Response Criterion for Determining Ipsilateral and Contralateral Acoustic Reflex Thresholds Using a 1000-Hz Probe Tone

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INTRODUCTION: The middle-ear cavity between the eardrum and inner ear houses two muscles and three tiny bones. When a loud sound enters the ear, contraction of the stapedius muscle reduces sound transmission of the middle-ear by stiffening the boney chain, helping shield the inner ear from damage. This is known as the acoustic reflex (AR). Clinical AR measurements are applied to help diagnose dysfunctions in the auditory system. During AR testing, a pure tone is presented in the ear canal as the probe signal and another loud sound, to activate the reflex, is presented in the same ear (ipsilateral test) or the other ear (contralateral test). The lowest level of the activator that causes a criterion change in acoustic measure is known as AR threshold (ART). ART testing is typically conducted with a 226-Hz probe tone. However, the resonant frequency of the middle-ear is approximately 1000 Hz in adults. Little research has been done on ARTs tested with a 1000-Hz probe tone in adults, or which response criterion is most reliable.

PURPOSE: This study aimed to identify the optimal response criterion for determining ARTs using a 1000-Hz probe tone.

METHODS: Data was obtained from 28 participants. Ipsilateral AR tests were run with five activators: four tones (0.5, 1, 2, and 4 kHz) and broadband noise (BBN). Contralateral tests were conducted with 4-kHz tone and BBN. Testing order was randomized. The activator was presented at 60 dB HL, then increased in 5-dB steps. Three ARTs were determined per test as the lowest activator level that caused a criterion change of 0.03, 0.09, and 0.13 mmho, respectively ($ART_{0.03}$, $ART_{0.09}$, and $ART_{0.13}$).

RESULTS: Mean data showed that the ipsilateral $ART_{0.13}$ was approximately 85–90 dB HL for tonal activators and approximately 70 dB HL for BBN. The contralateral $ART_{0.13}$ was slightly higher (~5 dB). $ART_{0.09}$ was slightly lower (<5 dB) than $ART_{0.13}$ for all activators, while the difference reached significance for a few conditions ($p<0.05$, one-way repeated measures ANOVA on ranks). Standard deviation (SD) was similar between $ART_{0.13}$ and $ART_{0.09}$. $ART_{0.03}$ was significantly lower (~10–20 dB) than $ART_{0.13}$ for all conditions ($p<0.05$), but SD was much larger. Detectability of $ART_{0.03}$ was 100% across all conditions, whereas it was between 78.6–100% for $ART_{0.09}$, and 71.4–96.4% for $ART_{0.13}$. Pearson product-moment correlation coefficient was statistically significant between $ART_{0.09}$ and $ART_{0.13}$ in all conditions ($r=0.59–0.98$), but only for two conditions between $ART_{0.03}$ and $ART_{0.13}$ ($r=0.06–0.53$).

CONCLUSION: While possible to record lower thresholds using the 0.03 mmho criterion for 1000-Hz ART testing, large individual variation and poor correlation between $ART_{0.03}$ and $ART_{0.13}$ exists. Using the 0.09 criterion, greater detectability and lower ARTs can be achieved, compared to the 0.13 criterion. Accordingly, we recommend using the 0.09 mmho response criterion in conducting 1000-Hz ART tests.