Hearing Review™

Making Education Easy

Issue 14 – 2009

In this issue:

Welcome to the fourteenth issue of Hearing Review.

One of our studies profiled this month discusses the waking effectiveness of smoke alarms (auditory, visual and tactile) for adults who are hard of hearing. The ability for such people to wake to smoke alarms is of paramount importance; these study results should be disseminated throughout the community.

Three of the studies look at the issue of candidacy for cochlear implantation; two regarding children, and one for adults. One explored clinician views and experiences relating to the cochlear implantation of children with hearing outside typical audiological criteria for candidacy; another looked at factors affecting the referral process for cochlear implantation in children; and the third looked at pre-operative levels of residual hearing for potential adult recipients. It would be interesting to compare these findings with similar investigations among New Zealand children.

I hope you enjoy the latest edition and welcome your comments and feedback.

Kind regards,

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Enjoyment of music by elderly hearing-impaired listeners

Authors: Leek MR et al

Summary: This article reports on 68 elderly hearing-impaired subjects (average age of 75 years) with regard to listening to music whilst wearing their hearing aids (HAs). The data were acquired via telephone interviews based on 37 questions. Ninety-three percent of the participants had a sensorineural hearing loss due to noise exposure or presbycusis. Hearing losses ranged from mild to moderately severe. Seventy-eight percent of participants reported wearing their HAs while listening to music. Twenty-eight percent reported that their hearing losses affected their enjoyment of music. The most common complaints reported were loudness (too loud or too soft) and/or that it was difficult to understand the words within the music.

Comment: Although 78% of respondents reported wearing HAs for music, 37% of these indicated that HAs made no difference. Although the main goal of HA fitting is usually to improve speech perception, music listening is often another important auditory stimuli for patients. Music as an acoustic signal has significantly greater variability in amplitude levels and frequencies compared to speech, and therefore the sound processing parameters of HAs may need to be modified. Difficulty understanding lyrics, poor sound quality, and distorted pitch/melodies are common complaints. The latter two may be related to both factors surrounding the sound processing capabilities of HAs compounded with physiological changes associated with hearing loss. The former would be comparable to a speech in noise condition where the listener needs to separate the speech signal (lyrics) from the background (music).

Reference: J Am Acad Audiol. 2008;19:519-26

http://tinyurl.com/c66npm

Bone conduction auditory steady state response: Investigations into reducing artifact

Authors: Brooke RE et al

Summary: These researchers examined electromagnetic artifact in bone conduction auditory steady state responses (ASSRs) and sought to determine how to reduce the level of stimulus artifact. ASSR stimuli consisted of sinusoidal tones with the carrier frequencies 500, 1000, 2000, and 4000 Hz that were 100% amplitude modulated at 83, 87, 91, and 95 Hz, respectively. Artifacts were observed at the modulation rates of the 1000-, 2000-, and 4000-Hz carrier frequencies, they were proportional to stimuli intensity and were observed when using sampling rates of 1000 and 2000 Hz but not 1250 and 1600 Hz. Altering the electrode lead/transducer cable layout and orientation of the B-71 transducer significantly affected the amplitude of the artifact. Using grounded screens to screen the B-71 transducer and cable reduced the amplitude of the artifact to a level that was not significantly above background noise. A mu-metal screen had a significantly greater effect than aluminum or copper.

Comment: ASSRs are an objective method to estimate behavioural puretone thresholds and can be used for a similar purpose to tone-burst ABR (auditory brainstem response) testing. Like the ABR and behavioural tests, both air and bone conduction (BC) thresholds are required to differentiate the type of loss. Stimulus and electromagnetic artifact are two common problems in obtaining BC ASSR thresholds. This article provides some useful suggestions for reducing artifact through minor equipment and procedural changes. An interesting point raised that applies to both ABR and ASSR is that the interaural attenuation in neonates may be larger than for adults as their skull bones are not fused, which would lessen the need for masking.

Reference: Ear Hear. 2009;30(1):23-30
http://tinyurl.com/d7og8q

Another cause for conductive hearing loss with present acoustic reflexes

Authors: Ebert CS Jr et al

Summary: This report highlights the importance of obtaining a thorough history and of performing a complete examination, including audiometric testing and radiographic evaluation when necessary, before diagnosing the cause of adult onset unilateral conductive hearing loss. The authors present the case of a patient with an intact tympanic membrane, no history of ear disease or trauma who as an adult developed progressive, conductive hearing loss because of an anomalous course of a dehiscent facial nerve. The authors advise that, for the patient with a conductive hearing loss and at least partially intact reflexes, clinicians must consider superior semicircular canal dehiscence, fracture of the stapes superstructure proximal to the tendon, other third window phenomena, and now dehiscence of the facial nerve resulting in decreased mobility of the ossicular chain.

Comment: A unilateral, adult-onset, progressive conductive hearing loss with no history of otitis media, tympanic membrane perforation, or trauma may result for a number of reasons, the most common being otosclerosis, ossicular chain fixation, and superior semicircular canal dehiscence. In this case study, the diagnosis of otosclerosis was made. Carhart's notch was noted on the audiogram; however, unlike a typical otosclerotic presentation, the patient had acoustic reflexes at 500 and 1000 Hz. The finding was Facial Nerve Dehiscence which reduced the mobility of the ossicular chain. Although this is relatively uncommon, it highlights how certain clinical presentations can result from a host of conditions; be wary of jumping to conclusions!

Reference: Laryngoscope. 2008;118(11):2059-61
http://www3.interscience.wiley.com/journal/121605681/abstract

Risk factors of hearing impairment in Indian children: a retrospective case-file study

Authors: Rout N et al

Summary: These researchers sought to determine causative factors of hearing impairment among school-aged children in India, using data obtained from 1000 case files. The mean age of hearing loss (HL) detection was 3.03 years and the mean age of HL identification by audiological rehabilitation was 7.38 years. Significant predictors of hearing impairment included prenatal diseases, exposure to X-rays during gestation, premature delivery, low birth weight, postnatal jaundice, neonatal seizures and rubella.

Comment: This interesting study looks at the identification of HL for infants in India. In a country with the population of India, a national universal hearing screening programme may not be feasible, and definitely unlikely in the immediate future. With a population over 1 billion, a birth rate of 22.69/1000 (i.e. 22,690,000 births), and over 3 million children under 6 years of age, universal screening would be an overwhelmingly large task. It is concerning that the mean identification age of HL of 3.03 years, with 2/3 having their HL identified between age 1.65–4.41 years, and the mean age where audiological intervention was received of 7.38 years. The study also found that the use of a high risk register (HRR) screening system may be beneficial in that <1% of the children identified with a HL had no risk factors, with 62% having 1 risk factor, and 32% having multiple risk factors. So possibly in a country with the population of India, a HRR screening programme may be a worthwhile compromise.

Reference: Int J Rehabil Res. 2008;31(4):293-6
http://www.ncbi.nlm.nih.gov/pubmed/19008677

Research Review publications are intended for NZ Medical Professionals.

Independent commentary by Dr Valerie Looi, a 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.

Effect of preoperative residual hearing on speech perception after cochlear implantation

Authors: Adunka OF et al

Summary: The effect of substantial preoperative residual hearing on speech perception outcomes was examined in 29 adult patients who underwent cochlear implantation. Twenty-one implant recipients matched for age and duration of hearing loss, but without preoperative residual hearing, served as controls. Postoperative speech perception was assessed at 1, 3, 6, and 12 months after implantation, using the City University of New York sentence Consonant-Nucleus-Consonant (CNC) and Hearing In Noise test in quiet and in noise (+10 dB signal to noise ratio). No significant between-group differences were observed for any of the test results. The mean change in speech perception abilities from baseline was significantly greater for controls than those with substantial preoperative residual hearing at a number of the time intervals across the various conditions. Some patients in the residual hearing group experienced initial declines in their speech perception scores, but ultimately, all of the patients with substantial residual hearing surpassed their preoperative performance.

Comment: The title of this study is a little misleading; it looks more at outcomes for patients whose pre-surgery speech perception scores are better than the typical implantation criteria. Their findings are consistent with similar studies, and emphasise the need for careful counselling if a patient's performance exceeds the implantation criteria. Most patients do achieve even better speech perception outcomes with their CI, but take longer to obtain these scores and/or can experience diminished speech perception in the initial months after implantation, when compared to pre-surgery scores. This is less likely to be an issue in NZ due to the funding and current waiting lists, but may arise for a few who consider going privately, in which case careful counselling would be even more important.

Reference: Laryngoscope. 2008;118(11):2044-9.
http://tinyurl.com/c7k7c4

Pediatric cochlear implantation: How much hearing is too much?

Authors: Fitzpatrick E et al

Summary: This Canadian study examined clinical practice related to the cochlear implantation of children with hearing outside typical audiological criteria for candidacy. Practitioners' perspectives on the process and the factors influencing candidacy decisions were explored through focus group interviews with hospital and school-based practitioners. Qualitative analyses informed a questionnaire designed to further explore clinician views and experiences. Responses from 11 cochlear (CI) implant centres indicated that most were willing to consider these children as potential recipients, however they needed more careful and in depth assessment. The definition of 'borderline' varied across the programmes from approximately 70 dB HL to <90 dB HL. All centres emphasised the importance of considering factors beyond the child's audiometric thresholds in candidacy decision-making.

Comment: Another study in this issue of HRR looked at the implantation of adults exceeding the usual CI criteria. This study looks at a similar issue for children, but from the clinician's perspective. Usually a CI is recommended when a child receives limited benefit from conventional amplification; however, what constitutes 'limited benefit'? A key issue is the ever-evolving boundaries of implantation. Issues discussed in this article include defining borderline hearing, assessing more than just the audiogram, age, management post-CI, other factors affecting decision-making (e.g. parental and teacher input, the use of HAs), and having a 'waiting period' for borderline cases. Overall, for borderline cases, comprehensive assessment requires extending beyond just hearing and speech perception results, and involves a range of personnel and input.

Reference: Int J Audiol. 2009;48(2):91-7

Access to cochlear implant candidacy evaluations: Who is *not* making it to the team evaluations?

Authors: Wiley S and Meinzen-Derr J

Summary: These researchers investigated trends in the referral process among paediatric CI candidates, by reviewing data from medical and audiological charts between 2003 and 2005, of children aged ≤5 years with moderately-severe or worse sensorineural hearing loss. Of the 105 audiograms meeting the inclusion criteria, 69% were referred for a CI, with 52% being considered as definite candidates for an implant by audiologists with expertise in CI clinical work. Children referred for an implant, compared to children who were not referred, were more likely to have married parents (91% vs 70%; p=0.02) and more likely to have private insurance (56% vs 29%; p=0.02).

Comment: Some studies have shown that affluence, income, race, and type of insurance can affect access to a CI, or more specifically referral for a CI. Although not all findings may be as relevant here in NZ (e.g. insurance issues), it would be interesting to see if factors such as income, parental marital status, race, and other such demographic factors are correlated with referral patterns for a CI. Of more direct relevance and concern were the low agreement rates (66%–68%) between audiologists in determining which children should/should not be referred for a CI. This was regardless of whether the audiologists were clinical CI audiologists or not. This would also have an impact on referrals for a CI. Once referred, the implantation criteria are fairly defined and structured; however, it seems that referral guidelines may need to be more explicit to ensure better consistency.

Reference: Int J Audiol. 2009;48(2):74-9
http://www.informaworld.com/smpp/content~db=all?content=10.1080/14992020802475227

Impact of occupational noise on pure-tone threshold and distortion product otoacoustic emissions after one workday

Authors: Müller J and Janssen T

Summary: This study investigated whether distortion product otoacoustic emissions (DPOAEs) usefully detect small changes in cochlear amplifier functionality after occupational noise exposure of one workday, and whether efferent reflex strength of the medial olivocochlear bundle predicts the ear's susceptibility to noise. High-resolution ($\Delta f2$ = 47 Hz) DPOAEs were recorded between 3.5 and 4.5 kHz at close-to-threshold primary tone levels. Pure-tone audiometry (PTA) served as a comparator. Efferent reflex strength was measured using DPOAEs at a specific frequency with and without contralateral acoustic stimulation. Changes were statistically significant for pure-tone thresholds (ΔLht = +1.6 dB, n=155) and DPOAE levels (ΔLdp = –1.0 dB, n=646; L2 = 20 dB SPL) in factory workers but not in office workers (ΔLht = –1.3 dB, n = 80; ΔLdp = 0.0 dB, n=336) (controls).

Comment: Industrial audiology and noise exposure at work are ever-present concerns. The clinical application of this paper is that it may help determine effective and efficient methods to monitor hearing levels for employees exposed to potentially hazardous noise levels at work. Although there was little difference between the sensitivity of PTA and DPOAEs for measuring changes in hearing, DPOAEs provide the advantage of being objective and faster – important considerations if regular monitoring is to be performed, particularly if conducted after an employee's shift finishes. An issue of consistent ear probe calibration was raised as a possible limiting factor. Both the DPOAE and PTA results indicated that hearing levels of factory workers decreased after one 8-hr day at work, compared to no change for office workers. The article did not mention the use of hearing protection for the factory workers, however.

Reference: Hear Res. 2008;246(1-2):9-22

http://tinyurl.com/cwynvr

Hearing loss and paid employment: Australian population survey findings

Authors: Hogan A et al

Summary: Outcomes are reported from an analysis of participation in paid employment for adults with a hearing loss (HL), using data from the 2003 Australian survey of disability, aging and carers (SDAC). HL was associated with an increased rate of non-participation in employment of between 11.3% and 16.6%. Advancing age and the existence of co-morbidities contributed significantly to reduced participation in employment. Women and those with low education and communication difficulties were disproportionately affected. After controlling for co-morbidities, HL was associated with a 2.1% increase of non-participation in employment, a proportional difference of 1.4 times the population. People with HL were less likely to be found in highly skilled jobs and were over-represented among low income earners.

Comment: The shift to service and communication jobs, and the current global economic state, make the issues addressed in this study highly relevant. In addition to a higher risk of unemployment, those with an HL may be more at risk of underemployment – i.e. under-represented in professional/managerial roles, and over-represented in blue-collar positions. The study found that hearing difficulties reduced workforce participation, particularly for females, older age, those with no post-school qualifications, and those with another health condition. Further, those with communication difficulties and/or those who used a hearing device reported greater restrictions in: the type of work they did in their current employment, their ability to change jobs, and their ability to obtain their preferred job. These employment issues impact on quality of life.

Reference: Int J Audiol. 2009;48(3):117-22

http://www.informaworld.com/smpp/content~db=all?content=10.1080/14992020802449008

Smoke alarms for sleeping adults who are hard-of-hearing: comparison of auditory, visual, and tactile signals

Authors: Bruck D and Thomas IR

Summary: This study compared waking effectiveness of auditory, tactile, and visual signals at a range of intensities. Thirty-eight adults with mild to moderately severe hearing loss of 25 to 70 dB (in both ears) were tested during deep sleep cycles (verified via EEG) with various stimuli: a bed-shaker, a pillow-shaker, three auditory signals, and strobe lights. The most effective waking signal was a 520 Hz square wave presented at 75 dB(A), which woke up 92% of the participants, compared with 56% waking to the 75 dB(A) high-pitched alarm. Strobe lights only woke 27% of the participants; bed- and pillow-shakers woke 80 to 84%.

Comment: This was a very interesting study on an important, but often overlooked, issue. Smoke alarms are (or should be) installed in most houses. However, most alarms use a high frequency signal, and the most common type of HL is a high-frequency HL. The USA standards are that alarms need to be 75 dB(A) at the pillow. With research suggesting that the difference in detecting a signal when awake vs. asleep is approximately 40 dB, this suggests that a 75 dB(A) signal may not be reliably detected by someone with a moderate or worse high frequency HL when asleep. The study evaluated a range of types of alarms, finding a 520 Hz square wave to be the most effective, awakening 92% of participants. However, for those with greater levels of HL, both an auditory and tactile alarm (e.g. bed- or pillow-shaker) may be worthwhile.

Reference: Ear Hear. 2009;30(1):73-80

http://tinyurl.com/c3vdel