Bone conduction amplification in children: Abutment vs. softband

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Pediatric Amplification Lab
Arizona State University
Disclosures

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Research Assistants (The Pitt Crew):

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- Amy Stahl
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- Tove Rosenbom – Oticon Medical, DK
- Ravi Sockalingam – Oticon Medical, US
- Liz Presson – Oticon Medical, US
Bone Conduction Amplification in Children: Stimulation via a Percutaneous Abutment versus a Transcutaneous Softband

Andrea L. Pittman

Word Recognition and Learning: Effects of Hearing Loss and Amplification Feature

Andrea L. Pittman¹, Elizabeth C. Stewart¹, Amanda P. Willman¹, and Ian S. Odgear¹

Detecting and Learning New Words: The Impact of Advancing Age and Hearing Loss

Andrea L. Pittman, Elizabeth C. Stewart, and Amanda P. Willman
Bone-Anchored Hearing Device Applications

Conventional Skin-Drive

Percutaneous Direct-Drive

## Bone-Anchored Hearing Device Applications

<table>
<thead>
<tr>
<th>Authors</th>
<th>Configuration</th>
<th>Subjects</th>
<th>Speech Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kara et al (2016)</td>
<td>Abutment vs. Softband</td>
<td>Adults and Children</td>
<td>Significant*</td>
</tr>
<tr>
<td>Verstraeten et al (2009)</td>
<td>Abutment vs. Softband</td>
<td>Adults</td>
<td>Abutment +10% better</td>
</tr>
<tr>
<td>Hol et al (2013)</td>
<td>Abutment vs. Magnet</td>
<td>Children</td>
<td>Abutment +7% better</td>
</tr>
</tbody>
</table>
Purpose

To determine if the benefit of direct stimulation is limited to small improvements in speech perception or if direct stimulation also improves performance for auditory processes important for learning new information.
Method

Test Parameters
- Quiet
- 50 dB SPL
- 0° azimuth

Data Collection
- Computer interface
- Digital audio recordings

Tasks
1. Word recognition
2. Lexical decision
3. Non-word detection
4. Rapid word learning
Method

Participants
17 children
10 boys, 7 girls
7 – 15 years
Method

Participants

17 children
10 boys, 7 girls
7 – 15 years

14 bilateral conductive

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Method

Participants
17 children
  10 boys, 7 girls
  7 – 15 years
14 bilateral conductive
1 unilateral conductive
2 unilateral profound
Method

Fitting & Testing

Direct Drive

Skin Drive

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Method

Verification

Interacoustics Affinity Hearing Aid Analyzer with SHS10 Skull Simulator
Method

Verification

![Graph showing device output and difference (Skin-Direct) across frequencies. The graph compares Skin Drive and Direct Drive output. The difference in output is indicated by bars at different frequencies.]
Method

Verification

In-Situ Hearing Thresholds (dB HL)

- Skin Drive
- Direct Drive

Difference (Skin-Direct)

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Air-Conduction Hearing Device Applications

Oticon miniAlta RITE

- 21 children with SN hearing loss
  (8-12 years)

- FF Thresholds
- 10 kHz
- 4 kHz

- sothnud
- doztul
- fosnush
- stomun
- homtul


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Word Recognition

NU-6 Word Lists (25 words)

21 children with SN hearing loss (8-12 years)

Oticon miniAlta RITE


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Word Recognition NU-6 Word Lists (25 words)

Direct stimulation improved perception of familiar words.

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>79%</td>
<td>72%</td>
</tr>
<tr>
<td>SD</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td>N</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

F(1,15)=10.014, p=.006, N=.40

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Auditory Lexical Decision

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swin</td>
<td>Not Real</td>
</tr>
<tr>
<td>Not Real</td>
<td>Not Real</td>
</tr>
</tbody>
</table>

"Swin"


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Auditory Lexical Decision


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Auditory Lexical Decision

Direct stimulation improved children’s lexical decisions.

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>72%</td>
<td>59%</td>
</tr>
<tr>
<td>SD</td>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>N</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

$F(1,15)=11.948, \ p=.004, \ N=.44$

$\Delta 17\%$
<table>
<thead>
<tr>
<th># of nonsense words</th>
<th>Example phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Clocks tick on time.</td>
</tr>
<tr>
<td>1</td>
<td>Birds <em>rike</em> long worms.</td>
</tr>
<tr>
<td>2</td>
<td><em>Dats</em> catch slow <em>bice</em>.</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
</tr>
</tbody>
</table>


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Non-Word Detection 1.0

Oticon miniAlta RITE

21 children with SN hearing loss (8-12 years)


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Non-Word Detection 2.0

<table>
<thead>
<tr>
<th># of nonsense words</th>
<th>Example phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Clocks tick on time.</td>
</tr>
<tr>
<td>1</td>
<td>Birds <em>rike</em> long worms.</td>
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<td><em>Dats</em> catch slow <em>bice</em>.</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
</tr>
</tbody>
</table>
Non-Word Detection 2.0

Direct stimulation did NOT improve detection of unfamiliar words in context.

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.41</td>
<td>1.18</td>
</tr>
<tr>
<td>SD</td>
<td>0.95</td>
<td>1.08</td>
</tr>
<tr>
<td>N</td>
<td>17</td>
<td>17</td>
</tr>
</tbody>
</table>

F(1,16)=1.975, p=.179, N=.11
Non-Word Detection 2.0

Children (n=23)  Adults (n=22)

Hearing Level (dB HL)

- Aided SF
- Unaided SF

Frequency (kHz)

Speech Intelligibility Index (SII)

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Pittman (in prep) Effects of audibility on the lexical decisions of children and adults with hearing loss.
Rapid Word Learning

Learning something new

Singular
Plural

PERFORMANCE (% Correct)

$P_c = 1 - 0.80e^{-n/c}$

Learning Speed:
3 = 1 trial (perfect learning)
2 = 10 trials
1 = 100 trials
0 = 1000 trials (no learning)

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Rapid Word Learning


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Rapid Word Learning

Direct stimulation significantly improved the speed of word learning.

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trials</td>
<td>60</td>
<td>166</td>
</tr>
<tr>
<td>SD</td>
<td>.21</td>
<td>.16</td>
</tr>
<tr>
<td>N</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

F(1,15) = 7.694, \( p = .014 \), N = .34
Across-Task Benefit

The graph shows the number of tasks showing benefit with the Direct Drive, plotted against age in years. The data points are differentiated by unilateral (Conductive, SSD) and bilateral (Conductive) groups. The trend indicates a decrease in tasks showing benefit with increasing age.
What have we learned?

Detecting new words is directly related to the audibility of the auditory signal.
Learning new words is related to the clarity of the auditory signal.

Difficulty detecting and learning new words is...

... not specific to the type of hearing loss
... not specific to the type of amplification device.
thank you