Comparison of peripheral compression estimates using auditory steady-state responses (ASSR) and distortion product otoacoustic emissions (DPOAE)

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ABSTRACT

The healthy auditory system shows a compressive input/output (IO) function as a result of healthy outer hair cell function. Hearing impairment often leads to a decrease in sensitivity and a reduction of compression, mainly caused by loss of inner and/or outer hair cells. Compression is commonly estimated based on behavioral procedures (Plack et al., 2004), which are time consuming and rely on assumptions regarding the ability to selectively investigate cochlear processing, or on objective recordings such as otoacoustic emissions (OAEs) (Neely et al., 2003), which allow to selectively study cochlear processing but the interpretation of results for individual data is challenging.

Auditory steady-state responses (ASSR) are another objective method which allows fast, reliable and frequency-specific measurements of hearing function. It is hypothesized that compressive behavior is observed in normal-hearing (NH) listeners while in hearing-impaired (HI) listeners, sensitivity and compression are reduced. ASSR data are later compared to data from distortion-product otoacoustic emissions (DPOAE) recordings.

RESULTS

**ASSR measurement in NH subjects**

- NH subjects consistently show compressive functions with slopes between 0.2 and 0.5 dB/dB.
- ASSR saturates or even decreases at higher stimulus levels.
- Repeated points (~) recorded in different sessions show small variability in the response.

**ASSR measurement in HI subjects**

- HI subjects show higher variability in the results.
- Significant responses at input levels of 30 dB SL and above have been obtained for HI subjects.
- ASSR IO functions in HI subjects reflect the loss of sensitivity at lower stimulus levels.

**DPOAE in NH:**

- The panels show DPOAE IO functions for four different center frequencies recorded in a NH subject.
- Panel A: 50 Hz at f1 = 60 Hz, Panel B: 1 kHz at f2 = 87 Hz, Panel C: 2 kHz at f2 = 95 Hz, and Panel D: 4 kHz at f2 = 89 Hz. The subject has normal-hearing: pure tone audiogram ≤ 20 dB HL, as shown in the inset audiogram (panel A).

**DPOAE in HI:**

- Multiple and single frequency stimulation elicit similar responses.
- No interaction among the different SAM tones seems to be present in the ASSR recordings from the used multi-frequency stimulus.
- Results from single frequency stimulation recordings show slightly higher variability than results from multi-frequency stimulation.

**DPOAE recordings show growing IO function with constant slopes using mid-range stimulus levels.**

**Compression estimate from DPOAE IO functions was obtained using ASSRs versus DPOAEs?**

- Assuming DPOAE to reflect basilar membrane motion and ASSR IO functions brainstem coding, the difference in compression estimates could lead to an additional compression mechanism in the peripheral auditory system.

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