Detailed DPOAE level/phase maps provide insight into normal and noise-damaged human ears

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Distortion product otoacoustic emission (DPOAE) level/phase maps were generated from detailed 2f1-f2 and 2f2-f1 DPOAE measurements obtained from 20 normal-hearing subjects and 10 patients with noise-induced hearing loss (NIHL). The experimental paradigm used an f2/f1 fixed-ratio approach incremented in 0.025-interval steps between 1.025 and 1.5 in response to two equi-level and one, offset-level primary-tone sweeps (L1=L2=75 and 80, and L1,L2=65,55 dB SPL). The extended DPOAE frequency span ranged from 0.5-6 kHz in DPOAE frequency steps of 44 Hz. While both wave- and place-fixed emissions were evident for the 2f1-f2 emission, only place-fixed emissions were apparent for the 2f2-f1 emission in both normal and NIHL subjects with measurable emissions. In addition, DPOAE level/phase maps were used to compute comprehensive measures of DPOAE group delay. The group-delay measures in normal-hearing subjects were consistent with data in the literature and were sufficiently sensitive to reveal expected differences due to primary-tone levels and frequency-sweep methods. In general, while NIHL appeared to eliminate or reduce both 2f1-f2 and 2f2-f1 DPOAEs, the effects of NIHL on group delays were level- and/or frequency-dependent. For example, for primary-tone levels of 65,55 dB SPL, group delays were substantially (16-30 %) longer in the low frequency region. Consequently, DPOAE level/phase mapping may be a useful technique for the early detection and monitoring of cochlear structural irregularities caused by hazardous noise exposure.