Relationship Between Distortion Product Otoacoustic Emissions and Audiometric Thresholds in the Extended High-Frequency Range

Clinical audiometry is typically limited to frequencies between 125 and 8000 Hz; however, thresholds at frequencies above 8000 Hz appear to be most susceptible to ototoxic insult, aging, and possibly acoustic overexposure. Extended high-frequency distortion product otoacoustic (DPOAE) measurements offer an alternative metric of assessing cochlear health and may be sensitive to the effects of cochlear damage before they are apparent on audiometric testing. Furthermore, DPOAEs are common in audiology clinics and have practical benefits compared to audiometry such as reduced test duration and no need for patient participation. DPOAEs in the extended high frequencies, however, have proven to be less reliable due to the influence of standing waves in the ear canal. To reduce the test-retest variability of these measures, forward-pressure-level (FPL) and emitted-pressure-level (EPL) calibrations for the stimulus and response, respectively, are recommended. The purpose of this study was to assess the correlation between behavioral audiometry and DPOAEs in the high-frequency and extended high-frequency ranges when using these more precise calibration techniques.

We collected data from 165 individuals with normal hearing as defined by traditional clinical audiometry. Thresholds above 8 kHz were allowed to vary. Following individual ear FPL calibrations, we measured swept DPOAEs from 2-16 kHz. Audiometric thresholds were assessed from 250-16 kHz. Frequency specific audiometric thresholds and DPOAE amplitudes were each averaged across the high-frequency (3-8 kHz) and the extended high-frequency (9-16 kHz) ranges.

Extended high-frequency thresholds were negatively correlated with extended high-frequency DPOAE amplitudes. Age was correlated with audiometric thresholds and DPOAEs in both the high and extended high-frequency ranges. The strongest correlation was between age and extended high-frequency audiometry. Though also highly correlated with age, extended high-frequency DPOAE amplitudes fall to the noise floor for many subjects over the age of 40. High-frequency DPOAEs were not tightly correlated with high-frequency audiometric thresholds, but this could be an artifact of the narrow range of thresholds in that frequency range (< 25 dB HL).

Preliminary results suggest that with appropriate calibration methods, extended high-frequency DPOAEs are sensitive to reductions in audibility within the same frequency range. These findings support the use of DPOAEs in clinical applications such as ototoxicity monitoring and hearing conservation programs.