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

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Publication date: 2014

Citation (APA):
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 (DPOAEs) recordings.

RESULTS

Normal-hearing:

- NH subjects consistently show compressive functions with slopes between 0.1 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.

Healthy-impaired:

- 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.

DPOAEs in NH:

- Similar to NH, DPOAEs are reduced in HI subjects.
- Multi-stimulus (SAM) tones were used.
- Basilar membrane (unrolled) 20 kHz.
- HI subjects show higher variability than results from multi-frequency (NH).

Hyposis:

Peripheral compression can be estimated through ASSR and DPOAE IO slopes in NH subjects. HI subjects show a change in sensitivity and compression estimation.

How do compression estimates correlate when measured using ASSRs versus DPOAEs?

METHODS

ASSR

- 64-channel EEG system with active electrodes ( Biosens)
- ASSR magnitude obtained from the recorded ASSR spectrum, computed from the weighted averaged waveform.
- Detection of significant results using F-test (p-value ≤ 1%)

DPOAE

- 12 NH subjects
- Fitting curves

Comparison between IO functions recorded in NH subjects:

- Single ASSR (F-test = 0)
- ASSR IO functions recorded in NH subject ([F-test = 0.5 kHz] at F1 = 4 kHz, and Panel D: F2 = 4 kHz at F1 = 0 kHz). The subject showed normal-hearing (pure tone audiogram ≤ 20 dB HL), as shown in the inset audiogram (panel A).

Comparison between IO functions recorded in HI subjects:

- Single ASSR (F-test = 1)
- ASSR IO functions recorded in HI subject ([F-test = 0.5 kHz] at F1 = 4 kHz, and Panel D: F2 = 4 kHz at F1 = 0 kHz). The subject showed normal-hearing (pure tone audiogram ≤ 20 dB HL), as shown in the inset audiogram (panel A).

Hypothesis

- HI subjects show less consistent IO functions compared to NH.
- Reduction of compression at levels close to threshold (≤ 4 kHz).

REFERENCES


Acknowledgment

Thank to G. Long and S. Henin from CUNY for their support in the DPOAE data processing. This work was supported by the Center for Applied Hearing Research (CAHR) at DTU.