Letter to Editor

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Re: Delaroche, M., Thiebaut, R., Dauman, R. (2004) "Behavioural audiometry: protocols for measuring hearing thresholds in babies aged 4 – 18 months", International Journal of Pediatric Otorhinolaryngology 68 pp 1233 – 1243

Dear Sir

We welcome the recent publication of protocols for assessing infants hearing via behavioural methods (Int J Pediatr Otorhinolaryngol 2004; **68**: 1233 – 1243). We feel that dissemination and discussion of current audiological practice is extremely helpful, especially when examples of good practice can be shared with the wider clinical community. However there are several issues that are raised within this

publication that we feel are not necessarily representative of current knowledge and best practice within Audiology.

The authors appear to underestimate the capabilities and importance of certain electrophysiological techniques in threshold estimation in young infants (i.e. less than six months) stating that threshold determination over the normal audiometric frequencies is not possible using these techniques. Contrary to this, there is a significant body of evidence suggesting that Auditory Brainstem Response (ABR) testing using low and high frequency tone bursts [1, 2, 3, 4] delivered through air conduction and bone conduction transducers [5, 6, 7, 8, 9] and Auditory Steady State Responses [10, 11, 12, 13, 14, 15, 16] are capable of providing accurate, ear and frequency specific and time efficient threshold data across the audiometric frequencies (i.e. 0.5, 1, 2 and 4 kHz) as well as determining the nature of the hearing impairment.

Relevant literature [17, 18, 19] question the reliability of behavioural methods in determining hearing 'thresholds' for infants under six months of age, drawing attention to the fact that such responses in young infants are normally suprathreshold, are dependant on tester experience and prone to tester bias, are greatly influenced by the developmental level of the infant and demonstrate wide variability. We therefore contest the assertion that threshold information obtained from behavioural methods should be given more credence than threshold information obtained by objective test methods for this population. An appropriate use of behavioural audiometry in this population would be to reinforce the results of electrophysiological tests or to demonstrate the benefit of amplification provision and reassure the clinician that over-

amplification is not evident. However, even in this use, a test protocol should include systematic measures of observer behaviour (i.e. to determine the observers ability to discriminate between the infant's responses to stimuli or random activity not linked to stimuli) and observation of the infant during periods of stimulation and non-stimulation ('no sound' trials). We are concerned that there is no mention of such controls within the Delaroche protocol.

We are also surprised by the authors' choice of air conduction transducer. They describe using transducers that satisfy ISO standard [20] and a foam pad (this standard does not describe transducers in detail. A more relevant standard would be [21]). We presume from the photographs included in the publication that earphones encased in supra-aural enclosures (such as Telephonics TDH39, 49 or 50 transducers in MX41/AR cushions) are used. No reference is made to the use of insert earphones (such as Etymotic Research ER-3A) that are now widely used in UK paediatric audiology centres. The benefits of insert earphones are well established and include reducing the effects of noise on the auditory thresholds of the test ear [22], increasing interaural attenuation and reducing the need for masking [23, 24, 25, 26], preventing ear canal collapse [22] and translating results into dBSPL relative to a 2cc coupler when prescribing hearing aids.

The authors repeatedly describe obtaining 'threshold' information. Behavioural procedures such as those described in the Delaroche Protocol are obviously non-directed procedures, that is, the infant is not asked to attend to sound and therefore is not likely to respond at absolute threshold. For this reason 'minimum response level' (MRL) provides a better description of the infants observed responses [27]. Although

this correction may appear pedantic, knowledge that an infants response is not likely to be ‘threshold’ is important when interpreting results and prescribing hearing aids [28].

It is our belief that the Delaroche Protocol is inefficient and is likely to increase the time taken to achieve accurate assessment of frequency and ear specific minimum response levels. The test order described in the procedure for infants over six months of age (including stimulus level and frequency as well as air and bone conduction stimulus delivery) is also, in our opinion, a point of contention. The Delaroche protocol begins using a two-tone whistle that corresponds to approximately 2000 and 2500 Hz at a stimulus level of 30 dB (the authors do not stipulate the decibel scale used, see [29] for a review of current practice) presented in the sound field. This stimulus is increased in 10 dB steps until ‘threshold’ is determined. If the child is observed to respond to the two-tone whistle at 30 or 40 dBA, bone conduction threshold determination is initiated. However if the response of the infant to the tonal whistle is greater than 40 dB, low frequency hearing (250 - 750 Hz) is assessed using ‘live voice’ delivery of the sound “coucou”.

We would argue that, routinely, it is more appropriate to obtain information about an infants hearing across a range of audiometric frequencies presented in the sound field (warble tones at 1000, 4000 and 500 Hz) before proceeding to bone conduction testing, especially if responses to sound field stimuli are within a defined normal range. This is likely to better facilitate management of an infants care, particularly as infants may withdraw their co-operation at any time. Bone conduction testing can be utilised where MRLs are raised outside the normal range to determine type of hearing

loss. Use of bone conduction testing at frequencies where sound field MRLs are thought to be at a 'normal' level does not provide the clinician with any further information that is important for future management. Once repeatable bone conduction minimum response levels have been obtained ear specific information should be sought using insert earphones [30].

The Delaroche Protocol describes testing with headphones, initially presenting stimuli simultaneously to both ears before ear specific thresholds are obtained by presenting stimuli to ears separately through the headphones. This is performed in order to facilitate hearing aid provision, and guard against inappropriate amplification of the better ear when the hearing loss is asymmetric. However, if thorough assessment of hearing ability in the sound field were performed, it would not be necessary to present sounds simultaneously to both ears if complete and frequency specific assessment was performed in the sound field.

With the advent of neonatal hearing screening, there is an increased pressure on audiologists to provide accurate hearing assessments for increasingly younger infants. The rationale behind neonatal hearing screening is well known [31], therefore it is important that procedures and protocols for assessing hearing in the infant population utilise up to date technology and techniques that are proven to reliably provide accurate and valid information about hearing status and are efficient in terms of time taken to obtain sufficient information to provide safe and effective intervention. In summary, we do not feel that the Delaroche Protocol attains these standards.

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