Validation of Audiological Measures Via Telepractice for Cochlear Implants

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ACIA 2013, Washington D.C.
Outline

• Why the interest in telepractice for CI recipients?

• Summary of existing validation studies (audiology)

• Description of barriers that remain
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Why Telepractice for CIs?

• Numerous visits required post-implant
  - Audiology/Programming:
    • 6-8 visits in first year
    • 1-2 visits yearly thereafter
    • Additional visits for problems or upgrades
  - Speech/language/listening therapy:
    • Number of sessions depends on recipient needs & resources
  - Medical follow-up:
    • Typically just one visit prior to IS; more if complications
Why Telepractice for CIs?

• Limited access to specialized services
Why Telepractice for CIs?

- Limited access to specialized services

7-hr drive

Omaha: 3 CI centers
Why Telepractice for CIs?

• Options:

1. Make numerous long-distance trips
   - Monetary costs (travel, meals, missed work)
   - Time costs (missed work, school)
Why Telepractice for CIs?

- Options:

1. Make numerous long-distance trips
   - Monetary costs
   - Time costs

2. Forego services
   - Suboptimal performance
   - Device nonuse
Why Telepractice for CIs?

• Options:

1. Make numerous long-distance trips
   - Monetary costs
   - Time costs
2. Forego services
   - Suboptimal performance
   - Device nonuse
3. Remote access to follow-up services
Why Telepractice for CIs?

Potential benefits of remote services:

- For the recipient:
  - Less time lost from work/school
  - Reduced travel expenses
  - More immediate access to specialized services

- For the clinic:
  - Fewer cancelled appointments (e.g., inclement weather, insufficient travel time)
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Existing Studies

- Most have focused on comparing map levels in adult recipients for in-person versus remote programming:
  - Ramos et al. (2009)
  - McElveen et al. (2010)
  - Wesarg et al. (2010)
  - Hughes et al. (2012)
Existing Studies

• Ramos et al. (2009)

Methods:

- 5 AB recipients, split-half design
- Mapping done either in person or remotely
- Main outcome measures:
  1) M-levels
  2) ECAP thresholds
  3) SF thresholds
  4) Open-set words
Existing Studies

• Ramos et al. (2009)

Results (in-person versus remote):

1) M-levels **not** significantly different
2) ECAP thresholds “**similar**” (no statistics reported)
3) Average SF thresholds **not** significantly different
4) Open-set word scores **not** significantly different
Existing Studies

• Ramos et al. (2009)

Limitations:

- SF thresholds and speech perception conducted in traditional in-person setting
  - OK for assessing validity of remote maps
  - Doesn’t solve the problem of validating these assessments for remote use
Existing Studies

- McElveen et al. (2010)

Methods:

- 2 groups of adult Nucleus recipients
  - 7 mapped in person (Raleigh, NC)
  - 7 (1 teenager) mapped remotely (Greenville, SC)
  - Similar durations of deafness between groups

- Main outcome measures:
  - SF thresholds
  - HINT, CNC
Existing Studies

- McElveen et al. (2010)

Results:

1) SF thresholds *significantly lower* for remote group
2) HINT and CNC scores *not* significantly different between groups
Existing Studies

- McElveen et al. (2010)

Limitations:

- Not a within-subjects comparison
- Groups not matched; small N
- Speech perception and SF thresholds appear to have been conducted locally for each group (not explicitly described)
  - Can’t parse out map effects versus environment/tester effects
Existing Studies

• Wesarg et al. (2010)

Methods:

- 57 adult, 13 pediatric Nucleus recipients (1-72 years old; 4 centers)
- 1 remote and 1 in-person visit within 2 days (split-half design)
- Main outcome measures:
  - T and C levels (adjusted from pre-study baseline map)
Existing Studies

- Wesarg et al. (2010)

Results:

- T and C levels **not** significantly different for in-person versus remote.
Existing Studies

• Wesarg et al. (2010)

Limitations:

- No details regarding age, duration of CI use, programming methods for the 13 pediatric subjects tested.
Existing Studies

• Hughes et al. (2012)

Methods:

- 29 subjects (14 AB, 15 Cochlear)
- 3 remote sites
- 1 remote and 2 in-person visits within 2 weeks (ABA design)
- Each outcome measure repeated twice/visit
Existing Studies

• Hughes et al. (2012)

Methods, continued:

- Main outcome measures:
  1) Electrode impedance
  2) ECAP thresholds (clinical & research software)
  3) Psychophysical thresholds (3IFC; research software)
  4) T and M/C-levels
  5) Speech perception (CNC, HINT, BKB-SIN)
Existing Studies

- Hughes et al. (2012)

Methods, continued:

- Speech perception methods differed from other studies:
  - Others: *Speech perception used to measure remote maps; testing done in traditional setting*
  - Ours: Used daily map (not remote map)
  - Ours: Tested in realistic remote environments (hospital, universities with no sound booth)
Session Demonstration

- Speech Perception Testing (2 CNC, 1 HINT, 1 BKB-SIN)
Existing Studies

• Hughes et al. (2012)

Results (in-person versus remote):

1) Impedance **not** significantly different
2) ECAP thresholds **not** significantly different
3) Psychophysical thresholds **not** significantly different
4) T, C, M levels **not** significantly different
5) Speech perception significantly **poorer** for remote
CNC Words & Phonemes

- Significant effect of visit: remote site poorer
  - Words: ~14% lower for visit 2 (p<0.0001)
  - Phonemes: ~10% lower for visit 2  (p<0.001)

*N = 29*
HINT Sentences (Quiet) & BKB-SIN

- Significant effect of visit: remote site poorer
  - HINT: ~19% lower for visit 2 (p<0.001)
  - BKB-SIN: ~3.1 dB poorer for visit 2 (p<0.001)

*2-way RM MANOVA
Existing Studies

• Goehring et al. (2012)

Aim:

- Examine effects of test environment (booth, office) and remote technology (Polycom, hybrid system) on speech perception in CIs

- Total of 4 listening conditions
Existing Studies

• Goehring et al. (2012)

Methods:

- 16 recipients (12 adult, 4 older pediatric; age 12-87 years)
- 3 tests:
  • CNC
  • HINT (quiet)
  • BKB-SIN
Existing Studies

- Goehring et al. (2012)

**Methods:**

- Polycom system:
  - Used in Hughes et al. (2012)
  - Transmits recorded speech stimuli from tester’s computer to speaker at recipient site
Existing Studies

• Goehring et al. (2012)

Methods:

- Hybrid system:
  • Examiner remotely controls presentation of stimuli that reside on computer at recipient site (eliminates compression, bandwidth, transmission effects)
Existing Studies

- Goehring et al. (2012)

**Results:**

- Speech in quiet:
  - Booth significantly better than office
  - No effect of presentation system
Existing Studies

• Goehring et al. (2012)

Results:

- Speech in noise:
  • Polycom poorer than Hybrid in the office only
Existing Studies

• Goehring et al. (2012)

Conclusions:

- For speech in quiet, test environment is main factor.

- For speech in noise, combination of environment and test system affect results. Hybrid system better for noisy/reverberant environments.
Questionnaire Results

• Ramos et al (2009):
  - 2/12 remote sessions experienced overstimulation (0 for in-person)
  - 4/12 remote sessions judged as too long (0 for in-person)
  - All 12 remote sessions satisfied with results of remote programming
Questionnaire Results

- Wesarg et al (2010):
  - 62% able to communicate effectively via remote
  - 78% were comfortable interacting via distance technology
  - 93% judged duration of session acceptable
  - 83% judged remote fitting as efficient alternative
  - 22% afraid of negative influence on relationship with audiologist
Questionnaire Results

  - Travel expense to remote site better
  - Subjects did not feel overwhelmed by the technology
  - Room at remote site poorer (noisier, harder to hear)
  - How often would you take advantage of remote option for clinic or research: “sometimes”
Examination Time

- Ramos et al. (2009): Remote session averaged 1 min longer (20 vs. 21 minutes)

- McElveen et al. (2010): “No substantial difference in time commitment”

- Wesarg et al. (2010): Remote visit 10 or more minutes longer for 53% of audiologists

- Hughes et al. (2012): Remote visit averaged 12 mins longer (excluding connection time)
Summary

• Electrode-specific measures made via remote testing are comparable to those made face-to-face.

• Generally acceptable to patients.

• Remote sessions may take slightly longer.

• Poorer speech perception in remote condition.
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Next Steps

• Issues not specifically related to audiology:
  - Multi-state licensure/reciprocity
  - Reimbursement
  - Technological access (areas/homes without high-speed internet, computers, etc.)
Next Steps

• Need to empirically validate use of remote technology for *all* services that are typically provided for patients of *all* ages.
Next Steps

• Some remaining areas:

1) Troubleshooting equipment
  • Ample supply of spare parts needed at remote site
  • Other specialized tests?

Images courtesy of Advanced Bionics
Next Steps

• Some remaining areas:

2) Pediatric mapping & testing
   • Mapping procedures differ from adults (CPA, BOA)
   • Speech perception materials and procedures differ
Next Steps

- Some remaining areas:

  3) Sound-field threshold testing
     - Used to verify map settings
     - Sound booth needed
Next Steps

• Some remaining areas:

4) Adult aural rehabilitation
   • Children typically have better access (EI, IFSP, IEP)
   • Adult AR services not routine
   • If provided, typically just auditory training (computer-based listening exercises)
   • Counseling/coaching component is very important and often omitted
Next Steps

• Some remaining areas:

5) Solutions for improving speech perception test results if no sound booth available
  • Acoustic treatments to test rooms
  • Correction factors based on noise, reverberation?
  • Direct-connect testing
Bottom Line

- We’ve come a long way, but still have more work to do to expand access to specialized services for cochlear implant recipients
References


Acknowledgements

Funding:
NIH, NIDCD
R01 009595-01A1S1 and P30 DC 04662
THANK YOU FOR YOUR ATTENTION!