Individualized Cochlear Implantation Using the Concept of Partial Insertion

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Disclosure

• myCl
  – Collaboration project MedEl - MHH funded by German Ministry of Education and Research
Introduction

- **Longer electrodes: FLEX28**
  - Largest cochlear coverage and **best** speech perception outcomes in electric-only stimulation (ES)

- **Shorter electrodes: FLEX16/20/24**
  - Good hearing preservation results
  - Very good speech perception results in EAS
  - **However:** If residual hearing is lost, speech performance is worse with short electrodes in ES

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New Approach: Partial Insertion of longer electrodes for EAS candidates

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Concept of Individual Partial Insertion

Determination of patient individual insertion depth

based on statistical analyses of MHH Data

1. **Prediction of postoperative residual hearing**
   - Estimate **Crossover Frequency (CoF)** for EAS

2. **Prediction of individual electrode position**

   - **Selection of Individual IED**
     1. **Trade-Off**: **Hearing Preservation** and **Electrical Cochlear Coverage** up to region of CoF

Software Tool developed to perform procedure

Electrode Selection Tool (EST)
Surgical Procedure

1. Place fascia at selected contact, FLEX28
2. Very slow insertion with ECochG cochlear monitoring
3. Insert until fascia touches round window membrane
4. Fixation of electrode
Electrode Selection Tool

Input Parameters

- Prediction of postoperative residual hearing
- Prediction of individual electrode position
- Selection of Individual IED and Electrode Array

Interactive Tool:
Final electrode selection by user (physican)
Hearing Preservation Partial Insertion

6 months

<table>
<thead>
<tr>
<th>6 Months</th>
<th>Median Hearing Loss (125..1.5kHz)</th>
<th>Low-Frequency Hearing Loss (125 Hz, 250Hz, 500, 1, 1.5 kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤15 dB</td>
<td>&gt;15 HV ≤30 dB</td>
</tr>
<tr>
<td>Insertion depth 18.2 ± 2.6mm FLEX24 (N=13)</td>
<td>12 dB</td>
<td>9 (69.2%)</td>
</tr>
<tr>
<td>Insertion depth 20.7 ± 1.8mm FLEX28 (N=14)</td>
<td>12 dB</td>
<td>9 (64.3%)</td>
</tr>
</tbody>
</table>
## Hearing Preservation 6M – Comparison full insertion

<table>
<thead>
<tr>
<th>Partial Insertion</th>
<th>6 Months</th>
<th>Median Hearing Loss (125..1.5kHz)</th>
<th>Low-Frequency Hearing Loss (125 Hz, 250Hz, 500, 1, 1.5 kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IED ≤16mm (14.3 ± 0.8mm, N=3)</td>
<td>7 dB</td>
<td>≤15 dB</td>
<td>&gt;15 HL ≤30 dB</td>
</tr>
<tr>
<td>IED ≤20mm (18.8 ± 0.9mm, N=13)</td>
<td>9 dB</td>
<td>3 (100%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>IED ≤24mm (21.8 ± 0.8mm, N=11)</td>
<td>15 dB</td>
<td>6 (54.4%)</td>
<td>4 (36.4%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Full insertion</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FLEX16 (n=10)</td>
<td>9.0 dB</td>
<td>8 (80.0%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>FLEX20 (n=46)</td>
<td>14.5 dB</td>
<td>24 (52.2%)</td>
<td>12 (26.1%)</td>
</tr>
<tr>
<td>FLEX24 (n=45)</td>
<td>16.0 dB</td>
<td>20 (44.4%)</td>
<td>13 (28.9%)</td>
</tr>
</tbody>
</table>
Partial Insertion- Speech perception in noise

HSM sentence test 10 dB SNR

EAS Users (n=22)

n=2 became ES Users
HSM 3 months = 24% (Mean)

n=2 cases of afterloading
Comparison Partial Insertion/Full Insertion

**Partial Insertion:**
- IED Group ≤16 & ≤20: n=6
- Mean (IED) = 17.9 mm
- Mean (inserted contacts) = 7.67
- Median AC threshold @ 250 Hz = 32.5 dB

**Full Insertion:**
- FLEX16 (n=9)
- Inserted contacts = 12
- Median AC threshold @ 250 Hz = 25.0 dB

**Residual hearing matched**

HSM sentence test 10 dB SNR – 6 months

- Full Insertion: FLEX16 (n=9)
  - Inserted contacts = 12
  - Median AC threshold @ 250 Hz = 25.0 dB

- Partial Insertion: IED Group ≤16 & ≤20: n=6
  - Mean (IED) = 17.9 mm
  - Mean (inserted contacts) = 7.67
  - Median AC threshold @ 250 Hz = 32.5 dB

EAS HSM sentence test in noise 10 dB SNR, % correct

- EAS 86%
- 89%
Afterloading of electrode

Partial Insertion
15.06.2018

IED = 16.7 mm

Sucessfull hearing preservation

06.05.19

9 contacts activated
HSM 10 dB SNR in ES = 0%

Full Insertion
07.05.2019

IED = 22.6 mm

08.05.19

11 contacts activated
HSM 10 dB SNR = 68.8%
Surgery: Afterloading of electrode

Insertion of further electrode contacts
Conclusion

Partial Insertion

allows for:

• individual selection of insertion depth based on patient specific hearing thresholds and anatomy
• full cochlear coverage in ES, in case of hearing loss

shows:

• very good hearing preservation results
• excellent hearing performance results in EAS
• a successful afterloading in n=2 cases with good hearing performance in ES-only