FACT SHEET

NATIONAL INSTITUTES OF HEALTH

# Cochlear Implants

One of the more groundbreaking biomedical achievements in the last thirty years is the cochlear implant, an electronic device that provides a sense of sound to individuals who are profoundly deaf or severely hard-of-hearing. Cochlear implants process sounds from the environment and directly stimulate the auditory nerve, bypassing damaged portions of the inner ear. Derived in part from NIH-funded research that dates back to the early 1970s and continues today, this remarkable technology enables deaf and severely hard-of-hearing individuals to enjoy an enhanced quality of life by providing the ability to listen and participate in conversations as they typically occur throughout our society.

## Yesterday

- Most profoundly deaf or severely hearing-impaired children were not diagnosed until they were 2 1/2 to 3 years old. As a result, many children were not offered treatment until long after the period an individual normally starts to acquire speech and language skills.
- Children with hearing loss often fell behind their peers in language, cognitive, and social skills. They also were limited in their academic performance and long-term job opportunities.
- Prior to 1975, the primary medical device for profoundly deaf or severely hearing-impaired children and adults was the behind-the-ear (BTE) analog hearing aid. Unlike the cochlear implant, a hearing aid primarily amplifies sounds so that they can be detected by the surviving portions of the ear; therefore, the more severe the hearing loss, the less effective a hearing aid will be.
- The first cochlear implants to be tested were single-channel cochlear implants, which transmit all sound frequencies as a single signal to the inner ear. These devices proved the value of electrical stimulation of the surviving auditory nerve. Individuals were aware of environmental sounds, such as sirens, and speech lip-reading skills were significantly improved.
- In the late 1970s, implants were developed to stimulate different portions of the surviving auditory nerve, based on the different sound frequencies present in the environment. This enhancement greatly increased the complexity of the device and mimicked normal function of the inner ear.
- Individuals using this device were able to understand speech without any lip-reading cues.
- In 1984, the Food and Drug Administration (FDA) approved the first cochlear implant for use in adults ages 18 and older. Five years later, the FDA approved the first cochlear implant for use in children ages 2 years and older. And in 2000, the FDA approved the implantation of children as young as 12 months of age for one type of cochlear implant.
- The NIH sponsored two Consensus Development Conferences, one in 1988, and a second in 1995, which offered guidance on the benefits, limitations, and technical and safety issues to consider in the use and study of cochlear implants.

## Today

- Nearly 188,000 individuals worldwide are fitted with a cochlear implant. In the United States, more than 41,000 adults and nearly 26,000 children have one.
- NIH-supported scientists showed that profoundly deaf children who receive a cochlear implant at a young age develop language skills at a rate comparable to children with normal hearing.
- Although the benefits of the cochlear implant can vary among individual users, improvements in speech processors and other related technologies allow children with cochlear implants to succeed in mainstream classrooms.
- NIH-supported scientists found that the benefits of the cochlear implant far outweigh its costs in children. A cochlear implant costs approximately $60,000 (including the surgery, adjustments, and training). In comparison, the services, special education, and

adaptation related to a child that is deaf before age three costs more than $1 million.

## Tomorrow

The NIH is poised to make major discoveries that will help provide increased benefits to cochlear implant users and preempt poor outcomes.

- Scientists are studying large groups of children who were identified early with hearing loss and implanted with a cochlear implant. Knowledge from this research will shed light on the variables most related to improved speech and language acquisition as well as reading and higher academic performance in children with cochlear implants. They are also evaluating the factors that may be responsible for the large individual differences seen in outcomes for these children.
- Engineers are continuing to look for ways to optimize the current generation of cochlear implant technology in order to provide every possible benefit to the user. Novel signal processing and improved microphones could be used to help reduce background noise. New battery technology is under development to make these devices more convenient for users.
- Researchers are seeking ways to improve the design of the cochlear implant electrode to preserve existing hearing at low frequencies, provide a truer representation of the original signal, and improve the overall health of the auditory nerve.
- Some individuals with severe to profound hearing loss are receiving two cochlear implants, one for each ear. Research is demonstrating that these cochlear implant users are significantly better at localizing sounds and hearing speech in a noisy room, when compared to individuals with one implant. Advanced signal processing techniques are needed for researchers to fully make use of these capabilities. Continued research to assess how well current users benefit from their cochlear implants will assist in the design of the next generation of implants.

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