Use of Intracochlear Electrocochleography to Estimate Cochlear Implant Electrode Location within the Cochlea

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Disclosure

Aniket Saoji, PhD
• 13 years of employment with Advanced Bionics (AB). Consultant for AB.
• Research support from AB, Cochlear, Med-EL, and Envoy Medical.

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• Consultant for AB, Cochlear, and Envoy Medical
Electrocochleography

- Cochlear Microphonics (CM)
- Auditory Nerve Neurophonics (ANN)
- Compound Action Potential (CAP)
- Summating Potential (SP)

(Lempert, Lawrence & Weaver, 1947)
An alternating polarity acoustic tone burst (e.g., 500 Hz) is used to elicit CMs.
The most apical electrode is used as the recording electrode and an extracochlear electrode is used as the return electrode.
Intra-op ECOG

- 2000 Hz
- 1000 Hz
- 500 Hz
- 250 Hz

Basilar membrane

Basal end | Apical end

Cochlear microphonics (µV)

Time
Patient audiogram
Waiting For Impedances

Active monitoring will begin when a low enough impedance is reached.
Use of multi-tone electrocochleography to measure cochlear microphonics during cochlear implant surgery

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Abstract

Introduction

Cochlear implantation is a surgical procedure that can provide patients with hearing impairment with a usable signal that allows for meaningful auditory perception. The cochlear implant electrode activates the auditory nerve through a combination of mechanical and electrical stimulation, with the electrical component being the predominant factor. Cochlear implant electrode performance monitoring during surgery is important to determine the success of cochlear implantation surgery and to correct any mechanical issues that may arise. Cochlear implant electrode performance monitoring during surgery can be performed using a variety of methods, including multi-frequency electrocochleography (M-ECochG). M-ECochG measures the cochlear microphonic (CM) response and helps to determine the quality of the cochlear implant electrode contact placement.

Methods

In the present study, CM responses were measured using multi-frequency cochlear implant monitoring during cochlear implant electrode insertion. A total of 24 patients were enrolled in the study, and the CM responses were measured at different electrode contact locations. The CM responses were measured using a multi-frequency electrocochleography system, which allows for the measurement of the CM response at multiple frequencies simultaneously. The CM responses were measured at different electrode contact locations to determine the quality of contact placement.

Results

The results show that multi-frequency ECochG can be used to measure and optimize cochlear implant electrode placement. Optimal CM responses can be measured at different electrode contact locations, which helps to optimize the cochlear implant electrode contact placement.

Discussion

The results from this study suggest that multi-frequency ECochG can be used as a valuable tool for optimizing cochlear implant electrode contact placement. The CM responses can be measured at different electrode contact locations, which helps to optimize the contact placement and improve the overall performance of the cochlear implant.

References


Figure 1: Example multi-frequency (125, 500, 1600, and 3200 Hz) CM waveform recorded during cochlear implant electrode placement.

Figure 2: Examples of multi-frequency CM amplitude measurements during cochlear implant electrode placement. Left graphs show pre-operative CM thresholds (red) and post-operative CM thresholds (green).
Intra-op audiogram

- Intra-op CM thresholds
- Pre-op pure tone thresholds

Post-op ECOG

2000 Hz  1000 Hz  500 Hz  250 Hz

Cochlear microphonics (µV)

Electrode

Basal end  Apical end
Post-op ECOG

Normalized CM amplitude

- 2000 Hz
- 1000 Hz
- 500 Hz
- 250 Hz

Electrodes

Basal: -
Electrodes: →
Apical: +

- 125 Hz
Post-op ECOG

- Normalized CM amplitude

- Electrodes

- Basal

- Apical

- Frequencies: 2000 Hz, 1000 Hz, 500 Hz, 250 Hz

- Lines: 125 Hz, 250 Hz
Post-op ECOG

Normalized CM amplitude

Baseline | Electrodes | Apical

2000 Hz 1000 Hz 500 Hz 250 Hz

Electrodes
Post-op ECOG

- 2000 Hz
- 1000 Hz
- 500 Hz
- 250 Hz

Normalized CM amplitude

Basal | Electrodes | Apical

- 125 Hz
- 250 Hz
- 500 Hz
- 1000 Hz
Post-op ECOG

Normalized CM amplitude

Basal  Electrodes  Apical

2000 Hz  1000 Hz  500 Hz  250 Hz

- 125 Hz
- 250 Hz
- 500 Hz
- 1000 Hz
- 2000 Hz
Conclusions

• Intra-operative ECOG can be used to monitor and optimize electrode placement during cochlear implant surgery.

• Post-operative ECOG (CM) tuning curves can be used to determine the location of individual electrode contacts across the tonotopic axis of the cochlea.
THANK YOU !!!