Paediatric bilateral cochlear implantation: A qualitative study of communication outcomes and functional benefits

Dr Nerina Scarinci and Professor Louise Hickson
The University of Queensland, School of Health and Rehabilitation Sciences, Communication Disability Centre, Australia

Background
➢ An increasing number of profoundly hearing impaired children are receiving bilateral cochlear implants (CIs).
➢ A recent systematic review on the effectiveness of bilateral CIs in children concluded that although the current level of evidence is low, bilateral CIs improve sound localization, and speech perception, although results for sound localization are less consistent (Sparreboom et al., 2010).
➢ Little is known, however, about the communication outcomes and functional benefits of bilateral CIs over unilateral CIs.
➢ Our preliminary research with 22 children who received sequential bilateral CIs found improved speech perception abilities within one year post bilateral CI, however no significant differences in receptive vocabulary, expressive, receptive, and total language scores 1-2 years after bilateral CI (Wong, Scarinci, Hickson, Rose, & Constantinescu, submitted). The varied results highlight the need for further research on outcomes of bilateral CIs.

Aim
To examine the communication outcomes and functional benefits of bilateral CIs in children who received sequential bilateral CIs.

Participants
➢ Parents of 11 children from an early Auditory-Verbal Therapy Intervention Centre.
➢ Children were recruited using maximum variation sampling (Guba & Lincoln, 1989).
➢ All children had severe-profound hearing loss (mean = 107.73dB; SD = 13.24).

Results
➢ Parents reported a range of benefits in listening, language, and speech production outcomes.
➢ Results were highly variable with some parents reporting significant improvements: “I feel like he has really escalated a lot quicker since he had the two” (P5), and others reporting limited benefit: “He has had his implant for almost 3 years and so far we haven’t had a lot of gain out of it” (P8).
➢ Analysis of in-depth interviews revealed the following changes following 2CI:

<table>
<thead>
<tr>
<th>Area of change</th>
<th>Participant ID</th>
<th>Example Participant Quote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance of bilateral implants</td>
<td>P4, P8, P10, P11</td>
<td>“I think it’s just getting used to something different that’s been the barrier” (P6)</td>
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<tr>
<td>Fast acceptance</td>
<td>P1, P3, P5, P6, P7</td>
<td>“He was happy with it straight away” (P1)</td>
</tr>
<tr>
<td>Adjustment to binaural hearing</td>
<td>P2, P3, P4, P5, P6, P10</td>
<td>“It’s not exactly clear when you just put it on and sometimes it isn’t the same as the first one so it kind of isn’t balanced” (P10)</td>
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<tr>
<td>Fast adjustment</td>
<td>P1, P7, P9</td>
<td>“The mapping was quicker, her understanding was a lot quicker, you couldn’t give her a chance to catch up” (P7)</td>
</tr>
<tr>
<td>Listening skills</td>
<td>P6, P8, P9</td>
<td>“I think it is just hearing more … hearing more sounds definitely” (P5)</td>
</tr>
<tr>
<td>Improved sound localisation</td>
<td>P2, P3, P4, P5, P6, P7, P11</td>
<td>“When he first had it switched on it was immediately apparent that he could locate sound direction” (P2)</td>
</tr>
<tr>
<td>Improved hearing over distances</td>
<td>P1, P3, P6, P7</td>
<td>“He was probably more responsive over distance with the two vs. the one definitely” (P3)</td>
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<tr>
<td>Improved hearing in background noise</td>
<td>P3, P2, P3, P6, P9, P10</td>
<td>“He can recognise my voice in the background noise a bit better. Being able to talk to him and him still being able to understand directions with background noise” (P3)</td>
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<td>Improved hearing of environmental sounds</td>
<td>P6, P11</td>
<td>“I noticed with crowds and that sort of thing, she closes all the doors and windows because it’s just so noisy in the evening” (P6)</td>
</tr>
<tr>
<td>Improved hearing at school</td>
<td>P5, P6, P8, P11</td>
<td>“Her ability to hear in class is much better, she is able to see in the class and she still gets the teacher. Before she had to sit at the front!” (P5)</td>
</tr>
<tr>
<td>Improved ability to hear music, phone</td>
<td>P1, P6, P11</td>
<td>“The ‘I … he doesn’t hear as clearly with one vs. two’ (P1)</td>
</tr>
<tr>
<td>Language skills</td>
<td>P1, P4, P9</td>
<td>“I didn’t overly notice ‘Oh she is hearing a lot more’, ‘I didn’t notice anything like that’ (P4)</td>
</tr>
<tr>
<td>Improved</td>
<td>P5, P7, P11</td>
<td>“He just loves talking now and he doesn’t keep to himself anymore – he talks the whole way through dinner” (P5)</td>
</tr>
<tr>
<td>Improved incidental language learning</td>
<td>P2, P5, P6, P7, P1</td>
<td>“Instructively I was thinking he was picking up language more in a natural fashion, picking stuff up from the environment rather than having it given to him in an audited, artificial way” (P2)</td>
</tr>
<tr>
<td>Speech skills</td>
<td>P4, P5, P6, P9</td>
<td>“I don’t think he says anything clearer than he used to” (P5)</td>
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<td>Initial deterioration</td>
<td>P11</td>
<td>“Her speech was falling – going backwards because she was no longer hearing it properly” (P11)</td>
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<tr>
<td>Improved</td>
<td>P1, P7</td>
<td>“She is talking clearer since the second one has been around. I think she concentrates more on her words” (P7)</td>
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</table>

MAIS, MUSS, & SSQ Results
More than 50% of parents reported slightly better, better, or much better abilities in the following areas since receiving 2CI:

Speech Perception
➢ Spontaneously responding to name in quiet and in background noise (MAIS 3.4)
➢ Following speech in background noise and in quiet (SSQ Speech Perception 1,2,5,8)

Spatial Hearing
➢ Child’s control over loudness, length of syllables, and pitch of voice in spontaneous speech (MUSS 3)
➢ Identifying location of sound in unfamiliar place (SSQ Spatial Hearing 1)
➢ Identifying location of speaker in group conversation and at home (SSQ Spatial Hearing 2.3)

Other Qualities of Hearing
➢ Spontaneously alerting to, or responding to auditory signals at home, and in new environments (MAIS 5.6,7)
➢ Awareness of speech in background noise (SSQ Other Qualities of Hearing 2)
➢ Spontaneously discriminating between speakers using audition alone (MAIS 8, SSQ Other Qualities of Hearing 3)

Discussion
➢ According to parent report, bilateral CIs improve children’s listening skills, particularly sound localization and listening in background noise.
➢ Impact of bilateral CIs on language and speech production skills was less evident with only a small number of participants reporting improvement.
➢ Parent reports of improved incidental language learning is consistent with Crosson and Geers (2001) who attributed incidental learning to improved sound localization and better speech perception, especially in noisy environments.
➢ Older children and children with a greater interval between 1CI and 2CI appeared to take longer to accept the bilateral CI, and reported more difficulties and negative experiences than younger children, a finding supported by Scherf et al. (2009) who found that younger children had more positive experiences and reported fewer negative experiences than older children.
➢ Older children also appeared to take longer to adjust to binaural hearing, which is consistent with Peters, Litovsky, Parkinson, and Lake (2007), who found younger children acquired speech perception abilities more rapidly and to a higher level than older children.
➢ Results on the MAIS, MUSS, and SSQ questionnaires were consistent with functional gains noted by parents in in-depth interviews, providing more functional information than speech perception testing alone.

Clinical use of these measures is recommended.

Future Research
➢ Future research employing a longitudinal framework is required along with the study of reports of children’s teachers and therapists.
➢ Investigate factors that may influence outcomes of bilateral implantation (e.g., interval between 1CI and 2CI, time with 2CI, age)

Data Collection
➢ Semi-structured in-depth interview, probing areas including: experience with bilateral CIs; acceptance/adaptation to bilateral CIs, and changes observed from 1CI to 2CIs.
➢ Modified versions of the Meaningful Auditory Intervention Scale (MAIS; Robbins, Renshaw, & Berry, 1998), Meaningful Use of Speech Scale (MUSS; Robbins & Odberger, 1980), and the Speech, Spatial, and Qualities of Hearing Scale for Parents of Children with Impaired Hearing (SSQ-M; Galvin, Mok, & Dowell, 2007). Parents indicated degree of change for each item since receiving 2CI (worse, no difference, slightly better better, much better).
➢ Interview data was transcribed verbatim and analysed using qualitative content analysis (Patton, 2002) and questionnaire data was analysed using descriptive statistics.

References

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