Comparison of Ipsilateral Wideband and Single-frequency Acoustic Reflex Thresholds in Normal-hearing Adults

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INTRODUCTION: The human ear can be divided into three primary portions: the outer ear, middle ear, and inner ear. The acoustic reflex (AR) refers to an involuntary muscle contraction in the middle ear when an intense sound enters the ear. Clinical AR measurements has been applied in audiology for decades to help diagnose pathologies in the auditory system, but some limitations have concerned clinicians. In AR testing, a single pure tone (e.g., 226 Hz, 1000 Hz) is used as the probe signal. Wideband acoustic reflex (WAR) is a newly developed technique, utilizing wideband signals (clicks or chirps) as the probe, which includes frequencies ranging from 226 to 8000 Hz. A few early studies showed some advantages of the WAR and its potential for clinical use. It is warranted to systematically compare it with the existing clinical procedure. Both WAR and AR can be tested in the ipsilateral mode. That is, the probe and reflex-activating signals are presented in the same ear. The reflex threshold is the most commonly used measure, which is defined as the lowest level of an activator eliciting a measurable change in the probe signal.

PURPOSE: This study aimed to compare the ipsilateral WAR and AR thresholds using two probe tones in the same ears.

METHODS: Data were collected in 18 adults (18-35 years old) with stringent subject inclusion criteria. The AR test was performed with a GSI TymStar tympanometer. A Wideband Tympanometry Research System (Interacoustic) was used for WAR tests. AR thresholds were tested with 226-Hz (ART_{226Hz}) and 1000-Hz (ART_{1000Hz}) probe tones. They were determined by a repeatable change of ≥0.03 mmho and of ≥0.13mmho in acoustic admittance, respectively. WAR thresholds were automatically determined by the system, which included a low frequency ($WART_{LF}$) and a high frequency ($WART_{HF}$) measure. For both tests were used five activators: 500, 1000, 2000, and 4000 Hz pure tones and broadband noise.

RESULTS: The $WART_{LF}$ was significantly lower (~10 to 23 dB) than ART_{226Hz} for all activators ($p<0.05$, paired t-test). The ART_{226Hz} and ART_{1000Hz} were not significantly different (~ 1 dB) for all activators ($p>0.05$, paired t-test). The differences (~2 to 6 dB) between $WART_{HF}$ and $WART_{LF}$ were not significant for all activators ($p>0.05$, paired t-Test).

CONCLUSION: The WAR threshold was 10 to 23 dB lower on average than the single-frequency ART. The WAR procedure is more sensitive in testing the middle-ear muscle reflex than the AR. The results indicates that the WAR compensate for restrictions of the AR in clinical applications.