Rehabilitating SSD

Stephen O’Leary
Chair of Otolaryngology, University Melbourne
Royal Victorian Eye & Ear Hospital
Patient’s issues & ENT’s options

- Hear on the deaf side
- Hear in background noise
- Directional Hearing
- Sound quality
- Tinnitus
- CROS
- Bone conduction
- CI
Understanding binaural hearing is now a clinical necessity

Sound arrives:
- Earlier
- Louder

Sound Localisation

Sound arrives:
- Later
- Softer
Sound arrives:
- Earlier
- Louder

Sound arrives:
- Later
- Softer

Sound Localisation

You cannot localise sound with one ear
Melbourne experience (28 patients) p=0.035

Objective comparison

CI improves localisation

But not for everyone

Hanson et al, Otol Neurotol 2013, 34:1681-1687
In fact, many adults just *lateralise* sound

SSD – hearing ear alone

SSD – hearing ear and CI

Responses from speaker array
Nawaz, Otol Neurotol 2014; 35:271-276

Sound lateralisation *is not* true localisation but clinically useful!
Sound localization and attention
You can **chose** the sound to **attend to** if you know **where** the sound is coming from.

You cannot do this with one ear.
Real-life soundscapes with a dead ear

“Head Shadow”
Speech in noise and the CI

Melbourne Experience
Quality of life - comparing options

Speech, Spatial Qualities of hearing questionnaire

- CROS & Baha significantly poorer than CI

Normal contralateral ear

Hear on the deaf side

- Hear in background noise
- Sound quality
- Directional Hearing
- Tinnitus

(Bi-CROS)

Bone conduction

CI

Legend
- Appropriate
- Inappropriate
Caution!
Directional hearing and long-term hearing loss
Young children *can truly* localize but only if 2\textsuperscript{nd} CI is within a few years. 

- **Error >40 deg**
  - 2\textsuperscript{nd} CI: 6.9y
  - time b/w 4y

- **Error <40 deg**
  - 2\textsuperscript{nd} CI: 3.6y
  - time b/w 2.1y

Courtesy Karen Galvin, University of Melbourne
Long-term deaf ear

Normal Contralateral ear

- Hear on the deaf side
- Hear in background noise
- Sound quality
- Directional Hearing
- Tinnitus

CROS

Bone conduction

CI
Long-term deaf ear

- Normal Contralateral ear
  - Hear on the deaf side
  - Hear in background noise
  - Sound quality
  - Directional Hearing
  - Tinnitus

- CROS
- Bone conduction
Summary (1)

Wants to hear on deaf side. Trouble in noise.

Trial of CROS or BC

CI
Summary (2)

- Directional hearing. Tinnitus.
- Wants to hear on deaf side. Trouble in noise.
- CI
- Trial of CROS or BC
Cases
Binaural testing in clinical practice
Melbourne normative data

Pre-CI: S/N*: 4.7 dB
Post-CI: S/N -0.3 dB
(p = 0.003)

Pre-CI: -8.7 dB
Post-CI: -9.8 dB
(p=0.026)

* Free-field testing
Signal-to-Noise at 50% word recognition
Sound Localisation with CI
Melbourne normative data

<table>
<thead>
<tr>
<th></th>
<th>Pre-operative</th>
<th>Post-operative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Localisation</td>
<td>40.4° RMS</td>
<td>30.6° RMS</td>
</tr>
</tbody>
</table>
Pre-CI: 15 dB, 4.6 dB
Post-CI: 2.3 dB, -4.9 dB
CI: Better in noise in both ears, localisation a little better
Pre-CI -6 dB 0.2 dB
Post-CI -13 dB -1.5 dB
Localisation

Pre-CI: 84° (rms)
Post-CI: 35° (rms)

CI: better when speech in bad ear. Localisation much better.
SRT: Doing better than CI with HA
Localisation as good as CI with HA

<table>
<thead>
<tr>
<th></th>
<th>No hearing aid</th>
<th>Hearing aid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal-to-Noise</td>
<td>5.6 dB</td>
<td>0.4 dB</td>
</tr>
<tr>
<td>Localisation</td>
<td>81° (rms)</td>
<td>28° (rms)</td>
</tr>
</tbody>
</table>
Doing better than average CI patient (+8 dB) in deaf ear
Localisation $6.9^\circ$ (rms)

Is doing better than average with CI. Patient has a lot to lose with CI.