Quarterly Abstract Update

July – September 2007

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11 Bodmer D.; Shipp D. B.; Ostroff J. M.; Ng A. H.; Stewart S.; Chen J. M.; & Nedzelski J. M.; (2007); "A comparison of postcochlear implantation speech scores in an adult population"; Laryngoscope. 117(8):1408-1411 11

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13 Caner G.; Olgun L.; Gultekin G.; & Balaban M.; (2007); "Optimizing fitting in children using objective measures such as neural response imaging and electrically evoked stapedius reflex threshold"; Otol Neurotol. 28(5):637-640 12

14 Carroll J. & Zeng F. G.; (2007); "Fundamental frequency discrimination and speech perception in noise in cochlear implant simulations"; Hear Res. 231(1-2):42-53 13

15 Cervera-Paz F. J. & Manrique M. J.; (2007); "Auditory brainstem implants: Past, present and future prospects"; Acta Neurochir.Suppl. 97(Pt 2):437-442 13

16 Ching T. Y. C.; van Wanrooy E.; & Dillon H.; (2007); "Binaural-bimodal fitting or bilateral implantation for managing severe to profound deafness: A review"; Trends in Amplification. 11(3):161-192 14

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1. **"Cochlear implant fixation in children using periosteal sutures".** Adunka, O. F. & Buchman, C. A.; (2007); Otol Neurotol. 28(6):768-770

Objective: To describe a simple technique for implant receiver/stimulator (ICS) fixation that uses a seat for the device and suture fixation through the native cranial periosteum. This technique has been used through minimal-access surgical techniques in children since 2003. Patients: One hundred & sixty pediatric cochlear implant recipients. Intervention: Implantation using the described technique for ICS fixation. Main Outcome Measure: Postoperative complications related to ICS fixation. Results: No complications have been observed. Conclusion: This report describes a simple and effective technique to secure the ICS package for pediatric cochlear implant surgery.

2. **"Value of computed tomography in the evaluation of children with cochlear nerve deficiency".** Adunka, O. F.; Jewells, V.; Buchman, C. A.; (2007); Otol Neurotol. 28(5):597-604

Objective: To assess the predictive value of high-resolution computed tomography (HRCT) in the evaluation of children with cochlear nerve deficiency (CND). Study Design: Retrospective review of medical records. Setting: Tertiary referral center, hospital setting. Patients: Nineteen children (31 ears) with CND. Interventions: Magnetic resonance imaging (MRI), HRCT, and audiologic evaluation. Main Outcome Measures: Comparisons of the morphology of the internal auditory canal (IAC), the bony cochlear nerve canal (BCNC) as seen on HRCT, and audiologic data. Results: Of 12 ears with MRI evidence of an absent cochlear nerve (CN) and a normal-size IAC, all had a patent BCNC as revealed by HRCT. Four of these ears failed auditory stimulation after cochlear implantation, confirming clinically significant CND. Of 15 ears with a narrow IAC and a single nerve visible on MRI, 2 (13.3%) had a normal-size BCNC, 4 (26.7%) were narrow, and 9 (60.0%) were absent. One ear with a narrow IAC, normal BCNC, and a single nerve as revealed by MRI has benefited from cochlear implantation. Conclusion: Using BCNC patency, as revealed by HRCT, as a means of identifying CND would miss all cases of absent CNs in the setting of a normal-size IAC. Thus, MRI should be the primary modality for imaging children with severe to profound sensorineural hearing loss. When MRI demonstrates a single nerve within a narrow IAC, the addition of HRCT can further identify more than half of these cases as involving absent CNs because of an absent BCNC. In a subset of patients, CN status remains indeterminate.

3. **"The relationship of hearing loss sensitivity to demographic, age and intervention strategies in children".** Ali, L.; (2007); Pakistan.Paediatric Journal. 31(2):80-84

Objective: To demonstrate how hearing loss sensitivity and variables of demographic, age and treatment strategies are related in children. Design: Descriptive study from Jan 2005 to Dec 2005. Setting: Department of Paediatric Audiology, The Children's Hospital and the Institute of Child Health Lahore.

Material and Methods: A total 5120 children were assessed for hearing in the age range of 0-18 years from all over the country during a period of one year and different variables were documented for analysis. Results: Among the total children, 2917 (56.97%) were males and 2203 (43.03%) were females. 2023 (39.51%) were in the age range of 0-2 years, 1717 (33.54%) in 2-5 years, 1319 (25.76%) in 5-14 years and 61 (1.10%) above 14 years. 1966 (38.40%) had normal hearing, 932 (18.20%) had mild, 615 (12.01%) had severe, 1554 (30.35%) profound and 53 (1.04%) had anacusis. Among 3154 hearing impaired children, 1713 (54.31%) had sensorineural, 1128 (35.77%) mixed and 313 (9.92%) conductive hearing loss. 2481 (78.66%) were recommended for hearing aids fitting, 620 (19.66%) referred for medical / surgical intervention and 53 (1.68) suggested cochlear implant surgery. 5053 (98.69%) were from Punjab, 33 (0.65%) from NWFP, 8 (. 16%) from Baluchistan, 6 (0.12%) from Sindh and 20 (0.387%) from Azad Kashmir. Conclusion: Majority of children from Lahore division within age of 0-2 years having profound degree sensorineural hearing loss, recommended for hearing aids, were identified as hearing impaired.

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

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

5. **"Mini-incision for pediatric cochlear implantation with a MED-EL device".** Bayazit, Y. A.; Goksu, N.; Ozbilen, S.; (2007); ORL J Otorhinolaryngol Relat Spec. 69(5):311-315

Objective: Minimal invasive approaches have been described for cochlear implantation. However, the number of reports about minimal invasive approaches for MED-EL devices is sparse. In this technical note, we describe our pediatric cochlear implantation and incision techniques for MED-EL devices. Methods: Among 92 cochlear implantations performed between November 2002 and November 2006, there were 32 consecutive pediatric cochlear implantations with MED-EL devices which were performed between July 2005 and October 2006. In our technique, standard posterior tympanotomy and cochleostomy were

performed after 4- to 5-cm mini-incisions in the postauricular region. However, suture fixations were not used for the implant receiver nor its electrode. Results: There were 14 girls and 18 boys with a mean age of 3.9 years. The mean follow-up duration was 5.8 months. No flap necrosis, hematoma or infection, nor implant migration, extrusion or breakdown were encountered. Revision surgery was performed in 3 patients due to cochlear ossification, perilymph leakage and extracochlear implantation. Conclusion: MED-EL implantation can be performed using small incisions without suture fixation of the receiver and its electrode.

6. **"Sound localization ability of young children with bilateral cochlear implants".** Beijen, J. W.; Snik, A. F.; Mylanus, E. A.; (2007); Otol Neurotol. 28(4):479-485

Objective: To evaluate the benefit of bilateral cochlear implantation in young children. Study Design: Clinical trial comparing a group of bilaterally implanted children with a group of unilaterally implanted children. Setting: Tertiary referral center. Patients: Five bilaterally implanted children (mean age at testing, 3 yr 7 mo) were compared with 5 unilaterally implanted children (mean age at testing, 5 yr 3 mo). Meningitis was the cause of deafness in all of the children. Methods: Children were asked to localize a prerecorded melody band limited from 500 to 4,000 Hz presented from loudspeakers placed at either -90 or 90 degrees or -30 or 30 degrees azimuth. Their parents filled in the Speech, Spatial and Qualities of Hearing Scale (SSQ) and PedsQL questionnaires on hearing and health-related quality of life of their children. Results: The bilaterally implanted children had significantly better scores on the localization test than the children with unilateral cochlear implants. The scores of the children with bilateral cochlear implants were also significantly higher on the spatial domain of the SSQ, which concerns localization. No significant differences were found in the speech and quality of hearing domains and the total scores on the SSQ or the PedsQL between the two groups. Conclusion: Children with bilateral cochlear implantation already demonstrate an advantage over unilaterally implanted children at a young age.

7. **"Companding to improve cochlear-implant speech recognition in speech-shaped noise".** Bhattacharya, A. & Zeng, F. G.; (2007); J Acoust Soc Am. 122(2):1079-1089

Nonlinear sensory and neural processing mechanisms have been exploited to enhance spectral contrast for improvement of speech understanding in noise. The "companding" algorithm employs both two-tone suppression and adaptive gain mechanisms to achieve spectral enhancement. This study implemented a 50-channel companding strategy and evaluated its efficiency as a front-end noise suppression technique in cochlear implants. The key parameters were identified and evaluated to optimize the companding performance. Both normal-hearing (NH) listeners and cochlear-implant (CI) users performed phoneme and sentence recognition tests in quiet and in steady-state speech-shaped noise. Data from the NH listeners showed that for noise conditions, the implemented strategy improved

vowel perception but not consonant and sentence perception. However, the CI users showed significant improvements in both phoneme and sentence perception in noise. Maximum average improvement for vowel recognition was 21.3 percentage points ($p<0.05$) at 0 dB signal-to-noise ratio (SNR), followed by 17.7 percentage points ($p<0.05$) at 5 dB SNR for sentence recognition and 12.1 percentage points ($p<0.05$) at 5 dB SNR for consonant recognition. While the observed results could be attributed to the enhanced spectral contrast, it is likely that the corresponding temporal changes caused by companding also played a significant role and should be addressed by future studies.

8. **"[Neuroradiological imaging in patients with sensorineural hearing loss prior to cochlear implantation]".** Biller, A.; Bartsch, A.; Knaus, C.; Muller, J.; Solymosi, L.; Bendszus, M.; (2007); Rofo. 179(9):901-913

Cochlear implantation (CI) is an established technique for enabling speech perception in patients suffering from severe bilateral sensorineural hearing loss (SNHL). Thorough preoperative radiological assessment is essential for correctly evaluating the indication for surgery and safely performing cochlear implantation. CT and conventional and functional MRI are available for radiological assessment. Therefore, knowledge of the most frequent congenital syndromal, non-syndromal, and acquired malformations of inner ear structures is fundamental. This article provides information about imaging techniques prior to CI and relevant malformations of the inner ear. Safety aspects for patients with a cochlear implant undergoing MR imaging are also discussed.

9. **"Sound-processing strategy for cochlear implants".** Blamey, P. J.; (2007); J Acoust Soc Am. 122(1):29

Abstract unavailable.

10. **"Neural and behavioral sensitivity to interaural time differences using amplitude modulated tones with mismatched carrier frequencies".** Blanks, D. A.; Roberts, J. M.; Buss, E.; Hall, J. W.; Fitzpatrick, D. C.; (2007); J Assoc Res Otolaryngol. 8(3):393-408

Bilateral cochlear implantation is intended to provide the advantages of binaural hearing, including sound localization and better speech recognition in noise. In most modern implants, temporal information is carried by the envelope of pulsatile stimulation, and thresholds to interaural time differences (ITDs) are generally high compared to those obtained in normal hearing observers. One factor thought to influence ITD sensitivity is the overlap of neural populations stimulated on each side. The present study investigated the effects of acoustically stimulating bilaterally mismatched neural populations in two related paradigms: rabbit neural recordings and human psychophysical testing. The neural coding of interaural envelope timing information was measured in recordings from neurons in the

inferior colliculus of the unanesthetized rabbit. Binaural beat stimuli with a 1-Hz difference in modulation frequency were presented at the best modulation frequency and intensity as the carrier frequencies at each ear were varied. Some neurons encoded envelope ITDs with carrier frequency mismatches as great as several octaves. The synchronization strength was typically nonmonotonically related to intensity. Psychophysical data showed that human listeners could also make use of binaural envelope cues for carrier mismatches of up to 2-3 octaves. Thus, the physiological and psychophysical data were broadly consistent, and suggest that bilateral cochlear implants should provide information sufficient to detect envelope ITDs even in the face of bilateral mismatch in the neural populations responding to stimulation. However, the strongly nonmonotonic synchronization to envelope ITDs suggests that the limited dynamic range with electrical stimulation may be an important consideration for ITD encoding.

11. **"A comparison of postcochlear implantation speech scores in an adult population".** Bodmer, D.; Shipp, D. B.; Ostroff, J. M.; Ng, A. H.; Stewart, S.; Chen, J. M.; Nedzelski, J. M.; (2007); Laryngoscope. 117(8):1408-1411

Objective: The vast majority of cochlear implant recipients realize significant improvement in speech perception. However, there continue to be a small group that does not realize such a benefit. In an effort to identify possible predictors for this, we have compared pre- and post-implant audiologic data using Hearing In Noise Test (HINT), City University of New York (CUNY), or Central Institute for the Deaf (CID) scores for 445 consecutive English-speaking adult patients followed for a minimum of 1 year post-implantation in two distinct groups, poor versus excellent performers. Study Design: Retrospective. Methods: Poor performers were those who realized a worsening, no improvement, or an improvement of less than 10%. This group numbered 58 (13%). High performers consisted of a cadre of 194 (44%) patients who scored between 91 and 100% post-implantation. Demographic data relating to onset of deafness, education exposure, etiology, etc., were evaluated. Results: Of the poor performers, 33 (57%) were pre-/ peri-lingually deafened. Of these, 79% had not received any auditory/oral training in childhood. On the other hand, a total of 109 implant recipients were individuals who were pre-/peri-lingually deafened. Of these, 24 were in the excellent performer category. All were identified early and were recipients of a strong auditory/oral education. Of the high performers, 170 (88%) were deafened late. Other findings such as pre-operative electronystagmography with caloric testing, hearing aid use, device type, and high-resolution computed tomography scan of the temporal bone will be discussed for both groups. Conclusions: A high pre-implant speech score, auditory verbal therapy, and post-lingual deafness statistically correlate with higher post-implant speech scores 1 year after cochlear implantation. Device type, caloric response and hearing aid use pre-implantation, age at surgery, and sex do not statistically correlate with either poor or excellent speech discrimination scores post-cochlear implantation.

12. **"[Auditory brainstem implant: indications and results]".** Bouccara, D.; Kalamarides, M.; Bozorg Grayeli, A.; Ambert-Dahan, E.; Rey, A.; Sterkers, O.; (2007); Ann Otolaryngol Chir Cervicofac. 124(3):148-154

Objectives: To summarize the indications and evaluate the Auditory Brainstem Implant (ABI) performances in neurofibromatosis type 2 (NF2) and other otologics indications, as post-meningitis ossified cochlea. Material and Methods: Main and first indication of ABI is NF2. Emergent indications are bilateral total ossified cochlea, vestibular schwannoma with controlateral lesions, cochlear nerve aplasia or inner ear's malformations. The pre-operative evaluation includes clinical, radiological, lipreading, and psychological status. A translabyrinthine or retrosigmoid approach is performed, depending on tumoral or not tumoral status. The auditory perception with the ABI is evaluated by testing, the words recognition in open-set lists, and the speech understanding with usual sentences. Results: In NF2 patients, best results are obtained in cases of smaller vestibular schwannoma and none, or short term, auditory deprivation. Negative prognostic factors are duration of total hearing loss (>10 years), tumor size (>30 mm), difficulties in electrode array placement, complications during post-operative course and number of active electrodes (<10). In cases of post-meningitis total deafness with totally ossified cochlea, results demonstrate a good benefit reaching these obtained with cochlear implant in post-meningitis deafness. Conclusion: These results show a clear benefit of ABI in NF2 patients, with or without previous tumor removal, in case of small tumor with a short duration of hearing loss. In case of post-meningitis ossified cochlea, results potentially reach those of cochlear implants.

13. **"Optimizing fitting in children using objective measures such as neural response imaging and electrically evoked stapedius reflex threshold".** Caner, G.; Olgun, L.; Gultekin, G.; Balaban, M.; (2007); Otol Neurotol. 28(5):637-640

Objective: To study over time correlations between Compound Action Potential measured through Neural Response Imaging (NRI) and electrically Evoked Stapedius Reflex Thresholds (eSRT) and psychophysical measurements to develop guidelines for using those objective measures to optimize HiRes programs in patients implanted with Advanced Bionics CII-Bionic Ear or a HiRes90K cochlear implants. Patients: Fifteen pediatric subjects, all implanted with a CII-Bionic Ear or a HiRes90K. Interventions: NRI was measured on 4 electrodes intra-operatively at first fitting and after 3, 6, and 12 months of use. eSRT recordings were performed intra-operatively with SoundWave speech bursts. Subjects were fitted using the SoundWave defaults. Relationships between NRI thresholds (tNRI), eSRT, and most comfortable levels (M) are presented. Main Outcome Measures: Intra-operative eSRT, and intra-operative and postoperative tNRI at each fitting session. Auditory performance measured by Categories of Auditory Performance and Meaningful Auditory Integration Scale. Results: First fitting Ms are 97% of intra-operative tNRI; stable Ms (12 months of implant use) are equal to 115% of 12 months' tNRI and to 76% of intra-operative

eSRT on average across the electrode array with great inter-subject variability. Conclusion: The results show that single-channel tNRI and eSRT values can be clinically useful for programming cochlear implants in children, although this should be done with caution as there is considerable inter-patient variability.

14. **"Fundamental frequency discrimination and speech perception in noise in cochlear implant simulations".** Carroll, J. & Zeng, F. G.; (2007); Hear Res. 231(1-2):42-53

Increasing the number of channels at low frequencies improves discrimination of fundamental frequency (F0) in cochlear implants (Geurts, L., Wouters, J., 2004. Better place-coding of the fundamental frequency in cochlear implants. J. Acoust. Soc. Am. 115 (2), 844-852). We conducted three experiments to test whether improved F0 discrimination can be translated into increased speech intelligibility in noise in a cochlear implant simulation. The first experiment measured F0 discrimination and speech intelligibility in quiet as a function of channel density over different frequency regions. The results from this experiment showed a tradeoff in performance between F0 discrimination and speech intelligibility with a limited number of channels. The second experiment tested whether improved F0 discrimination and optimizing this tradeoff could improve speech performance with a competing talker. However, improved F0 discrimination did not improve speech intelligibility in noise. The third experiment identified the critical number of channels needed at low frequencies to improve speech intelligibility in noise. The result showed that, while 16 channels below 500Hz were needed to observe any improvement in speech intelligibility in noise, even 32 channels did not achieve normal performance. Theoretically, these results suggest that without accurate spectral coding, F0 discrimination and speech perception in noise are two independent processes. Practically, the present results illustrate the need to increase the number of independent channels in cochlear implants.

15. **"Auditory brainstem implants: Past, present and future prospects".** Cervera-Paz, F. J. & Manrique, M. J.; (2007); Acta Neurochir.Suppl. 97(Pt 2):437-442

The purpose of the auditory brainstem implant (ABI) is to directly stimulate the cochlear nucleus complex and offer restoration of hearing in patients suffering from profound retrocochlear sensorineural hearing loss. Electrical stimulation of the auditory pathway via an ABI has been proven to be a safe and effective procedure. The function of current ABIs is similar to that of cochlear implants in terms of device hardware with the exception of the electrode array and the sound-signal processing mechanism. The main limitation of ABI is that electrical stimulation is performed on the surface of the cochlear nuclei, thereby making impractical the selective activation of deeper layers by corresponding optimal frequencies. In this article, we review the anatomical, and experimental basis of ABIs and the indications, and surgical technique for their implantation. To the best

of our knowledge, we describe the first pathology images of the cochlear nucleus in a patient who had received an ABI.

16. **"Binaural-bimodal fitting or bilateral implantation for managing severe to profound deafness: A review".** Ching, T. Y. C.; van Wanrooy, E.; Dillon, H.; (2007); Trends in Amplification. 11(3):161-192

There are now many recipients of unilateral cochlear implants who have usable residual hearing in the non-implanted ear. To avoid auditory deprivation and to provide binaural hearing, a hearing aid or a second cochlear implant can be fitted to that ear. This article addresses the question of whether better binaural hearing can be achieved with binaural/bimodal fitting (combining a cochlear implant and a hearing aid in opposite ears) or bilateral implantation. In the first part of this article, the rationale for providing binaural hearing is examined. In the second part, the literature on the relative efficacy of binaural/bimodal fitting and bilateral implantation is reviewed. Most studies on comparing either mode of bilateral stimulation with unilateral implantation reported some binaural benefits in some test conditions on average but revealed that some individuals benefited, whereas others did not. There were no controlled comparisons between binaural/bimodal fitting and bilateral implantation and no evidence to support the efficacy of one mode over the other. In the third part of the article, a crossover trial of two adults who had binaural/bimodal fitting and who subsequently received a second implant is reported. The findings at 6 and 12 months after they received their second implant indicated that binaural function developed over time, and the extent of benefit depended on which abilities were assessed for the individual. In the fourth and final parts of the article, clinical issues relating to candidacy for binaural/ bimodal fitting and strategies for bimodal fitting are discussed with implications for future research.

17. **"Molecular study in Brazilian cochlear implant recipients".** Christiani, T. V.; Alexandrino, F.; de Oliveira, C. A.; Amantini, R. C.; Bevilacqua, M. C.; Filho, O. A.; Porto, P.; Sartorato, E. L.; (2007); Am J Med Genet A. 143(14):1580-1582

The most common form of non-syndromic autosomal recessive deafness (NSRD) is caused by mutations in the GJB2 gene. Recently, a deletion truncating the GJB6 gene, called del(GJB6-D13S1,830) has also been described normally accompanying mutations in another allele of the GJB2 gene. Among all the mutations described to date, 35delG in the GJB2 gene is the most common. Preliminary data suggest that pathologic changes due to GJB2 mutations do not affect the spiral ganglion cells, which are the site of stimulation of the cochlear implant. Besides, the survival of the spiral ganglion cells is believed to be an important determinant of the outcome after surgery. Therefore, we have studied 49 non-syndromic deaf patients with unknown etiologies in order to determine the prevalence of GJB2 and GJB6 gene mutations in patients undergoing cochlear implantation surgery. Also, the molecular studies were performed using polymerase chain reaction amplification and direct sequencing. As a result, we

found 19 individuals with GJB2 mutation including one new mutation (K168R), one patient homozygous for the del(GJB6-D13S1,830). These results establish that genetic screening can provide an etiologic diagnosis, and may help with prognosis after cochlear implantation, as has been hypothesized in previous studies.

18. **"The potential of stem cells for auditory neuron generation and replacement".** Coleman, B.; de Silva, M. G.; Shepherd, R. K.; (2007); Stem Cells. 25:2685 -2694

Sensory hair cells in the mammalian cochlea are sensitive to many insults including loud noise, ototoxic drugs and ageing. Damage to these hair cells results in deafness and sets in place a number of irreversible changes which eventually result in the progressive degeneration of auditory neurons, the target cells of the cochlear implant. Techniques designed to preserve the density and integrity of auditory neurons in the deafened cochlea are envisaged to provide improved outcomes for cochlear implant recipients. This review examines the potential of embryonic stem cells to generate new neurons for the deafened mammalian cochlea, including the directed differentiation of stem cells toward a sensory neural lineage and the engraftment of exogenous stem cells into the deafened auditory system. Although still in its infancy, the aim of this therapy is to restore a critical number of auditory neurons, thereby improving the benefits derived from a cochlear implant.

19. **"Beneficial auditory and cognitive effects of auditory brainstem implantation in children".** Colletti, L.; (2007); Acta Otolaryngol. 127(9):943-946

Conclusion: This preliminary study demonstrates the development of hearing ability and shows that there is a significant improvement in some cognitive parameters related to selective visual/spatial attention and to fluid or multisensory reasoning, in children fitted with auditory brainstem implantation (ABI). The improvement in cognitive paramenters is due to several factors, among which there is certainly, as demonstrated in the literature on a cochlear implants (CIs), the activation of the auditory sensory canal, which was previously absent. The findings of the present study indicate that children with cochlear or cochlear nerve abnormalities with associated cognitive deficits should not be excluded from ABI implantation. Objectives: The indications for ABI have been extended over the last 10 years to adults with non-tumoral (NT) cochlear or cochlear nerve abnormalities that cannot benefit from CI. We demonstrated that the ABI with surface electrodes may provide sufficient stimulation of the central auditory system in adults for open set speech recognition. These favourable results motivated us to extend ABI indications to children with profound hearing loss who were not candidates for a CI. This study investigated the performances of young deaf children undergoing ABI, in terms of their auditory perceptual development and their non-verbal cognitive abilities. Patients and Methods: In our department from 2000 to 2006, 24 children aged 14 months to 16 years received an ABI for different tumour and non-tumour diseases. Two children had NF2 tumours. Eighteen children had bilateral

cochlear nerve aplasia. In this group, nine children had associated cochlear malformations, two had unilateral facial nerve agenesia and two had combined microtia, aural atresia and middle ear malformations. Four of these children had previously been fitted elsewhere with a CI with no auditory results. One child had bilateral incomplete cochlear partition (type II); one child, who had previously been fitted unsuccessfully elsewhere with a CI, had auditory neuropathy; one child showed total cochlear ossification bilaterally due to meningitis; and one child had profound hearing loss with cochlear fractures after a head injury. Twelve of these children had multiple associated psychomotor handicaps. The retrosigmoid approach was used in all children. Intraoperative electrical auditory brainstem responses (EABRs) and postoperative EABRs and electrical middle latency responses (EMLRs) were performed. Perceptual auditory abilities were evaluated with the Evaluation of Auditory Responses to Speech (EARS) battery - the Listening Progress Profile (LIP), the Meaningful Auditory Integration Scale (MAIS), the Meaningful Use of Speech Scale (MUSS) - and the Category of Auditory Performance (CAP). Cognitive evaluation was performed on seven children using the Leiter International Performance Scale - Revised (LIPS-R) test with the following subtests: Figure ground, Form completion, Sequential order and Repeated pattern. Results: No postoperative complications were observed. All children consistently used their devices for >75% of waking hours and had environmental sound awareness and utterance of words and simple sentences. Their CAP scores ranged from 1 to 7 (average =4); with MAIS they scored 2-97.5% (average =38%); MUSS scores ranged from 5 to 100% (average =49%) and LIP scores from 5 to 100% (average =45%). Owing to associated disabilities, 12 children were given other therapies (e.g. physical therapy and counselling) in addition to speech and aural rehabilitation therapy. Scores for two of the four subtests of LIPS-R in this study increased significantly during the first year of auditory brainstem implant use in all seven children selected for cognitive evaluation.

20. **"Identifying impaired cochlear implant channels via speech-token confusion matrix analysis".** Collins, L. M. & Remus, J. J.; (2007); ICASSP, IEEE International Conference on Acoustics., Speech and Signal Processing.- Proceedings. 4(IV741-IV744)

Cochlear implant patients exhibit a wide range of performance on speech recognition tasks. One potential explanation for such variability is the existence of psychophysically observed phenomena that might indicate the presence of anomalous percepts associated with certain electrical stimuli, which in turn could limit the transmission of important auditory cues. Exhaustive psychophysical testing to detect all such psychophysical anomalies is time prohibitive; however, the search for anomalous channels could be expedited with prior information identifying channels potentially containing an anomaly. This study proposes a method of analyzing confusion matrices from speech token recognition tasks with the intent of identifying impaired channels. Results using both normal-hearing subjects tested with impaired acoustic models and cochlear implant subjects

suggest that the proposed methods are providing information about the probability of impairment on each channel.

21. **"Contribution of implicit sequence learning to spoken language processing: Some preliminary findings with hearing adults".** Conway, C. M.; Karpicke, J.; Pisoni, D. B.; (2007); The Journal of Deaf Studies and Deaf Education. 12(3):317-334

Spoken language consists of a complex, sequentially arrayed signal that contains patterns that can be described in terms of statistical relations among language units. Previous research has suggested that a domain-general ability to learn structured sequential patterns may underlie language acquisition. To test this prediction, we examined the extent to which implicit sequence learning of probabilistically structured patterns in hearing adults is correlated with a spoken sentence perception task under degraded listening conditions. Performance on the sentence perception task was found to be correlated with implicit sequence learning, but only when the sequences were composed of stimuli that were easy to encode verbally. Implicit learning of phonological sequences thus appears to underlie spoken language processing and may indicate a hitherto unexplored cognitive factor that may account for the enormous variability in language outcomes in deaf children with cochlear implants. The present findings highlight the importance of investigating individual differences in specific cognitive abilities as a way to understand and explain language in deaf learners and, in particular, variability in language outcomes following cochlear implantation.

22. **"Cochlear reimplantation: Causes of failure, outcomes, and audiologic performance".** Cote, M.; Ferron, P.; Bergeron, F.; Bussieres, R.; (2007); Laryngoscope. 117(7):1225-1235

Objectives/Hypothesis: To review Quebec's experience with cochlear reimplantation in adults and children and describe failure rates, causes of revision, surgical findings, and the impact of reimplantation on audiologic performances. Study Design: Retrospective analysis of all 45 cochlear implant revision surgeries (43 reimplantations) performed on 16 adults and 25 children at the Centre Hospitalier Universitaire de Québec (Hôtel-Dieu de Québec) in Quebec City, between 1987 and 2005. Methods: Data on patient demographics, failure sources including review of manufacturer's investigation reports, surgical findings, and outcomes (electrode insertion, complications, and audiologic performances). Results: Mean length of device use before explantation was 5.5 years and ranged from 3 months to 17 years. Explantation was related to documented hard failure (53.3%), traumatic device failure (13.3%, only in children), extrusion of electrode array or scalp flap infection (13.3%), a decrease in performance or soft failure (11.1%), intratemporal pathology (6.7%), and a perilymphatic fistula (2.2%). Overall revision rates of 8.0% and 5.4% were obtained for children and adults, respectively. Total device failure rates of 6.2% in children and 3.3% in adults were calculated. Failure rates decreased with each new generation of Nucleus devices.

Perioperative complications were uncommon. A moderate amount of fibrosis was found in the cochlea lumen, and sometimes osteoneogenesis made the reinsertion challenging. Electrode reinsertion depth was mostly comparable with the initial surgery. Speech perception abilities were maintained after reimplantation. Conclusions: Management of implant failures, including revision surgeries, is becoming an increasingly important part of cochlear implant program activity. It appears more commonly in children because of trauma. Medical and audiologic outcomes are generally excellent. Revision implantation appears to be a safe and effective procedure.

23. **"Cochlear implantation in prelingually deaf persons with additional disability".** Daneshi, A. & Hassanzadeh, S.; (2007); J Laryngol Otol. 121(7):635-638

Objectives: We aimed to identify the frequency with which the following conditions were present as a second disability in cochlear-implanted, prelingually deaf persons: mild and moderate mental retardation; learning disability; attention deficit/hyperactivity disorder; cerebral palsy; congenital blindness; and autism. We also aimed to document the development of auditory perception in patients having one of these additional disabilities. Study Design: A retrospective study was designed to pursue the above aims. Methods: We examined the records of 398 cochlear-implanted, prelingually deaf patients who had received a cochlear implant at least one year previously. Patients were selected who showed a delay in motor, cognitive or emotional development. The selected cases were referred for psychological evaluation in order to identify patients with additional disabilities. We then compared these patients' auditory perception prior to and one year following cochlear implantation. Results: A total of 60 (15 per cent) cochlear-implanted, prelingually deaf patients were diagnosed with additional disabilities. These were classified as: mild mental retardation in eight cases (13.33 per cent); moderate mental retardation in five (8.33 per cent); learning disability in 20 (33.33 per cent); attention deficit/hyperactivity disorder in 15 (25 per cent); cerebral palsy in five (8.33); congenital blindness in three (5 per cent); and autism in four (6.66 per cent). All patients showed significant development in speech perception, except for autistic and congenitally deaf-blind patients. Conclusion: Although cochlear implantation is not contraindicated in prelingually deaf persons with additional disabilities, congenitally deaf-blind and autistic patients showed limited development in auditory perception as a main outcome of cochlear implantation. These patients require unique rehabilitation in order to achieve more auditory development.

24. **"Maternal contributions: Supporting language development in young children with cochlear implants".** DesJardin, J. L. & Eisenberg, L. S.; (2007); Ear Hear. 28(4):456-469

Objective: The principal goal of this study was to investigate the relationships between maternal contributions (e.g., involvement, self-efficacy, linguistic input)

and receptive and expressive (oral and sign) language skills in young children with cochlear implants. Design: Relationships between maternal contributions and children's language skills were investigated by using correlation and regression analyses. Thirty-two mothers (mean age = 36.0 yr) and their children (mean age = 4.8 yr) were videotaped during free play and storybook interactions. Mothers' and children's quantitative (MLU, number of word-types) and mothers' qualitative (facilitative language techniques) linguistic input were analyzed. Mothers completed a measurement tool specifically designed to quantify their sense of involvement and self-efficacy (Scale of Parental Involvement and Self-Efficacy). The Reynell Developmental Language Scales and data from videotaped transcription analyses were used to evaluate children's oral and sign language skills. Results: Maternal involvement and self-efficacy relating to children's speech-language development were positively related to mothers' quantitative and qualitative linguistic input. After controlling for child's age, mothers' MLU and two facilitative language techniques (recast and open-ended question) were positively related to children's language skills. Conclusions: The performance of young implant users may vary in part because of their mothers' sense of involvement and self-efficacy, as well as the ways in which mothers interact with their children. Given this information, it would be fruitful for professionals working with these families to incorporate goals that enhance caregivers' involvement, self-efficacy, and linguistic input to better support language development in young children after cochlear implantation.

25. **"Functional outcome of auditory implants in hearing loss".** Di Girolamo, S.; Saccoccio, A.; Giacomini, P. G.; Ottaviani, F.; (2007); Acta Neurochir.Suppl. 97(Pt 2):425-429

The auditory implant provides a new mechanism for hearing when a hearing aid is not enough. It is the only medical technology able to functionally restore a human sense i.e. hearing. The auditory implant is very different from a hearing aid. Hearing aids amplify sound. Auditory implants compensate for damaged or non-working parts of the inner ear because they can directly stimulate the acoustic nerve. There are two principal types of auditory implant: the cochlear implant and the auditory brainstem implant. They have common basic characteristics, but different applications. A cochlear implant attempts to replace a function lost by the cochlea, usually due to an absence of functioning hair cells; the auditory brainstem implant (ABI) is a modification of the cochlear implant, in which the electrode array is placed directly into the brain when the acoustic nerve is not anymore able to carry the auditory signal. Different types of deaf or severely hearing-impaired patients choose auditory implants. Both children and adults can be candidates for implants. The best age for implantation is still being debated, but most children who receive implants are between 2 and 6 years old. Earlier implantation seems to perform better thanks to neural plasticity. The decision to receive an implant should involve a discussion with many medical specialists and an experienced surgeon.

26. **"Residual hearing in cochlear implant patients".** Di Nardo, W.; Cantore, I.; Melillo, P.; Cianfrone, F.; Scorpecci, A.; Paludetti, G.; (2007); Eur Arch Otorhinolaryngol. 264(8):855-860

Preservation of residual hearing should be a desirable outcome of implant surgery. Prevention of neural degeneration due to loss of residual hair cells, together with the continuous progress in cochlear implant technology should be able to preserve cochlear integrity as well as possible. The degree of hearing preservation may vary depending on surgical approach, maximum insertion depth and other factors not uniformly considered to date. The aim of this retrospective case controlled study is to evaluate residual hearing after cochlear implant surgery. In particular, we analyzed data obtained with use of two different kinds of electrode arrays, with and without rigid introductor (stylet). We report the results on 37 patients with measurable preoperative hearing thresholds, mean age of 28 years (5-70 years), having the following implants: seven Advanced Bionics, four Med-El, 24 Cochlear, two MXM; 19 of them were performed using the stylet and the other 18 without it. A minimally invasive surgical approach was performed with a short retroauricular incision and a 1.2 mm cochleostomy. A complete electrode array insertion was obtained in all patients. Responses to pure-tone stimuli were measured for each ear in pre-implantation conditions and 3-12 months after surgery. After implantation 14 patients (38%) showed no hearing threshold variation, 29 (78%) maintained an appreciable hearing threshold level in the implanted ear, 8 (22%) had a total loss of residual hearing. Median increases of threshold levels were, in all 37 studied patients, 5, 10, 10 and 5 dB HL, respectively, for 125, 250, 500 and 1 kHz. For the 18 patients having implants without the stylet median increases of threshold levels were 0, 10, 5 and 7 dB HL; in the stylet group, they were 10, 5, 5 and 10 dB HL. On a comparison between the stylet and the non-stylet group, no significant differences in mean hearing threshold worsening were found. Data seem to suggest that cochlear function is less sensitive to mechanical trauma during implant surgery than was thought. Besides, electrode array stiffness seems not to influence preservation of cochlear residual functional integrity. Finally, the authors hypothesize a direct spiral ganglion activation under strong mechanical stimulation.

27. **"Decision making for solitary vestibular schwannoma and contralateral Meniere's disease".** Dispenza, F.; De Stefano, A.; Flanagan, S.; Romano, G.; Sanna, M.; (2007); Audiol Neurootol. 13(1):53-57

The existence of dual inner ear pathology such as unilateral Meniere's disease (MD) with a contralateral vestibular schwannoma (VS) is very rare, but provides the otologist with a significant management dilemma. In this study, we present 5 cases of unilateral disabling MD with a contralateral VS in the better hearing ear. Conservative management of the VS is mandated unless there are impending complications, with management directed toward controlling the vertigo attributed to MD. If and when the VS requires intervention, or the hearing in that ear

deteriorates to unserviceable levels, cochlear implant of the ear affected by MD prior to addressing the VS provides optimal management.

28. **"Central auditory development: Evidence from CAEP measurements in children fit with cochlear implants".** Dorman, M. F.; Sharma, A.; Gilley, P.; Martin, K.; Roland, P.; (2007); J Commun Disord. 40(4):284-294

In normal-hearing children the latency of the P1 component of the cortical evoked response to sound varies as a function of age and, thus, can be used as a biomarker for maturation of central auditory pathways. We assessed P1 latency in 245 congenitally deaf children fit with cochlear implants following various periods of auditory deprivation. If children experience less than 3.5 years of auditory deprivation before implantation, P1 latencies fall into the range of normal following 3-6 months of electrical stimulation. Children who experience greater than 7 years of deprivation, however, generally do not develop normal P1 latencies even after years of stimulation. Moreover, the waveforms for these patients can be markedly abnormal. Cortical reorganization stimulated by deprivation is likely to be a significant factor in both variation in the latency and morphology of the cortical evoked response to sound for children fit with a cochlear implant and variation in the development of oral speech and language function. Learning Outcomes: The reader will be introduced to research using cortical evoked responses (CAEPs), positron emission tomography (PET) scans and in-depth recording from the auditory cortex of congenitally deaf cats that converges on the existence of a sensitive period for the development of central auditory pathways in children. The reader will also be provided with two case studies that illustrate the use of the P1 response as biomarker for development of central auditory pathways. Finally, suggestions for future research will be provided.

29. **"Effects of temporal fine structure on the lateralization of speech and on speech understanding in noise".** Drennan, W. R.; Won, J. H.; Dasika, V. K.; Rubinstein, J. T.; (2007); J Assoc Res Otolaryngol. 8(3):373-383

This study evaluated the role of temporal fine structure in the lateralization and understanding of speech in six normal-hearing listeners. Interaural time differences (ITDs) were introduced to invoke lateralization. Speech reception thresholds (SRTs) were evaluated in backgrounds of two-talker babble and speech-shaped noise. Two-syllable words with ITDs of 0 and 700 micros were used as targets. A vocoder technique, which systematically randomized fine structure, was used to evaluate the effects of fine structure on these tasks. Randomization of temporal fine structure was found to significantly reduce the ability of normal-hearing listeners to lateralize words, although for many listeners, good lateralization performance was achieved with as much as 80% fine-structure randomization. Most listeners demonstrated some rudimentary ability to lateralize with 100% fine-structure randomization. When ITDs were 0 micros, randomization of fine structure had a much greater effect on SRT in two-talker babble than in speech-shaped noise. Binaural advantages were also observed. In steady noise,

the difference in SRT between words with 0- vs 700-micros ITDs was, on average, 6 dB with no fine-structure randomization and 2 dB with 100% fine-structure randomization. In two-talker babble this difference was 1.9 dB and, for most listeners, showed little effect of the degree of fine-structure randomization. These results suggest that (1) improved delivery of temporal fine structure would improve speech understanding in noise for implant recipients, (2) bilateral implant recipients might benefit from temporal envelope ITDs, and (3) improved delivery of temporal information could improve binaural benefits.

30. **"Children with cochlear implants and complex needs: A review of outcome research and psychological practice".** Edwards, L. C.; (2007); The Journal of Deaf Studies and Deaf Education. 12(3):258-268

In recent years, the number of children receiving cochlear implants who have significant disabilities in addition to their deafness has increased substantially. However, in comparison with the extensive literature on speech, language, and communication outcomes following pediatric implantation in children without complex needs, the available literature for this special group of children is relatively sparse. This article reviews the available research on outcomes, grouping studies according to the nature of the additional disabilities and specific etiologies of deafness. The methodological problems relating to outcome research in this field are outlined, followed by some tentative conclusions drawn from the literature base while bearing these problems in mind. The remainder of the article focuses on the challenges for clinical practice, from a psychological perspective, of implanting deaf children with complex needs. Two groups of children are considered, those whose additional disabilities have been identified prior to implantation and those whose difficulties become apparent at some point afterward, sometimes many years later. A case example describing the psychological assessment of a deaf-blind child being considered for implantation is presented.

31. **"Local dexamethasone therapy conserves hearing in an animal model of electrode insertion trauma-induced hearing loss".** Eshraghi, A. A.; Adil, E.; He, J.; Graves, R.; Balkany, T. J.; Van De Water, T. R.; (2007); Otol Neurotol. 28(6):842-849

Hypothesis: The progressive loss of hearing that develops after electrode insertion trauma (EIT) can be attenuated by local dexamethasone (DXM) therapy. Background: Hearing loss (HL) that develops after cochlear implant EIT occurs in two stages in laboratory animals, that is, an immediate loss followed by a progressive loss. Direct infusion of DXM into the guinea pig cochlea can attenuate both ototoxin- and noise-induced HL. Materials and Methods: Auditory-evoked brainstem responses (ABRs) of guinea pigs were measured for 4 frequencies (i.e., 0.5, 1, 4, and 16 kHz) before, immediately after, and more than 30 days post-EIT for experimental (EIT,EIT + artificial perilymph, and EIT + DXM) and for the contralateral unoperated cochleae of each group. An electrode analog of 0.14-mm

diameter was inserted through a basal turn cochleostomy for a depth of 3 mm and withdrawn. DXM in artificial perilymph was delivered immediately post-EIT into the scala tympani via a miniosmotic pump for 8 days. Results: The ABR thresholds of EIT animals increased progressively post-EIT. Contralateral unoperated cochleae had no significant changes in ABR thresholds. Immediately post-EIT, that is, Day 0, the DXM-treated animals exhibited a significant HL at 1, 4, and 16 kHz, but this HL was no longer significant by Day 30 compared with contralateral control ears. Conclusions: The results from immediate local treatment of the cochlea with DXM in an animal model of EIT-induced HL suggest a novel therapeutic strategy for hearing conservation by attenuating the progressive HL that can result from the process of electrode array insertion during cochlear implantation.

32. **"Cochlear implant electrode misplaced in the carotid canal".** Eun, J. S.; Sang, C. K.; Jae, Y. C.; (2007); Archives of Otolaryngology - Head and Neck Surgery. 133(8):827-829

Extract first 150 words: Cochlear implantation has become a relatively routine operation; however, like any surgical procedure, it carries a risk of complications. The likelihood of causing injury to adjacent vital structures is rare but can lead to serious consequences. During the surgical procedure, it is important to obtain maximal exposure through the facial recess to avoid potential risk to the carotid canal or the carotid artery. An intraoperative or postoperative radiograph should be obtained to confirm the correct positioning of the electrode. Herein, we report a rare complication involving injury to the carotid canal that was caused by an electrode during cochlear implantation in a child. To our knowledge, there has been only 1 other report of iatrogenic carotid canal injury during cochlear implantation, and it involved an adult.

33. **"Current steering creates additional pitch percepts in adult cochlear implant recipients".** Firszt, J. B.; Koch, D. B.; Downing, M.; Litvak, L.; (2007); Otol Neurotol. 28(5):629-636

Objective: The number of spectral channels is the number of discriminable pitches heard as current is delivered to distinct locations along the cochlea. This study aimed to determine whether cochlear implant users could hear additional spectral channels using current "steering." Current steering involves the simultaneous delivery of current to adjacent electrodes, where stimulation can be steered to sites between the contacts by varying the proportion of current delivered to each electrode in an electrode pair. Current steering may increase the number of spectral channels beyond the number of fixed electrode contacts. Study Design: Prospective clinical study. Setting: Twelve tertiary care centers in North America. Patients: The subjects were 106 adults with postlingual onset of severe-to-profound hearing loss. Interventions: Subjects received the Advanced Bionics CII or HiResolution 90K device (Advanced Bionics Corporation, Valencia, CA, USA). Main Outcome Measures: After loudness balancing and pitch ranking the 3 electrode pairs (2 and 3, 8 and 9, and 13 and 14), the subjects identified the

electrode with the higher pitch while current was varied proportionally between the electrodes in each pair. The smallest change in proportion yielding a discriminable change in pitch was defined as the spectral resolution. Results: The data from 115 ears indicate that the number of spectral channels averaged 3.8 for the basal pair, 6.0 for the midarray pair, and 5.3 for the apical pair. Assuming that the number of channels on these 3 electrode pairs represents the entire array, the total potential number of spectral channels was calculated and ranged from 8 to 451, with an average of 63. Conclusion: These results indicate that additional pitch percepts can be created using current steering.

34. **"Bone island tunnel for cochlear and vibrant soundbridge implantation".** Foyt, D.; Steiniger, E.; Rende, S.; (2007); Laryngoscope. 117(8):1395-1396

Abstract unavailable.

35. **"Perceptual learning and auditory training in cochlear implant recipients".** Fu, Q. J. & Galvin, J. J., III; (2007); Trends in Amplification. 11(3):193-205

Learning electrically stimulated speech patterns can be a new and difficult experience for cochlear implant (CI) recipients. Recent studies have shown that most implant recipients at least partially adapt to these new patterns via passive, daily-listening experiences. Gradually introducing a speech processor parameter (eg, the degree of spectral mismatch) may provide for more complete and less stressful adaptation. Although the implant device restores hearing sensation and the continued use of the implant provides some degree of adaptation, active auditory rehabilitation may be necessary to maximize the benefit of implantation for CI recipients. Currently, there are scant resources for auditory rehabilitation for adult, postlingually deafened CI recipients. We recently developed a computer-assisted speech-training program to provide the means to conduct auditory rehabilitation at home. The training software targets important acoustic contrasts among speech stimuli, provides auditory and visual feedback, and incorporates progressive training techniques, thereby maintaining recipients' interest during the auditory training exercises. Our recent studies demonstrate the effectiveness of targeted auditory training in improving CI recipients' speech and music perception. Provided with an inexpensive and effective auditory training program, CI recipients may find the motivation and momentum to get the most from the implant device.

36. **"Frequency modulation detection with simultaneous amplitude modulation by cochlear implant users".** Fu, Q. J. & Luo, X.; (2007); Journal of the Acoustical Society of America. 122(2):1046-1054

To better represent fine structure cues in cochlear implants (CIs), recent research has proposed varying the stimulation rate based on slowly varying frequency

modulation (FM) information. The present study investigated the abilities of CI users to detect FM with simultaneous amplitude modulation (AM). FM detection thresholds (FMDTs) for 10-Hz sinusoidal FM and upward frequency sweeps were measured as a function of standard frequency (75-1000 Hz). Three AM conditions were tested, including (1) No AM, (2) 20-Hz Sinusoidal AM (SAM) with modulation depths of 10%, 20%, or 30%, and (3) Noise AM (NAM), in which the amplitude was randomly and uniformly varied over a range of 1, 2, or 3 dB, relative to the reference amplitude. Results showed that FMDTs worsened with increasing standard frequencies, and were lower for sinusoidal FM than for upward frequency sweeps. Simultaneous AM significantly interfered with FM detection; FMDTs were significantly poorer with simultaneous NAM than with SAM. Besides, sinusoidal FMDTs significantly worsened when the starting phase of simultaneous SAM was randomized. These results suggest that FM and AM in CI partly share a common loudness-based coding mechanism and the feasibility of " FM+AM " strategies for CI speech processing may be limited.

37. **"Perceptual benefit and functional outcomes for children using sequential bilateral cochlear implants".** Galvin, K. L.; Mok, M.; Dowell, R. C.; (2007); Ear Hear. 28(4):470-482

Objective: To evaluate the additional perceptual benefit provided to children through the use of two cochlear implants in comparison to one after 6 to 13 mo experience with sequential bilateral implants. Design: A second cochlear implant was received by 11 children. The principal selection criteria were being age 4 to 15 yr with a bilateral profound hearing loss and being a consistent user of a first implant with a commitment to use of a second implant. Horizontal localization was assessed by using pink noise bursts presented from a 180 degrees, eight-loudspeaker array. Speech perception was assessed by using a four-alternative forced-choice spondee test, with speech presented from in front and adaptive background noise presented from 90 degrees to the left or right. Both tests were completed in the first implant alone and bilateral conditions. A questionnaire measured the pre- to postoperative change in the parent's ratings of the child's performance in specific listening situations. Items were related to speech perception, spatial hearing, or other qualities of hearing. Regular parental reports of device use, attitude and performance were collected. Most subjects were assessed at 6 mo after surgery, with two assessed at 13 mo. Results: The 11 subjects demonstrated a great range of outcomes. For one subject, only anecdotal data were collected. Speech perception testing indicated that when noise was presented ipsilateral to the first implant, 8 of 10 subjects showed a benefit in the bilateral condition. None of the nine subjects tested showed a benefit when noise was contralateral to the first implant. Generally, there was no benefit to localization in the bilateral condition. For eight subjects, postoperative performance ratings were generally higher than preoperative ratings, particularly in the spatial hearing section. Anecdotal reports indicated that most subjects had a negative attitude toward, and gained limited experience with, the second implant alone. The subjects developed a range of speech perception skills, from detection to

conversation level. Regarding the use of bilateral implants, attitudes were more positive and device use was consistent for eight subjects, and six parents reported some evidence of improved performance in daily life. Conclusions: Children over age 4 yr may gain significant additional benefit from a second implant, including improved speech perception in some noise contexts and functional advantages in daily life. There is, however, no evidence from this study to suggest that binaural listening skills, including localization, will develop during the first 6 mo. Furthermore, some children who may be committed users of a first implant may not adapt to or benefit from a second implant during the first 6 mo of device use. Although the factors influencing benefit cannot be clearly identified, limited preoperative auditory experience with the second ear, a delay of years between implants, relatively advanced age, and lack of second-implant-alone experience do not preclude benefit. Continued evaluation of these and additional subjects will clarify the factors that do contribute to benefit. Such information will be vital in helping families of implanted children to make an informed decision regarding a second implant.

38. **"Effect of spectral smearing on the perceptual segregation of vowel sequences".** Gaudrain, E.; Grimault, N.; Healy, E. W.; Bera, J. C.; (2007); Hear Res. 231(1-2):32-41

Although segregation of both simultaneous and sequential speech items may be involved in the reception of speech in noisy environments, research on the latter is relatively sparse. Further, previous studies examining the ability of hearing-impaired listeners to form distinct auditory streams have produced mixed results. Finally, there is little work investigating streaming in cochlear implant recipients, who also have poor frequency resolution. The present study focused on the mechanisms involved in the segregation of vowel sequences and potential limitations to segregation associated with poor frequency resolution. An objective temporal-order paradigm was employed in which listeners reported the order of constituent vowels within a sequence. In Experiment 1, it was found that fundamental frequency based mechanisms contribute to segregation. In Experiment 2, reduced frequency tuning often associated with hearing impairment was simulated in normal-hearing listeners. In that experiment, it was found that spectral smearing of the vowels increased accurate identification of their order, presumably by reducing the tendency to form separate auditory streams. These experiments suggest that a reduction in spectral resolution may result in a reduced ability to form separate auditory streams, which may contribute to the difficulties of hearing-impaired listeners, and probably cochlear implant recipients as well, in multi-talker cocktail-party situations.

39. **"Combined electric and contralateral acoustic hearing: Word and sentence recognition with bimodal hearing".** Gifford, R. H.; Dorman, M. F.; McKarns, S. A.; Spahr, A. J.; (2007); Journal of Speech, Language, and Hearing Research. 50(4):835-843

Purpose: The authors assessed whether (a) a full-insertion cochlear implant would provide a higher level of speech understanding than bilateral low-frequency acoustic hearing, (b) contralateral acoustic hearing would add to the speech understanding provided by the implant, and (c) the level of performance achieved with electric stimulation plus contralateral acoustic hearing would be similar to performance reported in the literature for patients with a partial insertion cochlear implant. Method: Monosyllabic word recognition as well as sentence recognition in quiet and at +10 and +5 dB was assessed. Before implantation, scores were obtained in monaural and binaural conditions. Following implantation, scores were obtained in electric-only and electric-plus-contralateral acoustic conditions. Results: Postoperatively, all individuals achieved higher scores in the electric-only test conditions than they did in the best pre-implant test conditions. All individuals benefited from the addition of low-frequency information to the electric hearing. Conclusion: A full-insertion cochlear implant provides better speech understanding than bilateral, low-frequency residual hearing. The combination of an implant and contralateral acoustic hearing yields comparable performance to that of patients with a partially inserted implant and bilateral, low-frequency acoustic hearing. These data suggest that a full-insertion cochlear implant is a viable treatment option for patients with low-frequency residual hearing.

40. **"Auditory brainstem activity and development evoked by apical versus basal cochlear implant electrode stimulation in children".** Gordon, K. A.; Papsin, B. C.; Harrison, R. V.; (2007); Clin Neurophysiol. 118(8):1671-1684

Objective: The role of apical versus basal cochlear implant electrode stimulation on central auditory development was examined. We hypothesized that, in children with early onset deafness, auditory development evoked by basal electrode stimulation would differ from that evoked more apically. Methods: Responses of the auditory nerve and brainstem, evoked by an apical and a basal implant electrode, were measured over the first year of cochlear implant use in 50 children with early onset severe to profound deafness who used hearing aids prior to implantation. Results: Responses at initial stimulation were of larger amplitude and shorter latency when evoked by the apical electrode. No significant effects of residual hearing or age were found on initial response amplitudes or latencies. With implant use, responses evoked by both electrodes showed decreases in wave and interwave latencies reflecting decreased neural conduction time through the brainstem. Apical versus basal differences persisted with implant experience with one exception; eIII-eV interlatency differences decreased with implant use. Conclusions: Acute stimulation shows prolongation of basally versus apically evoked auditory nerve and brainstem responses in children with severe to profound deafness. Interwave latencies reflecting neural conduction along the

caudal and rostral portions of the brainstem decreased over the first year of implant use. Differences in neural conduction times evoked by apical versus basal electrode stimulation persisted in the caudal but not rostral brainstem. Significance: Activity-dependent changes of the auditory brainstem occur in response to both apical and basal cochlear implant electrode stimulation.

41. **"Horizontal-plane localization of noise and speech signals by postlingually deafened adults fitted with bilateral cochlear implants".** Grantham, D. W.; Ashmead, D. H.; Ricketts, T. A.; Labadie, R. F.; Haynes, D. S.; (2007); Ear Hear. 28(4):524-541

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

with previously reported data, subjects with bilateral cochlear implants localized sounds in the horizontal plane remarkably well when using both of their devices, but they generally could not localize sounds when either device was deactivated. They could localize the speech signal with slightly, but significantly better accuracy than the noise, possibly due to spectral differences in the signals, to the availability of envelope ITD cues with the speech but not the noise signal, or to more central factors related to the social salience of speech signals. For most subjects the remarkable ability to localize sounds has stabilized by 5 mo after activation. However, for some subjects who perform poorly initially, there can be substantial improvement past 5 mo. Results from Experiment 2 suggest that ILD cues underlie localization ability for noise signals, and that ITD cues do not contribute.

42. **"Influence of evoked compound action potential on speech perception in cochlear implant users".** Guedes, M. C.; Weber, R.; Gomez, M. V.; Neto, R. V.; Peralta, C. G.; Bento, R. F.; (2007); Rev Bras Otorrinolaringol (Engl Ed). 73(4):439-445

Electrically Evoked Compound Action Potential is a measure of synchronous cochlear nerve fibers activity elicited by electrical stimulation of the cochlear implant. The electrophysiological nerve responses may contribute to explain the variability in individual performance of cochlear implant recipients. Aim: To compare speech perception tests performances of cochlear implant users according to the presence or absence of intra-operative neural telemetry responses. Material and Method: Prospective study design with 100 "Nucleus 24" cochlear implant users divided in two groups according to the presence or absence of intra-operative neural telemetry responses. Speech perception tests were performed after 6 months of continuous use of the device and compared among groups. Results: Intra-operative action potentials were observed in 72 % of individuals. Open-set sentence test results were better in implant users who had neural telemetry responses when compared to implant users in whom this potential was absent (averages 82.8 % versus 41 %, p = 0.005). There was a strong association between post meningitis-related deafness and absence of intra-operative potentials. Conclusion: The absence of intra-operative neural telemetry responses was associated with worse performances in speech perception tests and meningitis as etiology of deafness. On the other hand, the presence of these potentials suggests excellent prognosis.

43. **"Evidence of a tonotopic organization of the auditory cortex in cochlear implant users".** Guiraud, J.; Besle, J.; Arnold, L.; Boyle, P.; Giard, M. H.; Bertrand, O.; Norena, A.; Truy, E.; Collet, L.; (2007); Journal of Neuroscience. 27(29):7838-7846

Deprivation from normal sensory input has been shown to alter tonotopic organization of the human auditory cortex. In this context, cochlear implant subjects provide an interesting model in that profound deafness is made partially reversible by the cochlear implant. In restoring afferent activity, cochlear

implantation may also reverse some of the central changes related to deafness. The purpose of the present study was to address whether the auditory cortex of cochlear implant subjects is tonotopically organized. The subjects were thirteen adults with at least 3 months of cochlear implant experience. Auditory event-related potentials were recorded in response to electrical stimulation delivered at different intra-cochlear electrodes. Topographic analysis of the auditory N1 component (~85 ms latency) showed that the locations on the scalp and the relative amplitudes of the positive/negative extrema differ according to the stimulated electrode, suggesting that distinct sets of neural sources are activated. Dipole modeling confirmed electrode-dependent orientations of these sources in temporal areas, which can be explained by nearby, but distinct sites of activation in the auditory cortex. Although the cortical organization in cochlear implant users is similar to the tonotopy found in normal-hearing subjects, some differences exist. Nevertheless, a correlation was found between the N1 peak amplitude indexing cortical tonotopy and the values given by the subjects for a pitch scaling task. Hence, the pattern of N1 variation likely reflects how frequencies are coded in the brain.

44. **"[Discrimination of musical pitch with cochlear implants]".** Haumann, S.; Muhler, R.; Ziese, M.; von Specht, H.; (2007); HNO. 55(8):613-619

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

45. **"Spontaneous activity of auditory-nerve fibers: Insights into stochastic processes at ribbon synapses".** Heil, P.; Neubauer, H.; Irvine, D. R. F.; Brown, M.; (2007); Journal of Neuroscience. 27(31):8457-8474

In several sensory systems, the conversion of the representation of stimuli from graded membrane potentials into stochastic spike trains is performed by ribbon synapses. In the mammalian auditory system, the spiking characteristics of the vast majority of primary afferent auditory-nerve (AN) fibers are determined primarily by a single ribbon synapse in a single inner hair cell (IHC), and thus

provide a unique window into the operation of the synapse. Here, we examine the distributions of interspike intervals (ISIs) of cat AN fibers under conditions when the IHC membrane potential can be considered constant and the processes generating AN fiber activity can be considered stationary, namely in the absence of auditory stimulation. Such spontaneous activity is commonly thought to result from an excitatory Poisson point process modified by the refractory properties of the fiber, but here we show that this cannot be the case. Rather, the ISI distributions are one to two orders of magnitude better and very accurately described as a result of a homogeneous stochastic process of excitation (transmitter release events) in which the distribution of interevent times is a mixture of an exponential and a gamma distribution with shape factor 2, both with the same scale parameter. Whereas the scale parameter varies across fibers, the proportions of exponentially and gamma distributed intervals in the mixture, and the refractory properties, can be considered constant. This suggests that all of the ribbon synapses operate in a similar manner, possibly just at different rates. Our findings also constitute an essential step toward a better understanding of the spike-train representation of time-varying stimuli initiated at this synapse, and thus of the fundamentals of temporal coding in the auditory pathway.

46. **"Neurosurgical intervention after major head injury in pediatric cochlear implant patients: Case reports".** Ho, A. C. & Hui, Y.; (2007); Am J Otolaryngol. 28(5):350-352

Abstract unavailable.

47. **"Unexpected exit of a cochlear implant electrode through the wall of the basal turn of the cochlea - a report on two patients".** Ho, E. C.; Proops, D.; Andrews, P.; Graham, J.; (2007); Cochlear Implants Int. 8(3):162-171

We describe the unusual complication of the cochlear implant electrode eroding through the lateral bony wall of the cochlear basal turn in 2 different patients. This complication, occurring during life, has not been previously described in the literature. Radiological investigations were vital in making this diagnosis. We also discuss the likely pathophysiology behind this complication.

48. **"In reference to Orbital sequelae of rhinosinusitis after cochlear implantation in children".** Hoffman, R. A.; Parisier, S. C.; Roland, J. T.; (2007); Laryngoscope. 117(8):1505

Abstract unavailable

49. **"The application and computer simulation of multi-channel cochlear implant based on all phase DFT filter".** Hou, Z.; Pang, Z.; Tian, L.; (2007); ICASSP, IEEE International Conference on Acoustics., Speech and Signal Processing.- Proceedings. 4(IV701-IV704)

Band-pass filter bank is an essential part in cochlear implant (CI). Its characteristics are important for synthesized sound quality because the outputs of filter bank contain a lot of fine structure cues which need to be encoded and transmitted to implanted electrode and then to stimulate auditory nerves. All phase DFT (APDFT) filter is a novel and high efficient digital filter, which possesses concurrent merits, such as zero-phase (or all-phase), abrupt cut-off characteristic. This paper presents the principle and the design method of APDFT filter bank and applies this filter into CI signal processing. Under the same acoustic simulation conditions, based on the continuous interleaved sampling (CIS) strategy, we analyze and evaluate the simulation results. Comparing with classical Butterworth filter bank adopted in CI processors, some objective waveform and spectra show that the output signal from APDFT filter bank is much closer to the original sound. For the normal-hearing (NH) listener, the synthetic speech and music by the APDFT filter bank have higher quality, and perceptual tests on six NH listeners primarily verify the improvement of intelligibility in noise. Thus, the APDFT filter could potentially improve the hearing quality for CI user.

50. **"Effects of steroids and lubricants on electrical impedance and tissue response following cochlear implantation".** Huang, C. Q.; Tykocinski, M.; Stathopoulos, D.; Cowan, R.; (2007); Cochlear Implants Int. 8(3):123-147

The present study examined the effects of steroids and lubricants on electrical impedance and tissue response following cochlear implantation in animal models. Guinea pigs were implanted following either no treatment, or intrascalar injection with dexamethasone, triamcinolone, sodium hyaluronate or saline. Cats were implanted following either no treatment, or intrascalar injection with dexamethasone, triamcinolone or a mixture of triamcinolone with sodium hyaluronate. In guinea pigs, impedance changes and intracochlear tissue response were less for the hyaluronate and saline groups. In cats, impedance in the dexamethasone group increased similar to non-treated cats. Impedance of triamcinolone treated cats remained low for about two months after implantation, before increasing to levels similar to the other groups. Significant fibrous tissue growth was observed histologically. The results of the present study indicate that a single intracochlear application of hyaluronate or triamcinolone may postpone, but will ultimately not prevent the rise in impedance following cochlear implantation.

51. **"Auditory cortical plasticity: Does it provide evidence for cognitive processing in the auditory cortex?".** Irvine, D. R.; (2007); Hear Res. 229(1-2):158-170

The past 20 years have seen substantial changes in our view of the nature of the processing carried out in auditory cortex. Some processing of a cognitive nature, previously attributed to higher-order "association" areas, is now considered to take place in auditory cortex itself. One argument adduced in support of this view is the evidence indicating a remarkable degree of plasticity in the auditory cortex of adult animals. Such plasticity has been demonstrated in a wide range of paradigms, in which auditory input or the behavioural significance of particular inputs is manipulated. Changes over the same time period in our conceptualization of the receptive fields of cortical neurons, and well-established mechanisms for use-related changes in synaptic function, can account for many forms of auditory cortical plasticity. On the basis of a review of auditory cortical plasticity and its probable mechanisms, it is argued that only plasticity associated with learning tasks provides a strong case for cognitive processing in auditory cortex. Even in this case the evidence is indirect, in that it has not yet been established that the changes in auditory cortex are necessary for behavioural learning and memory. Although other lines of evidence provide convincing support for cognitive processing in auditory cortex, that provided by auditory cortical plasticity remains equivocal.

52. **"Phonological awareness, vocabulary, and word reading in children who use cochlear implants: Does age of implantation explain individual variability in performance outcomes and growth?".** James, D.; Rajput, K.; Brinton, J.; Goswami, U.; (2007); The Journal of Deaf Studies and Deaf Education

The phonological awareness (PA), vocabulary, and word reading abilities of 19 children with cochlear implants (CI) were assessed. Nine children had an implant early (between 2 and 3.6 years) and 10 had an implant later (between 5 and 7 years). Participants were tested twice over a 12-month period on syllable, rhyme, and phoneme awareness (see James et al., 2005). Performance of CI users was compared against younger hearing children matched for reading level. Two standardized assessments of vocabulary and single word reading were administered. As a group, the children fitted early had better performance outcomes on PA, vocabulary, and reading compared to hearing benchmark groups. The early group had significant growth on rhyme awareness, whereas the late group showed no significant gains in PA over time. There was wide individual variation in performance and growth in the CI users. Two participants with the best overall development were both fitted with an implant late in childhood.

53. **"Anatomical vibrations that implantable microphones must overcome".** Jenkins, H. A.; Pergola, N.; Kasic, J.; (2007); Otol Neurotol. 28(5):579-588

Hypothesis: The goal of this study was to measure the tissue vibration amplitude that would be associated with an implantable microphone. Background: Totally implantable hearing devices have been desired by the hard-of-hearing community for some time. However, an implanted microphone must pick up desired acoustic signals in the presence of undesired signals, including vibration. To design an effective microphone, the level of tissue vibrations originating from anatomical sources and the implanted transducer must be understood. Methods: Using a laser Doppler vibrometer and an accelerometer, tissue vibrations were measured under the following conditions: (1) Normal control subjects during vocalization (n=4); (2) Vocalization and biological sounds measured on cranium and in soft tissue on normal subjects (n=6); (3) Transducer vibration measured on Otologics semi-implantable hearing device wearer (n=1) and human cadavers (n=4 ears). Results: Anatomical noise vibrations are 20 to 25 dB greater in soft tissue for frequencies less than 1,000 Hz than on the cranium, whereas vibrations due to implanted transducers are 20 to 25 dB greater on the cranium than in soft tissue inferior to the mastoid. Chewing vibrations are 10 to 15 dB greater than vocalization on the mastoid. Mastoid vibration levels measured in patients are equivalent to those in cadavers. Vibration levels do not vary significantly with respect to location on the cranium next to the pinna. Conclusion: The greatest anatomical vibrations that an implanted microphone must overcome are because of vocalization in the soft tissue inferior to the mastoid and chewing vibrations on the mastoid. A human cadaver is an appropriate model for transducer cranial vibration studies. If the implantable microphone is placed on the cranium near the pinna, it makes little difference with regard to actual location.

54. **"Applied anatomy of the artificial cochlear implantation in young children".** Jin, J.; Yang, X.; Shao, H.; Chen, C.; Ni, L.; (2007); Jiepou Xuebao. 38(3):373-375

Objective: To provide anatomic data for operation of inserting the electrode cochlear in young children. Methods: Fourteen heads, 28 sides specimens of young children of 1-to-5-year old were dissected, through posterior tympanum approach, via mastoidectomy, posterior tympanotomy to enter posterior tympanum. The related anatomy structures of the location of the electrode cochlear inserted into the proper sites were observed and measured under surgical microscope. Results: The round window was seated in superior part of the round window niche. The pyramidal eminence, tendo musculi stapedius, incudostapedial joint, base of stapes, cochleariform process, round window niche and promontorium tympani were all visible from different directions. The posterior arch of stapes was situated in the prozone of scala. Scala was situated in the posteroinferior scala vestibuli. The distance from the middle point of the anteri or border of the round window niche to the inferior wall was (1.49 +/- 0.42) mm, to the posterior wall of the Scala tympani (0.90 +/- 0.31) mm, to the basal tissue

(1.49 +/- 0.41) mm, to the pyramidal eminence (3.28 +/- 0.55) mm, to the lateral semicircular canal (7.41 +/- 0.90) mm, to the inferior margin of the base of stapes (3.09 +/- 0.53) mm. Conclusion: It is considered that the location of the insertion should be at the middle point of anterior border of the round window niche anterior from 0.90mm to 1.49mm, deorsum from 0mm to 1.49mm. When the round window niche is not found, the location of the insertion has to be at the middle point of the inferior margin of the base of stapes deorsum 3mm.

55. **"[Development of hearing, speech and language in congenitally deaf infants and children after cochlear implantation]".** Kaga, K.; Shinjo, Y.; Yamasoba, T.; Ito, K.; Akamatsu, Y.; Uchiyama, T.; Tokumitsu, H.; (2007); No To Hattatsu. 39(5):335-345

In Japan, universal newborn hearing screening has been partly introduced since 2000 in order to discover neonates with congenital deafness, and the average age at discovery was around five months; however, among infants who were not examined by the universal newborn hearing screening, the average age at discovery was around two years. After fitting hearing aids, congenitally deaf infants are educated in a preschool for speech and hearing. If hearing aids are not effective to develop hearing and speech, cochlear implant surgery is performed as modern technology. The outcome of hearing, speech and language after cochlear implantation was excellent. At the age of elementary school enrollment, most of their verbal IQ was considered to be the same as age-matched normal children. Cochlear implant is the most important treatment at present.

56. **"Effect of filter spacing on melody recognition: Acoustic and electric hearing".** Kasturi, K. & Loizou, P. C.; (2007); J Acoust Soc Am. 122(2):EL29-EL34

This paper assesses the effect of filter spacing on melody recognition by normal-hearing (NH) and cochlear implant (CI) subjects. A new semitone filter spacing is proposed for music. The quality of melodies processed by the various filter spacings is also evaluated. Results from NH listeners showed nearly perfect melody recognition with only four channels of stimulation, and results from CI users indicated significantly higher scores with a 12-channel semitone spacing compared to the spacing used in their daily processor. The quality of melodies processed by the semitone filter spacing was preferred over melodies processed by the conventional logarithmic filter spacing.

57. **"Real-time labview implementation of cochlear implant signal processing on PDA platforms".** Kehtarnavaz, N.; Loizou, P.; Peddigari, V.; (2007); ICASSP, IEEE International Conference on Acoustics., Speech and Signal Processing.- Proceedings. 2(II357-II360)

This paper presents the real-time implementation of a cochlear implant signal processing system on PDA platforms. PDAs are chosen as they provide portable and cost-effective computation platforms. To gain software flexibility and interactivity, the LabVIEW graphical programming environment is used. The paper discusses the optimization steps which are taken to achieve a real-time throughput. These steps consist of using dynamic link libraries, utilizing efficient memory allocation, and performing fixed-point arithmetic. These steps are general purpose in the sense that the same steps can be deployed for real-time implementation of other clinical or industrial signal processing applications on PDAs.

58. **"The Pakistan (Lahore) cochlear implant programme: Issues relating to implantation in a developing country".** Khan, M. I.; Mukhtar, N.; Saeed, S. R.; Ramsden, R. T.; (2007); J Laryngol Otol. 121(8):745-750

The Pakistan cochlear implant programme was started in Lahore in August 2000. It was initially established with the technical support of the Manchester cochlear implant team. There are no government resources available for cochlear implantation in Pakistan and the cost of cochlear implantation is met by the candidates and their families. Up till December 2005, 52 individuals have been implanted. Forty-four (84.6 per cent) of these patients were children and eight (15.4 per cent) patients were adults. Congenital deafness (94 per cent) is the main aetiological factor in children. Seventy-six per cent of these children were born to blood related parents. All patients received a Med-El Combi 40+ device. The listening progress profile, the meaningful auditory integration scale and the meaningful use of speech scale were used to assess the auditory performance in children. Thirty-nine children achieved an average listening progress profile score of 37.7 after 12 months of implantation. The overall rate of major and minor complications was 11.5 per cent. Failure rate for the device itself has been 3.8 per cent. In addition to considering these preliminary outcomes and funding issues, the problems of setting up a cochlear implant programme in a developing country are discussed.

59. **"Twenty-five years of auditory brainstem implants: Perspectives".** Kuchta, J.; (2007); Acta Neurochir.Suppl. 97(Pt 2):443-449

The auditory brainstem implant (ABI) provides auditory sensations, recognition of environmental sounds and aid in spoken communication in more than 300 patients worldwide. It is no more a device under investigation but it is widely accepted for the treatment of patients who have lost hearing due to bilateral tumors of the

vestibulocochlear nerve. Most of these patients are completely deaf when the implant is switched off. In contrast to the cochlear implants (CI), only few of the implanted patients achieve open-set speech recognition without the help of visual cues. In the last few years, patients with lesions other than tumors have also been implanted. Auditory perceptual performance in patients who are deaf due to trauma, cochlea aplasia or other non-tumor lesions of the cochlea or the vestibulocochlear nerve turned out to be much better than in NF2 tumor patients. Until recently, the target region for ABI implantation has been the ventral cochlear nucleus (CN). The electrodes are implanted via the translabyrinthine or retrosigmoid approach. Currently, new targets along the central auditory pathways and new, minimally invasive techniques for implantation are under investigation. These techniques may further improve auditory perceptual performance in ABI patients and provide hearing to a variety of types of central deafness.