Quarterly Abstract Update

January-March 2006

1 Micromechanical resonator array for an implantable bionic ear; Bachman Mark; Zeng Fan-Gang; Xu Tao; Li G.P.; (2006); Audiol Neurootol 11(2): 95-103

In this paper we report on a multi-resonant transducer that may be used to replace a traditional speech processor in cochlear implant applications. The transducer, made from an array of micro-machined polymer resonators, is capable of passively splitting sound into its frequency sub-bands without the need for analog-to-digital conversion and subsequent digital processing. Since all bands are mechanically filtered in parallel, there is low latency in the output signals. The simplicity of the device, high channel capability, low power requirements, and small form factor (less than 1 cm) make it a good candidate for a completely implantable bionic ear device.

2 Hearing-impaired children in the United Kingdom, II: Cochlear implantation and the cost of compulsory education; Barton Garry R.; Stacey Paula C.; Fortnum Heather M.; Summerfield Quentin A.; (2006); Ear & Hearing 27(2): 187-207

OBJECTIVE: The objective of this study was to estimate the impact of cochlear implantation on the cost of compulsory education of hearing-impaired children in the United Kingdom.
STUDY DESIGN: In a cross-sectional survey, teachers were asked to report the school placement of, and amount of support provided to, a representative sample of hearing-impaired children. Costs of school placement were obtained from published sources. Costs of support were calculated from a survey of 11 special education services. The annual education cost (in euros at 2001/2002 levels) of each child was calculated by summing the placement and support costs. Linear regression analyses calculated the association between annual education cost and possession of an implant while controlling nine other variables: average (unaided, preoperative) hearing level (AHL), age at onset of hearing impairment, age, gender, the number of additional disabilities, parental occupational skill level, ethnicity, parental hearing status, and academic achievement.
RESULTS: Data were received for 2241 children, 383 of whom had cochlear implants. Mean annual education cost ranged from 15,745 euros for children with moderate hearing impairments to 30,071 euros for nonimplanted children with profound hearing impairments and was 28,058 euros for implanted children. A lower annual education cost was associated with a more favorable AHL, a later age at the onset of hearing impairment, female gender, a younger age, fewer additional disabilities, and a higher level of academic achievement. When these variables were controlled, costs were lower on average for implanted compared with nonimplanted children for the subset of children whose AHLs exceeded 111 dB. At the mean AHL of the implanted children (115 dB), implantation was associated with a reduction of 3105 euros (95% confidence interval, 1105 euros to 5106 euros) in annual education costs.

CONCLUSIONS: Pediatric cochlear implantation is sufficiently effective to influence resource-allocation decisions in the education sector. The health-service cost of implantation is partly offset by savings in the cost of education. These savings occur without detriment to academic achievements.

3 Frequency transposition around dead regions simulated with a noiseband vocoder; Baskent Deniz; Shannon Robert V; (2006); J. Acoust Soc. Am. 119(2): 1156.63

In sensorineural hearing loss, damage to inner hair cells or the auditory nerve may result in dead regions in the cochlea, where the information transmission is disrupted. In cochlear implants, similar dead regions might appear if the spiral ganglia do not function. Shannon et al. J. Assoc. Res. Otolaryngol. 3, 185-199 (2002) simulated dead regions of varying size and location using a noiseband vocoder. Phoneme recognition by normal-hearing subjects was measured under two frequency-place mapping conditions: the frequency range corresponding to the dead region was (1) removed or (2) reassigned to bands adjacent to the dead region to simulate the off-frequency stimulation of neurons at the edge of a dead region. The present study extends the results of Shannon et al. by including a frequency transposition mapping condition, where the overall acoustic input frequency range was distributed over the entire remaining nondead region. The frequency transposed map provided more acoustic information when compared to the map with the frequency range corresponding to the dead region removed. However, speech perception did not improve for many simulated dead region conditions, possibly due to the spectral distortions in the frequency-place mapping.

4 The cochlear implant electrode-pitch function; Baumann Uwe; Nobbe Andrea; (2006); Hear Res 213(1-2): 34-42

The cochlear frequency-place function in normal hearing ears has been found to be an exponential relationship in a wide variety of species D.D. Greenwood, J. Acoust. Soc. Am. 87 (1990) 2592-2605 . Although it seems reasonable to assume a similar function for electrical stimulation by means of an intra-cochlear electrode array, the exact frequency-place function for this special type of stimulation needs to be investigated. Six users of the MED-EL COMBI 40+ cochlear implant device with moderate to profound hearing loss between 125 and 1000Hz in the non-implanted ear took part in a binaural pitch adjustment experiment. The COMBI 40+ electrode array provides a deep insertion into the scala tympani and a wide spatial separation between the stimulating electrodes. Insertion depth was controlled by Stenver's view plain radiographs and the insertion angle was estimated. The task of the subjects was to adjust the frequency of a sinusoid presented in the non-implanted ear by means of an adjusting knob until they perceived the same pitch as was elicited by a reference stimulus in the implanted ear. The results show adjustments corresponding to electrode positions along the cochlea, with the exception of the two most apical

electrodes for most of the subjects. Pitch increased in an orderly fashion with an average of 98Hz per electrode separation (40Hz/mm). In contrast to the exponential predictions according to D.D. Greenwood, J. Acoust. Soc. Am. 87 (1990) 2592-2605 for normal hearing, the average electrode-pitch function shows a linear relationship.

5 Effects of auditory feedback on fricatives produced by cochlear-implanted adults and children: acoustic and perceptual evidence; Bharadwaj Sneha V.; Tobey Emily A.; Assmann Peter F.; Katz William F.; (2006); J. Acoust Soc. Am. 119(3): 1626-35

Acoustic analyses and perception experiments were conducted to determine the effects of brief deprivation of auditory feedback on fricatives produced by cochlear implant users. The words /si/ and /Si/ were recorded by four children and four adults with their cochlear implant speech processor turned on or off. In the processor-off condition, word durations increased significantly for a majority of talkers. These increases were greater for children compared to adults, suggesting that children may rely on auditory feedback to a greater extent than adults. Significant differences in spectral measures of /S/ were found between processor-on and processor-off conditions for two of the four children and for one of the four adults. These talkers also demonstrated a larger /s/-/S/ contrast in centroid values compared to the other talkers within their respective groups. This finding may indicate that talkers who produce fine spectral distinctions are able to perceive these distinctions through their implants and to use this feedback to fine tune their speech. Two listening experiments provided evidence that some of the acoustic changes were perceptible to normal-hearing listeners. Taken together, these experiments indicate that for certain cochlear-implant users the brief absence of auditory feedback may lead to perceptible modifications in fricative consonants.

6 Bacterial meningitis among children with cochlear implants beyond 24 months after implantation; Biernath Krista R.; Reefhuis Jennita; Whitney Cynthia G.; Mann Eric A.; Costa Pamela; Eichwald John; Boyle Coleen; (2006); Pediatrics 117(2): 284-9

BACKGROUND: More than 11000 children in the United States with severe-to-profound hearing loss have cochlear implants. A 2002 investigation involving pediatric cochlear implant recipients identified meningitis episodes from January 1, 1997, through September 15, 2002. The incidence of pneumococcal meningitis in the cohort was 138.2 cases per 100000 person-years, >30 times higher than that for children in the general US population. Children with implants with positioners were at higher risk than children with other implant models. This higher risk of bacterial meningitis continued for up to 24 months after implantation.

OBJECTIVE: To evaluate additional reported cases to determine whether the increased rate of bacterial meningitis among children with cochlear implants extended beyond 24 months after implantation.
METHODS: Our study population consisted of the cohort of children identified through the 2002 investigation; it included 4265 children who received cochlear implants in the United States between January 1, 1997, and August 6, 2002, and who were <6 years of age at the time of implantation. We calculated updated incidence rates and incidence according to time since implantation.
RESULTS: We identified 12 new episodes of meningitis for 12 children. Eleven of the children had implants with positioners; 2 children died. Six episodes occurred >24 months after implantation. When cases identified in the 2002 and 2004 investigations were combined, the incidence rate of > or =24-months postimplantation bacterial meningitis among children with positioners was 450 cases per 100000 person-years, compared with no cases among children without positioners.
CONCLUSIONS: Our updated findings support continued monitoring and prompt treatment of bacterial infections by health care providers and parents of children with cochlear implants. This vigilance remains important beyond 2 years after implantation, particularly among children with positioners. The vaccination recommendations for all children with implants, with and without positioners, and all potential recipients of implants continue to apply.

7 Pseudodominants of two recessive connexin mutations in non-syndromic sensorineural hearing loss?; Birkenhoager R.; Zimmer A.J.; Maier W.; Schipper J.; (2006); Laryngorhinootologie 85(3): 191-6

BACKGROUND: Hitherto more than hundred genes and gene loci for non-syndromic or syndromic deafness have been identified. Mutations in the connexin 26 gene (GJB2) account for up to 50 % of the cases of autosomal recessive hearing loss. The genes GJB2 (Connexin 26), GJB3 (connexin 31) and GJB6 (connexin 31) are located on chromosome 13q11-12. In the inner ear up to four different connexins are expressed. Connexins appertain to a group of gap junction proteins. These proteins can oligomerize to form single-membrane channels called connexons. Each connexon is composed of six subunits, that allow communication between adjacent cells by providing a channel for diffusion of ions, metabolites and second messengers.
METHOD: Each of the exons and flanking splice regions of the connexin 26, 30, and 31 genes (GJB2, GJB3, and GJB6) have been analysed by direct sequencing.
RESULTS: In the involved families three heterozygous mutations could be detected in the connexin 26 (GJB2) and connexin 30 (GJB6) genes. If a combination of two of those mutations occurs, 35DeltaG with 146/147DeltaC and 35DeltaG with GJB6-D13S1830 it results in hearing loss and deafness.
CONCLUSION: By evidences of a familial background of hearing loss it is reasonable to analyse the connexin genes (GJB2, GJB3 and GJB6) for

mutations, additionally to a specific hearing diagnostic, in order to enhance linguistic development through hearing aid or CI-implantation at an early stage.

8 The consequences of neural degeneration regarding optimal cochlear implant position in scala tympani: A model approach; Briaire Jeroen J.; Frijns Johan H. M.; (2006); Hear Res. 214(1-2): 17-27

Cochlear implant research endeavors to optimize the spatial selectivity, threshold and dynamic range with the objective of improving the speech perception performance of the implant user. One of the ways to achieve some of these goals is by electrode design. New cochlear implant electrode designs strive to bring the electrode contacts into close proximity to the nerve fibers in the modiolus: this is done by placing the contacts on the medial side of the array and positioning the implant against the medial wall of scala tympani. The question remains whether this is the optimal position for a cochlea with intact neural fibers and, if so, whether it is also true for a cochlea with degenerated neural fibers. In this study a computational model of the implanted human cochlea is used to investigate the optimal position of the array with respect to threshold, dynamic range and spatial selectivity for a cochlea with intact nerve fibers and for degenerated nerve fibers. In addition, the model is used to evaluate the predictive value of eCAP measurements for obtaining peri-operative information on the neural status. The model predicts improved threshold, dynamic range and spatial selectivity for the peri-modiolar position at the basal end of the cochlea, with minimal influence of neural degeneration. At the apical end of the array (1.5 cochlear turns), the dynamic range and the spatial selectivity are limited due to the occurrence of cross-turn stimulation, with the exception of the condition without neural degeneration and with the electrode array along the lateral wall of scala tympani. The eCAP simulations indicate that a large P(0) peak occurs before the N(1)P(1) complex when the fibers are not degenerated. The absence of this peak might be used as an indicator for neural degeneration.

9 Monaural speech segregation using synthetic speech signals.; Brungart Douglas S.; Lyer Nandini; Simpson Brian D.; (2006); J. Acoust Soc. Am. 119(4): 2327-33

When listening to natural speech, listeners are fairly adept at using cues such as pitch, vocal tract length, prosody, and level differences to extract a target speech signal from an interfering speech masker. However, little is known about the cues that listeners might use to segregate synthetic speech signals that retain the intelligibility characteristics of speech but lack many of the features that listeners normally use to segregate competing talkers. In this experiment, intelligibility was measured in a diotic listening task that required the segregation of two simultaneously presented synthetic sentences. Three types of synthetic signals were created: (1) sine-wave speech (SWS); (2) modulated noise-band speech (MNB); and (3) modulated sine-band speech (MSB). The listeners performed worse for all three types of synthetic signals than they did with natural speech signals, particularly at low signal-to-noise ratio (SNR) values. Of the three

synthetic signals, the results indicate that SWS signals preserve more of the voice characteristics used for speech segregation than MNB and MSB signals. These findings have implications for cochlear implant users, who rely on signals very similar to MNB speech and thus are likely to have difficulty understanding speech in cocktail-party listening environments.

10 Voice analysis in pediatric cochlear implant recipients; Campisi Paolo; (2006); Int J Pediatr Otorhinolaryngol 70(4): 760

Abstract unavailable.

11 Effects of stimulation mode, level and location on forward-masked excitation patterns in cochlear implant patients; Chatterjee Monita; Galvin John J.; Fu Qian-Jie; Shannon Robert V.; (2006); J Assoc Res Otolaryngol 7(1): 15-25

In multi-channel cochlear implants, electrical current is delivered to appropriate electrodes in the cochlea to approximate the spatial representation of speech. Theoretically, electrode configurations that restrict the current spread within the cochlea (e.g., bi- or tri-polar stimulation) may provide better spatial selectivity, and in turn, better speech recognition than configurations that produce a broader current spread (e.g., monopolar stimulation). However, the effects of electrode configuration on supra-threshold excitation patterns have not been systematically studied in cochlear implant patients. In the present study, forward-masked excitation patterns were measured in cochlear implant patients as functions of stimulation mode, level and location within the cochlea. All stimuli were 500 pulses-per-second biphasic pulse trains (200 micros/phase, 20 micros inter-phase gap). Masker stimuli were 200 ms in duration; the bi-polar configuration was varied from narrow (BP+1) to wide (BP+17), depending on the test condition. Probe stimuli were 20 ms in duration and the masker-probe delay was 5 ms; the probe configuration was fixed at BP+1. The results indicated that as the distance between the active and return electrodes in a bi-polar pair was increased, the excitation pattern broadened within the cochlea. When the distance between active and return electrodes was sufficiently wide, two peaks were often observed in the excitation pattern, comparable to non-overlapping electric fields produced by widely separated dipoles. Analyses of the normalized data showed little effect of stimulation level on the shape of the excitation pattern.

12 Auditory capability evaluation for children after cochlear implantation using meaningfnl auditory integration scale; Chen Xue-qing; Wang Liang; Kong Ying; Liu Sha; Liu Bo; Mo Ling-yan; Wang Shuo; Wu Yan-jun; Han Na; Meng Li-hui; Li Hai-zhen; (2006); Zhonghua Er Bi Yan Hou Tou Jing Wai Ke Za Zhi 41(2): 112-5

OBJECTIVE: To analyze the auditory capability of preschool children before and after cochlear implantation using meaningful auditory integration scale (MAIS) questionnaire.
METHODS: Eighty-two prelingually deaf patients participated in this study. They received a cochlear implant at the age of 3 to 6 years and 11 months. The audiologists who were trained for the research used the MAIS questionnaire. Audiologists asked for the parents' answers and recorded all the information about the device using (Q1,2) and the patient's spontaneous auditory behavioural responses including spontaneous alerting to sound Q3 approximately 6 and deriving meaning from sound (Q7 approximately 10). The evaluation was performed before operation and 1, 3, 6 months, 1, 1.5, 2 years after switch-on.
RESULTS: The scores of question 1a and 1b were not significantly different among the different periods after switch-on. The scores of question 2 to 10 were significantly different among the different periods after switch-on.
CONCLUSIONS: Considerable variability across subjects' auditory ability after cochlear implantation was noted. Most of the patients showed no consistent response to sound in everyday life before implantation. After cochlear implantation, a significant increase in auditory capability occurred. The children demonstrated faster development of device using relative to spontaneous alerting to sound and deriving meaning from sound.

13 A novel approach to compute the impedance matrix of a cochlear implant system incorporating an electrode-tissue interface based on finite element method; Choi Charles T.M.; Lai Wei-Dian; Lee Sih-Sian; (2006); IEEE Trans Magn 42(4): 1375-1378

This paper proposes to use a new and realistic finite element model of a single turn human cochlea and cochlear implant electrode array with electrode-tissue interface to model the electric field imaging technique, which creates an impedance matrix. Due to discrepancy in the Warburg capacitor in the active and nonactive electrode contacts and electric power lost along the cochlea, the diagonal terms of the impedance matrix is larger than the off diagonal terms, which represent the impedance values of the nonactive electrode contacts. The impedance matrix from electric field imaging measurements is compared with the simulation results. COPYRIGHT 2006 IEEE. 8 Refs.

14 Review. The multiple-channel cochlear implant: the interface between sound and the central nervous system for hearing, speech, and language in deaf people-a personal perspective; Clark Graeme M.; (2006); Philos Trans R Soc Lond B Biol Sci 361(1469): 791-810

The multiple-channel cochlear implant is the first sensori-neural prosthesis to effectively and safely bring electronic technology into a direct physiological relation with the central nervous system and human consciousness, and to give speech perception to severely-profoundly deaf people and spoken language to children.Research showed that the place and temporal coding of sound frequencies could be partly replicated by multiple-channel stimulation of the auditory nerve. This required safety studies on how to prevent the effects to the cochlea of trauma, electrical stimuli, biomaterials and middle ear infection. The mechanical properties of an array and mode of stimulation for the place coding of speech frequencies were determined.A fully implantable receiver-stimulator was developed, as well as the procedures for the clinical assessment of deaf people, and the surgical placement of the device. The perception of electrically coded sounds was determined, and a speech processing strategy discovered that enabled late-deafened adults to comprehend running speech. The brain processing systems for patterns of electrical stimuli reproducing speech were elucidated. The research was developed industrially, and improvements in speech processing made through presenting additional speech frequencies by place coding. Finally, the importance of the multiple-channel cochlear implant for early deafened children was established.

15 Psychophysical measures in patients fitted with Contour TM and straight Nucleus electrode arrays; Cohen L.T.; Saunders E.; Knight, M.R.; Cowan R.S.C.; (2006); Hearing Research 212(1-2): 160-75

The objective of this study was to compare the psychophysical performance of patients using the Nucleus Contour TM electrode array with that of patients using the straight banded-electrode array. In particular, we wished to consider how psychophysical parameters would differ for an electrode array positioned closer to the modiolus, and how this might influence both patient benefits and the design of speech processing strategies. Nine subjects participated in the study: four used the Nucleus straight array and five used the Nucleus Contour electrode array. Radiographic analyses found that the Contour array lay closer to the modiolus, was more deeply inserted and spanned a larger fractional length of the basilar membrane than the straight banded-electrode array. The results were analysed in terms of array type and of the position of the individual electrode band, both distance from the modiolus and longitudinal placement. Mean threshold was lower for the Contour array but maximum comfortable level was similar. Whereas threshold varied significantly with distance of electrode band from the modiolus, maximum comfortable level did not. Pitch varied fairly regularly with longitudinal position of the stimulated electrode, with the exception of one Contour subject. The forward masking profiles, using moderately loud

maskers, were narrower for the Contour array, indicative of more localized neural excitation. All rights reserved Elsevier.

16 Digital volume tomography: radiologic examinations of the temporal bone; Dalchow Carsten V.; Weber Alfred L.; Yanagihara Naoaki; Bien Siegfried; Werner Jochen A.; (2006); AJR Am J Roentgenol 186(2): 416-23

OBJECTIVE: We evaluated the clinical applicability and the value of digital volume tomography for visualization of the lateral skull base using temporal bone specimens.
MATERIALS AND METHODS: Twelve temporal bone specimens were used to evaluate digital volume tomography on the lateral skull base. Aside from the initial examination of the temporal bones, radiologic control examinations were performed after insertion of titanium, gold, and platinum middle-ear implants and a cochlear implant.
RESULTS: With high-resolution and almost artifact-free visualization of alloplastic middle-ear implants of titanium, gold, or platinum, it was possible to define the smallest bone structures or position of the prosthesis with high precision. Furthermore, the examination proved that digital volume tomography is useful in assessing the normal position of a cochlear implant.
CONCLUSION: Digital volume tomography expands the application of diagnostic possibilities in the lateral skull base. Therefore, we believe improved preoperative diagnosis can be achieved along with more accurate planning of the surgical procedure. Digital volume tomography delivers a small radiation dose and a high resolution coupled with a low purchase price for the equipment.

17 Quality of life and cochlear implantation in usher syndrome type I.; Damen Godelieve W.J.A.; Pennings Ronald J.E.; Snik Ad F.M.; Mylanus Emmanuel A.M.; (2006); Laringoscope 116(5): 723-8

OBJECTIVES:: The objectives of this descriptive, retrospective study were to evaluate quality of life, hearing, and vision in patients with Usher syndrome type I with and without cochlear implant.
METHODS:: Quality of life (QoL) of 14 patients with Usher type I (USH1) with a cochlear implant (CI) (seven adults, seven children) was compared with those of 14 patients with USH1 without a CI (12 adults, two children) by means of three questionnaires: NCIQ, SF12, and the Usher Lifestyle Survey. Additional information on hearing level was obtained by the equivalent hearing loss (EHL) principle and on the visual deterioration by the functional vision score (FVS).
RESULTS:: A significant benefit of CI was seen in the hearing-specific questionnaire NCIQ. This difference could not be detected in the generic SF12 survey. The Usher Lifestyle Survey indicated that patients with USH1 with a CI tend to be able to live an independent life more easily than the profoundly deaf unimplanted patients with USH1. EHL and FVS scores varied in both groups.
CONCLUSIONS:: Overall QoL can be enhanced by CI in patients with USH1, although effects are mostly seen in hearing-related QoL items.

18 Influence of early hearing screening on cochlear implantation; De Raeve L.; (2006); Tijdschrift voor Geneeskunde 62(3): 245-252

Flanders was in 1998 the first region in the world to screen the hearing of all newborns before the age of 6 weeks. The early hearing-screening programme was combined with a further diagnostic and rehabilitation-guidance programme. The Universal Neonatal Hearing Screening (UNHS) exerts a big impact as well on the family, the way of working in home guidance centres, audiology and the rehabilitation as on cochlear implants. Implantation at age 6-8 months is not an exception anymore in Belgium. In KIDS (Koninklijk Instituut voor Doven en Spraakgestoorden) located in Hasselt, 12 early screened children are now wearing their cochlear implants for a minimum of three years. Six of these children received their implant before the age of 18 months. When analyzing the expressive vocabulary of these children, we found out that 3 of these children (25%) have a score within the normal range at age 4. We know from several studies that children who are implanted earlier, reach a higher level than children who receive their implant later. Most of these studies examine children implanted at an age of 18 months or older. We can conclude from our study that children implanted before 18 months reach a higher expressive language level, than children implanted between 24 and 30 months, even if both are detected very early. More research has of course to be executed on this topic to obtain statistically relevant conclusions. On the other hand and considering that 75% of our study group does not reach the normal language level (within 3 years after implantation), one has to be careful to predict the results.

19 Audiological and medical diagnostic for cochlear implantation in children, implantation and fitting; Desloovere C.; (2006); Tijdschrift voor Geneeskunde 62(3): 240-244

Since neonatal hearing screening was introduced in Flanders in 1998, an audiological diagnostic became necessary in very young children. Beside the classical BERA (Brainstem Evoked Response Audiometry), ASSR (Auditory Steady State Responses) is more frequently used for objective hearing threshold measurements. However a comparison with the BOA (Behavioral Observation Audiometry) and VRA (Visual Reinforcement Audiometry) remains important for instance if an auditive neuropathy is suspected. An evolution takes place in the diagnostic criteria for cochlear implantation. The hearing threshold, the age of the child, additional abnormalities and the results of a trial with hearing aids in borderline cases play an important role. Meningitis may be an indication for urgent cochlear implantation in case of labyrinthitis Different cochlear implants, operation technique, intraoperative objective tests and postoperative fitting are discussed.

20 ELVAS sightings: Cochlear implants and hearing aids get wired; Dybala P. D.; (2006); Hearing Journal 59(3): 10-15.

In the brave new world of 21st century technology, hearing aids may soon be multi-tasking along with the rest of us. The author explains how through converging technologies what was once merely an amplifying device for the hearing impaired may soon be part of an entire ear-level communication system.

21 The right information may matter more than frequency-place alignment: simulations of frequency-aligned and upward shifting cochlear implant processors for a shallow electrode array insertion; Faulkner, Andrew; Rosen, Stuart; Norman, Clare; (2006); Ear & Hearing 27(2): 139-52

OBJECTIVE:: It has been claimed that speech recognition with a cochlear implant is dependent on the correct frequency alignment of analysis bands in the speech processor with characteristic frequencies (CFs) at electrode locations. However, the use of filters aligned in frequency to a relatively basal electrode array position leads to significant loss of lower frequency speech information. This study uses an acoustic simulation to compare two approaches to the matching of speech processor filters to an electrode array having a relatively shallow depth within the typical range, such that the most apical element is at a CF of 1851 Hz. Two noise-excited vocoder speech processors are compared, one with CF-matched filters, and one with filters matched to CFs at basilar membrane locations 6 mm more apical than electrode locations.
DESIGN:: An extended crossover training design examined pre- and post-training performance in the identification of vowels and words in sentences for both processors. Subjects received
about 3 hours of training with each processor in turn.
RESULTS:: Training improved performance with both processors, but training effects were greater for the shifted processor. For a male talker, the shifted processor led to higher post-training scores than the frequency-aligned processor with both vowels and sentences. For a female talker, post-training vowel scores did not differ significantly between processors, whereas sentence scores were higher with the frequency-aligned processor.
CONCLUSIONS:: Even for a shallow electrode insertion, we conclude that a speech processor should represent information from important frequency regions below 1 kHz and that the possible cost of frequency misalignment can be significantly reduced with listening experience.

22 Clinical performance of children following revision surgery for a cochlear implant; Fayad Jose N.; Eisenberg Laurie S.; Gillinger Melinda; Winter Margaret; Martinez Amy S.; Luxford William M.; (2006); Otolaryngol Head Neck Surg. 134(3): 379-84

OBJECTIVES: The purpose of this study was to describe the causes for revision surgery and to compare clinical performance before and after surgery in children who required electrode reinsertion.
STUDY DESIGN AND SETTINGS: Soundfield thresholds and speech recognition scores were compared before device failure and following electrode reinsertion. Temporal bones from a deceased adult implant user who underwent bilateral revision implantation were analyzed.
RESULTS: Histopathology in the adult temporal bones revealed new bone formation in the scala tympani and substantially reduced spiral ganglion counts, with open-set speech recognition realized. Of 28 children undergoing revision surgery, 18 required electrode reinsertion. With the exception of 1 patient with severe cochlear malformation, new electrode arrays were fully inserted without difficulty. Clinical outcomes between pre-device failure and post-electrode reinsertion did not differ statistically.
CONCLUSION AND SIGNIFICANCE: Electrode reinsertion is technically feasible in the pediatric population. The majority of children recover their prerevision clinical performance. EBM rating: C-4.

23 Minimal access surgery for the Symphonix/Med-El Vibrant Soundbridge middle ear hearing implant; Foyt, David; Carfrae, Matthew; (2006); Otol Neurotol 27(2): 167-71

OBJECTIVE: To develop a minimal access approach for implantation of the Vibrant Soundbridge middle ear hearing implant. This approach ideally uses the smallest skin incision possible, minimal or no hair shave, and the least possible amount of tissue and bone manipulation. This will facilitate the acceptability of the procedure to the general community and reduce the flap-related complication rate. The procedure is similar to the minimal access approach described for cochlear implantation.
STUDY DESIGN: Eight patients with various degrees of sensorineural hearing loss and one with a mixed hearing loss who met implant criteria for the Vibrant Soundbridge middle ear hearing implant received the device over a 42-month period. The first two patients underwent the traditional implant procedure with postauricular hair shave, postauricular S-shaped incision, and implant receiver suture fixation to the temporal bone. The following seven consecutive patients received a progressively smaller C-shaped postauricular skin incision, no hair shave, retrograde skull drilling for the implant seat, and no implant suture fixation until the technique closely approximated the minimal access cochlear implant procedure. Postoperative performance of the Soundbridge/Vibrant Med-El was evaluated through audiology testing and subjective patient reports.

SETTING: Private neurotology clinic and tertiary care teaching hospital.
RESULTS: The technique was feasible in all patients. Follow-up for the minimal access group ranged from 3 years to 5 months. There were no complications related to the approach, and all patients were satisfied users of the implant. The lack of hair shave and small incision size was greatly appreciated and warmly endorsed by the patients.
CONCLUSION: The Vibrant Soundbridge/Vibrant Med-El can be safely implanted using the minimal access method that has been popularized for cochlear implant surgery. A large incision, extensive hair shave, risk of flap necrosis, and possibility of unsightly scar may deter patients from pursuing the potential benefits of implanted hearing technology. The technique may make the device more accessible to individuals who have concerns regarding cosmetics and potential flap complications.

24 Structure and function in the auditory system: From cochlea to cortex; Friedland David R.; (2006); Anat Rec A Discov Mol Cell Evol Biol 288(4): 326-30

This special issue of the Anatomical Record examines the relationship between structure and function in the auditory system. Early anatomical studies defined this relationship on a macroscopic level and described the roles of structures such as the tympanic membrane, ossicular chain, Eustachian tube, and cochlea. As new tools emerged, the microscopic structure of the organ of Corti was described and later the brain stem regions involved in auditory processing were identified. Further technical advances allowed the description of cells within these central auditory regions in both morphological and physiological terms. More recently, studies of the auditory system have employed molecular biological techniques and novel imaging protocols. All these techniques continue to provide important insights into the structure and function of the auditory system on gross, cellular, and molecular levels. This issue expounds on this theme by demonstrating the importance of anatomy, whether the shape of the otic capsule or the sequence of a gene, in determining the function of the system and even the phenotype of the organism. The articles in this issue represent the cutting edge of today's auditory science and look back at the evolution of hearing and balance, as well as forward toward improving cochlear implant outcomes and gene therapies for treating sensorineural hearing loss. Anat Rec Part A, 2006. (c) 2006 Wiley-Liss, Inc.

25 Syntactic movement in orally trained children with hearing impairment; Friedmann Naama; Szterman Ronit ; (2006); J Deaf Stud Deaf Educ 11(1): 56-75

This study explored the comprehension and production of sentences derived by syntactic movement, in orally trained school-age Hebrew-speaking children with moderate to profound hearing impairment, aged 7;8-9;9 years. Experiments 1 and 2 tested the comprehension of relative clauses and topicalization sentences

(with word orders of OVS object, verb, subject and OSV object, subject, verb) using a sentence-picture matching task. Experiments 3 and 4 tested the production of relative clauses using two elicitation tasks. Experiment 5 tested the comprehension of relative clauses with and without resumptive pronouns. As a group, the children with hearing loss failed to understand object relatives and OVS topicalization sentences. In the production tasks they either avoided producing a sentence with syntactic movement, by using a relative clauses with a resumptive pronoun instead of a gap or by producing a sentence without a relative clause, or produced ungrammatical sentences. They understood correctly object relatives with resumptive pronouns, which are not derived by movement. Both comprehension and production of the hearing-impaired group was significantly different from that of the hearing control group. Individual performance was strongly correlated with the age of intervention: only children who received hearing aids before the age of 8 months performed well in the comprehension tasks. Type of hearing aid, duration of use of a cochlear implant, and degree of hearing loss did not correlate with syntactic comprehension.

26 An evoked potential study of the developmental time course of the auditory nerve and brainstem in children using cochlear implants; Gordon, Karen A; Papsin, Blake C; Harrison, Robert V.; (2006); Audiol Neurootol 11(1): 7-23

Central auditory responses to electrical stimulation from a cochlear implant were studied in 75 pre-lingually deafened children and 11 adults. Electrically evoked auditory brainstem response (EABR) latencies significantly decreased with duration of cochlear implant use and were not significantly affected by the age at implant activation. Significant decreases in early latency waves and interwaves occurred within the first 1-2 months of implant use, whereas longer term changes (6-12 months) were found for eV and eIII-eV, which measure activity in the more rostral brainstem. Comparisons to acoustically evoked auditory brainstem response (ABR) in children with normal hearing suggested shorter interwave EABR latencies, reflecting either distinct neural generators or increased neural synchrony, but similar rates of change in the later latency eV and eIII-eV with time in sound. In sum, normal-like development of the rostral auditory brainstem is promoted by cochlear implant use in children of a wide range of ages. Copyright 2006 S. Karger AG, Basel.

27 Effects of early auditory experience on the spoken language of deaf children at 3 years of age; Grant Nicholas Johanna ; Geers Ann E.; (2006); Ear & Hearing 27(3): 286-98

OBJECTIVE:: By age 3, typically developing children have achieved extensive vocabulary and syntax skills that facilitate both cognitive and social development. Substantial delays in spoken language acquisition have been documented for children with severe to profound deafness, even those with auditory oral training and early hearing aid use. This study documents the spoken language skills

achieved by orally educated 3-yr-olds whose profound hearing loss was identified and hearing aids fitted between 1 and 30 mo of age and who received a cochlear implant between 12 and 38 mo of age. The purpose of the analysis was to examine the effects of age, duration, and type of early auditory experience on spoken language competence at age 3.5 yr.
DESIGN:: The spoken language skills of 76 children who had used a cochlear implant for at least 7 mo were evaluated via standardized 30-minute language sample analysis, a parent-completed vocabulary checklist, and a teacher language-rating scale. The children were recruited from and enrolled in oral education programs or therapy practices across the United States. Inclusion criteria included presumed deaf since birth, English the primary language of the home, no other known conditions that interfere with speech/language development, enrolled in programs using oral education methods, and no known problems with the cochlear implant lasting more than 30 days.
RESULTS:: Strong correlations were obtained among all language measures. Therefore, principal components analysis was used to derive a single Language Factor score for each child. A number of possible predictors of language outcome were examined, including age at identification and intervention with a hearing aid, duration of use of a hearing aid, pre-implant pure-tone average (PTA) threshold with a hearing aid, PTA threshold with a cochlear implant, and duration of use of a cochlear implant/age at implantation (the last two variables were practically identical because all children were tested between 40 and 44 mo of age). Examination of the independent influence of these predictors through multiple regression analysis revealed that pre-implant-aided PTA threshold and duration of cochlear implant use (i.e., age at implant) accounted for 58% of the variance in Language Factor scores. A significant negative coefficient associated with pre-implant-aided threshold indicated that children with poorer hearing before implantation exhibited poorer language skills at age 3.5 yr. Likewise, a strong positive coefficient associated with duration of implant use indicated that children who had used their implant for a longer period of time (i.e., who were implanted at an earlier age) exhibited better language at age 3.5 yr. Age at identification and amplification was unrelated to language outcome, as was aided threshold with the cochlear implant. A significant quadratic trend in the relation between duration of implant use and language score revealed a steady increase in language skill (at age 3.5 yr) for each additional month of use of a cochlear implant after the first 12 mo of implant use. The advantage to language of longer implant use became more pronounced over time.
CONCLUSIONS:: Longer use of a cochlear implant in infancy and very early childhood dramatically affects the amount of spoken language exhibited by 3-yr-old, profoundly deaf children. In this sample, the amount of pre-implant intervention with a hearing aid was not related to language outcome at 3.5 yr of age. Rather, it was cochlear implantation at a younger age that served to promote spoken language competence. The previously identified language-facilitating factors of early identification of hearing impairment and early educational intervention may not be sufficient for optimizing spoken language of profoundly deaf children unless it leads to early cochlear implantation.

28 How we do it: Patient participation in cochlear implant selection; Geyer M.; Seymour F. K.; Stott L.; Lynch C.; Beukes M.; Aleksy W.; Graham J. M.; (2006); Clin Otolaryngol 31(1): 56-61

Keypoints * Involving patients and parents in the choice of their cochlear implant encourages an active role in the process and facilitates 'bonding' and 'ownership' of the device. * The most frequent reasons given by patients for selecting a device included cochlear implant comfort and appearance. * We describe the Implant Programme based at the Royal National Throat, Nose and Ear Hospital, London, and also examine patient satisfaction with the scheme.

29 Functional supply of hearing loss; Hempel J. M.; Wechtenbruch J.; Berghaus A.; (2006); Padiatrische Praxis 68(1): 99-109.

Language is the basic principle of cognitive conceptualisation, it leads to socialisation. Basic requirement for a normal speech and language development is hearing. By means of an early diagnosis of a hearing loss or deafness severe developmental disorders can be avoided. An efficient fitting with a hearing aid or cochlear implant is important after the diagnosis. A cochlear implant is a hearing aid which is established sin ce 20 years for people, who lost the function of their inner ear and this device transmits sound directly into the auditory nerve via electrodes surgically implanted into the cochlea. If the child does not develop verbal speech in spite of a powerful hearing aid a cochlear implant is indicated. Important is not only the early and optimal fitting of the devices but also the initiation of an expert rehabilitation and a continuous professional qualified care. The point beside the counselling of the parents and teacher is not only the development of the hearing skills, but also an integrated and early intervention of the child. To meet the requirements for a normal speech development an early supply and intervention is required.

30 Conditioning pulse trains in cochlear implants: effects on loudness growth; Hong, Robert S; Rubinstein, Jay T.; (2006); Otol Neurotol 27(1): 50-6

HYPOTHESIS: The addition of a high-rate (5 kpps) conditioning pulse train to the input signal of cochlear implants will result in shallower loudness growth across the dynamic range of cochlear implant patients.
BACKGROUND: High-rate conditioning pulse trains have been shown to increase the dynamic range of sinusoidal stimuli for cochlear implant recipients in a manner consistent with stochastic resonance. This study further characterizes the effects of conditioning stimuli on loudness by examining the loudness growth functions for sinusoidal stimuli both with and without conditioning.
METHODS: Seven post-lingually deafened adults using the Clarion CII cochlear implant participated in this study. The loudness growth functions of each subject were characterized using sinusoidal stimuli, both with and without the presence of a high-rate conditioner. Loudness was measured using magnitude estimation.
RESULTS: The loudness growth functions of all seven subjects demonstrate an

increase in dynamic range for sinusoidal stimuli with the addition of the conditioning pulse train. Shallower loudness growth is seen across the dynamic range with the addition of a conditioner. This result was shown for loudness growth fitted to exponential, power, and cumulative gaussian functions. CONCLUSION: The addition of high-rate conditioning pulse trains to sinusoidal stimuli presented to cochlear implant recipients results in larger dynamic ranges, with more gradual increases in loudness growth across the dynamic range. This suggests that signal-processing strategies incorporating conditioning may be clinically useful, requiring less compression of the input signal and leading to less distortion perceived by cochlear implant patients.

31 Voice and pronunciation of cochlear implant speakers; Horga Damir; Liker Marko; (2006); Clin Linguist Phon 20(2): 211-7

Patients with cochlear implants have the ability to exercise auditory control over their own speech production and over the speech of others, which is important for the development of speech control. In the present investigation three groups of 10 subjects were compared. The groups comprised: (1) cochlear implant users, (2) profoundly deaf using traditional hearing aids, and (3) hearing controls. The subjects in three groups were matched in age. While repeating after a model the subjects were recorded and the following linguistic voice variables were analysed: (1) vowel formant space, (2) voice vs. voiceless difference, (3) closure duration and VOT, (4) word accent production, (5) sentence stress production, (6) voice quality, (7) pronunciation quality. Acoustic analysis and perceptual assessment by phoneticians showed that in great majority of variables, subjects with cochlear implants performed better than the profoundly deaf subjects with traditional hearing-aids.

32 Bilateral treatment with cochlear implants; Hoth S.; (2006); HNO 54(2): 77

Abstract unavailable.

33 Electrophysiologic channel interaction, electrode pitch ranking, and behavioral threshold in straight versus perimodiolar cochlear implant electrode arrays; Hughes Michelle L.; Abbas Paul J.; (2006); J. Acoust Soc. Am. 119(3): 1538-47

The primary goal of this study was to examine electrophysiologic measures of channel interaction, electrode pitch discrimination ability using a pitch-ranking task, and behavioral threshold levels in individuals implanted with a straight electrode array versus a perimodiolar array. It was hypothesized that perimodiolar arrays should yield lower thresholds, less channel interaction as measured with the electrically evoked compound action potential (ECAP), and better electrode pitch-ranking ability. Results from ten adult Nucleus 24 recipients

(N=5 straight array, N=5 perimodiolar Contour array) showed no significant difference in threshold between the two electrode designs; however, there was significantly better electrode pitch-ranking ability and less channel interaction as measured with the ECAP for perimodiolar electrodes. Additionally, there was a significant positive correlation between behavioral threshold and width of the ECAP interaction function for Contour group data. There was no significant correlation between behavioral threshold and electrode pitch-ranking ability. These data suggest that electrode design and/or perimodiolar position may reduce physiologic channel interaction in the cochlea and improve electrode pitch discrimination ability; however, this positive finding did not translate into significantly better speech perception ability for Contour subjects.

34 The relation between electrophysiologic channel interaction and electrode pitch ranking in cochlear implant recipients; Hughes Michelle L.; Abbas Paul J.; (2006); J. Acoust Soc. Am. 119(3): 1527-37

The primary goal of this study was to examine the relation between electrophysiologic measures of channel interaction and the ability to discriminate pitch between electrodes in a psychophysical pitch-ranking task. It was hypothesized that cochlear implant recipients should perform better on an electrode pitch-ranking task when using electrodes with less channel interaction as measured with the electrically evoked compound action potential (ECAP). The width of the ECAP channel interaction function was compared with the slope of the pitch-ranking function for 10 adult Nucleus 24 recipients. Results showed no significant correlation between electrode pitch-ranking ability and width of the ECAP channel interaction function for individual subjects or for group data. Additionally, there was no significant correlation between speech perception performance and either pitch-ranking ability or width of the ECAP channel interaction function. These results suggest that the width of the ECAP interaction function may not be an accurate predictor of the ability to discriminate between electrodes on the basis of pitch.

35 Retinal prostheses for the blind; Ann Acad Med Singapore; Javaheri Michael; Hahn David S.; Lakhanpal Rohit R.; Weiland James D.; Humayun Mark S.; (2006); 35(3) 137-8

Using artificial means to treat extreme vision impairment has come closer to reality during the past few decades. The goal of this research has been to create an implantable medical device that provides useful vision for those patients who are left with no alternatives. Analogous to the cochlear implants for some forms of hearing loss, these devices could restore useful vision by converting visual information into patterns of electrical stimulation that excite the remaining viable inner retinal neurons in patients with retinitis pigmentosa or age-related macular degeneration. Methods: Data for this review were selected through a comprehensive literature search. Results: Advances in microtechnology have facilitated the development of a variety of prostheses that can be implanted in the

visual cortex, around the optic nerve, or in the eye. Some of these approaches have shown the promise of providing useful visual input to patients with visual impairments. Conclusion: While the development of various retinal prostheses have shown promise in limited clinical trials, there are distinct advantages and disadvantages for each type of prosthesis. This review will focus primarily on the Epiretinal Intraocular Retinal Prosthesis, studied by our group, but will also briefly review other modalities: the subretinal prosthesis, cortical prosthesis, and optic nerve prosthesis.

36 Vestibular-evoked myogenic potentials in cochlear implant children; Acta Otolaryngol; Jin Yulian; Nakamura Masako; Shinjo Yukiko; Kaga Kimitaka; (2006); 126(2): 164-9

CONCLUSIONS. Our results suggest that the sacculi of most children with cochlear implants can easily be damaged, as shown by the absence of vestibular-evoked myogenic potentials (VEMPs) in response to click stimuli. Also, in most of the children, the vestibular nerve was seemingly not stimulated by the cochlear implant. These results suggest that electrical stimulation at the C level can stimulate the cochlear nerve; however, this stimulation did not spread to the vestibular nerve in our children. In some children with Mondini dysplasia or vestibulocochlear nerve abnormality, the vestibular nerve was stimulated when the cochlear implant device was on, because of a VEMP response to electrical stimulation. Objective. To clarify the diagnostic value of VEMPs in cochlear implant patients. Material and methods. The click-evoked myogenic potentials of 12 children who underwent cochlear implantation surgery were investigated. The latency and amplitude of the VEMP responses were measured. Results. Before surgery, 6 of the 12 children showed normal VEMPs, 1 showed a decrease in the amplitude of VEMPs and five showed no VEMP response. After surgery, with the cochlear implant device off, 1 child showed a decreased VEMP and 11 showed no VEMPs. With the cochlear implant device on, four children showed VEMPs and eight did not.

37 Fabrication and optimal design of differential electromagnetic transducer for implantable middle ear hearing device; Kim Min-Kyu; Park Il-Yong; Song Byung-Scop; Cho Jin-Ho; (2006); Biosens Bioelectron 21(11): 2170-5

A differential electromagnetic transducer (DET), with similar frequency characteristics to those of a normal middle ear, is designed and implemented for use in an implantable middle ear hearing device (IMEHD). To optimize the characteristics of the DET that depend on the electromagnetically forced vibration, a theoretical analysis is conducted to design the vibrating part. The electromagnetic force of the DET is simulated according to the design parameters of the coil size using a finite element analysis (FEA). As a result, the maximal vibration force is achieved when the optimal length and thickness of the cylindrical coil is 70% of the length of the magnets and 56% of their radius. The

vibration characteristics of the DET are then simulated when applying the maximal force. The optimally designed DET is implemented using MEMS technology and vibration experiments carried out with the fabricated DET in an unloaded state. The vibrating displacement of the DET is about 200nm within a range between 0.1 and 1.5kHz when a current of 1mA(rms) is applied to the coil. To investigate the usefulness of the DET, in vitro and in vivo experiments are conducted using the ossicular chain of a cadaver and guinea pig, and the results verify that the implemented DET performs well as a transducer for an IMEHD.

38 Social and emotional characteristics of adults seeking a cochlear implant and their spouses; Knutson John F.; Johnson Abigail; Murray Kathleen T.; (2006); Br J Health Psychol 11(2):279-92

OBJECTIVES: Because past research has shown that benefits of cochlear implantation may include a significant decrease in psychological and emotional difficulties, this study examined whether persons seeking cochlear implants in recent years differed psychologically from those referred in the early 1980s. A second objective was to explore mechanisms by which profound deafness could contribute to psychological and emotional difficulties for implant candidates and their spouses.
METHODS: 178 cochlear implant candidates referred from 1981 to 1998 at the University of Iowa Hospitals completed a standard battery of psychological tests and questionnaires. The sample was divided into six 3-year cohorts and compared on standardized measures of psychological and emotional adjustment, and in participation in social and non-social activities. Spouses of implant candidates completed a similar assessment.
RESULTS: The sample was characterized by elevations in depression, social introversion, suspiciousness, and social anxiety and loneliness. There were no significant differences among cohorts across time except for an increase in expectations for implant success. Spouses also evidenced elevated levels of psychological distress. Hearing status was associated with significant differences in social activity participation. A paradoxical interaction was found between marital status and deafness.
CONCLUSIONS: There was no evidence that the psychological status of implant candidates is changing across time, suggesting continued psychological benefit for persons receiving cochlear implants. Both candidates and their spouses participated in fewer social activities than normal controls. Findings underscore the complex relation between marital status, deafness, and engagement and participation in positive activities.

39 Imaging and clinical findings in large endolymphatic duct and sac syndrome; Koesling Sabrina; Rasinski Christine; Amaya Beatrice; (2006);. Eur J Radiol 57(1): 54-62

OBJECTIVE: Large endolymphatic duct and sac syndrome (LEDS) is known as the most common kind of inner ear malformations, which is radiologically detectable. Nevertheless, nowadays many questions are not fully cleared and

LEDS is relatively unknown among general radiologists. The aim of this study was to evaluate the incidence of LEDS in the own patient population and to present our experiences regarding imaging findings, clinical presentation and follow up.
MATERIALS AND METHODS: Based on a complete recording of all patients, sent from ENT department to radiology, we identified all radiological diagnosed cases of inner ear malformations including LEDS and all patients in whom an inner ear malformation was clinically suspected. The retrospective study included clinical records, HR-CT and MRI performed between 1994 and 2002. RESULTS: Among 169 patients (338 ear), 17 of patients (median age: 12 years) and 28 ears, respectively, had enlarged endolymphatic structures. In 10 patients - 6% - (15 ears), no other abnormalities were detected, called isolated LEDS, seven patients showed additional inner ear abnormalities. One patient showed a labyrinthine hemorrhage after sudden hearing loss. Audiometric data revealed sensorineural hearing loss in 22 ears, deafness in 5 ears and normal hearing in 1 case of 28 ears. In 10 (67%) of 15 ears with isolated LEDS, the hearing loss was downward-fluctuating progressive. Twelve patients (eight with isolated LEDS) had partly repeated sudden hearing losses. A trigger for worsening of hearing was found in five patients. A correlation between the severity of morphological changes on imaging and the degree of hearing disturbances could not be detected. Only four young patients underwent a radiological examination within the first or second year after onset of hearing loss. Three patients received a cochlear implant.
CONCLUSIONS: LEDS might be the cause of progressive hearing loss and repeated acute hearing losses in children and young adults. Imaging plays an important role in making the diagnosis.

40 Factors affecting the use of noise-band vocoders as acoustic models for pitch perception in cochlear implants; Laneau J.; Moonen M.; Wouters J.; (2006); Journal of the Acoustical Society of America 119(1): 491-506

Although in a number of experiments noise-band vocoders have been shown to provide acoustic models for speech perception in cochlear implants (CI), the present study assesses in four experiments whether and under what limitations noise-band vocoders can be used as an acoustic model for pitch perception in CI. The first two experiments examine the effect of spectral smearing on simulated electrode discrimination and fundamental frequency (F0) discrimination. The third experiment assesses the effect of spectral mismatch in an F0-discrimination task with two different vocoders. The fourth experiment investigates the effect of amplitude compression on modulation rate discrimination. For each experiment, the results obtained from normal-hearing subjects presented with vocoded stimuli are compared to results obtained directly from CI recipients. The results show that place pitch sensitivity drops with increased spectral smearing and that place pitch cues for multi-channel stimuli can adequately be mimicked when the discriminability of adjacent channels is

adjusted by varying the spectral slopes to match that of CI subjects. The results also indicate that temporal pitch sensitivity is limited for noise-band carriers with low center frequencies and that the absence of a compression function in the vocoder might alter the saliency of the temporal pitch cues.

41 Improved music perception with explicit pitch coding in cochlear implants; Laneau Johan; Wouters Jan; Moonen Marc; (2006); Audiol Neurootol 11(1): 38-52

Music perception and appraisal is very poor in cochlear implant (CI) subjects partly because (musical) pitch is inadequately transmitted by the current clinically used sound processors. A new sound processing scheme (F0mod) was designed to optimize pitch perception, and its performance for music and pitch perception was compared in four different experiments to that of the current clinically used sound processing scheme (ACE) in six Nucleus CI24 subjects. In the F0mod scheme, slowly varying channel envelopes are explicitly modulated sinusoidally at the fundamental frequency (F0) of the input signal, with 100% modulation depth and in phase across channels to maximize temporal envelope pitch cues. The results of the four experiments show that: (1) F0 discrimination of single-formant stimuli was not significantly different for the two schemes, (2) F0 discrimination of musical notes of five instruments was three times better with the F0mod scheme for F0 up to 250 Hz, (3) melody recognition of familiar Flemish songs (with all rhythm cues removed) was improved with the F0mod scheme, and (4) estimates of musical pitch intervals, obtained in a musically trained CI subject, matched more closely the presented intervals with the F0mod scheme. These results indicate that explicit F0 modulation of the channel envelopes improves music perception in CI subjects. Copyright 2006 S. Karger AG, Basel.

42 Quality of life in postlingually deaf patients following cochlear implantation; Lassaletta Luis; Castro Alejandro; Bastarrica Marta; de Sarrioa Maria Josoe; Gaviloan Javier; (2006); Eur Arch Otorhinolaryngol 263(3): 267-70

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 an 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. The results cannot only be explained by enhancements to auditory perception.

43 Contributions of temporal and spectral cues to Chinese tone recognition in the continuous interleaved sampling strategy; Li Chunxiao; Pan Xiang; Liu Ju; Nie Kaibao; (2006); Sheng Wu Yi Xue Gong Cheng Xue Za Zhi 23(1): 41-4

Recent studies have revealed temporal waveform envelope cues as a function of time having significant influence on tone recognition in continuous interleaved sampling (CIS) of cochlear implants. In this study, temporal cues of speech signal have been modulated so that to different tones have nearly the same temporal waveform envelope. The processing signal is named modulated signal. The modulated signals and original signals are processed through software emulations of cochlear-implant signal processors. The recognition score of the modulated signals and originals are compared. The result indicates that temporal cues have great influence on tone recognition, but spectral cues are the principal factor determining the identification of tones.

44 Cochlear implantation with ipsilateral petroclival chondrosarcoma; Lin Erin M.; Ray Michael E.; Telian, Steven A.; (2006); Otol Neurotol 27(3): 337-41

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.

45 Bilateral cochlear implants in children: localization acuity measured with minimum audible angle; Litovsky Ruth Y.; Johnstone Patti M.; Godar Shelly; Agrawal Smita; Parkinson Aaron; Peters Robert; Lake Jennifer; (2006); Ear & Hearing 27(1): 43-59

OBJECTIVE:: To evaluate sound localization acuity in a group of children who received bilateral (BI) cochlear implants in sequential procedures and to determine the extent to which BI auditory experience affects sound localization acuity. In addition, to investigate the extent to which a hearing aid in the nonimplanted ear can also provide benefits on this task.
DESIGN:: Two groups of children participated, 13 with BI cochlear implants (cochlear implant + cochlear implant), ranging in age from 3 to 16 yrs, and six with a hearing aid in the nonimplanted ear (cochlear implant + hearing aid), ages 4 to 14 yrs. Testing was conducted in large sound-treated booths with loudspeakers positioned on a horizontal arc with a radius of 1.5 m. Stimuli were spondaic words recorded with a male voice. Stimulus levels typically averaged 60 dB SPL and were randomly roved between 56 and 64 dB SPL (+/-4 dB rove); in a few instances, levels were held fixed (60 dB SPL). Testing was conducted by using a "listening game" platform via computerized interactive software, and the ability of each child to discriminate sounds presented to the right or left was measured for loudspeakers subtending various angular separations. Minimum audible angle thresholds were measured in the BI (cochlear implant + cochlear implant or cochlear implant + hearing aid) listening mode and under monaural conditions.
RESULTS:: Approximately 70% (9/13) of children in the cochlear implant + cochlear implant group discriminated left/right for source separations of </=20 degrees , and, of those, 77% (7/9) performed better when listening bilaterally than with either cochlear implant alone. Several children were also able to perform the task when using a single cochlear implant, under some conditions. Minimum audible angle thresholds were better in the first cochlear implant than the second cochlear implant listening mode for nearly all (8/9) subjects. Repeated testing of a few individual subjects over a 2-yr period suggests that robust improvements in performance occurred with increased auditory experience. Children who wore hearing aids in the nonimplanted ear were at times also able to perform the task. Average group performance was worse than that of the children with BI cochlear implants when both ears were activated (cochlear implant + hearing aid versus cochlear implant + cochlear implant) but not significantly different when listening with a single cochlear implant.
CONCLUSIONS:: Children with sequential BI cochlear implants represent a unique population of individuals who have undergone variable amounts of auditory deprivation in each ear. Our findings suggest that many but not all of these children perform better on measures of localization acuity with two cochlear implants compared with one and are better at the task than children using the cochlear implant + hearing aid. These results must be interpreted with caution, because benefits on other tasks as well as the long-term benefits of BI cochlear implants are yet to be fully understood. The factors that might contribute

to such benefits must be carefully evaluated in large populations of children using a variety of measures.

46 Multi-slice spiral CT imaging in the post-operative assessment of cochlear implanted electrode; Ma H.; Han P.; Kong W.J.; Kong X.Q.; Liang B.; Tian Z.L.; Lei Z.Q.; Liu, F.; Feng G.S.; (2006); Acta Academiae Medicinae Sinicae 28(1): 13-15.

OBJECTIVE: To evaluate the usefulness of multi-slice spiral CT (MSCT) in the post-operative assessment of cochlear implanted electrode.
METHODS: Twenty-three cochlear implant recipients were enrolled in this study. All patients were examined with a SOMATOM Sensation 16-slice CT scanner (Siemens) using the following parameters: 120 kV, 100 mAs, 0.75 min collimation, 1 mm reconstruction slice thickness and increment, a pitch factor of 1, and a FOV of 100 mm. The axial images of interested ears were reconstructed with 0. 1 min increment and a FOV of 50 mm, and then volume rendering technique (VRT) reconstruction were done on the work station.
RESULTS: The electrode arrays were detected on axial CT images. Both inner ear and electrode array could be displayed on one image simultaneously. VRT provided an intuitionistic view of the relationship between electrode array and cochlea. VRT showed the number of the electrode array in 20 patients implanted with Combi 40 + standard electrode array and demonstrated the shape, position, and insertion depth. The electrode array number determined by VRT was in accordance with the surgical findings in 18 patients, and was underestimated in two patients. In 3 patients with Combi 40 + compressed electrode array, only 4 to 5 electrodes arrays were clearly identified and others were not observed.
CONCLUSION: MSCT with VRT can provide useful three-dimensional information of the electrode array and indicate the exact relationship between electrode array and cochlea.

47 Endoscopically guided placement of prefabricated cochlear implant electrodes in a common cavity malformation; Manolidis Spiros; Tonini Ross; Spitzer Jaclyn; (2006); Int J Pediatr Otorhinolaryngol 70(4): 591-6

OBJECTIVE: To devise a safe and effective method of optimal customized 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 bones of these two children. Electrode positioning was achieved with direct endoscopic view of the cavity utilizing a three-hole common cavity technique.
RESULTS: Optimal electrode positioning in apposition to the medial neuroepithelium in 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.

48 Analysis of the cochlear implant as a treatment technique for profound hearing loss in pre and postlocutive patients; Manrique M.; Ramos A.; Morera C.; Cenjor C.; Lavilla M.J.; Boleas M.S.; Cervera-Paz F.J.; (2006); Acta Otorrinolaringol Esp. 57(1): 2-23

INTRODUCTION: These are the objectives planned for this study: 1. Evaluate the results from the communication point of view. 2. Evaluate the cochlear implant (CI) impact on the quality of life. 3. Evaluate medical complications and technical failures. 4. Assess direct and indirect costs generated during the phases of a cochlear implantation programme. 5. Determine which factors have a high impact on the clinical evolution and the financial cost.
MATERIALS AND METHOD: A population of 877 patients, postlingual and prelingual, adults and children, have been studied. They were treated in 5 Spanish centres with cochlear implant programmes. Audiometric tests and global questionnaires on life quality have been carried out. Medical and CI technology complications have also been computed. Direct and indirect economic costs of a cochlear implant have been calculated.
RESULTS: Postlocutive-implanted patients reached the 40 dB SPL threshold in the Pure Tone Audiometry, and this result was maintained during the 12-year evolution. In Vowels test, it evolved from a 30% on pre-stimulation to 80-90%, in Disyllables words test it evolved from a 10% to a 50-60%, and in CID Sentences test it evolved from an 18% to a 60-70%. In the prelocutive population, results were influenced by the child's age at implantation. The best results were obtained by the children who had been implanted earlier. Those implanted between 0 and 3 years old evolved in the Vowels test from 0% during pre-stimulation to 95%, from a 0% to a 90% in Disyllables words test and from a 0% to a 90-95% in CID Sentences test. Also, the speech acquisition and development of the pre-locutive population was also influenced by the implantation age. An 80% of postlocutive adult patients stated a mood and sociability improvement after the cochlear implantation. They did not show health changes in general nor relevant modifications in the attention they usually received from relatives and friends. Severe medical-surgical complications were registered for a 3.42% of the cases, a 7.06% of mild medical-surgical complications and a 3.07% of technical breakdowns in the internal components of the CI. Financial cost of implantation for a post-locutive adult oscillated between 36,912 Euro and 37,048 Euro, and between 37,689 Euro and 44,273 Euro for a pre-locutive child.
CONCLUSIONS: Cochlear implants clearly enhance communication skills of the implantees. Results obtained for the prelocutive implanted population justify the creation of hearing screening programmes in new-borns. Postlocutive implanted adults have expressed satisfaction for the results obtained. However, they did perceive some limitations in situations of unfavourable acoustic conditions. An analysis of direct and indirect costs related to a CI programme has been made. It

may be useful to carry out reports on the cost-benefit ratio in this field. The low index of complications observed shows which cochlear implant treatment technique complies with the adequate safety margins. The factors influencing the most in the evolution are: duration of hearing deprivation, age at implantation, cochlear anatomy and functionality of the auditory pathway, patient's and relative's motivation, and the coexistence of other handicaps associated to hearing losses.

49 Adjustment of cochlear implant speech processing program; Masuda S.; Ueda, Y.; Ichioka Y.; Hirakawa K.; Yajin K.; Yoshioka M.; Iwata K.; (2006); Practica Otologica, Supplement 117: 77-82

Cochlear implants require periodic adjustments of their speech processing program. The present study investigated the necessity and frequency of adjustment of the cochlear implant speech processing program in adult patients. Subjects were 19 adult patients who underwent cochlear implantation at our department and had worn the implant continuously for more than one year. A cochlear implant manufactured by Cochlear Ltd. was used in all patients: the Nucleus 22 system in 13 patients, and the Nucleus 24 system in 6 patients. Excluding adjustments made within the first month of implantation, adjustment of the speech processing program, i.e., MAPping, was performed a total of 860 times. Changes in MAP within the past three months or previously were classified as those performed to improve hearing or to alleviate adverse effects (uncomfortable noisy sensation, dizziness, earache and headache). The results were analyzed in relation to patient age at the time of surgery and hearing performance. The study showed that when MAPping was performed frequently to reduce noise, patients often experienced dizziness, earache or headache. If a patient experiences an adverse effect, while MAP might need to be adjusted, this could also worsen hearing. However, at our department, MAPping was done to deal with adverse effects without negatively affecting hearing performance.

50 A wideband frequency-shift keying demodulator for wireless neural stimulation Microsystems; Mian Dong; Chun Zhang; Songping Mai; Zhihua Wang; Dongmei Li; (2006); Proceedings. 19th International Conference on VLSI Design held jointly with 5th International Conference on Embedded Systems and Design. 4

This paper presents a wideband frequency-shift keying (FSK) demodulator which is suitable for a digital data transmission chain of wireless neural stimulation microsystems such as cochlear implants and retinal prostheses. The demodulator circuit derives a constant frequency clock directly from a FSK carrier, and uses this clock to sample the data bits. The circuit occupies 0.03 mm/sup 2/ in a 0.6 mu m, 2M/2P, standard CMOS process, and consumes 0.25mW at 5V. This demodulator circuit is experimentally tested at the transmission speed up to 2.5Mbps while receiving a 5/10 MHz FSK carrier signal in a cochlear implant system.

51 A wideband wireless micro-stimulating ASIC for cochlear implant; Mian Dong; Chun Zhang; Songping Mai; Zhihua Wang; Dongmei Li; (2006); Proceedings. The 17th ICM 2005. 2005 International Conference on Microelectronics (IEEE Cat. No.05EX1112C). 5

This paper presents a wireless micro-stimulating ASIC for cochlear prosthesis application, to restore auditory function in profoundly deaf individuals. A new wideband frequency-shift keying (FSK) demodulator is designed to guarantee the high bandwidth of the digital data transmission chain. The demodulator circuit derives a constant frequency clock from FSK carrier directly, and uses this clock to sample the data bits. The circuit is experimentally tested at the stimulus rate up to 75k pulses per second with transmission speed of 2.5Mbps while receiving a 5M/10MHz FSK carrier signal. The whole circuit occupies 7.5 mm/sup 2/ in a 0.6 mu m, 2M/2P, standard CMOS process, and consumes 12.5mW at 5V.

52 The influence of mastoidectomy on natural history of secretory otitis media in cochlear implant children; Migirov Lela; Amir Achiya; Kronenberg Jona; (2006); ORL J Otorhinolaryngol Relat Spec 68(3): 156-8

Secretory otitis media (SOM) is a common childhood disease. The goal of the present study was to determine the influence of mastoidectomy on the incidence of postimplantation SOM in cochlear implant children. We conducted a retrospective study of all the children up to the age of 8 years, who underwent cochlear implantation from 1993 to 2001 in our department. The children were divided into two groups according to the surgical technique used for the implantation: 94 children underwent implantation with the posterior tympanotomy approach (including mastoidectomy) and 48 children were implanted with a suprameatal approach (without mastoidectomy). The incidence of SOM before and after the implantation was compared between the two groups. There were no significant differences between the two study groups in terms of age and the pre- and postimplantation incidence of SOM. Mastoidectomy failed to demonstrate any influence on the natural history of SOM. Copyright (c) 2006 S. Karger AG, Basel.

53 Speech perception of children with cochlear implants and children with traditional hearing aids; Mildner Vesna; Sindija Branka; Vrban Zrinski Karolina; (2006); Clin Linguist Phon 20(2): 219-29

The aim of the study was to analyse speech perception of children with cochlear implants (N = 29) and children fitted with traditional hearing aids (N = 20). One- and two-syllable words were presented auditorily in a forced choice minimal-pair discrimination task. The children repeated the word and pointed to the appropriate picture presented on computer screen. The words were minimal pairs with respect to voicing or place of articulation in stops and fricatives; among affricates the minimal pairs included the most frequently substituted fricatives and stops in addition to voicing and place of articulation. Vowel discrimination was

tested in minimal pairs and in nonsense words differing only in the vowel. Unaided, all children were profoundly hearing impaired and were included in auditory-oral therapy (Verbotonal method). The smallest differences between the groups were found for stops and vowels, and the largest for fricatives and affricates. The implanted children were significantly more successful.

54 Speech perception for adults who use hearing AIDS in conjunction with cochlear implants in opposite ears; Mok Mansze; Grayden David; Dowell Richard C; Lawrence David; (2006); 49(2): 338-51

This study aimed to (a) investigate the effect of using a hearing aid in conjunction with a cochlear implant in opposite ears on speech perception in quiet and in noise, (b) identify the speech information obtained from a hearing aid that is additive to the information obtained from a cochlear implant, and (c) explore the relationship between aided thresholds in the nonimplanted ear and speech perception benefit from wearing a hearing aid in conjunction with a cochlear implant in opposite ears.Fourteen adults who used the Nucleus 24 cochlear implant system in 1 ear participated in the study. All participants had either used a hearing aid in the nonimplanted ear for at least 75% of waking hours after cochlear implantation, and/or, hearing loss less than 90 dB HL in the low frequencies in the nonimplanted ear. Speech perception was evaluated in 3 conditions: cochlear implant alone (CI), hearing aid alone (HA), and cochlear implant in conjunction with hearing aid in opposite ears (CIHA). Three speech perception tests were used: consonant-vowel nucleus-consonant (CNC) words in quiet, City University of New York style (CUNY) sentences in coincident signal and noise, and spondees in coincidental and spatially separated signal and noise. Information transmission analyses were performed on the CNC responses.Of the 14 participants tested, 6 showed significant bimodal benefit on open-set speech perception measures and 5 showed benefit on close-set spondees. However, 2 participants showed poorer speech perception with CIHA than CI in at least 1 of the speech perception tests. Results of information transmission analyses showed that bimodal benefit (performance with CIHA minus that with CI) in quiet arises from improved perception of the low frequency components in speech. Results showed that participants with poorer aided thresholds in the mid-to-high frequencies demonstrated greater bimodal benefit. It is possible that the mid-to-high frequency information provided by the hearing aids may be conflicting with the cochlear implants.

55 Spectral and temporal cues in cochlear implant speech perception; Nie Kaibao; Barco Amy; Zeng Fan-Gang; Ear & Hearing 27(2): 208-17

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.

56 Evidence-based overview of ophthalmic disorders in deaf children: a literature update; Nikolopoulos T.P.; Lioumi D.; Stamataki S.; O'Donoghue G.M.; (2006); Otol Neurotol 27 27(2) Suppl 1-24

BACKGROUND: Deaf children are heavily reliant on the sense of vision in order to develop efficient communication skills and explore the world around them. Any ophthalmic disorder may thus negatively impact on this process, especially if it is unrecognised in the early years of life. These disorders may be correctable (such as myopia) or treatable (such as cataract), and their early identification is of the utmost importance to optimise language development (spoken or sign, or both) and develop social cognition. Those children with non-correctable and non-treatable visual disorders, like retinitis pigmentosa in Usher syndrome, require multiple environmental adaptations and appropriate support services and information. AIM:: To review the accumulated scientific knowledge on ophthalmic

disorders in deaf children and assess the quality of evidence published in the literature in order to contribute to better diagnosis and management of these conditions.
MATERIAL AND METHODS: The project reviewed more than 1000 published papers and other sources. 191 papers complied with the aims of the study and were used in the project. From these studies, 95% were based on type III or IV evidence (mainly descriptive studies or case reports). Only 3% were based on type II evidence and 2% on type I evidence.
RESULTS-CONCLUSIONS: The main conclusions of this project are: a) the overall quality of evidence in the literature concerning deaf children and their ophthalmic problems is very low, b) the prevalence of ophthalmic problems in deaf children is very high (approximately 40% to 60%) and these problems may remain undetected for years although they may have a serious impact on children's acquisition of communication skills, c) screening for ophthalmic problems in deaf children should be encouraged and specialist ophthalmic examination should be carried out as soon as the diagnosis of deafness is confirmed irrespective of age, and may need to be repeated at intervals following diagnosis, d) families should be informed about the nature of the screening process in discussion with the relevant professionals and appropriate information should be available in a range of formats and in different community languages, e) professionals administering the tests should be familiar with the needs of deaf children with ophthalmic problems and should be sensitive to the communication needs of the child, especially undertaking behavioural testing where their collaboration is needed, f) while orthoptists can perform the majority of psychophysical tests (visual and stereo acuity tests, ocular motility tests, etc.) a comprehensive opthalmologic assessment by slit lamp biomicroscopy, streak retinoscopy, direct and indirect ophthalmoscopy, intraocular pressure measurement etc is required. Electrophysiologic testing to help identification of Usher syndrome may also be required, and finally g) serial hearing assessments of children with dual sensory deficits are needed to monitor hearing thresholds, to optimise hearing aid use and to ensure timely referral for cochlear implantation for those who need it.

57 Cochlear implant outcomes and quality of life in the elderly: Manchester experience over 13 years; Orabi A.A.; Mawman D.; Al-Zoubi F.; Saeed S.R.; Ramsden R.T.; (2006); Clin Otolaryngol 31(2): 116-22

OBJECTIVES: To objectively evaluate the clinical and functional outcomes of cochlear implantation in an elderly population. Design: Retrospective comparative study. Setting: Neurotology unit at Manchester Royal Infirmary, a supraregional tertiary referral centre in collaboration with Adult Cochlear Implant Programme at The University of Manchester. Participants: All cochlear implant procedures (38) undertaken on post-lingually deafened elderly patients (age range at the time of implantation 65-80 years, n = 34) in the period from 1989 to 2002. Main outcome measures: Medical and surgical outcomes. Audiological performance outcomes for isolated words, words in sentences in quiet and noise.

Functional outcome measures used are self-reported measures of the social, psychological and emotional aspects of quality of life, and the differences between expectations for functional outcomes and the realization of functional outcomes. They included expectation profiles, Glasgow Benefit inventory (GBI) and Glasgow Health Status Inventory Questionnaire (GHSI).
RESULTS: There was statistically significant improvement post-implantation of both open and closed set test scores ($P < 0.01$). Eighty-two percentage of patients were completely satisfied with their cochlear implants. Patients judged that implantation restored half the loss of quality of life that they had experienced as a result of severe-profound deafness with a highly significant ($P < 0.001$) improvement in overall quality of life after implantation. The commonest post-operative observation was transient mild pyrexia.
CONCLUSIONS: The age of a cochlear implant candidate should not be a factor in the candidacy decision-making process. The quality of life of our elderly recipients was significantly improved after cochlear implant.

58 Substance distribution in a cochlea model using different pump rates for cochlear implant drug delivery electrode prototypes; Paasche Gerrit; Boegel Lars; Leinung Martin; Lenarz Thomas; Stoever Timo; (2006); Hear Res. 212(1-2): 74-82.

Several studies using animals have shown the protective effects of neurotrophic factors (NF) on spiral ganglion cells (SGC). This is of particular importance since the number of SGCs is considered to be among the factors defining the efficacy of cochlear implants. A device for local inner ear treatment is therefore of great interest. As described previously, we modified a Contour(TM) cochlear implant electrode, to examine the inbuilt canal to be used for fluid release Paasche, G., Gibson, P., Averbeck, T., Becker, H., Lenarz, T., Stoever, T., 2003. Technical report: modification of a cochlear implant electrode for drug delivery to the inner ear. Otol. Neurotol. 24, 222-227 . In the present study, three different electrode prototypes with openings of the delivery channel at various locations along the electrode array were examined to determine distribution of dye in a cochlea model over time. We compared dye delivery with: (a) release of the dye at the tip, (b) release of the dye at the tip and the side of the electrode, and (c) release of the dye only at the side of the electrode (6mm from the tip). A mechanical pump was used to drive the system at pump rates of 100, 10, and 1mul/h. Dye concentration changes along the length of the whole cochlea were investigated. Mean values for all experimental conditions show that the distribution along the array is fastest with two outlets whereas the distribution via a single outlet at the side of the electrode array is not considered to be sufficient. The established experimental setup provides the possibility of investigating prototypes of a fluid based drug delivery system for the treatment of inner ear pathologies in combination with electrical stimulation.

59 Late postnatal onset of hearing loss due to GJB2 mutations; Pagarkar Waheeda; Bitner-Glindzicz Maria; Knight Jeffrey; Sirimanna Tony; (2006); Int J Pediatr Otorhinolaryngol 70(6): 1119-24

GJB2 mutations account for approximately 50% of recessive non-syndromic deafness, with 35delG being the most prevalent. Homozygous 35delG mutations cause prelingual, non-progressive hearing loss that is detected on newborn hearing screening programmes. We present a sibling pair with homozygous 35delG mutations, who passed hearing tests in early infancy and developed progressive sensorineural hearing loss, one requiring a cochlear implant. These cases illustrate that deafness due to such mutations may have a late onset and consequently be missed on neonatal screening programmes and they may present an argument to consider neonatal screening for GJB2 mutations in order to aid early intervention.

60 Dynamics of auditory plasticity after cochlear implantation: a longitudinal study; Pantev C.; Dinnesen A.; Ross B.; Wollbrink A.; Knief A.; (2006); Cereb Cortex 16(1): 31-6

Human representational cortex may fundamentally alter its organization and (re)gain the capacity for auditory processing even when it is deprived of its input for more than two decades. Stimulus-evoked brain activity was recorded in post-lingual deaf patients after implantation of a cochlear prosthesis, which partly restored their hearing. During a 2 year follow-up study this activity revealed almost normal component configuration and was localized in the auditory cortex, demonstrating adequacy of the cochlear implant stimulation. Evoked brain activity increased over several months after the cochlear implant was turned on. This is taken as a measure of the temporal dynamics of plasticity of the human auditory system after implantation of cochlear prosthesis.

61 A survey of parental views regarding their child's hearing loss: A pilot study; Park Albert H.; Warner Jonathan; Sturgill Nanette; Alder Stephen C.; (2006); Otolaryngol Head Neck Surg. 134(5): 800-1

OBJECTIVE: Assess parental perceptions of their child's sensorineural hearing loss care.
METHODS: Families of pediatric patients diagnosed with a sensorineural hearing loss from 2000 to 2004 were sent a survey asking about their experiences with their child's hearing loss.
RESULTS: One hundred eight of 389 families surveyed were studied. Thirteen percent did not know the results of the newborn screening. Twenty-two percent of the primary care physicians were not involved in the child's hearing evaluation. Forty percent of the patients underwent 4 or more audiologic tests before a diagnosis. The most common reason for delayed diagnosis was difficulty in obtaining an appointment with an audiologist. Sixty-two percent of families had difficulties obtaining hearing aids, and 58% noted difficulties obtaining cochlear implants.
CONCLUSIONS: Families reported multiple obstacles to obtain timely diagnosis and treatment. Otolaryngologists may need to be more involved in the evaluation and treatment of these patients. EBM rating: C-4.

62 Biomechanical strength of reconstruction plates when used for medial support of med-el cochlear implants: implications for diagnostic MRI; Poetker David M.; Wackym Ashley P.; Yoganandan Narayan; Runge-Samuelson Christina L.; Firszt Jill B.; Pintar Frank A.; (2006); ORL J Otorhinolaryngol Relat Spec. 68(2): 77-82

Purpose:It is hypothesized that a mesh reconstruction plate designed to fit a cochlear implant (CI) internal device will provide immediate structural support to the site of the implant and that this strength far exceeds the forces induced by a 1.5-tesla MRI. Procedures: Human calvarial 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 302.9 N, 283.0 N and 3.05 mm, 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 234.0 N, respectively. Mean force of first failure was 92.0 N for group 2 and 164.8 N for group 3. Conclusions: The force required for failure of the mesh is significantly greater than the 0.17 N exerted on a CI magnet by a 1.5-tesla MRI scan.

63 Effects of reverberation and masking on speech intelligibility in cochlear implant simulations; Poissant Sarah F.; Whitmal Nathaniel A.; Freyman Richard L.; (2006); J. Acoust Soc. Am. 119(3): 1606-15

Two experiments investigated the impact of reverberation and masking on speech understanding using cochlear implant (CI) simulations. Experiment 1 tested sentence recognition in quiet. Stimuli were processed with reverberation simulation (T=0.425, 0.266, 0.152, and 0.0 s) and then either processed with vocoding (6, 12, or 24 channels) or were subjected to no further processing. Reverberation alone had only a small impact on perception when as few as 12 channels of information were available. However, when the processing was limited to 6 channels, perception was extremely vulnerable to the effects of reverberation. In experiment 2, subjects listened to reverberated sentences, through 6- and 12-channel processors, in the presence of either speech-spectrum noise (SSN) or two-talker babble (TTB) at various target-to-masker ratios. The combined impact of reverberation and masking was profound, although there was no interaction between the two effects. This differs from results obtained in subjects listening to unprocessed speech where interactions between reverberation and masking have been shown to exist. A speech transmission index (STI) analysis indicated a reasonably good prediction of speech recognition performance. Unlike previous investigations, the SSN and TTB maskers produced equivalent results, raising questions about the role of informational masking in CI processed speech.

64 Revision cochlear implantation for facial nerve stimulation in otosclerosis; Polak Marek; Ulubil Arif S.; Hodges, Annelle V.; Balkany Thomas J.; (2006); Arch Otolaryngol Head Neck Surg. 132(4): 398-404

OBJECTIVE: To find if patients experiencing postsurgical facial nerve stimulation caused by underlying disease process (ie, otosclerosis) can improve their hearing performance with their cochlear implant by reimplantation and by an optimal programming strategy.
DESIGN: Retrospective analysis.
SETTING: Academic tertiary referral center.
PATIENTS: Two cochlear otosclerosis patients with resistant facial nerve stimulation (FNS). Both patients were initially implanted with Nucleus 22 devices (Cochlear Corporation, Englewood, Colo) and they developed FNS after a period of use. Owing to the decreasing number of active electrodes, concurrent decreases in speech understanding occurred.
INTERVENTIONS: Various programming approaches were used to address the FNS. Both subjects ultimately received Nucleus 24 devices. One was reimplanted in the same ear, and the other was implanted in the opposite ear. Both have been followed up for 8 months following the reimplantation. MAIN OUTCOME MEASURES: Cochlear implant programming levels, cochlear implant performance, and facial nerve stimulation.

RESULTS: The FNS was managed for more than 3 years through optimized programming. However, the FNS progressed until performance dropped below acceptable levels. Reimplantation was believed to be the only option for improvement. After reimplantation and programming, both subjects showed immediate improvement in speech discrimination. One user increased his consonant-nucleus-consonant word score from 12% preoperatively to 42%, and the other's performance increased from 0% to 86%.
CONCLUSIONS: Our results suggest that having more programming options with newer devices is critical in otosclerotic or ossified users who experience FNS. Also, reimplantation may be a useful tool to improve performance.

65 Auditory responses in cochlear implant users with and without GJB2 deafness; Propst Evan Jon; Papsin Blake C.; Stockley Tracy L.; Harrison Robert V.; Gordon Karen A.; (2006); Laryngoscope 116(2): 317-27

OBJECTIVE/HYPOTHESIS: It is reasonable to suppose that the pattern of sensorineural damage along the length of the cochlea depends on the etiology of a hearing loss (HL). In GJB2-related deafness, we hypothesize that gap junction deficits are uniformly distributed and will result in similar damage along the length of the cochlea as compared with non-GJB2 subjects. We assessed this by measuring patterns of neural activity and hearing from apical versus basal cochlear implant electrode regions.
STUDY DESIGN: This was a prospective, blind, controlled study.
METHODS: Blood from 301 pediatric cochlear implant users was analyzed for mutations in GJB2 by direct sequencing. After exclusion of patients with monoallelic GJB2 mutations, associated syndromes, or risk factors for HL that were not congenital, 39 children with biallelic GJB2 mutations and 58 without GJB2 mutations were evaluated. Hearing was measured before implantation at frequencies ranging from 250 Hz to 8 kHz. After implantation, neural activity at the apical and basal ends of the implanted array was measured using electrically evoked compound action potentials of the auditory nerve (ECAPs) and evoked stapedius reflexes (ESRs).
RESULTS: GJB2 and non-GJB2 groups were not significantly different with respect to sex, age at implantation, duration of auditory deprivation, hearing aid use, duration of aided hearing, ear implanted, implant model, or depth of insertion ($P>.05$). Children with GJB2-related HL had greater similarities between low- and high-frequency residual hearing and between neural activity electrically evoked at apical and basal regions of the cochlea as compared with children with non-GJB2-related HL who demonstrated larger deficits in basal regions.
CONCLUSION: Results suggest more consistent spiral ganglion survival along the length of the cochlea in GJB2-related HL as compared with non-GJB2-related HL, which appears to involve a decreasing gradient of spiral ganglion survival from the apex to the base of the cochlea. Our findings support our premise that in GJB2-related HL, dysfunction of gap junctions likely occurs to a similar degree in the apical and basal regions of the cochlea. This knowledge might be used to customize implantable devices for patients with HL in the future.

66 Ethnicity and mutations in GJB2 (connexin 26) and GJB6 (connexin 30) in a multi-cultural Canadian paediatric Cochlear Implant Program;
Propst Evan Jon; Stockley Tracy L; Gordon Karen A; Harrison Robert V; Papsin Blake Croll; (2006); Int J Pediatr Otorhinolaryngol, 70(3): 435-44

OBJECTIVE: To determine the relationship between ethnicity and mutations in the GJB2 and GJB6 genes in multi-cultural patients enrolled in a Canadian paediatric Cochlear Implant Program.
METHODS: Blood was analyzed from 65 paediatric cochlear implant users by direct sequencing of the coding region and intron/exon boundaries of the GBJ2 gene. Individuals heterozygous for one mutation in GJB2 or in whom mutations in GJB2 were not detected were analyzed for the common 342kb deletion mutation D13S1830 in the GJB6 gene. Information regarding ethnicity of patients' families was obtained from patient records and/or interview.
RESULTS: GJB2 mutations were found in 36.9% of paediatric cochlear implant users tested. Nine different GJB2 mutations were identified among individuals from 14 different countries of origin. Seventy-eight percent of all identified pathogenic GJB2 mutations were 35delG. Biallelic GJB2 mutations were found in 16 cochlear implant users (66.7% of GJB2 mutations). Three novel GJB2 sequence changes were identified: (1) a missense mutation T107C (L36P) in an individual of African decent; (2) a missense mutation G475T (D159Y) in an individual of Caribbean decent; (3) a regulatory region change 1-34C to T in an individual of African decent. GJB6-D13S1830 mutations were not found in any of the patients tested. Individuals of African, Caribbean and East Indian decent had different GJB2 mutations than the remainder of individuals tested. Patients of Asian, Italian, Spanish, Polish and Armenian decent were not found to carry mutations in GJB2 or the common GJB6-D13S1830 mutation.
CONCLUSIONS: This study represents the largest number of biallelic GJB2 mutations isolated in a group of paediatric cochlear implant users to date. Numerous and diverse GJB2 mutations were found in this multi-cultural group of children. Even though GJB2 mutations have been widely reported in the literature, this discussion represents the first report of GJB2 mutations in a multi-ethnic population (Canadian), as compared with previous studies that investigated fairly homogeneous populations. The diversity of GJB2 mutations identified reinforces the importance of testing for changes in GJB2 by direct sequencing of the entire coding region rather than testing only for common mutations.

67 Effects of introducing unprocessed low-frequency information on the reception of envelope-vocoder processed speech; Qin Michael K; Oxenham Andrew J.; (2006); J Acoust Soc. Am. 119(4) 2417-26

This study investigated the benefits of adding unprocessed low-frequency information to acoustic simulations of cochlear-implant processing in normal-hearing listeners. Implant processing was simulated using an eight-channel noise-excited envelope vocoder, and low-frequency information was added by replacing the lower frequency channels of the processor with a low-pass-filtered version of the original stimulus. Experiment 1 measured sentence-level speech reception as a function of target-to-masker ratio, with either steady-state speech-shaped noise or single-talker maskers. Experiment 2 measured listeners' ability to identify two vowels presented simultaneously, as a function of the F0 difference between the two vowels. In both experiments low-frequency information was added below either 300 or 600 Hz. The introduction of the additional low-frequency information led to substantial and significant improvements in performance in both experiments, with a greater improvement observed for the higher (600 Hz) than for the lower (300 Hz) cutoff frequency. However, performance never equaled performance in the unprocessed conditions. The results confirm other recent demonstrations that added low-frequency information can provide significant benefits in intelligibility, which may at least in part be attributed to improvements in F0 representation. The findings provide further support for efforts to make use of residual acoustic hearing in cochlear-implant users.

68 Cochlear implantation of patients with far-advanced otosclerosis; Rama-Loopez Julio; Cervera-Paz Francisco J; Manrique Manuel; (2006); Otol Neurotol 27(2): 153-8

OBJECTIVE:: This current single-subject, repeated-measures study was to describe our experience with 30 patients who had been diagnosed with "far-advanced otosclerosis" and who were included in our program of cochlear implants. We analyzed the history of the patients and their families before implantation, the surgical findings, and the performance over a follow up of 3 years.
MATERIAL AND METHODS:: All patients met one or more of the after criteria: 1) previous surgical intervention as a treatment of their otosclerosis; 2) signs of pericochlear hypodensities in high resolution computed tomography (HRCT) scans; and 3) family precedents of otosclerosis. All underwent standard surgical cochlear implantation.
RESULTS:: In 78% of the cases, a stapedectomy had previously been realized. Cochlear otosclerosis could be appreciated in HRCT in 78% of the patients. A family history of otosclerosis was found in 40%, and 33.3% of patients had familial precedents of nonfilial hypoacusis. The mean results in the two-syllable test were 20% preimplantation, 54% 6 months after implantation, and 52%, 62%,

54% at 1, 2, and 3 years after implantation. In the CID sentence test, they were in the order of 32% preimplantation and of 64% at 6 months, 66% after 1 year, of 68% after 2 years, and reaching 72% after 3 years. No complications related to the surgery were detected.
CONCLUSION:: Patients diagnosed with far-advanced otosclerosis have a good prognosis with cochlear implantation comparable to that of other patients in whom postlingual implants are performed.

69 Complications in cochlear implantation; Ramos A.; Charlone R.; de Miguel I.; Valdivielso A.; Cuyas, J. M.; Poerez D.; Vasallo J.R.; (2006); Acta Otorrinolaringol Esp. 57(3): 112-5

OBJECTIVE: The objetive of this paper is to present the surgical complications in cochlear implant, in a serie of 346 patients, submitted to surgery by the same surgical team with the subsequent control and follow-up for a long period of time. We show the description and the handling of each complication.
MATERIAL AND METHODS: A follow-up was carried out on 346 cochlear implant patients by the same surgical team, from February 1993 to March 2004. The complications were assessed and their handling and follow-up is reported. The series includes 211 children and 135 adults.
RESULTS: The complication rate was 9.8% (n = 34). The complications found were: Intraoperatory Complications: Cerebrospinal Fluid Leaks (CSF), 7; Facial nerve injury, 1; excessive thinning of the posterior wall, 2; inmediate post operatory complications: infection of the surgical wound, 4; post operatory persistent pain, 1; Tinnitus, 2; late complications: Mastoiditis, 2; extrusion of the stimulating receptor, 1; facial nerve stimulation, 5; late infections of the stimulation receptor, 2; technical failure of the implanted system, 7. Neither alteration or migration was found in the receptor placing.
CONCLUSIONS: The cochlear implant surgery has a low morbility. We found no cases of meningitis due to this procedure.

70 Cochlear implant speech processor placement and compression effects on sound sensitivity and interaural level difference; Ricketts Todd; Wesley Grantham D.; D'Haese Patrick; Edwards Jason; Barco Amy; (2006); J Am Acad Audiol 17(2): 133-40.

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 localization 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 localize better in the compression-off condition.

71 In vitro model for intraoperative adjustments in an implantable hearing aid (MET); Rodriguez Jorge Jesus; Pfister Markus; Zenner Hans P.; Zalaman Ilse M.; Maassen, Marcus M.; (2006); Laryngoscope 116(3): 473-81

OBJECTIVE: Assessment of the optimal static preloading of Otologics Middle Ear Transducer (MET) Ossicular Stimulator, when coupled to the incus.
BACKGROUND: The MET Ossicular Stimulator is a partially implantable electromagnetic middle ear hearing device that transmits vibrations to the ossicular chain. The vibration patterns were measured with laser-Doppler vibrometry.
STUDY DESIGN: Experimental. MATERIAL: We used three human cadaveric temporal bones (TB) and one MET ossicular stimulator.
METHODS: Laser-Doppler vibrometry was used for the selection of TBs. The cochlea was subsequently extirpated from the posterior side to measure the vibrational patterns (VP) of the footplate. Three TBs with different VP were selected based on data obtained from volunteers with normal hearing (n = 110): one TB with a VP larger than +1 SD, one TB with a VP in the range of +/-1 SD, and 1 TB with a VP smaller than -1 SD. Transfer functions were calculated between VP of the measurement points at the coupling rod, umbo, incus, and footplate. The TBs were subsequently defrosted. The MET was implanted and coupled to the ossicular chain. Different coupling loads were measured at the incus, the umbo, and the footplate.
RESULTS: Optimal transfer function between the MET transducer and the oval window was achieved during contact when the coupling rod advanced 0.0625 mm (90 degrees rotation). Additional advances of 0.0625 mm (180 degrees turn = 0.125 mm) resulted in a decreased vibrational amplitude, ranging between 20 and 40 dB below 3 kHz. The lowest linear distortion occurred up to 10 kHz during direct contact without advancing the coupling rod.

72 Cochlear implant explantation as a sequela of severe chronic otitis media: case report and review of the literature; Roehm Pamela C.; Gantz Bruce J.; (2006); Otol Neurotol 27(3): 332-6

INTRODUCTION:: In the 1980s, intracranial and inner ear infections were feared complications in patients with recurrent or chronic otitis media (COM) who had undergone cochlear implantation. Current studies show a low incidence of such complications. We present a case of a patient who developed severe COM requiring cochlear explantation.
CASE:: Our patient had a previous cleft palate repair and as a three-year-old was implanted with a Nucleus-24 implant. She developed chronic otorrhea in the implanted ear, which was managed by her pediatrician until her cochlear implant stopped functioning. Radiographic imaging revealed erosion of the cochlea and extrusion of the distal electrode medially in the petrous apex.

SETTING:: Tertiary care university hospital.
INTERVENTION/RESULTS:: The patient underwent cochlear explantation, subtotal petrosectomy, obliteration of ear, and intravenous antibiotic therapy. One month later she was implanted in the contralateral ear.
CONCLUSION:: COM poses potentially severe complications in patients receiving cochlear implants. Patients receiving cochlear implants who are at high risk for COM require follow-up for an extended period of time.

73 Sensitivity to isolated and concurrent intensity and fundamental frequency increments by cochlear implant users under natural listening conditions; Rogers Cheryl F.; Healy Eric W.; Montgomery Allen A.; (2006); J. Acoust Soc. Am. 119(4): 2276-87

Sensitivity to acoustic cues in cochlear implant (CI) listening under natural conditions is a potentially complex interaction between a number of simultaneous factors, and may be difficult to predict. In the present study, sensitivity was measured under conditions that approximate those of natural listening. Synthesized words having increases in intensity or fundamental frequency (F0) in a middle stressed syllable were presented in soundfield to normal-hearing listeners and to CI listeners using their everyday speech processors and programming. In contrast to the extremely fine sensitivity to electrical current observed when direct stimulation of single electrodes is employed, difference limens (DLs) for intensity were larger for the CI listeners by a factor of 2.4. In accord with previous work, F0 DLs were larger by almost one order of magnitude. In a second experiment, it was found that the presence of concurrent intensity and F0 increments reduced the mean DL to half that of either cue alone for both groups of subjects, indicating that both groups combine concurrent cues with equal success. Although sensitivity to either cue in isolation was not related to word recognition in CI users, the listeners having lower combined-cue thresholds produced better word recognition scores.

74 Environmental micro-patterning for the study of spiral ganglion neurite guidance; Ryan, Allen F; Wittig, John; Evans, Amaretta; Dazert, Stefan; Mullen, Lina; (2006); Audiol Neurootol 11(2): 134-43

The projection of neuronal processes is guided by a variety of soluble and insoluble factors, which are sensed by a fiber's growth cone. It is the differential distribution of such guidance cues that determine the direction in which neurites grow. The growth cone senses these cues on a fine scale, using extensible filopodia that range from a few to tens of mum in length. In order to study the effects of guidance cues on spiral ganglion (SG) neurites, we have used methods for distributing both soluble and insoluble cues on a scale appropriate for sensing by growth filopodia. The scale of these methods are at the micro, rather than nano, level to match the sensing range of the growth cone. Microfluidics and transfected cells were used to spatially localize tropic factors within the fluid environment of extending neurites. Micro-patterning was used to present neurites

with stripes of insoluble factors. The results indicate that differentially distributed permissive, repulsive and stop signals can control the projection of SG neurites. Implications for future micro-patterning studies, for SG development and for the growth of deafferented SG dendrites toward a cochlear implant are discussed.

75 Erratum: Restoration of auditory nerve synapses in cats by cochlear implants (Science (December 2, 2005) (1490)); Ryugo D. K.; (2006); Science 311(5763): 954

Abstract unavailable

76 Solutions to electromagnetic interference problems between cochlear implants and GSM phones; Sorri Martti J.; Piiparinen Peeta J.; Huttunen Kerttu H.; Haho Mikko J.; (2006); IEEE Trans Neural Syst Rehabil Eng 14(1): 101-8

For persons using cochlear implants, electromagnetic compatibility (EMC) problems may sometimes be an obstacle to using digital cellular telephones. This study aimed at exploring the benefit of three new assistive listening device prototypes that eliminate or diminish EMC problems. Ten experienced cochlear implant users listened in quiet to running speech samples and a sentence test on a landline phone, a digital cellular phone with and without three prototypes. The subjects' performance was assessed using a sentence test, a subjective visual analog scale, and by ranking the best and the poorest listening condition. Compared to the other test conditions, listening to a digital cellular phone alone revealed, on average, the poorest sentence recognition scores (29%) and the poorest results in four different subjective judgments (the amount of disturbances, the clarity of the message, the quality of the sound, overall judgment) with all three implant systems tested. The prototypes generally helped the implantees to recognize speech better on the cellular telephone (by 10-21 percent units, on average). Use of assistive listening devices and further development of EMC of both cochlear implant systems and digital cellular phones needs to take place to enable smooth use of digital cellular phones for all implantees.

77 Cochlear electrode arrays: past, present and future; Spelman Francis A.; (2006); Audiol Neurootol 11(2): 77-85

Cochlear implants are very successful devices: more than 60000 people use them throughout the world. Key to the success of these prostheses is the development of electrode arrays that place contacts close to the target neurons, survive for decades in the tissues of the inner ear, and that provide reliable and repeatable excitation to the cells of the auditory nerve. This article describes the early electrode arrays and their development into the arrays that are used presently in clinical cochlear prostheses. While integrated circuit techniques were

proposed and tested in the laboratory two decades ago, the present clinical devices still are hand built and made of wire-based technologies. Current approaches that seek to automate the construction of cochlear electrode arrays are described and discussed.

78 Hearing-impaired children in the United Kingdom, I: Auditory performance, communication skills, educational achievements, quality of life, and cochlear implantation; Stacey Paula C.; Fortnum Heather M.; Barton Garry R.; Summerfield Quentin A.; (2006); Ear & Hearing; 27(2): 161-86

OBJECTIVES: The objectives of this study were to identify variables that are associated with differences in outcome among hearing-impaired children and to control those variables while assessing the impact of cochlear implantation.
STUDY DESIGN: In a cross-sectional study, the parents and teachers of a representative sample of hearing-impaired children were invited to complete questionnaires about children's auditory performance, spoken communication skills, educational achievements, and quality of life. Multiple regression was used to measure the strength of association between these outcomes and variables related to the child (average hearing level, age at onset of hearing impairment, age, gender, number of additional disabilities), the family (parental occupational skill level, ethnicity, and parental hearing status), and cochlear implantation.
RESULTS: Questionnaires were returned by the parents of 2858 children, 468 of whom had received a cochlear implant, and by the teachers of 2241 children, 383 of whom had received an implant. Across all domains, reported outcomes were better for children with fewer disabilities in addition to impaired hearing. Across most domains, reported outcomes were better for children who were older, female, with a more favorable average hearing level, with a higher parental occupational skill level, and with an onset of hearing-impairment after 3 years. When these variables were controlled, cochlear implantation was consistently associated with advantages in auditory performance and spoken communication skills, but less consistently associated with advantages in educational achievements and quality of life. Significant associations were found most commonly for children who were younger than 5 years when implanted, and had used implants for more than 4 years. These children, whose mean (preoperative, unaided) average hearing level was 118 dB, were reported to perform at the same level as nonimplanted children with average hearing levels in the range from 80 dB to 104 dB, depending on the outcome measure.
CONCLUSIONS: When rigorous statistical control is exercised in comparing implanted and nonimplanted children, pediatric cochlear implantation is associated with reported improvements both in spoken communication skills and in some aspects of educational achievements and quality of life, provided that children receive implants before 5 years of age.

79 Effects of electrode design and configuration on channel interactions; Stickney Ginger S.; Loizou Philipos C.; Mishra Lakshmi N.; Assmann Peter F.; Shannon Robert V.; Opie Jane M.; (2006); Hear Res 211(1-2): 33-45

A potential shortcoming of existing multichannel cochlear implants is electrical-field summation during simultaneous electrode stimulation. Electrical-field interactions can disrupt the stimulus waveform prior to neural activation. To test whether speech intelligibility can be degraded by electrical-field interaction, speech recognition performance and interaction were examined for three Clarion electrode arrays: the pre-curved, enhanced bipolar electrode array, the enhanced bipolar electrode with an electrode positioner, and the Hi-Focus electrode with a positioner. Channel interaction was measured by comparing stimulus detection thresholds for a probe signal in the presence of a sub-threshold perturbation signal as a function of the separation between the two simultaneously stimulated electrodes. Correct identification of vowels, consonants, and words in sentences was measured with two speech strategies: one which used simultaneous stimulation and another which used sequential stimulation. Speech recognition scores were correlated with measured electrical-field interaction for the strategy which used simultaneous stimulation but not the strategy which used sequential stimulation. Higher speech recognition scores with the simultaneous strategy were generally associated with lower levels of electrical-field interaction. Electrical-field interaction accounted for as much as 70% of the variance in speech recognition scores, suggesting that electrical-field interaction is a significant contributor to the variability found across patients who use simultaneous strategies.

80 Loudness adaptation in acoustic and electric hearing; Tang Qing; Liu Sheng; Zeng Fan-Gang; (2006); J Assoc Res Otolaryngol 7(1): 59-70

The present study is aimed to evaluate and compare loudness adaptation between normal hearing and cochlear-implant subjects. Loudness adaptation for 367-s pure tones was measured in five normal-hearing subjects at three frequencies (125, 1,000, and 8,000 Hz) and three levels (30, 60, and 90 dB SPL). In addition, loudness adaptation for 367-s pulse trains was measured in five Clarion cochlear-implant subjects at three stimulation rates (100, 991, and 4,296 Hz), three levels (10, 50, and 90% of the electric dynamic range), three stimulation positions (apical, middle and basal), and two stimulation modes (monopolar and bipolar). The method of successive magnitude estimation was used to quantify loudness adaptation. Similar to the previous results, we found that loudness adaptation in normal-hearing subjects increases with decreasing level and increasing frequency. However, we also found a small but significant loudness enhancement at 90 dB SPL in acoustic hearing. Despite large individual variability, we found that loudness adaptation in cochlear-implant subjects increases with decreasing levels, but is not significantly affected by the rate, place and mode of stimulation. A phenomenological model was proposed to

predict loudness adaptation as a function of stimulus frequency and level in acoustic hearing. The present results were not fully compatible with either the restricted excitation hypothesis or the neural adaptation hypothesis. Loudness adaptation may have a central component that is dependent on the peripheral excitation pattern.

81 Cochlear implanted pupils in Scottish schools: 4-year school attainment data (2000-2004); Thoutenhoofd Ernst; (2006) J Deaf Stud Deaf Educ 11(2) 171-88

The Achievements of Deaf Pupils in Scotland (ADPS) project has been tracking the educational attainment of deaf pupils in Scotland's schools since 2000. At the time of writing, the database contains records for 1,752 deaf pupils (2000-2005). Here 4-year aggregate educational attainment data are reported for a subset of 152 school-aged deaf pupils with cochlear implants notified to the ADPS database between June 2000 and June 2004. The data describe primary and secondary school results in reading, writing, and math for this subgroup, as well as placement and communication characteristics. The educational attainment of the group of deaf pupils with cochlear implants is clearly marked when the deaf pupil population is disaggregated for hearing loss, achieving comparatively higher average attainment in both 5-14 Curriculum National Tests (Mathematics in particular) and Standard Grades. Therefore the gap in performance relative to the national population data is reduced for those deaf pupils, although it still widens at higher levels of achievement for the National Tests. Although most pupils with cochlear implants are placed in the mainstream, there is no pattern of migration toward mainstream schools. Some deaf pupils with cochlear implants moved out of mainstream to other types of placement, and this has implications for health-economic cost-utility assessments of cochlear implantation that favor mainstream education by drawing upon the relative cost of different placement types. These findings suggest that the ADPS program of research can contribute school outcome data as valuable real-life outcome measures in wider assessments of the benefit of cochlear implants to deaf children and deaf young people.

82 An investigation of weak syllable processing in deaf children with cochlear implants; Titterington Jill; Henry Alison; Kroamer Martin; Toner Joe G; Stevenson Mike; (2006); Clin Linguist Phon 20(4): 249-69

In this study the influence of prosodic foot structure on the processing of weak syllables in children with cochlear implants (CI) was investigated. A battery of tests investigating processing of weak syllables in single and multiword utterances was carried out on four groups of children: 15 children with CI developing spoken language as expected (Main CI); five children with CI reported to have additional speech and language problems; 15 age matched; and 15 language matched (LM) children with normal hearing (NH). Children in the main CI and, to a lesser extent, the LM groups processed footed weak

syllables preferably over unfooted weak syllables (particularly as memory load increased). Thus, these children with CI appear to possess a similar Prosodic Hierarchy (PH) to their LM peers with NH, and possibly due to the impact of delayed and constrained exposure to audition on the development of linguistic processing and short-term memory, are influenced by its foot structure in the processing of weak syllables.

83 Indications for fitting hearing aids and for cochlear implantation in children; Vantrappen G.; Wouters J.; Desloovere C.; (2006); Tijdschrift voor Geneeskunde 62(3): 235-239

Last years, a geat deal of research has been executed to optimise the effects of hearing aids in children because it is known that serious hearing loss at a young age exerts a negative effect on speech-language development, general development as well as on psychosocial well-being. The electrode of a cochlear implant, which has been surgically inserted in the cochlea, stimulates the functional auditory neurons in a direct way. Several audiometrical, medical and psychosocial criteria must be fulfilled to consider a cochlear implantation. The duration of the deafness and the age at the moment of implantation are the most important variables for the success of a cochlear implant. Until now, no tests are available to predict the outcome after cochlear implantation. The last few years, a worldwide discussion exists on the advantage of bilateral cochlear implantation. In Belgium, a governmental project is ongoing in the different clinical research centres to evaluate the effect of bilateral implantation. Results and recommendations may be expected within 5 years.

84 Good speech recognition and quality-of-life scores after cochlear implantation in patients with DFNA9; Vermeire K.; Brokx J.P.L.; Wuyts F.L.; Cochet E.; Hofkens A.; De Bodt M.; Van de Heyning P.H.; (2006); Otol Neurotol 27(1): 44-9

OBJECTIVE: To compare audiometric and quality-of-life results in DFNA 9 patients who received a cochlear implant with cochlear implant patients with adult-onset progressive sensorineural hearing loss.
STUDY DESIGN: Prospective comparative design; results were collected cross-sectionally.
SETTING: Tertiary referral center.
PATIENTS: Eleven DFNA 9 patients were included in the study as well as a comparative group of 39 post-lingually deafened cochlear implant subjects with adult-onset progressive sensorineural hearing loss.
INTERVENTIONS: All patients received a cochlear implant. Subjects were implanted with either the Nucleus 24 M/RCS or Med-el Combi 40+ cochlear implant systems implementing the SPEAK, ACE, or CIS+ coding strategies.
MEAN OUTCOME MEASURES: Speech recognition was determined by means of phonetically balanced monosyllabic word lists. The Hearing Handicap Inventory for Adults, the Glasgow Benefit Inventory, and the Scale for the

Prediction of Hearing Disability in Sensorineural Hearing Loss were used to quantify the quality of life.
RESULTS: The results show that the speech perception and the quality of life of the DFNA 9 patients do not differ significantly from the control group (p=0.179; p=0.56).
CONCLUSION: In spite of the fact that DFNA 9 is a disease that is known to involve cochlear dendrites, cochlear implantation is a good option for treatment of deafness in DFNA 9.

85 Axon guidance cues in auditory development; Webber, Audra; Raz, Yael; (2006); Anat Rec A Discov Mol Cell Evol Biol 288(4): 390-6

The innervation of the cochlear sensory epithelium is intricately organized, allowing the tonotopy established by the auditory hair cells to be maintained along the ascending auditory pathways. These auditory projections are patterned by several gene families that regulate neurite attraction and repulsion, known as axon guidance cues. In this review, the roles of various axon guidance molecules, including fibroblast growth factor, ephs, semaphorins, netrins and slits, are examined in light of their known contribution to auditory development. Additionally, morphogens are discussed in the context of their recently described influence on axonal pathfinding in other sensory systems. The elucidation of these various mechanisms may guide the development of therapies aimed at maximizing the connectivity of auditory neurons in the context of congenital or acquired sensorineural hearing loss, especially as pertains to cochlear implants. Further afield, improved understanding of the molecular processes which regulate innervation of the organ of Corti during normal development may prove useful in connecting regenerated hair cells to the central nervous system. Anat Rec Part A, 2006. (c) 2006 Wiley-Liss, Inc.

86 GJB2 mutations and additional disabilities in a pediatric cochlear implant population; Wiley S.; Choo D.; Meinzen-Derr J.; Hilbert L.; Greinwald J.; (2006); Int J Pediatr Otorhinolaryngol 70(3): 493-500

BACKGROUND: Children with severe to profound sensorineural hearing loss due to GJB2 mutations have often been deemed good cochlear implant candidates. Studies on children with GJB2 mutations and cochlear implants have typically excluded children with additional disabilities.
OBJECTIVE: To investigate the presence of additional disabilities among children with and without GJB2 mutations in a cochlear implant population.
METHODS: A retrospective chart review was performed of children with non-syndromic sensorineural hearing loss (SNHL) who received a cochlear implant between 1993 and 2004.
RESULTS: Among 108 children within the cochlear implant database; 46 patients met the inclusion criteria of idiopathic non-syndromic hearing loss. Sixteen children had GJB2 mutations, 12 were GJB2 negative, and 17 did not receive GJB2 testing but had no other identifiable etiology or risk factor contributing to

hearing loss. The proportion of children with additional disabilities that would affect either pre-operative assessments or post-operative results in the GJB2 positive group was 44% compared to 33% of children in the GJB2 negative. Additional disabilities were present in 41% of the children who did not receive GJB2 testing. The disabilities in the GJB2 positive group included specific learning disability, apraxia, epileptiform aphasia, attention deficit disorder, global developmental delay, and gross motor delay. The GJB2 negative and those children not receiving GJB2 testing had motor delays, language delay, autism, specific learning disability, and attention deficit disorder. The proportion of children with at least 6 months CI use who relied on oral communication was 62% in the GJB2 positive group, 66% in the GJB2 negative group, and 38% in the untested group. A majority of the genetic alleles were 35delG (81%) and 10 of 16 (63%) patients with GJB2 mutations were homozygous 35delG. The rate of developmental diagnoses was similar in patients with homozygous GJB2 compared to compound heterozygous genotypes.
CONCLUSIONS: The presence of biallelic GJB2 mutations does not rule out non-hearing related disorders that can have an effect on speech, language and learning. Forty-four percent of children with GJB2 mutations had other conditions that could directly affect pre-implant evaluation and post-implant performance. This rate is similar to the reported prevalence among the overall population of children with hearing loss. All children should have a comprehensive evaluation of development and behavior regardless of the etiology of hearing loss.

87 Bacterial meningitis among cochlear implant recipients--Canada, 2002; Wilson-Clark Samantha D.; Squires S; Deeks S.; Centers for Disease Control and Prevention (CDC); (2006); MMWR Morb Mortal Wkly Rep 55(1): 20-4

INTRODUCTION: In July 2002, a cluster of bacterial meningitis (BM) cases was identified among European cochlear implant recipients (CIRs), prompting Health Canada to conduct a retrospective cohort study to determine the rate of BM infection among Canadian CIRs and to identify risk factors for acquiring BM.
METHODS: A survey was mailed to 1,432 Canadian CIRs who had received implants during January 1995-July 2002 to assess occurrence of postimplant BM infection. Data collection included demographics, episodes of meningitis, and vaccination status.
RESULTS: A total of 1,024 (72%) surveys were completed. Median age of CIRs at implantation was 16 years (range: 7 months-81 years). Five (0.5%) cases of BM infection were reported (two pneumococcal, one meningococcal, and two of unknown etiology); one CIR died. Four cases occurred among children aged <18 years. Time between implantation and BM infection varied (range: 7 months-7.7 years; median: 11 months). The rate of BM infection per 1,000 person-years was 0.7 among CIRs aged > or =18 years and 2.9 among those aged <18 years. The proportion of CIRs vaccinated against pneumococcal and meningococcal disease was low (46% and 41%, respectively). Preimplant meningitis was identified as a risk factor for postimplant BM (p = 0.002). No other risk factors

evaluated were associated with an increased risk for BM infection.
CONCLUSION: CIRs have a high rate of postimplant BM infection. Preimplant BM infection was identified as a risk factor. Cases of BM infection might have been prevented through vaccination.

88 Study of polycrystalline diamond piezoresistive position sensors for application in cochlear implant probe; Yuxing Tang; Aslam, D.M.; Jianbai Wang; Wise, K.D.; (2006); Diamond and Related Materials 15(2-3): 199-202

Polycrystalline diamond (poly-C) piezoresistive sensors, with high sensitivity, were fabricated and tested for the purpose of integration with Si-based microsystems. The dependence of piezoresistive gauge factor (GF), from 6 to 70, of poly-C films on film resistivities and grain sizes was investigated in detail. Two seeding methods, with high (10/sup 10/ cm/sup -2/) and low (10/sup 8/ cm/sup -2/) seeding density, were used to grow poly-C films with small (0.3 mu m) and large (0.8 mu m) grains, respectively, on 4 inch oxidized Si wafers. Results show that higher resistivities and larger grain sizes yield higher GF. Poly-C piezoresistive position sensors, with a tested GF of 28 and potential GF of 70, were fabricated and integrated into a Si-based cochlear implant probe for the first time. All rights reserved Elsevier.

89 Speech perception in individuals with auditory neuropathy; Zeng Fan-Gang; Liu Sheng; (2006); 49(2): 367-80

PURPOSE: Speech perception in participants with auditory neuropathy (AN) was systematically studied to answer the following 2 questions: Does noise present a particular problem for people with AN? Can clear speech and cochlear implants alleviate this problem?
METHOD: The researchers evaluated the advantage in intelligibility of clear speech over conversational speech in 13 participants with AN. Of these participants, 7 had received a cochlear implant. Eight sentence-recognition experiments were conducted to examine the clear speech advantage in 2 listening conditions (quiet and noise) using 4 stimulation modes (monaural acoustic, diotic acoustic, monaural electric, and binaurally combined acoustic and electric stimulation).
RESULTS: Participants with AN performed more poorly in speech recognition in noise than did the normal-hearing, cochlear-impaired, and cochlear implant controls. A significant clear speech advantage was observed, ranging from 9 to 23 percentage points in intelligibility for all listening conditions and stimulation modes. Electric stimulation via a cochlear implant produced significantly higher intelligibility than acoustic stimulation in both quiet and in noise. Binaural hearing with either diotic acoustic stimulation or combined acoustic and electric stimulation produced significantly higher intelligibility than monaural stimulation in quiet but not in noise.
CONCLUSIONS: Participants with AN most likely derive the clear speech advantage from enhanced temporal properties in clear speech and improved neural synchrony with electric stimulation. Although the present result supports

cochlear implantation as one treatment choice for people with AN, it suggests that the use of innovative hearing aids may be another viable option to improve speech perception in noise.