Predicting Depth of Electrode Insertion by Cochlear Measurements on CT scan

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The authors have no relevant disclosures to make.
Controversial, but it has been reported that a deep insertion into the cochlea results in better auditory perception outcome.

(Gani et al. 2007; Buchman et al. 2014; Hochmair et al. 2003; Hamzavi et al. 2006).

“Full insertion = Better outcome”
BACKGROUND

• Longer and thinner electrodes for deeper insertion.
• However, even the normal cochlea has a significant size variability (Alexiades et al. 2014; Avci et al. 2014).
• Size variability can affect depth of insertion and the number of contacts inside the cochlea.
BACKGROUND

The Med-El CI system has developed an insertion electrode to gauge the depth of insertion and help select the appropriate electrode length. However, this system requires 2 insertions and this may not be desirable.
OBJECTIVE

Cochlear measurements using standard HRCT scan predict cochlear depth of insertion and aid in the *a priori* selection of the electrode length.
Subjects

N = 47 patients reviewed, 35 were included.
Age: 33.9 years (mean); range 1-80 yrs.
Gender: 16 female, 21 male.

Inclusion criteria.
1. Cochlear implant surgery with Med-El devices
2. Complete clinical and operative records.
3. Available preoperative HRCT scan.
4. Absence of obvious cochlear dysplasia or radiological abnormality.

Exclusion criteria:
1. Labyrinthitis ossificans.
2. Cochlear dysplasia.
3. Major inner ear malformations.
Temporal Bone Computerized Tomography

- High resolution images.
- 1 mm contiguous axial and coronal images
- Visual inspection by blinded examiners.
- Abnormalities: $\geq 2$ SD (Purcell et al. 2002).
- Axial plane: *basal turn width*.
- Coronal plane: *cochlear height*.

Image taken from: Purcell et al. 2002
METHODOLOGY

BASAL WIDTH
METHODOLOGY

COCHLEAR HEIGHT

A: 5.3mm
Review of Operative Reports

- Med-El SonataTi100:
  - Standard Electrode: 31.5 (26.4) mm.
  - Medium Electrode: 24 (20.9) mm.
  - Compressed: 15 (12.1) mm.
  - Flex28: 28 (23.1) mm.
  - Flex24:24 (20.9) mm.

Image taken from Med-El electrode practicum
Review of Operative Reports

• Deep insertion:
  - >24 mm insertion into the cochlea:
    - Full insertion of a Flex28.
    - No more than one contact outside when SEA was used.

• No deep insertion:
  - MEA, CEA or Flex24.
  - More than one contact outside when using SEA or one contact out when using Flex28.
## RESULTS

### Full insertion?

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>27</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Cochlear Height (mean)</td>
<td>6.26 ± 0.8 mm</td>
<td>5.79 ± 0.3 mm</td>
<td>0.003 **</td>
</tr>
<tr>
<td>Basal Turn Width (mean)</td>
<td>1.58 ± 0.14 mm</td>
<td>1.46 ± 0.16 mm</td>
<td>0.039 *</td>
</tr>
</tbody>
</table>
**RESULTS**

*Probability of insertion according to cochlear height*

Cochlear height : Probability

- 5.98mm : 75%
- 6.50mm : 91%
- 6.56mm : 94%
- 6.57mm : 95%
CONCLUSION

1. Cochlear height determination using coronal planes of standard HRCT scan can predict depth of insertion.
2. Full insertion of a long electrode array can be attempted if cochlear height > 6.5mm.
3. No complicated formulas.
Thank you very much for your attention