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Author/s:

Galvin, KL

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Achievement of early clinical milestones and long-term functional outcomes for children and young adults with bilateral cochlear implants

Karyn L. Galvin

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Corresponding Author:

Karyn L. Galvin

Dept of Audiology and Speech Pathology

The University of Melbourne

550 Swanston St

Victoria 3010

Australia

Email for correspondence: kgalvin@unimelb.edu.au

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www.maney.co.uk

Introduction

Since 2003, University of Melbourne researchers have been investigating paediatric bilateral cochlear implants (BiCIs). Objective assessments of spatial hearing, speech perception, and listening effort have been conducted; see, for example, Galvin et al. (2011), Galvin et al. (2008), and Hughes and Galvin (2013). Subjective information has also been collected, both to document early postoperative progress in adapting to BiCIs, and to document functional outcomes at a longer term point at which such outcomes were likely to be stable.

Methods

Phone interviews with 71 parents were conducted monthly for up to 24 months. Parents identified the postoperative point at which their child achieved specified clinical milestones. Age at sequential bilateral implantation was 8 months to 20.9 years (M 7.4y; SD 5.3y) and inter-implant interval was 1.5 months to 16.7 years (M 4.8y; SD 4y).

Subsequently, longer-term functional outcomes data was collected from parents whose children were 3.5+ years postoperative. Of the original 71 parents, 53 were eligible; 50 of these, plus seven parents of simultaneously implanted children, responded to a questionnaire administered via phone, email (n = 1), or face-to-face (n = 6). Age at bilateral implantation was 8 months to 19.8 years (M 5.9y; SD 4.9y) and inter-implant interval was 0 to 16.7 years (M 3.9y; SD 3.9y). Fifty-four children were ≥ 3.5 years postoperative, whilst three were 3.3 years postoperative (M 4.4y; SD 1.2y).

Self-reports of longer-term outcomes were also obtained from 26 adolescents/young adults aged 11.2 to 24.1 years; for 20 in this group, parent-reported outcomes had also been collected, although not necessarily at the same time point. Age at sequential bilateral implantation was 5.7 to 20.9 years (M 11.5y; SD 4.3y) and the inter-implant interval was 1.8 to 16.7 years (M 7.8y; SD 3.3y). Twenty-five participants were ≥ 3.5 years postoperative, whilst one was 2.8 years postoperative (M 4.4y; SD 1.4y).

Results

With regard to the clinical milestones, by the 2-month point, around 80% of parents reported that their child had achieved the milestones of “happy to wear two implants together” and “full-time BiCI use”. Three and five children respectively had not achieved each of these milestones by the final interview (which occurred at 16 months for one child). By the 3-month point, around 50% of parents reported that the following milestones had been achieved: a demonstrated preference for BiCIs, superior listening performance with BiCIs,

and comfortable using the second implant alone. By the 6-month point, 30% of parents reported that their child demonstrated similar performance using each implant alone. Around half of the children did not achieve this milestone, although six of these children were followed for less than 20 months. Those who did achieve this milestone tended to be younger at bilateral implantation.

With regard to the longer-term functional outcomes, only one quarter of parents reported that their child had not adapted to BiCIs (defined as “happily using both implants together most of the time”). Sixty-eight percent reported that their child would choose to use BiCIs over a unilateral implant, and 72% reported full-time BiCI use. Only 8% reported minimal BiCI use (<30% of the time). The majority of parents reported superior performance when using BiCIs (70%) or that there was no unilateral use so comparison was not possible (18%). Only 48% of parents of sequentially implanted children reported that the first implant remained superior to the second; an additional 14% reported no unilateral implant so that comparison was not possible. The majority of parents of sequentially implanted children reported that their child had a positive (72%) or neutral (16%) attitude towards their second implant. The majority (86%) of all parents reported that, when risks and costs were balanced with benefits, obtaining the second implant had been worthwhile; only 9% were unsure and 5% reported it was not worthwhile. When compared with an older implanted group (>3.5 years; n = 32), significantly more parents in a younger-implanted group (≤ 3.5 years; n = 25) reported a positive outcome on each of the measures of: adaptation to BiCIs, BiCI usage, device preference, attitude towards the second implant, and performance with each implant alone ($\chi^2 \geq 4.71, p \leq 0.03$). A detailed description of this data was presented in Galvin et al. (2014).

With regard to the self-reported longer-term functional outcomes, only 15% of adolescents/young adults had not adapted to BiCIs. Eighty-one percent would choose to use BiCIs rather than a unilateral implant. Nevertheless, only 54% wore BiCIs full-time; an additional quarter used BiCIs 60 to 90% of the time. Only 15% reported minimal BiCI use (<30% of the time). The majority reported superior performance when using BiCIs (88%) or superior performance in some situations (4%). The majority (81%) also reported that the first implant remained superior, although 19% reported similar performance with each implant alone.

Discussion

The majority of a group of 71 sequentially implanted children were reported to have made relatively quick progress in achieving important postoperative clinical milestones related to

BiCI use, preference, and superior listening performance. Fifty percent or more achieved the relevant milestones within 3 months, however up to 20% required >12 months to achieve each of these milestones, or did not achieve them. This latter group included children aged 2.9 to 13.5 years at bilateral implantation, but did not include any of the nine adolescents/young adults bilaterally implanted at >14 years. Achievement of second-implant related milestones was slower and more inconsistent, and more likely for younger children. In the longer term (3.5+ years), a positive outcome was reported by around 70% of parents for most outcomes measures examined, including ease of adaptation and attitude towards the second implant (for sequentially implanted children), BiCI usage, device preference, and superior listening performance with BiCIs. An even higher proportion (86%) reported that obtaining BiCIs was worthwhile. Of the additional 9% who were unsure, one child suffered a postoperative infection and one found adaptation more difficult than expected. Only for the outcome measure of performance with each implant alone did less than half of the parents report a positive outcome. For each outcome measure, and particularly for performance with each implant alone, parents of younger children (with shorter inter-implant interval) reported a positive outcome more often. Nevertheless, there was inconsistency across individuals and negative outcomes were reported for some young children with a short delay, whilst many positive outcomes were reported for some young adults with a long delay.

The self-reported longer-term outcomes were fairly similar, with 70 to 90% of adolescents/young adults reporting a positive outcomes on most measures. Given this, the somewhat limited proportion reporting full-time BiCI use was surprising. The adolescents and young adults may have been more selective than younger children regarding the situations in which they chose to use BiCIs. It was not surprising that <20% of this group reported similar performance with each implant alone, given that three-quarters had 5+ years experience using the first implant alone before receiving the second.

Conclusions

In summary, recipients of all ages with short or long inter-implant intervals demonstrated adaptation to BiCIs, benefit in everyday life, and a range of other positive functional outcomes. Adaptation and demonstrated benefit typically occurred relatively easily and within months of bilateral implantation. Conversely, for a small proportion of recipients, adaptation was difficult, second implant use was limited (or discontinued), and bilateral benefit was limited. Poorer outcomes were more common for older recipients with a long inter-implant interval, although this was not exclusively the case and some older recipients

were highly motivated BiCI users and demonstrated very positive outcomes. In particular, older recipients were less likely to achieve similar performance with each implant.

This data is important for the refinement of selection criteria and the development of evidence-based preoperative counselling practices. Such counselling will help families to make informed decisions about BiCIs, and to develop appropriate postoperative expectations regarding progress and benefit. The data is also relevant to the provision of effective postoperative management. It provides evidence for likely postoperative progress, and highlights the need to be aware of the minority who have difficulty adapting to BiCIs and/or who do not easily achieve full-time BiCI use. This group, the majority of whom will be sequentially implanted, need additional encouragement and support.

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