Prescription and Verification of Bone Conduction Devices

Bill Hodgetts, PhD
Disclosure And Acknowledgements

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- Many Thanks to:
  - Susan Scollie, Dylan Scott, Herman Lundgren, Kristina Kuffel, Bill Cole…
Overview

• Take home:
  • We are a long way toward a complete prescription and verification solution for kids and adults with an implant
  • We still struggle to verify and prescribe for soft band fittings but are working hard on a solution for this as well
Knowledge to Action Gap
Knowledge to Action Gap

• Clinicians are concerned that they don’t know how to verify the output of BC devices
  • Verification

• Clinicians are concerned that they don’t know how to set the device for best performance and rely on manufacturers’ settings
  • Prescription
Perceived Handicap
Lifestyle
Speech Perception
Skin Attenuation
Mech Impedance
Transcranial Attenuation
Listening Environment
Transmission From Abutment to Cochlea

Gain/Compression Settings
Noise Reduction
Maximum Power Output
Frequency Response
Wireless Tech
Directional Mics
Feedback Management
Frequency Lowering
Bandwidth

Good Match
Identification of hearing loss → Treatment Selection → Hearing Aid Fitting → Outcome Measurement

Doing well? Carry on… pat on back…

Doing Poorly?
Approaches to Hearing Aid Fitting

Traditional Approach

Clinical Experience

+ Device capabilities

Assessment

Preselection

Evaluation

Selection

Theoretical Approach

Assessment

Selection/prescription

Verification

Validation/Evaluation

Theoretical Rationale

Device Capabilities

Seewald et al., 1996
Why are we stuck?

- There are evidence-based fitting protocols for air conduction hearing aids to provide optimal amplification to infants and young children (e.g. AAA, 2013, Bagatto et. al, 2010).
Verification Options

Q6 My workplace is set-up with the following equipment: (check all that apply)

Answered: 117  Skipped: 28

- Sound field speakers in sou... 98.29%
- CD player 86.32%
- Recorded speech materials 93.16%
- Two channel audiometer 99.15%
- Real-ear hearing aid test system 96.58%
- Skull simulator 13.68%
- None of the above

Gorley and Bagatto, 2015

Skull Simulators

Hodgetts and Scollie, in Review
Q13 I verify my bone conduction devices for children using: (select one)

Answered: 111  Skipped: 34
Measures of Audibility?

Patient: I have a lot of difficulty hearing warble tones in quiet.

Clinician: I have just the test for you.
Aided Thresholds

**Graph 1:**
- **Y-axis:** dB OFL on Skull Simulator
- **X-axis:** Frequency (Hz)
- **Curves:**
  - Black: Freq Response 1 - 75 dB Input
  - Gray: Freq Response 2 - 75 dB Input

**Graph 2:**
- **Y-axis:** dB HL
- **X-axis:** Frequency (Hz)
- **Curves:**
  - Black dots: Aided Audio 1
  - Open gray circles: Aided Audio 2
  - Dotted gray line: Critical Difference +
  - Dashed gray line: Critical Difference -
55 dB Input

65 dB Input

75 dB Input

**A comparison of three approaches to verifying aided Baha output**

**Abstract**

Objective: The objective of the present study was to compare three methods of estimating the audibility of aided speech using the Baha.

Subjects: 23 Adult Baha users with primarily bilateral conductive hearing loss were recruited from the Boston Cochlear Center.

**Sumario**

El objetivo del presente estudio fue comparar tres métodos de estimación del nivel de audibilidad (audibilidad del LTASS) del lenguaje amplificado usando el Baha. Se reclutaron 23 usuarios adultos del Baha, principalmente con hipoacusia conductiva bilateral. Del Programa de Amplificación por Coas...
Maximize the audibility of important and useable speech information

“Although it is true that mere detection of a sound does not ensure its recognition, it is even more true that without detection the probabilities of correct identification are greatly diminished”

David Pascoe, 1980
Previous Work

Hodgetts et al., 2011
Consonants in Noise  

HINT

N = 16

Hodgetts et al., 2011
Air Conduction

HL $\rightarrow$ RETSPL $\rightarrow$ + RECD

SPL
Bone Conduction

"HL" → + RETFL → + RHCD → OFL

HL → + RETSPL → + RECD → SPL
Bone Conduction

“HL” + RETFL + RHCD → OFL

HL + RETSPL + RECD → SPL

40 HL +3 +5 = 48 dBSPL

Example
2000 Hz
Bone Conduction

\[ \text{HL} \rightarrow + \text{RETFL} \rightarrow + \text{RHCD} \rightarrow \text{OFL} \]
\[ 30 \text{ "HL"} + 30 -1 = 59 \text{ dBOFL} \]

\[ \text{HL} \rightarrow + \text{RETSPL} \rightarrow + \text{RECD} \rightarrow \text{SPL} \]

Example
2000 Hz
FLogram

Maximum Dynamic Range

Force Level Thresholds (dB ref 1 uN)

Frequency (Hz)

- 0 dB HL (in Force)
- Loudness Discomfort
FLogram

Maximum Dynamic Range Given MPO limitations

- 0 dB HL (in Force)
- MPO (power device)
- LDL (hypothetical)
FLogram

- DR with patient and device limitations
- 20 dB "HL"
- 30 dB "HL"

Hearing Thresholds
0 dB HL (in Force)
MPO I (power device)
RECD
RHCD

Hodgetts et al. in Review
RHCD on RECD Scale
Audibility

- Verification
- Prescription

- Device comparisons are suspect in the absence of this info
SII with DSL

Hodgetts and Scollie, in Review
Oticon Medical

We are in discussions with Cochlear as well
Skin Drive vs Direct Drive

![Graph showing transcutaneous percussive thresholds](image)
Skin Thickness?

Mylanus et al., 1996
How Tight Should the Softband Be?

Table 1. Difference in dB OFL (ref: 1 μN) between the 5 N and 2 N contact force conditions. Positive numbers indicate that the OFL was greater for the 5 N condition

<table>
<thead>
<tr>
<th></th>
<th>250</th>
<th>500</th>
<th>750</th>
<th>1000</th>
<th>1500</th>
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<td>5</td>
<td>2</td>
<td>3</td>
<td>1.63</td>
<td>2.26</td>
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</table>

Hodgetts et al., 2006
Measuring the Softband

Hodgetts et al., 2006
Case Example

- DW
  - Long standing history of chronic ear disease
  - He has had multiple mastoidectomies and his ears are dry today
  - He’s tried hearing aids in the past, but they always lead to infections and feedback and he’s been advised against their use
### Power User...

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Thank you very much for listening

Any Questions?