

Hearing Review™

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Issue 21 - 2010

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Welcome to the twenty-first issue of Hearing Review.

One of the research studies covered in this issue involves the experience of listening to music in adult cochlear implant (CI) users, who generally find music to be less enjoyable following implantation. The study highlights the need for the development of a music training program for cochlear implant recipients in order to maximise their enjoyment of music with current technology. Although there are a host of aural rehabilitation packages to train speech perception, there is nothing comparable for music.

Also discussed in this edition are the funding issues related to cochlear implantation here in NZ. Our candidacy criteria is a lot more restrictive than many overseas clinics, largely due to the limited funding available.

As ever, there is a wide range of topics covered in this issue, which I hope you find useful in your practice and I welcome your comments and feedback. Keep warm and dry!

Kind regards,

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Birth characteristics and acute otitis media in early life

Authors: Bentdal YE et al

Summary: Data are reported from 33,192 children participating in the Norwegian Mother and Child Cohort at the Norwegian Institute of Public Health, in this investigation into whether preterm birth and low birth weight are associated with single and recurrent episodes of acute otitis media (AOM) in the first 18 months of life. Preterm birth was slightly associated with both single and recurrent episodes of AOM during these first 18 months. According to regression analyses that controlled for potential confounders, the adjusted relative risk (aRR) for having any episode of AOM was 1.37 if born before week 33, and the aRR for having recurrent AOM was 1.34 if born in weeks 33–36 (reference group: ≥ 37 weeks). No such tendency was observed for low birth weight.

Comment: There has been evidence of a relationship between low birth weight and/or premature birth, and an increased risk of otitis media. For example, preterm infants are born with lower levels of maternal IgG* and have been shown to have underdeveloped immune systems for longer time periods, increasing their susceptibility to upper respiratory tract infections. This is exacerbated by the eustachian tube being less developed, increasing the risk of middle ear infections. This study confirmed an increased risk of AOM for premature births, but not for low birth weight. It also found that 32.7% of all the children involved had experienced at least one episode of AOM before age 18 months, more often between the ages of 6 & 18 months, than during the first 6 months of age.

The study used maternal reports of acute AOM, which were incorporated into a questionnaire administered as part of the Norwegian Mother and Child Cohort Study. More detail about the study, and the questionnaires, can be found at: http://www.fhi.no/eway/default.aspx?pid=238&trg=MainArea_5811&MainArea_5811=5895:0:15,3046:1:0:0::0:0

*maternal IgG is an immunoglobulin antibody transferred across the placenta, serving to protect the foetus and neonate against infection.

Reference: *Int J Pediatr Otorhinolaryngol.* 2010;74(2):168-72.

<http://www.ijporonline.com/article/S0165-5876%2809%2900580-1/abstract>

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Music perception of cochlear implant users: a questionnaire, and its implications for a music training program

Authors: Looi V, She J

Summary: These researchers developed and administered a questionnaire (The University of Canterbury Music Listening Questionnaire: UCMLQ) to 100 adult cochlear implant (CI) users, with the aim of collecting information to assist with the future development of a music training programme (MTP) for CI recipients to increase their enjoyment and appreciation of music. The respondents generally found music to be less enjoyable post-implantation, and considered that music did not sound as they would expect it to sound to a person with normal hearing. However, it was reported that music listening could be enhanced by controlling the listening environment, being selective about the music chosen, and using a contralateral hearing aid (HA). The preferred logistics for a MTP were 30-minute sessions, 2–3 times per week, using a DVD format. The researchers advise that any MTP should focus on improving recipients' ability to recognise tunes, and encompass a wide range of musical styles.

Comment: This study provides information that may be useful when counselling new or potential adult CI recipients, particularly those with an interest in music. For example, 40% of recipients in this study noticed a difference in sound quality between listening with their CI-only, as opposed to a CI with a contralateral HA. Of these, 93% said that the CI+HA was better for music. Those who used a CI+HA reported music to sound more pleasant and natural.

The study also provides suggestions for recipients wanting to start to listen to music – for example, solo, duet or trio instrumentations could be better than larger groups such as orchestras or bands; start with music you are familiar with that have lyrics; maximise your listening environment (e.g. no background noise, use high quality speakers or earphones); and be willing to dedicate time and attention to focus on the music and/or practice. Research has shown that incidental exposure to music does not improve music perception for recipients.

Reference: *Int J Audiol.* 2010;49(2):116-28.

<http://tinyurl.com/28hnsuc>

Auditory development in early amplified children: factors influencing auditory-based communication outcomes in children with hearing loss

Authors: Sininger YS et al

Summary: This study sought to determine the effects of auditory deprivation in early childhood on auditory-based communication skills, including speech perception, speech production, and spoken language skills. The study population included 44 infants and toddlers, first identified with mild to profound bilateral hearing loss, who were being fitted with amplification (ranging in age from 1 to 72 months). Of all predictor variables assessed for their contribution to auditory-based communication outcomes, age at fitting of amplification showed the largest influence and was a significant factor in all outcome models. The degree of hearing loss was an important factor in the modelling of speech production and spoken language outcomes. Use of a cochlear implant indicated significantly improved outcomes in both speech production and expressive and receptive language. The other predictive factors (i.e., a multilingual home, parent-child interaction, intensity of oral education) made relatively minor contributions to prediction of outcome.

Comment: As opposed to the predominance of existing research that has focused on language outcomes, this longitudinal observational study looked at the effect of hearing loss on auditory development. All of the children had a bilateral sensorineural hearing loss (SNHL), encompassing the range from mild to profound. Of significance, in finding that age of amplification fitting was the most important factor for predicting speech perception outcomes, the authors reported that every month of delay was associated with a ¾ month increase in the age where the child would reach a specified performance level. Hearing loss was fourth on the list of predictors for speech perception, but the best predictor of speech production. Every 10dB worsening of thresholds predicted a 1/3 drop in the child's 'z' scores for a test. Age of amplification fitting was a significant predictor of every auditory outcome measured. Parent interaction, auditory training and a multilingual home were each only predictive of one of the five auditory outcomes.

Reference: *Ear Hear.* 2010;31(2):166-85.

<http://tinyurl.com/25ojstd>

Slight-mild sensorineural hearing loss in children: audiometric, clinical, and risk factor profiles

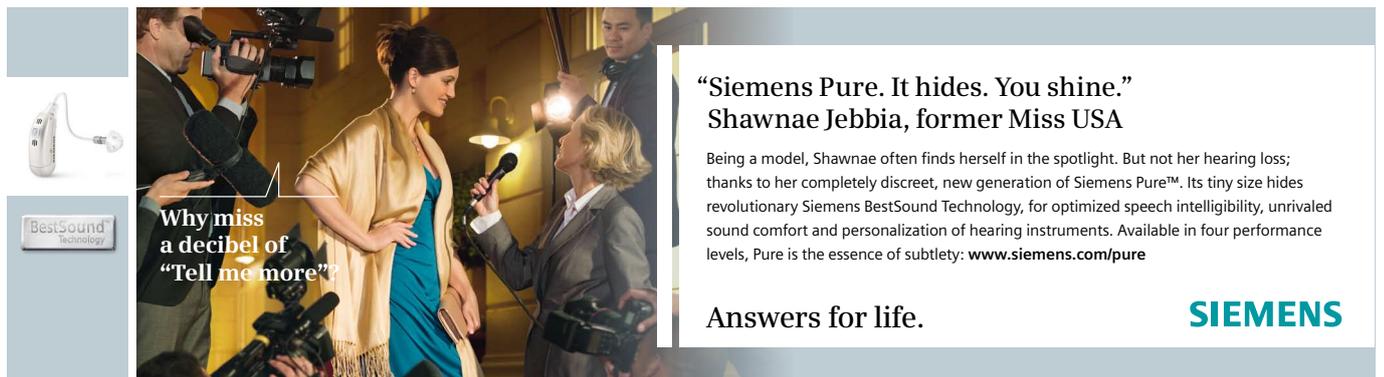
Authors: Cone BK et al

Summary: In this study, 6240 Australian children enrolled in years 1 and 5 of elementary school underwent audiometric screening for slight-mild sensorineural hearing loss (SNHL). The two specific aims of the study were (1) to describe the audiometric and clinical characteristics of children identified with slight-mild bilateral SNHL and (2) to compare children with slight-mild SNHL to those with normal hearing (NH) with respect to potential risk factors for congenital or acquired for hearing loss. A total of 55 children were identified with slight-mild SNHL; 5490 had NH. Of those with SNHL, 39 had a slight loss (16 to 25 dB HL) and 16 had a mild loss (26 to 40 dB HL). The majority of the losses were bilateral and symmetrical, and the mean pure-tone average for the better ear for all 55 children was 22.4 dB HL. The most prevalent risk factor was "neonatal intensive care unit/special care nursery admission," involving 12.5% of the SNHL and 8.4% of the NH group. Reported use of personal stereos was a significant risk factor (OR 1.7; p=0.05).

Comment: It is well established, and has been mentioned in previous issues of HRR, that a slight-mild hearing loss (HL) can impact on long-term educational progress, particularly if the loss was present during the child's sensitive period for speech and language development. Of the 6240 children in this study, 695 (11%) had a HL of some nature; 6.3% were conductive. Fifty-five children (0.88%) had a slight-mild SNHL. Although NICU/SCN admission was the most prevalent risk factor for a slight-mild SNHL, 16.7% had more than 1 neonatal risk factor. However, only 1.5% of children with risk factors had a HL. 28.3% of the parents of children with SNHL expressed concerns about their child's hearing (compared to 9.9% of the parents of NH children), with a positive predictive value of only 2%. A parental survey administered at the start of the study, prior to the hearing test, found that only 2 of the 55 parents of children with a slight-mild SNHL were concerned about their child's hearing.

Reference: *Ear Hear.* 2010;31(2):202-12.

<http://tinyurl.com/2ew9g78>



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Evidence for the expansion of adult cochlear implant candidacy

Authors: Gifford RH et al

Summary: This US study retrospectively reviewed data from postoperative speech perception performance scores for 22 adult cochlear implant (CI) recipients who demonstrated preoperative Consonant Nucleus Consonant (CNC) word recognition scores of $\geq 30\%$ in the best-aided condition, to determine whether a revision and/or expansion of current audiological CI candidacy criteria is warranted. The mean preoperative best-aided monosyllabic word score for the 22 patients was 41% correct. The degree of postoperative benefit for the best postoperative condition (electric only or bimodal) ranged from 10 to 68% points with a mean benefit of 27% points for the electric-only condition and 40% points for the bimodal condition. Highly significant differences were observed between preoperative-aided, implant-only, and bimodal performance on the CNC test both postoperative scores (electric only and bimodal) differed significantly from one another and from the preoperative best-aided performance.

Comment: The criteria for CI candidacy is dependent on a host of factors, including outcomes of current recipients, technological improvements, HA technology, and funding, to name a few. Unfortunately, although this study found that the preoperative audiological criteria should be expanded to enable more hearing-impaired individuals to be implanted, here in NZ, the funding from the Ministry of Health would preclude this. Expansion of the criteria would just mean lengthening of the current waiting list. However, this is something the Government needs to consider if the significantly hearing-impaired adults in NZ are to be afforded the same opportunities as their overseas counterparts.

The other important clinical finding from this study was that the use of %-correct scoring for the HINT sentences, a speech perception test often used in pre- and/or post-CI audiological assessments, may not be the best choice, being prone to ceiling level scores for many recipients. It should be administered in the manner it was designed for – i.e. adaptively in background noise to determine the signal-to-noise ratio required for 50% accuracy. Alternatively, more difficult sentence perception tests should be utilised.

Reference: *Ear Hear.* 2010;31(2):186-94.

<http://tinyurl.com/2axcjdj>

Bilateral and unilateral cochlear implant users compared on speech perception in noise

Authors: Dunn CC et al

Summary: This study assessed speech perception in noise on matched bilateral cochlear implant (BiCI) and unilateral cochlear implant (CI-only) users. The 30 subjects in each group were matched for age at implantation, duration of profound deafness, and preoperative residual hearing. According to a battery of speech perception tests in noise that used an eight-loudspeaker array, the BiCI subjects significantly outperformed the CI-only subjects on speech in noise.

Comment: Continuing on from the previous article, and the comments regarding funding to enable more adult recipients, one other area the Government needs to re-consider are bilateral implants, particularly for children. Bilateral pediatric implants are becoming standard practice in numerous countries, including clinics in the USA, UK and Australia. However they appear to be some way off here in NZ, despite the fact that they allow for the use of binaural mechanisms and have been shown to be beneficial over a CI-only across a host of listening situations and tasks. After all, we fit (and the Government funds) bilateral hearing aids for children with bilateral hearing losses. This study further demonstrates that bilateral implants allow faster sound localization, enhanced ability to separate and attend to a target signal presented in noise, better processing of speech whilst attending to other tasks, and improved ease of listening.

Reference: *Ear Hear.* 2010;31(2):296-8.

<http://tinyurl.com/2dd9o8j>

The current status of audiological rehabilitation for profound unilateral sensorineural hearing loss

Authors: Bishop CE, Eby TL

Summary: This literature review assesses the various treatment options for audiological rehabilitation of individuals with a profound unilateral sensorineural hearing loss (USNHL). Once limited to the use of air-conduction contralateral routing of sound (CROS) hearing aids, treatment applications now include the bone-anchored hearing aid (BAHA), the transcranial hearing aid (t-CROS), and the cochlear implant. Some data attest to the limited efficacy of air-conduction CROS hearing aids in alleviating hearing handicap associated with USNHL. Current investigations on providing cross hearing are generally focused on use of the BAHA. Scant evidence exists as to whether new developments in hearing aid technology can improve on conventional air-conduction CROS or t-CROS approaches. The cochlear implant appears promising for individuals with USNHL and tinnitus who also have intact auditory nerve pathways.

Comment: Although relatively rare, a profound unilateral SNHL provides a challenge for audiologists when determining a HA fitting. Sound localisation, speech perception in noise and listening effort are commonly reported issues. CROS HAs have been the traditional approach, although BAHAs have more recently been attracting interest. BAHAs have more commonly been fitted to patients with a permanent conductive HL, but there is a suggestion that it can be effectively used for patients with a unilateral SNHL by providing direct transcranial stimulation through exciting the cochlear fluids, with minimal distortion. This article discusses potential fitting options, including air-conduction CROS or BICROS HAs, transcranial air-conduction HAs (where a powerful HA is fitted to the unimpaired ear with enough output to stimulate the contralateral cochlea via bone conduction), BAHAs, and cochlear implants, and a comparison of outcomes between BAHAs and CROS HAs is provided.

Reference: *Laryngoscope.* 2010;120(3):552-6.

<http://www3.interscience.wiley.com/journal/123213703/abstract>

Childhood auditory processing disorder as a developmental disorder: the case for a multi-professional approach to diagnosis and management

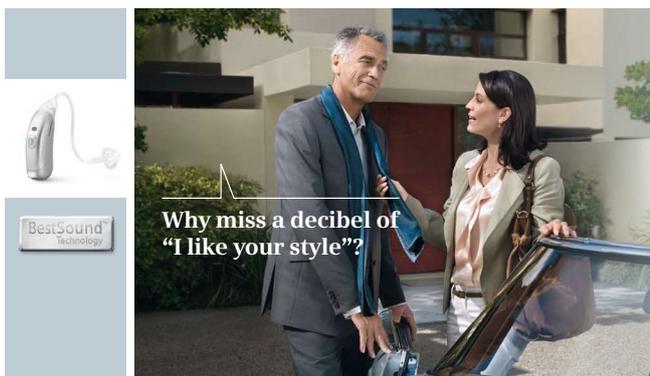
Authors: Witton C

Summary: This review explores the association between auditory processing disorder (APD) and other specific developmental disorders such as dyslexia and attention-deficit hyperactivity disorder. The review considers clinical implications of co-occurring symptoms of other developmental disorders and concludes that a multi-professional approach to the diagnosis and management of APD, involving speech and language therapy and psychology as well as audiology, is essential to ensure that children receive the most appropriate support and interventions.

Comment: The criteria for APD diagnosis in the USA and UK differ in that the USA recommends that tests include speech stimuli, whereas the UK criteria stipulate identification of APD using non-speech tests. Further, the USA guidelines incorporate non-audiological tests including speech & language and cognitive evaluations. This article highlights the similarities between APD and other developmental disorders such as dyslexia, developmental coordination disorder, specific language impairments, and attention-deficit hyperactivity disorder. In all of these, the disorder is broadly defined and linked to social and educational outcomes. Further, difficulties with auditory processing are often observed in these other disorders, and developmental disorders including APD are rarely restricted to one modality. This suggests that a child with suspected APD is likely to present with symptoms of another developmental disorder, and hence a cross-disciplinary approach to both diagnosis and management should be considered.

Reference: *Int J Audiol.* 2010;49(2):83-7.

<http://informahealthcare.com/doi/abs/10.3109/14992020903289808>



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The impact of health literacy on patient understanding of counseling and education materials

Authors: Nair EL, Cienkowski KM

Summary: In this investigation into patient health literacy, the researchers assessed the grade level of language used in verbal and written communication samples during routine hearing aid orientation appointments, by videotaping and transcribing patient counselling sessions, as well as transcribing hearing aid instruction guides used during counselling sessions. The Flesch-Kincaid grade level formula was used to determine the approximate United States grade level equivalent of the counselling sessions, hearing aid instruction guides, and to predict patient health literacy. As a result of their analysis, the study authors suggest that patient-predicted health literacy likely impacts on the understanding of both one-on-one counselling sessions and hearing aid instruction guides.

Comment: Previous studies have suggested that 40–80% of the information provided by a healthcare professional was soon forgotten post-appointment. One study by Martin et al. (1990 – Texas Journal of Audiology Speech Language Pathology, Vol. 16) found that of 35 adults surveyed shortly after being diagnosed with a HL by an audiologist, none of them knew what an audiogram was.

It is possible that the emotions related to being diagnosed with a HL may affect the retention of information, and hence written information may be useful. However, both the counselling discussion and the written material need to be at a language level that the patient can comprehend. As this study indicates, there is often a large discrepancy between this – i.e. the language used in the printed material and/or verbal discussions is too advanced for the average patient's health literacy level. Obviously, a fine balance lies between being comprehensible vs. being condescending, and both training and experience in audiological counselling would assist less experienced audiologists.

Reference: *Int J Audiol.* 2010;49(2):71-5.

<http://tinyurl.com/2da7h8v>

Independent commentary by Dr Valerie Looi, a Senior Lecturer in Audiology for the Department of Communication Disorders at the University of Canterbury. Her primary areas of research are in the field of cochlear implants, along with the music perception of those with a hearing impairment. She is particularly interested in developing a music training programme for cochlear implant users.

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Diagnosing cochlear dead regions in children

Authors: Malicka AN et al

Summary: These researchers sought to determine the consistency of the fast-Psychophysical Tuning Curve (PTC) and Threshold Equalising Noise (TEN) tests in diagnosing a dead region (DR) in 12 hearing-impaired children (21 ears). In addition, the masked thresholds for eight normal-hearing children (16 ears) were measured with different TEN levels to assess whether any age-related effect exists in children compared with adults. The study participants were aged 7–13 years. For the TEN test, the masked TEN thresholds measured for normal-hearing children were usually below and never exceeded 5 dB above the normed TEN level per averaged equivalent rectangular bandwidth, indicating a lack of age-related effect on masked thresholds in children compared with adults. All hearing-impaired children were able to perform the TEN test and fast-PTCs. The results of the two tests were consistent in 17 of 21 ears (81%): eight ears did not show evidence of a DR and nine ears did. In three ears, the criteria for a DR were met on the TEN test, but there was no evidence of a DR on the fast-PTC test. In one ear, the TEN test did not show evidence of DRs at two frequencies, whereas fast-PTCs did.

Comment: A cochlea DR is an area where the inner hair cells and/or neurons are absent or significantly impaired, resulting in a tone that produces maximum vibration at this point on the basilar membrane being detected at a different place. This can result in abnormal pitch perception, rapid and unpredictable loudness growth, pitch distortion, and impaired speech and music perception. There have been studies suggesting that amplification should not be provided at frequencies where DRs lie, as it may have a deleterious effect on speech perception, and hence tests have been developed to identify the location and extent of these DRs – PTCs, and the TEN test.

This article examined the use of these tests in children down to age 8, with regards to sensitivity, specificity, clinical applicability, and determining suitable paediatric diagnostic criteria. The TEN test is faster to complete, however, the PTCs are considered to be more reliable as the TEN test is associated with more false positives. The authors recommend first doing the TEN test, and then using PTCs (with an adapted fast-procedure) if the TEN test results are outside the normal limits (i.e. masked thresholds are 10–14 dB above the normed TEN level). More details on the application and interpretation of both of these tests are provided in the article.

Reference: *Ear Hear.* 2010;31(2):238-46.

<http://tinyurl.com/29nhbm4>

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