of poor performers, the bilateral advantage was shown in both patients with symmetrical ( $n = 6$ ) and asymmetrical results ( $n = 2$ ). In bilateral conditions, the sound localization ability in noise was improved compared to monaural conditions in patients with symmetrical and asymmetrical performance between the 2 ears. No preoperative factor (age, duration of deafness, use of hearing aids, etiology, etc.) could predict the asymmetrical performance, nor which ear would be the best. Conclusion: This study demonstrates a bilateral advantage (at 12 months after the implantation) in speech intelligibility and sound localization in a complex noisy environment. In quiet, this bilateral advantage is shown in cases of poor performance of both ears, and in cases of good performance with symmetrical results between the 2 ears. No preoperative factor can predict the best candidates for a simultaneous bilateral implantation.

- 254. Vermeire K, Van de Heyning P (2009) Binaural hearing after cochlear implantation in subjects with unilateral sensorineural deafness and tinnitus, *Audiol Neurotol*, 14(3): 163-71.**

Abstract:

The aim of this clinical study was to assess speech recognition in noise after cochlear implantation in subjects with single-sided deafness and incapacitating tinnitus. 20 subjects complaining of severe intractable tinnitus unresponsive to treatment received a MED-EL cochlear implant (CI). 11 subjects had normal hearing (NH group) on the contralateral side, while 9 used a hearing aid (HA group). The subjects were tested in noise in two listening conditions, i.e. with their acoustic hearing only and with adding the CI to the acoustic hearing (binaural). Subjective improvement in daily life was evaluated using the Speech Spatial and Qualities Hearing Scale (SSQ). The summation effect (3.3 dB for the HA group and 0.6 dB for the NH group) is not significant in both groups. A significant squelch effect of adding the CI was seen for the HA users (3.8 dB), but not for the NH group (1.2 dB). Additionally, a significant effect of adding the CI was found for the spatial configuration where noise is presented in front and speech on the CI side for both the HA group (6.5 dB) and the NH group (1.7 dB). Results of the SSQ show a significant overall benefit of wearing the CI for both groups. The preliminary results of these 20 subjects suggest that cochlear implantation can improve hearing in people suffering from single-sided deafness combined with tinnitus.

- 255. Zakirullah, Mukhtar N, Khan MIJ, Ahsan M, Shah SA (2008) Evaluation of auditory perception skills development in profoundly deaf children following cochlear implantation – preliminary report. J Ayub Med Coll Abbottabad, 20(1): 94-7.**

Abstract:

Background: Cochlear implant is a medical treatment option for individuals with severe to profound sensori-neural hearing loss on account of non-functioning cochlea or part thereof. Technology is ever evolving and the candidacy criteria are widening. Appropriate selection of patient, successful implantation of an appropriate device and adequate post-implantation rehabilitation protocol are the key factors that dictate the eventual outcome. Bilateral cochlear implantation in children and combined electro-acoustic stimulation are the new developments in this field of rehabilitation for the deaf. Pakistan Cochlear Implant Programme was started in year 2000 and one hundred and fifty subjects have undergone cochlear implant surgery so far at Karachi, Lahore and Peshawar since. This prospective study was designed to evaluate the development of auditory perception skills and language in children, over a twelve months period, following cochlear implantation. Methods: Twenty-one patients were enrolled in this evaluation. These were divided into three groups as per age factor. Group 1 included eleven children of ages less than five years, Group 2 included eight children of ages between five and nine years whereas, Group 3 included two eleven years old children. Furthermore, subjects in Group 1 & 2 were pre-lingual whereas those in Group 3 were post-lingual. The three groups were evaluated using "Evaluation of Auditory Responses to Speech" (EARS). Results: Improvement in performance on all measures was noticed in all the groups over a twelve months period following implantation. Dynamics of improvement in auditory skills suggested more and rapid development in younger age group. Conclusion: Children of varying ages, both pre and post lingual, did show improvement in the development of auditory perception skills, that was evident more in the younger age group.

- 256. Majdani O, Leinung M, Rau T, Akbarian A, Zimmerling M, Lenarz M, Lenarz T, Labadie R (2008) Demagnetization of cochlear implants and temperature changes in 3.0T MRI environment, Otolaryngol Head Neck, 139: 833-9.**

Abstract:

OBJECTIVE: To investigate the level of demagnetization of the magnets and temperature changes in cochlear implants (Cis) in a 3.0 tesla (3.0T) MRI. STUDY DESIGN: Experimental. SUBJECTS AND METHODS: Demagnetization and remagnetization measurements were done on magnets for different types of CIs. Temperature of different body and electrode sides was measured in the MRI environment. RESULTS: Demagnetization of the magnets of the CI is dependent on the angle between the magnetic field of the CI magnet and the MRI. When this angle was greater than 80 degrees, relevant demagnetization occurred and sufficient remagnetization was not possible with the 3.0T MRI magnet. Maximum temperature rise was 0.5 degrees C. CONCLUSIONS: Patients carrying CIs with non-removable magnets should not enter a 3.0T MRI device in a routine clinical setup. Under special conditions (angle between the two magnets less than 80 degrees) imaging in a 3.0T MRI may be possible without harming the patient or the implant.

- 257. Van de Heyning P, Vermeire K, Deibl M, Nopp P, Anderson I, De Ridder D (2008) Incapacitating unilateral tinnitus in single-sided deafness treated by cochlear implantation, Annals of ORL, 117(9): 645-52.**

Abstract:

OBJECTIVES: Tinnitus is a well-known, difficult-to-treat symptom of hearing loss. Users of cochlear implants (CIs) have reported a reduction in tinnitus following implantation for bilateral severe-to-profound deafness. This study assessed the effect of electrical stimulation via a CI on tinnitus in subjects with unilateral deafness and ipsilateral tinnitus who underwent implantation in an attempt to treat tinnitus with the CI. METHODS: Twenty-one subjects who complained of severe intractable tinnitus that was unresponsive to treatment received a CI. Tinnitus loudness was measured with a Visual Analog Scale; loudness percepts were recorded with the device activated and deactivated. Tinnitus distress was measured with the Tinnitus Questionnaire before and after implantation. RESULTS: Electrical stimulation via a CI resulted in a significant reduction in tinnitus loudness (mean +/- SD; 1 year after implantation, 2.4 +/- 1.8; 2 years after implantation, 2.5 +/- 1.9; before implantation, 8.5 +/- 1.3). With the device deactivated, tinnitus loudness was still reduced to between 6.1 and 7.0 over 24 months. The Tinnitus Questionnaire revealed a significant positive effect of CI stimulation. CONCLUSIONS: Unilateral tinnitus resulting

from single-sided deafness can be treated with electrical stimulation via a CI. The outcomes of this pilot study demonstrate a new method for treatment of tinnitus in select subjects, perhaps an important new indication for cochlear implantation.

- 258. Vermeire K, Nobbe A, Schleich P, Nopp P, Voormolen MH, Ven de Heyning PH (2008) Neural tonotopy in cochlear implants: An evaluation in unilateral cochlear implant patients with unilateral deafness and tinnitus, *Hearing Res*, 245(1-2): 98-106**

Abstract:

In cochlear implants, the signal is filtered into different frequency bands and transmitted to electrodes along the cochlea. In this study the frequency-place function for electric hearing was investigated as a means to possibly improve speech coding by delivering information to the appropriate cochlear place. Fourteen subjects with functional hearing in the contralateral ear have been provided with a MED-EL cochlear implant in the deaf ear in order to reduce intractable tinnitus. Pitch scaling experiments were performed using single-electrode, constant-amplitude, constant-rate stimuli in the implanted ear, and acoustic sinusoids in the contralateral ear. The frequency-place function was calculated using the electrode position in the cochlea as obtained from postoperative skull radiographs. Individual frequency-place functions were compared to Greenwood's function in normal hearing. Electric stimulation elicited a low pitch in the apical region of the cochlea, and shifting the stimulating electrode towards the basal region elicited increasingly higher pitch. The frequency-place function did not show a significant shift relative to Greenwood's function. In cochlear implant patients with functional hearing in the non-implanted ear, electrical stimulation produced a frequency-place function that on average resembles Greenwood's function. These results differ from previously derived data.

- 259. Helbig S, Baumann U, Helbig M, Hey C, Gstoettner W (2008) A new combined speech processor for electric and acoustic stimulation – Eight months experience, *ORL*, 70(6): 359-65.**

Abstract:

PURPOSE: Electric acoustic stimulation (EAS) relies on the preservation of low-frequency hearing and adequate amplification of these frequencies. EAS has been achieved by fitting the cochlear implant (CI) speech processor together with an ipsilateral in-the-ear hearing aid. This study will evaluate the outcomes when CI/EAS users upgrade to a new combination of hearing aid and speech processor in 1 device (DUET). METHOD: Nine EAS patients participated in this study. Before switchover and after 2 and 8 months of DUET device use, they were assessed using monosyllables and sentences in quiet and in noise. Additionally, a questionnaire, the Abbreviated Profile for Hearing Aid Benefit (APHAB), was used to evaluate subjective impressions. RESULTS: All subjects performed equally well, or even better, after switchover. This was also demonstrated over time. The participants with EAS before switchover performed equally afterwards, while those who used CI only did markedly better with the new device, especially in noisy conditions. Slight preference for the new system was also demonstrated with the APHAB. CONCLUSION: All subjects showed benefit in noise; CI-only users before switchover particularly benefited from the new hearing system. Those who applied EAS before switchover performed equally well. The DUET allows individuals better access to EAS

- 260. Gstoettner WK, Van de Heyning P, Fitzgerald O'Connor A, Morera C, Sainz M, Vermeire K, McDonald S, Cavallé L, Helbig S, García Valdecasas J, Anderson I, Adunka OF (2008) Electric acoustic stimulation of the auditory system: results of a multi-centre investigation, *Acta Otolaryngol*, 12:1-8.**

Abstract:

Conclusion. A high rate of hearing preservation during cochlear implantation for electric acoustic stimulation (EAS) is possible, even when surgery is conducted by a number of different surgeons. Objectives. This study aimed to determine the degree of hearing preservation using surgery for EAS in a European multi-centre clinical investigation. It also aimed to demonstrate the effect of EAS in individuals with residual low frequency hearing, both on speech perception and on subjective quality of life measures. Patients and methods. Eighteen patients with profound high frequency hearing loss were recruited in five participating European centres. Subjects were assessed based on an audiologic test battery, as well as on a subjective hearing aid benefit questionnaire. Each subject underwent attempted hearing preservation cochlear implantation using the MED-EL C40+ device with a Medium electrode. Residual ipsilateral hearing and speech discrimination abilities were assessed at defined intervals up to 12 months after the combined electric-acoustic mode was introduced. Results. Results showed that

some degree of hearing preservation was possible in 15718 patients. All subjects showed statistically significant benefit on all three speech perception tests over time. These significant benefits were also reflected in the subjective benefit outcomes.

- 261. Välimaa TT & Löppönen HJ (2008) Comparison of the body-worn CIS-PRO+ and the behind-the-ear-worn TEMPO+ cochlear implant systems in Finnish-speaking adult CI users: differences in results with experienced listeners? Acta Otolaryngol, 128: 984-91.**

Abstract:

Conclusion. The results indicate that the need for upgrading the processor and/or speech coding strategy should be considered individually, if the processor and coding strategy are functioning properly and a good level of speech perception has been achieved. Objectives. Our aim was to study the intra-individual differences of the body-worn CIS-PRO+ and the behind-the-ear-worn TEMPO+ cochlear implant systems used in the MED-EL Combi40/Combi40+ implants. Subjects and methods. The hearing level, sentence, word and phoneme recognition of eight adult subjects were determined in an ABA study design. Additionally, a self-assessment questionnaire was used. Mean scores and 95% confidence intervals, and individual scores were analysed. Results. The subjects tended to score slightly better on word and phoneme recognition with CIS-PRO+ and CIS strategy than with TEMPO+ and CIS+, but there were no statistically significant differences. Subjectively the participants ranked speech perception and discussion in noise to be slightly easier with TEMPO+ and CIS+. Six of the eight subjects preferred TEMPO+ and CIS+ and two of eight preferred CIS-PRO+ with CIS or number-of-maxima

- 262. Le Maner-Idrissi G, Barbu S, Bescond G, Godey B (2008) Some aspects of cognitive and social development in children with cochlear implant, Dev Med and Child Neurol, 50: 793-99.**

Abstract:

None.

- 263. Anderson I, Phillips L, Roberts L, Jamieson L, Costa A, Cross S (2008) TeenEARS: Development of a pilot assessment battery for cochlear implanted adolescents, Cochlear Implants Int., 9(3): 119-31.**

Abstract:

Changes in selection criteria have led to the inclusion of pre-lingually deafened adolescents as potential cochlear implant candidates, depending on their degree of residual hearing, access to and use of acoustic amplification, use of oral communication, and other factors such as motivation and support. Outcomes results in adolescents vary widely, and it has become evident that there is a need for a test battery that can assess a wide range of skills over time. This article presents the development and validation of one such test battery: TeenEARS. Eleven tests were assessed for inclusion in the test battery. Consideration was given to the ability of the test to measure improvement over time; the fact that there needed to be easier and more difficult tests in terms of language, communication and listening; the need for closed and open-set assessments; and a range of listening tasks: from sounds to conversational language. Data on 23 adolescents assessed and judgment based on clinical experience resulted in eight tests being included in the TeenEARS test battery.

- 264. Probst R (2008) Kochleaimplantation bei einseitiger Taubheit? (Cochlear implantation for unilateral deafness?) HNO, 56(9): 886-8.**

Article in German.

Abstract:

None.

- 265. Buss E, Pillsbury HC, Buchman CA, Pillsbury CH, Clark MS, Haynes DS, Labadie RF, Amberg S, Roland PS, Kruger P, Noval MA, Wirth JA, Black JM, Peters R, Lake J, Wackym PA, Firszt JA, Wilson BS, Lawson DT, Schatzer R, D'Haese PSC, Barco AL (2008) Multicenter US bilateral MED-EL cochlear implantation study: Speech perception over the first year of use, Ear Hear, 29:20-32.**

Abstract:

Objective: Binaural hearing has been shown to support better speech perception in normal-hearing listeners than can be achieved with monaural stimulus presentation, particularly under noisy listening conditions. The purpose of this study was to evaluate whether bilateral electrical stimulation could confer similar benefits for cochlear implant listeners. Design: A total of 26 postlingually deafened adult patients with short duration of deafness were implanted at five centers and followed up for 1 yr. Subjects received MED-EL COMBI 40+ devices bilaterally; in all but one case, implantation was performed in a single-stage surgery. Speech perception testing included CNC words in quiet and CUNY sentences in noise. Target speech was presented at the midline (0 degrees), and masking noise, when present, was presented at one of three simulated source locations along the azimuth (-90, 0, and +90 degrees). Results: Benefits of bilateral electrical stimulation were observed under conditions in which the speech and masker were spatially coincident and conditions in which they were spatially separated. Both the “head shadow” and “summation” effects were evident from the outset. Benefits consistent with “binaural squelch” were not reliably observed until 1 yr after implantation. Conclusions: These results support a growing consensus that bilateral implantation provides functional benefits beyond those of unilateral implantation. Longitudinal data suggest that some aspects of binaural processing continue to develop up to 1 yr after implantation. The squelch effect, often reported as absent or rare in previous studies of bilateral cochlear implantation, was present for most subjects at the 1 yr measurement interval.

**266. Castro A, Lassaletta L, Bastarrica M, Perez-Mora R, De Sarriá MJ, Gavilán J (2008) Benefits from a mobile telephone adapter in COMBI 40+ cochlear implant users, *Acta Otolaryngol*, 128: 661-5.**

Abstract:

Conclusions. Telephone adapters can help cochlear implanted patients to enhance their telephonic conversations. However, these devices should be further developed to be useful for daily life. Objectives. To test a mobile telephone adapter to improve speech discrimination by mobile telephone in Combi40+ users. To evaluate the influence of the mobile telephone in communication. Subjects and methods. Seventeen Combi40+ implantees were tested with bisyllabic words presented through mobile telephones with and without a telephone adapter in quiet and noisy environments. Speech audiometries in open field were obtained for every patient. Results. Mean speech discrimination without the adapter in a quiet environment was 51.2%. In a noisy environment, mean discrimination increased significantly with the adapter from 30.3% to 42.9%. No statistically significant difference was found between speech discrimination in the quiet environment without the adapter and speech discrimination in the noisy environment with the adapter. When comparing speech discrimination in open field without lip-reading with equivalent telephonic conditions a statistically significant difference was found in favour of the open field.

**267. Vermeire K, Anderson I, Flynn M, Ven de Heyning P (2008) The influence of different speech processor and hearing aid settings on speech perception outcomes in electric acoustic stimulation patients, *Ear Hear*, 29: 76-86.**

Abstract:

OBJECTIVE: Electric acoustic stimulation (EAS) is an increasingly popular means of treating individuals with a steeply sloping mid-to-high frequency hearing loss, who traditionally do not benefit from hearing instruments. These persons often have too much residual hearing to be considered for a cochlear implant. Several studies have demonstrated the ability both to preserve the remaining low-frequency hearing in these individuals, and to provide significant benefit through combining a cochlear implant with a hearing aid to amplify the same ear. These improvements in performance have been especially noted in noise. Often overlooked is that these outcomes may be influenced by the fitting parameters of both the cochlear implant and the hearing aid. DESIGN: This study assessed four EAS subjects, with a minimum of 1 month's EAS use, on eight different fitting parameters. Sentence testing in different noise levels (+15, +10, and +5 dB SPL) was conducted. Subjects also evaluated each condition using a visual analogue scale. RESULTS: Results demonstrated that a reduced overlap of cochlear implant and hearing aid amplification produced best results across listening conditions. CONCLUSIONS: The hearing aid should be fit to a patient-specific modified audiogram at least up to the point where low-frequency hearing is not measurable. The cochlear implant should be fit from a higher frequency point than is standard in patients without residual hearing in the implanted ear, to provide reduced overlap with the amplification provided

by the hearing aid. Therefore, a small amount of overlap between the frequency ranges used by the hearing aid and the cochlear implant seems beneficial.

- 268. Grantham DW, Ashmead DH, Ricketts TA, Haynes DS, Labadie RF (2008) Interaural time and level difference thresholds for acoustically presented signals in post-lingually deafened adults fitted with bilateral implants using CIS+ processing, *Ear hear*, 29: 33-44.**

Abstract:

Objectives: The main purpose of the study was to measure thresholds for interaural time differences (ITDs) and interaural level differences (ILDs) for acoustically presented noise signals in adults with bilateral cochlear implants (CIs). A secondary purpose was to assess the correlation between the ILD and ITD thresholds and error scores in a horizontal plane localization task, to test the hypothesis that localization by individuals with bilateral implants is mediated by the processing of ILD cues. Design: Eleven adults, all postlingually deafened and all bilaterally fitted with MED-EL COMBI 40+ CIs, were tested in ITD and ILD discrimination tasks in which signals were presented acoustically through headphones that fit over their two devices. The stimulus was a 200-msec burst of Gaussian noise bandpass filtered from 100 to 4000 Hz. A two-interval forced-choice adaptive procedure was used in which the subject had to respond on each trial whether the lateral positions of the two sound images (with the interaural difference favoring the left and right sides in the two intervals) moved from left-to-right or right-to-left. Results: In agreement with previously reported data, ITD thresholds for the subjects with bilateral implants were poor. The best threshold was ~400  $\mu$ sec, and only five of 11 subjects tested achieved thresholds <1000  $\mu$ sec. In contrast, ILD thresholds were relatively good; mean threshold was 3.8 dB with the initial compression circuit on the implant devices activated and 1.9 dB with the compression deactivated. The ILD and ITD thresholds were higher than previously reported thresholds obtained with direct electrical stimulation (generally, <1.0 dB and 100 to 200  $\mu$ sec, respectively). When the data from two outlying subjects were omitted, ILD thresholds were highly correlated with total error score in a horizontal-plane localization task, computed for sources near midline ( $r = 0.87$ ,  $p < 0.01$ ). Conclusions: The higher ILD and ITD thresholds obtained in this study with acoustically presented signals (when compared with prior data with direct electrical stimulation) can be attributed—at least partially—to the signal processing carried out by the CI in the former case. The processing strategy effectively leaves only envelope information as a basis for ITD discrimination, which, for the acoustically presented noise stimuli, is mainly coded in the onset information. The operation of the compression circuit reduces the ILDs in the signal, leading to elevated ILD thresholds for the acoustically presented signals in this condition. The large magnitude of the ITD thresholds indicates that ITDs could not have contributed to the performance in the horizontal-plane localization task. Overall, the results suggest that for subjects using bilateral implants, localization of noise signals is mediated entirely by ILD cues, with little or no contribution from ITD information.

- 269. Goupell MJ, Laback B, Majdak P, Baumgartner WD (2008) Effects of upper-frequency boundary and spectral warping on speech intelligibility in electrical stimulation, *J Acoust Soc Am*, 123(4): 2295-2309**

Abstract:

Speech understanding was tested for seven listeners using 12-electrode Med-El cochlear implants (CIs) and six normal-hearing listeners using a CI simulation. Eighteen different types of processing were evaluated, which varied the frequency-to-tonotopic place mapping and the upper boundary of the frequency and stimulation range. Spectrally unwarped and warped conditions were included. Unlike previous studies on this topic, the lower boundary of the frequency and stimulation range was fixed while the upper boundary was varied. For the unwarped conditions, only eight to ten channels were needed in both quiet and noise to achieve no significant degradation in speech understanding compared to the normal 12-electrode speech processing. The unwarped conditions were often the best conditions for understanding speech; however, small changes in frequency-to-place mapping (<0.77 octaves for the most basal electrode) yielded no significant degradation in performance from the nearest unwarped condition. A second experiment measured the effect of feedback training for both the unwarped and warped conditions. Improvements were found for the unwarped and frequency-expanded conditions, but not for the compressed condition. These results have implications for new CI processing strategies, such as the inclusion of spectral localization cues.

- 270. Lorens A, Polak M, Piotrowska A, Skarzynski H (2008) Outcomes of treatment of partial deafness with cochlear implantation: A DUET study, *laryngoscope*, 118: 288-94.**

Abstract:

**Objectives:** To compare speech test performance of adults with partial deafness cochlear implantation (PDCI) with that of adults with cochlear implant (CI). Based on the results, our objective is to determine the efficacy of the two applications of cochlear implantation, the first characterized by a shallow electrode insertion and preservation of low-frequency natural hearing for partial deafness, and the second characterized by a very deep electrode insertion used in subjects with severe to profound deafness. All the PDCI participants in this study were fitted with a recently upgraded DUET Hearing System from Med-El Corporation, Innsbruck, Austria. **Study Design:** This is a two-group comparison study. Eleven experienced PDCI adults and 22 postlingually deafened CI adults participated in this study. Subjects were implanted with either COMBI 40+ or PULSAR cochlear implant. **Methods:** Subjects were tested with monosyllable and sentence tests in Polish in quiet and under various signal-to-noise ratio (SNR) in the conditions of DUET only, CI only, DUET hearing aid (HA) only, and best aided (DUET plus contralateral hearing). CI subjects were tested with their CI. **Results:** PDCI subjects performed significantly better than CI subjects did. Speech tests demonstrated the best results in the conditions of best aided and DUET only. The poorest results were obtained in the condition DUET HA only. Results show a greater benefit for the PDCI group of subjects fitted with the DUET, compared to the CI alone group. **Conclusions:** The shallow electrode array insertion with preserved low-frequency hearing is a highly effective method for the treatment of partial deafness. The combination of HA and CI processor, i.e., the DUET, is beneficial in noise and in quiet.

- 271. Yin S, Chen Z, Wu Y, Zhang J, Zhou W, Zou W, Huang J, Shen Z, Qiu J (2008) Suprameatal approach for cochlear implantation in 45 Chinese children, IJPORL, 72(3): 397-403.**

Abstract:

**OBJECTIVE:** To investigate the feasibility of applying the suprameatal approach (SMA) for cochlear implantation in Chinese children with profound sensory hearing loss, and to demonstrate a technical modification incorporated in the procedure due to an observed racial difference. **STUDY DESIGN:** Retrospective study. **SETTING:** University hospital. **PATIENTS:** Forty-five Chinese children (total 47 ears) with profound sensory hearing loss were surgically treated from May 2005 to May 2006. The patients were followed anywhere from 1 month to 20 months post-surgery, with 30 patients being followed for more than 6 months. **INTERVENTIONS:** All patients received cochlear implantation through the suprameatal approach. In this procedure, the cochleostomy was performed in one stage after the suprameatal tunnel was finished, rather than the two-stage approach described by Kronenberg (who firstly introduced the suprameatal approach). Three patients with low-lying dura (which is considered to be the contraindication for cochlear implantation with SMA) were treated with a further modified surgical approach. **RESULTS:** Among the 47 ears, full electrode pairs were completely inserted in 45 ears without surgical difficulties, but 1 ear was only fitted with 9 pairs of electrodes because of an ossified cochlea, and another with just 8 pairs of electrodes due to serious cochlear dysplasia. An intraoperative "gusher" occurred in the dysplasia case, and a small piece of temporalis muscle was used, along with biology glue, to seal the cochleostomy and prevent further leakage. In 1 case, the electrode was inserted into the cochlea through the tunnel lateral to the chorda tympani because adhesion had occurred between the incus and chorda tympani. There were no postoperative complications in any case. Thirty cases exhibited better hearing or speech development from cochlear implantation after more than 6 months of follow-up. **CONCLUSIONS:** The SMA was found to be a simple and safe technique for cochlear implantation in Chinese children. It enables wide exposure of the middle ear, and is especially suitable for cases with a narrow facial recess, an anteriorly located facial nerve, or an ossified cochlea. It is almost impossible to injure the facial nerve or the chorda tympani nerve. The cochleostomy can be performed in one stage in those patients with a normal cochlea. With some modifications, a low-lying dura will not be the absolute contraindication of SMA.

- 272. Baumann U, Rader T, Helbig S, Gstöttner W (2008) Acoustical frequency discrimination and pitch matching in bimodal and hybrid hearing, J Acoust Soc Am, 123(5): 3167.**

Abstract:

Frequency discrimination and pitch matching of implantees using combined electric and acoustic stimulation in either the same ear (EAS) or the opposite ear (bimodal condition) was assessed by means of adaptive procedures. EAS patients received either the MED-EL standard electrode or the recently introduced FLEX design with reduced diameter. Acoustic JNDF in EAS patients ranged from close to normal to grossly abnormal compared to a group of matched SNHL listeners. The median JNDF was 7.1% in the SNHL and 7.5% in the EAS group. There was no

statistically significant difference in terms of JNDF between both groups of listeners. Frequency mapping was studied by means of an adjustment method where subjects were instructed to control the pitch of an acoustically presented sinusoid in reference to electrical stimulation. The findings demonstrate that the insertion of an intra-cochlear electrode does not significantly hamper the average frequency discrimination ability in EAS patients.

- 273. Grantham DW, Ricketts TA, Ashmead DH, Labadie RF, Haynes DS (2008) Localization by postlingually deafened adults fitted with a single cochlear implant, *Laryngoscope*, 118: 145-151.**

Abstract:

**Objective:** The main purpose of the study was to assess the ability of adults with unilateral cochlear implants to localize noise and speech signals in the horizontal plane. **Design:** Six unilaterally implanted adults, all postlingually deafened and all fitted with MED-EL COMBI 40+ devices, were tested with a modified source identification task. Subjects were tested individually in an anechoic chamber, which contained an array of 43 numbered loudspeakers extending from  $-90^{\circ}$  to  $+90^{\circ}$  azimuth. On each trial, a 200 millisecond signal (either a noise burst or a speech sample) was presented from one of nine active loudspeakers, and the subject had to identify which source (from the 43 loudspeakers in the array) produced the signal. **Results:** The relationship between source azimuth and response azimuth was characterized in terms of the adjusted constant error ( $C^{\circ}$ ).  $C^{\circ}$  for three subjects was near chance ( $50.5^{\circ}$ ), whereas  $C^{\circ}$  for the remaining three subjects was significantly better than chance ( $35^{\circ}$ – $44^{\circ}$ ). By comparison,  $C^{\circ}$  for a group of normal-hearing listeners was  $5.6^{\circ}$ . For two of the three subjects who performed better than chance, monaural cues were determined to be the basis for their localization performance. **Conclusions:** Some unilaterally implanted subjects can localize sounds at a better than chance level, apparently because they can learn to make use of subtle monaural cues based on frequency-dependent head-shadow effects. However, their performance is significantly poorer than that reported in previous studies of bilaterally implanted subjects, who are able to take advantage of binaural cues.

- 274. Lassaletta L, Castro A, Bastarrica M, Pérez-Mora, Herrán B, Sanz L, de Sarriá, Gavilám J (2008) Changes in listening habits and quality of musical sound after cochlear implantation, *Otolaryngol Head Neck Surg*, 123: 363-7.**

Abstract:

**Objective:** To evaluate listening habits and quality of musical sound after cochlear implantation. **Study design:** A total of 89 consecutive, adult, postlingually deafened, cochlear implant recipients entered the study. Music questionnaire included questions about musical background, listening habits, and quality of musical sound through cochlear implants. Music perception was evaluated with the Primary Measures of Music Audiation (PMMA). The questionnaire and the PMMA were administered to 67 and 65 patients, respectively. **Results:** Listening habits significantly decreased postimplantation. The mean score (0-100) for the adjective pairs “like–dislike,” “sounds like music–doesn’t sound like music,” “natural–mechanical,” and “easy to follow–difficult to follow” was 60, 59, 50, and 40, respectively. The adjective pairs were associated with music enjoyment. Mean PMMA scores were 71 and 78 percent for tone and rhythm, respectively, with no association with music enjoyment. **Conclusion:** Music perception through a cochlear implant is a complex phenomenon that depends on audiological and nonaudiological factors.

- 275. Jamal AJ, Ghareeb RM, Al-Sharif OY, hamadeh RR (2008) Cochlear implantation in Bahrain: promising results, *Ann Saudi Med*, 27(6): 445-7.**

Abstract:

None.

- 276. Arnoldner C, Riss D, Brunner M, Durisin M, Baumgartner WD, Hamzavi J (2007) Speech and music perception with the new fine structure speech coding strategy: preliminary results, *Acta Otolaryngol*, 127(12): 1298-1303.**

Abstract:

**Conclusions.** Taking into account the excellent results with significant improvements in the speech tests and the very high satisfaction of the patients using the new strategy, this first implementation of a fine structure strategy could offer a new quality of hearing with cochlear implants (CIs). **Objective.** This study consisted of an intra-individual comparison of speech recognition, music perception and patient preference when subjects used two

different speech coding strategies with a MedEl Pulsar CI: continuous interleaved sampling (CIS) and the new fine structure processing (FSP) strategy. In contrast to envelope-based strategies, the FSP strategy also delivers subtle pitch and timing differences of sound to the user and is thereby supposed to enhance speech perception in noise and increase the quality of music perception. Patients and methods. This was a prospective study assessing performance with two different speech coding strategies. The setting was a CI programme at an academic tertiary referral centre. Fourteen post-lingually deaf patients using a MedEl Pulsar CI with a mean CI experience of 0.98 years were supplied with the new FSP speech coding strategy. Subjects consecutively used the two different speech coding strategies. Speech and music tests were performed with the previously fitted CIS strategy, immediately after fitting with the new FSP strategy and 4, 8 and 12 weeks later. The main outcome measures were individual performance and subjective assessment of two different speech processors. Results. Speech and music best scores improved statistically significantly after conversion from CIS to FSP strategy. Twelve of 14 patients preferred the new FSP speech processing strategy over the CIS strategy.

- 277. Raine CH, Lee CA, Strachan DR, Totten CT, Khan S (2007) Skin flap thickness in cochlear implant patients – a prospective study, *Cochlear Implants Int*, 8(3): 148-57.**

Abstract:

The thickness and quality of the skin overlying a cochlear implant is important for its integrity. It should be thick enough to protect the implant and prevent flap breakdown yet should not be so thick that it impedes the electronic signal or causes difficulty wearing the coil because of loss of the magnetic coupling. The principle of this study was to devise a method to assess the thickness of skin over a cochlear implant receiver stimulator package and prospectively measure this thickness during the first year following surgery. All patients studied were implanted with MED-EL COMBI 40+ implants. The first cohort consisted of 35 adults; the second 23 children. Various methods of measurement were assessed. In this study the principle of the Hall Effect electrode was used to measure the magnetic flux density of the magnet within the receiver stimulator package. Following standardization, results showed that skin thickness significantly thinned in the adult group before stabilizing. This was less obvious in children, probably due to the effect of the skin thickening as the child grows. Knowledge of skin thickness has implications relating to the functioning of an implant and avoiding potential flap related complications.

- 278. Lassaletta L, Castro A, Bastarrica M, Pérez-Mora R, Madero R, De Sarriá J, Gavilán J. (2007) Does music perception have an impact on quality of life following cochlear implantation? *Acta Otolaryngol*, 127(7): 682-6.**

Abstract:

CONCLUSION: Despite the decrease in listening habits, about half of the patients still enjoy music post implantation. Better quality of sound through the implant improves music enjoyment and contributes to achievement of better postoperative quality of life (QOL). OBJECTIVES: To evaluate music perception and enjoyment in cochlear implant (CI) users, and to assess their influence on QOL. MATERIALS AND METHODS: Sixty-five post-lingually deaf CI recipients were enrolled in this study. A musical questionnaire evaluated musical background, listening habits, and quality of musical sound through the CI. The validated Glasgow Benefit Inventory (GBI) was used to quantify changes in QOL. RESULTS: Fifty-two patients answered the questionnaires. Listening habits (music enjoyment and hours spent listening to music per week) significantly decreased following implantation when compared with the same parameters before deafness. Nevertheless, 52% of the patients enjoyed music post implantation. The quality of musical sound was rated >50 (0-100 scale) for the adjective pairs 'like-dislike', 'sounds like music-doesn't sound like music' and 'natural-mechanical' by most users. Med-el device users obtained better scores in the adjective pair 'sounds like music-doesn't sound like music' than Cochlear device users. Recipients rating higher scores for quality of sound enjoyed music post implantation and had higher total GBI scores than those rating lower scores.

- 279. Nobbe A, Schleich P, Zierhofer C, Nopp P (2007) Frequency discrimination with sequential or simultaneous stimulation in MED-EL cochlear implants, *Acta Oto Laryngol*, 127(12): 1266-72.**

Abstract:

Conclusion. Amplitude weighting using the bell-shaped filter design within the OPUS speech processors allows the creation of pitches intermediate to those of two adjacent electrodes. This mechanism can be used for both sequential and simultaneous stimulation. Objectives. This paper describes frequency discrimination experiments which are based on amplitude weighting of two adjacent electrodes. The effects of sequential versus simultaneous stimulation of the electrode pair were investigated. Materials and methods. The experiment was performed using a laboratory system emulating the signal processing using bell-shaped filters in the MED-EL speech processors. The system transformed input files (wav-files) into the stimulation data stream which was transmitted to the implant via the OPUS processor coil. Pitch discrimination was assessed for up to three electrode pairs in each subject, using an adaptive test method. Results for sequential stimulation were collected in eight subjects, a comparison between sequential and simultaneous stimulation was made in five subjects. Results. Results show an average frequency discrimination of 8.8% for sequential stimulation and 11.2% for simultaneous stimulation, of the nominal test frequency. Frequency discrimination ability varied across subjects and test electrode pairs. The difference in performance between sequential and simultaneous stimulation was not statistically significant.

- 280. Behr R, Müller J, Shehata-Dieler W, Schlake H, Helms J, Roosen K, Klug N, Hölper B, Lorens A (2007) The high rate CIS auditory brainstem implant for restoration of hearing in NF-2 patients, Skull base, 17: 91-108.**

Abstract:

Aim: Hearing preservation is one of the major goals of acoustic neuroma surgery. In NF-2 patients, bilateral hearing loss is frequently caused by the disease or results from its treatment. Several implant devices for electrical stimulation of the cochlear nucleus have been developed to restore serviceable hearing in these patients. We report our experience and results using a high rate continuous interleaved sampling (CIS) auditory brainstem implant (ABI). Methods: Between June 1997 and May 2004, 24 NF-2 patients were managed by our group. In 20 patients an ABI was implanted successfully. The cochlear nucleus was located using anatomical landmarks and E-ABR recordings after resection of the neuroma via a retrosigmoid approach in the semi-sitting position. The 12-channel stimulating electrode array was inserted and fixed in the lateral recess. There were no surgical complications related to implantation apart from pseudomeningo that were managed by lumbar drainage. Results: In one patient the electrode array became dislocated and this necessitated revision surgery which was successful. One patient failed to gain benefit from the implant. Overall, 70% of electrodes were found to be serviceable for auditory stimulation, 5.3% of electrodes were primarily nonauditory, and in 7.8% side effects during stimulation were observed. Lip reading was improved by more than 100% as a result of the additional auditory input. For many patients, comprehension of open speech was restored to a useful level. Almost all patients were able to perceive environmental sounds and tinnitus was masked. Conclusions: Restoration of hearing using ABIs in NF-2 patients is a safe and promising procedure for those who would otherwise be totally deaf. The high rate CIS speech processing strategy has proven to be very useful and effective in direct cochlear nucleus stimulation.

- 281. Skarzynski H, Lorens A, Piotrowska A, Anderson I (2007) Partial deafness cochlear implantation in children, IJPORL, 71(9): 1407-13.**

Abstract:

OBJECTIVE: Partial deafness cochlear implantation and electric-acoustic stimulation have proven to be a useful method of treating adults with a ski-slope type hearing loss. Good hearing preservation and speech perception outcomes have been reported. This study aims to assess partial deafness cochlear implantation in children. METHOD: Nine children, ranging in age from 4.2 to 12 years, received a cochlear implant following the round window surgical technique for partial deafness cochlear implantation. Hearing preservation was assessed by pure-tone audiometry and speech perception outcomes were measured using monosyllable word tests in quiet and noise. Data are available for most children up to a period of 1 year. RESULTS: Hearing could be preserved partially in all cases, however, one child does not have sufficient preservation to make use of electric-acoustic stimulation. The eight children with sufficiently preserved hearing either use the natural low frequency hearing in combination with a cochlear implant to hear or use the DUET combined hearing system. Speech perception tests showed improvement in quiet and noise over time. CONCLUSION: Results suggest that partial deafness cochlear implantation is a viable treatment method in children. However, surgery should only be conducted by an

experienced surgeon and parents need to be carefully counselled about the risks and benefits of partial deafness cochlear implantation.

- 282. Wasowski A, Palko T, Lorens A, Walkowiak A, Obrycka A, Skarzynski H (2007) Electrically elicited stapedius muscle reflex in cochlear implant system fitting in Medicon 2007, IFMBE Proceedings 16 (Jarm T, Kramar P, Zupanic A Eds), 940-42.**

Abstract:

The aim of this study was to assess the possibility of using electrically elicited stapedius muscle reflex (ESR) for estimation of most comfortable loudness level (MCL), one of the most important electrical stimulation parameter in cochlear implant system fitting. The material of this study consisted of 48 adult patients, sampled from the group of MedEI Combi 40+ and MedEI Pulsar users, implanted in the Institute of Physiology and Pathology of Hearing. Their cochlear implant system was fitted according to the results of psychophysical tests: loudness scaling and electrical amplitude growth function. ESR measurement was performed, and ESR thresholds and MCL values were compared. Good correlation after 12 months of using cochlear implant system was observed. Results indicate that ESR can be included in cochlear implant system fitting procedure as objective measurement for prediction of optimal MCL values.

- 283. Grantham DW, Ashmead DH, Ricketts TA, Labadie RF, David S (2007) Horizontal-plane localization of noise and speech signals by postlingually deafened adults fitted with bilateral cochlear implants, Ear Hear, 28(4): 524-41.**

Abstract:

**OBJECTIVES:** The main purpose of the study was to assess the ability of adults with bilateral cochlear implants to localize noise and speech signals in the horizontal plane. A second objective was to measure the change in localization performance in these adults between approximately 5 and 15 mo after activation. A third objective was to evaluate the relative roles of interaural level difference (ILD) and interaural temporal difference (ITD) cues in localization by these subjects. **DESIGN:** Twenty-two adults, all postlingually deafened and all bilaterally fitted with MED-EL COMBI 40+ cochlear implants, were tested in a modified source identification task. Subjects were tested individually in an anechoic chamber, which contained an array of 43 numbered loudspeakers extending from -90 degrees to +90 degrees azimuth. On each trial, a 200-msec signal (either a noise burst or a speech sample) was presented from one of 17 active loudspeakers (span: +/-80 degrees), and the subject had to identify which source from the 43 loudspeakers in the array produced the signal. Subjects were tested in three conditions: left device only active, right device only active, and both devices active. Twelve of the 22 subjects were retested approximately 10 mo after their first test. In Experiment 2, the spectral content and rise-decay time of the noise stimulus were manipulated. **RESULTS:** The relationship between source azimuth and response azimuth was characterized in terms of the adjusted constant error ( $\hat{c}$ ). (1) With both devices active,  $\hat{c}$  for the noise stimulus varied from 8.1 degrees to 43.4 degrees (mean: 24.1 degrees). By comparison,  $\hat{c}$  for a group of listeners with normal hearing ranged from 3.5 degrees to 7.8 degrees (mean: 5.6 degrees). When subjects listened in unilateral mode (with one device turned off),  $\hat{c}$  was at or near chance (50.5 degrees) in all cases. However, when considering unilateral performance on each subject's better side, average  $\hat{c}$  for the speech stimulus was 47.9 degrees, which was significantly (but only slightly) better than chance. (2) When listening bilaterally, error score was significantly lower for the speech stimulus (mean  $\hat{c}$  = 21.5 degrees) than for the noise stimulus (mean  $\hat{c}$  = 24.1 degrees). (3) As a group, the 12 subjects who were retested 10 mo after their first visit showed no significant improvement in localization performance during the intervening time. However, two subjects who performed very poorly during their first visit showed dramatic improvement (error scores were halved) over the intervening time. In Experiment 2, removing the high-frequency content of noise signals resulted in significantly poorer performance, but removing the low-frequency content or increasing the rise-decay time did not have an effect. **CONCLUSIONS:** In agreement with previously reported data, subjects with bilateral cochlear implants localized sounds in the horizontal plane remarkably well when using both of their devices, but they generally could not localize sounds when either device was deactivated. They could localize the speech signal with slightly, but significantly better accuracy than the noise, possibly due to spectral differences in the signals, to the availability of envelope ITD cues with the speech but not the noise signal, or to more central factors related to the social salience of speech signals. For most subjects the remarkable ability to localize sounds has stabilized by 5 mo after activation. However, for some subjects who perform poorly initially, there can be substantial improvement past 5 mo. Results

from Experiment 2 suggest that ILD cues underlie localization ability for noise signals, and that ITD cues do not contribute.

- 284. Haumann S, Mühler R, Ziese M, von Specht H (2007) Diskrimination musikalischer Tonhöhen bei Patienten mit Kochleaimplantat (Discrimination of musical pitch with cochlear implants), HNO, 55: 613-9.**

Article in German.

Abstract:

BACKGROUND: Numerous people with cochlear implants (CI) report difficulties in listening to music even though they understand speech quite well. One reason for this is a limited perception of pitch and timbre. In this study ability of adult CI subjects to discriminate musical pitch is investigated. PATIENTS AND METHODS: In two psychoacoustic experiments, each conducted in 10 adult CI subjects provided with MED-EL Combi 40+ cochlear implant devices and a control group of subjects with normal hearing, individual discrimination abilities for musical pitch perception were determined. To investigate the influence of the group of instruments on discrimination ability, stimuli representing four different groups of instruments were used: woodwind (clarinet), brass (trumpet), strings (violin) and keyboard instruments (piano). RESULTS: The discrimination thresholds determined varied between individual CI subjects, and on average they were significantly higher for the piano than for the other three instruments. CONCLUSIONS: The results show that in subjects with CI pitch perception differs from instrument to instrument and is in general worse than in persons with normal hearing.

- 285. Alvarez I, de la Torre A, Sainz M, Roldan C, Schoesser H, Spitzer P (2007) Generalized alternating stimulation: a novel method to reduce stimulus artifact in electrically evoked compound action potentials, J Neurosci Methods, 165(1): 95-103.**

Abstract:

Stimulus artifact is one of the main limitations when considering electrically evoked compound action potential for clinical applications. Alternating stimulation (average of recordings obtained with anodic-cathodic and cathodic-anodic bipolar stimulation pulses) is an effective method to reduce stimulus artifact when evoked potentials are recorded. In this paper we extend the concept of alternating stimulation by combining anodic-cathodic and cathodic-anodic recordings with a weight in general different to 0.5. We also provide an automatic method to obtain an estimation of the optimal weights. Comparison with conventional alternating, triphasic stimulation and masker-probe paradigm shows that the generalized alternating method improves the quality of electrically evoked compound action potential responses.

- 286. Bayazit YA, Goksu N, Ozbilen (2007) Mini-incision for pediatric implantation with a MED-EL device, ORL, 69: 311-315.**

Abstract:

OBJECTIVE: Minimal invasive approaches have been described for cochlear implantation. However, the number of reports about minimal invasive approaches for MED-EL devices is sparse. In this technical note, we describe our pediatric cochlear implantation and incision techniques for MED-EL devices. METHODS: Among 92 cochlear implantations performed between November 2002 and November 2006, there were 32 consecutive pediatric cochlear implantations with MED-EL devices which were performed between July 2005 and October 2006. In our technique, standard posterior tympanotomy and cochleostomy were performed after 4- to 5-cm mini-incisions in the postauricular region. However, suture fixations were not used for the implant receiver nor its electrode. RESULTS: There were 14 girls and 18 boys with a mean age of 3.9 years. The mean follow-up duration was 5.8 months. No flap necrosis, hematoma or infection, nor implant migration, extrusion or breakdown were encountered. Revision surgery was performed in 3 patients due to cochlear ossification, perilymph leakage and extracochlear implantation. CONCLUSION: MED-EL implantation can be performed using small incisions without suture fixation of the receiver and its electrode.

- 287. Skarzynski H, Lorens A, Piotrowska A, Anderson I (2007) Preservation of low frequency hearing in partial deafness cochlear implantation (PDCI) using the round window surgical approach, Acta otolaryngol, 127(1): 41-8.**

Abstract:

**CONCLUSION:** Successful hearing preservation is possible in individuals with excellent low frequency hearing. This is possible due to the partial insertion of an atraumatic electrode using an atraumatic round window surgical technique. **OBJECTIVES:** This paper describes the round window surgical technique used to preserve excellent low frequency hearing in patients receiving partially inserted MED-EL cochlear implant electrodes. Results of preserved low frequency hearing in partial deafness cochlear implantation (PDCI) are reported. **PATIENTS AND METHODS:** The surgical approach is described in detail. Ten subjects received a partial insertion of a standard electrode, using the round window approach. Pure tone audiometry was conducted in the implanted and non-implanted ear preoperatively, at implant fitting and then at 1, 3, 6 and 12 months after initial device fitting. **RESULTS:** Results show hearing preservation in 9 of the 10 subjects. One subject lost all hearing 2 weeks after cochlear implantation. Hearing has remained essentially stable up to the 1 year postoperative period. Eight of the nine subjects use the cochlear implant together with their natural low frequency hearing; one subject uses a hearing aid in the implanted ear to amplify the low frequencies.

- 288. Pau HW, Just T, Dahl R, Sivert U (2007) Monitoring residual hearing during cochlear implantation by intra-operative brainstem audiometry. *Auris Nasus Larynx*, 35: 264-8.**

Abstract:

**Objective:** Aim of this paper is to prove the applicability of intra-operative recordings of auditory brainstem responses during cochlear implantation. **Methods:** The clinical practicability of intra-operative monitoring of hearing thresholds (Notched-Noise BERA, Amplitude Modulation Following Response [AMFR]) is presented in the respective case. The recordings were performed prior to the cochlear implantation and were compared with those obtained during and after cochlear implantation. **Results:** It is demonstrated that the patient's cochlear function can be monitored; residual hearing is available after surgery. **Conclusion:** The possibility of monitoring of hearing thresholds may add some security to the concept of electric-acoustic stimulation.

- 289. Baumgartner WD, Jappel A, Morera C, Gstöttner W, Müller J, Kiefer J, Van de Heyning P, Anderson I, Bryde Nielsen S (2007) Outcomes in adults implanted with the FLEX<sup>soft</sup> electrode, *Acta otolaryngol*, 127: 579-86.**

Abstract:

**Conclusion:** Achieving deep insertions, as well as good speech perception results, the FLEX<sup>soft</sup> electrode array allows for some preservation in subjects with measurable low frequency hearing, even after a period of time. This opens the door for future research in electrode design, hearing preservation research and drug delivery systems. **Objectives:** The FLEX<sup>soft</sup> electrode is designed to be atraumatic to the structures of the cochlea during deep insertion of a cochlear implant electrode. This paper reports on the surgical and functional outcomes in implantations with the FLEX<sup>soft</sup> electrode array. **Patients and methods:** Twenty-three adult subjects received a FLEX<sup>soft</sup> electrode array and were assessed on speech perception tests (monosyllables, sentences in quiet and in noise), a subjective questionnaire (Nijmegen Cochlear Implant Questionnaire) and a pure-tone audiogram. **Results at 1, 3, 6 and 12 months post first fitting** were compared to scores from the preoperative interval. **Results:** Surgery was uneventful in all cases, the surgical handling was satisfactory and correct position of the electrode was achieved in all cases. Hearing could be preserved (as determined by the audiogram) in half of the subjects who had measurable audiograms preoperatively at the 1 month test interval, and in a quarter of subjects after 12 months of device use, despite deep insertion of the electrode. Speech perception scores showed significant improvement over time, as did quality of life scores, and were comparable to results with the standard electrode array as used in the COMBI 40+ and PULSARci<sup>100</sup>.

- 290. Arnoldner C, Riss D, Baumgartner WD, Kaider A, Hamzavi JS (2007) Cochlear implant channel separation and its influence on speech perception: Implications for a new electrode design, *Audiol Neurotol*, 12(5): 37-48.**

Abstract:

There are a variety of factors which can influence cochlear implantation outcome. Channel interaction is one of the variables responsible for audiological performance deterioration in multichannel implants. Electrode design is -

among others - one way to decrease the incidence of channel interaction. At present, electrodes differ in overall length, diameter, contact design and distribution, but none of the electrodes available have a distinct variability in the amount of space between contacts across the length of the electrode. The aim of this study was to investigate whether a new electrode design featuring larger contact spacing in the apical part of deeply inserted electrodes would lead to an increase in speech perception. Eighteen postlingually deafened patients fitted with MED-EL COMBI 40+ or MED-EL Pulsar cochlear implants using the MED-EL implementation of continuous interleaved sampling participated in this study. Patients were tested in 6 conditions, in which the channel spacing and distribution of electrode contacts in each patient were artificially varied by activating or deactivating different channels. Performance was tested immediately after each change in setup with a monosyllable and sentence test (Hochmaier, Schultz and Moser). Our results showed that the condition with the highest distance between contacts in the apical part (up to 6.4 mm instead of 2.4 mm) is the most effective for the matched map condition: the results improved statistically significantly for the sentence test from 72% in the standard 12-channel condition to 83.2% and from 40.8 to 50% for the monosyllable test. Based on these findings, we present a new electrode design which can help achieve further increases in speech perception with cochlear implants.

- 291. Dorman MF, Spahr T, Gifford R, Loiseau L, McKarns S, Holden T, Skinner M, Finley C (2007) An electric frequency-to-place map for a cochlear implant patient with hearing in the nonimplanted ear, JARO, 8: 234-Abstract:**

The aim of this study was to relate the pitch of high-rate electrical stimulation delivered to individual cochlear implant electrodes to electrode insertion depth and insertion angle. The patient (CH1) was able to provide pitch matches between electric and acoustic stimulation because he had auditory thresholds in his nonimplanted ear ranging between 30 and 60 dB HL over the range, 250 Hz to 8 kHz. Electrode depth and insertion angle were measured from high-resolution computed tomography (CT) scans of the patient's temporal bones. The scans were used to create a 3D image volume reconstruction of the cochlea, which allowed visualization of electrode position within the scala. The method of limits was used to establish pitch matches between acoustic pure tones and electric stimulation (a 1,652-pps, unmodulated, pulse train). The pitch matching data demonstrated that, for insertion angles of greater than 450 degrees or greater than approximately 20 mm insertion depth, pitch saturated at approximately 420 Hz. From 20 to 15 mm insertion depth pitch estimates were about one-half octave lower than the Greenwood function. From 13 to 3 mm insertion depth the pitch estimates were approximately one octave lower than the Greenwood function. The pitch match for an electrode only 3.4 mm into the cochlea was 3,447 Hz. These data are consistent with other reports, e.g., Boëx et al. (2006), of a frequency-to-place map for the electrically stimulated cochlea in which perceived pitches for stimulation on individual electrodes are significantly lower than those predicted by the Greenwood function for stimulation at the level of the hair cell.

- 292. Portmann D, Felix F, Negrevergne M, Bourdin M, Coulomb-Faye F, Polsanski JF (2007) Bilateral cochlear implantation in a patient with long-term deafness, Rev Laryngol Otol Rhinol, 128: 65-68.**

Abstract:

PURPOSE: 1) To report the case of a 70-year-old patient with a history of auditory deprivation for 80% of his life and who received bilateral cochlear implants and 2) to discuss different aspects of the case, including duration of auditory deprivation, the decision for bilateral implantation, age at implantation, and the use of this treatment modality for tinnitus. CASE REPORT: A two-stages bilateral cochlear implantation was performed in a 70-year-old patient with long-term deafness without operative or post-operative problems with excellent functional result. DISCUSSION: Various studies have reported that in patients with long-term auditory deprivation, the results of cochlear implants are delayed and sometimes unsatisfactory when compared to patients with more recent post-lingual deafness. However, they did not contraindicate the surgery. The positive results with the first implant (both for tinnitus and hearing loss) motivated the patient and medical team to proceed to bilateral implantation. CONCLUSION: Patients with longstanding auditory deprivation can achieve good functional results even though at a slower rate. The use of bilateral cochlear implants accelerates and optimizes the final outcome.

- 293. Hochmair I, Nopp P, Jolly C, Schmidt M, Schösser H, Garnham C, Anderson I (2006), MED-EL Cochlear implants: state of the art and a glimpse into the future, Trends Amplif. 2006 Dec;10(4):201-19**

Abstract:

Cochlear implantation is an accepted treatment method for adults and children with severe to profound hearing loss. Confidence in technology has led to changes in individuals who can receive a cochlear implant and changes in expected benefit with a cochlear implant. This article describes the research and development activities at MED-EL, which make possible the implementation of new speech-coding strategies as well as the application of acoustic and electric stimulation via a combined speech processor in MED-EL devices. Research on benefits from bilateral cochlear implantation and electric-acoustic stimulation are also reviewed. Finally, the potential of drug delivery systems is considered as a way to improve cochlear implant outcomes, and results from preliminary evaluations of a hybrid cochlear implant system with drug delivery capabilities are reported.

- 294. Liu H, Feng Y, Chen D, Cai X, He C (2006) The application of 3D reconstruction of CT scans for the observation of the cochlear implanted electrode location, Journal of Clinical Otorhinolaryngology Head and Neck Surgery, 20(13): 597-599**

Article in Mandarin.

Abstract:

**Objective:** To discuss the different methods of computed topography (CT) scans and three dimensional reconstruction of inner ear with implanted electrodes, and to evaluate the value and image features of these methods. **Method:** Six cochlear implant recipients (MED-EL COMBI 40+, Advanced Bionics) recipients were involved in this study. The implanted electrodes of all patients were examine don the seventh postoperative day. The data of the CT scans were transferred to workstation for three-dimensional reconstruction by volume rendering (VR), average intensity projection (AIP) and surface shaded display (SSD). **Results:** The three methods of three dimension reconstruction provided satisfactory image of implanted electrode including the shape and the special relationship of the electrode in the inner ear. The insertion depth of the electrode can be evaluated directly. Moreover, each of the electrode pairs can be identified clearly. **Conclusion:** Postoperative evaluation of the implanted electrode with three methods of CT scans with three dimensional reconstruction of the inner ear provide more accurate image of the spatial relationship of the electrode in the cochlear canal with direct demonstration of electrode insertion depth in the cochlea.

- 295. Castro A, Lassaletta L, Bastarrica M, Prim MP, De Sarriá MJ, Gavilán J (2006) Comparison of different mobile telephones in COMBI 40+ users, Acta Oto-laryngol, 126 : 714-7.**

Abstract:

**CONCLUSION:** Telephone usage is a difficult challenge for cochlear implanted patients. A significant number of cochlear implanted patients are able to carry on a land-line or mobile telephone conversation. The telephone model may be a critical factor for telephone performance. **OBJECTIVES:** The goals of this study were to evaluate speech discrimination through land-line and mobile telephones in Combi40+ users, and to compare different mobile telephone models to find out which could be more advisable for them. **PATIENTS AND METHODS:** Eighteen Combi40+ implantees were tested with CID sentences and bisyllabic words presented through land-line and mobile telephones, in both quiet and noisy environments. **RESULTS:** Mean scores for telephonic speech discrimination were over 85% for CID sentences and 28-59% for bisyllabic words. The Siemens M55 was superior to the other mobile telephones tested.

- 296. Ricketts TA, Grantham DW, Ashmead DH, Haynes DS, Labadie RF (2006) Speech recognition for unilateral and bilateral cochlear implant modes in the presence of uncorrelated noise sources, Ear Hear, 27: 763-73.**

Abstract:

**OBJECTIVE:** The purpose of the current investigation was to compare speech recognition in noise for bilateral and unilateral modes within postlingually deafened, adult bilateral cochlear implant recipients. In addition, it was of interest to evaluate the time course of the bilateral speech-recognition advantage and the effect of changing signal-to-noise ratio (SNR) on the magnitude of the bilateral advantage. **DESIGN:** In the first experiment, 16 postlingually deafened adults who were bilaterally implanted with the MED-EL C40+ cochlear device were evaluated in unilateral left, unilateral right, and bilateral conditions 4 to 7 mo after activation. Speech recognition in the presence of five spatially separated, uncorrelated noise sources was evaluated using both a single fixed SNR of +10 dB and an adaptive-SNR method. In a follow-up study, a subset of 10 participants was re-evaluated using

an identical fixed-SNR method 12 to 17 mo after activation to examine the time course of speech-recognition performance in both unilateral and bilateral modes at a single SNR. A third study was performed with a subset of six participants to examine performance over a range of SNRs. In this study, speech recognition was measured 12 to 17 mo after activation in quiet and at +5, +10, +15, and +20 dB SNRs using the same five uncorrelated noise sources. RESULTS: The speech-recognition data revealed a significant bilateral advantage of 3.3 dB using the adaptive-SNR method. A significant bilateral advantage of 9% was also measured using a fixed +10 dB SNR. Results from the second study revealed that experience resulted in a significant (11 to 20%) increase in speech-recognition-in-noise performance for both unilateral and bilateral modes; however, the magnitude of the bilateral advantage was not affected by experience. Results from the third study revealed the largest bilateral advantage at the poorest SNR evaluated. In addition, performance in quiet was significantly better than that measured in the presence of noise, even at the +20 dB SNR. CONCLUSIONS: The results of these experiments support a small but significant bilateral speech-recognition-in-noise advantage for cochlear implant recipients in an environment with multiple noise sources. This advantage is presumed to be attributable to the combined effects of binaural squelch and diotic summation. Although experience generally improved speech-recognition-in-noise performance in both unilateral and bilateral modes, a consistent bilateral advantage (approximately 10%) was measured at 4 to 7 mo and at 12 to 17 mo postactivation.

- 297. Nie K, Barco A, Zeng FG (2006) Spectral and temporal cues in cochlear implant speech perception, Ear Hear, 27: 208-17.**

Abstract:

OBJECTIVE: Taking advantage of the flexibility in the number of stimulating electrodes and the stimulation rate in a modern cochlear implant, the present study evaluated relative contributions of spectral and temporal cues to cochlear implant speech perception. DESIGN: Four experiments were conducted by using a Research Interface Box in five MED-EL COMBI 40+ cochlear implant users. Experiment 1 varied the number of electrodes from four to twelve or the maximal number of available active electrodes while keeping a constant stimulation rate at 1000 Hz per electrode. Experiment 2 varied the stimulation rate from 1000 to 4000 Hz per electrode on four pairs of fixed electrodes. Experiment 3 covaried the number of stimulating electrodes and the stimulation rate to study the trade-off between spectral and temporal cues. Experiment 4 studied the effects of envelope extraction on speech perception and listening preference, including half-wave rectification, full-wave rectification, and the Hilbert transform. Vowels, consonants, and HINT sentences in quiet, as well as with a competing female voice served as test materials. RESULTS: Experiment 1 found significant improvement in all speech tests with a higher number of stimulating electrodes. Experiment 2 found a significant advantage of the high stimulation rate only on consonant recognition and sentence recognition in noise. Experiment 3 found an almost linear trade-off between the number of stimulation electrodes and the stimulation rate for consonant and sentence recognition in quiet, but not for vowel and sentence recognition in noise. Experiment 4 found significantly better performance with the Hilbert transform and the full-wave rectification than the half-wave rectification. In addition, envelope extraction with the Hilbert transform produced the highest rating on subjective judgment of sound quality. CONCLUSIONS: Consistent with previous studies, the present result from the five MED-EL subjects showed that (1) the temporal envelope cues from a limited number of channels are sufficient to support high levels of phoneme and sentence recognition in quiet but not for speech recognition in a competing voice, (2) consonant recognition relies more on temporal cues while vowel recognition relies more on spectral cues, (3) spectral and temporal cues can be traded to some degree to produce similar performance in cochlear implant speech recognition, and (4) the Hilbert envelope improves both speech intelligibility and quality in cochlear implants.

- 298. Thomas AD, Evans RA (2006) Ineraid to MED-EL COMBI 40+ upgrade: a case report, CII, 7(2): 117-21.**

Abstract:

Continual changes in cochlear implant technology have resulted in the development of superior implants which improve quality of life of users. We present the case of a taxi driver who has been in our cochlear implant programme since 1991 and has required reimplantation. We discuss the benefits of the new implant on his life and work. A novel technique to successfully reimplant the ipsilateral cochlea is highlighted.

- 299. Anderson I, Baumgartner WD, Böheim K, Nahler A, Arnoldner C, D'Haese P (2006) Telephone use: what benefit do cochlear implant users receive? Int J Audiol, 45(8): 446-53.**

Abstract:

This study evaluated the use of landline and mobile phones in an international sample of cochlear implant users. A custom-designed survey was mailed to cochlear implant users from four different countries. A link to the survey was posted on the MED-EL website, with responses from a further six countries. Results from 196 surveys show that there is a significant shift from pre-operative non-use of a telephone to use of a telephone post-operatively. Seventy-one percent of MED-EL cochlear implant users are able to use a landline telephone to some extent and 54% are able to use a mobile phone to some extent. Talking to familiar speakers about familiar topics is the easiest listening condition on the telephone, and it is easier to recognize a voice using the landline. Many respondents found it difficult to make a call without some assistance. Most respondents could manage to call someone in an emergency, even on a mobile phone. Data obtained should provide useful information in the counselling and rehabilitation of cochlear implant recipients and candidates

- 300. Skarzynski H, Lorens A, Piotrowska A, Anderson I (2006) Partial deafness cochlear implantation provides benefit to a new population of individuals with hearing loss, *Acta Otolaryngol*, 126(9): 934-40.**

Abstract:

**CONCLUSION:** Partial deafness cochlear implantation (PDCI) is a feasible means of treating individuals who have good low frequency hearing, but a severe to profound hearing loss in the mid to high frequencies. The individuals have benefit in noise and show significant benefit in a number of difficult listening conditions, when compared with their acoustic-only hearing prior to implantation. This benefit is maintained over time. **OBJECTIVES:** PDCI using the round window surgical technique is one means of treating individuals with a 'ski-slope' hearing loss, who gain minimal benefit from amplification with conventional hearing instruments. This paper aims to demonstrate the benefit that PDCI provides these individuals. **PATIENTS AND METHODS:** Ten subjects received a partial insertion of a standard MED-EL electrode, using the round window approach. Pure tone audiometry and monosyllable testing in quiet and noise were conducted preoperatively, at implant fitting and then at 1, 3, 6 and 12 months after initial device fitting. The APHAB questionnaire was completed by subjects preoperatively and then at 6 and 12 months after receiving their cochlear implant. **RESULTS:** Hearing was preserved in 9 of 10 cases. One subject uses a hearing aid to amplify low frequency hearing, the remainder use natural low frequency hearing. Improvements in monosyllabic scores over time in both quiet and noise were significant, particularly within the first 3 months of PDCI use.

- 301. Boyd PJ (2006) Effects of programming threshold and maplaw settings on acoustic thresholds and speech discrimination with the MED-EL COMBI 40+ Cochlear Implant, *Ear Hear*, 27(6): 608-18.**

Abstract:

**OBJECTIVES:** The principal task in the programming of a cochlear implant (CI) speech processor is the setting of the electrical dynamic range (output) for each electrode, to ensure that a comfortable loudness percept is obtained for a range of input levels. This typically involves separate psychophysical measurement of electrical threshold ( $\theta_e$ ) and upper tolerance levels using short current bursts generated by the fitting software. Anecdotal clinical experience and some experimental studies suggest that the measurement of  $\theta_e$  is relatively unimportant and that the setting of upper tolerance limits is more critical for processor programming. The present study aims to test this hypothesis and examines in detail how acoustic thresholds and speech recognition are affected by setting of the lower limit of the output ("Programming threshold" or "PT") to understand better the influence of this parameter and how it interacts with certain other programming parameters. **DESIGN:** Test programs (maps) were generated with PT set to artificially high and low values and tested on users of the MED-EL COMBI 40+ CI system. Acoustic thresholds and speech recognition scores (sentence tests) were measured for each of the test maps. Acoustic thresholds were also measured using maps with a range of output compression functions ("maplaws"). In addition, subjective reports were recorded regarding the presence of "background threshold stimulation" which is occasionally reported by CI users if PT is set to relatively high values when using the CIS strategy. **RESULTS:** Manipulation of PT was found to have very little effect. Setting PT to minimum produced a mean 5 dB (S.D. = 6.25) increase in acoustic thresholds, relative to thresholds with PT set normally, and had no statistically significant effect on speech recognition scores on a sentence test. On the other hand, maplaw setting was found to have a significant effect on acoustic thresholds (raised as maplaw is made more linear), which provides some theoretical explanation as to why PT has little effect when using the default maplaw of  $c = 500$ . Subjective reports of background threshold stimulation showed that most users could perceive a relatively loud auditory percept, in

the absence of microphone input, when PT was set to double the behaviorally measured electrical thresholds (thetae), but that this produced little intrusion when microphone input was present. CONCLUSIONS:: The results of these investigations have direct clinical relevance, showing that setting of PT is indeed relatively unimportant in terms of speech discrimination, but that it is worth ensuring that PT is not set excessively high, as this can produce distracting background stimulation. Indeed, it may even be set to minimum values without deleterious effect.

**302. Kiefer J, Böhnke F, Adunka O, Arnold W (2006) Representation of acoustic signals in the human cochlea in presence of a cochlear implant electrode, *Hear Res*, 221: 36-43.**

Abstract:

BACKGROUND:: In subjects with remaining low frequency hearing, combined electric-acoustic stimulation (EAS) of the auditory system is a new therapeutic perspective. Intracochlear introduction of a cochlear implant electrode, however, may alter the biomechanical properties of the inner ear and thus affect perception of acoustic stimuli. STUDY DESIGN:: Based on histological observations of morphologic changes after cochlear implantation in cadaveric and post mortem studies the effects of basilar membrane (BM) stiffening in the ascending basal and middle turns of the cochlea due to close contact of the BM with the electrode were simulated in a 3D-computational finite element model of the inner ear. To verify our simulated results, pre- and postoperative pure-tone audiograms of 13 subjects with substantial residual hearing, who underwent cochlear implantation, were evaluated. RESULTS:: In the scenario of partial BM-fixation, acoustic energy of middle (2kHz) and high (6kHz) frequency was focused basally and apically to the fixed section, increasing BM displacement amplitudes up to 6dB at a stimulation level of 94dB (SPL). Lower frequencies were not affected by fixation in the basal and middle turn of the cochlea. In implanted subjects, a small but significant decrease of thresholds was observed at 1.5kHz, a place in tonotopy adjacent to the tip region of the implanted electrode. CONCLUSION:: Our model suggests that stiffening of the basilar membrane adjacent to an implanted electrode into the basal and middle cochlear turn did not affect BM movement in the low frequency area. Focussing of acoustic energy may increase perception in regions adjacent to the fixed section. Observations in implanted subjects were concordant with our model predictions. High frequencies, however, should not be amplified in patients using EAS to avoid disturbances in discrimination due to tonotopically incorrect frequency representation.

**303. Hamzavi J & Arnoldner C (2006) Effect of deep insertion of the cochlear implant electrode array on pitch estimation and speech perception, *Acta Otolaryngol*, 126: 1182-7.**

Abstract:

Conclusion: Deeply inserted electrodes offer the possibility that apical stimulation may improve speech performances. Therefore, deep insertion is reasonable and should be performed in patients with profound or total hearing loss. Objectives: To evaluate the importance of insertion depth beyond 25 mm in a group of cochlear implant patients with deeply inserted electrodes up to 32 mm. Patients and methods. In the first part of the study patients were asked to perform a pitch estimation for channels across the whole length of the electrode array. We evaluated whether pitch discrimination was possible along the whole cochlea and especially in its apical part. Then, the audiological performances of 10 patients were tested in 5 conditions, in which we artificially varied the insertion depth in each patient by activating and deactivating channels. The patients were tested immediately in the new condition to avoid adaptation. Results: The results showed that activating the electrodes in the uppermost region of the cochlea improves speech perception significantly. Furthermore it could be demonstrated that the pitch perceived in the cochlea with electrical stimulation decreases with increasing insertion depth along the whole length of deeply inserted electrode arrays.

**304. Steinbach S, Brockmeier SJ, Kiefer J (2006) The large vestibular aqueduct – a case report and review of the literature, *Acta Otolaryngol*, 126: 788-95.**

Abstract:

Patients with a large vestibular aqueduct (LVA) suffer from a loss of hearing in childhood at an early onset. An acute loss of hearing can be precipitated by minor head trauma. Until now there seems to be no sufficient therapy for stopping the progression of a loss of hearing. It has been shown that a cochlear implantation is a worthwhile procedure if the patient is almost deaf. We report the case of a patient with a bilateral LVA. A loss of hearing was confirmed at the age of 16 months. Exposure to loud noise triggered an acute progression of the hearing loss. At the age of 18 years, LVA was confirmed radiologically, revealing an enlarged endolymphatic duct and sac in MRI

scans and an enlarged vestibular aqueduct in the CT scan. We successfully performed a cochlear implant (MED-EL, COMBI 40+ flex). Proceeding from this case report, the paper reviews the literature on LVA.

- 305. Poetker DM, Wackym PA, Yoganandan N, Runge-Samuelson CL, Firszt JB, Pintar FA (2006) Biomechanical strength of reconstruction plates when used for medial support of MED-EL cochlear implants: Implications for diagnostic MRI, ORL, 68: 77-82.**

Abstract:

Purpose: It is hypothesised that a mesh reconstruction plate designed to fit a cochlear implant (CI) internal device will provide immediate structural support to the side of the implant and that this strength far exceeds the forces induced by a 1.5-tesla MRI. Procedures: Human cavarial specimens were drilled and plated with reconstruction mesh. Force was applied until failure was reached. Results: Mean maximum force, mean force to first failure and mean displacement measures for group 1 (resorbable mesh, n=10) were 302.9N, 283.0N and 3.05mm, respectively. The mean maximum force for group 2 (0.4-mm titanium mesh, n=10) and group 3 (0.6-mm titanium mesh, n=8), were 121.3 and 234.0N, respectively. Mean force of first failure was 92.0N for group 2 and 164.8N for group 3. Conclusions: The force required for failure of the mesh is significantly greater than the 0.17N exerted on a CI magnet by a 1.5-tesla MRI scan.

- 306. Manolidis S, Tonini R, Spitzer J (2006) Endoscopically guided placement of prefabricated cochlear implant electrodes in a common cavity malformation, IJPORL, 70: 591-6.**

Abstract:

Objective: To devise a safe and effective method of optimal customised electrode placement in the common cavity of children with cochleovestibular malformations. Methods: Specialized electrodes were manufactured on the basis of three-dimensional data obtained from the high resolution computed tomography (HRCT) scans of the temporal bone of these two children. The electrode positioning was achieved with direct endoscopic view of the cavity utilising a three-hole common cavity technique. Results: Optimal electrode positioning in apposition to the medial neuroepithelium on the common cavity was verified visually intraoperatively. Postoperatively, minimal stable electrical current levels were found to be required. Conclusions: Custom-designed electrodes have the potential to offer improved results in children with common cavity malformations. Intraoperative direct positioning may further improve these results.

- 307. Lin EM, Ray ME, Telian SA (2006) Cochlear implant with ipsilateral petroclival chondrosarcoma, Otol and Neurotol, 27(3):337-41.**

Abstract:

Objective: To highlight a case of cochlear implantation in the setting of ipsilateral petrous apex chondrosarcoma. Background: A patient with bilateral progressive hearing loss was incidentally found to have a destructive right petrous apex lesion on computed tomography before cochlear implantation. The patient had no associated symptoms and a magnetic resonance imaging scan was obtained, narrowing the differential diagnosis. A middle cranial fossa approach was performed for synchronous biopsy of the lesion and cochlear implantation. Results: Frozen sections revealed a low-grade chondroid lesion, and a MED-EL COMBI 40+ cochlear implant with a split electrode array was inserted via the middle fossa. Final pathologic examination revealed a Grade I chondrosarcoma. The patient suffered no complications postoperatively and was followed-up over 5 years with serial computed tomographic scans and clinical examinations. No additional treatment was administered. Eighteen months postoperatively, the patient experienced episodic vertigo. There were no new findings on computed tomography, and the vertigo improved with a low-salt diet. Otherwise, the patient had excellent hearing results, and the lesion has not progressed under observation. Conclusion: The implications of observing low-grade chondrosarcomas in well-selected patients and the unique aspect of cochlear implantation on the affected side are discussed.

- 308. Ricketts T, Grantham DW, D'Haese P, Edwards J, Barco A (2006) Cochlear implant speech processor placement and compression effects on sound sensitivity and interaural level difference, J Am Acad Audiol, 17(2): 133-40.**

Abstract:

The purpose of this investigation was to determine the impact of commonly recommended cochlear implant (CI) speech processor placements on microphone output both with and without single-channel front-end compression. The impact of this compression use on interaural level difference (ILD) magnitude was also evaluated for the ear-level position. Finally, pilot localisation data collected with and without single-channel, front-end compression was collected on seven bilateral cochlear implant recipients. The results revealed that differences in signal audibility due to clinical placement of CI speech processors in ear, shoulder, and collar positions can at least partially be offset through the use of front-end compression. These data also revealed that compression impacted ILD cues. Preliminary data indicated that some bilaterally implanted subjects were able to take advantage of the enhanced ILD cues when compression was turned off, while other bilaterally implanted subjects did not localise better in the compression-off condition.

- 309. Anderson I, D'Haese PSC, Pitterl M (2006) Opinions on cochlear implant use in senior MED-EL patients, *ORL*, 68: 221-7.**

Abstract:

This study assessed the subjective benefits of cochlear implants in senior patients wearing a MED-EL device. Data was compared with previous studies to assess the influence of recent speech-coding strategies and behind-the-ear speech processors; users of the behind-the-ear device and the bodyworn device were also compared. An adaptation of the Nucleus 22-channel survey was sent to 141 cochlear implant users. The survey assesses perception of the device, communication benefits, handling the device and quality of life. Ninety-five surveys were returned. Results demonstrate that advanced technology provides greater benefit now than 9–13 years ago, notably: improved listening across noise, better understanding on the telephone and better speech perception. Users of the behind-the-ear device did not report more difficulties than body-worn device users but demonstrated better performance. Results show a positive outcome for cochlear implantation in a MED-EL seniors group.

- 310. Lassaletta L, Castro A, Bastarrica, de Sarriá MJ, Gavilán J (2006), Quality of life in postlingually deaf patients following cochlear implantation, *Eur Arch Otorhinolaryngol*, 263: 267-70.**

Abstract:

Most cochlear implant studies are focused on improvement of speech perception associated with implantation. The goal of this study was to assess the impact of cochlear implantation on quality of life changes in Spanish users. Thirty postlingually deaf patients fitted with a cochlear implant completed the Glasgow Benefit Inventory, a questionnaire dealing with communication abilities, and open-ended questionnaire. The Glasgow Benefit Inventory revealed a positive effect in 93% of patients. The use of a cochlear implant significantly enhanced discrimination ability, telephone use and self-confidence. A high degree of satisfaction was achieved in all situations except with background noise. Ninety-six percent of patients would recommend the operation to a friend. A dramatic improvement in quality of life following cochlear implantation is revealed by a great majority of patients. Results cannot only be explained by enhancement to auditory perception.

- 311. Castro A, Lassaletta L, Bastarrica M, Alfonso C, Prim MP, de Sarriá, Gavilán J (2005) Calidad de vida en pacientes con implante coclear (Quality of life in cochlear implanted patients), *Acta Otorrinolaringol Esp*, 55: 192-7.**

Article written in Spanish.

Abstract:

Several articles show the audiologic benefits of cochlear implants, although it is still necessary to prove their impact on quality of life. In this study, 36 Med-El processor users were included. The Glasgow Benefit Inventory (GBI) was used to measure changes in quality of life, and another questionnaire was used to evaluate the communication abilities. Eighty-six percent of the patients answered our questionnaire. The quality of life improved significantly according to the specific questionnaire. The average total benefit obtained with the GBI was +41, and the average scores related to general, social and physics benefits were +57, +16, and +3, respectively. No significant difference was found between quality of life and other parameters like insertion depth of the array, etiology or duration of the deafness.

- 312. Castro A, Lassaletta L, Bastarrica M, Prim MP, de Sarriá J (2005) Discriminación verbal a través teléfono en pacientes implantados con un COMBI 40+ (Speech discrimination through telephone in patients with a COMBI 40+), Acta Otorrinolaringol Esp, 56: 246-51.**

Article written in Spanish

Abstract:

OBJECTIVE: To assess speech discrimination through line and mobile telephone in cochlear implanted patients. MATERIAL AND METHODS: Eighteen patients implanted with a Combi 40+ went through different speech discrimination tests with a line telephone and three mobile telephones, in quiet and noisy environment. RESULTS: Mean scores for telephonic speech discrimination were 84-92% using CID sentences, 27-58% using bisyllabic words in quiet environment and 15-41% using bisyllabic words in noisy environment. Among the mobile telephones tested, the Siemens M55 reached the best scores. CONCLUSIONS: Telephonic speech discrimination is achieved by a significant number of cochlear implanted patients. Certain mobile telephone models appear to be more advisable for these patients.

- 313. Henkin Y, Kaplan-Neeman R, Kronenberg J, Miigirov L, Hildesheimer M, Muchnik C (2005) Electrical stimulation levels and electrode impedance values in children using the MED-EL COMBI 40+ cochlear implant: A one year follow-up, J Basic Clin Physiol Pharmacol, 16(2): 127-37.**

Abstract:

The present study was designed to follow changes in electrical stimulation levels and electrode impedance values (EIV) in children using the Med-El Combi 40+ cochlear implant (CI) during the first 12 months of implant use. The maps of 24 prelingually deaf children implanted at a mean age of 5.9 years (range 1-15.9 years) using the TEMPO+ speech processor programmed with CIS+ strategy were examined at five time points: initial stimulation, and 1, 3, 6, and 12 months post-initial stimulation. Most comfortable levels (M) and electrode impedance values (EIV) were analyzed according to three cochlear segments: apical, medial, and basal. Results indicated a significant increase in M levels until the 3-month time point, thereafter stabilization was evident. Furthermore, M levels in the apical segment were lower than those in the medial and basal segments. EIV decreased from initial stimulation to the 3-month time point and was then stable through the study follow up. Interestingly, the finding of higher EIV in the apical segment may be attributed to the physical characteristics of the Med-El electrode. In conclusion, the pattern of stabilization of M levels found in the present study is similar to that reported for children using other devices. The data presented here may be useful as a guideline for programming M levels and monitoring EIV in infants and young children. They may further help clinicians to identify those children that fall outside the 'typical' range.

- 314. Adunka O, Kiefer J (2005) Wie funktioniert der Sprachprozessor von Cochlea-Implantaten (How does a cochlear implant speech processor work?) Laryngo-Rhino-Otol, 84: 841-50.**

Article in German.

Abstract:

Cochlear implants have become a standard treatment modality for sensorineural hearing loss. In this review article, assembly and function a cochlear implant are described. Cochlear implants replace the normal inner ear by transforming acoustic sound signals into electric stimuli and deliver these to the auditory nerve. Speech processors translate the acoustic signal of the microphone into one that fits electrostimulation of the auditory system. In multiple steps, the signal has to be analysed and processed to fit the demands of electrical stimulation. The speech processor then sends commands and the energy for stimulation to the implanted appts via a transcutaneous high frequency radio link. The implant refers the information as electrical stimuli to each electrode contact.

- 315. Helms J, Müller J, Brill S, Schön S, Shehata-Dieler W (2005) Modern cochlear implantation, Otolaryngologia Polska, LIX, 6: 803-5.**

No abstract.

- 316. Millar DA, Hillman TA, Shelton C (2005) Implantation of the ossified cochlea: Management with the Split electrode array, *Laryngoscope*, 115: 2155-60.**

Abstract:

Objectives/hypothesis: To describe indications for, the surgical technique required, and the expected functional results of split electrode array cochlear implants. Study design: retrospective chart review. Methods: Data collected included aetiology of deafness, radiographic findings, pre- and postoperative aided pure tone thresholds, and speech perception testing. Adult speech perception outcomes were measured using the Consonant Nucleus Consonant (CNC) monosyllable words and Hearing in Noise Test (HINT) in quiet/noise (+10dB). The children were assessed using the Infants and Toddlers Meaningful Auditory Integration Scale. Results: Five patients were implanted with a split electrode array. This included two adults and three children. Both adults had pre-operative binaural aided pure tone averages worse than 50dB and scores of 0% in both Hint quiet and CNC words. The children had undetectable pre-operative aided thresholds and scored an average 4/40 on the IT-MAIS. Post implant, the average threshold gain was 38.5dB in the adults and 81.5dB in the children. One adult improved to score 51%/22% on HINT quiet/noise at 6 months and 72%/30% at 12 months. The other adult continued to score 0% on HINT at 12 months but claimed substantial subjective auditory improvement after the first year of device use. The children averaged 28/40 on the IT-MAIS at 6 months after implantation. Forty-two of 48 implanted electrodes were functional. Conclusions: The split electrode array is a very useful alternative to traditional cochlear implants in treating deafened patients with cochlear ossification. Patients implanted with the split array showed a marked improvement in sound and speech perception.

- 317. Roland PS, Gstöttner W, Adunka O (2005) Method for hearing preservation in cochlear implant surgery, *Op tech In Otolaryngol*, 16(2): 93-100.**

Abstract:

Individuals with useful hearing in the lower frequencies (less than 1000 cycles per second) but with severe to profound losses in the higher frequencies often have poor speed discrimination scores, especially in noise. Conventional hearing aids only provide marginal increases in word discrimination for this class of individuals. Consequently, interest has developed in electrically stimulating those regions of the cochlear (apical) that subserve higher frequencies while permitting the individual to continue to hear (with or without a hearing aid) lower frequency sound acoustically. To successfully implement such a strategy, residual hearing must be maintained for lower frequency sounds. Technical alterations in the operative technique of cochlear implantation designed to preserve hearing include: (1) avoidance of acoustic trauma using low speed drills; (2) careful placement of the cochleostomy anterior and inferior to the round window membrane to avoid damage to the basilar membrane and osseous spiral lamina; (3) the use of steroids to protect against injury to the Organ of Corti at the cellular level; (4) the use of shorter, thinner, atraumatic electrodes; and (5) a small cochleostomy to prevent buckling of the electrode and escape of perilymph.

- 318. Bassim MK, Buss E, Clark MS, Kolln KA, Pillsbury CH, Pillsbury HC, Buchman CA (2005) MED-EL COMBI 40+ cochlear implantation in adults, *Laryngoscope*, 115: 1568-73.**

Abstract:

Objective/Hypothesis: Cochlear implantation is currently the treatment of choice for severe to profound sensorineural hearing loss. The MED-EL COMBI 40+ (Innsbruck, Austria) cochlear implant system was approved for use in the United States in 2001. This device employs a 31-mm-long electrode array, ceramic case, and continuous interleaved sampling with Hilbert transformation for envelope extraction. A single institution's experience with the COMBI 40+ implant in adult patients was reviewed. Study design: Retrospective chart review. Methods: Medical-surgical and audiological data were collected from 112 patients who received a MED-EL COMBI 40+ cochlear implant between December 1998 and April 2004. Results: The rate of surgical complications and speech perception testing results compared favourably with those of other cochlear implant systems. For postlingually deafened adults, mean CNC word, HINTQ, CUNY, and HINT + 10 dB signal-to-noise ratio scores after 1 year of implant usage were 54%, 87%, 96%, and 64%, respectively. Prelingually deafened adults also derived significant benefit, but plateau performance for these patients was well below that for patients with later onset of deafness and significant variability was seen in this group. Repeat implantation for suspected device

malfunction was undertaken in seven cases (6% of devices) (mean duration of use, 28 +/- 12 mo) with ultimate resolution of the presenting problem. Conclusion: The study results support the safety and efficacy of cochlear implantation with the MED-EL COMBI 40+ cochlear implant system.

- 319. Anderson I, Martin J, Costa A, Jamieson L, Bailey E, Plant G, Pitterl M (2005) Validation of the Common Objects Token (COT) Test for children with cochlear implants, Deafness and Education International, 7(3): 154-70**

Abstract:

Changes in selection criteria have meant that children are being provided with cochlear implants (CI) at increasingly younger ages. However, there is a paucity of measures appropriate for testing complex listening skills - most tests are too cognitively complex for such young children. The Common Objects Token (COT) Test was developed as a complex closed set test for children with profound hearing losses. This test was assessed for its usefulness in assessing children with cochlear implants. The test was administered to 20 implanted children over a period of two months. Results indicated that some subtests were equal and there was not a hierarchical subtest order. Based on these findings, the test was modified and then re-assessed on 85 children. Outcomes showed that all subtests assessed the same construct. Two subtests were able to predict the total score of the COT test. The test was modified to include two levels, one with easier tests suitable for younger children, and a shorter, quicker version for instances where there may be attention span or time constraints. Outcomes showed that the test may be suitable for children aged 3 and above and that children with less than 2 years of CI experience are able to perform on the test. The results of this testing indicated that the COT test is a useful addition to the test battery for assessing young implanted children.

- 320. Völter C, Shehata-Dieler W, Baumann R, Helms J (2005) Entwicklung eines neuen Kindersprachstests und Erprobung an CI-Kindern (Development of a new test for speech audiometry in children and results in CI children), Laryngo-Rhino-Otol, 84: 738-43**

Article in German.

Abstract:

Background: Speech audiometry plays an important role for hearing evaluation in children. Hearing impaired children, such as those with cochlear implant (CI) who frequently undergo testing, learn the test words by heart. Furthermore, the standard tests use words of former time. Patients and methods: Using the most frequently words of modern children's literature a speech assessment test was developed for children between 1 to 8 years. The material was first evaluated on normal hearing children. In a second step the phoneme and word perception scores of 35 CI children were measured using 60 - 100 dB SPL according to the most comfortable level (MCL) in free sound field. Results: The performance-intensity function for the single words were highly comparable with those of the Freiburger or Gottinger speech perception test. The average speech reception threshold in CI children was 44 % (test I), 36 % (test II), 63 % (test III) and 69 % (test IV), respectively. Compared to the Mainzer and Gottinger speech perception test the new words were more difficult to understand than those of the known tests. However, a statistically significant difference could be noted only for test II. Conclusions: The new developed "Wurzburger speech perception test" appears to be a useful additional tool for the evaluation of hearing impaired children in addition to the standard test procedures.

- 321. Gstöttner W, Pok SM, Peters S, Kiefer J, Adunka O (2005) Kochleaimplantat mit Tieftonrestgehörhalt (Cochlear implantation with preservation of residual deep frequency hearing), HNO, 53(9): 784-91.**

Article in German.

Abstract:

Background: The aim of the present paper is to evaluate the clinical parameters in patients implanted for combined, ipsilateral electric-acoustic stimulation of the auditory system. Methods: A total of 18 patients with residual deep frequency hearing were implanted with a COMBI 40+cochlear implant (MED-EL, Austria). Insertion depths ranged from 18 to 22 mm (360 degrees). A modified surgical technique should contribute to hearing preservation in low frequency regions of the cochlea. Pure-tone audiometric thresholds were measured pre- and postoperatively. A speech audiometric evaluation was performed on two subjects. Results: Utilizing adapted surgical procedures, the preservation of low frequency hearing was accomplished in 16 of 18 subjects (88.9%).

Seven (38.9%) patients had complete and nine (50.0%) partial preservation of residual hearing. The speech discrimination scores of two patients documented an increase in sentence intelligibility when compared with only the cochlear implant. Conclusions: Hearing preservation in cochlear implant surgery is possible. Insertions of 360 degrees provide a full functioning cochlear implant to stimulate sufficient neural structures for above average discrimination scores with the implant alone. A synergistic effect of the electric and the acoustic stimulation modes leads to high discrimination scores in background noise.

- 322. Adunka O, Kiefer J, Unkelbach M, Radeloff A, Gstoettner W (2005) Evaluating cochlear implant trauma to the scala vestibuli, Clin Otolaryngol, 30: 121-7.**

Abstract:

Objectives: Placement of cochlear implant electrodes into the scala vestibuli may be intentional, e.g. in case of blocked scala tympani or unintentional as a result of trauma to the basilar membrane or erroneous location of the cochleostomy. The aim of this study was to evaluate the morphological consequences and cochlear trauma after implantation of different cochlear implant electrode arrays in the scala vestibuli. DESIGN: Human temporal bone study with histological and radiological evaluation. SETTING: Twelve human cadaver temporal bones were implanted with different cochlear implant electrodes. Implanted bones were processed using a special method to section undecalcified bone. MAIN OUTCOME MEASURES: Cochlear trauma and intracochlear positions. RESULTS: All implanted electrodes were implanted into the scala vestibuli using a special approach that allows direct scala vestibuli insertions. Fractures of the osseous spiral lamina were evaluated in some bones in the basal cochlear regions. In most electrodes, delicate structures of the organ of Corti were left intact, however, Reissner's membrane was destroyed in all specimens and the electrode lay upon the tectorial membrane. In some bones the organ of Corti was destroyed. CONCLUSIONS: Scala vestibuli insertions did not cause severe trauma to osseous or neural structures, thus preserving the basis for electrostimulation of the cochlea. However, destruction of Reissner's membrane and impact on the Organ of Corti can be assumed to destroy residual hearing.

- 323. Mo B, Lindbæk M, Harris S (2005) Cochlear implants and quality of life: A prospective study, Ear Hear, 26: 186-94.**

Abstract:

Objective: To evaluate changes in quality of life, anxiety, and depression after cochlear implantation in adults. Design: Twenty-seven postlingually deafened adults who had received a MED-EL COMBI40+ implant were investigated. One generic Health-Related Quality of Life measure, the SF-36, two disease-specific measures, the Patient Quality of Life Form (PQLF) and the Index Relative Questionnaire Form (IRQF) completed by a near relative to the patient, in addition to a domain specific measure, the Hopkins Symptom Checklist 25 items (HSCL-25), were used in a prospective study. The subjects were investigated before surgery and 12 to 15 months after surgery. Results: The scores were significantly better after surgery in four of six categories of the PQLF. In the IRQF, where a family member of the cochlear implant recipient was studied, the scores were significantly better in four of five categories. There was a significant improvement in the HSCL-25 after surgery. In the SF-36, only one of eight scales showed significant improvement. Conclusions: Cochlear implants were associated with statistically significant improvements in quality of life in postlingually deafened adults. The improvements were largest in the categories concerning communication, feelings of being a burden, isolation, and relations to friends and family. There was a statistically significant reduction in degree of depression and anxiety. Reduction in anxiety and depression was associated with gain in quality of life.

- 324. Chu KMY, Au DKK, Chow CK, Wei WI (2005) Short electrode insertion in cochlear implantation: Speech perception performance of Cantonese-speaking subjects, Acta Oto-Laryngol, 125: 718-24.**

Abstract

Conclusions: Subjects with cochlear ossification derived benefits in terms of speech performance similar to those of the nonossified group. It is thus recommended that the insertion of short electrode arrays should be considered an alternative choice for patients with cochlear ossification. Objective: Cochlear ossification has been recognized as a major obstacle to the full insertion of a multichannel cochlear implant electrode array. To alleviate the technical difficulty of placing a standard electrode array and the possibility of causing undesirable trauma to the cochlea, a newly designed electrode array with the same number of electrodes compressed into a shorter length has been made available. The aim of the present study was to examine the speech perception performance of

patients implanted with the MED-EL C40+ SS compressed electrode array and to compare their results with those of matched groups implanted with the MED-EL C40+ / standard electrode array. Material and methods: One pre-lingually and two post-lingually deaf subjects using short electrode arrays were matched with three groups of subjects using standard electrode arrays. The pre- and postoperative speech perception scores were evaluated. Results: All three subjects using compressed electrode arrays achieved speech perception scores comparable to those of matched subjects using standard electrode arrays. There was also a tendency for the subjects to show similar patterns of speech perception scores as a function of the difficulty of the tests.

- 325. Brickley GJ, Boyd P, Wyllie F, O'Driscoll M, Webster D, Nopp P (2005) Investigations into electrically evoked stapedius reflex measures and subjective loudness percepts in the MED-EL COMBI 40+ cochlear implant, Cochlear Implants International, 6(1): 31-42.**

Abstract:

For several years there has been interest in using objective measures to set channel-specific upper programming limits when programming the speech processor of cochlear implant users. The present study aims to add to previous reports by examining correlations between electrically evoked stapedius reflex threshold (ESRT) and a range of psychophysical loudness estimates in a group of 22 adult users of the MED-EL COMBI 40+ system. Thirteen of the 15 subjects (87%) had recordable stapedius reflexes. Psychophysical measures of threshold, maximum comfort level (MCL) and maximum acceptable loudness (MAL) were recorded. Results showed that mean ESRT was closest to the MCL using 500ms burst ('MCL500'), with MCL50 (MCL using 50ms burst) and MAL500 some 2dB and MAL50 3dB higher. Correlations between ESRT and the behavioural loudness judgements were highest for MCL599 ( $R=0.69$ ,  $p<0.001$ ) and slightly less for MAL500. These results confirm the ease of measuring ESRT in a clinical setting and that a high level of confidence can be placed on the use of these measures for setting processor maps in the absence of behavioural data.

- 326. Weichbold V, Tsiakpini L, Coninx F, D'Haese P (2005) Konstruktion eines Eltern-Fragebogens zur entwicklung des auditiven Verhaltens von Kleinkindern bis zu zwei Jahren (Development of a parent questionnaire for assessment of auditory behaviour of infants up to two years of age), HNO, 84: 328-334.**

Article in German.

Abstract:

Background: There is an increasing need for an instrument, which allows to quickly and reliably assess the auditory behaviour of infants and toddlers. Scientific question and objective: The objective of this study was to develop and validate the "LittleEARS Hearing Questionnaire", a tool for assessing auditory behaviour in children up to 24 months of age. Methods:; Questionnaire construction followed the principles of classical test theory. The psychometric properties of 45 questions on infant auditory behaviour were examined in a sample of 218 parents of normal hearing infants up to age 24 months. Parental responses also served for computing normative values of the development of early auditory behaviour by regression analysis. Results: The final questionnaire contains 35 items, to be answered with either "yes" or "no". The sum of "yes"-answers yields an overall score, which can be compared to age-related normative values in order to appraise the age-appropriateness of the infant's auditory behaviour. The following scale characteristics have been found with the above sample: internal consistency: Cronbach's Alpha = 0.96; reliability: split-half  $r=0.88$ ; predictive accuracy: Guttman's Lambda 0 0.96; correlation between overall score and age of the children:  $r=0.91$ . Conclusion: The "LittleEARS Hearing Questionnaire" is suitable for the quick assessment of a little child's hearing behaviour, e.g. at physical examinations, at the postnatal hearing screening, or when evaluating rehabilitative measures.

- 327. Kanchanalarp C, Cheewaruangroj W, Kasemsuwan L, Thawin C, Sriwanyong S (2005) Pediatric cochlear implantation: Experience in Thai patients, J Med Assoc Thai 88(4): 484-91.**

Abstract:

Objective: This study was to evaluate the result of cochlear implantation in Thai paediatric patients from 1999-2003. Design: A prospective, open-labelled study. Setting: University teaching hospital. Material and method: Long term surgical and audiological results comparison after cochlear implantation in 2 cases with Mondini anomaly, 7 normal cochlea cases and a case of post meningitis post lingual child. Main outcome measures: Speech perception tests battery. Results: Among 10 children, 8 were implanted with Nucleus 22/24; the other two

were implanted with MED-EL device system. The pre-operated cochlea in 2 cases showed Mondini deformity; both had gushers during the operation with a good outcome. The other 8 cases had normal cochlea although one was deaf from bacterial meningitis. There were 3 re-implantations. Speech production and perception was improved faster in the two children implanted with MED-EL than those implanted with Nucleus devices. Conclusion: Cochlear implantation in Mondini cases can be successful in speech production and perception. Speech perception ability depended on the age of implantation and preoperative rehabilitation.

- 328. Spahr AJ, Dorman MF (2005) Effects of minimum stimulation settings for the MED-EL TEMPO+ speech processor on speech understanding, *Laryngoscope*, 115 (8): 2S-6S.**

Abstract:

Objective: The aim of this study was to assess the effects of variations in the settings for minimum stimulation levels on speech understanding for adult cochlear implant recipients using the MED-EL TEMPO+ speech processor. Design: Fifteen patients served as listeners. The test material included sentences presented at a conversational level in noise (74dB SPL at +10dB signal-to-noise ratio), sentences presented at a soft level in a quiet background (54dB SPL), consonants in "vCv" environment (74dB SPL re: vowel peaks), and synthetic vowels in "bVt" environment (54dB SPL re: vowel peaks). The patients' speech processors were programmed with minimum stimulation levels set to behavioral threshold, set to 10% of most comfortable loudness, and set to 0 muA. Results: The level of speech understanding achieved in the behavioral threshold condition was not significantly different from that achieved in either the 10% of most comfortable loudness or 0 muA conditions for any test material. Only 2 of the 15 patients demonstrated performance differences of greater than 10 percentage points between the 0 muA condition and the behavioral threshold condition on more than a single test. Conclusions: Our results demonstrate that there are no grievous consequences, in terms of speech understanding, for setting minimum stimulation levels below behavioral thresholds. The time savings from setting thresholds to 10% of MCL or 0 muA may be especially useful during the initial device fitting.

- 329. Schoen F, Mueller J, Helms J, Nopp P (2005) Sound localization and sensitivity to interaural cues in bilateral users of the MED-EL COMBI 40/40+ cochlear implant system, *Otol & Nuerotol*, 26: 429-37.**

Abstract:

OBJECTIVE: The purpose of this study was to investigate sound localization in subjects bilaterally implanted with MED-EL COMBI 40/40+ cochlear implants. In addition, the sensitivity to interaural cues was assessed. METHODS: In the localization test (11 subjects), CCITT noise (500 ms, original and HRTF-filtered, 70/75/80 dB sound pressure level) was presented from one of seven loudspeakers between -90 degrees and 90 degrees azimuth. The subject had to indicate which loudspeaker the noise was presented from. Sensitivity to interaural level differences (ILD) was assessed by performing localization tests (4 subjects) with the loudness of the two speech processors unbalanced to various degrees. To investigate the subjects' sensitivity to interaural time differences (ITD), lateralization was measured (7 subjects) as a function of the time difference between two Gaussian-like pulses, each directed to one of the subject's speech processor microphones by way of headphones. RESULTS: The judgments of all subjects significantly correlated with the positions of the loudspeakers. The scatter in the judged azimuth measured by the standard deviation of the responses was on average 27.5 degrees. Unbalanced loudness of the speech processors produced a bias in azimuth toward the speech processor with the louder volume setting. The mean rate of shift was 1.4 degrees per unit on the Wuerzburg loudness scale. Six of seven subjects showed a significant sensitivity to ITDs with the approximate time difference required for complete lateralization being 1,200ms on an average. The one subject not showing sensitivity to ITDs performed worst in the localization test. CONCLUSIONS: Bilateral cochlear implantation can restore spatial hearing in cochlear implant users. Both ILDs and ITDs are used by bilateral cochlear implant users in sound localization with ILDs appearing to be the dominant cue.

- 330. Kiefer J, Pok M, Adunka O, Stürzebecher E, Baumgartner W, Schmidt M, Tillein J, Ye Q, Gstoettner W (2005) Combined electric and acoustic stimulation of the auditory system: Results of a clinical study, *Audiol & Neuro-Otol*, 10: 134-44.**

Abstract:

Combined electric and acoustic stimulation (EAS) of the auditory system is a new therapy for patients with severe to profound high- and mid-frequency hearing loss but remaining low-frequency hearing. In a prospective study, 13

patients with low-frequency hearing of better than 60 dB below 1 kHz were implanted with a MED-EL COMBI 40+ cochlear implant. Pure tone thresholds as well as monosyllabic word scores and Hochmair-Schulz-Moser sentences in quiet and in noise were measured with hearing aids, cochlear implant alone and in the combined stimulation mode (EAS) in the same ear. Hearing could be partially preserved in 11 out of the 13 patients. All patients scored significantly higher with cochlear implant alone than with hearing aids. Seven patients scored higher in the EAS mode than with cochlear implant alone for sentences in noise, 4 remained unchanged, and 2 could not use EAS. Synergistic effects of EAS were most prominent for hearing in noise with increases of up to 72% as compared to cochlear implant alone.

- 331. Laback B, Pok SM, Baumgartner WD, Deutsch WA, Schmid K (2005) Sensitivity to interaural level and envelope time differences of two bilateral cochlear implant listeners using clinical sound processors, Ear Hear, 25: 488-500.**

Abstract:

**OBJECTIVES:** To assess the sensitivity of two bilateral cochlear implant users to interaural level and time differences (ILDs and ITDs) for various signals presented through the auxiliary inputs of clinical sound processors that discard fine timing information and only preserve envelope cues. **DESIGN:** In a lateralization discrimination experiment, the just noticeable difference (JND) for ILDs and envelope ITDs was measured by means of an adaptive 2-AFC method. Different stimuli were used, including click trains at varying repetition rates, a speech fragment, and noise bursts. For one cochlear implant listener and one stimulus, the sensitivity to envelope ITDs was also determined with the method of constant stimuli. The dependency of ILD-JNDs on the interaural place difference was studied with stimulation at single electrode pairs by using sinusoidal input signals in combination with appropriate single-channel processor fittings. In a lateralization position experiment, subjects were required to use a visual pointer on a computer screen to indicate in-the-head positions for blocks of stimuli containing either ILD or ITD cues. All stimuli were loudness balanced (before applying ILD) and fed directly into the auxiliary inputs of the BTE processors (TEMPO+, MED-EL Corp.). The automatic gain control and the processors' microphones were deactivated. **RESULTS:** Both cochlear implant listeners were highly sensitive to ILDs in all broadband stimuli used; JNDs approached those of normal-hearing listeners. Pitch-matched single electrode pairs showed significantly lower ILD-JNDs than pitch-mismatched electrode pairs. Envelope ITD-JNDs of cochlear implant listeners obtained with the adaptive method were substantially higher and showed a higher test-retest variability than waveform ITD-JNDs of normal-hearing control listeners and envelope ITD-JNDs of normal-hearing listeners reported in the literature for comparable signals. The envelope ITD-JNDs for the click trains were significantly lower than for the speech token or the noise bursts. The best envelope ITD-JND measured was ca. 250ms for the click train at 100 cycles per sec. Direct measurement of the psychometric function for envelope ITD by the method of constant stimuli showed discrimination above chance level down to 150 micros. The lateralization position experiment showed that both ILDs and envelope ITDs can lead to monotonic changes in lateral percept. **CONCLUSIONS:** The two cochlear implant users tested showed strong effects of ILDs in various broadband stimuli with respect to JNDs as well as lateralization position. The high dependency of ILD-JNDs on the interaural pitch difference suggests the potential importance of pitch-matched assignment of electrodes in the two ears by the speech processors. Envelope ITDs appear to be more ambiguous cues than ILDs, as reflected by the higher and more variable JNDs compared with normal-hearing listeners. The envelope ITD-JNDs of cochlear implant listeners depended on the stimulus.

- 332. Beltrame MA, Frau GN, Shanks M, Robinson P, Anderson I (2005) Double posterior labyrinthotomy technique: Results in Three MED-EL patients with common cavity, Otol Neurotol, 26: 177-82.**

Abstract:

**Hypothesis:** This study reports on the use of the double posterior labyrinthotomy surgical technique and a custom-designed electrode to ensure better positioning of stimulating electrodes within the common cavity and thus demonstrate suitable outcomes in patients. **Background:** Cochlear implantation has proven beneficial for numerous children with congenital malformations of the inner ear. Several studies show good auditory perception outcomes in children with common cavity. However, there have been risks involved with surgical techniques used in the actual implantation. These include possible aberrant facial nerve and the strong potential for a cerebrospinal fluid gusher. Improved surgical techniques and electrode design could allow for better electrode contact and avoid electrode placement in the internal auditory meatus. **Method:** The double posterior labyrinthotomy technique was

carried out in three cases using a custom made MED-EL COMBI 40+ electrode. Results: Surgery was carried out with no complications and is no more technically demanding than other standard surgical approaches. The speech processor program remains stable over time, and auditory perception results are similar to those obtained from children with no cochlear abnormalities. Conclusion: These results demonstrate the success of the double posterior labyrinthotomy approach with modified cochlear implant, and this could be recommended as the procedure of choice in children presenting to an implant team with a common cavity.

**333. Verschuur CA (2005) Effect of stimulation rate on speech perception in adult users of the MED-EL CIS speech processing strategy, *Int J Audiol*, 44: 58-63.**

Abstract:

The primary aim of the study was to determine the effect of altering channel stimulation rate on the performance of adult cochlear implant users. Six adult users of the MED-EL CIS processing strategy underwent tests of categorical identification of synthetic speech, tests of sentence recognition and tests of consonant recognition in three listening conditions: high channel stimulation rate (ranging from 1500 to 2020 pps/ch), a medium rate (800 pps/ch) and a low rate (400 pps/ch). Number of channels was held constant across rate conditions. With the categorical identification task, performance varied by acoustic cue type but did not vary with rate. With the consonant recognition task performance varied by phonological feature, but there was also no significant effect of rate. However, two subjects showed markedly reduced sentence scores at lower rates. Results suggest that higher stimulation rates with the CIS strategy may be beneficial to speech perception in some cases.

**334. Anderson I, Schmidt M, Buchreiter T, Bisanar K (2005) Handling of the MED-EL TEMPO+ ear-level speech processor by paediatric cochlear implant users and their parents, *Int J Audiol*, 43:579-84.**

Abstract:

MED-EL launched the first ear-level speech processor offering a high-rate CIS+ strategy, the TEMPO+, in 1999. Studies have already demonstrated improved speech perception, sound quality and ability to enjoy music with the TEMPO+ due to the new CIS+ speech-coding strategy, when compared to the body-worn processor. In this study we evaluated responses from parents of young children about ease of handling and usage of the TEMPO+, and satisfaction with the TEMPO+ and its performance. Overall, 65 custom-designed questionnaires were analysed. The results showed that MED-EL cochlear implant users felt comfortable manipulating the dials and switches, changing the battery pack, using external sources of input and using the accessories provided. These results confirm the suitability of the TEMPO+ for infants and toddlers.

**335. Anderson I, Pitterl M, Skarzynski H, Evans R, Godey B, Quevedo Sainz M, D'Haese PSC (2005) Long-term data on children implanted with a short electrode array, *IJPORL*, 69: 157-64.**

Abstract:

Ossification and cochlear malformations are no longer seen as a contra-indication to cochlear implantation. The MED-EL COMBI 40+ short electrode was designed specifically for cases where major ossification has occurred, or where full insertion of an electrode may not be possible due to abnormal structure of the cochlea. This study investigates outcomes of 18 children implanted with the short electrode array. These children were assessed using the EARS test battery pre-operatively and at a number of intervals thereafter. Results show a consistent improvement in time on most tests; these results appear to be independent of aetiology. Data from these children were compared to 18 matched pairs implanted with the standard COMBI 40+ electrode array. The short electrode children do not perform as well as the standard children initially, but do tend to catch-up at later test intervals. Results indicate the benefit of using a short electrode when complete insertion of the standard electrode is not viable.

**336. Extended Abstracts from the VIII International Cochlear Implant Conference, Indianapolis, USA: International Congress Series 1273 (2004).**

Wilson BS, Sun X, Schatzer R, Wolford RD. Representation of fine structure or fine frequency information with cochlear implants, pp 3-6.

Lorens A, Wasowski A, Walkowiak A, Piotrowska A, Skarzynski H. Stability of electrically elicited stapedius reflex threshold in implanted children over time, pp 84-86.

Muehloecker C, Bryde Nielsen S, Jaeger A. Using the Insertion Test Device for choosing the best suited cochlear implant electrode variant, pp 101-104.

Skarzynski H, Lorens A, Piotrowska A. Preservation of low-frequency hearing in partial deafness cochlear implantation, pp 239-242.

Von Ilberg C. EAS – state of the art, pp 261-264.

Eckl-Dorna J, Baumgartner WD, Jappel A, Hamzavi J, Frei K. Successful integration of cochlear-implanted children in regular school system, pp 409-412.

Lorens A, Piotrowska A, Skarzynski H. Pitch perception and the number of electrodes vs. long-term development of speech perception ability in auditory brainstem implants, pp 429-432.

Kompis M, Bettler M, Vischer M, Senn P, Häusler R. Bilateral cochlear implantation and directional multi-microphone systems, pp 447-450.

- 337. Adunka O, Kiefer J, Unkelbach MH, Radeloff A, Lehnert T, Gstöttner W (2004) Evaluation of an electrode design for combined electric-acoustic stimulation, *Laryngo-Rhino-Otol*, 83(10): 653-8.**

Article in German.

Abstract:

BACKGROUND: The objective of this study was to assess the intracochlear position and the extent of trauma to cochlear structures using the C40+ M electrode (MED-EL, Innsbruck, Austria), which was especially designed for the combined electric acoustic stimulation. METHODS: Five human temporal bones were implanted using a standard cochlear implant procedure featuring mastoidectomy, posterior tympanotomy, and promontory cochleostomy. For the cochleostomy, an inferior approach with preservation of the endosteum of the cochlea was used to contribute to hearing preservation in the in vivo condition. RESULTS: All insertions of the new electrode array were performed into the scala tympani of the cochlea. The average insertion depth was 288 degrees. Apically, 4 of the 5 implantations were completely atraumatic. One bone showed a rupture of the basilar membrane only at the tip of the electrode. However, 4 of the 5 arrays produced severe trauma to basal cochlear structures. Two pathomechanisms, the direct traumatization through drilling of the cochleostomy or the indirect traumatization via buckling of the array could be distinguished. CONCLUSIONS: Due to the reduced contact spacing and its flexible body, the C40+ M electrode is suitable for cochlear implantations with hearing preservation and combined electric and acoustic stimulation of the auditory system. Modifications of the surgical pathway to the cochlea should help to minimize the risk of basal cochlear trauma.

- 338. Morera C, Sainz M, Cavalle L, De La Torre A, Colaboradores: Anderson I, D'Haese P (2004) Speech understanding in post-lingual adults with cochlear implants, *Acta Otorrinolaringol Esp*, 55: 201-5.**

Article in Spanish.

Abstract:

It is well recognised that multi-channel cochlear implants are highly effective in gaining or regaining auditory perceptual skills of severe to profound hearing-impaired people. Research shows that adults rapidly improve in speech understanding after cochlear implantation. This study reports on speech understanding from two Spanish Clinics. 32 post-lingually deafened adults were fitted with either a MED-EL COMBI 40 or COMBI 40+ cochlear implant at the Hospital Universitario San Cecilio, at the Granada or Hospital Universitario La Fe, Valencia Clinic, Spain. Subjects were assessed at 1, 3, 6 and 12 months post-fitting on a number of speech perception tests. Results showed a highly significant improvement on all speech perception tests over the time. These ratify other studies in saying that cochlear implantation is a viable and successful treatment in post-lingually deafened adults.

- 339. Baskent D, Shannon RV (2004) Frequency-place compression and expansion in cochlear implant listeners, *J Acoust Soc Am*, 116(5): 3130-40.**

Abstract:

In multichannel cochlear implants, low frequency information is delivered to apical locations, while high frequency information is delivered to more basal locations, mimicking the normal acoustic tonotopic organisation of the auditory nerves. In clinical practice, little attention has been paid to the distribution of acoustic input across the electrodes of an individual patient that might vary in terms of spacing and absolute tonotopic location. In normal-hearing listeners, Baskent and Shannon (J. Acoust. Soc. Am. 113, 2003) simulated implant signal processing conditions in which the frequency range assigned to the array was systematically made wider or narrower than the simulated stimulation range in the cochlea, resulting in frequency-place compression or expansion, respectively. In general, the best speech recognition was obtained when the input acoustic information was delivered to the matching tonotopic place in the cochlea with the least frequency-place distortion. The present study measured phoneme and sentence recognition scores with similar frequency-place manipulations in six MED-EL COMBI 40+ implant subjects. Stimulation locations were estimated using the Greenwood mapping function based on the estimated electrode insertion depth. Results from frequency-place compression and expansion with implants were similar to simulation results, especially for postlingually deafened subjects, despite the uncertainty in the actual stimulation sites of the auditory nerves. The present study shows that frequency-place mapping is an important factor in implant performance and an individual implant patient's map could be optimised with functional tests using frequency-place manipulations.

- 340. Laback B, Deutsch WA, Baumgartner WD (2004) Coding of vowel-like signals in cochlear implant listeners, J Acoust Soc Am, 116(2): 1208-23.**

Abstract:

Neural-population interactions resulting from excitation overlap in multi-channel cochlear implants (CI) may cause blurring of the "internal" auditory representation of complex sounds such as vowels. In experiment I, confusion matrices for eight German steady-state vowel-like signals were obtained from seven CI listeners. Identification performance ranged between 42% and 74% correct. On the basis of an information transmission analysis across all vowels, pairs of most and least frequently confused vowels were selected for each subject. In experiment II, vowel masking patterns (VMPs) were obtained using the previously selected vowels as maskers. The VMPs were found to resemble the "electrical" vowel spectra to a large extent, indicating a relatively weak effect of neural-population interactions. Correlation between vowel identification data and VMP spectral similarity, measured by means of several spectral distance metrics, showed that the CI listeners identified the vowels based on differences in the between-peak spectral information as well as the location of spectral peaks. The effect of nonlinear amplitude mapping of acoustic into "electrical" vowels, as performed in the implant processors, was evaluated separately and compared to the effect of neural-population interactions. Amplitude mapping was found to cause more blurring than neural-population interactions. Subjects exhibiting strong blurring effects yielded lower overall vowel identification scores.

- 341. Firszt JB, Holden LK, Skinner MW, Tobey EA, Peterson A, Gaggl W, Runge-Samuelson CL, Wackym PA (2004) Recognition of speech presented at soft to loud levels by adult cochlear implant recipients of three cochlear implant systems, Ear Hear, 25: 375-87.**

Abstract:

Objective: The purpose of this study was to conduct a large-scale investigation with adult recipients of the Clarion, MED-EL, and Nucleus cochlear implant systems to (1) determine average scores and ranges of performance for word and sentence stimuli presented at three intensity levels (70, 60, and 50 dB SPL); (2) provide information on the variability of scores for each subject by obtaining test-retest measures for all test conditions; and (3) further evaluate the potential use of lower speech presentation levels (i.e., 60 and/or 50 dB SPL) in cochlear implant candidacy assessment. Design: Seventy-eight adult cochlear implant recipients, 26 with each of the three cochlear implant systems, participated in the study. To ensure that the data collected reflect the range of performance of adult recipients using recent technology for the three implant systems (Clarion HiFocus I or II, MED-EL COMBI 40+, Nucleus 24M or 24R), a composite range and distribution of consonant-nucleus-consonant (CNC) monosyllabic word scores was determined. Subjects using each device were selected to closely represent this range and distribution of CNC performance. During test sessions, subjects were administered the Hearing in Noise Test (HINT) sentence test and the CNC word test at three presentation levels (70, 60, and 50 dB SPL).

HINT sentences also were administered at 60 dB SPL with a signal-to-noise ratio (SNR) of +8 dB. Warble tones were used to determine sound-field threshold levels from 250 to 4000 Hz. Test-retest measures were obtained for each of the speech recognition tests as well as for warble-tone sound-field thresholds. Results: Cochlear implant recipients using the Clarion, MED-EL, or Nucleus devices performed on average equally as well at 60 compared with 70 dB SPL when listening for words and sentences. Additionally, subjects had substantial open-set speech perception performance at the softer level of 50 dB SPL for the same stimuli; however, subjects' ability to understand speech was poorer when listening in noise to signals of greater intensity (60 dB SPL + 8 SNR) than when listening to signals presented at a soft presentation level (50 dB SPL) in quiet. A significant correlation was found between sound-field thresholds and speech recognition scores for presentation levels below 70 dB SPL. The results demonstrated a high test-retest reliability with cochlear implant users for these presentation levels and stimuli. Average sound-field thresholds were between 24 and 29 dB HL for frequencies of 250 to 4000 Hz, and results across sessions were essentially the same. Conclusions: Speech perception measures used with cochlear implant candidates and recipients should reflect the listening challenges that individuals encounter in natural communication situations. These data provide the basis for recommending new candidacy criteria based on speech recognition tests presented at 60 and/or 50 dB SPL, intensity levels that reflect real-life listening, rather than 70 dB SPL.

- 342. Seeber BU, Baumann U, Fastl H (2004) Localization ability with bimodal hearing aids and bilateral cochlear implants, J Acoust Soc Am, 116(3): 1698-709.**

Abstract:

After successful cochlear implantation in one ear, some patients continue to use a hearing aid at the contralateral ear. They report an improved reception of speech, especially in noise, as well as a better perception of music when the hearing aid and cochlear implant are used in this bimodal combination. Some individuals in this bimodal patient group also report the impression of an improved localization ability. Similar experiences are reported by the group of bilateral cochlear implantees. In this study, a survey of 11 bimodally and 4 bilaterally equipped cochlear implant users was carried out to assess localization ability. Individuals in the bimodal implant group were all provided with the same type of hearing aid in the opposite ear, and subjects in the bilateral implant group used cochlear implants of the same manufacturer on each ear. Subjects adjusted the spot of a computer-controlled laser-pointer to the perceived direction of sound incidence in the frontal horizontal plane by rotating a trackball. Two subjects of the bimodal group who had substantial residual hearing showed localization ability in the bimodal configuration, whereas using each single device only the subject with better residual hearing was able to discriminate the side of sound origin. Five other subjects with more pronounced hearing loss displayed an ability for side discrimination through the use of bimodal aids, while four of them were already able to discriminate the side with a single device. Of the bilateral cochlear implant group one subject showed localization accuracy close to that of normal hearing subjects. This subject was also able to discriminate the side of sound origin using the first implanted device alone. The other three bilaterally equipped subjects showed limited localization ability using both devices. Among them one subject demonstrated a side-discrimination ability using only the first implanted device.

- 343. Kühn-Inacker H, Shehata-Dieler W, Müller J, Helms J (2004) Bilateral cochlear implants: A way to optimize auditory perception abilities in deaf children?, IJPORL, 68: 1257-66.**

Abstract:

**OBJECTIVES:** The Würzburg bilateral cochlear implant (CI) program was started with the aim to improve the patients' communicative abilities in complex listening situations. In this study, the auditory skills of children using bilateral cochlear implants were evaluated. **STUDY DESIGN AND SETTINGS:** Qualitative data based on free observations in the rehabilitation setup were collected in 39 bilaterally implanted children. A speech discrimination in noise test was performed in 18 of these children; lists of bisyllabic words were presented in noise at a signal to noise ratio (SNR) of +15 dB. **RESULTS:** Qualitative and quantitative data show clearly that bilateral CI improves the children's communicative behaviour, especially in complex listening situations. Children examined with the speech in noise test scored significantly better under the bilateral condition compared to the unilateral condition. Integration of the second implanted side and use of binaural information was observed to be easier and faster in children with a short time lag between both implants. **CONCLUSIONS:** To be able to obtain optimal benefit from bilateral cochlear implants, an intensive rehabilitation program is necessary. The important aspects of such a

program are creating realistic expectations in older children before implantation; performing the first processor fitting of the second side with the first side switched on; and separate intensive training with the new system in order to balance out the hearing competence of the second CI with that of the first.

- 344. Baumann U, Nobbe A (2004) Pulse rate discrimination with deeply inserted electrode arrays, *Hearing Research*, 196(1-2): 49-57.**

Abstract:

Pulse rate difference limen (PRDL) and amplitude modulation difference limen (AMDL) were assessed as a function of base rate and cochlear electrode location in seven (three for AMDL) subjects implanted with the MED-EL COMBI 40+ implant. The MED-EL COMBI 40+ electrode array allows deep insertion of the electrode up to the apex of the cochlea to minimize the rate/place mismatch for pulse rates below 500 pps. A three interval, two alternative forced-choice procedure with feedback was used to measure the difference limen. The base rate was in the range between 200 and 800 pps. The carrier rate for the AMDL measurement was 5081 pps. The PRDL increased with increasing base pulse rate. At 200 pps the average PRDL measured at the apical electrode amounted to 48.7 pps, at 400 pps the average PRDL reached 206.6 pps. No significant difference between PRDL obtained from apical or basal electrodes could be observed. AMDL was higher than PRDL at all tested base rates. The ability to discriminate rate changes is limited to base rates up to about 283 pps. The results indicate that rate changes smaller than a major third do not elicit distinguishable auditory perceptions in electrical hearing. The absence of a difference between apical and basal electrode locations indicates that a reduction of the rate/place mismatch does not improve discrimination performance.

- 345. Extended abstracts (2004): 4<sup>th</sup> Asian-Pacific Symposium on Cochlear Implant and Related Sciences, Taipei, Taiwan, 4-6 December, 2003; *Cochlear Implants International*, 5 Suppl 1.**

Ye Q, Kiefer J, Tillein J, Klinke R, Gstoettner W, Intracochlear application of steroids: An experimental study in guinea pigs, 17-8

Chow LCK, Hui Y, Au DKK, Chu KMY, Minimally invasive surgery for different types of cochlear implant, 75-77

Veekmans K, Nopp P, D'Haese P, Moeltner A, Speech comprehension over the telephone in adult cochlear implant subjects, 94-6

Kim CS, Chang SO, Lim D, Clinical evaluation of performance in children and adults with MED-EL TEMPO+ speech processors, 96-7

Mueller M, Chiong C, Martinez N, Santos R, Bilingual auditory and oral/verbal performance of Filipino children with cochlear implants, 103-5

Oh YL, Kim SC, Comparison of vocabulary size and speech performance in cochlear implantees in the institutional setting pre- and post-implantation, 118-20

Park MH, Lee KS, Early development of auditory performance in implanted infants and children with EARS-K in Korea, 120-4

Chu KMY, Au DKK, Hui Y, Chow CK, Wong RK, Wei WI, Short electrode insertion in cochlear implants: Performance in speech perception, 126-8

Au DKK, Chu KMY, Chow LCK, Hui Y, Wei WI, Cognitive abilities of patients with cochlear implants in the discrimination of tone stimuli with minimal contrast, 179-81

Ramos HM, Martinez N, Castro V, Mueller MM, Molanjao M, Three sisters with profound hearing loss: A case report, 217-24

Iwaki T, Masumura C, Yasuoka E, A Case of bilateral cochlear implantation (MED-EL COMBI 40+), 228-9

- 346. Helms J, Weichbold V, Baumann U, von Specht H, Schön F, Müller J, Esser B, Ziese M, Anderson I, D'Haese P (2004) Analysis of ceiling effects occurring with speech recognition tests in adult cochlear-implanted patients, *ORL*, 66(3): 130-5.**

Abstract:

This article presents a simple method of analysing speech test scores which are biased through ceiling effects. Eighty postlingually deafened adults implanted with a MED-EL COMBI 40/40+ cochlear implant (CI) were administered a numbers test and a sentence test at initial device activation and at 1, 3, 6, 12 and 24 months thereafter. As a measure for speech recognition performance, the number of patients who scored at the 'ceiling level' (i.e. at least 95% correct answers) was counted at each test interval. Results showed a quick increase in this number soon after device activation as well as a continuous improvement over time (numbers test: 1 month: 51%; 6 months: 73%; 24 months: 88%; sentence test: 1 month: 33%; 6 months: 49%; 24 months: 64%). The new method allows for the detection of speech recognition progress in CI patient samples even at late test intervals, where improvement curves based on averaged scores are usually assuming a flat shape.

- 347. Adunka O, Unkelbach M, Mack M, Hambek M, Gstottner W, Kiefer J (2004) Cochlear implantation via the round window membrane minimizes trauma to cochlear structures: A histologically controlled insertion study, *Acta Otolaryngol*, 124(7): 802-12.**

Abstract:

Objective: To evaluate cochlear implant trauma to intracochlear structures when inserting the electrode via the round window membrane. Material and Methods: Eight fresh human temporal bones were evaluated histologically after insertion using two types of cochlear implant array. Bones underwent a special fixation and embedding procedure that allowed sectioning of undecalcified bone with the electrode in situ. Insertions depths were evaluated radiologically and histologically. Results: All arrays were found in the scala tympani of the cochlea. Basal trauma could be avoided in all but one specimen. The mean depth of insertion was 382.5 degrees. Apically, only one implanted bone showed cochlear trauma exceeding lifting of the basilar membrane. Conclusion: Insertions through the round window membrane were shown to be atraumatic, even in basal cochlear regions. This route of insertion might be very effective for combined electric and acoustic stimulation of the auditory system.

- 348. Eshragi AA, Jolly C, Balkany TJ (2004) Small-fenestra cochleostomy for MED-EL electrode, *Cochlear Implants Int*, 5(2):71-5.**

Abstract:

Although the physical characteristics of cochlear implant electrode arrays vary substantially among manufacturers, many otolaryngologists have adopted a surgical cochleostomy technique that is familiar to all of them. The objective of this study was to compare the insertion dynamics of the MED-EL Flex electrode using two different sized cochleostomies. Six temporal bones were prepared with either a small fenestra (~1.0mm) or a larger fenestra (~1.8mm) cochleostomy and the electrodes inserted under video fluoroscopy. The resulting video images were analyzed for depth of insertion as well as dynamic flexion of the electrode during insertion. The study demonstrated that small-fenestra cochleostomies have a 'pool cue' or 'billiard cue' effect, stabilizing the electrode cable and resulting in easier and deeper insertions. This is achieved by limiting the buckling of the electrode just inside the cochleostomy site.

- 349. Braunschweig T, Schelhorn-Neise P, Biedermann F, Weisser P (2004) Examination to possibilities of a physiological fitting of cochlear implants, *Laryngorhinotologie*, 83(6): 387-90.**

Article in German.

Abstract:

Background: Cochlear implants (CI) convert acoustic events into electrical pulses. The auditory nerve picks these tiny electrical pulses up and sends them to the brain. The dynamics of the audible sound is compressed considerably. The limits for stimulation are determined with the patient. A map law determines which sound pressure level is assigned to which stimulation level. A sufficient speech understanding requests an allocation of high stimulation levels for weak sound signals. The higher the sound level, the lower the increase. Unfortunately, with such kind of map law unwanted background noise is also presented as well audible stimulation. These stimuli are often annoying to CI users in everyday situations. Patients and method: The possibility to give an s-shaped course to these map laws was examined in 9 patients. After the fitting procedure their speech understanding were tested. The results were compared with the results of former tests. Results: 8 patients reported definite

improvement of their hearing situation. Such map laws seem, therefore, suitable to optimise speech processor programming.

- 350. Franz DC, Caleffe-Schenk N, Iler Kirk K (2004) A tool for assessing functional use of audition in children: Results in children with the MED-EL COMBI 40+ cochlear implant system, *Volta Review*, 104(3): 175-96.**

Abstract:

An instrument for measuring and tracking changes in auditory skill development over time was developed for use with a group of children with profound deafness who received a MED-EL COMBI 40+ cochlear implant. The aim of this paper is to describe the use of this instrument, the Checklist of Auditory Communication Skills, and to present results obtained both pre- and post-operatively on a population of children who participated in the MED-EL COMBI 40+ Cochlear Implant System Clinical Trial in the United States. The Checklist of Auditory Communication Skills is intended to provide a means for rehabilitative professionals to track progress on a variety of auditory therapy targets arranged in hierarchical fashion. These behaviours range from the most basic detection skills through advanced auditory processing.

- 351. Tsiakpini L, Esser B, D'Haese PS (2004) Greek adaptation of EARS test battery, *Logoped Phoniatr Vocol*, 29: 51-55.**

Abstract:

Evaluation of Auditory Responses to Speech (EARS) is a test battery that was developed to measure the progress in the performance of children with cochlear implant. EARS was compiled in 1996 and is designed to assess hearing and speech perception skills in cochlear-implanted children. To date, the test battery has been adapted in 17 languages and is in use in various clinics worldwide. The aim of this study was to validate and determine the usability of a Greek EARS version in children with normal hearing. It was necessary to investigate whether the test items are appropriate for the language development in Greek children because of temporal and structural differences in language acquisition between Greek and English. Seventeen monolingual Greek children with normal hearing have been tested, aged 4 to 6 years, with the revised Greek version of EARS. The results pointed out the usability of EARS as an auditory test instrument for Greek children. Some materials and tasks had to be revised. The children had no difficulties with most of the subtests. In two of the seven subtests, children had some problems, perhaps due to their higher cognitive demand.

- 352. Wackym PA, Michel MAS, Prost RW, Bankls KL, Runge-Samuels CL, Firszt JB (2004) Effect of magnetic resonance imaging on internal magnet strength in MED-EL COMBI 40+ cochlear implants, *Laryngoscope*, 114: 1355-61.**

Abstract:

**Objective:** Magnetic resonance imaging (MRI) has been contraindicated when cochlear implants containing an internal magnet are in place because of concerns regarding torque, force, demagnetization, artefacts, induced voltages, and heating. The objective was to determine the magnetic field strength of MED-EL COMBI 40+ cochlear implant internal magnets after MRI studies. **Study design/methods:** Two fresh cadavers were used to study demagnetization using a repeated measures design and a magnetometer. Pre- and post-MRI measurement of magnetic field strength was completed. Five sets of sagittal T1-weighted, axial T1-weighted, and axial T2-weighted sequences were performed on a cadaver at 0.2 Tesla in the device-up and device-down positions. In the other cadaver, 15 sets of sagittal T1-weighted, axial T1-weighted, and axial T2-weighted sequences were performed on a cadaver at 1.5 Tesla were conducted, 5 each with the head oriented at 80, 90, and 100 degrees rotated around the yaw plane (rotated around the z-axis). Subsequently, three cochlear implant patients completed 0.2 Tesla MRIs. For these patients, subjective and objective assessment of cochlear implant performance was performed. **Setting:** Academic medical centre. **Results:** In the cadaver studies, analysis of variance showed no significant difference in the magnetic field strength after the 0.2 or 1.5 Tesla scans. There was no significant difference in the magnetic field strength for the three patients undergoing 0.2 Tesla MRIs and no adverse consequences, including no changes in telemetry, auditory sensations, non-auditory sensations, and sound quality. **CONCLUSIONS:** No significant demagnetization of the internal magnet occurred during repeated 1.5 Tesla MRI scans with the head orientations used in this study. In the cochlear implant patients, no significant demagnetization of the internal magnet occurred after a 0.2 Tesla MRI.

- 353. Baumann U, Nobbe A (2004) Pitch Ranking with Deeply Inserted Electrode Arrays, Ear and Hear, 25(3):275-83.**

Abstract:

Objective: Electrode pitch ranking was assessed as a function of cochlear region, electrode spacing, and stimulation rate in eight subjects implanted with the MED-EL COMBI 40+ implant. The MED-EL COMBI 40+ electrode array allows deep insertion of the electrode up to the apex of the cochlea and provides a wide electrode spacing of 2.4 mm. Design: The pitch of a reference electrode was compared with the pitch of two apical and two basal probe electrodes using a two-alternative forced-choice procedure. The reference electrodes were placed in the apical region, in the middle region, and in the basal region of the cochlea. Each condition was tested at pulse rates of 1515 pps, 500 pps, and 250 pps. Results: Electrode pitch ranking did not depend on electrode spacing, the position of the reference electrode in the cochlea, or stimulation rate. Conclusions: These results indicate that a spacing of 2.4 mm seems sufficient to allow good electrode pitch ranking performance for the average user and that electrode pitch ranking is similar in the apical, middle, and basal region of the cochlea, irrespective of the stimulation rate. Most importantly, the results of this study indicate that residual neural structures in the apical region of the cochlea are sensitive to pitch changes provided by different places of electrical stimulation.

- 354. Schleich P, Nopp P, D'Haese P (2004) Head shadow, squelch, and summation effects in bilateral users of the MED-EL COMBI 40/40+ cochlear implant, Ear Hear, 25: 197-204.**

Abstract:

Objective: The aim of the study was to investigate the impact of bilateral cochlear implant use in speech perception in noise in bilateral users of the MED-EL COMBI 40/40+ cochlear implants. Design: Speech reception thresholds were measured in 21 subjects using the Oldenburg sentence test. Speech was always presented from the front. Noise was either presented from the front, from the left side, or from the right side. Each condition was measured for unilateral and bilateral implant use. Results: For three subjects, the test was too difficult to be administered. The 18 subjects from whom a completed data set could be obtained showed a significant head shadow effect and summation effect for all test conditions; whereas the squelch effect was significant for noise from the left side only. Average effect sizes were significant for all effects and amounted to 6.8dB for the head shadow effect, 0.9dB for the squelch effect, and 2.1dB for the summation effect. Effect sizes were not correlated with duration of deafness. Conclusions: Bilateral cochlear implant users can at least qualitatively benefit from the effects that are known for normal-hearing subjects, that is, head shadow, summation, and squelch effect. Bilateral cochlear implantation also reduces the performance gap between cochlear implant users and normal-hearing subjects.

- 355. Nopp P, Schleich P, D'Haese P (2004) Sound localisation in bilateral users of MED-EL COMBI 40/ 40+ cochlear implants, Ear Hear, 25: 205-14.**

Abstract:

Objective: The purpose of the study was to investigate sound localisation with bilateral and unilateral cochlear implants. Design: Sound localisation tests were performed on 20 bilaterally implanted MED-EL COMBI 40/40+ users. All subjects were bilaterally implanted during adolescence or later. Sound localisation was tested in the frontal horizontal plane by using 9 equally spaced loudspeakers and speech-shaped noise bursts at randomised levels. Results: The group of subjects who were bilaterally deafened after 5 to 6 years of age (18 subjects) showed a statistically significant improvement in sound localisation when using both implants, compared with when using only one. The mean deviation between the presentation azimuth and the response azimuth was 16.6° when using both implants, which was on average 37.1° smaller than when using one implant only. When adjusted for the localisation error that was constant across loudspeakers, the mean deviation was 15.9° for bilateral implant use, representing an improvement of 30.1° over unilateral implant use. Statistical analysis showed that in this group, performance measures were not correlated with subject details such as age at onset of deafness or duration of unilateral implant use. In contrast, subjects who were bilaterally deafened before 6 years of age (2 subjects) did not show a benefit in sound localisation from bilateral implants. Conclusions: Bilateral cochlear implants offer a substantial benefit in sound localisation to late-deafened, late-implanted subjects. The very limited data from early-deafened subjects implanted at a later age could suggest that these subjects may not benefit in

sound localisation from bilateral cochlear implants. It is possible that early implantation for early deafened subjects might allow better acquisition of spatial hearing, thus leading to improved localisation performance.

- 356. Weichbold V, Anderson I, D'Haese (2004) Validation of three adaptations of the Meaningful Auditory Integration Scale (MAIS) to German, English and Polish, IJA, 43(3): 156-61.**

The Meaningful Auditory Integration Scale (MAIS) is a parent-report questionnaire for assessing auditory behaviour in aurally habilitated children. This study addressed the reliability and convergent validity of three different language versions of the MAIS: English, German, and Polish. A total of 114 parents (English: n = 27; Polish: n = 37; German: n = 50) completed the MAIS pre-operatively and at six months after cochlear implantation. Internal reliability (Cronbach's Alpha) ranged from 0.92 to 0.95 pre-operatively, and from 0.87 to 0.93 at six months. Split-half reliability was at least 0.90 pre-operatively, and ranged from 0.76 to 0.89 at six months. Corrected item-total correlation coefficients were significant ( $p < 0.05$ ) for all items except for item 1, which showed poor correlations in the Polish version. Correlation of the MAIS with the Listening Progress Profile (LiP), as a measure for convergent validity, yielded coefficients between 0.81 and 0.73 pre-operatively, and between 0.79 and 0.61 at six months. These findings demonstrate high reliability and convergent validity of the three MAIS versions.

- 357. Anderson I, Weichbold V, D'Haese PS, Szuchnik J, Sainz Quevedo M, Martin J, Shehata Dieler WS, Phillips L. (2004) Cochlear implantation in children under the age of two--what do the outcomes show us? Int J Pediatr Otorhinolaryngol, 68(4):425-31.**

Abstract:

Objectives: Literature that discusses the benefits of cochlear implantation (CI) in children under the age of two is limited. Previous concerns about surgical risk have been raised and addressed; however, actual benefit in terms of outcomes needs to be clearly defined. This study evaluates outcomes of children implanted under the age of two and compares them to children implanted at a later age. Methods: Data were reviewed from the MED-EL International Children's study database. Thirty-seven children enrolled in the study have received cochlear implants before the age of two. Outcomes were assessed using the LiP and MTP tests and the MAIS and MUSS questionnaires pre-operatively and then at initial fitting, 1, 3, 6 and 12 months after first fitting and then annually thereafter. Results: Statistical analysis demonstrated that these children's scores improved significantly over time. Improvement was shown to occur at a quicker rate than for children implanted at an older age with the MTP and MUSS, but not with the LiP and the MAIS. Scores may be limited by sample size and the fact that children reached ceiling on some tests. Conclusions: Results suggest a distinct advantage early implantation may have for severe to profoundly hearing impaired children. This may be particularly the case for skills necessary for development of receptive and expressive language skills.

- 358. Au DKK (2004) Effects of stimulation rates on Cantonese lexical tone perception by cochlear implant users in Hong Kong, Clin. Otolaryngol, 28: 533-8.**

Abstract:

High, moderate and low stimulation rates of 1800, 800 and 400 pulse per second (pps)/channel, respectively, were used to test the effects of stimulation rates in discrimination and identification of Cantonese lexical tones in 11 Chinese post-lingually deafened adults with cochlear implants (CIs). The subjects were implanted with the MED-EL COMBI 40+ CI system. They were randomly assigned to each of the stimulation rate conditions according to an ABC design. In both the Cantonese lexical tone tests, the subjects reached the highest scores in the high-stimulation-rate condition, and the lowest scores in the low-stimulation-rate condition ( $p < 0.01$ ). Post hoc comparisons between different stimulation rates did not yield consistent results. This study demonstrated that the maximum stimulation rate of 1800pps/channel could be an 'optimal' stimulation rate and an informed choice of parameter for the benefit of Cantonese-speaking CI users in lexical tone perception.

- 359. Anderson I, Weichbold V, D'Haese P (2004) Three-year follow up of children with open-set speech recognition who use the MED-EL cochlear implant system, Cochlear Implants International, 5(2): 45-57.**

Abstract:

Improvement in implant technology and the fact that children with cochlear implants have surpassed all expectations have led the field to believe that open-set speech understanding is a common and expected outcome. The available literature suggests this to be the case in open-set word understanding. This study shows results of forty-one pre-lingually deafened children with a minimum of 3 years cochlear implant experience. Children were assessed on the EARS test battery which includes open-set phoneme, word and sentence tests. Results show that some open-set skills emerge by 6 months after implantation. There is significant improvement over time, even after 3 years of cochlear implant experience. A significant effect of age at implantation is also demonstrated. Results suggest that cochlear implanted children develop open-set speech recognition soon after implantation and these skills develop over a long-period of time, highlighting the need for continued therapy to maximise listening and learning.

- 360. Lorens A, Walkowiak A, Piotrowska A, Skarzynski H, Anderson I (2004) ESRT and MCL correlations in paediatric cochlear implant users, Cochlear Implants International, 5(1): 28-37.**

Abstract:

The use of electrically evoked stapedius reflex thresholds (eSRT) has been suggested as a useful means for creating a cochlear implant speech processor programme. Studies in adult have shown that there is a high correlation between eSRT programmes and programmes created through behavioural testing. This study assessed the viability of using eSRT to create speech processor programmes in children, an often difficult-to-test population. Seven children with an average CI experience of 1.1 years participated in the study. Their MCL levels, established either through behavioural testing or through eSRT, were compared to each other; and parents were asked about their observations on which programme was superior. There was a high correlation between MCLs ( $r^2=0.789$ ), and there was no significant difference between the programmes, with the eSRT programme being slightly softer than the behavioural programme. Parents reported that the eSRT programme was as good as or better than the behavioural programme. Further studies need to be conducted on using the eSRT programme in the first fitting period in inexperienced CI users. However, current data suggest the viability of using eSRT programmes safely in the paediatric and difficult to assess population.

- 361. Adams JS, Hasenstab MS, Pippin G, Sismanis A (2004) Telephone use and understanding in patients with cochlear implants, ENT Journal, 83(2): 96-103.**

Abstract:

We conducted a mail survey of patients who had received cochlear implants to ascertain their ability to communicate on the telephone. Of 86 patients who responded, 38 (44%) did not use the telephone at all, 36 (42%) were able to use the telephone without assistance (independent users), and 12 (14%) were able to use the telephone with some type of assistance. Factors associated with independent use were male sex, older age at onset of hearing loss, longer duration of hearing loss, successful use of hearing aids prior to cochlear implantation, implantation with a MED-EL COMBI 40+ device, and a shorter duration of implant use. But regardless of circumstances, our findings suggest that many cochlear implant patients can use the telephone during daily activity without the need for assistive devices or relay services.

- 362. Bauer PW, Roland PS (2004) Clinical results with the MED-EL compressed and split arrays in the United States, Laryngoscope, 114: 428-33.**

Abstract:

Objectives: To determine the indications for which the Med-EL compressed and split arrays have been used in the United States, to assess the success achieved in insertion, to determine hearing outcomes, and assess complications associated with using these arrays. Study design: Retrospective review of data gathered during the US clinical trial. Methods: Data were extracted concerning indications for use, depth of insertion, number of electrodes in use, 3 and 6 month performance outcomes, and complications. The results obtained in postmeningitic patients using the compressed array were compared with patients using the split array. Results: Six adults and 22 children have been implanted with the compressed array. The principal indications have been postmeningitis or congenital cochlear malformations. The average improvement seen in the Meaningful Auditor Integration Scale scores was 17.6 for the compressed array group and 13.9 for the split array group. The same number of electrodes was inserted on average for both groups, with comparable numbers of electrodes in use. Conclusions: The MED-EL compressed array is an alternative to the standard or split array in managing patients

with postmeningitic deafness or congenital cochlear malformations. Benefits to these patients are most clearly seen in subjective measures.

- 363. Todd NW, Ball TI (2004) Interobserver agreement of coiling of MED-EL cochlear implant: Plain X-ray studies, *Otol & Nuerotol*, 25: 271-4.**

Abstract:

Objective: The objective of this study was to describe the interobserver agreement of otologists in judging the extent of cochlear electrode insertion as depicted in plain radiographs done in various projections relative to that of Stenvers (45° from midline). Study design: Ten experienced US MED-EL cochlear implant surgeons, unaware of the image history, judged depths of electrode coiling in 12 images. Methods: In a bequeathed cranial base specimen, a standard MED-EL COMBI 40++ electrode was inserted 3mm less than full and stabilised. With a custom cephalostat, the specimen was positioned in the Frankfurt horizontal plane. Plain radiographs were made in six projections in 15° increments, from posterior-anterior to near lateral. After the electrode array was withdrawn 5mm and stabilised, six additional radiographs were similarly taken. Results: Greater variability of assessed coiling was associated with projections other than Stenvers. The coefficient of variation for Stenvers was significantly less than half that of the anterior-posterior and other projections studied. Conclusion: In plain radiographic assessment of the degree of coiling of the MED-EL electrode, interobserver agreement was best for the Stenvers view.

- 364. Kiefer J, Gstöttner W, Baumgartner W, Pok SM, Tillein J, Ye Q, von Ilberg C (2004) Conservation of low frequency hearing in cochlear implantation, *Acta Otolaryngol*, 124: 272-80.**

Abstract:

Objectives: as results with cochlear implantation have continued to improve, patients with some remaining cochlear function have become eligible for cochlear implantation. Thus, preservation of acoustic hearing after implantation has gained importance. Hearing preservation can be considered a benchmark for atraumatic implantation preventing neural degeneration from loss of residual hair cells or subsequent to local trauma. In this prospective study, the possibility of preserving low-frequency hearing in cochlear implantation using a modified surgical technique has been explored. Material and methods: on a prospective study design, 1 subjects with considerable low-frequency hearing of 20-60dB in the frequency range 125-500Hz, but with unsatisfactory speech understanding with hearing aids of <35% monosyllabic word understanding were implanted with a MED-EL COMBI 40+ cochlear implant. The insertion depth was intentionally limited to 19-24mm to prevent damage to low-frequency regions of the cochlea. Pre- and post-operative pure-tone thresholds were measured. Results: hearing was conserved within 0-10dB in 9/14 subjects and within 11-20dB in 3/14 subjects; in 2/14 subjects hearing was completely lost in the implanted ear. Thus hearing could at least partially be conserved in 12/14 subjects (84%). Median threshold values decreased by 10, 15, 17.5 and 5dB at 125, 250, 500 and 1000Hz respectively. Even high levels of hearing, e.g. 30dB at 500Hz, could be maintained after implantation in some subjects. Conclusions: this study reports successful conservation of hearing after cochlear implantation using a modified surgical technique. Even high levels of hearing could be maintained; showing that implantation of an intraocular electrode can be performed atraumatically with preservation of functional structures.

- 365. Daneshi A, Hassanzadeh S, Abasalipour P, Emamdjomeh H, Farhadi M (2003) Cochlear implantation in Mondini Dysplasia, *ORL*, 65: 39-44.**

The use of cochlear implantation to treat patients with inner ear malformations such as Mondini dysplasia has been increasingly successful. Until now, conventional hearing aids in these patients have not performed well. Consequently, the hearing problems for patients with this condition has been somewhat improved with the use of cochlear implants. Various results of cochlear implantation have been reported in these patients so far. This is a report of 5 patients with Mondini malformation who have undergone cochlear implant surgery.

- 366. Extended abstracts (2003): 7<sup>th</sup> International Cochlear Implant conference, Manchester, UK, 4-6 September 2002, *Cochlear Implants International*, 4(4) Suppl 1.**

Verschuur C, Effect of stimulation rate on speech perception in adult users of the MED-EL COMBI 40+ and Ineraid cochlear implants, 15-6.

Brockmeier SJ, Emotional response to music in COMBI 40/40+ users, 25-6.

De la Torre A, Sainz M, Roldan C, Perception of tone with cochlear implants: Influence of the coding strategy, 27-8.

Eyles JA, Brickley, GJ Speech perception by adult COMBI 40+ users using a telephone stimulation test, 29-30.

Sainz M, de la Torre A, Roldan C, Application of statistical analysis of the programming maps for fitting cochlear implants in children, 59-60.

Stark T, Brockmeier SJ, Nopp P, Vischer M, Baumgartner WD, Schön F, Müller J, Braunschweig T, Arnold W, Allum DJ, Correlation of speech and music appreciation in post-lingually deaf COMBI 40/40+ cochlear implant users, 68-9.

**367. Published abstracts (2003): Proceedings of the XVII World Congress of the International federation of Oto-Rhino-Laryngological Societies (IFOS), (2002), Oto-Rhino-Laryngology, 1240.**

Hochmair E, Hochmair I, Nopp P, Jolly C, Müller J, Peter O, Speech performance and cochlear coverage with cochlear implants, 165-71.

With 10 cochlear implant (CI) wearers having fully inserted COMBI 40+ electrodes, acute speech performance tests were performed simulating different contact distributions along the cochlea by selectively activating 0 to 12 stimulation channels. Within patient comparison using monosyllables and sentences in noise as test material showed that cochlear coverage, i.e. the extent of the contact array along the cochlea, is the decisive electrode parameter determining speech performance. With a 30mm deep insertion, monosyllable scores improved significantly by 24% over a 20mm insertion depth. Speech reception thresholds improved by 6.6dB. No difference in speech understanding was found between 8 and 12 channel configurations, both featuring full cochlea coverage, respectively. It is concluded that deep insertion improves tonotopicity and, due to the larger contact distance, channel separation as well. As a corollary, with deep insertion, the need for coding strategies providing extra channel separation by additional processing is eliminated.

Skarzynski H, Piotrowska A, Lorens A, Szuchnik J, Walkowiak A, Sliwa L, Szkielkowska A, Kochanek K, Applications of electric-acoustic stimulation in patients with profound hearing loss: Case study, 291-5.

Improvement of cochlear implant technology has resulted in the extension of the selection criteria for cochlear implant candidates. Prelingually deafened children are considered for the implantation even if they still demonstrate some benefits from the use of hearing aids. The aim of this study was to examine speech perception skills in patients with cochlear implant and hearing aid in the contralateral ear. Positive results obtained indicate that patients with combine 'd stimulation perform better than with cochlear implant or hearing aids only.

Sainz M, Lopez-Soler C, C Roldan, de la Torre A, Sanchez E, Vargas JL, Pure-tone audiometry in cochlear implanted patients, 317-20.

No abstract.

Lorens A, Skarzynski H, Piotrowska A, Walkowiak A, Sliwa L, Kochanek K, Objective methods of post operative tests in cochlear implants patients, 379-83.

The aim of this study was to determine the correlation between the maximum comfort levels (MCL) and the electrical elicited stapedius reflex threshold (ESRT). Material consisted of six pre-lingually deafened children, sampled from the group of the experienced users of COMBI 40+ implant system. The ESRT was measured postoperatively, contralaterally, using an up/down protocol. ESRT values were compared with the MCL of the child's map in each channel. It was possible to measure the ESRT in each case. The correlation between the MCL and ESRT was observed, although in two cases in some channels the ESRT was relatively higher than the programmed MCL. However, in these children, there was no evidence of discomfort during the measurements. The child's map was then corrected according to the measurement results. Children accepted the new map. Obtained results confirmed the results of other studies that the ESRT could be very useful in estimation of MCL in the paediatric population.

Jamieson L, Ajayi F, Costa A, Martin J, Raine CH, Use of the TEMPO+ behind-the-ear speech processor and COMBI 40+ cochlear implant with very young children, 391-7.

Objectives: To investigate the issues for very young children, families and cochlear implant centres surrounding the transfer from a body-worn (BW) speech processor to a behind-the-ear (BTE) speech processor. Study design: A group of 18 young children (median age 3.5 years) was transferred from a CIS PRO+ (BW) processor to a TEMPO+ (BTE) processor 2 to 3 months after initial programming. Programming issues were investigated and sound field performance measures carried out. Parental perceptions of the changeover were assessed by use of a questionnaire designed for the study, covering eight categories including such issues as response to speech, equipment handling, ease of use, troubleshooting, comfort and length of daily use. Results: All 18 questionnaires were returned. The results illustrated the degree of preference for either the BW or BTE processor for each category. Of eight categories, there were four that indicated a statistically significant preference for the TEMPO+, and one indicating a statistically significant preference for the CIS PRO+. For the questionnaire results overall, there was a significant preference for the TEMPO+. Conclusion: Parental perceptions indicate that the BTE TEMPO+ is suitable for use with very young children.

Sainz M, Roldan C, de la Torre A, Gonzalez MV, Ruiz JM, Transitory alterations of the electrode impedances in cochlear implants associated to middle and inner ear diseases, 407-10.

No abstract

Skarzynski H, Behr R, Szuchnik J, Lorens A, Zawadzki R, Walkowiak A, Skarzynska B, Piotrowska A, Sliwa L, Three-year experience in the rehabilitation of brainstem implant patients, 429-32.

Three patients have been provided with auditory brainstem implants at the Institute of Physiology and Pathology of Hearing I the years 1998 – 2001. COMBI 40+ implant systems were applied. This modern auditory prosthesis can be used in the case of bilateral, total hearing losses resulting from neurofibromatosis type II. After activation of the implant system, the patients took part in a 2 year rehabilitation programme, which is obligatory for adults and provided within the Warsaw Brainstem Implant Programme.

- 368. Bredberg G, Lindström B, Baumgartner WD, Farhadi M, Goldberg T, Gstöttner W, Pillsbury H, Skarzynski H, Sorri M, Van de Heyning P, Zaghisi A, Graham J, Williams G, D’Haese P (2003) Open-set speech perception in adult cochlear implant users with ossified cochleae, Cochlear Implants International, 4(2): 55-72.**

Abstract:

This study describes open-set speech recognition in cochlear implant subjects with ossified cochleae and compares it to a control group with open cochleae. Twenty-one postlingually deafened adults with a MED-EL COMBI 40/40+ GB split electrode implant were matched to patients using a MED-EL cochlear implant with a standard electrode. Speech recognition was assessed over an 18-month period. Split-electrode patients improved significantly over time, but their scores were significantly lower and increased significantly slower than those of controls. Of 14 patients with a duration of deafness less than 20 years, average sentence test scores were 50%, and average monosyllabic word tests scores were 31%. This study provides evidence that cochlear implantation is beneficial to patients with ossified cochleae, but early implantation is advisable.

- 369. Raine CH, Strachan DR, Gopichandran T (2003) How do we do it: Using a surgical navigation system in the management of the ossified cochlea, Cochlear Implants International, 4 (2): 96-101.**

Abstract:

The ossified cochlea poses both concerns and challenges to any implant team. One of the surgical aims is to implant as many of an implant system’s electrodes into the cochlea as close to the modiolus as possible, thus facilitating stimulation of the surviving cell bodies in the spiral ganglion. Within the field of otorhinolaryngology various surgical navigation systems have been introduced to facilitate surgical orientation during endoscopic sinus and skull-base surgery. The principle behind such systems is that specialised software uses high-resolution computerised tomography and magnetic resonance imaging scans to create a 3D image of the patient’s anatomical landmarks. Surgical instruments registered into, or linked with, the system can then be tracked within the 3D model. This is the first time this system has been described for surgery of the inner ear, and we describe

how the technique allows more precise control of the bur tip while drilling tunnels that approximate with the apical and distal parts of the basal coil of the ossified cochlea.

- 370. Anderson I, Schmidt M, Buchreiter T, Bisanar K (2003) Handling of the TEMPO+ behind-the-ear speech processor by MED-EL cochlear implant users, Cochlear Implants International, 4(3): 110-18.**

Abstract:

MED-EL launched their ear-level speech processor, the TEMPO+, in 1999. Studies have already demonstrated improved speech perception, sound quality and the ability to enjoy music with the TEMPO+ due to the new CIS+ speech coding strategy. This study evaluated responses to 185 questionnaires about ease of handling and usage of the TEMPO+, opinion and satisfaction about the TEMPO+ and its performance, as well as satisfaction with accessories. There was particular interest to see if the TEMPO+ was suitable for use with children. Results showed that MED-EL CI users felt comfortable manipulating the dials and switches, changing the battery pack, using external sources of input and with provided accessories. Overall, there was excellent satisfaction with the TEMPO+. Notably, 1/3<sup>rd</sup> of respondents were under the age of 10. Results show the suitability of the TEMPO+ behind-the-ear speech processor for young children.

- 371. Kompis M, Vibert D, Senn P, Vischer MW, Häusler R (2003) Scuba diving with cochlear implants, Ann Otol Rhinol Laryngol, 112(5): 425-7.**

Abstract:

We report on a patient with bilateral cochlear implants (a MED-EL COMBI40 and MED-EL COMBI 40+), as well as considerable experience in scuba diving with his cochlear implants. After having been exposed to 68 and 89 dives, respectively, in depths of up to 43m, both cochlear implants are in working order and the patient continues to receive excellent speech recognition scores with both cochlear implant systems. The presented data show that scuba diving after cochlear implantation is possible over a considerable number of dives without any major negative impact on the implants.

- 372. Hamzavi J, Baumgartner WD, Pok SM, Franz P, Gstöttner W (2003) Variables affecting speech perception in postlingually deaf adults following cochlear implantation, Acta Otolaryngol, 123: 493-8.**

Abstract:

Objective: to evaluate the time span over which there is greatest improvement in postlingually deaf adults undergoing cochlear implantation. Additionally, to quantify potential patient and device factors that may predict the postoperative results. Materials and methods: a longitudinal study was conducted. Numbers, monosyllables and sentence test results were collected for 66 cochlear implant subjects (COMBI 40/40+, N=60; Clarion HF2, n=2; Nucleus 24m/k, n=4) at regular intervals for up to 6 years following cochlear implantation. Results: all patients showed a steady improvement over time on all tests. Progress during the first 12 months was statistically significant, with further improvements being recorded after the 12-month testing period. The duration of deafness and number of electrodes (8 for the COMBI 40, 12 for the COMBI 40+) appeared to be weakly correlated with postoperative performance. Re-implantation after device failure had no negative effect on speech reception. Subjects who were "upgraded" from an analogue to a digital cochlear implant improved their test results almost twofold. Conclusion: all the patients in our study gained substantial benefit from their cochlear implants. It is encouraging to note that the factors examined were not deemed to be relevant predictors of performance. Even long-term deaf subjects and re-implantees are able to achieve an excellent level of speech perception.

- 373. Sainz M, Skarzynski H, Allum JHJ, Helms J, Rivas A, Martin J, Zorowka PG, Phillips L, Delauney J, Brockmeier SJ, Kompis M, Korolewa I, Albegger K, Zwirner P, Van De Heyning P, D'Haese P (2003) Assessment of auditory skills in 140 cochlear implant children using the EARS protocol, ORL, 65: 91-6.**

Abstract:

Auditory performance of cochlear implant (CI) children was assessed with the Listening Progress Profile (LiP) and the Monosyllabic-Trochee-Polysyllabic-Word Test (MTP) following the EARS protocol. Additionally, the 'initial drop' phenomenon, a recently reported decrease of auditory performance occurring immediately after first fitting was investigated. Patients were 140 prelingually deafened children from various clinics and centres worldwide implanted with a MED-EL COMBI 40/40 +. Analysis of LiP data showed a significant increase after 1 month of CI

use compared to preoperative scores ( $p < 0.01$ ). No initial decrease was observed with this test. Analysis of MTP data revealed a significant improvement of word recognition after 6 months ( $p < 0.01$ ), with a significant temporary decrease after initial fitting ( $p < 0.01$ ). With both tests, children's auditory skills improved up to 2 years. Amount of improvement was negatively correlated with age at implantation.

- 374. Todd NW, Ajayi EF, MS Hasenstab, Webster DA, Boyd PJ (2003) Childhood otitis media and electrically elicited stapedius reflexes in adult cochlear implantees, *Otol and Neurotol*, 24: 621-4.**

Abstract:

Background: electrical stapedius reflex threshold are helpful in programming cochlear implants, but only approximately two-thirds of patients have identifiable reflexes. Hypothesis: childhood otitis media correlates with absent stapedius reflexes or with high electric stimulation needed to elicit a reflex in cochlear implantees. Study population: twenty-five adults with acquired hearing loss who underwent implantation with the MED-EL COMBI 40+ standard electrode array. Study parameters: the extent of temporal bone pneumatization, an indicator of childhood otitis media, was measured from pre-operative computed tomographic images. Clinical units (in microamperes) needed to elicit a contralateral stapedius reflex, or maximum stimulation tried, were recorded. Results: no definite association of pneumatization volume with intensity of stimulation was observed. The null hypothesis of no association cannot be rejected. Conclusion: childhood otitis media does not seem to explain absent electric stapedius reflexes and the wide range of clinical nits needed for maximum comfortable loudness level. Remaining potential explanations probably include the wide range of cochlear neurons that can be electrically stimulated, and that the maximum tolerable stimulation is too low to elicit a stapedius reflex.

- 375. Hochmair I, Arnold W, Nopp P, Jolly C, Müller J, Roland P (2003) Deep electrode insertion in cochlear implants: apical morphology, electrodes and speech perception results, *Acta Otolaryngol*, 123: 612-7.**

Abstract:

Morphological examination of the human temporal bone in the apical region supports the benefits of deep electrode insertion. Initiation of spikes on peripheral processes close to the basilar membrane would provide improved channel selectivity during electrical stimulation but recruiting of nerve fibres requires a higher current. A clinical study was performed on 10 users of the MED-EL COMBI 40+ implant to evaluate the effect of the insertion depth of the cochlear implant electrode on speech perception. All subjects were implanted with the standard COMBI 40+ electrode with an insertion depth of  $>30$ mm. Acute speech tests were carried out in which stimulation was restricted to the apical, middle and basal regions of the cochlea in turn, and using electrode arrangements in which contacts were either distributed over the whole length of the cochlea or concentrated at the basal end, thus mimicking an insertion depth of  $\approx 20$ mm only. The results showed that stimulation of the apical region of the cochlea supports a significant degree of speech understanding, and that distributing the contacts over the whole length of the cochlea improves speech perception in quiet and in noise.

- 376. Schenk BS, Baumgartner WD, Hamzavi JS (2003) Changes in vowel quality after cochlear implantation, *ORL*, 65: 184-8.**

Abstract:

Since auditory feedback is partially restored after cochlear implantation, the aim of the present study was to investigate features of vowels, which reflect improvements in speech production. Ten postlingually deafened subjects (5 male/5 female) were recorded reading a German text before and 3 and 12 months after implantation, respectively. Selected vowels were analysed regarding the fundamental frequency ( $F_0$ ), the formant frequencies ( $F_1$ ,  $F_2$ ,  $F_3$ ) and the vowel space (difference between  $F_1$  and  $F_2$  in Hertz). The  $F_0$  decreased only descriptively after 3 and 12 months, respectively.  $F_1$  of the vowel /e/ was significantly lower after 12 months ( $411 \pm 20$  compared to  $349 \pm 25$ Hz,  $p \leq 0.05$  and for /o/ after 3 months ( $446 \pm 29$  compared to  $408 \pm 31$ Hz,  $p \leq 0.05$ ) for the male patients: their vowel space also expanded significantly for the vowel /o/ ( $372 \pm 37$  compared to  $467 \pm 32$ Hz,  $p \leq 0.05$ ) after 12 months. Regained auditory feedback after cochlear implantation had an effect on the improvement of the production of vowels.

- 377. Wilson BS, Lawson DT, Müller JM, Tyler RS, Kiefer J (2003) Cochlear implants: some likely next steps, *Ann Rev Biomed Eng*, 5: 207-49.**

Abstract:

The history of cochlear implants is marked by large improvements in performance, especially over the past two decades and especially due to the development of ever-better processing strategies. Although the progress to date has been substantial, present devices still do not restore normal speech reception, even for top performers and particularly for listening to speech in competition with noise or other talkers. In addition, a wide range of outcomes persist, with some patients receiving little benefit using the same devices that support high levels of speech reception for others. The purpose of this review is to describe some likely possibilities for further improvement, including (a) combined electric and acoustic stimulation of the auditory system for patients with significant residual hearing, (b) use of bilateral implants, (c) a closer replication with implants of the processing steps in the normal cochlear, and (d) applications of knowledge about factors that are correlated with outcomes to help patients presently at the low end of the performance scale.

- 378. Sainz M, de la Torre A, Roldán C, Ruiz JM, Vargas JL (2003) Analysis of programming maps and its application for balancing multichannel cochlear implants, IJA, 42(1) 43-51.**

Abstract:

Channel balancing is important for correct perception when using multichannel cochlear implants. In this paper we analyse the effect of channel imbalance on hearing perception in cochlear-implanted patients. Based on warble tone audiometry measured for 10 implanted patients, we evaluate how hearing sensitivity is affected by an imbalance. We also study the distribution along the cochlea of the programming parameters for 146 patients. The parameters are compared for different groups of patients (defined taking into account the age at implantation, the stimulation mode, and the presence of severe cochlear damage). The aim of this study is to obtain information that can be useful for balancing the channels for the patients in the different groups, as well as to evaluate the effect of an imbalance on perception. These results provide complementary information that can be applied to the correct fitting of the cochlear implant processor.

- 379. Au DK, Hui Y, Wei WI (2003) Superiority of bilateral cochlear implantation over unilateral cochlear implantation in tone discrimination in Chinese patients, Am J Otolaryngol, 24: 19-23.**

Abstract:

The benefits of bilateral cochlear implants (CIs) versus unilateral CIs were evaluated by comparing the Cantonese lexical tone discrimination scores conducted in a quiet environment and against background noise. Four post-lingually deafened Cantonese-speaking adults (2 men and 2 women) with bilateral CIs were included in the study. The subjects were their own control in the monaural hearing condition. Both the Cantonese lexical tone stimuli and the speech-weighted background noise were presented at 0° azimuth and at a distance of 1m from the subject. The speech stimuli, which were maintained at 65dB sound pressure level, were presented in both quiet and against a background noise at signal to noise ratios (SNRs) of +15, +10, +5, 0, -5, -10 and -15. Against a background noise, the bilateral CIs required +5SNR only to obtain significant scores in discrimination Cantonese lexical tones and to achieve discrimination scores that were comparable to the optimal discrimination scores obtained in quiet. No significant difference in the discrimination scores was observed between binaural and monaural hearing conditions when the tests were conducted in quiet. Our study showed that in the presence of background noise, bilateral CIs were better than unilateral CIs in discrimination Cantonese lexical tones.

- 380. Skarzynski H, Lorens A, Piotrowska A (2003) A new method of partial deafness treatment, Med Sci Monit, 9(4): CS20-24.**

Abstract:

There is a significant group of patients whose hearing impairment is characterised by normal or slightly elevated thresholds in the low frequency band with nearly total deafness in high frequency range. These patients remain beyond the scope of effective treatment by hearing aids. We name this kind of hearing loss "partial deafness". A new method of partial deafness treatment was applied in the case of a young woman. A partially-inserted cochlear implant was used to restore hearing at high frequencies, while preserving low-frequency acoustic hearing in the implanted ear. The results demonstrate a substantial improvement in speech discrimination and communication skills when electric stimulation on one side was combined with acoustic stimulation on both sides.

- 381. Petrov SM (2002) Some aspects of adjustment of a speech processor of the cochlear implants COMBI 40/40+ and TEMPO+, Vesta Otorinolaryngol, 6: 16-8.**

Article in Russian

Abstract:

The author describes how to perform the first switching on the speech processors (SP) and subsequent adjustment of cochlear implant SP. These SP COMBI 40/40+ and TEMPO+ were adjusted in 25 patients aged 2 to 27 years who lost hearing at the age of 0-26 years. By problems arising at the first switching on and adjustment, all the implanted patients can be divided into three groups: postlingual – those who lost hearing after speech establishment, perilingual – those who lost hearing step by step starting by hypoacusis; prelingual – those who had lost hearing before they could speak. How to adjust SP in each group of the above patients is described.

- 382. Arnold W, Bredberg G, Gstöttner W, Helms J, Hildmann H, Kiratzidis T, Müller J, Ramsden RT, Roland P, Walterspiel JN (2002) Meningitis following cochlear implantation: Pathomechanisms, clinical symptoms, conservative and surgical treatments, ORL, 64: 382-89.**

Abstract:

Pneumococcal otogenic meningitis is a rare postsurgical complication that can develop following stapedectomy and cochlear implantation. The bacterial infection can be fatal in some instances. A recent increase in the incidence of otogenic meningitis among cochlear implant wearers is of concern. The majority of meningitis cases are associated with a 2-component electrode manufactured by one cochlear implant company. The device with the added 'positioner' component has been withdrawn from the market (FDA Public Health Web Notification: Cochlear Implant Recipients may be at Greater Risk for Meningitis, Updated: August 29, 2002, [www.fda.gov/cdrh/safety/cochlear.html](http://www.fda.gov/cdrh/safety/cochlear.html)). Not all cases have been subsequent to otitis media and symptoms have developed from less than 24h up to a few years after implantation. The purpose of this paper is to review and discuss the pathogenesis, pathology/bacteriology and to elaborate on some clinical features of otogenic meningitis in implanted children and adults. Essential aspects of surgery, electrode design, and cochleostomy seal are discussed. Conclusions are drawn from the available data and recommendations are made for good practice I cochlear implantation and follow up.

- 383. Jackson KB, Mark G, Helms J, Mueller J, Behr R (2002) An auditory brainstem implant system, Am J Audiol, 11(2): 128-33.**

Abstract:

Neurofibromatosis type II (NF2) is a condition that may result in bilateral acoustic neuromas. The tumours and their removal may cause profound bilateral deafness. Because the auditory nerve is compromised, people with NF2 are unable to receive a cochlear implant to restore a sensation of hearing. Electrical stimulation of the auditory pathway can provide hearing in such people. This is possible by means of an auditory brainstem implant (ABI). This article focuses on the MED-EL high-rate multichannel ABI system. The system consists of the implanted and external components. Appropriate placement of the ABI is dependant on electrical auditory brainstem response testing performed intra-operatively. Data on a group of European patients implanted with the MED-EL ABI are presented. Results are promising and include some open-set speech ability

- 384. Müller J (2002) Cochlear-Implant-Versorgung heute [Cochlear implant care today], HNO, 9: 793-796.**

Article in German

Abstract:

While, at the end of the 1970ies, cochlear implant devices enabled patients just to recognize and differentiate environmental sounds, today open-set speech recognition after cochlear implantation has become reality for many patients. Binaural cochlear implantation allows for even better speech understanding and for restoration of the spatial hearing. Consequently, indication to cochlear implantation has become successively expanded. Technological progress included the implantable electronics, the electrodes, and the speech coding strategies. As there are a lot of modifiable parameters, complex interactions between them are possible. Regarding the current high standard of technology, further progress includes the risk of not attaining all of the envisioned goals.

On the occasion of the "Cochlear Implant" meeting at the German-Austrian ENT congress at Baden-Baden, a brief overview on the current status of discussion and on recent developments shall be provided.

- 385. Franz D (2002) Pediatric performance with the MED-EL COMBI 40+ cochlear implant system, Ann Otol Rhinol Laryngol, 111: 66-68.**

Abstract:

Presented here are the results of speech perception measures and subjective scales from 68 children with 6 months of device experience and from 49 children with 12 months of experience using the MED-EL COMBI 40+ cochlear implant system. All children demonstrated bilateral profound hearing loss before operation, and 90% experienced onset before 3 years of age, but their hearing losses had a broad range of causes. A battery of age-appropriate objective speech perception measures was administered, in addition to a battery of subjective auditory skills assessments. The group data indicate that the children showed a statistically significant improvement in a wide array of speech perception skills and auditory behaviours with this device. In addition, subjective therapist survey data indicated changes in primary receptive and expressive communication method with COMBI 40+ device use. Individually, all children showed significant improvement on at least 1 of the speech perception measures used in the test battery. The evidence suggests that the MED-EL COMBI 40+ system can provide meaningful auditory information for profoundly deaf children, which in turn supports meaningful functional improvement in speech perception and communicative skill development.

- 386. Garnham C, O'Driscoll M, Ramsden R, Saeed S (2002) Speech understanding in noise with a MED-EL COMBI 40+ cochlear implant using reduced channel sets, Ear & Hear, 23: 540-52.**

Abstract:

The objective of the investigation described in this paper was the determination of the number of (widely spaced) active electrodes needed for users of a COMBI 40+ cochlear implant to achieve asymptotic performance in the recognition of speech against a background of wideband noise. This study measured the performance in speech tests of patients using the MED-EL implementation of continuous interleaved sampling with widely spaced electrode pair subsets of 2, 3, 4, 6, 8, and 10 out of a possible maximum of 12. An eight-vowel test, a 16-consonant test, and BKB sentences were presented a background of pink noise. Additionally, AB monosyllabic words were presented both in quiet and noise to processors with 6, 8 and 11 widely spaced electrodes. 11 subjects participated in this study. Using moderate signal-to-noise ratios, for these patients the curve relating percentage score to increasing numbers of active electrodes approached an asymptote before the 10-channel data point was reached. Asymptotic performance was achieved using four channels for consonants, and eight channels for sentences. Understanding of monosyllabic words reached a maximum value at a similar number of channels for both quiet conditions and against a background of pink noise, and the mean increase in test scores between 6 and 11 channels was only 7%. These results are similar to those of previous experiment carried out in quiet listening conditions. The data suggest that 12 frequency channels (the number implemented by the COMBI 40+ cochlear implant) are more than adequate for users to achieve asymptotic performance levels in clinical speech tests applied in the presence of wideband noise at moderate signal-to-noise ratios.

- 387. Kompis M, Jenk M, Vischer MW, Seifert E, Häusler R (2002) Intra- and intersubject comparison of cochlear implant systems using the Esprit and the tempo+ behind-the-ear speech processor, IJA, 41: 555-62.**

Abstract:

A patient with bilateral profound deafness was implanted with a Nucleus CI24M cochlear implant (CI) and used an Esprit behind-the-ear (BTE) speech processor. Thirteen months later, the implant had to be removed because of a cholesteatoma. As the same electrode could not be reinserted, a MED-EL COMBI 40S CI was implanted in the same ear, and the patient used a TEMPO+ BTE speech processor. After 1 year of use of the COMBI40S/TEMPO+ system, speech recognition was rated better subjectively than with the CI24M/Esprit system. Speech recognition and subjective ratings were also assessed for two matched groups of 9 CI users each, using either an esprit or TEMPO+ processor. On average, speech recognition scores were higher for the group of TEMPO+ users, but the difference was not statistically significant. Users of the Esprit processors rated their device higher in terms of cosmetic appearance and comfort of wearing.

- 388. Müller J, Schön F, Helms J (2002) Speech understanding in quiet and noise in bilateral users of the MED-EL COMBI40/40+ cochlear implant system, Ear and Hear, 23: 198-206.**

Abstract:

Objective: The purpose of the study was to investigate speech understanding in quiet and noise in subjects bilaterally implanted with multi-channel cochlear implants. Design: Nine adults bilaterally implanted with the MED-EL implants were included in the study. The subjects were tested in three conditions: with both implants, with the right implant only, and with the left implant only. Speech tests included monosyllables in quiet and noise (10dB signal to noise ratio) and sentences in noise (10dB signal to noise ratio). Speech was presented from the front, and noise was presented either from 90° or 270° azimuth. Results: All subjects reported benefit from bilateral stimulation. Speech scores for all subjects were higher with bilateral than with unilateral stimulation. The average score across subjects for sentence understanding was 31.1 percentage points higher with both cochlear implants compared with the cochlear implant ipsilateral to the noise. The average score for recognition of monosyllabic words was 18.7 percentage points higher with both cochlear implants than with one cochlear implant. All of these differences in average scores were significant at the 5% level. Conclusions: Bilateral cochlear implantation provides a significant benefit in speech understanding in both quiet and noise.

- 389. Hamzavi J, Baumgartner WD, Pok SM (2002) Does cochlear reimplantation affect speech recognition? Int J Audiol, 41 (3) 151-6.**

Abstract:

Although cochlear implantation has proven to be a very effective method of rehabilitation for post-lingually deaf adults and pre-lingually deaf children, as electronic devices, cochlear implants are occasionally subject to damage or breakdowns. In these cases, re-implantation would be necessary. The aim of this study was to find out whether or not there are any negative effects on speech abilities after re-implantation with the same type of multichannel digital implant in the same ear. Seven patients were provided with a digital multichannel implant. One subject suffered manipulative damage to the implant, and in six subjects an implant failure was observed. All re-implantations were performed in the same ear as the initial implantation, with the same implant type. Parameters such as insertion depth and number of active channels were the same in all subjects before and after re-implantation. Immediately following the revision surgery, three patients attained the same level of hearing that they had with their original implants. Three months following re-implantation, five subjects achieved almost the same scores as they had before re-implantation. The results showed that cochlear implant patients undergoing re-implantation can anticipate achieving nearly the same level of speech recognition as they had with their original implant. Nevertheless, patients need to be aware of potential problems before undergoing re-implantation so that expectations are not too high.

- 390. Schön F, Müller J, Helms J (2002) Speech reception thresholds obtained in a symmetrical four-loudspeaker arrangement from bilateral users of MED-EL cochlear implants, Otol & Neurotol, 23: 710-4.**

Abstract:

Objective: The purpose of the study was to investigate speech reception in noise in subjects who had undergone bilateral implantation with multichannel cochlear implants. Methods: Nine adults with bilateral MED-EL implants were included in the study. The subjects were tested using both implants and the better implant only. Tests were performed in a symmetrical set up, which ideally eliminates the head shadow effect. Speech tests included sentences in quiet and at various signal-to-noise ratios. From the results, the gain in signal-to-noise ratios at the speech reception threshold was determined. Results: All subjects showed a substantial gain in signal-to-noise ratios of approximately 4dB on average. In addition, the gain in signal-to-noise ratios was essentially stable for as long as 4.4 years. Conclusions: The results indicate that bilateral cochlear implant users are able to binaurally process speech.

- 391. Skarzynski H, Lorens A, D'Haese P, Walkowiak A, Piotrowska A, Sliwa L, Anderson I (2002) Preservation of residual hearing in children and post-lingually deafened adults after cochlear implantation: An initial study, ORL, 64(4): 247-53.**

Abstract:

**Objective:** To investigate whether the residual hearing of severely hearing-impaired children and adults could be preserved using the soft surgery approach. **Patients and methods:** This project employed a prospective study design. All testing and surgery took place in the Institute of Physiology and Pathology of Hearing, Warsaw, Poland. Twenty-six patients (7 children and 19 post-lingually deafened adults) with residual hearing were assessed. Subjects were assessed using conventional pure-tone audiometry at least 1 month prior to surgery. Cochlear implant surgery with a MED-EL COMBI 40/40+ standard electrode array was conducted, using the soft surgery approach. Pure-tone audiometry thresholds were re-assessed at least 1 month after surgery. The researchers assessed change in auditory thresholds using pure-tone audiometry to determine preservation of residual hearing. **Results:** Sixteen of 26 patients (62%) retained their residual hearing within 5dBHL of pre-operative scores. Only 5 of 26 patients (19%) lost all measurable residual hearing after cochlear implantation. This suggests that surgeons are often able to preserve residual hearing during cochlear implant surgery using the soft surgery technique. **Conclusions:** Preservation of residual hearing is an important consideration on cochlear implantation in the light of changing selection criteria for cochlear implant candidates, and as younger children are receiving implants. This is important, as we do not know yet the long-term effects of inner ear damage due to traumatic insertions of electrodes. This finding suggests a good prognosis for future possibilities of re-implantation.

- 392. Gfeller K, Witt S, Woodworth G, Mehr MA, Knutson J (2002) Effects of frequency, instrumental family, and cochlear implant type on timbre recognition and appraisal, *Ann Otol Rhinol Laryngol*, 111: 349-56.**

Abstract:

The purpose of this study was to compare postlingually deafened cochlear implant recipients and normal-hearing adults on timbre (tone quality) recognition and appraisal of 8 musical instruments representing 3 frequency ranges and 4 instrumental families. The implant recipients gave significantly poorer ratings than did the normal-hearing adults to those instruments played in the higher frequency range and to those from the string family. The timbre measures were weakly correlated with speech perception measures, but were significantly correlated with 3 cognitive measures of sequential processing.

- 393. Balkany TJ, Eshragi AA, Yang N (2002) Modiolar proximity of three perimodiolar cochlear implant electrodes, *Acta Otolaryngol*, 122: 363-9.**

Abstract:

A new generation of cochlear implant electrodes has been designed to position the stimulating contacts close to the modiolus in order to reduce power consumption and increase stimulation selectivity. The purpose of this study was to assess electrode position in the cochlea for three recently designed electrodes. Fifteen cadaveric temporal bones were implanted with one of three perimodiolar electrode arrays: Nucleus Contour, MED-EL COMBI40+PM (developmental version); and Clarion HiFocus II. Image-enhanced videofluoroscopy and computer morphometrics were used to assess stimulating contact position relative to the modiolus. The mean distance ( $\pm 1$  standard deviation) to the modiolus for all electrode contacts was 0.33 ( $\pm 0.24$ ), 0.30 ( $\pm 0.27$ ) and 0.16mm ( $\pm 0.19$ ) for the Contour, COMBI40+ PM and HiFocus II arrays respectively. In addition, dynamic videofluoroscopy was used to correlate device-specific insertion characteristics with contact-to-modiolus distance. All three devices were successful in terms of locating electrode contacts very close to the modiolar wall.

- 394. Backous DD, Dunford RG, Segel P, Mühlöcker C, Carter P, Hampson N (2002) Effects of hyperbaric exposure on the integrity of the internal components of commercially available cochlear implant systems, *Otol & Neurotol*, 23: 463-7.**

Abstract:

**Hypothesis:** This study investigated whether pressure changes common to scuba diving and to hyperbaric oxygen therapy would not cause crush damage or leakage from critical seals in commercially available cochlear implants. **Background:** The implanted packages of cochlear implants are susceptible to electrical failure caused by leakage from critical seals and to crush injury when exposed to changing barometric pressures encountered in recreational diving and in hyperbaric oxygen therapy. **Methods:** Six Clarion 1.2, eight MED-EL COMBI 40+, six Nucleus CI22M, and six Nucleus CI24M cochlear implants underwent three exposures at 165 feet of seawater (FSW) (6ata abs), 99 FSW (4 ata abs), and 60 FSW (2.8 ata abs), simulating rates in accordance with US Navy dive tables for

non-decompression dives. Dives to 45 FSW (2.4 ata abs) simulated wound therapy. Before each dive began, after each dive, and after completion of the dive protocol, each device underwent telemetry and electrical integrity checks. All electrodes were returned to their respective factories for final electrical and quality control testing. Results: All 26 devices completed the dive protocol. Nucleus CI24M implant had a fault recorded at electrode lead 18 on pre-dive and final product testing, which was absent during interval dive measurements. All 26 devices passed final electrical and quality control testing. In addition, the six Clarion units passed repeat helium leak testing. Conclusion: The implanted components of the Clarion 1.2, MED-EL COMBI40+, and Nucleus CI22M and CI24M were safely subjected to repeated pressure changes up to 6 atm abs, equivalent to 165 feet of seawater, without electrical failure from leakage at critical seals or crush damage.

**395. Petrov SM (2002) Previous considerations regarding fitting of cochlear implant speech processors, Vestnii Otorhinolaryngology, 4: 18-20.**

Article in Russian

Abstract:

The fitting of the cochlear implant speech processor is the first procedure in the rehabilitation process. A brief description of cochlear implant characteristics serves to show how speech signal parameters are changed after speech processing. This is done to show the significance of correct speech processor fitting: too high or too low threshold levels are of concern for speech perception quality of cochlear-implanted patients. The correct definition of thresholds and comfortable levels gives the patient maximum acoustical information.

**396. Baumgartner WD, Pok SM, Egelierler B, Franz P, Gstöttner W, Hamzavi J (2002) The role of age in pediatric cochlear implantation, Int J Pediatr Otorhinolaryngol, 62: 223-28.**

Abstract:

Objective: To document progress, benefit and importance of age in paediatric cochlear implantation. Design: The EARS test battery was performed on 33 prelingually deaf children at regular intervals up to 36 months following implantation. All children participated in individually tailored intensive audiological rehabilitation programs after receiving their implants. In this respect, it was attempted to evaluate speech perception scores in children implanted before and after the age of 3 in a homogenous group. Results: All children demonstrated encouraging improvements over time in their speech recognition abilities. Furthermore, it was observed that the children who were implanted under the age of 3 achieved higher levels of speech perception performance. Conclusion: In order to shorten the process of central maturation of the auditory system, it is desirable to implant the children as young as possible. Early intervention seems to be the ideal strategy in enabling prelingually deaf children to derive maximum benefit from cochlear implantation.

**397. Hüttenbrink KB, Zahnert T, Jolly C, Hofmann G (2002) Movements of cochlear implant electrodes inside the cochlea during insertion: an X-ray microscopy study, Otol Neurotol, 23(2): 187-91.**

Abstract:

Background: There are no satisfactory, non-invasive techniques currently available to visualise the cochlear implant (CI) electrode in a dynamic state as it is advanced inside the cochlea. Objective: this study describes a radiologic technique that can be used in temporal bones to monitor the electrode position in real time and to visualise the basilar membrane. Methods: A cochleostomy was performed in accordance with the normal procedure for cochlear implantation in seven fresh cadaveric temporal bones. A special x-ray tube (Microfocus, Wunstorf, Germany) with a spot size of 1µm and fluoroscopy were used for continuous videotape imaging of the advancing electrode in the cochlea. Conventional electrodes (MED-EL C40+, MED-EL, Innsbruck, Austria) and prototypes of perimodiolar electrodes (MED-EL), with varying thicknesses and angles of insertion, were used for the study. Finally, contrast liquid (Ultravist, Belex Imaging, Schering, Germany) was injected into the scala vestibuli through the stapes footplate. Results: The advancing electrode carrier was clearly visible at x20 magnification. With the perimodiolar electrodes, deep insertion was impossible if the guiding wire was too rigid, and retraction occurred if the wire was soft. The intact nature of the basilar membrane could be confirmed by the sequential filling of scala vestibuli and scala tympani. Conclusion: To our knowledge, this is the first non-invasive study demonstrating continuous visualisation with high-resolution and x-ray magnification of CI electrode advancement inside the intact cochlea. Our technique can be used for the development of CI electrodes with

optimal design characteristics, especially stiffness. Visualisation of the basilar membrane will influence the insertion techniques when CIs are developed for patients with residual hearing.

- 398. Zimmerling MJ, Hochmair ES (2002) EAP recordings in Ineraid patients: Correlation with psychophysical measures and possible implications for patient fitting, *Ear Hear*, 23(2): 81-91.**

Abstract:

Objective: Objective measurements can be helpful for cochlear implant fitting of difficult populations, as for example very young children. One method, the recording the electrically evoked compound action potential (EAP), measures nerve recruitment in the cochlea in response to stimulation through the implant. For coding strategies implemented at a moderate stimulation rate of 250pps per channel, useful correlations between EAP data and psychophysical data have already been found. With new systems running at higher rates, it is important to check these correlations again. Design: This study investigates the correlations between psychophysical data and EAP measures calculated from EAP amplitude growth functions. EAP data were recorded in 12 Ineraid subjects. Additionally, behaviour thresholds (THR) and maximum acceptable loudness levels (MAL) were determined for stimulation rates of 80pps and 2,020 pps for each electrode. Results: Useful correlations between EAP data and psychophysical data were found at the low stimulation rate (80pps). However, at the high stimulation rate (2,020pps) correlations were not significant. They were improved substantially, however, by introducing a factor that corrected for disparities due to temporal integration. Incorporation of this factor, which controls for the influence of the stimulation rate on the threshold, improved the correlations between EAP measures recorded at 80pps and psychophysical MALs measured at 2,020pps to better than  $r = 0.70$ . Conclusions: EAP data as such can only be used to predict behavioural THRs and MCLs at low stimulation rates. To cope with temporal integration effects at higher stimulation rates, EAP data must be rate corrected. The introduction of a threshold-rate-factor is a promising way to achieve that goal. Further investigations need to be performed.

- 399. Winkler F, Schön F, Peklo L, Müller J, Feinen Ch, Helms J (2002) The Würzburg questionnaire for assessing the quality of hearing in CI children (WH-CIK), *Laryngorhinootologie*, 81(3): 211-6.**

Article in German

Abstract:

Background: The goal of this study was to compare the auditory behaviour of bilaterally implanted children while using both CIs to their auditory behaviour during the time when they were using one CI. Methods: for this purpose a questionnaire looking at different aspects of hearing such as hearing in background noise, in complex listening situations and directional hearing was developed. The questionnaire was completed by parents of 28 bilaterally implanted children. They were instructed to state their judgement or the behaviour of the children. The parents scaled their judgements using a method of extended category scaling similar to that applied in the loudness scaling with the Würzburg hearing field. Each of the five verbal categories was subdivided into 10 numerical subdivisions, so that the parents were able to express judgements lying between the different categories. Results: Eight out of eleven items showed that hearing with bilateral CIs was significantly better than with one CI ( $p < 0,003$ ). The two items, which did not show a significant difference between the two conditions were those related to the interest in auditory rehabilitation and to aversion to noise. Conclusions: The questionnaire has proven to be a useful instrument to assess the quality of hearing in children. The possibility of bilateral implantation should be considered during the decision process prior to implantation.

- 400. Anderson I, Weichbold V, D'Haese P (2002) Recent results with the MED-EL COMBI 40+ cochlear implant and TEMPO+ behind-the-ear processor, *ENT Journal*, 81(4): 229-33.**

Abstract:

Cochlear implantation is a viable treatment for patients with severe to profound hearing loss. We report the results of speech perception tests (numbers, monosyllables, and sentence tests) achieved with MED-EL's COMBI 40+ (C40+) cochlear implant after 12 months of use. These findings, which were taken from a larger German study, were similar to those of other studies of the C40+ implant. We also compared the differences in speech perception observed with the CIS PRO+ body-worn speech processor and the newer TEMPO+ behind-the-ear speech processor. Although these results were similar with respect to most of the measured parameters, the TEMPO+ processor had a distinct advantage during tests in noise.

- 401. Kubo T, Takahashi Y, Iwaki T (Eds) (2002) *Cochlear Implants: An update, Kugler Publications: The Hague, The Netherlands.***

Proceedings from the 3<sup>rd</sup> Congress of the Asia Pacific Symposium on Cochlear Implant and Related Sciences.

Includes:

Backous DD & Hochmair ES Specific considerations for determining safety with MRI use in cochlear implant patients

Borkowski G, Hilmann H & Stark T Surgical aspects of cochlear implantation in young and very young children

Backous DD, Comer L, Bishop R & Balko K Preliminary results using a two-staged technique for cochlear implant insertion in a patient with bilateral fenestration cavities

Singh RS & Shanks MS Cochlea implants in abnormal cochlea

Brockmeier SJ, Nopp P, Vischer M, Baumgartner W, Stark T, Schön F, Müller J, Braunschweig T, Busch R, Getto M, Arnold W & Allum DJ Correlation of speech and music perception in COMBI 40/40+ users

Schenk BS, Hamzavi JS, Moosmüller S, Baumgartner WD & Deutsch WA The effect of auditory feedback on the production of fricatives and sentence duration after cochlear implantation

Hamzavi JS, Schenk BS, Moosmüller S, Baumgartner WD & Deutsch WA The effect of auditory feedback on the production of vowels cochlear implantation

Stark T, Müller J, Vischer M, Schön F, Senn P, Engel A, Kompis M, Hildmann H & Helms J Multicentre study on bilateral cochlear implantation

Au DK, Hui Y, Wei W & Wong BY Speech recognition between bilaterally and unilaterally cochlear implanted and hearing-aid fitted users

Kiefer J, Tillein J, von Ilberg C, Pfenningdorf T, Stürzbecher E, Klinke R & Gstöttner W Fundamental aspects and first results of the clinical application of combined electric and acoustic stimulation of the auditory system

**402. Hochmair ES (2001), MRI Safety of MED-EL C40/C40+ cochlear implants, Cochlear Implants International, 2(2): 98-114.**

Abstract:

Cochlear implants are an accepted means for the treatment of profound bilateral deafness. Magnetic resonance imaging (MRI) is gaining more and more importance as a diagnostic tool. It is therefore very likely that cochlear implant wearers will, at some point in their life, become MRI candidates. This makes a discussion of MRI safety of cochlear implants a most timely subject. With the C40/C40+ system as an example, all the major and potentially troublesome interactions are discussed, as well as the conditions for safe conduct of MR examinations with cochlear implant wearers. For the C40/C40+ systems, safe MR imaging is possible with 0.2 Tesla, 1.0 Tesla and 1.5 Tesla scanners.

**403. Baumgartner WD, Youssefzadeh S, Hamzavi J, Czerny C, Gstöttner W (2001) Clinical application of magnetic resonance imaging in 30 cochlear implant patients, Otol and Neurotol, 22: 818-22.**

Abstract:

Objective: The goal of this investigation was to provide evidence that magnetic resonance imaging (MRI) can be performed safely and effectively on cochlear implant patients who require diagnosis of additional diseases. Study design: A retrospective study was performed over 5 years. In a total of 300 patients with cochlear implants at the authors' centre, MRI was performed whenever it was medically indicated. Setting: All patients underwent scanning in a Philips Gyroscan T10-NT MRI machine, using commercially available Powertrac 300 software. Patients: All patients with cochlear implants for whom MRI was indicated (n=30) were included in this study. They had a wide variety of conditions necessitating MRI, including cervical disc prolapse, hypophyseal adenoma, epipharynx carcinoma, knee degeneration, parotid tumour and pre-operative evaluation for re-implantation and bilateral implantation. Results: No adverse effects from MRI were reported by any of the patients. The cochlear implants all retained their function. All images were of diagnostic value. Because of the MRI, the patients did not need to undergo additional, more invasive and expensive diagnostic procedures. Examples of MRI images from 5 patients are shown. Conclusions: MRI on cochlear implant patients, using the MED-EL COMBI 40 and Nucleus mini series 22 at 1 Tesla, can be a safe procedure. Removal of any magnet is not necessary.

**404. Schmidt R, Werner E, Koch A (2001) Management of a deaf-blind patient with a 12-channel cochlear implant, Laryngorhinotologie, 80(5): 245-8.**

Article in German

Abstract:

A case study of a deaf-blind patient implanted with the COMBI 40+ cochlear implant is presented. The patient is a 70-year-old woman who has been blind since the age of 40. Since 1977 the hearing loss continuously increased. Before surgery she had a very small residual hearing (with hearing aid: 40% speech intelligibility with four syllable numbers) and she used Braille and finger spelling on her hand to communicate with other people. The patient has a high intelligence and so she did not have any problems when the speech processor was fitted and during the hearing therapy. After one month she had open-set speech recognition. The quality of her life is much better than before surgery. The communication by fingerspelling on her hand is not necessary any longer.

- 405. Valimaa TT, Sorri MJ, Lööponen (2001) Speech perception and functional benefit after multichannel cochlear implantation, Scand Audiol Suppl, 52: 45-7.**

Abstract:

This study was done to investigate the effect of a multichannel cochlear implant on speech perception and the functional benefit of cochlear implantation in Finnish-speaking postlingually deafened adults. Fourteen subjects were enrolled. Sentence and word recognition were studied with open-set tests auditory only. One year after implantation, the listening performance was assessed by case histories and interviews. Before implantation for subjects with a hearing aid, the mean recognition score was 38% for sentences and 17% for words. One year after switching on the implant, the mean recognition score was 84% for sentences and 70% for words. Before implantation, the majority of the subjects were not aware of environmental sounds and only a few were able to recognise some environmental sounds. One year after switching on the implant, the majority of the subjects were able to use the telephone with a familiar speaker. All the subjects were able to recognise speech auditory only and had thus gained good functional benefit from the implant.

- 406. Karinen PJ, Sorri MJ, Valimaa TT, Hüttunen KH, Lööponen HJ (2001) Cochlear implant patients and quality of life, Scand Audiol Suppl, 52: 48-50.**

Abstract:

During the last two decades, cochlear implants have been available for profoundly hearing-impaired patients who do not benefit from conventional hearing aids. The quality of life of these implantees has not been extensively studied, and has not been studied at all in Finland. To assess their quality of life, the Nottingham Health Profile questionnaire was sent to all adult implanted patients in Finland. Implantees tended to have more favourable average pain, emotional reaction and mobility indexes in each age group studied than the average population. Social-isolation seemed to be more common in the youngest and oldest groups of implantees. Apparently, implantees are physically healthier than the average population. However, a bias caused by the strict selection of implant candidates cannot be excluded.

- 407. Valimaa TT, Sorri MJ, Lööponen HJ (2001) The effect of a multichannel cochlear implant on phoneme perception, Scand Audiol Supl, 52: 51-3.**

Abstract:

This study was done to investigate the effects of a multichannel cochlear implant on phoneme perception in Finnish-speaking postlingually deafened adults. Phoneme recognition was studied with 100 pre-recorded nonsense syllables (open-set) presented at 70dB SPL, auditory only, in the free-field situation. Ten subjects were tested before implantation both with and without a hearing aid (HA), and 3, 6 and 12 months after switching on the implant. Before implantation without a HA, the subjects did not recognise vowels, consonants or syllables. Four of the subjects used a HA before implantation, and the mean recognition scores of these subjects were 34% for vowels, 28% for consonants and 13% for syllables. One year after switching on the implant, the mean recognition scores were 77% for vowels, 66% for consonants and 46% for syllables. According to phonological analysis vowels appear to be easier to perceive than consonants during the first stage after multichannel cochlear implantation.

- 408. Valimaa TT, Sorri MJ (2001) Speech perception and functional benefit after cochlear implantation: a multicentre survey in Finland, Scand Audiol, 30(2): 112-18.**

Abstract:

This study was done to survey the effect of cochlear implantation on hearing level, speech perception and listening performance in Finnish-speaking adults. The subjects of the study comprise 67 adults. Pure-tone

thresholds (0.125-8kHz), word recognition and listening performance were studied before and after implantation. After switch-on of the implant, the median values of PTA (0.5-4kHz) in the sound field were fairly stable across the evaluation period. Three months after switch-on of the implant, the mean word recognition score was 54%. There was clear improvement in the word recognition scores over a longer period of time, the mean score being 74% 24 months after switch-on. Six months after switch-on, the majority of subjects (40/48) were able to recognise some speech without speech reading, and 26 of these 48 subjects were able to use the telephone with a known speaker, gaining good functional benefit from the implant.

- 409. Szuchnik J, Skarzynski H, Geremek A, Zawadzki R (2001) Results of total deafness treatment in young pre- and postlingually deafened children, *Scand Audiol*, 30: Suppl 52: 42-4.**

Abstract:

Developing a cochlear implant programme is one of the most difficult problems we need to solve concerning young children. Application of cochlear implants to this group of patients gives hope for better speech and language development than using conventional hearing aids. Children comprise about 40% of all implanted patients at the Institute of Physiology and Pathology of Hearing in Warsaw. They are provided with different types of cochlear implants, 16 of which are included in the international comparative study EARS (Evaluation of Auditory Responses to Speech). In this paper results are presented of auditory speech perception in pre-, peri- and postlingual children using the multichannel cochlear implant systems COMBI 40 and 40+. All the children were regularly evaluated following the EARS procedure with a number of perception tests. Monitoring of auditory perception development is fundamental and allows prognosis of speech and language development in children.

- 410. Hamzavi J, Franz P, Baumgartner WD, Gstöttner W (2001) Hearing performance in noise of cochlear implant patients versus severely-profoundly hearing-impaired patients with hearing aids, *Audiology*, 40(1): 26-31.**

Abstract:

It is possible for most post-lingually deafened patients to attain significant open speech recognition following cochlear implantation. In contrast, many severely-profoundly sensorineural hearing-impaired patients receive no benefit from their hearing aids, especially in situations with background noise. The aim of the study was to evaluate the speech recognition ability in quiet and in noise of post-lingually deaf adults implanted with COMBI40/40+ cochlear implants versus severely-profoundly sensorineural hearing-impaired patients fitted with hearing aids. For this purpose, we tested two groups of patients: one that had received cochlear implants (n=22) and a group of subjects with severe-profound sensorineural hearing impairment, fitted with hearing aids (n=15). All of the patients were tested using the Hochmair, Schultz and Moser discrimination test in quiet and noise. The results of the study demonstrate that most of our cochlear implant patients received a substantial benefit from their implant, achieving scores of 70 to 100% (mean, 90%) for the numbers test and 10 to 72% (mean, 43%) for the monosyllable test 1 year after implantation. Even in situations with background noise, scores of 1 to 99% (mean, 45.65%) for a signal to noise ratio (SNR) of +15dB 1 year following the implantation improved to 7 to 95% (mean, 50.7%) at 2 years and 8 to 99% (mean, 60%) at 3 years after implantation. These results are significantly ( $p < 0.04$ ) superior to the hearing aid patient's scores of 1 to 64.2% (mean, 26.7%) for a SNR of 15dB. The results of the present study may have clinical implications in regard to selection of candidates for cochlear implantation.

- 411. Gstöttner WK, Adunka O, Franz P, Hamzavi J, Plenk H, Susani M, Baumgartner W, Kiefer J (2001) Perimodiolar electrodes in cochlear implant surgery, *Acta Otolaryngol*, 121(2): 216-9.**

Abstract:

Perimodiolar-positioned cochlear implant electrodes have been developed in order to bring the electrode contacts as close as possible to the spiral ganglion cells, which are the target of electrostimulation. This results in lower electrical thresholds, higher dynamic ranges and less channel interaction when compared with normal implant electrodes, which are usually located peripherally within the scala tympani. In this study we evaluated 4 different types of perimodiolar electrode: the Clarion Performed electrode, the Clarion Performed electrode with positioner, the Nucleus Contour electrode and the MED-EL Perimodiolar COMBI 40 electrode. These devices require different approaches to achieve a perimodiolar electrode position. The electrodes were inserted in fresh human temporal bones. After processing these bones with these electrodes in situ by employing a sawing, grinding and polishing technique, the inner ear structures as well as the electrode positions could be evaluated in detail. All electrode types studied had a more or less perimodiolar position; however, each type produced a certain amount

of trauma to cochlear structures, which is discussed in relation to mechanical properties. Further human temporal bone studies with improved perimodiolar cochlear implant electrodes are necessary in order to find an optimised type of electrode.

- 412. Helms J, Müller J, Schön F, Winkler F, Moser L, Shehata-Dieler W, Kastenbauer E, Baumann U, Rasp G, Schorn K, Ebetaer B, Baumgartner W, Hamzavi S, Gstöttner W, Westhofen M, Doring W, Dujardin H, Albeffer K, Mair A, Zenner H, Haferkamp C, Schmitz-Salue C, Arnold R, Sesternhenn G, Jahnke V, Wagner H, Grabel S, Bockmul U, Häusler R, Vischer M, Kompis M, Hildmann H, Radu H, Stark T, Engel A, Hildmann A, Steitberger C, Hüttenbrink K, Muller-Aschoff E, Hofmann G, Seeling K, Hloulou U, von Ilberg C, Kiefer J, Pfenningdorff T, Gall V, Breitfuss A, Stelzig Y, Begall K, Hey M, Vowerk W, Thumfart W, Gunkel A, Zorowka P, Stephan K, Gammert C, Mathis A, DeMin N, Freigang B, Ziese M, Stutzel A, von Specht H, Arnold W, Brockmeier S, Ebenhoch H, Steinhoff A, Zierhofer C, Zwicknagel M, Stobich B (2001) Comparison of the TEMPO+ ear-level speech processor and the CIS PRO+ body-worn processor in adult MED-EL cochlear implant users, *ORL J Otorhinolaryngol Relat Spec*, 63(1): 31-40.**

Abstract:

The study was conducted to compare the new MED-EL TEMPO+ ear-level speech processor with the CIS PRO+ body-worn processor in the COMBI 40/COMBI40+ implant system. Speech tests were performed in 46 experienced subjects in two test sessions approximately 4 weeks apart. Subjects were switched over from the CIS PRO+ to the TEMPO+ in the first session and used only the TEMPO+ in the time between the two sessions. Speech tests included monosyllabic word tests and sentences via the telephone. An adaptive noise method was used to adjust each subject's scores to approximately 50%. Additionally, subjects had to complete a questionnaire based on their 4 weeks of experience with the TEMPO+. The speech test results showed a statistically significant improvement in the monosyllabic word scores with the TEMPO+, indicating some learning in his task. In the questionnaire, the vast majority of subjects found that the TEMPO+ allows equal or better speech understanding and rated the sound quality of the TEMPO+ higher. All these objective and subjective results indicate the superiority of the TEMPO+ and are mainly attributed to a new coding strategy called CIS+ and its implementation in the TEMPO+. In other words, based on the results of this study, it appears that after switching over from the CIS PRO+ to the TEMPO+, subjects are able to maintain or even improve their own speech understanding capability.

- 413. Hüttenbrink KB, Zahnert T, Hofmann G, Kronholz G, Jolly C (2001). Visualisation of cochlear implant electrode movements in the cochlea by using x-ray microscopy *Laryngorhinootology*, 80(2): 66-70.**

Abstract:

**BACKGROUND:** The movements of the electrode cable of a cochlear implant inside the cochlea during the insertion procedure generally are invisible, even in temporal bone experiments. Yet, the development of new designs of electrodes, their positioning near to the modiolus etc requires an exact knowledge of the dynamic behaviour of the electrodes inside the cochlea. The exclusive method for looking through the undamaged cochlea is by x-ray technique. **METHODS:** A specific x-ray tube with a focal spot size of barely 5 microns allows useful direct magnifications of more than 20-30 times. We performed temporal bone experiments with this tube and studied the behaviour of conventional and perimodiolar electrode cables of MED-EL CI during the insertion procedure under fluoroscopic viewing. **RESULTS:** The high-resolution imaging revealed the influence of stiffness of the electrode cable on the insertion depth of a conventional electrode. If the angle of the direction of insertion was too steep, the resulting kinking of the cable at the medial wall of the basal turn was immediately visible. The direct visualisation of the movements of the cable was useful in optimising the design and stiffness of various prototypes of perimodiolar electrodes for deep insertion. **CONCLUSIONS:** The dynamic examination technique disclosed that the stiffness of actual electrode cables is not optimally adapted to the form of the cochlear cavity for deep insertion. The non-destructive visualisation technique will facilitate the development of advanced electrode design, especially for various concepts of perimodiolar electrodes.

- 414. Ovchinnikov IM, Borodin AA (2001) Cochlear implantation with implant COMBI 40+ produced by MED-EL, *Vestn Otorinolaringol*, 1: 33-6.**

Article in Russian

Abstract:

The paper reports three cases of cochlear implantation using the implant COMBI 40+ produced by MED-EL (Austria). Short-term post-operative testing results demonstrate an appreciable progress in hearing. Changes in speech discrimination and speech production are evaluated.

- 415. Sorri MJ, Hüttunen KH, Valimaa TT, Karinen PJ, Lööpponen HJ (2001) Cochlear Implants and GSM phone, Scand Audiol Suppl, 52: 54-6.**

Abstract:

Use of a telephone and GSM phones, in particular, was assessed by means of a postal interview sent to all adult Finish implantees. The response rate was very high (87%). Fifty-one of 61 respondents used a telephone and 27/61 also used a mobile phone, usually a digital phone. Two GSM phone models from Nokia (3110 and 6110) were tested with three different cochlear implant systems used by nine patients. Definite characteristics between the processors were found. Nucleus Spectra (2 implantees) could not be used with any of the phones under any test condition. Nucleus Sprint was incompatible with both GSM phone models in a poor field, while GSM phone model 6110 could be used in a good field. The MED-EL COMBI 40+ processor was compatible with both GSM models tested under any condition.

- 416. Clark G and Lawrence D (2000) Technical features of the Nucleus, MED-EL and Clarion Cochlear Implants, Aust J Otolaryng, 3(5): 516-22.**

Abstract:

Cochlear implants have become an established treatment and are used by severely to profoundly deaf adults and children in almost every phase of daily life. Electronic designs have improved to meet clinical and research demands, technological developments have made the devices smaller and more reliable, and speech processing research has yielded a series of improvements in patient benefit. The performance of a cochlear implant system is inextricably linked to the engineering of the device. It is important for clinicians to understand how various technological features can affect results. A large amount of information is available; however the rationale for the features is not always substantiated. The features referred to are for devices in regular, clinical use in mid 1999: Cochlear Limited (Nucleus-24), MED-EL (COMBI-40), and Advanced Bionics (Clarion-S) devices. The details are those available from the manufacturers' manuals, websites, patents and scientific papers. These issues are discussed ignore detail in the chapter on Cochlear Implants for Adults and Children in Audiological Medicine.

- 417. Quigley SM, Brazil-Pierce C, Dobaj H, Backous D (2000) Initial results of patients implanted in the MED-EL COMBI 40+ investigational trial at Virginia Mason Medical Center, Adv Otorhinolaryngol, 57: 442-6.**

Abstract:

Virginia Mason Medical Centre is participating in the United States Food and Drug Administration (FDA) trial of MED-EL COMBI 40+ (C40+) cochlear implant system. The trial is to demonstrate safety and effectiveness with postlingually deafened adults, adults deafened prior to 6 years of age (prelingual), and children as young as 18 months. Fourteen patients have been implanted to date, 2 children have compressed arrays due to ossification of the cochlea as a result of meningitis. All 12 standard arrays are inserted beyond 29mm. There have been no device failures, and one minor flap complication treated conservatively. Up to 6-month data is presented. All patients use Continuous Interleaved Sampler (CIS). Two pre-lingually deafened adults and 1 child have not yet been activated.

- 418. Zupancic J, Battelino S (2000) Intraoperative stapedius reflex measurements after deep electrode insertion compared with postoperative fitting values in cochlear implant patients, Adv Otorhinolaryngol, 57: 316-9.**

Abstract:

None

- 419. Hüttenbrink KB, Zahnert T, Vogel U, Hofmann G (2000) Biologic fixation of the electrode cable of cochlear implants, Otorhinolaryngol Nova, 10: 213-16**

Abstract:

Objectives: To verify the necessity for special surgical techniques or clips for fixation of the electrode cable of a cochlea implant against dislocation, and to test the stability of postoperative biologic cicatrisation as the sole and solid anchoring of the cable. Material: Temporal bone experiments with a simulated connective tissue sheath

around conventional (MED-EL COMBI 40+) and prototype (profiled surface) cables. Results and conclusions: the electrode cable is anchored securely in a sheath of scar tissue, since unphysiological loads are needed for pulling it out if its anchorage. The drag during one extraction trial with a profiled cable even resulted in the rupture of the cable. These results confirm our confidence in this biologic fixation of the electrode cable inside its postoperative cicatric tissue sheath. More than 80 cochlear implantations with the electrode simply embedded in a drop of fibrin glue in the posterior tympanotomy never demonstrated a shift of the electrodes in the last 8 years. Therefore, special fixation of the electrode cable with clips or surgical techniques is not necessary.

- 420. Valimaa TT, Sorri MJ (2000) Speech perception after multichannel cochlear implantation in Finnish-speaking postlingually deafened adults, *Scand Audiol*, 29(4): 276-83.**

This study was done to examine the short-term and long-term effects of multichannel cochlear implantation on speech perception in Finnish-speaking adults. The subjects comprise 20 adults. Pure-tone thresholds (0.125-8kHz), discrimination of phoneme quantity, sentence recognition, word recognition, phoneme recognition and listening performance were studied before and after cochlear implantation. After switch-on of the implant, the median pure-tone threshold values in the sound field were comparable to the level of mild hearing impairment. Most improvement in sentence recognition took place during the 6 months after switch-on (mean score 74%). In word recognition, most improvement took place during the 12 months after the switch-on (mean score 66%), and clear improvement was noted even thereafter. In phoneme recognition, the performance of the subjects improved over the entire follow-up period and 24 months after the switch-on the mean score was 52%. Individual variation was seen in the performance of the subjects. With 3 months of listening experience, all subjects were able to recognise some speech without speech reading, and they gained good functional benefit from the implant. The use of speech recognition tests with different degrees of difficulty is essential for the follow-up of adult cochlear implant subjects.

- 421. Hochmair E, Behr R, Müller J (2000) Auditory Brainstem Implants using high rate multichannel pulsatile stimulation. *Otology Japan*, 10(5): 559-69.**

Abstract:

None

- 422. Gstöttner WK, Hamzavi J, Baumgartner WD, Czerny CC (2000) Fixation of the electrodes array with bone pate in cochlear implant surgery, *Acta Otolaryngol*, 120(3): 369-74.**

Abstract:

The aims of this study are to report on our experiences using a bone pate (a mixture of bone dust and fibrin glue) fixation technique of the COMBI40/COMBI 40+ electrode array during cochlear implant surgery. A retrospective study involving 57 patients implanted with the COMBI 40/ COMBI 40+ cochlear implants over 31 months fixated with bone pate was performed, utilising our electrical fitting data as well as re-operation and X-ray findings. We found no signs of electrode retraction in any of the 57 patients. Electrical fitting data showed no reduction in the number of active channels between the first and last times patients were evaluated (a period of 4 – 31months). Furthermore, a comparison of X-rays performed within the first week following cochlear implant surgery and again 7 – 27 months later showed no signs of electrode retraction in 10 patients. Three patients who required re-operations after implantation allowed us the opportunity to examine the effectiveness of the bone pate fixation and revealed new bone growth with the electrode fixed in place. Histological examinations of the newly built bone showed laminar and compact bone structures. The use of bone pate was thus found to be a suitable method of electrode fixation in cochlear implant surgery. Compared with other fixation methods, it is inexpensive and uses no foreign materials.

- 423. Gstöttner WK, Hamzavi J, Egelierler B, Baumgartner WD (2000) Speech perception performance in prelingually deaf children with cochlear implants, *Acta otolaryngol*, 120(2): 209-13.**

Abstract:

The goals of this study were to report mean values of speech perception performance in prelingually deaf children implanted with a COMBI 40/40+ cochlear implant. A total of 31 patients were included in the study. The time span ranged over 3 years, during which time the Evaluation of Auditory Responses to Speech (EARS) test battery was used with the children. The EARS battery contains four measures of closed-set speech perception and three open-set tests. The mean test results exhibited steady improvement on all parts of the EARS test battery, even up to 3 years post-implantation. The preoperative scores for the Listening Progress Profile (LiP) were 4%, rising to

93% at 36 months post-implantation. Results for the open-set testing measures were most encouraging, with some children reaching fairly high levels of speech perception, receiving scores as high as 100%, by the 36 month evaluation. The congenitally and prelingually deaf children in our study showed continuous improvement in both closed and open set speech perception following cochlear implantation, although variability individual performance among the children was noted.

- 424. Müller J, Schön F, Helms J (2000) Bilateral cochlear implant – New aspects for the future, Adv Otorhinolaryngol, 57: 22-7.**

Abstract:

None

- 425. Allum JH, Greisinger R, Straubhaar S, Carpenter MG (2000). Auditory perception and speech identification in children with cochlear implants tested with the EARS protocol. British Journal of Audiology, 34(5): 293-303.**

Abstract:

The performance of children who receive a cochlear implant may be dependent on both the age at implantation and the amount of experience with the implant. In this study we investigated changes in auditory perception and speech identification with experience in 71 children who had received a cochlear implant. The children were divided into 3 groups, those above and below 7 years of age at the time of implantation and those 3 years or younger deafened by meningitis. The children received either the Nucleus 22, Nucleus 24 or the MED-EL C40+ implant. The test material was a reduced form of the EARS evaluation protocol developed by MED-EL into a multi-language format. Tests were performed pre-operatively, within 2-5 days of first fitting of the speech processor, then at 1, 3 and 6 months and every 6 months thereafter for a total period of 24 months. The results indicated that all children showed improvement after 6-12 months. The rate of improvement differed between age groups. Children over 7 years of age had preoperatively higher test scores than younger children, presumably because of previous experience with hearing aids. These children showed an immediate post-operative drop in performance that recovered 1-3 months later. Children under 7 years started at lower performance levels but approached those of the elder children after 12 months of CI use because their post-operative drop was less significant and their performance improved faster. Children who had been deafened by meningitis and had been implanted at the age of three or less made little progress over the first 6 months but approached test levels of the under-7 year olds by 18 months or later. All three components of the evaluation protocol employed, the Listening Progress Profile (LiP), the Monosyllabic-Trochee-Polysyllabic Test (MTP) and the Meaningful Auditory Integration Scale (MAIS) proved to be valuable in demonstrating improvement in performance of CI children in all age groups once the immediate post-operative drop had been overcome.

- 426. Baumgartner WD, Gstöttner W, Hamzavi J, Adunka O, Czerny C (2000). Präoperative Diagnostik vor einer Cochlear-Implantation. Wien Klin Wochenschr 112(11): 505-8.**

(Preoperative diagnostic procedures before cochlear implantation)

Article in German

Abstract:

About 200 patients are considered each year for cochlear implant recipientcy. Only ¼ of these candidates actually receive an implant. The aim of this study is to discuss the pre-operative procedure we use, which is aimed to exclude patients who would not benefit from an implant. A cochlear implant is an example of very expensive high-profile medical therapy, a single implant costing about 280 000 Austrian shillings. The aim of the pre-operative diagnostic procedure is to select the right patients, with a view to providing the best audiological outcome. During the past 20 years, important parameters have been identified to determine suitable patients. Candidates for a cochlear implant are infants and children (independent of the aetiology of deafness or high grade hearing loss), as well as post-lingual deaf adults. Congenitally deaf adults or teenagers are considered unsuitable to receive an implant.

- 427. Baumgartner WD, Youssefzadeh S, Czerny C, Hamzavi J, Adunka O, Gstöttner W (2000) Klinische Anwendung von Magnetresonanztomographie bei Cochlear-implantierten Patienten. Wien Klin Wochenschr 112(11): 512-4.**

(Clinical utilisation of magnetic resonance imaging for patients with cochlear implants.)

Article in German

Abstract:

To date, MR imaging is absolutely contraindicated in cochlear-implanted patients. The aim of this study is to document the potential value of MR imaging in such patients, without injurious or side effects and without technical device failure. After in vitro experimental testing, 25 cochlear-implanted patients underwent MRI. Radiological evaluation was also possible. The use of 1-Tesla fast spin echo sequences minimised artefacts. All cochlear implants were still in working order; no changes in fitting data or a reduction in speech understanding were observed. MR helped to avoid other invasive medical procedures.

- 428. Brockmeier SJ, Baumgartner WD, Steinhoff J, Nopp P, Weisser P, Thurner E, Ebenhoch H, Gedlicka W, Arnold W, Gstöttner (2000) Influence of the Band-Pass Filter Configuration on Speech Perception and Patient Preference in the COMBI 40+ Cochlear Implants. Adv ORL, 57: 405-7.**

Abstract:

None

- 429. Czerny C, Gstöttner W, Adunka O, Hamzavi J, Baumgartner WD (2000) Präoperative Bildgebung vor dem Einsetzen eines multikanalikulären Cochlear-Implantates mittels Computer- und Magnetresonanztomographie der Innenohrregion. Wien Klin Wochenschr 112(11): 481-6.**

(Pre-operative imaging of the inner ear prior to the implantation of a multi-channel cochlear implant using computed and MR technology)

Article in German

Abstract:

CT and MRT are now standard examinations prior to insertion of a cochlear implant. Both methods have advantages and disadvantages in terms of discovering potentially pathological structures in the inner ear. The aim of this study was to evaluate the pros and cons of using CT and MRT before cochlear implantation. CT is usually performed using axial planigraphic planes. Like MRT, bone-specific CT is helpful in the diagnosis of congenital and acquired changes within the inner ear. Congenital defects in the meatus acousticus internus, the endolymphatic duct and sac, the cochlea and the vestibulum can be diagnosed and also quantified. Infectious morphologic changes can be seen on CT images in their terminal residual state (sclerotic tissue). However, acute inflammation and fibrotic tissue is not visible on CT. T2-specific MRT images are very fluid sensitive and play a major role in preoperative cochlear implant diagnosis. This examination demonstrates fluid within the peri-and endolymphatic cave and permits the diagnostician to determine whether congenital or acquired diseases have destroyed such fluid-filled cavities. In order to demonstrate pathological changes in the temporal bone and neural structures in the inner ear, MRT is the preferred method. Displaying the modiolus and the cochlear nerve is extremely important because, in their absence, a cochlear implantation may be contra-indicated. MRT also demonstrates other neural structures such as facial nerve. This information may be important for the surgeon, e.g. the state of the pneumatic system in the mastoid cavity (which is best visualised by bone-specific CT).

- 430. Czerny C. Et al (2000) Postoperative Darstellung und Erfassung der Lage und Insertionstiefe von multikanalikulären Cochlear-Implantaten durch die hochauflösende Computertomographie und durch das Nativröntgen. Wien Klin Wochenschr (Post-operative imaging and evaluation of the electrode position and depth of insertion of multi-channel implants by means of high-resolution computed tomography and conventional x-rays) 112(11): 509-11.**

Article in German.

Abstract:

Following cochlear implantation, post-operative imaging of the electrode is very important to measure depth of insertion and the position of the electrode, so that kinking and incorrect electrode placement can be clearly identified. The aim of this study was to outline the diagnostic value of CT and conventional x-ray for these parameters. For this purpose we obtained radiographs of patients who had received a cochlear implant. Computed tomography was performed by obtaining axial sections. For conventional x-ray we used digital imaging, utilising a modified Chausse III projection. The images were then rated according to electrode position, insertion depth and possible complications. We also measured the radiation dose using a dummy and evaluated cost of each examination. Both examinations permit excellent identification of electrode position and insertion depth.

However, the depth of insertion can be measured more accurately by means of digital x-ray. The radiation dose of CT was 230 times higher than that of conventional x-ray and the cost of CT 5 times that of digital x-ray.

- 431. Gstöttner W, Adunka O, Hamzavi J, Baumgartner WD (2000) Rehabilitation Hörgeschädigter mit Cochlear-Implantaten – eine Übersicht. (Rehabilitation of hearing-impaired patients with cochlear implants: A review) Wien Klin Wochenschr 112(11): 464-72.**

Article in German

Abstract:

The aim of this paper is to provide an overview of the cochlear implant. The history of this entity is traced from the early development of implants, involving the stimulation of the hearing nerve, up to the currently available standard multichannel implants. The physiological background is also elucidated. A cochlear implant consists of an implantable portion, which lie within the ear, and of parts worn externally on the body. Differences between the first implants and those now in use are as follows: transcutaneous information and energy transmission, the position of the electrode in the ear, and the configuration of the electrode. Differences between the currently available implants mainly concern the number of electrodes, speech coding strategies and the mode of electrode stimulation. Almost all of the most recent implants are equipped with electrodes that are implanted in the tympanic scale of the cochlea.

- 432. Gstöttner W, Adunka O, Hamzavi J, Lautischer M, Baumgartner WD (2000) Sprachdiskrimination bei postlingual ertaubten (Speech discrimination in post-lingually deaf patients with cochlear implants), Cochlear-implantierter Patienten. Wien Klin Wochenschr 112(11): 487-91.**

Article in German.

Abstract:

The aim of this study was to measure the speech discrimination performance of post-lingually deaf patients using the COMBI 40/40+ cochlear implant (MED-EL, Innsbruck). The speech performance of 37 adults was tested over a time span of three years. We used a standardised test battery comprising number, monosyllable, sentence, consonant and vowel discrimination tests. Testing was performed immediately after initial fitting and 1,3,5,12,24 and 36 months thereafter. The average correct answers for all tests were as follows: right after the implantation 29.1%, after 1 month 46.7%, after 3 months 53.9%, after 1 year 63.5% and after 3 years 68.5%. Some patients reached a number discrimination rate of 100%. The discrimination for monosyllables averaged 41.1% two years after implantation. The results demonstrated continuous improvement of speech perception, even after three years following implantation.

- 433. Gstöttner W, Baumgartner WD, Hamzavi J, Adunka O (2000) Cochlear-Implantation – die Wiener Operationstechnik (Cochlear implantation: The Viennese technique). Wien Klin Wochenschr 112(11): 473-6.**

Article in German.

Abstract:

The aim of the study was to report the current surgical procedure that has been established on the basis of about 200 implantations with the COBI 40/40+ implant system. The outstanding features of this procedure are the skin incision and the fact that the electrode can be inserted to a depth of 34mm into the cochlea. In order to provide better magnetic positioning of the external parts, a flap-reducing technique may be required. For insertion we used a soft surgery method to preserve structures within the cochlea. In some cases we were able to inspect the cochlea with microendoscopes, which helped to prevent electrode kinking, since fibrous obliterations were found before the insertion. For electrode fixation in the mastoid cavity we used bone plate.

- 434. Gstöttner W, Hamzavi J, Baumgartner WD, Egelierler B, Adunka O (2000) Hör-und Sprachdiskriminationsleistungen prälingual ertaubter Cochlear-implantierter Kinder (Hearing and speech discrimination scores of prelingually deaf children with cochlear implants). Wien Klin Wochenschr 112(11): 492-7.**

Article in German.

Abstract:

The goal of this study is to report mean values of speech perception performance in prelingually deaf children who received a COMBI 40/40+ cochlear implant. Thirty-one patients were included in the study. The time span ranged over 3 years, during which time the Evaluation of Auditory responses to Speech (EARS) test battery was used in the children. The EARS battery contains 4 measures closed-set speech perception and 3 open-set tests. The mean test results exhibited steady improvement in all parts of the EARS test battery, even up to 3 years post-implantation. The mean preoperative scores were 0.3%, increasing to 92.3% at 36 months post-implantation for the best children. Results for the closed-set testing measures were most encouraging, with some children reaching fairly high levels of speech perception and achieving scores as high as 98.7% at the 36 month evaluation. The congenitally and prelingually deaf children in our study showed continuous improvement in both closed and open set speech perception following cochlear implantation, although individual variations in performance were noted.

- 435. Gstöttner W, Hamzavi J, Franz P, Plenk H, Czerny C, Susani M, Adunka O, Baumgartner WD (2000). Intracochleäre Position von Cochlear-Implantat-Elektroden (Intracochlear position of cochlear implant electrodes). Wien Klin Wochenschr 112(11): 477-80.**

Article in German.

Abstract:

The insertion of cochlear implant electrodes in human temporal bones may be associated with the destruction of structures within the cochlear. The aim of this study was to measure such insertional trauma by means of histological processing of implanted human temporal bones following implantation of a COMBI40/40+ electrode array (MED-EL, Innsbruck). We implanted 6 human temporal bones with original electrodes (3 with COMBI 40 and 3 with COMBI 40+). In 4 bones Healon was used for electrode insertion. The histological investigation was performed after radiographic evaluation of the position of the electrode. For the histological procedure we used a technique, which keeps the electrodes in position within the cochlea. In these slides we could clearly identify the electrodes in the tympanic scale. When inserted properly (point of first resistance) no trauma occurred in the basal portion of the cochlea and minimal trauma in the middle portion of the cochlea.

- 436. Hamzavi JS, Adunka O, Baumgartner WD, Gstöttner W (2000). Sprachdiskrimination im Störschall bei Cochlear-implantierten Patienten (Speech discrimination in noise for patients with cochlear implants). Wien Klin Wochenschr 112(11): 498-504.**

Article in German.

Abstract:

The aim of the study was to evaluate the speech discrimination ability of post-lingually deaf adults implanted with the COMBI40+ cochlear implant in noise and to compare the results with the speech discrimination ability of patients provided with hearing aids. The 12-month post-operative hearing performance of 12 consecutive patients was tested using sentence discrimination tests in quiet and noise. The results of the present study demonstrate that all patients obtained substantial benefit from their implants even in situations coupled with noise. The speech understanding of cochlear-implanted patients appears to be better than that of patients provided with hearing aids. Very high scores (mean 40.2%) were achieved at a signal-to-noise ratio of 15dB.

- 437. Hamzavi JS, Baumgartner WD, Adunka O, Franz P, Gstöttner W (2000) Audiological Performance with Cochlear Reimplantation from Analogue Single-Channel Implants to Digital Multi-channel Devices. Audiology 39: 305-10.**

Abstract:

Cochlear implantation has been performed for almost two decades at the Vienna University Hospital. Until 1994, single-channel implants were used (Ball-Electrode, SC6/2SC6, Vienna/Epoxy, MED-EL, Innsbruck, Austria). The development of multi-channel devices (Combi40/40+), which provide significantly improved speech recognition performance, led to the re-implantation of some patients who had previously received single-channel implants. It was of particular interest to find out if there was a deterioration of the central "learning process" by the re-implantation from the analogue single-channel device to the tonotopic pulsatile multi-channel stimulation. In this study, we attempted to demonstrate that single-channel devices have an impact on the neural organisation of the auditory system. Two groups of post-lingually deaf adult patients were tested. Group A had previously received single-channel implants and were re-implanted with the new COMBI 40/40+ cochlear implant (MED-EL,

Innsbruck, Austria) in the same ear. Group B was implanted only with the COMBI40/40+. Six different speech recognition tests were subsequently performed on all patients, and the two groups performed similarly. Furthermore, it was discovered that group A obtained a significant speech recognition improvement ( $p < 0.05$ ) with monosyllabic words and number tests 1 month following re-implantation.

- 438. Hamzavi JS, Baumgartner WD, Egelier B, Franz P, Schenk B, Gstöttner W (2000) Follow up of cochlear implanted handicapped children. *Int. Journal of Paediatric ORL*, 56 (2): 169-74.**

Abstract:

Objective: To document progress and benefit of multi-handicapped children using cochlear implants. Design: The Evaluation of Auditory Responses to Speech (EARS) test battery was performed on the children in this study at regular intervals following implantation. All children went through individually tailored intensive audiological rehabilitation programmes following cochlear implantation. Results: Individual results from ten multi-handicapped children receiving cochlear implants are presented in this paper. The majority of children in this study are successful implant users. Whenever possible, test scores are included as well as subjective case reports. Conclusion: Providing multi-handicapped children with cochlear implants can result in substantial benefit for both the child and parents. Multi-handicapped children are not contra-indicated for cochlear implantation, although not all are considered to be good candidates.

- 439. Jolly CN, Gstöttner W, Hochmair-Desoyer I, Baumgartner WD, Hamzavi J (2000) Principles and outcome in perimodiolar positioning, *Ann Otol Rhinol Laryngol Suppl*, 185: 20-3.**

Abstract:

A perimodiolar electrode based on the MED-EL C40+ multichannel implant has been designed. A unique positioning paradigm conforms the array to the inner wall of the scala, regardless of cochlear size, insertion depth, and ear side. In vitro and in situ data confirm that the minimally invasive electrode is easily implantable, explantable, reimplantable. Prior to insertion, the outer structure of the array is indistinguishable from the original electrode. Surgical procedure and cochleostomy size is unchanged.

- 440. Hochmair ES, Teissl C, Kremser C, Hochmair-Desoyer I (2000) Magnetic resonance imaging safety of the COMBI 40/40+ cochlear implants *Adv Otorhinolaryngol*, 57: 39-41.**

Abstract:

None

- 441. Baumgartner WD, Youssefzadeh S, Czerny C, Franz P, Hamzavi J, Gstöttner W (2000) Clinical application of magnetic resonance imaging in cochlear-implanted patients, *Adv Otorhinolaryngol*, 57: 28-31.**

Abstract:

None

- 442. Knaus C, Hofmann E, Mueller J, Teissl, Preibisch C (2000) Functional magnetic resonance tomography of the auditory cortex during noninvasive stimulation of the cochlear nerve, *Adv Otorhinolaryngol*, 57: 224-8.**

Abstract:

None

- 443. Ziese M, Stutzel A, von Specht H, Begall K, Friegang B, Sroka S, Nopp P (2000) Speech Understanding with the CIS and the n-of-m strategy in the MED-EL COMBI 40+ System. *ORL Relat Spec*, 62: 321-9.**

Abstract:

Speech tests have been performed on 6 subjects for comparing the standard 12-channel continuous interleaved sampling (CIS) strategy (CIS12), the 7-channel CIS strategy (CIS7) and the 7-of-12 strategy in the MED-EL COMBI40+ system. An ABAB experimental design was used whereby each strategy was reversed and replicated. Speech tests were performed in quiet (vowels, consonants, monosyllables, sentences) and noise (sentences). Results showed that for vowels, CIS12 is significantly superior to CIS7, for consonants and sentences CIS23, CIS7 and 7-of-12 performed equally well, and that for monosyllables 7-of-12 is significantly superior to CIS 7 by almost the same amount as CIS12, but in this case the difference is not significant. Further, all strategies have been found to be equally robust in noise with respect to sentence understanding. The differences between CIS12 and 7-of-12 on the one hand and CIS7 on the other may be attributed to decreased spectral resolution of the latter. The fact that, in contrast to what has been reported for the SPEAK strategy, 7-of-12 is equally robust in

noise as the CIS strategies is explained by the use of higher stimulation rates, wider frequency bands and a higher percentage of channels stimulated in each cycle.

- 444. Hofmann E, Preibisch C, Knaus C, Müller J, Kresmer C, Teissl C (1999) Noninvasive direct stimulation of the cochlear nerve for functional MR Imaging of the auditory cortex, AJNR Am J Neuroradiol, 20: 1970-2.**

Abstract:

We herein present our preliminary experience with functional MR imaging of the direct electrical stimulation of the auditory nerve using an MR imaging-compatible electrode placed in the external auditory meatus of five patients with binaural sensorineural hearing loss. The stimulator was placed outside the imager's bore, and the electrode produced virtually no susceptibility artefacts. In three of five patients, it was possible to activate the superior temporal gyrus during functional MR imaging. No side effects were observed.

- 445. Teissl Ch, Kremser Ch, Hochmair E, Hochmair-Desoyer I (1999) Magnetic resonance imaging and cochlear implant: Compatibility and safety aspects, Journal of Magnetic Resonance Imaging, 9: 26-38.**

Abstract:

With cochlear implants, magnetic resonance imaging (MRI) has until recently been contraindicated due to excessive magnetic and electromagnetic interference. The aim of this study was to determine the MRI compatibility of the MED-EL COMBI 40/40+ cochlear implant, within a wide range of clinical MRI applications. In vitro experiments on a 1.5T MR scanner were performed. Torque, force, demagnetisation, artefacts, induced voltages and temperature increase were measured in worst-case scenarios for the implant. In addition, stabilization experiments were performed. It was shown that most of the electromagnetic interferences between the cochlear implant and the 1.5T scanner remained within acceptable limits. One exception is the torque on the internal magnet, which represents a hazard for patients with these cochlear implants. Therefore, MRI examination should only be performed if there is a strong medical indication, and certainly some assessment of the relative risks involved versus the risk of not providing the diagnostic capabilities of MRI, will have to be made. Appropriate safety measures should be taken

- 446. Colletti V, Fiorino FG (1999) New window for cochlear implant insertion, Acta otolaryngol, 119(2): 214-8.**

Abstract:

Nine patients with profound bilateral hearing loss received a cochlear implant via the middle fossa. Subjects presented with a bilateral radical mastoidectomy cavity, fibro-adhesive otitis media, autoimmune inner ear disease, previous cranial trauma, and genetic prelingual deafness. A classic middle fossa approach was adopted. A small cochleostomy was performed on the most superficial part of the basal turn. A Nucleus 24M cochlear implant system (Cochlear Corporation) was inserted in four patients, a Lauraflex implant (Philips hearing implant) was used in three patients and a COMBI 40+ (MED-EL) with a double electrode array in two. The receiver stimulator was positioned in a bone well previously drilled in the temporal squama and the electrode carrier was inserted in the fenestrated cochlea. Speech perception tests, performed over a period of time ranging from one to six months after cochlear implant activation, yielded better results in these patients compared with those obtained in postlingually deaf patients operated on via the traditional transmastoid route. Cochlear implant insertion via the middle fossa approach is a technique which is suitable for auditory rehabilitation of subjects with a bilateral radical mastoidectomy cavity, chronic middle ear disease, patients suffering from middle ear malformations, and patients with partial obliteration of the cochlea in the basal turn. However, the main advantage of middle fossa cochleostomy consists in the possibility of stimulating areas of the cochlea, i.e. middle and apical turns, where a greater survival rate of spiral ganglion cells is known to occur. This new approach led to major improvements in speech recognition in all patients compared with patients operated on via the transmastoid approach and thus, given the present state of the art, it is the only approach which allows stimulation of the entire cochlea and enables the best auditory outcomes to be achieved in patients with a cochlear implant.

- 447. Colletti V, Fiorino FG, Saccetto L, Giarbini N, Carner M (1999) Improved auditory performance of cochlear implant patients using the middle fossa approach, Audiology, 38(4): 225-34.**

Abstract:

The preliminary results of insertion of a cochlear implant via the middle fossa in nine patients with profound bilateral hearing loss are described. Aetiologies included bilateral radical mastoidectomy cavity, adhesive otitis media, autoimmune inner ear disease, previous cranial trauma, genetic prelingual deafness, and otosclerosis. A

classic middle fossa approach was adopted. A small cochleostomy measuring 1.5mm in diameter was performed on the most superficial part of the basal turn. A Nucleus 24M cochlear implant system (Cochlear Corporation) was inserted in four patients, a Lauraflex implant (Philips hearing implant) was used in three patients and a COMBI 40\* (MED-EL) with a double electrode array in two. Single electrode arrays were inserted from the cochleostomy to the cochlear apex and occupied a portion of the basal turn, as well as the middle and apical turns. Double electrode arrays were inserted, one towards the apex and one into the basal turn of the cochlea towards the round window. The receiver stimulator was positioned in a bone well previously drilled in the temporal squama and the electrode carrier was inserted in the fenestrated cochlea. The activity of the inserted electrodes was tested by means of telemetry and intra-operative recording of electrically evoked auditory brainstem responses (EABR). Speech recognition tests, performed over a period of time ranging from one to six months after cochlear implant activation, yielded better results in these patients compared with those obtained in postlingually deaf patients operated on via the traditional transmastoid route. Cochlear implant insertion via the middle fossa approach is a technique, which is suitable for the implantation of patients with bilateral radical mastoidectomy cavities, chronic middle ear disease, middle ear malformations, or with partial obliteration of the cochlea in the basal turn. However, the main advantage of inserting the implant through the middle fossa cochleostomy consists in the possibility of stimulating, with the single array, areas of the cochlea, i.e. part of the basal, middle and apical turns, where a greater survival rate of spiral ganglion cells is known to occur. In addition, with the double array total occupation of the cochlea is possible, providing the possibility of replicating tonotopic organisation of the cochlea. This new approach has led to major improvements in speech recognition in all patients compared with patients operated on via the transmastoid approach and, given the present state of the art, may be the elective approach for optimal implantation outcomes.

- 448. D'Haese PS, Van de Heyning PH (1999). Internationale Anwendung von EARS (Evaluation of auditory responses to speech). In Hören-verstehen-Kommunizieren, eds Diller G, Gall V et al., OIRO – Friedberg, 243-50.**

Article in German

Abstract:

A multi-language test battery, consisting of seven different measures was compiled to evaluate auditory perceptual skills of children using cochlear implants. A major goal of the test battery was to allow a standard through which performance comparisons can be made within and across languages. The battery of tests is called the Evaluation of Auditory Responses to Speech (EARS) and is administered in the hearing only condition. The adaptation of EARS for the Dutch language was done by collaboration between Patrick D'Haese of the University Department of Otorhinolaryngology and Head and Neck Surgery of the University Hospital Antwerp (UIA) and Dr Dianne J. Allum-Mecklenburg for the MED-EL company.

- 449. Stephan K, Welzl-Müller K (1999) Post-operative Stapedius Reflex Tests with Simultaneous Loudness Scaling in Patients Supplied with Cochlear Implants. *Audiology* 39(1): 13-8.**

Abstract:

The estimation of the maximum comfort loudness levels (MCL) by measurements of the electrically elicited stapedius reflex was examined in six experienced cochlear implant users supplied with the COMBI 40 implant system. The stapedius reflex was tested and loudness scaling was performed simultaneously using an up/down stimulation protocol close to the reflex threshold with automated recording of both test procedures. The electrical stapedius reflex threshold (ESRT) and loudness scaling were evaluated separately. Scaling at the reflex threshold ranged between normal and loud. The range of stimulus intensities corresponding to ESRT is much smaller than at a particular loudness category. The overall correlation between ESRT and MCL was high ( $r=0.92$ ), with a similar dependence of ESRT and MCL on the channel stimulated. Thus, when the stapedius reflex can be detected post-operatively, the ESRT can be applied successfully for the fitting procedure of the speech processor. Simultaneous loudness scaling during the entire reflex test showed that over stimulation via the implant can be avoided effectively.

- 450. Stobich B, Zierhofer CM, Hochmair ES (1999) Influence of automatic gain control parameter settings on speech understanding of cochlear implant users employing the continuous interleaved sampling strategy, *Ear Hear*, 20(2): 104-16.**

Abstract:

**OBJECTIVE:** The purpose of the present study was to gather data on the influence of compression ratio and attack and release times of slow-acting front-end automatic gain control (AGC) systems on speech understanding of cochlear implant users in various listening situations. The data should allow evaluation of the usefulness of front-end AGC in body-worn speech processors. **DESIGN:** Subjects were 12 experienced postlingually deafened adult users of the MED-EL COMBI 40 multichannel cochlear implant. Six different front-end configurations, including a linear setting, the standard AGC of the MED-EL COMBI40 processor, and four slow-acting dual front-end AGCs (use of two instead of one level detector for improved transient handling), were evaluated in two experiments. In experiment 1, tests were performed at 55, 70 and 85dB SPL, roughly corresponding to soft, medium and loud speech. Experiment 2 was intended to evaluate the quality of transient handling of the six configurations. In this experiment, an intense transient “chink” at 100dB SPL was spliced onto the beginning of each sentence (presented at 85dB SPL). **RESULTS:** At 55dB SPL subjects performed significantly more poorly with the linear setting than with the AGC settings, but no differences in performance could be found for the AGC settings. At 70dB SPL subjects showed the poorest performance with the high compression ratio dual front-end AGCs. No differences in performance of the six front-end configurations were found at 85dB SPL. In the presence of intense chinks, performance of the standard AGC dropped significantly. **CONCLUSIONS:** The results indicate that slow-acting front-end AGC can be used effectively in speech processors for cochlear implants to expand the range of input levels that are audible for the cochlear implant user, without any need to adjust a processor control, and that incorporation of an additional fast-acting AGC component can improve performance under conditions where intense transients occur.

- 451. Zehnder A, Allum JH, Honegger F, Probst R (1999) The usefulness of intra-operatively registered, electrically evoked stapedius reflex for the programming of cochlear implants in children, HNO, 47(11): 970-5.**

Article in German

Abstract:

The programming of a cochlear implant speech processor used by young children is often difficult, especially when the stimulus level associated with maximum auditory loudness (MAL) needs to be determined. Excessively high stimulation should be avoided as this can have a traumatic effect. The aim of this study was to determine if a relationship exists between the intra-operatively determined electrical stapedius reflex threshold (ESRT) and the postoperatively determined MAL and hearing threshold for 27 patients, each having one of three implant types. The question of whether the ESRT provides a practical technique to simplify, improve and accelerate speech processor programming was investigated. For the monopolar stimulation mode used for the MED-EL and Clarion implant systems, the average MAL and threshold was expressed as a percentage of the average ESRT across all electrodes. For the “common ground” stimulation mode used for the Nucleus implant system, a parabolic transformation was used to relate MAL and ESRT to one another. These transformations between MAL values calculated from the ESRT and the actual MAL values, determined psychoacoustically, diverged considerably from one another. Therefore it was not possible to determine the MAL from the ESRT with certainty. The ESRT does, however, provide a means to estimate an approximate upper boundary for the MAL, apart from its use to control implant function. The determination of the exact MAL will still need to be determined using behavioural techniques.

- 452. Teissl Ch, Kremser Ch, Hochmair E, Hochmair-Desoyer (1998) Cochlear Implants: In Vitro Investigation of Electromagnetic Interference at MR Imaging – Compatibility and Safety Aspects, Radiology, 208: 700-8.**

Abstract:

In vitro experiments were performed to determine the compatibility of a cochlear implant at 0.2 and 1.5 T magnetic resonance (MR) imaging. Except for the torque at 1.5 T, all electromagnetic interferences remained within acceptable limits. MR imaging should be performed only if there is a strong medical indication, by following appropriate safety procedures. MR imaging at 0.2 T should be safe; at 1.5 T however, the relative risks will have to be assessed.

- 453. Bance ML, O’Driscoll M, Giles E, Ramsden RT (1998) Vestibular stimulation by multichannel cochlear implants, Laryngoscope, 108 (2): 291-4.**

Abstract:

The recipient of a Nucleus 22 multichannel cochlear implant began to experience severe vestibular stimulation related to the implant. This patient's experience initiated a study with the objective of determining the frequency of implant-related vestibulo-ocular stimulation. Subjects consisted of 17 randomly selected patients who use cochlear implants. Included in the study were 14 Nucleus 22 and three MED-EL COMBI 40 devices. Stimulation of the implants was performed both by individual channel and with sound-field broadband 80dB noise using the users normal device settings. Eye movements were monitored with infrared videonystagmography. Only one subject, who used a MED-EL COMBI 40, showed a consistent and strong ocular response to cochlear stimulation but had no subjective symptoms. The authors conclude that vestibulo-ocular activation is possible with multichannel cochlear implants but is infrequent and may not be clinically significant.

- 454. Kiefer J, von Illberg C et al. (1998). Results of cochlear implantation in patients with severe to profound hearing loss- implications for patient selection. *Audiology*, 37(6): 382-95.**

Abstract:

In patients with some residual hearing and minor benefit from conventional hearing aids, the benefits of cochlear implantation have to be weighed carefully against eventual adverse effects. In this study, pre-and post-operative thresholds as well as functional results after cochlear implantation are reported; 17 of 44 implanted adults had residual hearing pre-operatively (mean threshold 250- 4000Hz: 106dbHL) in the implanted ear. Residual hearing in the implanted ear, could not, in general, be preserved post-operatively. Seventeen of 44 implanted children had some amount of residual hearing in the implanted ear pre-operatively (implanted ear: 114dBHL; contra-lateral ear: 109dBHL; mean thresholds 250-4000Hz). Contrary to the results in adults, residual hearing in the implanted ear remained statistically unchanged. Hearing in the contra-lateral ear increased significantly from 109.9 to 101.9dB HL post-operatively. This increase was attributed mainly to maturation of the central auditory pathway. In adults with residual hearing, the monosyllable word recognition scores increased significantly from 9% pre-operatively to 42% post-operatively. Children with residual hearing tended to perform better on speech-related test material compared to children without prior auditory experience. Cochlear implantation is indicated in adults and children with residual hearing and minor benefit from conventional amplification. The contra-lateral ear in children should be considered for additional acoustical stimulation.

- 455. Van de Heyning PH, D'Haese PS et al. (1998). Cochlear implantation: an overview of existing implants, *Acta oto-rhino-laryngologica belg*, 52: 91-103.**

Article in Dutch

Abstract:

Cochlear implants (CI) bypass the external and middle ear and parts of the inner ear, by delivering electrical stimuli to the remaining neural fibres of the acoustic nerve in a meaningful way. Many features of current CI are similar. They are all multi-channel devices with intracochlear placement of the active electrodes and with transcutaneous information and energy transfer. Factors affecting the auditory performance of CI patients are patient-linked factors and device factors. An overview is given of key design parameters, processing characteristics and specifications of the following CI platforms: Clarion S-Series, COMBI 40 and COMBI40+, Digisonic DX10, Laura-Flex and Nucleus CI22 and CI24M. These data, combined with outcome parameters can enhance the information of CI teams, patients or parents of children in their decision making process when faced with a hearing impairment to such an extent that hearing aids are of little or no benefit.

- 456. Youssefzadeh S, Baumgartner W, Dorffner R, Gstöttner W, Trattig S (1998) MR compatibility of MED-EL cochlear implants: clinical testing at 1.0T, *J Comput Assist Tomogr*, 22(3): 346-50.**

Abstract:

PURPOSE: Our aim was to evaluate the MR compatibility of MED-EL cochlear implants by performing in vitro and in vivo tests. METHOD: All experiments were done on a 1.0T machine. Potential movements of the cochlear electrode relative to a scale were recorded. Potential dislodgement of the magnetic receiver coil was evaluated with the coil fixed to the retroauricular skin of a volunteer. Temperature changes were measured with temperature sensors fixed to the electrode, performing standard MR sequences. In 11 patients, MRI of the brain was performed 1 day before explantation of the devices using standard MR sequences. Testing of the auditory abilities was done before and after the examination. All explanted devices were assessed for function. RESULTS: There was no detectable movement of the electrode or the receiver coil or any temperature change. There were no

adverse events for the patients. All 11 explanted cochlear implants retained their function. CONCLUSION: MED-EL cochlear implants are not a firm contra-indication for MRI

- 457. Gstöttner WK, Baumgartner WD, Franz P, Hamzavi J (1997) How I do it: Cochlear implant deep insertion surgery, Laryngoscope, 107: 544-6.**

Abstract:

None

- 458. Brill, SM, Gstöttner W, Helms J, von Ilberg C, Baumgartner W, Müller J, Kiefer J (1997) Optimization of channel number and stimulation rate for the fast continuous interleaved sampling strategy in the COMBI 40+, Am J Otol, 18 (suppl): S104-6.**

Abstract:

Objective: to investigate the interrelation between number of channels and stimulation rate in the continuous interleaved sampling strategy (CIS). Subjects and methods: three of the first recipients of the new COMBI 40+ cochlear implant participated in consonant, vowel, number and sentence tests. Speech understanding was evaluated for different combinations of number of active channels from two to twelve and stimulation rate per channel between 1,515 and 9,090 pulses per second. Results: the results indicate that the optimum number of active channels is not necessarily the maximum number of useable channels.

- 459. Arnold W, Brockmeier SJ (1997) Medical, surgical and technical complications with the COMBI 40, Am J Otol, 18(6 Suppl): S67-8.**

Abstract:

We present the first report on complications of cochlear implantation with the COMBI 40 (MED-EL, Innsbruck). Between January 1995 and May 1996, 325 devices had been implanted by 58 different surgeons. Complications were reported with the help of standardised complication report form. The overall rate of complications was 4.6%. Most common problems were flap necrosis and incorrect positioning of the electrode. No technical failures occurred. The incidence of complications was lower than those reported by other authors.

- 460. Bredberg G, Lindström B, Löppönen H, Skarzynski H, Hyodo M, Sato H (1997) Electrodes for Ossified Cochleas, Am J Otol, 18: S42-S43.**

Abstract:

None

- 461. Gstöttner W, Plenk H, Franz P, Hamzavi J, Baumgartner W, Czerny C, Ehrenberger K (1997) Cochlear implant deep electrode insertion: extent of insertional trauma, Acta Otolaryngol, 117(2): 274-7.**

Abstract:

We have recently undertaken deep insertions of the COMBI 40 cochlear implant electrode (MED-EL; Innsbruck, Austria) into apical regions of the scala tympani using a cochleostomy approach. In order to examine the extent of the insertional trauma, 12 fresh human temporal bones were implanted with original COMBI 40 electrodes. The specimens were histologically processed with the implants in place by employing a sawing and grinding technique. In most cases, only very discrete distortions of the epithelium of the spiral ligament occurred within the middle cochlear turns. Furthermore, a slight displacement of the basilar membrane caused by the electrode was occasionally seen. However, in 2 cases more severe damage such as basilar membrane rupture and electrode displacement was found. Attempts to insert the electrode beyond the point of first resistance resulted in electrode kinking within the basal cochlear turn with subsequent fracture of the osseous spiral lamina. According to our results, deep electrode insertions do not aggravate the insertional trauma provided no force is applied when resistance is felt.

- 462. Helms J, Müller J, Schön F, Moser L, Arnold W, Janssen T, Ramsden R, von Ilberg C, Kiefer J, Pfennigdorf T, Gstöttner W, Baumgartner W, Ehrenberger K, Skarzynski H, Ribari O, Thumfart W, Stephan K, Mann W, Heinemann M, Zorowka P, Lippert KL, Zenner HP, Bohndord M, Hüttenbrink K, Hochmair-**

**Desoyer I et al. (1997). Evaluation of performance with the COMBI 40 cochlear implant in adults: a multicentric clinical study, ORL, 59: 23-35.**

Abstract:

The present multi-centric study involves 19 centres, 16 of them in German speaking countries, 1 British, 1 Polish and 1 Hungarian. 60 post-lingually deafened adults with a mean age of 47.5 years (20-70) and mean duration of deafness 5.3 years (0.5-20) have been evaluated with the MED-EL COMBI 40 cochlear implant which implements a high-rate continuous-interleaved-sampling strategy with 8 channels. Safety and effectiveness data have been collected. Speech perception tests include a 16-consonant, an 8-vowel, a sentence and a monosyllabic word test in all languages and a 2-digit figure test in all languages but English. Test intervals are 1, 3, 6 months and 1 year after first fitting. 41 of the 60 post-lingually deafened adult study patients have completed their 6-month evaluation. While their pre-operative monosyllabic word score was 0%, their mean monosyllabic word score 6 months after first fitting was 48% (8-90) with a median of 50%. The mean sentence understanding was 84% (24-100) with a median of 90%. The respective values for the 1-year evaluations with 25 patients are a mean of 50% (5-85), with a median of 60% for the monosyllables and a mean of 89% (30-100), with a median of 97% for the sentences.

- 463. Kiefer J, Müller J, Pfenningdorff T, Schön F, Helms J, von Ilberg C, Baumgartner WD, Gstöttner W, Ehrenberger K, Arnold W, Stephan K, Thumfart W, Baur S. (1997) Speech understanding in quiet and in noise with the CIS speech coding strategy (MED-EL COMBI 40) compared to the MPEAK and SPEAK strategies (Nucleus), Adv ORL, 52: 286-90.**

Abstract:

This study compares sentence understanding in quiet and noise with 3 different speech-coding strategies for cochlear implants. The results show that the spectral-peak (SPEAK) and continuous-interleaved-sampling (CIS) coding strategies based on spectral signal analysis, allow for better speech understanding in quiet as well as noise, than the multipeak (MPEAK) coding strategy, which relies on speech feature extraction. In the intrasubject comparison of the MPEAK and SPEAK strategies, the SPEAK coding strategy provided a considerable improvement in quiet and in noise for the majority of patients using the Nucleus Mini 22 implant. In the intersubject comparisons, the mean results in noise with the CIS strategy were superior to both the MPEAK and SPEAK strategies. The difference was greatest for the most difficult tests in noise. Understanding in noise was last reduced for the CIS strategy. Understanding in quiet was not significantly different between the CIS and the SPEAK strategies, both strategies were significantly better than the MPEAK strategy in quiet. These results are still preliminary, due to the relatively small number of patients and the great inherent intersubject variability of results.

- 464. Müller J, Schön F, Helms J (1997) Fast-stimulator cochlear implant systems - the Würzburg experience using the MED-EL COMBI 40: Surgical considerations and results, Adv Otorhinolaryngol, 52: 272-3.**

Abstract:

None

- 465. Opie JM, Allum JH, Probst R (1997) Evaluation of electrically elicited stapedius reflex threshold measured through three different cochlear implant systems, Am J Otol, 18(6 Suppl): S107-8.**

Abstract:

Objective: To evaluate intra-operative electrically elicited stapedius reflex thresholds (ESRTs) measured through three different cochlear implant systems: the Nucleus Mini 22, the Clarion Enhanced Bipolar, and the MED-EL COMBI40. Subjects and method: Relations between intra-operative ESRT and postoperative maximum comfort level (MCL) were examined in seven children (4 Nucleus, 2 Clarion, 1 MED-EL) and one adult (1 Clarion). Results: Preliminary results indicated most ESRTs were either higher or both higher and lower (across the electrode array within a subject) than MCLs. All systems provided satisfactory means for measuring ESRTs. Conclusion: It is recommended that hand-held systems have a direct readout to the programming station and that audio and visual feedback be improved for all units.

- 466. Ribari O, Küstel M, Speer K, Korpassy P (1997) Comparative results with different cochlear implants, Acta Otolaryngol, 117(2): 169-73.**

Abstract:

The cochlear implant programme in Budapest began in 1985, since when 60 operations have been performed, 14 of them on children (51 primary procedures and 9 re-implantations). Different devices and also different techniques have been used: extracochlear promontory, extracochlear round window and intracochlear implants. Various speech processors were applied, at first digital pulsatile sound-encoding system, later on analogue processors were used, while processors operating on the basis of the CIS strategy are preferred nowadays. The operations were performed on both pre-and postlingual patients. In several cases contralateral hearing improvement was observed 6 months after the operation. Considerable experience has been gained of unique cases, such as a deaf-blind prelingual child and prelingual twins. Evaluating cochlear implant performance, in addition to the usual audiological tests measuring post-operative speech understanding, warble tone sound field thresholds were also established.

- 467. Schmidt M, Griesser A (1997) Long-Term stability of fitting parameters with the COMBI40, Am J Otol, 18 (suppl 6): 109-10.**

Abstract:

Having experience with the COMBI 40 for over two years, it is now possible to look at the development of patient fitting data (thresholds, dynamic ranges etc) at two days, one month, three months, six months and twelve months post first fitting. Subjects are CI users participating in the COMBI 40 European Multicentric Study. Long-term fitting parameters show a favourable development. Stable fitting parameters and the safety features implemented in the COMBI 40 serve as a basis for reliable long-term speech understanding.

- 468. Zierhofer C, Hochmair IJ, Hochmair ES (1997) The advanced COMBI 40+ Cochlear Implant, Am J Otol, 18 (suppl 6): 537-8.**

Abstract:

A 12-channel cochlear implant (CI) for high-rate pulsatile stimulation strategies is presented. Symmetric biphasic current pulses can be generated up to a maximum pulse repetition rate of 18.18kpulses/second. The stimulation pulse amplitude can be selected within 1.5 microA-1.5mA. Data and power are transcutaneously transferred using a single radio frequency (RF) channel. A fully digital data transfer format is employed at an overall data rate of 600kBit/second. The implant contains a single mixed analogue/digital CMOS-ASIC (Application Specific Integrated Description) for data synchronisation and stimulus generation. Stimulation signals are applied via a monopolar intracochlear multi-channel electrode. Output capacitors for each channel are employed for safety reasons. A self-calibrating back telemetry system is included for estimating the channel impedance and field distribution along the electrode array. Dimensions of the ceramic package of the implant are only 33.50 x 23.40 x 3.96mm<sup>3</sup>.

- 469. Kiefer J, Gall V, Desloovere C, Knecht R, Mikowski A, von Ilberg C (1996) A follow-up study of long-term results after cochlear implantation in children and adolescents, Eur Arch Otorhinolaryngol, 253(3): 158-66.**

Abstract:

The time course of speech development in children after cochlear implantation may extend over many years, thus making long-term studies necessary to evaluate any outcome. We report our long-term results after cochlear implantation in children and adolescents. Mean follow-up was 28 months, ranging from 1 –5 years. After at least 1 year of experience all children were found to benefit from their cochlear implants. The majority of children scored above chance in speech identification tasks requiring closed set word and sentence understanding. At the 4-year interval, all children tested including prelingually deaf children had developed open-set sentence understanding. The most relevant factor accounting for differences was the duration of implant use in all groups. Even beyond 3 years the results continued to improve. Peri- or postlingually deafened children tended to have favourable results. For prelingually deaf children, duration of deafness and age at implantation were correlated negatively with the results.

- 470. Kiefer J, Müller J, Pfenningdorff T, Schön F, Helms J, von Ilberg C, Baumgartner WD, Gstöttner W, Ehrenberger K, Arnold W, Stephan K, Thumfart W, Baur S. (1996) Speech understanding in quiet and in noise with the CIS speech coding strategy (MED-EL COMBI 40) compared to the MPEAK and SPEAK strategies (Nucleus), ORL, 58(3): 127-35.**

Abstract:

This study compares sentence understanding in quiet and in noise with 3 different speech-coding strategies for cochlear implants. The results show that the spectral-peak (SPEAK) and continuous-interleaved-sampling (CIS) coding strategies, based on spectral signal analysis, allow for better speech understanding in quiet as well as in noise, than the multi-peak (MPEAK) coding strategy, which relies on speech feature extraction. In the intra-subject comparison of the MPEAK and SPEAK strategies, the SPEAK coding strategy provided a considerable improvement in quiet and noise for the majority of patients using the Nucleus 22 Mini-implant. In the inter-subject comparisons, the mean results in noise with the CIS strategy were superior to both the MPEAK and SPEAK strategies. The difference was greatest for the most difficult tests in noise. Understanding in noise was least reduced for the CIS strategy. Understanding in quiet was significantly different between the CIS and SPEAK strategies; both strategies were significantly better than the MPEAK strategy in quiet. These results are still preliminary, due to the relatively small number of patients and the great inherent inter-subject variability of results.

- 471. Ribari O, Küstel M, Farkas Z (1996) Cochlear implants in children, Folia Phoniatrica et Logopaedica, 48: 127-30.**

Abstract:

The authors give an account of their experiences with cochlear implants on the basis of 10 years work. Pre-operative evaluation, operating methods and post-operative rehabilitation are presented. During a decade 56 operations were performed, 11 of them on children. Results with prelingually deaf children are demonstrated together with the phenomenon of hearing improvement observed on the contralateral side of the operation.

- 472. Hochmair-Desoyer IJ, Hochmair E (1995). Implementation of coding strategies in cochlear implant systems and comparative results. Central and East European Journal of Otorhinolaryngology and Head and Neck Surgery 1(1): 33-41.**

Abstract:

Coding strategies for cochlear implants are discussed with respect to their ability to code spectral and temporal features. The implementation of the CIS-strategy, which to a considerable extent encodes the spectral as well as the temporal domain, in the COMBI40 fast stimulator cochlear implant system is described. The speech understanding provided by this system is characterised by a median of 60% for sound-only monosyllabic word understanding 6 to 12 months after implantation achieved by 27 postlingually deafened adults who had received the COMBI40 within the frame of a multicentric clinical study. With the broadband analogue strategy, which is implemented in the COMFORT system featuring an ear level speech processor, results from prospective clinical studies are not available. The most successful German-speaking patients have reached up to 52% of single syllable word understanding. Good values of 30-52%, however, in most cases developed slowly over many months or several years of implant use.

- 473. Wagner H, Gerhardt HJ, Stürzebecher E, Werbs M (1995) Preoperative assessment of function of the auditory nerve using electroaudiometry and notched noise auditory brainstem response technique, Ann Otol Rhinol Laryngol Suppl, 166: 198-201.**

Abstract:

None

- 474. Schulz E, Kerber M (1994) Music perception with the MED-EL implants, In Advances in Cochlear Implants, Eds. Hochmair-Desoyer IJ, Hochmair ES, Wien, 326-32.**

Abstract:

The most important aim of a cochlear implant usually is to achieve speech understanding. Music-perception is also an aspect of hearing that can be considered as a contribution to the total benefit a patient gains from his implant. In order to find out, to what extent an implant user is able to perceive musical features; a test battery has been developed. The battery comprises 15 test items that are arranged in three categories: category 1 deals with the subjective impressions elicited by different musical instruments and different rhythm patterns, when presented to an implant user. Category 2 tests the ability to discriminate between ascending, descending and even-pitched sequences played on a piano. Category 3 checks the ability to recognise different rhythms, pitched tunes and instruments, each from a closed set. The music material has been presented under free-field conditions, either played live or from a tape-recorder. In order to find out how normal-hearing persons score, the test has also been

performed with a group of normal hearing persons. The first results from implant users show a tendency that temporal features, like the ones discriminating different rhythms, can be perceived better than features related to pitch, like expressed discrimination and recognition of tunes or different musical instruments. As the number of test individuals is rather small at the time, these results have to be considered preliminary.

- 475. Hochmair-Desoyer IJ, Zierhofer C, Hochmair ES (1993) New hardware for analogue and combined analogue and pulsatile sound-encoding strategies, Prog Brain Res, 97: 291-300.**

Abstract:

Development for cochlear implants of primarily analogue design focuses in two directions. The first direction is miniaturisation. A behind-the-ear (BTE) speech processor has been developed which can replace the body worn processor for approximately 90% of the users of a MED-EL cochlear implant and works with two 1.4V hearing aid batteries for between seven and twelve days. Consonant, vowel and sentence testing and patient questioning revealed that the BTE speech processor demonstrates a significant improvement in speech understanding compared to the body-worn processor, and that the patient's device acceptance is superior for the BTE processor. The result for the second direction for our cochlear implant development is the multichannel cochlear implant, CAP, with combined analogue and pulsatile stimulation. It aims at complementing the information from the broadband analogue signal by adding spectral information, that is, tonotopic information. This device is capable of simultaneously stimulating one electrode with a broadband analogue signal and one of eight electrode channels with a pulsatile signal. The system can also be used for purely analogue or for purely pulsatile stimulation. Preliminary results with the first recipient of a CAP cochlear implant system demonstrate that the device works as expected.

- 476. Wilson BS, Finley CC, Lawson DT, Wolford RD, Eddington DK, Rabinowitz WM (1991) Better speech recognition with cochlear implants, Nature, 352(6332): 236-8.**

Abstract:

High levels of speech recognition have been achieved with a new sound processing strategy for multi-electrode cochlear implants. A cochlear implant system consists of one or more implanted electrodes for direct electrical activation of the auditory nerve, an external speech processor that transforms a microphone input into stimuli for each electrode, and a transcutaneous (rf-link) or percutaneous (direct) connection between the processor and electrodes. We report here the comparison of the new strategy and a standard clinical processor. The standard compressed analogue (CA) processor presented analogue waveforms simultaneously to all electrodes, whereas the new continuous interleaved sampling (CIS) strategy presented brief pulses to each electrode in a non-overlapping sequence. Seven experienced implant users, selected for their excellent performance with the CA processor, participated as subjects. The new strategy produced large improvements in the scores of speech reception tests for all subjects. These results have important implications for the treatment of deafness and for minimal representations of speech at the auditory periphery.

- 477. Wilson B., Lawson D. et al (1991) Coding strategies for multichannel cochlear prostheses, Am J Otol, 12 Suppl: 56-61**

Abstract:

Comparisons of analogue and pulsatile coding strategies for multichannel cochlear prostheses are reviewed. The results are related to design considerations for paediatric implants, including efficacy, safety, ease of fitting and access to future improvements.