Fully-implantable hearing aid

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Fully-implantable hearing aids

TICA (Implex)  
ESTEEM (Envoy)  
CARINA (Cochlear)
Carina

Digital signal processor and battery

Magnet

Receiver coil

Microphone

Transducer/actuator
Stapes head
Stapes footplate
Round window membrane
Carina – indication range

Middle- to high-grade sensorineural hearing loss

Mixed hearing loss with middle- to high-grade inner ear component
Sensorineural hearing loss
Sensorineural hearing loss

Middle- to high-grade sensorineural hearing loss

- Air conduction threshold
- Air conduction with external button soundprocessor
Sensorineural hearing loss

Middle- to high-grade sensorineural hearing loss

- Usage of conventional hearing aids is not possible (chronic otitis externa, eczema..)
- Work-related reasons: wet or dusty surroundings

**Carina versus Cochlear Implant**
- Air conduction threshold
- Speech recognition
  - WRS max
# Sensorineural hearing loss

**Lefebvre P et. Al 2016**
“A Retrospective Multicentre Cohort Review of Patient Characteristics and Surgical Aspects versus the Long-Term Outcomes for Recipients of a Fully Implantable Active Middle Ear Implant”

<table>
<thead>
<tr>
<th>Motivation</th>
<th>Patients (n=66)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical reasons</td>
<td>2 % (1)</td>
</tr>
<tr>
<td>Cosmetical reasons</td>
<td>27% (17)</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>19% (12)</td>
</tr>
<tr>
<td>Work-related reasons</td>
<td>52% (32)</td>
</tr>
</tbody>
</table>
Sensorineural hearing loss

Original Paper

Audiology & Neurotology

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Long-Term Outcome Data in Patients following One Year’s Use of a Fully Implantable Active Middle Ear Implant

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Sensorineural hearing loss

• **Study design:**
  – prospective

• **Patients**
  – 58 patients, Otologics
  – Sensorineural hearing loss

• **Outcome parameter**
  – WRS in quiet at 65 dB SPL
  – APHAB
Mixed hearing loss

- Failed tympanoplasty/ossiculoplasty
  - Poor middle ear ventilation
  - Postinflammatory stapes fixation
- Draining radical cavity
Mixed hearing loss

Bone conduction threshold in dB HL

Frequenzy in kHz

0,125 0,25 0,5 1 1,5 2 3 4 6 8

- measuring limit of the audiometer
- bone conduction Carina
- bone conduction VSB
Mixed hearing loss

Stapes footplate

Round window

Stapes head

Stapes arch
Outcome of Carina implantation in Dresden

- 38 Carina implantations in Dresden (2017 – 2019)
- 29 patients with a follow-up of 6 months
- Coupling site
  - Incus (n=4)
  - Stapes head (n=9)
  - Stapes footplate (n=10)
  - Round window membrane (n=6)
Preoperative audiometric data

![Graph showing preoperative bone conduction and air conduction hearing loss in dB HL across different frequencies in kHz.]

- Frequency in kHz: 0.125, 0.25, 0.5, 1, 1.5, 2, 3, 4, 6, 8
- Hearing loss in dB HL:
  - Preoperative bone conduction
  - Preoperative air conduction
Coupling site – word recognition score

- Incus (n=4)
- Stapes head (n=9)
- Stapes footplaste (n=10)
- Round window (n=6)

Word recognition score in %
Coupling site: thresholds in free-field

<table>
<thead>
<tr>
<th>Coupling Site</th>
<th>Number of Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incus (n=4)</td>
<td></td>
</tr>
<tr>
<td>Stapes head (n=9)</td>
<td></td>
</tr>
<tr>
<td>Stapes footplate (n=10)</td>
<td></td>
</tr>
<tr>
<td>Round window (n=6)</td>
<td></td>
</tr>
</tbody>
</table>

- **Frequency in kHz:**
  - 0.125
  - 0.25
  - 0.5
  - 1
  - 1.5
  - 2
  - 3
  - 4
  - 6
  - 8

- **Hearing loss in dB HL:**
  - 0
  - 10
  - 20
  - 30
  - 40
  - 50
  - 60
  - 70
  - 80
  - 90
  - 100

Legend:
- Blue line: Incus (n=4)
- Red line: Stapes head (n=9)
- Green line: Stapes footplate (n=10)
- Purple line: Round window (n=6)
Carina implantation in radical cavities
Fat obliteration and Carina implantation

Word recognition score in %

Presentation level without obliteration (n=20) with obliteration (n=9)

65 dB 80 dB
Fat obliteration and Carina implantation

Hearing loss in dB HL without obliteration (n=20) with obliteration (n=9)

frequency in kHz

0,125 0,25 0,5 1 1,5 2 3 4 6 8

Hearing loss in dB HL

- without obliteration (n=20)
- with obliteration (n=9)
Recent developments…


Conclusion

- Carina implantation provides an alternative treatment option in patients with middle to high-grade sensorinerral hearing loss.
- Different coupling elements allow for sufficient hearing rehabilitation in patients with mixed hearing loss.
- Fat obliteration does not affect the output of the actuator.
Thank you for your attention!