Long-term Outcomes of Children and Young People with Cochlear Implants

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Introduction

Profound childhood hearing loss has a huge impact on early communication skills, the acquisition of spoken language, and hence on educational attainments and employment prospects. Over the centuries, educators of the deaf attempted to overcome the challenge by using visual means (sign language and / or lipreading, written approaches) amidst great controversy. However, the seminal work of Conrad (1979) illustrated that, in spite of the dedicated attempts of educators, deaf children typically left school with less than functional literacy [1]. With the advent of cochlear implantation for children in the 1980s, providing access through hearing to spoken language as never before, there were expectations that the educational impact of profound deafness would be addressed. Expectations were initially cautious: awareness of environmental sounds and an aid to lipreading.

Cochlear implantation has become routine provision for profoundly deaf children, and over 160,000 children now have implants worldwide. Outcomes have surpassed expectations and are now not disputed. "Speech perception, speech intelligibility, language, literacy, and psychosocial adjustment far exceeded that reported for similar groups before the advent of CI technology" (Geers et al. [2]). Cochlear implantation has been shown to be safe, to be reliable, and to be effective, and the long-term outcomes of this surgical intervention are being seen in education. So, what do we know of these outcomes in the long term and what are the remaining challenges?

Changes in candidature

Initially, cochlear implant teams were cautious, implanting those with no residual hearing, and those who had lost their hearing. Now children are being implanted:

- Who are born deaf
- In the first year of life
- With some residual hearing
- With complex needs
- With two implants, rather than one
- Who are wearing a hearing aid and an implant
- With deaf parents
- Who are teenagers, and choosing implantation for themselves.

Speech and language outcomes

In providing useful hearing for both environmental sounds and for speech, for the first time, speech and language measures normed on hearing children are being used for deaf children. Children implanted early are developing communication skills following the normal developmental pattern [3]. In the long term we know that young people with implants are developing intelligible spoken language and using spoken language as their chosen means of communication [2, 4, 5]. The majority can use the telephone with those they know and many with those they are unfamiliar with; and many enjoy music and the usual activities of teenagers.

Educational outcomes

The educational decisions of whether deaf children should go to mainstream or specialist schools, and which communication mode should be used have been hugely influenced by cochlear implantation. Although political initiatives have also promoted a move to mainstream provision, those with implants are more likely to go to mainstream schools, as compared to special provision [6]. The contentious issue of whether to use spoken or sign language has also been influenced by the advent of cochlear implantation, with more using spoken language [7]. Oral communication is a factor in producing benefit and those using a visual means of communication prior to implantation are changing to spoken language after implantation, particularly those implanted young [3]. The choice of communication mode being used in educational settings is being questioned [7], with an increasing look at the more flexible use of 'signed support' where spoken language is used, supported by sign, rather than sign language with its different grammar, for those who may require visual support in the classroom [7]. There is increasing evidence that young people with implants have a flexible view of their communication needs: while becoming proficient spoken language users, they may also value signed communication.

The reported improvements in spoken language have led to greater educational attainments, including better reading levels [6, 8], with a positive shift in literacy outcomes for learners with cochlear implants. However, there is also some evidence that while children with implants are doing better than their peers with hearing aids, they are not doing as well as their hearing peers, particularly in the long term [6]. For example, in the group reported by Geers and Hayes (2011) reading levels in the normal range were obtained when the group were tested at eight / nine years of age, but when they were retested at 15 / 16 years of age, there was much greater variability [8]. This may be because of difficulties in more subtle communication skills, such as pragmatic skills, needed to succeed in the classroom and to develop higher order literacy skills [9]. Young people report challenges particularly in high school, where acoustic conditions are demanding and language is more complex [6].

Psychosocial issues

There is little evidence to show that young people with cochlear implants have greater mental health issues than previously [6, 10]. Young people with cochlear implants report a flexible view of themselves [6, 10] reporting feeling deaf and hearing – the first time that this has been possible. Young people report satisfaction with their implants, and wearing them consistently in the long term is a sign of the value they place on them [4, 5, 11].

Bilateral implantation: two ears are better than one

Initially, children received only one implant; however, we know that listening in noise and locating where sound comes from is difficult with hearing only in one ear, providing challenges in the classroom [12]. Two implants are now routine in many places in the world, and have been found to be more effective than unilateral implantation [13]. Young people with two implants report that it is easier to listen in class, but need help to learn to listen with their second, sequential implant [14].

Complex children with cochlear implants

With increasing evidence of the benefits of implantation, there has been growing interest in implanting deaf children with complex needs:

"There is little evidence to show that young people with cochlear implants have greater mental health issues than previously."

about 30% of deaf children have additional needs, and for many, cochlear implantation has produced significant, if difficult to measure, benefit which is valued by parents [15]. However, for parents of these children, there remains the challenge of timely referral, and of appropriate educational support should implantation proceed.

What predicts better outcomes?

Deaf children are a hugely heterogeneous group, with many factors influencing progress: cochlear implantation has added yet more variables, making the drawing of robust conclusions even more challenging. Outcomes from paediatric cochlear implantation are marked by variation, but age at implantation is consistently shown to be a major factor. Other emerging predictors of better outcomes are rich parental input and interaction with the young child, the educational levels of mothers, cognition and having the latest technology [16].

Summary

The results from cochlear implantation have far outweighed expectations, even for those originally cautious, who acknowledge greater benefits in terms of spoken language than they had foreseen and the reported results are likely to be conservative: they are based on those with old technology, often with only one implant, and children implanted later than is the case today.

However, we need to recognise the huge variation in results, particularly in the long term, and need to be aware that while cochlear implantation has dramatically changed the impact of profound deafness, it has not cured it. Young people with cochlear implants remain deaf, but are being deaf differently today. Their needs are more subtle than those of previous generations, and may be masked by excellent levels of speech intelligibility. What we do know is that their long-term educational needs will continue to be more diverse and complex than before, and that deaf educators have a major challenge to keep pace with the changes set by today's otologists and scientists.

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