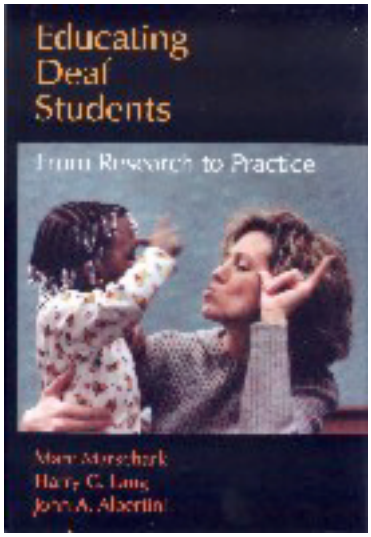

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Educating Deaf Students: From Research to Practice, New York: Oxford University Press, 2002.

Chapter 3: Cochlear Implants

By 1997, more than 9000 adults and 700 children worldwide had received cochlear implants, and they have rapidly become one of the most important issues for teachers, school administrators, and educational researchers (Marschark, 2001a). We therefore will try to at least touch on the major issues concerning cochlear implants in children.

Perhaps the best summary of the functioning of cochlear implants was provided by the National Institutes of Health (1995):

The cochlear implant is an electronic device that, under the appropriate conditions, provides a sense of sound to persons who are profoundly hearing impaired or deaf. It does not restore normal hearing, but it can help the user understand speech and perceive sounds from the environment. The vast majority of adults who are deaf and have cochlear implants derive substantial benefit from them when they are used in conjunction with speech reading, and a considerable number of implanted individuals can understand speech without visual cues. Benefits also have been observed in children, including those who were born deaf or lost their hearing before learning spoken language. (p.4)

Whereas hearing aids amplify sound, cochlear implants provide a direct connection between sound in the environment and the nerves that normally carry that information to the brain. Implantation involves surgically inserting a set of electrodes directly into the cochlea. Like a hearing aid, the user has one of several models of the external device that includes a microphone and a receiver which converts sound to electrical energy. (The external mechanism is attached magnetically to the internal part of the unit; there are no wires sticking out of the head.) The cochlear implant system includes a micro-processor which generates electrical signals corresponding to sounds varying in loudness and frequency and sends them directly to nerve fibers in the cochlea (fig. 3.3)

One does not frequently encounter opposition to hearing aids, even if some deaf people prefer not to wear them. Cochlear implants are a more sensitive issue, for several reasons. First, implantation involves invasive surgery (with attendant risks) that destroys any residual hearing in the implanted ear, although complications appear to be rare. Second, implantation is not a simple, "one-shot" affair. The initial implantation surgery costs $40,000-$50,000, expenses now being paid by most health insurers, and requires minimal hospital stay. Following implantation, however, support for speech and hearing rehabilitation involves a team of individuals including doctors, speech therapists, and others working with a child for years and, according to recent figures, this follow-up can cost another $20,000 or so a year.

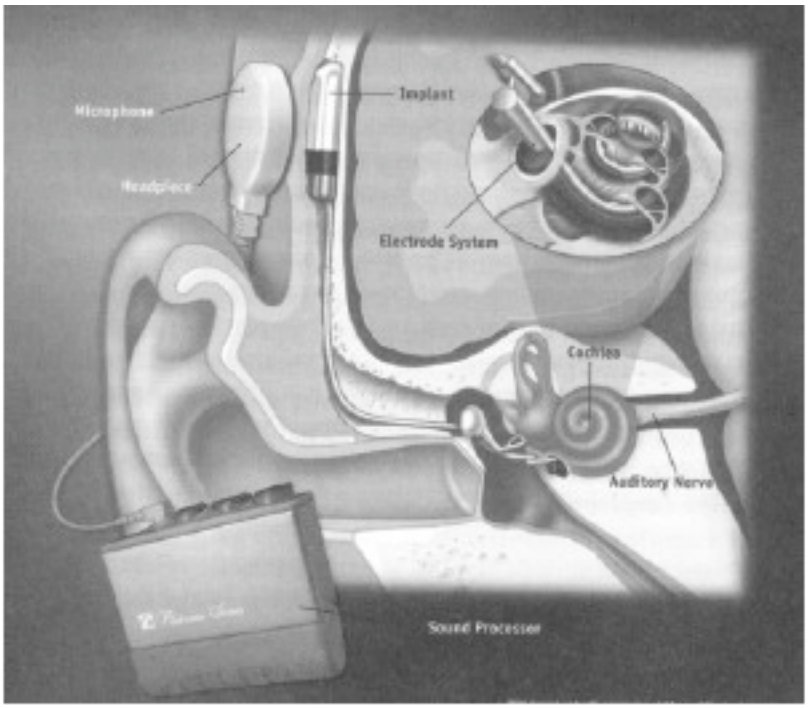

Figure 3.3 Schematic of a cochlear implant. (Courtesy of Advanced Bionics.)

Beyond practical matters, a third issue with regard to implantation comes from the social-cultural perspective, held by some Deaf and hearing individuals, that performing surgery to try to restore hearing implicitly tells children that being deaf is bad and that they have to be medically repaired. There is some concern that such children will lack self-esteem and may find themselves stuck between Deaf and hearing cultures, not a member of either. There is also an underlying, less-frequently stated fear that the increasing number of cochlear implantations might lead to the demise of the Deaf community. In chapter 2, we described the history of deaf people seeking to be recognized as individuals, and the emergence of Deaf communities as a linguistic and cultural minority group. Throughout that history, the long-running debate about the best methods for communication has blurred with other issues, and social opinions always have been added to the argument of what works for whom and when. With increasing visibility now being given to the Deaf community and to the roles of deaf people in all walks of life, cochlear implants do seem threatening— and apparently with good cause. An eminent physiologist whose research contributed significantly to the development of the cochlear implants currently in use has argued that deafness is a medical condition that needs to be cured. "The simple fact is," he noted, "that if the culture could be reliably wiped out, it would be a good thing to wipe out" (Clay, 1997, p. 28). Nevertheless, some Deaf adults have chosen to get implants and stay in the Deaf community. Others have made different decisions.

While social-cultural concerns are important to some individuals, they are likely to be of

only secondary importance for hearing parents who are more interested in trying to have their children be as "normal" as possible. In the end, it will be the decision of parents - hopefully an informed decision - as to whether a child receives a cochlear implant. Motivation and enthusiasm for a cochlear implant on the part of the recipient generally is the best predictor of its success, providing perseverance through the operation and the extensive "mapping" (tuning of the device) and training periods that follow. When parents decide on a cochlear implant for their young children, or when adults are pressured into implantation by family members, the outlook is less certain. Yet, parents often appear to value cochlear implants more than the children do, hoping to give their child "a normal life." Not surprisingly, the lowest usage rates among individuals with cochlear implants are found in teenagers, who typically have already established sign communication skills, are less likely to acquire strong speech skills, and are likely to be influenced by identity and psychosocial implications of using the device (i.e., peer pressure; O'Donoghue, 1996; Pollard, 1996).

Setting aside opinions about cochlear implants, the most important issue for educators and parents is the extent to which the implants contribute to language development, social development, cognitive development, and educational success. This means balancing risks, benefits, and the alternative of not having the implantation. Many parents are understandably concerned about possible isolation, depression, academic difficulties, and future employment challenges for their children. Support from the Deaf community and others notwithstanding, these are certainly risks to be considered, and many deaf adults report having experienced such obstacles, even if they ultimately were successful in overcoming them. Not being familiar with either deafness or the Deaf community, the promise of making their child able to function in a hearing world is very attractive to hearing parents.

At the same time, hearing parents cannot really understand what it means - and does not mean - to be deaf. We have already noted that deaf life is different from just life without hearing, and there is nothing that will turn a deaf child into a hearing child. Even with a cochlear implant, there is no guarantee that a particular child will be able to understand spoken language - even if the implant's microprocessor is commonly referred to as a "speech processor,' by manufacturers. It therefore is worth considering the language issue a bit more thoroughly.

As can be seen in the schematic of a cochlear implant (fig. 3.3), the business end of the device is the wire inserted into the cochlea. The wire contains multiple "channels," each consisting of an electrode sending a different frequency. Early single-channel cochlear implants, first implanted in adults in 1957, were rarely successful in allowing deaf children to understand speech and did not significantly improve their speech intelligibility (Carney & Moeller, 1988). With the development of more sophisticated, multiple-channel implants transmitting 22-26 separate frequencies, studies have demonstrated that deaf children's speech perception and production ability continue to increase 4-5 years after implantation. In 1995 the National Institutes of Health (NIH) stated that "speech produced by children with implants is more accurate than speech produced by children with comparable hearing losses using vibrotactile devices or hearing aids.... just one year after implantation, speech intelligibility is twice that typically reported for children with profound hearing impairment and continues to improve." It is important to note the reference to profound hearing losses, because

children with hearing losses up to around 90 dB have been found to have as good or better speech perception and production with hearing aids as children with cochlear implants, and children with losses less than 90 dB typically are not considered candidates for cochlear implants.

On the basis of advertising of implant manufacturers and seeing "cochlear implant stars" on television, many parents believe that implantation will improve deaf children's auditory perception and speech production sufficiently to make them fully able to communicate through spoken language alone. Those expectations frequently are not met, sometimes with significant negative emotional consequences for all concerned (Kampfe et al., 1993; Pollard, 1996). The outcome of receiving a cochlear implant can range from the success of those perhaps infrequent stars to acceptable levels of functioning to no benefit at all to the occasional catastrophic failure, in which an implant must be removed. At present, we are unable to find any statistics concerning the frequency of the two extremes in this continuum, although they are both infrequent.

Based on a thorough review of the literature, it is evident that there are many more positive outcomes of cochlear implantation than negative outcomes (Spencer, in press). The "average" outcome is one in which sounds are detected 90 percent of the time, but spoken language is correctly identified less than 50 percent of the time. Although the "success stories" are described as being able to talk fluently on the telephone, the average recipient of an implant has only limited use of the telephone for short and contextually well-defined utterances. Unfortunately for both users and investigators, outcome variability is so great that it is difficult to make any good generalizations at this point.

Descriptions of particular studies concerning the speech and hearing abilities of children who have received cochlear implants are beyond the scope of the present discussion and invariably will capture only part of the bigger picture. More important for present purposes, research concerning language development (see chapter 5) in deaf children with cochlear implants is just beginning, and we do not yet know how implants will impact school achievement and socialization. In fact, few studies have addressed either academic or social functioning.

In one study, described as a follow-up of all of the children who had received cochlear implants at a particular center, among eight children who had received implants and were in mainstream educational settings, all but two were performing in the top half of their classes (Nevins & Chute, 1995). Five of the children were rated by their teachers as academically and socially successful in the classroom, two as socially but not academically successful, and one not successful in mainstream. Unfortunately, the investigators did not follow-up the other eight children, who were not enrolled in mainstream programs, so it is difficult to draw any firm conclusions. Taken together, however, the published research indicates that cochlear implants improve speech perception at frequencies that might contribute to language processing and language acquisition. They also suggest that language development may be enhanced by cochlear implants relative to preimplantation levels for many children, particularly those who lost their hearing after some exposure to auditory stimulation (Tait & Lutman, 1994; Vermeulen et al., 1995; see Spencer, in press, for review).

One often encounters claims by manufacturers and individuals that implanted children in spoken-language environments do better in language development than children in environments that include sign language (e.g., Tait & Lutman, 1994). Such claims are difficult to evaluate because most children who receive implants were previously educated in spoken language environments and continue in those programs after they receive their implants. Several published and unpublished studies suggest that children enrolled in total communication settings have shown the greatest advances in language development (e.g., Preisler & Ahlstroem, 1997).

Length of time with the implant has been reported to be an important predictor of speech and language success in some studies, but not in others (Dawson et al., 1995). Unlike adults deafened later in life, who show the greatest benefits from cochlear implants within the first year or two of implantation, children tend to show smaller gains during the first 18 months after implantation. One recent investigation (claiming strong support for implantation), however, found that the length of time with an implant accounted for only 1 percent of the variability in whether children attended mainstream programs rather than special programs for deaf children (Francis et al., 1999). In contrast to the view of many medical researchers, the consensus among investigators of the development of deaf children appears to be that most children who receive implants are ill-prepared for full-time placement in mainstream programs without additional support (Patricia Spencer, personal communication, March 2, 20001.

Clearly, there are many questions to be answered. Most important, perhaps, is the issue of who will benefit from implants and who will not. As the implantation of young children continues, it is essential that we conduct more research on the linguistic, cognitive, and social impact of cochlear implantation, coupled with ongoing research concerning speech perception and production. In the meantime, as long as it appears that sign language might support the development of spoken language by children with implants, total communication environments appear to offer the broadest possible support for language and social development. Even if children with cochlear implants eventually come to depend more on spoken language than on sign language, early access to language is essential for deaf children's cognitive development and literacy skills in their ability to benefit from school experiences, and sign language may be helpful for many children with implants (Preisler & Ahlstroem, 1997; Tomblin et al., 1999). Because understanding that different school settings can support and emphasize different aspects of development in education, let us briefly consider the issue of alternative school placements.

Carney, A. E. & Moeller, M. P. (1988). Treatment Efficacy: Hearing loss in children. *Journal of Speech, Language, and Hearing Research*, *41*, S61-S84.

Clay, R. A. (1997). Do hearing devices impair deaf children? *APA Monitor*, *28*, July.

Dawson, P. W., Blamey, P. J., Dettman, S. J., Barker, E. J., & Clark, G. M. (1995). A clinical report on receptive vocabulary skills in cochlear implant users. *Ear and Hearing*, *16*, 287-294.

Francis, H. W., Koch, M. E., Wyatt, J. R., & Niparko, J. K. (1999). Trends in educational placement and cost-benefit considerations in children with cochlear implants. *Archives of Otolaryngology and Head and Neck Surgery*, *125*, 499-505.

Kampfe, C. M., Harrison, M., Oettinger, T., Ludington, J., McDonald-Bell, C., & Pillsbury, H. C. III (1993). Parental expectations as a factor in evaluating children for the multichannel cochlear implant. *American Annals of the Deaf*, *138*, 297-303.

Marschark, M. (2001a). Context, cognition, and deafness: Planning the research agenda. In M. D. Clark, M. Marschark, & M. Karchmer (eds.), *Cognition, context and deafness* (pp. 179-198). Washington, DC: Gallaudet University Press.

National Institutes of Health (1995). *Cochlear implants in adults and children*. Online NIH Consensus Statement, 13(2), 1-30. Bethesda, MD: NIH.

Nevins, M. E. & Chute, P. M. (1995). Success of children with cochlear implants in mainstream educational settings. *Annals of Otolaryngology, Rhinology, and Laryngology Supplement*, *166*, 100-102.

O'Donoghue, G. M. (1996). Cochlear implants in children: Principles, practice, and predictions. *Journal of the Royal Society of Medicine*, *89*, 345P-347P.

Pollard, R. Q. Jr. (1996). Conceptualizing and conducting the pre-operative psychological assessments of cochlear implant candidates. *Journal of Deaf Studies and Deaf Education*, 1, 16-28.

Preisler, G. M. & Ahlstroem, M. (1997). Sign language for hard of hearing children - A hindrance or a benefit for their development? *European Journal of Psychology of Education*, *2*, 465-477.

Spencer, P. E. (in press). Language development of children with cochlear implants. In J. Christiansen & I Leigh (Eds.), *Cochlear implants: The dilemma*. Washington, DC: Gallaudet University Press.

Tait, M., & Lutman, M. E. (1994). Comparison of early communicative behavior in deaf children with cochlear implants and was hearing aids. *Ear and Hearing*, *15*, 352-361.

Vermeulen, A. M., Beijk, C. M., Brokx, J. P., van den Borne, S., & van den Broek, P. (1995), Development of speech perception abilities of profoundly deaf children: a comparison between children with Cochlear implants and those with conventional hearing aids. *Annals of Otolaryngology, Rhinology, and Supplement*, *166*, 215-217.