

Hearing Review™

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Issue 10 – 2008

In this issue:

- *Comparing ear plugs and ear muffs*
- *Introducing a “trainable” hearing aid*
- *TEN(HL) vs ATEN test outcomes*
- *Visual cues for speech comprehension*
- *DPOAEs a predictive marker for tinnitus?*
- *Paediatric myringoplasty success rate*
- *CI benefits in deaf children with disabilities*
- *What underlies unilateral sudden deafness?*
- *The potential value of the PI function*
- *Assessing very early cochlear implantation*

Welcome to the tenth issue of Hearing Review.

In this edition, we feature a couple of studies that investigated developmental outcomes after cochlear implantation in certain paediatric populations; in deaf children with associated disabilities, and in children implanted before one year of age relative to those implanted at later ages.

The remaining studies cover a wide range of topics, from an assessment of how visual cues benefit speech perception to the mechanisms underlying tinnitus and the feeling of ear fullness in acute sensorineural hearing loss.

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

Kind regards,

Valerie Looi

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Effectiveness of hearing protector devices in impulse noise verified with transiently evoked and distortion product otoacoustic emissions

Authors: Bockstael A et al

Summary: The effect of impulse noise on otoacoustic emissions (OAEs) was evaluated during use of a passive non-linear earplug or an active level-dependent earmuff. First, distortion-product otoacoustic emissions (DPOAEs) and transient evoked otoacoustic emissions (TEOAEs) were recorded in 24 subjects before, immediately after gunfire practice, and after one hour of non-exposure. Second, both types of OAEs were evaluated in 31 subjects before and after exposure during a five-day military practice. Significant differences existed between the ears in most cases; the emissions from the right ear had a tendency to be more robust. There were no significant changes in OAEs either before and after exposure, or over multiple days.

Comment: With no difference in the effectiveness of passive (ear plugs) and active (ear muffs) level-dependent hearing protectors (HP) in attenuating impulse noise, the wearer's preference should always be foremost. However, earplugs seem to give greater variability in results. This may be due to the variation in actual levels of protection obtained; earplugs are harder to wear correctly than earmuffs, and differences in inserting the plugs may partially account for the variability. This indicates that proper training on the use of HP is required.

Reference: *Int J Audiol.* 2008;47:119-33

<http://dx.doi.org/10.1080/14992020701704784>

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Client-based adjustments of hearing aid gain: the effect of different control configurations

Authors: Dreschler WA et al

Summary: This laboratory study tested the concept of self-adjustment of the gain-frequency response by evaluating feedback from 24 hearing aid users employing four different controllers with a limited number of control functions to indicate their preferences in different acoustic conditions presented audiovisually. Feedback was systematic and reproducible; the average short-term test/retest standard deviation value was 2.8 dB. Two of the control configurations featured volume/slope and volume/bass/treble keys; these proved to be more time-efficient and reliable, and were also preferred by 86% of the subjects. The control configuration did not strongly influence the end result, but the gain-frequency response from which the subjects started their adjustments significantly affected their preferred settings.

Comment: With most hearing aid (HA) manufacturers promoting the automated features of their device, this article comes from a different approach to HA design and fitting. The finding that client-based adjustments for fine-tuning settings are reliable, and often quickly achieved, is something for clinicians and manufacturers to consider. This seems to be regardless of age, or experience with HAs, although patients with flat losses are able to select their preferences faster and more reliably than those with steeply-sloping losses. The article mentions a trainable HA; with a patent for this already in place – watch this space! For those interested in trainable HAs, an article by Zakis et al. (*Ear Hearing*, 2007;28(6):812-30) may be useful.

Reference: *Ear Hear.* 2008;29:214-27

<http://tinyurl.com/6ptb4v>



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Evaluation of an aided TEN test for diagnosis of dead regions in the cochlea

Authors: Marriage J et al

Summary: Results from the original version of the threshold equalising noise [TEN(HL)] test for diagnosing dead regions (DRs) in the cochlea, using stimuli presented via headphones, were compared with results from an aided version of the test (ATEN test), in which subjects listened to stimuli presented in free field using their own hearing aids. The study involved 25 subjects aged 12–19 years with severe or profound sensorineural hearing loss. It was not possible to intensify the TEN(HL) test to give ≥ 10 dB of masking, so results were often inconclusive; fewer inconclusive results were seen with the ATEN test. More positive DR diagnoses were observed with the ATEN test than with the TEN(HL) test. However, KEMAR measurements indicated that distortion, compression, and/or feedback cancellation probably affected outcomes of the ATEN test, yielding false positives and also “missed” cases.

Comment: The identification of cochlea DRs in those with severe to profound hearing losses can be a useful predictive (or evaluative) tool on the effectiveness of amplification and/or cochlear implantation. DRs are rare when hearing thresholds are < 70 dB at the test frequency, but increasingly common with greater levels of loss above this. Although it overcame one of the initial drawbacks of the original TEN test, the aided version used in this study is not suitable for clinical use due to the impact of nonlinear processing features in hearing aids. Alternatives are suggested. An efficient and accurate test for identifying DRs would be useful both clinically and in research.

Reference: *Ear Hear.* 2008;29:392-400

<http://dx.doi.org/10.1097/AUD.0b013e3181690701>

Audiovisual perception of speech in noise and masked written text

Authors: Zekveld AA et al

Summary: This study examined the support obtained from presenting sentences auditorily (speech reception threshold test), visually (text reception threshold test), and audiovisually to 18 subjects aged 19–31 years with normal hearing. A bar pattern masked the text for 9 subjects; random dots masked the text for the remaining subjects. The text was presented simultaneously or delayed relative to the speech. Masked text substantially supported the comprehension of speech in noise; bimodal support (defined as the difference between the observed bimodal performance and that predicted by an independent channels model) ranged from 15% to 25% correct. When the text was masked by the bar pattern, delaying the text yielded negative effects in some conditions.

Comment: It is well accepted that visual cues such as lip-reading can aid speech perception in noise. This study looked at providing visually displayed words instead. The finding that such information, even if incomplete, can significantly benefit speech perception suggests that the use of automatic speech recognition systems as an assistive listening device could be more widely implemented across a range of situations. Further research is needed to investigate the impact of additional factors such as age, cognitive skills, auditory processing skills, working memory, and linguistic knowledge, on the level of benefit achievable from bimodally presented information.

Reference: *Ear Hear.* 2008;29:99-111

<http://tinyurl.com/6j3v3c>

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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Relation of distortion product otoacoustic emission with tinnitus

Authors: Ami M et al

Summary: Cochlear outer hair cell function based on distortion-product otoacoustic emissions (DPOAEs) was investigated in 49 patients with tinnitus attending a hospital-based otorhinolaryngology clinic. The group comprised 16 patients (32 ears) with tinnitus and reduced hearing, 13 patients (26 ears) with tinnitus and normal hearing, 7 patients (13 ears) without tinnitus with reduced hearing, and 13 patients (26 ears) without tinnitus with normal hearing. Mean DPOAE levels differed significantly between the four groups of patients ($p=0.00$), suggesting that reduced outer hair cell activity, as detected by reduced DPOAE levels, may manifest as tinnitus prior to any shift in hearing threshold.

Comment: The finding that there is a nonlinear relation between hearing thresholds to DPOAE amplitude in patients with tinnitus, which is further affected by a co-existing hearing loss (HL), is something clinicians should be mindful of. That is, the interpretation of DPOAE results should account for tinnitus status. For example, patients with both a HL and tinnitus had higher DPOAE levels at 1 and 4kHz than those with a HL loss but no tinnitus. The findings also suggest that another clinical application of DPOAEs is as a predictive marker for tinnitus, post-acoustic trauma. For those interested, this article also discusses the 3 main theories of tinnitus involving peripheral and central neural function.

Reference: *Laryngoscope*. 2008;118:712-7

<http://tinyurl.com/6l77v2>

Pediatric myringoplasty: factors that affect success – a retrospective study

Authors: Sckolnick JS et al

Summary: Hospital charts for 604 children aged 1–18 years were retrospectively reviewed, to evaluate the impact of patient and graft variables on the successful closure of tympanic membrane perforations treated with myringoplasty from 2000 to 2005, for a total of 777 procedures. The success of closure was significantly affected by the following variables: patient age, number of prior tubes, perforation aetiology ($p<0.000$), presence of a retained tube ($p<0.000$) as well as tube type ($p=0.016$), graft material ($p=0.001$), and history of Down's syndrome ($p=0.035$). Outcomes were not affected by season of procedure ($p=0.599$), presence or absence of adenoid tissue ($p=0.910$), prior otorrhoea ($p=0.175$), nor perforation location ($p=0.318$) and duration ($p=0.150$).

Comment: This article would be of interest to paediatric audiologists who have ever wondered about the success rate of myringoplasty, and the variables that may impact on outcomes. Apart from the perforation aetiology, factors such as the retention of the tube, tube type, graft material, number of prior tubes, and the child's age, all have a significant impact on outcomes. Increasing age (up to 9 years) decreases the odds of success by ~9% per year. Also, patients with Down's syndrome and/or chronic perforations had significantly lower success rates. The information may help with counselling and/or postulating outcomes.

Reference: *Laryngoscope*. 2008;118:723-9

<http://tinyurl.com/5tde49>

Cochlear implantation in deaf children with associated disabilities: Challenges and outcomes

Authors: Berrettini S et al

Summary: These researchers analysed post-implantation outcomes of 23 profoundly deaf children with neuropsychiatric disorders, using objective measures of speech perception, and a questionnaire administered to the parents. The results were quite variable, but overall positive, in terms of speech perception, communication abilities, and improvement in quality of life.

Comment: If a child has additional disabilities, the decision to implant is less straightforward or clear cut. Reported open-set speech perception scores for these children are lower. However, it must be asked whether routine speech tests are the best outcome measure for this population? Further, the baseline from which post-CI improvements are gauged should be appropriate for this group of children. Improved sound awareness, alertness, responsiveness, communication of needs, and overall quality of life are commonly reported; these may be more applicable areas to evaluate for this population. The assessment of CI benefit should therefore include a broader and more comprehensive range of measures than just open-set speech perception.

Reference: *Int J Audiol*.

2008;47:199-208

<http://dx.doi.org/10.1080/14992020701870197>

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A comparison between the feeling of ear fullness and tinnitus in acute sensorineural hearing loss

Authors: Sakata T et al

Summary: Investigations into 171 ears of patients admitted with unilateral sudden deafness to a hospital ENT division revealed an association between tinnitus and worse high-frequency hearing thresholds, where hearing loss was relatively severe; the association strengthened after the hearing threshold had stabilised. There was an association between the feeling of ear fullness (FEF) and the low-frequency region, where hearing loss was relatively mild; this association disappeared after the hearing threshold had stabilised.

Comment: Tinnitus and FEF are commonly reported in cases of sudden sensorineural hearing loss, although the former is comparatively more comprehensively researched. This study reported that whereas tinnitus may be predictive of hearing in the mid-to-high frequencies, with a stronger association for more significant and stable levels of loss, FEF is initially predictive of low-frequency thresholds, when the loss is mild. Once the hearing loss has stabilised, though, the association is no longer significant. This would suggest that the mechanisms underlying tinnitus and FEF are different, with the two symptoms being independent. The article discusses possible underlying mechanisms for both, speculating that FEF arises from a functional cause rather than having an organic cochlear origin.

Reference: *Int J Audiol.* 2008;47:134-40

<http://dx.doi.org/10.1080/14992020701760547>

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The performance/intensity function: an underused resource

Authors: Boothroyd A

Summary: This article discusses the potential value of the Performance versus Intensity (PI) function and is illustrated by examples from both research and clinical settings. The author explains that PI function describes recognition probability as a function of average speech amplitude, showing the cumulative distribution of useful speech information across the amplitude domain, as speech rises from inaudibility to full audibility. The basic PI function can be modelled by a cubed exponential function with three free parameters representing: (a) threshold of initial audibility, (b) amplitude range from initial to full audibility, and (c) recognition probability at full audibility. Phoneme scoring of responses to consonant-vowel-consonant words makes it possible to obtain complete PI functions in a reasonably short time with acceptable test-retest reliability.

Comment: This article is definitely worth reading for any audiologist using CVC words (e.g. AB-word lists) as part of their clinical testing. It explains the advantage of scoring these in phonemes (as opposed to whole words), a standard practice by audiologists in NZ, anyhow. Further, the benefits of presenting a sufficient number of lists to obtain an accurate PI function are also explained. Specific examples are also given of how this PI function can then provide extra information in a clinical situation for a flat moderate, flat severe, and severe high-frequency sensorineural hearing loss.

Reference: *Ear Hear.* 2008 May 8. **Published ahead of print.**

<http://dx.doi.org/10.1097/AUD.0b013e318174f067>

An exploratory look at pediatric cochlear implantation: Is earliest always best?

Authors: Holt RF and Svirsky MA

Summary: These researchers aimed to determine whether significant gains are made by children implanted before 1 year of age relative to those implanted at later ages, and whether there is behavioural evidence for sensitive periods in spoken language development, using data from 96 children with congenital profound sensorineural hearing loss bilaterally and no additional identified disabilities who were implanted before the age of 4 years. In general, the developmental trajectories of children implanted earlier were significantly better than those of children implanted later. However, the advantage of implanting children before 1 year of age versus waiting until the child was between 1 and 2 years was small and was evident only in receptive language development. Children implanted earlier in life progressed faster in oral language development than children implanted later in life.

Comment: With some reports of anaesthetic risks being 3–4 times greater in children <1 year of age than those older than 1 year, this must be counterbalanced with potential longer-term benefits of very early implantation. Although the authors concluded that the benefit of very early implantation showed only for receptive, not expressive language development, there were only 6 subjects. The study's major findings confirm existing behavioural and physiological-based research showing a sensitive period for language development, with this period seemingly shorter (<4 years of age) for spoken language development than for spoken word recognition. For non audiologists, this article also provides an overview of both behavioural and objective measures that can be used to test infants' hearing.

Reference: *Ear Hear.* 2008 March 29. **[Epub ahead of print]**

<http://dx.doi.org/10.1097/AUD.0b013e31816c409f>

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