Noise-Induced Adaptation of Stimulus Frequency Otoacoustic Emissions (SFOAEs) and Cochlear Microphonic (CM) Residuals in Gerbil

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Previous SFOAE measurements in humans showed adaptation.

**Mechanisms?**

Middle Ear Muscle (MEM)
Medial Olivocochlear (MOC)
Intrinsic Cochlear

Examine further by measuring SFOAES and CM in an animal model.
Animal Model

- Mongolian gerbils, age 7 to 57 weeks.

- Pre-anesthesia - Atropine Sulphate
- Anesthesia – Ketamine / xylazine
- Paralysis - Pancuronium bromide
Experimental Conditions:

Paralysis
Ipsilateral, Contralateral, and Bilateral stimulation
Olivocochlear Bundle cut
Postmortem
Experimental Setup

Etymotic ER10-C probes
Round window electrode
CardDeluxe two-channel sound card
Custom Software
Stimulus Waveforms

probe tone

noise elicitor

probe tone + noise

nonlinear residual = $P_1 + P_2 - P_{12}$
Data Analysis

- Average 16 sets of recordings
- Nonlinear residual modeled as
  \[ Y(t) = \alpha + \beta_1 \sin(2\pi ft) + \beta_2 \cos(2\pi ft) + \varepsilon \]
- Analyzed in 25 ms windows
  Generalized Least Squares regression, yielding confidence intervals
Before and After Paralysis

SFOAE

CM

Suggests adaptation NOT due to MEM reflex
Contralateral, Ipsilateral, & Bilateral Noise

SFOAE

Suggests adaptation NOT due to MOC reflex

CM
Olivocochlear Bundle Section

LSO  LNTB  MSO  VNTB

CUT  CUT

Scale: 0.5 mm
Before and After OCB Cut

SFOAE

CM

Suggests adaptation NOT due to MOC reflex
Postmortem Recordings

during elicitor

post-elicitor

elicitor = 71 dB SPL
probe = 48 dB SPL
2 kHz

gb022-04
Postmortem Recordings

during elicitor  post-elicitor

SFOAE  CM

Suggests adaptation NOT due to MOC or MEM reflex
Comparison of SFOAE

Gerbil

Human
Summary

- Adaptation shows evidence of intrinsic cochlear processes
- No evidence of MOC or MEM in gerbil

- What specific cochlear processes?
  - Reciprocal or other non-olivocochlear-efferent synapses? (Guinan et al, 2003)
  - OHC Gating stiffness?
  - Chloride, Calcium homeostasis?
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