Incidental Residual Hearing and Speech Perception Outcomes Following Pediatric Cochlear Implantation

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Disclosures

- Ursula Findlen, PhD- Research support from Advanced Bionics, Inc.
- Prashant Malhotra, MD- Pediatric Advisory Board, Med-El
- Oliver Adunka, MD:
  - Consultant for:
    • Advanced Bionics Corporation
    • MED-EL Corporation
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    • Spiral Therapeutics
  - Research Support:
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    • Advanced Bionics Corporation
  - Ownership:
    • Advanced Cochlear Diagnostics, LLC

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Background

• Hearing preservation after CI is possible
  • More prevalent in the pediatric population regardless of internal device \(^1, 2\)
  • Using a standard electrode array and a soft surgical technique\(^3\)

• The preservation of low frequency hearing preserves fine structure cues and thus improves speech perception in noise as well as music appreciation \(^3\)
Study Aims

• To characterize *incidental hearing preservation* in the pediatric population for patients implanted with a standard cochlear implant electrode array, regardless of surgical technique

• To evaluate whether degree of *residual hearing* correlates with perceptual outcomes
Methods

- Retrospective study of patients implanted at Nationwide Children’s Hospital from 2012-2018
- Inclusion criteria:
  - Pre-operative low frequency pure tone average (LFPTA) of 75 dB HL or better
  - Implantation with a standard length electrode array
  - A minimum of one post-operative unaided pure-tone evaluation
  - Post-operative speech perception testing
Subject Demographics

<table>
<thead>
<tr>
<th>Demographics</th>
<th>43 patients (47 ears)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age at implant (years)</strong></td>
<td>12.23 ± 4.5</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>26 (60%)</td>
</tr>
<tr>
<td><strong>LFPTA pre-op score</strong></td>
<td></td>
</tr>
<tr>
<td>Normal/mild</td>
<td>23 (49%)</td>
</tr>
<tr>
<td>Moderate/severe</td>
<td>24 (51%)</td>
</tr>
<tr>
<td><strong>Surgery</strong></td>
<td></td>
</tr>
<tr>
<td>Round Window</td>
<td>27 (63%)</td>
</tr>
<tr>
<td>Cochleostomy</td>
<td>16 (37%)</td>
</tr>
<tr>
<td><strong>Surgery side</strong></td>
<td></td>
</tr>
<tr>
<td>Left side</td>
<td>22 (51%)</td>
</tr>
<tr>
<td>Right side</td>
<td>21 (49%)</td>
</tr>
</tbody>
</table>

ETIOLOGY

- Idiopathic, 28%
- EVA, 19%
- ANSD, 13%
- Wolfram Syndrome, 2%
- Suspected Hereditary, 21%
- Suspected Prematurity, 6%
- Ototoxicity, 9%
- Meningitis, 2%
Subject Demographics

**ELECTRODE ARRAY**
- Synchrony Standard, 9%
- Synchrony Flex, 9%
- Nucleus 422/522, 23%
- Nucleus 532, 19%
- Nucleus CA/512, 26%
- HiFocus MidScala, 14%

**SKARZYNSKI CATEGORIES [4]**
- Complete HP, 19%
- Partial HP, 67%
- No HP, 5%
- Minimal HP, 9%
Analysis

• Pre and post operative LFPTA were compared using a mixed effect model

• A subset of speech recognition scores of 18 children were compared using Spearman correlations
Results

• The mean shift in hearing between the pre-op LFPTA and initial post-op LFPTA was approximately 30 dB which is consistent with the mean shift using a shorter electrode array [5]

• No significant change in residual hearing at subsequent post-op visits
## Predictors of Incidental Residual Hearing

<table>
<thead>
<tr>
<th></th>
<th>Pre LFPTA</th>
<th>LFPTA time 1</th>
<th>LFPTA time 2</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-op LFPTA</strong></td>
<td></td>
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<tr>
<td>Normal/mild (n=23)</td>
<td>32.97 ± 12.86</td>
<td>66.96 ± 16.87</td>
<td>66.62 ± 22.14</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Mod/severe (n=24)</td>
<td>65.52 ± 6.78</td>
<td>92.64 ± 16.49</td>
<td>90.30 ± 14.25</td>
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</tr>
<tr>
<td><strong>Surgery</strong></td>
<td></td>
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<tr>
<td>Round window (n=31)</td>
<td>46.61 ± 20.42</td>
<td>75.43 ± 21.36</td>
<td>72.58 ± 24.38</td>
<td>0.001*</td>
</tr>
<tr>
<td>Cochleostomy (n=16)</td>
<td>55.36 ± 15.96</td>
<td>89.06 ± 17.53</td>
<td>81.67 ± 17.14</td>
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<tr>
<td><strong>Surgery side</strong></td>
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<tr>
<td>Right side (n=23)</td>
<td>49.56 ± 21.08</td>
<td>81.01 ± 22.50</td>
<td>70.24 ± 19.09</td>
<td>0.81</td>
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<tr>
<td>Left side (n=24)</td>
<td>49.62 ± 17.89</td>
<td>79.17 ± 19.87</td>
<td>79.74 ± 24.96</td>
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<tr>
<td><strong>Gender</strong></td>
<td></td>
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<tr>
<td>Male (n=28)</td>
<td>49.94 ± 20.93</td>
<td>81.01 ± 22.73</td>
<td>79.82 ± 23.86</td>
<td>0.61</td>
</tr>
<tr>
<td>Female (n=19)</td>
<td>49.08 ± 17.17</td>
<td>78.68 ± 18.65</td>
<td>67.50 ± 18.56</td>
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</tbody>
</table>
Correlation Analysis

**Pre-Operative**

- **Best CNC Performance (%):**
  - Post-Op LFPTA (dB HL)
  - \( r = -0.32, p = 0.15 \)
  - \( N = 18 \)

**Post-Operative**

- **Best CNC Performance (%):**
  - Post-OP LFPTA (dB HL)
  - \( r = -0.31, p = 0.17 \)
  - \( N = 18 \)
Conclusions

• Hearing preservation is possible with a standard length electrode
• A better pre-op and/or post-op LFPTA may lead to improved perceptual outcomes
• We do NOT have to wait to implant children with good residual hearing even if they will be implanted with a standard length array
  – Early implantation may lead to better perceptual outcomes in this population
Limitations

• Retrospective study
  – Time at which post operative testing was completed was inconsistent
  – Inconsistent speech perception word lists

• Small sample size

• Future Directions:
  – Complete a prospective study that continues to evaluate the LFPTA pre and post operatively to determine how this correlates to speech perception scores
References

Thank You

www.nationwidechildrens.org