Hearing Review™

Making Education Easy

Issue 16 – 2009

In this issue:

Welcome to the sixteenth issue of Hearing Review.

Amongst the topics covered in this issue of Hearing Review Research, we discuss the risk of hearing loss from iPod use, how universal newborn hearing screening reduces the age at which hearing loss is detected and intervention initiated, the advantages and disadvantages of bimodal vs. bilateral cochlear implants, and an investigation into the long-term effectiveness of the bone-anchored hearing aid (BAHA) in adults with single-sided deafness.

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

Kind regards,

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Survey of college students on iPod use and hearing health

Authors: Danhauer JL et al

Summary: These researchers designed and implemented an 83-item questionnaire to evaluate college students' knowledge and practices regarding use of iPods and/or other personal listening devices (PLDs) and hearing health. Six hundred and nine students responded from 47 different universities across 33 US states. The type of PLD owned by most students was iPods (66.2%), and only 6.1% said that they did not own any device. Seventy-six percent of respondents listened to their iPods using earbud-type earphones. Based on a loudness scale of 1 through 10, 71% of participants self identified as listening at ≥60% of full volume, 50% of participants reported listening at ≥70% of full volume, and 25% listened at ≥80% of full volume.

Comment: In addition to the obvious sound output level, other features that increase the risk of iPod-related hearing loss include a large memory capacity to allow users to listen uninterrupted for long time periods, and poor quality earbuds without noise suppression. A previous study has shown that when listening in background aeroplane noise, listeners using iPod earbuds averaged levels 11 dB(A) higher than those using earphones with passive noise-suppression.

This large-scale study targeted American college students, using an 83-item online questionnaire developed for the study. The questionnaire is provided in the article, and may be a useful guide for clinicians. It assesses participant's knowledge of hearing health, iPod listening habits, attitudes to, and reasons for iPod use. With 2 in 3 college students using an iPod, with most having earbud phones, the need for age- and lifestyle-appropriate education is obvious. The study suggested that such education may be most effective via statements on the internet or TV made by doctors or other experts, along with warnings on the device or device packaging.

Reference: J Am Acad Audiol. 2009;20(1):5-27.
http://www.ingentaconnect.com/content/aaa/jaaa/2009/00000020/00000001/art00004

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.

Perception of envelope-enhanced speech in the presence of noise by individuals with auditory neuropathy

Authors: Narne VK and Vanaja CS

Summary: This study was designed to investigate whether enhancement of the speech envelope improves speech identification in the presence of noise for 15 patients with auditory neuropathy (AN). Their open-set speech identification abilities were assessed for unprocessed and envelope-enhanced speech presented in quiet and at three signal to noise ratios (SNRs) (10, 5, and 0 dB SNR). Speech identification ability was affected more for the noisy than quiet conditions. The participants were classified into two groups, Good Performers and Poor Performers, based on their speech identification scores in quiet. The reduction in mean speech identification scores in noise was less for Good Performers compared with Poor Performers. Envelope enhancement of the signal improved speech identification scores in both the groups. Whereas Good Performers experienced significant improvements in all conditions, Poor Performers improved only in quiet and +10 dB SNR.

Comment: Speech perception in noise is hampered as the noise interferes with our ability to perceive the temporal envelope of the speech signal (i.e. the low-frequency modulations). In those with AN, the difficulties in noisy environments are significantly greater than would be expected for their level of hearing loss; research suggests that even in a +3-5dB SNR, those with AN experience significant problems. HAs have been shown to have little, if any, benefit for these individuals. Hence it may be that modifications to signal processing may be required, such as the one used in this study – enhancing the temporal envelope of the speech signal. This serves to enhance the consonant portion of the sound, while compressing the more dominant vowel portion to make the important cues for accurate speech perception more obvious, be it in quiet or noise. The one thing to consider is that the implementation of such a strategy in a HA would require pre-processing algorithms that accurately differentiate the speech signal from the background noise – a whole area of research in itself.

Reference: Ear Hear. 2009;30(1): 136-42.

http://tinyurl.com/mf9tjf

Efficacy of the bone-anchored hearing aid for single-sided deafness

Authors: Linstrom CJ et al

Summary: This study examined the short-term and long-term efficacy of the bone-anchored hearing aid (BAHA) in 7 adults with single-sided deafness after 1 month to 1 year of BAHA use. A control group consisted of 20 adults with essentially normal-hearing sensitivity, bilaterally. Outcome measures included the Hearing in Noise Test (HINT), Abbreviated Profile of Hearing Aid Benefit (APHAB), and Single-Sided Deafness Questionnaire (SSD). In the BAHA group, none of the factors (time, HINT condition, amplification status) or their interactions were significant predictors of change in signal-to-noise ratio (SNR) from baseline over time on the HINT. The mean SNR (non-baseline-subtracted) was significantly lower in the directional BAHA versus the unaided status and in the omnidirectional BAHA versus the unaided status, but only under the noise in front, speech lateralised to the bad ear HINT condition. Significant short- and long-term BAHA benefit was observed on the APHAB (all subscales except Aversiveness) and SSD (all questionnaire items).

Comment: In addition to the more common cases of conductive and mixed hearing losses, BAHAs have also received USA FDA approval for managing single-sided sensorineural deafness (i.e. a unilateral severe-to-profound loss). Existing research has shown the initial benefits of BAHAs in noisy environments when speech is on the side of the poor-hearing ear, compared to an unaided condition. However, when noise is directed to the worse ear, a BAHA disadvantage is seen. Patients also report benefits of the BAHA on subjective satisfaction assessments.

In this study, the efficacy of the BAHA was investigated over a longer time frame. Speech perception and subjective benefit results were similar to existing findings. Additionally, though, this study found that the greatest differences were between pre- and 1 month post-surgery results, with no significant change for the 1–6, or 6–12-month assessments. Omnidirectional microphones were better than directional microphones when speech was presented to the worse ear, but the former resulted in greater disadvantage when noise was presented to the bad ear.

Reference: Laryngoscope. 2009;119(4):713-20.

http://www3.interscience.wiley.com/journal/122241272/abstract

Loudness and satisfaction ratings for hearing aid users

Authors: Blamey PJ and Martin LFA

Summary: These investigators assessed loudness and satisfaction ratings using a combined loudness and satisfaction questionnaire to rate 18 everyday environmental sounds, in an analysis of 10 sets of data from four studies, covering three conditions: unaided condition, wide dynamic range compression (WDRC), and adaptive dynamic range optimisation (ADRO®). A total of 61 subjects yielded over 3,000 pairs of ratings for loudness and satisfaction. There was a significant interaction between loudness level and new/existing sounds for loudness ratings. Satisfaction ratings for the "comfortable" category were significantly higher than for all other loudness categories. Satisfaction was lowest for sounds that were "uncomfortably loud". Aided conditions gave higher loudness and satisfaction ratings than the unaided condition, and the ADRO hearing aids gave significantly higher satisfaction ratings than the WDRC hearing aids.

Comment: There are several rationales used to set the loudness levels in HA fittings. Most of these (e.g. WDRC) are based on the wearer's threshold and loudness discomfort levels. However, it would appear that many HA users are dissatisfied with their HAs' loudness levels, with one study reporting that 83% of HA users want to hear more soft sounds, and 81% want increased comfort for loud sounds.

The amplification and fitting scheme in this paper, ADRO, was developed in Melbourne, initially for cochlear implant fittings, but is now implemented in HAs as well. Its algorithm is based on the patient's perceptual comfortable levels, using 4 rules to ensure audibility and comfort. The output level does not exceed the 'Comfort' target more than 10% of the time, and does not fall below an 'Audibility' target more than 30% of the time. The Audibility target is set at approximately 20 dB less than the Comfort target. Findings suggest that ADRO may be worth trialling, particularly if a patient reports perceptual loudness issues.

Reference: J Am Acad Audiol. 2009;20(4):272-82.

http://www.ingentaconnect.com/content/aaa/jaaa/2009/00000020/00000004/art00009

Receptive vocabulary development in deaf children with cochlear implants: Achievement in an intensive auditory-oral educational setting

Authors: Hayes H et al

Summary: This study compared receptive vocabulary of 65 oral, deaf children with cochlear implants (CIs) to their hearing age-mates, looking both at overall vocabulary level and growth over time. It also investigated the effects of age of implantation on vocabulary abilities and growth rates. On average, the children with CIs had lower vocabulary scores than their hearing peers. However, the children with CIs demonstrated substantial vocabulary growth, making more than 1 year's worth of progress in a year. A negative quadratic trend indicated that growth tapered off and was less rapid with time. After controlling for the positive effect of implant year, age at implant had a significant impact on rates of vocabulary growth and acceleration. Children who were implanted early in life had steeper slopes than older-at-implant children, although the older-at-implant children's slopes tapered off less with time than the younger-at-implant group. Growth curves indicated that children who were implanted by the age of 2 years achieved receptive vocabulary skills within the average range for hearing children.

Comment: In addition to communication, receptive vocabulary development is also important for reading. Existing research has found that children with CIs have larger receptive vocabularies than profoundly deaf children with HAs, but smaller vocabularies than age-equivalent normally hearing (NH) peers. Their progress in learning vocabulary is also slower than NH children.

However, with extraneous factors such as parent education, non-verbal intelligence, communication method, age of implantation, and education setting potentially affecting outcomes, this study aimed to assess a more homogenous participant group – children from the same school for the deaf, using an auditory-oral approach, diagnosed before age 3, and implanted by age 5. The results showed that although the children were delayed when first implanted, they progressed at rates above age norms each year, to narrow the gap to NH peers. Children implanted by age 2 were able to achieve age-appropriate receptive vocabulary levels after several years of CI use.

Reference: Ear Hear. 2009;30(1):128-35.

http://tinyurl.com/mgtap7

Research Review publications are intended for NZ Medical Professionals.

Expectations, prefitting counseling, and hearing aid outcome

Authors: Saunders GH et al

Summary: This study sought to determine whether supplementing pre-fitting counselling with demonstration of real-world listening can (1) alter expectations of new hearing aid (HA) users and (2) increase satisfaction over verbal-only counselling. The study also examined the relationship between pre-fitting expectations and post-fitting outcome, as well as the effect of HA fine-tuning on HA outcome. Sixty new HA users aged between 55 and 81 years with symmetrical sensorineural hearing loss were fitted binaurally with Beltone Oria behind-the-ear digital HAs. Forty participants received pre-fitting counselling and demonstration of listening situations with the Beltone AVE™ (Audio Verification Environment) system; 20 received pre-fitting counseling without a demonstration of listening situations. Pre-fitting HA counselling had small but significant effects on expectations. The two forms of counselling did not differ in their effectiveness at changing expectations; however, anecdotally, many participants reported that they enjoyed listening to the auditory demonstrations and that they found them to be an interesting listening exercise. The data also showed that positive expectations regarding the impact HAs will have on psychosocial well-being are important for successful HA outcomes.

Comment: Determining patient expectations pre-HA fitting is vital to validate and evaluate fitting success, with approximately 15% of outcome variability being attributable to expectations. Higher expectations are usually associated with better outcomes. However, it may also be argued that unreasonably high expectations may result in unmet needs and dissatisfied patients. Pre-fitting counselling should address issues such as what a HA can and cannot do, patient attitudes to hearing loss and HAs, appropriate communication tactics & listening strategies, auditory training, and the impact of hearing loss & background noise.

This article also looks at incorporating real-world listening stimuli and tasks into the counselling process. Audiological counselling is an under-addressed issue in NZ. It is not specifically taught at the Universities, nor are there regular training programmes or professional development workshops for audiologists. It is currently predominantly 'self learnt' and/or based on experience and observations of others.

Reference: J Am Acad Audiol. 2009;20(5):320-34.

http://www.ingentaconnect.com/content/aaa/jaaa/2009/00000020/00000005/art00008

Self-perception of hearing ability as a strong predictor of hearing aid purchase

Authors: Palmer CV et al

Summary: These researchers retrospectively analysed answers from patient files of 840 hearing-impaired adults aged 18–95 years who were asked the following question by audiologists: "On a scale from 1 to 10, 1 being the worst and 10 being the best, how would you rate your overall hearing ability?" This question was posed in the clinic as a means of quantifying patient readiness for amplification. Outcomes data were consistent with previous research showing a lack of relationship between hearing threshold data and self-perceived hearing difficulties. According to this analysis, someone with a significant degree of hearing loss, according to an audiometric exam, who perceives little to no hearing difficulty (e.g., with a self-perceived rating of 8 to the question) may decide not to pursue treatment options. On the other hand, someone who exhibits a mild degree of hearing loss but perceives difficulty may pursue treatment (e.g., a self-perceived rating of 3).

Comment: Following on from the study above by Saunders and colleagues, another issue that should be addressed pre-HA fitting is their readiness for amplification. There is little correlation between hearing thresholds, and either self perception of hearing loss, or satisfaction with HAs. This study used a single question asking patients to rate their perceived overall hearing ability using a 10-point numerical rating scale. Such a question could help clinicians quickly determine a person's readiness to pursue treatment and/or to help determine levels and type(s) of counselling required. The authors suggested that those with ratings of '6' or '7' required the most information and counselling. It should be highlighted that the use of a single question would NOT be a substitute for subjective questionnaires such as the COSI, or clinician-patient questions and interaction.

Reference: J Am Acad Audiol. 2009;20(6):341-7.

http://www.ingentaconnect.com/content/aaa/jaaa/2009/00000020/00000006/art00004

Newborn hearing screening speeds diagnosis and access to intervention by 20–25 months

Authors: Sininger YS et al

Summary: These researchers took advantage of the staggered start-up of Newborn Hearing Screening programmes in California between 2002 and 2005 to identify a cohort of 63 infants and toddlers, all of whom had verified hearing loss; 46 had been screened for hearing loss at birth and 17 had not. In a comparison of outcomes between children who had been screened and those who had not, those who had been screened as newborns were diagnosed an average of 24.6 months earlier, fitted with amplification 23.5 months earlier, and enrolled in early intervention programmes 19.98 months earlier. Screening status did not influence delays in fitting of amplification or enrolment in intervention following diagnosis. Seven of the infants with hearing loss passed the NHS, and the ages at benchmarks of those children were slightly but not significantly earlier than infants who had not been screened.

Comment: This longitudinal study investigated 63 hearing-impaired children (mild to profound losses) born during the roll out of Universal Hearing Screening in California. Of the 46 children who were screened, concerningly, 7 of these children 'passed' (i.e. false negative result). Those who failed the screen (i.e. true positive) had significantly lower ages of diagnosis, amplification fitting, and enrolment in early intervention than those not screened. The time advantage was, on average, approximately 2 years for diagnosis & hearing aid fitting, and 20 months for early intervention, for those screened vs. not screened. Also of interest was the trend for the 7 children who passed screening to have earlier diagnosis, amplification fitting, and early intervention than those never screened. It may be that the screening process itself educated the parents, and increased their awareness of hearing (loss).

Reference: J Am Acad Audiol. 2009;20(1):49-57.

http://tinyurl.com/myu3wl

An implementation study of neonatal hearing screening in the Netherlands

Authors: Uilenburg N et al

Summary: This investigation sought to determine the feasibility of integrating universal neonatal hearing screening into the existing Youth Health Care Program (YHCP) in the Netherlands. A screening programme was chosen that consisted of a three-stage transient evoked otoacoustic emission (TEOAE) screening, performed in three different screening settings by nurses from the YHCP: 1) at home in combination with screening for metabolic diseases (within 4–7 days of birth), (2) at home in combination with the first home visit (within 3 weeks of birth), and (3) the well baby clinic in a special screening session (within 4 weeks of birth). Screening was performed on 3114 healthy newborns. The setting where universal neonatal hearing screening is integrated with the screening for metabolic diseases, proved to be most efficient and effective. This setting also had the highest participation rate (88.9%) and the lowest overall refer rate (1.4%).

Comment: The Netherlands has had national hearing screening since the 1960s, using a distraction test performed during an infant's 1st year of life, as part of the country's YHCP. Although coverage is approximately 95–96% of babies, an ever-increasing refer rate, false positive rate, and late diagnosis age (at least 18 months of age), led the Government to consider Universal Neonatal Hearing Screening.

After trialling the 3-stage TEOAE screening protocol, this feasibility study recommended a 3-stage screening procedure (Stages 1 & 2: TEOAE; Stage 3: A-ABR), to be conducted at the neonate's home, when they were also screened for metabolic diseases (4–7 days after birth). Unlike NZ, in the Netherlands 30–35% of babies are born at home, with 85% of hospital births being discharged within 24 hours of birth, hence hospital-based screening is not feasible. Follow-up screening would also be done at home, all in conjunction with the YHCP.

Reference: Int J Audiol. 2009;48(3):108-16.

http://www.informaworld.com/smpp/content~content=a909498133~db=all~jumptype=rss

What to do with the other ear after cochlear implantation

Authors: Tange RA et al

Summary: In the light of growing experimental evidence demonstrating that binaural stimulation is of great importance to achieve the best results of auditory rehabilitation, this paper reviews factors that impact upon the choice between bilateral cochlear implantation (i.e. 2 cochlear implants (CIs)) and bimodal stimulation (i.e. 1 CI and 1 or 2 hearing aid(s)). The paper shows that cortical auditory evoked potential measurements can be an important decision-making tool for bilateral implantation in young children. Bimodal stimulation is used by this clinic for patients with enough residual hearing in the non-implanted ear. The authors of this paper discuss the decision trees used in their centre to determine cochlear implantation CI candidacy.

Comment: Binaural hearing advantages are well known, with interaural communication between the central auditory pathways assisting sound localisation and listening in complex environments. This is the case for normally hearing (NH) listeners as well as those using hearing aids (HAs) and/or CIs.

This article provides a concise overview of the advantages and disadvantages of bimodal vs. bilateral CIs. Bilateral CIs are recommended for children post-meningitis, those with Usher's syndrome, and those younger than 4 (still aged within the sensitive period for learning language), who are not benefiting from optimally fitted HAs. The assessment of HA benefit should be made using objective measures such as cortical auditory evoked potentials, as research has shown P1 latencies to reduce (i.e. become more similar to age-equivalent NH peers) after a period of appropriate amplification with rehabilitation.

Reference: Cochlear Implants Int. 2009;10(1):19-24.

http://www3.interscience.wiley.com/journal/121462075/abstract