Perimodiolar, Slim Straight and Slim Modiolar Cochlear Implant Electrode Arrays: Comparison of Performance Outcomes

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Presenter Disclosure Information

- No relationships to disclose
Introduction

- Round window insertion with a slim straight electrode may be less traumatic and more likely to preserve hearing
- Perimodiolar (curved) electrode arrays tend to have lower neural response telemetry (NRT) thresholds, T and C levels and consume less power
- Perimodiolar electrodes may provide improved hearing performance from a more focused, precise stimulation
- Do the programming parameters and outcome data for subjects differ by type of CI electrode array?
Methods

- IRB-exempt, retrospective comparative study
- Three groups of subjects
  - Perimodiolar array (CI24RE or CI512)
  - Thin straight array (CI422/522)
  - Slim modiolar array (CI532)
- Study period July 2012 to Jun 2017 of surgeries performed at a single CI center
- FDA criteria met for implantation
- Assessment
  - Programming parameters - T and C Levels as well as NRT thresholds
  - AzBios sentences and CNC word performance at 3, 6, and 12 months post-activation
  - Hearing preservation
- Statistical comparison by 1-way ANOVA
<table>
<thead>
<tr>
<th>Groups</th>
<th>Subjects</th>
<th>Age (years) At surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perimodiolar (CI24RE /CI512)</td>
<td>N=64</td>
<td>Range: 18-90 yrs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean: 62 yrs</td>
</tr>
<tr>
<td>Thin straight (CI422 /CI522)</td>
<td>N=62</td>
<td>Range: 20-91 yrs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean: 65 yrs</td>
</tr>
<tr>
<td>Slim modiolar (CI532)</td>
<td>N=35</td>
<td>Range: 29-89 yrs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean: 61 yrs</td>
</tr>
<tr>
<td>TOTAL</td>
<td>N=160</td>
<td>Range: 18-91 yrs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean: 63 yrs</td>
</tr>
</tbody>
</table>
T and C levels - Initial Activation

Average T Levels by Implant Type

Average C Levels by Implant Type

- CI24Re (n=64)
- CI532 (n=34)
- CI422 (n=62)
T and C levels - 6 months

Average T Levels by Implant Type

Average C Levels by Implant Type
NRT thresholds by implant type

Average NRT Thresholds at 3 mo. by Implant Type

- CI422 (n=57)
- CI24RE/CI512 (n=57)
- CI532 (n=28)
Outcome Data -
Sentences in Quiet

No statistically significant performance difference seen at 3m, 6m, 12m

3m: $F(2,152) = 2.691, \ p = 0.071$
6m: $F(2,112) = 2.89, \ p = 0.06$
12m: $F(2,82) = 0.669, \ p = 0.52$
Outcome Data - Words in Quiet

No statistically significant performance difference seen at 3m, 6m, 12m

3m: F(2,114) = 0.6142, p = 0.54
6m: F(2,105) = 1.203, p = 0.3
12m: F(2,76) = 0.6271, p = 0.52
No statistically significant performance difference seen

F(2,66) = 1.995, p = 0.14
**Hearing Preservation - Perimodiolar**

<table>
<thead>
<tr>
<th>LF PTA (dB HL)</th>
<th>Pre-op (%)</th>
<th>Initial – 2 wk (%)</th>
<th>Latest – 11m (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>26-40</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>41-55</td>
<td>4</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>56-70</td>
<td>22</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>71-85</td>
<td>22</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>&gt;85</td>
<td>51</td>
<td>78</td>
<td>86</td>
</tr>
<tr>
<td><strong>Total N</strong></td>
<td><strong>64</strong></td>
<td><strong>37</strong></td>
<td><strong>51</strong></td>
</tr>
</tbody>
</table>

**LF PTA <85 dB:**
31/64 pt - 49%

**LF Hearing Preservation:**
7/31 pt - 22%

LF PTA - Low Frequency Pure Tone Average (250 and 500 Hz)
Initial Activation at 2 weeks
Latest follow up - average 0.9y range 0.5-3.5y
## Hearing Preservation - Thin straight

<table>
<thead>
<tr>
<th>LF PTA (dB HL)</th>
<th>Pre-op (%)</th>
<th>Initial – 2 wk (%)</th>
<th>Latest – 12m (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>26-40</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>41-55</td>
<td>21</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>56-70</td>
<td>29</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>71-85</td>
<td>22</td>
<td>21</td>
<td>13</td>
</tr>
<tr>
<td>&gt;85</td>
<td>13</td>
<td>63</td>
<td>74</td>
</tr>
<tr>
<td><strong>Total N</strong></td>
<td><strong>62</strong></td>
<td><strong>59</strong></td>
<td><strong>62</strong></td>
</tr>
</tbody>
</table>

**LF PTA <85 dB:**
54/62 pt - 87%

**LF Hearing Preservation:**
16/54 pt - 30%

**LF PTA - Low Frequency Pure Tone Average (250 and 500 Hz)**
Initial Activation at 2 weeks
Latest follow up - average 1.0y range 0.5-3.3y
# Hearing Preservation - Slim modiolar

<table>
<thead>
<tr>
<th>LF PTA (dB HL)</th>
<th>Pre-op (%)</th>
<th>Initial -2 wk (%)</th>
<th>Latest -4m (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>26-40</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>41-55</td>
<td>22</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>56-70</td>
<td>16</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>71-85</td>
<td>31</td>
<td>22</td>
<td>7</td>
</tr>
<tr>
<td>&gt;85</td>
<td>31</td>
<td>59</td>
<td>70</td>
</tr>
<tr>
<td><strong>Total N</strong></td>
<td>35</td>
<td>27</td>
<td>27</td>
</tr>
</tbody>
</table>

LF PTA <85 dB: 24/35 pt - 69%
LF Hearing Preservation: 8/24 pt - 33%

LF PTA - Low Frequency Pure Tone Average (250 and 500 Hz)
Initial Activation at 2 weeks
Latest follow up - average 0.3y range 0.5-1y
Slim Modiolar Audiological Experience

- With the slim modiolar array, impedances are more uniform, and tend to be low. Unusual to have electrodes out of voltage compliance.

- Because electrodes are in voltage compliance, and T-levels are relatively uniform, faster programming time noted. Fewer T-levels need to be measured and interpolation is more accurate.

- Battery power consumption appears lower, leading to longer battery life, which is extremely important for Kanso recipients.

- Despite hearing preservation with the thin straight and slim modiolar, patients are preferring to utilize the Kanso processor and forgo an acoustic component.
Conclusions

- T and C values similar between perimodiolar and slim modiolar electrode
- No statistically significant difference in sentence and word performance amongst electrodes
- To date with early data, LFHP possible with slim modiolar at rate similar to thin straight
- Early Audiological experience

Study Limitations

- Limitations inherent in retrospective review
- Continual accrual of data for the slim modiolar array
- Confounders not controlled for ie. Surgical approach
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