

Hearing Review™

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Issue 15 - 2009

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Welcome to the fifteenth issue of Hearing Review.

As usual, we cover a wide range of topics in this issue, from a study that considered the risk of amplified music on hearing loss and tinnitus in disc-jockeys to the psychosocial benefits of cochlear implantation in adult and paediatric populations, as well as research into the occurrence of postoperative vertigo following cochlear implantation.

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

Kind regards,

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Spatial benefit of bilateral hearing aids

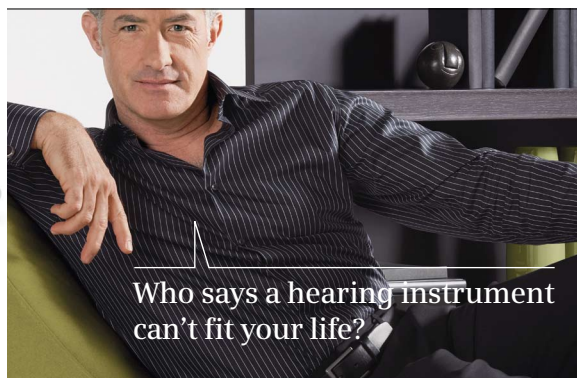
Authors: Ahlstrom JB et al

Summary: Twenty-one older adults with sloping high-frequency hearing loss provided with commercially available bilateral hearing aids were assessed at 3 to 6 months post fitting to determine the extent to which hearing aids (HAs) improve spatial benefit by restoring the availability of interaural difference cues. Speech levels corresponding to 50% correct recognition of sentences from the Hearing in Noise Test (HINT) were measured in a 65-dB SPL babble, with speech and babble low-pass filtered at 1.8, 3.6, and 5.6 kHz. The Acceptable Noise Level (ANL) procedure measured subjects' willingness to tolerate background noise with and without amplification. Thresholds for HINT sentences in babble and ANL improved significantly when aided and when speech and babble were spatially separated. Specifically, HA benefit improved significantly as cutoff frequency increased from 1.8 to 3.6 kHz but only when speech and babble were spatially separated; likewise, spatial benefit improved significantly from 1.8 to 3.6 kHz but only in the aided condition. No further improvement in HA or spatial benefit was observed when cutoff frequency was increased from 3.6 to 5.6 kHz.

Comment: Research has shown that those with a hearing loss (HL) have greater difficulty localising sounds and perceiving speech in noise, and obtain less benefit from spatial separation of speech and noise sources than those with normal hearing (NH). The ability to effectively use interaural timing difference cues would improve the functional signal-to-noise ratio. This study found that bilateral HAs provided some benefit, but the amount of benefit was less than predicted. This may have been due to the HAs being unable to restore speech audibility across the entire frequency range, that the participants could not effectively use the extra cues, that signal distortion in HAs reduced speech intelligibility, that listeners with a HL have higher masked thresholds in background noise than NH listeners, and/or that subjects had additional peripheral and/or central impairments not corrected by amplification. For example, the participants were aged 69–83, hence factors related to aging must be considered. The lack of significant correlations between self-reported and measured speech recognition performance also highlights the need for audiologists to obtain both types of evaluations from patients.

Reference: *Ear Hear.* 2009;30(2):203-18.

<http://www.ear-hearing.com/pt/re/earhearing/abstract.00003446-200904000-00006.htm>



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Tinnitus and hearing loss in 15–16-year-old students: Mental health symptoms, substance use, and exposure in school

Authors: Brunberg E et al

Summary: These Swedish researchers surveyed 2871 15–16-year-old adolescents in mainstream schools about self-reported tinnitus, hearing loss (HL), and other disabilities. Thirty-nine percent of students reporting hearing loss (slight, mild, or moderate) versus 6% of students with normal hearing had often experienced tinnitus in the past three months. Almost no gender difference was observed among students with normal hearing reporting tinnitus (boys 6.3%, girls 5.6%), whereas a gender difference was noticed amongst hard-of-hearing (HH) students (boys 50%, girls 28%). Scores for mental health symptoms, substance use, and school problems were considerably higher in adolescents with both HL and tinnitus than in other students. Anxiety in the past three months, male gender, and alcohol consumption in the past year were associated with tinnitus in HH students. Irritation and anxiety in the past three months, disability, use of illicit drugs, and truancy predicted tinnitus in the normal-hearing group.

Comment: Research involving adults with tinnitus has shown a frequent association with a range of mental health symptoms such as depression, irritability, and difficulty concentrating. However, how about adolescents? Previous research showed that adolescents with HL experienced more mental health symptoms and school problems than those with normal hearing; the presence of other disabilities was additionally associated with increased substance use (e.g. smoking, alcohol, drugs). This study found that the co-existence of HL and tinnitus was associated with more frequent reports of problems including headaches, stomach troubles, tiredness, stress, anxiety, depression, irritability, restlessness, substance use, poor school performance, behavioural issues and bullying. Audiologists, educationalists and schools should be aware of these potential links, and programmes and/or counselling services need to be made available.

Reference: *Int J Audiol.* 2008;47(11):688-94.

<http://tinyurl.com/lk9rla>

Modification of otoacoustic emissions following ear-level exposure to MP3 player music

Authors: Bhagat SP and Davis AM

Summary: The aim of this study was to examine the effects of exposure level and duration of MP3 player music on auditory function in 20 normally hearing adults. Distortion-product otoacoustic emissions (DPOAEs), synchronised spontaneous otoacoustic emissions (SSOAEs), and hearing thresholds were measured in the participants before and after 30-minute MP3 music exposure. DPOAEs were acquired with 65/45 dB SPL primary tones ($f_2=0.842-7.996$ kHz) with a frequency resolution of 8 points/octave. A probe microphone system recorded ear-canal music levels and was used to equalise levels at approximately 85 dB(C) across individuals during the music presentation. Comparison of pre- and post-exposure hearing thresholds revealed no significant differences, but mean DPOAE half-octave band levels centered from 1.4–6.0 kHz were significantly reduced following the music exposure. Post-exposure shifts in SSOAE frequency and level were highly variable in individuals identified with SSOAEs.

Comment: Previous editions of HRR have included articles that showed that OAEs (DPOAEs and TEOAEs) can be used to predict threshold changes prior to the deterioration being noted in the audiogram. This article also evaluated SOAEs which have also been shown to be susceptible to intense sounds. As DPOAEs and SOAEs partially originate from different mechanisms, the evaluation of both can provide a more comprehensive assessment of how loud sounds affect cochlear micromechanics. In contrast to many previous studies, this study used probe microphone measurements to assess the effect of 30 minutes of 85dB(C) of music, as measured at the ear drum. Although findings indicate no short- or long-term 'damage' from this level of music listening, it must be remembered that i) most MP3 players output levels are far higher than 85dB, which only corresponds to a volume setting of approximately 60% of the maximum; many people use settings higher than this; ii) many people would listen to their MP3 for longer than 30 minutes, and iii) the measurements were made in dB(C), and not the more-conventional dB(A).

Reference: *Int J Audiol.* 2008;47(12):751-60.

<http://www.informaworld.com/smpp/content~db=all?content=10.1080/14992020802310879>

The risks of amplified music for disc-jockeys working in nightclubs

Authors: Potier M et al

Summary: To evaluate the risks of amplified music for disc-jockeys (DJs) working in nightclubs, these researchers measured sound levels within six DJ mixing booths that were playing almost exclusively "techno music". A questionnaire was used to obtain usual administrative details, weekly exposure to noise, length of time in the profession, and any known otological problems. Audiograms and tinnitus pitch matching was also performed.

Comment: The noise levels from the DJ mixing booths of nightclubs in this study ranged from 92 to 102dB(A), averaging at 99dB(A). The safe listening time for 99dB(A) is around 15–20 minutes. Hence DJs, employees and frequent patrons of nightclubs are at high risk of noise-related hearing damage. This was reflected in this study where DJs had a mean loss of 20dBHL, as opposed to the 5dBHL thresholds for the control group. Interestingly, the hearing loss for the DJs was not only noted as a 6kHz notch, but also as a low frequency loss between 125–500Hz; thresholds improved between 1 & 4kHz. Few studies describe low frequency hearing loss resulting from music exposure. Of the DJs, 76% reported tinnitus, with the pitch of the tinnitus usually corresponding to the frequency where the hearing loss was most predominant.

Reference: *Ear Hear.* 2009;30(2):291-3.

<http://www.ncbi.nlm.nih.gov/pubmed/19194290>

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.

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Reported benefits and shortcomings of cochlear implantation by patients and their significant others

Authors: Stephens D et al

Summary: Responses to open-ended questionnaires were analysed from 97 adults who had been fitted with cochlear implants (CIs) for at least six months. They were asked to list the benefits and shortcomings they experienced as a result of their implants; their partners completed similar questionnaires. A wide range of benefits was reported, predominantly acoustical and psychosocial. Most of the shortcomings were acoustical and practical. Significant others reported fewer benefits and fewer shortcomings than the patients. However, the overall pattern of responses was similar. More acoustical and psychosocial benefits were reported by those fitted with cochlear implants than by those with hearing aids or bone-anchored hearing aids.

Comment: The open-ended questionnaire used in this study consisted of two questions phrased for either the CI user or their significant other (SO): 1) List the benefits you have had from wearing your CI in order of importance, and 2) List the problems/shortcomings you have had from wearing your CI in order of importance. The questionnaires were used in two centres, one in Wales, and one in Sweden, with similar findings for the two centres. For CI users the main acoustic benefits were improved conversations, hearing everyday sounds, and the ability to use the phone. Psychosocial benefits were increased confidence and feeling alive. Major shortcomings were hearing in background noise, and also (seemingly contradictorily), telephone conversations. Recipients and their SO had similar opinions of the benefits of implantation. The authors suggest that this indicates that SO responses may be used if patients are unable to provide responses themselves (e.g. language issues, intellectual impairments, children).

Reference: *Cochlear Implants Int.* 2008;9(4):186-98.
<http://tinyurl.com/l3e5na>

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Factors that affect the social well-being of children with cochlear implants

Authors: Percy-Smith L et al

Summary: These researchers investigated whether the effect-related factors for speech and language outcomes also affected social well-being in 167 children with cochlear implants (CIs). In structural interviews, parents rated their child's level of social well-being regarding the degree of their child's personal-social adjustment. Logistic regression models and proportional odds models revealed that the communication mode at home was the most highly associated factor. A statistically significant association was found between the level of social well-being and speech understanding, speech production and vocabulary. Children who were exposed to a spoken language had considerably better odds of having a high level of social well-being compared to children with a mixture of spoken language and sign support or sign language.

Comment: The study by Stephens and colleagues reported on the left looked at the benefits of implantation reported by adults – both acoustical and psychosocial. This study looks at the latter benefits in children with CIs. Age of implantation, time with the CI, mode of communication, educational placement and gender are well-documented to correlate to speech and language outcomes. This study's results suggest that of these, communication mode (oral) and gender (female) were associated with better social well-being, as reported by the child's parents. Children with spoken language had 7.64 better odds of a high level of social well-being than children using some sign language; girls had 1.98 better odds than boys. Also, the finding that education placement was not associated with social well-being suggests that children in mainstream school settings are, on average, not experiencing significantly greater social or emotional difficulties.

Reference: *Cochlear Implants Int.* 2008;9(4):199-214.
<http://www3.interscience.wiley.com/journal/121454048/abstract>

Incidence and quality of vertigo symptoms after cochlear implantation

Authors: Krause E et al

Summary: Forty-seven adult patients undergoing unilateral cochlear implantation (CI) were assessed postoperatively for the incidence of vestibular disturbance and for the quality of vertigo symptoms. Twenty-one (45%) patients reported vertigo symptoms following CI. In 90%, the symptoms suggested an otogenic origin. The majority of patients reported paroxysmal vertigo with a duration of seconds to minutes. Typical concomitant symptoms were tinnitus, fluctuating hearing loss and vegetative reactions. Serious disablement by vertigo was rare.

Comment: Previous studies on the frequency of vertigo after CI have reported widely varying results from 0.33% to 75%. A wide range of potential causes have been proposed. Symptoms, onset, and frequency vary between patients. In this study, of the 45% of recipients who had post-surgery vertigo, onset was within 2 weeks of surgery for 58%, 34% had prolonged symptoms, and only 8% had symptoms first appearing after 2 weeks post-surgery. Based on the symptoms, the authors concluded the most common cause of vertigo was from direct damage to the vestibular organ during electrode insertion. Potential recipients need to be counselled regarding the potential of post-CI vertigo, and the nature of these symptoms. Age, sex, aetiology of deafness, and pre-operative horizontal semicircular canal function was not significantly associated with the occurrence of post-operative vertigo.

Reference: *J Laryngol Otol.* 2009;123(3):278-82.
<http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=4369992>

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Screening for hearing loss and middle-ear effusion in school-age children, using transient evoked otoacoustic emissions: a feasibility study

Authors: Georgalas C et al

Summary: This study used otoacoustic emission (OAE) testing to screen for middle-ear disorders and hearing loss in 196 school-age children. Twenty percent of children failed in both ears, while OAEs emissions could not be recorded in at least one ear in 32% of children. Younger children had higher rates of absent TEOAEs. The absence of OAEs was highly correlated with tympanic membrane changes seen on otoscopy and the presence of a type B tympanogram. As a single screening modality, OAEs had 100% sensitivity in diagnosing hearing loss worse than 30 dB, and 90% sensitivity with 64% specificity in diagnosing hearing loss worse than 25 dB, which did not improve by adding tympanometry to the screening protocol.

Comment: Even for countries/areas with Universal Newborn Hearing Screening, the addition of school-age screening can provide an advantage of detecting progressive and later-onset pathologies, which have been reported to account for up to 20% of cases of childhood hearing loss. This study looked at the feasibility of using TEOAEs to screen older children (age 6–12) for hearing loss and/or Otitis Media with effusion. The criteria used was a 'pass' if the TEOAE spectrum was recorded at least 3dB above the noise floor and halfway across the frequency bands 2–3 and 3–4 kHz. The study's results suggest that TEOAEs can be used as a screening tool for school-age children, if used to identify children with a hearing loss greater than 25 or 30 dB. Its role in screening for Type B tympanograms is less clear with a specificity of only 75%, and 69% sensitivity.

Reference: *J Laryngol Otol.* 2008;122(12):1299-304.

<http://tinyurl.com/m7d63p>

Variation in preferred gain with experience for hearing-aid users

Authors: Keidser G et al

Summary: Real life gain preferences for average input levels and comfortable loudness levels were monitored for 50 new users of the same hearing aid (HA) family at 1, 4, and 13 months post fitting, and at 1 month post fitting for 26 experienced HA users. Participants were fitted with three listening programmes (NAL-NL1, and NAL-NL1 with low- and high-frequency cuts) in the same hearing instrument family. Compared with experienced HA users, new HA users preferred progressively less overall gain than prescribed as the hearing loss increased. Gain adaptation occurred in new HA users with greater hearing loss, but was not complete at the 13-month post fitting appointment, and was not explained by changes in loudness perception. Preferences for a high-frequency gain cut by half of all study participants could not be predicted from audiological data.

Comment: Previous research has reported that for new users, less gain should be used initially, with gradually increasing gain levels post fitting. Hence some HAs have a feature that will automatically increase gain over time. However, there is debate regarding the need for this gain adaptation. This study found that new HA users only preferred approximately 2.7dB less gain than experienced HA users. The data also suggested that not all HA users had adapted to prescribed overall gain levels after 12 months of HA use, and that at 13 months post fitting, 60% preferred a different frequency response than that prescribed by the NAL-NL1 prescription. Acclimatisation is discussed as one reason for gain adaptation, where changes in the auditory system, stemming from neural plasticity, result from HA use.

Reference: *Int J Audiol.* 2008;47(10):621-35.

<http://www.informaworld.com/smpp/content-db=all?content=10.1080/14992020802178722>

Hearing aids and tinnitus therapy: a 25-year experience

Authors: Trotter MI and Donaldson I

Summary: These researchers analysed data concerning the subjective tinnitus perception of patients with audiological proven unilateral or bilateral hearing loss presenting to a tinnitus clinic, both before and after hearing aid (HA) provision, and the impact of the HA fitting on tinnitus perception. A total of 1440 patients were given HAs (826 unilateral and 614 bilateral). There was little difference in tinnitus perception between unilaterally and bilaterally aided patients with 67% of unilaterally aided patients and (69%) of bilaterally aided patients reporting some improvement in their tinnitus perception following aiding.

Comment: The Otolaryngology department of this hospital had set up a multi-disciplinary tinnitus clinic, which provided tinnitus therapy along with HA fittings (if the patient had a sensorineural hearing loss). Patients were asked if they noticed subjective improvements in their tinnitus perception post HA fitting. Of the 826 patients fitted with a unilateral HA, 350 (42%) reported more than 50% improvement in their tinnitus; for the 614 bilaterally fitted, 262 (43%) reported more than 50% improvement. More recent fittings with digital HAs resulted in significantly greater improvements in tinnitus perception being reported, when compared with older analogue HA fittings. This would make sense in view of the extra flexibility, precision, and features that digital devices offer. With research finding that tinnitus frequency often corresponds to the region of greatest hearing loss, the digital HAs should allow more specific amplification to those particular frequencies (most commonly high frequencies) whilst not over-amplifying other frequencies. These findings suggest that for patients with tinnitus and a sensorineural hearing loss, an HA fitting may help decrease their awareness of the tinnitus, and hence its subjective impact on their life.

Reference: *J Laryngol Otol.* 2008;122(10):1052-6.

<http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=2304328>

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