Angular Insertion Depth and Electrocochleography Predict Cochlear Implant Speech Outcomes

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Disclosures

• None
Outline

• Variability in cochlear implant (CI) speech perception outcomes

• Relationship between outcomes and:
  1) Electrocochleography (ECochG)
  2) Angular insertion depth (AID) of the electrode array

• Implications for electrode array selection and use of ECochG in future work
Variability in Speech Perception

• Multifactorial issue
  • Duration of deafness (Holden et al. 2013)
    • “Cochlear health” with electrocochleography (Fontenot et al. 2018)
  • Duration of device use (Lenarz et al. 2012)
  • Electrode array placement
    • Scalar location (Finley et al. 2008)
    • AID (Buchman et al. 2014; O’Connell et al. 2016)

(Holden et al. 2013)
Variability in Speech Perception

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ECochG

• The total response (ECochG-TR)
  • Single measurement obtained at the round window prior to implantation
  • Measures the sum of amplitudes of significant responses at the first three harmonics in response to tones of different stimulus frequencies
ECochG and Outcomes

• Can account for up to 40-50% of variance in CNC word scores in adults

(Fontenot et al. 2018)
AID

- Angular vs. linear depth

(Vanderbilt Institute for Surgery and Engineering)
AID

• Angular vs. linear depth

28 mm

(Vanderbilt Institute for Surgery and Engineering)
AID and Outcomes

• Relationship dependent on array design
• Better speech perception with:
  • Lateral wall – Deeper insertion maximizes cochlear coverage (Buchman et al. 2014; O’Connell et al. 2016)
  • Perimodiolar – Shallower basal insertion results in closer modiolar proximity (Holden et al. 2013; Chakravorti et al. 2019)
Objective

• Determine whether AID accounts for additional variance in speech perception outcomes not accounted for by cochlear physiology measured with ECochG-TR
Methods

• 50 adult CI recipients who underwent intraoperative ECochG
  • Lateral wall (n=41)
  • Perimodiolar (n=9)
• Retrospectively reviewed intraoperative x-ray with a rotating helical scala tympani model to determine AID
• Compared ECochG-TR and AID with CNC word scores at 6 months in the CI-alone condition
Methods

• Rotating helical scala tympani model
Variability in AID

Angular Insertion Depth (°)

Contour Advance
HiFocus Mid-Scala
Flex24
Flex28
Standard

Electrode Array
ECochG-TR and Speech Perception

![Graph showing the relationship between CNC (6 months, % correct) and TR (dB re 1 μV). The graph includes a linear regression line with the equation $n=50$ and $r^2=0.43$.](image-url)
AID Predicts Residual Variance

![AID Predicts Residual Variance](image)

**Legend:**
- Contour Advance
- HiFocus Mid-Scala
- Flex24
- Flex28
- Standard
AID Predicts Residual Variance

![Graph showing the relationship between predicted CNC word score and actual CNC word score. The graph includes data points for different conditions such as Contour Advance, HiFocus Mid-Scala, Flex24, Flex28, and Standard, with an r^2 value of 0.72.]
Conclusions

• Shallow perimodiolar and deep lateral wall array insertions optimize CI-alone speech perception outcomes

• ECochG can serve as a powerful tool to help control for the substantial variability observed in speech perception outcomes

• Future studies addressing additional surgical factors (e.g., modiolar proximity) with computed tomography
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Thank you

16th International Conference on Cochlear Implants and Other Implantable Technologies
March 18-21, 2020
www.ci2020orlando.org
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