CT-scan contouring technique (CoT): implication in cochlear implantation with straight electrode-arrays

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Outline

- Overview
- Aims and purposes
- Methodology (Image analysis)
- Results and Conclusion
Overview – why do it

- More than 45,000 CIs are sold worldwide each year
- The global CI market is likely to exceed USD 2 billion by the year 2020
- In modern cochlear implantation surgery, an important goal is preserving residual hearing and auditory structures
- There are large inter-individual variations in cochlear anatomy that determines the insertion depth.
Why do it?

- The rate of cochlear trauma appears to increase with insertion depth, the EA should preserve the residual hearing coding the regions of low frequency.

- Cross-sectional imaging plays an essential role in cochlea pre-implantation, to avoid cochlear trauma during operation.
How we do it

- Patients do temporal bone CT scans without ear malformation, neither anormal cochlear nor uninterpretable examinations.
- GE 750 HD 64 slices, 0.625mm slice thickness.
- The CT measurements were made on a workstation.
- Two radiologists with 3 years and > 30-year experience reviewed the images.
How we do it?

- The length of the cochlea is often *indirectly* estimated by the “distance A” using Escudé’s method.

- With the current accuracy of CT-scans, we *directly* measured the cochlear size on CT-scans by contouring the external wall of the cochlea, mimicking the route of a straight EA of cochlear implant.
How to do?
Escudé’s methods

\[ L = 2.62A \times \loge (1.0 + \Theta / 235). \]
With \( \Theta = 360^\circ \), the formula gives: \( L_{360^\circ} = 2.434A. \)
With \( \Theta = 540^\circ \), the formula gives: \( L_{540^\circ} = 3.126A. \)
How do it
Results

- 200 temporal bones were included in this retrospective study. Patients had average age 53.3 years (13–85 year old).

- First, in the 15 patients with cochlear implant, the CoT proved to give measurements **highly accurate** when compared with the real length of EA-insertion (R= 0.9744, p< 0.001).
Results

- The distance $A$ and $L_{360^\circ}$ and $L_{540^\circ}$ were significantly greater in men than in women.

### Table 2
Mean, standard deviation and range of measurements by sex

<table>
<thead>
<tr>
<th></th>
<th>Female ($n=64$)</th>
<th>Male ($n=36$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter $A$ (mm)</td>
<td>$8.92 \pm 0.38$</td>
<td>$9.16 \pm 0.42$</td>
</tr>
<tr>
<td></td>
<td>8.2–10.4</td>
<td>8–10</td>
</tr>
<tr>
<td>Measured $L_{360^\circ}$ (mm)</td>
<td>$21.5 \pm 0.87$</td>
<td>$22.0 \pm 1.0$</td>
</tr>
<tr>
<td></td>
<td>19.7–24.7</td>
<td>18.8–24.1</td>
</tr>
<tr>
<td>Measured $L_{540^\circ}$ (mm)</td>
<td>$25.7 \pm 1.3$</td>
<td>$26.2 \pm 1.5$</td>
</tr>
<tr>
<td></td>
<td>23–29.6</td>
<td>21.3–29.5</td>
</tr>
</tbody>
</table>
Results

- There was no significant difference for any of the dimensions measured between the right and left sides.
Results

- The intra-individual mean difference between Escudé’s methods and contouring technique for $L_{360^\circ}$ was $0.2 \pm 0.7$ mm and ranged from $-1.6$ mm to $+2.0$ mm.

- Intra-individual difference of measurements between the two methods for $L_{540^\circ}$, was on average $2.2 \pm 1.2$ mm and ranged from $-1.3$ mm to $+5.6$ mm.
Conclusion

- The CoT can predict with accuracy the length of EA-insertion depth, more precisely than estimation methods.
- The CoT provides highly reliable measurements of cochlear length.
Conclusion

- Should DO temporal bone CT scan and measure the length of cochlear by Contouring technique before cochlear implantation.
Thank you for your attention!
CT-scan contouring technique allows for direct and reliable measurements of the cochlear duct length: implication in cochlear implantation with straight electrode-arrays

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