

Hearing Review™

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Issue 19 – 2010

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Welcome to the nineteenth issue of Hearing Review and the first

for 2010. Happy New Year. I hope you all had a restful and enjoyable Festive season, and I wish you all the best for the year ahead. Our first study in this issue has implications for the evaluation of quality of life (QoL) in young children using cochlear implants. The researchers looked at the influence of cochlear implantation on a child's physical, social and emotional well-being.

Two very interesting studies that we discuss investigated the early spoken language milestones of young children with hearing loss (HL); the acquisition of their first 100-word lexicon, the emergence of the first word combinations, and the lexical content. The results of both studies may be expected to impact upon therapy/rehabilitation of children with HL.

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

Kind regards,

Valerie Looi

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Parent versus child assessment of quality of life in children using cochlear implants

Authors: Warner-Czyz AD et al

Summary: Quality of life (QoL) in children using cochlear implants (CIs) relies consistently on parental perceptions of their child's QoL. These researchers evaluated QoL in 50 preschoolers (4–7-year-olds) using a CI and their parents with the Kiddy KINDL®, an established QoL measure. Children using CIs rated their overall QoL significantly more positively than did their parents. When overall QoL data were compared between the CI users and their normal hearing peers, ratings did not differ significantly. Overall QoL correlated inversely with CI experience and chronological age, but did not correlate with implantation age.

Comment: Most QoL studies involving children with CIs ask parents to rate their child; this one additionally asks the child to make self-ratings. The paediatric QoL measure used may be of interest to clinicians, being an easy to administer 24-item questionnaire, available in a range of languages. Although it's a generic and non disease-specific measure, there are 3 versions available to suit different age groups, as well as a module for parents. See www.kindl.org for more information.

The finding that ratings from the children were more positive than those from their parents, particularly for the areas of self-esteem, family, and friends, suggests that whilst parental ratings may suffice for domains related to physical well-being and functioning, more subjective and personal dimensions should be rated by the child themselves for a more comprehensive picture. This would be even more pertinent for older children. The other finding of interest is that the children with CIs attained overall QoL ratings similar to their hearing peers.

Reference: *Int J Pediatr Otorhinolaryngol.* 2009;73(10):1423-9.

<http://www.ijporonline.com/article/S0165-5876%2809%2900380-2/abstract>

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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Music exposure and hearing disorders: an overview

Authors: Zhao F et al

Summary: These researchers reviewed the risk of hearing loss (HL) caused by exposure to loud music from various potential music exposure sources. They note that whilst it is generally accepted that excessive exposure to loud music results in various hearing symptoms such as tinnitus and potentially leads to noise-induced HL, inconsistent and scant audiometric evidence of the presence of HL caused by music exposure has led to confusion. The researchers discuss ways in which hearing status may be monitored and what prophylactic measures may be taken in order to prevent the development of debilitating hearing impairment.

Comment: Excessive noise exposure is a well researched cause of HL. Extended high-intensity noise exposure increases the shearing force on hair cells and results in a metabolic change. Repeated exposure can lead to disorganisation, fusion, and loss of the outer hair cells' stereocilia, along with damage and neurotransmitter changes affecting the inner hair cells, all of which cause permanent HL. Music and noise do differ, though, in their acoustic characteristics (e.g. frequency range, dominant frequencies, levels, etc). This informative review concentrates specifically on music. The authors conducted systematic literature searches and report on several issues related to, and rates of, HL in classical musicians, rock/pop musicians, employees working in music venues, and adolescents. It also discusses the risk of HL from personal music players, and concert and night club attendance. Tables summarising research findings are provided and serve as a useful resource.

Reference: *Int J Audiol.* 2010;49(1):54-64.

<http://tinyurl.com/ybtmhpq>

An evaluation of musician earplugs with college music students

Authors: Chesky K et al

Summary: This study sought feedback from college music majors on their responses to earplugs. A total of 323 college students were provided with earplugs for use during and following an experimental condition designed to mimic a night club; 51.7% reported music as their designated major. Feedback indicated challenges associated with earplugs in environments that are both loud and require verbal interaction. While respondents generally liked the earplugs and believed that they are valuable, most of the musicians cited problems when using the earplugs while playing music.

Comment: Despite the risks of HL from listening to music, as covered in the previous article, the use of earplugs amongst musicians is varied, with issues such as distortion, reduced communication, poorer sound localisation, discomfort, safety, peer pressure, and insufficient education being cited as contributory factors. This 3-part questionnaire explored the impact, perceived advantages/disadvantages, and use of 'proper' musician earplugs (*Etymotic ER-20*). These provided 20dB noise attenuation across all frequencies, differing from generic foam earplugs that tend to provide more attenuation of the higher than low-to-mid frequencies.

In spite of this, many of the musicians who trialled the earplugs whilst playing their instruments reported a negative impact. It is worthwhile considering that this may not be solely attributable to the impact on sound quality. Physical considerations related to dynamic movements of the mouth/jaw (e.g. when playing a wind or brass instrument) would subsequently change one's ear canal shape which may generate pain and/or cause a poor fit of the plugs.

Reference: *Int J Audiol.* 2009;48(9):661-70.

<http://informahealthcare.com/doi/abs/10.1080/14992020903019320>

Diabetes-related changes in auditory brainstem responses

Authors: Konrad-Martin D et al

Summary: These researchers sought to determine how the severity of diabetes mellitus affects auditory brainstem response (ABR) in military Veterans with (n=166) and without (n=138) diabetes and with no more than moderate hearing loss (HL). Diabetes severity was classified as insulin-dependent (IDDM), non-insulin-dependent (NIDDM), or no diabetes. ABR measures included wave I, III, and V latencies; I-III, III-V, and I-V latency intervals; and wave V amplitude; for each ear at three repetition rates (11, 51, and 71 clicks/second), and both polarities. Outcomes were stratified by three age tertiles (<50, 50-56, and 57+ years) and adjusted for pure tone threshold at 3 kHz. Compared with no diabetes, IDDM was associated with significant increases in wave V latency and wave I-V interval, and a significant reduced wave V amplitude in the younger tertile only (<50 years). Adjusting for threshold at 3 kHz had minimal effect. ABR differences were related to HbA_{1c} (a measure used to control DM) and poor circulation, not to self-reported noise exposure.

Comment: Some audiologists ask in their case-history if patients have diabetes; researchers have reported that those with diabetes have greater levels of HL than those without. Although the patho-physiology of diabetes-associated HL is unclear, theories involve elevated serum creatinine levels, thickened vessels and/or atrophy of the stria vascularis, along with outer hair cell lesion/death. This study's results suggest that the discrepancy in hearing levels between those with and those without diabetes is more marked for ages <50 years. The ABR discrepancies were noted only for patients with more severe diabetes (i.e. insulin-dependent). The authors proposed that as the effect of ABR waveforms for the younger patients in the IDDM group was observed for measures generated above the auditory nerve (e.g. abnormal wave V amplitude and latency, abnormal wave I-V interpeak intervals, but normal wave I-III intervals), this suggests the involvement of the central auditory system, in addition to the peripheral auditory system.

Reference: *Laryngoscope.* 2010;120(1):150-8.

<http://www3.interscience.wiley.com/journal/122681361/abstract>

Early language development in children with profound hearing loss fitted with a device at a young age: part I – the time period taken to acquire first words and first word combinations

Authors: Nott P et al

Summary: These researchers investigated the early spoken language milestones of 24 children with profound hearing loss (HL) from two perspectives: the acquisition of the first 100-word lexicon and the emergence of the first word combinations. These children were compared with 16 normal hearing (NH) children. Twenty-three children with HL were fitted with a cochlear implant and one with bilateral hearing aids. All of these were "switched-on" or fitted before 30 months of age and half at <12 months of age. Compared with the HL group, the NH group took significantly less time to acquire the first 50 and 100 words. The overall pattern of lexical acquisition was similar for both groups; both took a shorter time to reach the second 50 words relative to the first 50 words. The NH group produced word combinations significantly earlier than the HL group; however, the size of the single-word lexicon when word combinations emerged was similar for both groups.

Comment: The Diary of Early Language (Di-EL) used in this study is a validated measure where parents record their child's first 100 single words, along with any word combinations that emerge in this time period. It provides a more representative sample of words produced than a checklist approach. It additionally benefits parents who report being more focused and tuned into their child's initial word production.

This very interesting and informative article reports on the lexical development of both hearing and hearing-impaired children. As expected, the NH group achieved their lexical milestones earlier than the hearing-impaired children, by approx. 3-4 months; however, the pattern of lexical growth for both groups was similar – i.e. slow beginning, rapid acceleration, with word combinations emerging when single-word lexicons were between 60-70 words. This suggests that the process of language acquisition is similar for hearing and hearing-impaired children.

Reference: *Ear Hear.* 2009;30(5):526-40.

<http://tinyurl.com/y9jxqs6>



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Random Gap Detection Test and Random Gap Detection Test-Expanded results in children with auditory neuropathy

Authors: Yalçınkaya F et al

Summary: This study assessed the performance of 5 children aged 7–13 years with auditory neuropathy (AN) on the Random Gap Detection Test (RGDT) and RGDT-Expanded (RGDT-EXP). Their performance was compared with 10 normal hearing (NH) children aged 7–16 years with no auditory processing problems, who served as controls. None of the AN group was able to perform the RGDT. Gap detection thresholds (GDTs) were detected at 500–4000 Hz; composite GDTs (CGDTs) were identified for both study groups. GDT/CGDT >20 ms was considered as abnormal for temporal processing disorder. For the study group, GDTs exceeded 50 ms at 500–4000 Hz and CGDTs exceeded 50 ms. In contrast, GDTs were within normal limits for all controls except for two subjects and CGDTs were within normal limits for all except one child, whose CGDTs were slightly higher than normal. At all frequencies of 500–4000 Hz, the mean GDT was significantly higher in the AN group than in the control group. Similarly, the mean CGDT was significantly higher in the AN group than in the control group.

Comment: AN affects synchronisation activity in the auditory nerve without necessarily affecting the inner ear's amplification function. As a result, patients can hear sounds, but find it difficult to understand speech, largely attributable to impaired temporal processing skills making it difficult for them to follow the rapid transitions in speech. This study confirmed that temporal processing skills, in this case gap detection, was significantly poorer than for NH children. All children with AN had gap detection thresholds >50 ms (M = 97.5 ms, compared to the NH children M = 10.35 ms). Children need to be able to separate two tones at rates of 20ms to adequately perceive the rapid formant frequency changes in ongoing speech. This, combined with the impaired frequency resolution abilities associated with AN, would have a significant negative impact on speech discrimination.

Reference: *Int J Pediatr Otorhinolaryngol.* 2009;73(11):1558-63.

<http://tinyurl.com/yd937ea>

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Adults with auditory neuropathy: comparison of auditory steady-state response and pure-tone audiometry

Authors: Jafari Z et al

Summary: Pure-tone audiometric threshold (PTAT) and auditory steady-state response (ASSR) results were compared in 16 adults (32 ears) with auditory neuropathy/auditory dys-synchrony (AN/AD). PTAT and ASSR with high-rate stimulus modulation were measured at four octave frequencies, 500, 1000, 2000, and 4000 Hz, in each ear. The average pure-tone thresholds revealed a moderate hearing loss, with a focus on the low frequencies. Low-frequency loss audiograms were observed in almost two-thirds of the participants. At all frequencies, the ASSR estimated auditory thresholds were substantially higher than the PTAT measures. No significant correlations were observed between the PTAT and ASSR results at the 1000, 2000, and 4000 Hz frequencies, but there was a weak, significant correlation between the two measures at 500 Hz (p=0.029, r = 0.39).

Comment: It has been estimated that AN/AD has a prevalence rate of 11–15% in populations with a hearing loss. As mentioned in the previous article, poor speech discrimination is a primary characteristic of the disorder, being significantly worse than indicated by the hearing thresholds. The ASSR provides frequency-specific information and has been recommended for difficult to test individuals, those with a profound sensorineural loss, and/or where auditory brainstem response audiometry is not possible. However, the results of this study do not support its use in testing adults with AN. The authors also found that more than 60% of their participants had a low frequency/rising audiogram, probably due to the greater susceptibility of the long nerve axons which terminate in the low frequency region of the cochlea (i.e. the apical end), in keeping with the suggestion by some researchers that distal dendritic damage is associated with AN.

Reference: *J Am Acad Audiol.* 2009;20(10):621-8.

<http://www.ingentaconnect.com/content/aaa/jaaa/2009/00000020/00000010/art00006>

A naturalistic approach to assessing hearing aid candidacy and motivating hearing aid use

Authors: Walden TC et al

Summary: These researchers describe a naturalistic approach to assessing hearing aid (HA) candidacy and motivating HA use based on patient preferences for unamplified and amplified sound samples typical of those encountered in everyday living, in a cohort of 48 adults self-referred for a hearing evaluation.

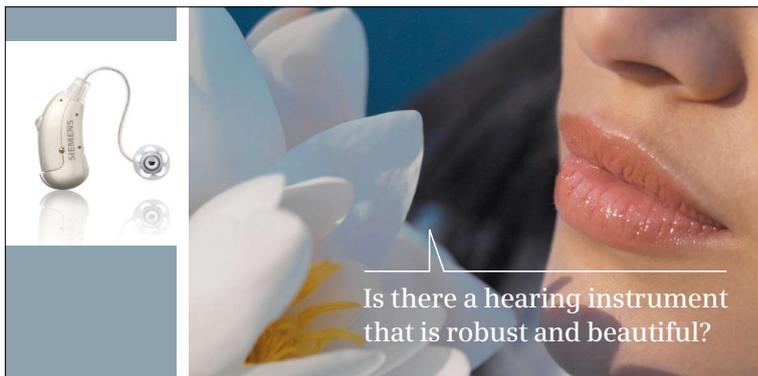
Comment: Although the results indicated somewhat mixed findings as to the use of the naturalistic sounds to determine HA candidacy, the methodology and stimuli could be a useful tool for pre- and post-fitting counselling and/or evaluating subjective benefit using everyday sounds. For example, they could be used for borderline candidates to demonstrate potential advantages of amplification, to counsel new HA users regarding realistic expectations or benefits of HA use, to compare back to situations patients report as problematic, and/or to identify areas where further assistance, training, or counselling are required. It should be noted that the amplification simulations used in this programme were not fitted to the individual's own hearing loss. Instead, only two different single-channel wide-dynamic-range compression parameters were used (mild and moderate gain settings), with no inclusion of advanced processing features such as multi-channel compression, noise suppression, microphone directionality, etc.

Reference: *J Am Acad Audiol.* 2009;20(10):607-20.

<http://tinyurl.com/ye7qwoh>

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Evaluation of nonlinear frequency compression: clinical outcomes

Authors: Glista D et al

Summary: This study investigated the use of multichannel nonlinear frequency compression (NFC) signal processing for hearing aid users, and tested both laboratory outcomes (speech recognition) and real world outcomes (functional performance and preference) with and without the NFC processor activated. The study involved 13 hearing impaired adults and 11 children with sloping, high-frequency (HF) hearing loss. Analyses of outcomes indicate that NFC processing can improve HF speech detection and speech recognition ability for adult and child listeners; however, individual outcomes vary according to factors such as degree and configuration of hearing loss, age of participant, and type of outcome measure.

Comment: Providing HF amplification to those with a severe or profound HL remains controversial. Some studies report that HF audibility provides little speech benefit when the hearing loss is severe, possibly due to limitations in the perceptual abilities of the patient to extract the information. On the other hand, other studies have demonstrated the benefits of HF information, particularly for noisy environments. It may be that the need for HF amplification should be determined on an individual basis.

Frequency lowering has been suggested as one approach to overcoming the bandwidth limitations of HAs, in order to provide such HF information. This can be achieved by frequency transposition, where HF information is shifted to lower regions by a fixed amount, or frequency compression, where the output bandwidth is compressed by a specified ratio. In this study, the use of a prototype NFC processor was trialled with adults and children, with results suggesting that children were more likely to benefit from, and prefer, the nonlinear compression. The magnitude of the HF loss and audiometric drop-off frequency were contributory factors.

Reference: *Int J Audiol.* 2009;48(9):632-44.

<http://www.informaworld.com/smpp/content~content=a912064431~db=all~jumptype=rss>

Early language development in children with profound hearing loss fitted with a device at a young age: part II – content of the first lexicon

Authors: Nott P et al

Summary: This study compared the lexical content of the first 50 and 100 words produced by the children who participated in the study discussed above. All single word and frozen phrase data from each child's Diary of Early Language were allocated to 1 of 15 word types grouped into four word categories (noun, predicate, grammatical, and paralexical). The NH and HL groups showed similar distributions of word categories, with nouns constituting the largest portion of the lexicon followed by predicates and paralexicals, and lastly by grammaticals. However, in both the 50- and 100-word lexicons, there were some between-group differences in proportional use across word categories and types. Compared with the HL group, a higher number of the NH group used grammatical word types other than adverbs (including pronouns).

Comment: The findings of this second section would assist educators in better understanding lexical development and/or in deciding if intervention should focus on certain word types or categories over others. For example, the noun bias is well established for NH infants, accounting for approximately 30–40% of their first 50-word lexicon.

The results found that although nouns dominated the 50- and 100-word lexicons, NH infants used more common nouns and pronouns, with fewer predicates and onomatopoeic words than infants with a hearing impairment. One interesting proposition by the authors was that the lexical development of children with hearing impairments may be impacted on by therapy/rehabilitation. For example, auditory-verbal therapy often encourages parents to focus on 'sound associations' such as "woof" or "sh". This may relate to the greater proportion of onomatopoeic words in the hearing-impaired children's lexicon. Additionally, parental language input may be more simplified and predictable for these children, changing the content of their lexicon when compared to NH infants.

Reference: *Ear Hear.* 2009;30(5):541-51.

<http://tinyurl.com/ydcyq22>

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