

Language outcomes after cochlear implant

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Abstract

Question A young infant seen in our practice was diagnosed with profound congenital hearing loss. Their parents want to pursue cochlear implant surgery for their child, but they are concerned about language acquisition before and after the surgery. What should they know about the procedure, and how can they improve language outcomes?

Answer Congenital hearing loss is often identified on newborn screening hearing tests. Cochlear implants may lead to overall improved spoken language skills among children with profound hearing loss. Some factors associated with successful language acquisition in children after cochlear implant surgery include having the procedure at an earlier age and family engagement in early intervention programs. Learning sign language before cochlear implant surgery may improve subsequent language outcomes and support the child's cognitive and socioemotional success.

Congenital hearing loss affects 1 to 3 of 1000 live births.¹ Hearing disorders disrupt language development and as a result can affect a child's social development and literacy.² Most high-income countries, including Canada, have implemented hearing detection and intervention programs for infants and children shortly after birth to address hearing health proactively.³ These programs include universal newborn hearing screening, communication support such as sign-language classes, family support for infants with permanent and irreversible hearing loss, and hearing aids and cochlear implants.^{3,4}

It is important to note that the use and promotion of cochlear implants are controversial topics among people who are deaf or hard of hearing and their supporters.⁵ In this hypothetical case the parents have decided to proceed with cochlear implant surgery for their child, thus a detailed examination of the controversy is beyond the scope of this article. However, clinicians should familiarize themselves with these concerns and acknowledge them in individualized discussions with patients' parents.

Cochlear implants process sound electronically and then transmit electric stimulation to the cochlea.⁶ In general, infants with moderate to severe permanent hearing impairment who have no contraindications to surgery are candidates for cochlear implantation.⁴ More than 90% of children with deafness or hearing loss are born to hearing parents and most of these parents opt for their children to gain access to sound and spoken language.⁷ Cochlear implants may lead to overall better spoken-language skills for children with profound hearing loss.⁸

There is statistically significant variability in the rate of success in language development among children with congenital hearing loss who receive cochlear implants.^{9,10} Primary care providers play a role in enhancing the likelihood of successful language acquisition² by using tools to support and improve outcomes after cochlear implants.

Improving outcomes

Several factors are associated with successful language acquisition in children after cochlear implant surgery.

Age at implantation. Children with substantial congenital hearing impairment who receive cochlear implants at a younger age have better speech and language acquisition outcomes.¹¹ The auditory cortex has the most neural plasticity at birth, and this plasticity decreases over time. The critical period of learning and language development is within the first 3.5 years of life. Early cochlear implantation, ideally before 12 months of age, is associated with the highest rate of successful hearing and oral language production after surgery.^{12,13}

A prospective study of 350 children from Australia reported that 5-year-old children who received cochlear implants at 24 months of age had mean global language scores that were 1.4 standard deviations below those of children who received cochlear implants at 6 months of age, based on 20 measures of language outcomes (-21.4 score points, 95% CI -33.9 to -9.0).¹⁴ A multicentre study of 209 children with congenital hearing loss reported that children with cochlear implants placed before 12 months of age had statistically significantly better receptive language skills and cognitive outcomes at school entry (5 to 7 years of age) than children who received cochlear implants between 12 and 60 months of age.¹⁵

A 12-year retrospective study at the Children's Hospital of Eastern Ontario in Ottawa revealed that 118 of 187 children (63%) received cochlear implants after 12 months of age.¹⁶ Almost 10% of the implantations that occurred more than 12 months after diagnosis were delayed owing to family indecision, emphasizing the difficulties in decision making about the surgical procedure.¹⁷

Family involvement. Interventions focused on parent-child interactions can improve language outcomes for children with cochlear implants.¹⁸ A retrospective cohort study of 42 children with cochlear implants in Australia found that intensive family involvement in early intervention programs

was associated with greater scores on a standardized measure of single-word receptive vocabulary.¹⁹

A meta-analysis of 27 studies of children with cochlear implants reported that the effect of parental linguistic input, including all language types they exposed their children to, accounted for one-third (31.7%) of the variance in the children's language outcomes ($r=0.564$, $P<.001$, 95% CI 0.449 to 0.660).²⁰ The authors concluded that high-quality parent-child language interactions after cochlear implant surgery are important to successful language acquisition. Higher family socioeconomic status⁸ and higher levels of maternal education^{8,21} were associated with improved language outcomes.

Disabilities. Having an additional disability was associated with poor language outcomes in children with cochlear implants. Among 3-year-old children with hearing loss, having additional disabilities accounted for 15% to 21% of variance in language outcomes.²¹ Nonverbal cognitive ability was a statistically significant predictor of receptive and expressive language outcomes in children with disabilities who received cochlear implants, and was positively correlated with all language and speech measures.¹⁰ Access to early cochlear implant surgery and the role of multidisciplinary care teams were extremely important to ensuring favourable outcomes in this population.²¹

Learning sign language

Cochlear implantation is usually scheduled 6 to 12 months after the diagnosis of congenital hearing loss,¹⁶ and children may be at high risk of limited language exposure (linguistic deprivation) during that time, which may result in long-term language delay.¹³

There is a paucity of high-quality evidence to suggest whether learning a visual language such as American Sign Language before implantation improves oral language acquisition later in life.²²⁻²⁴ However, providing access to sign language at a young age will offer children an initial language and support cognitive and socioemotional success.²⁵⁻²⁷

Conclusion

Cochlear implantation may enable children to learn oral or sign language. Implant surgery early in life and family involvement in care are associated with favourable outcomes in children, while the presence of additional disabilities may delay language development. Learning sign

language before cochlear implantation may help avoid language deprivation. Primary care providers and multidisciplinary care teams can initiate counseling, surgery, and postimplant follow-up, and families can seek additional support from provincial or territorial services.

Competing interests

None declared

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