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THE COCHLEAR IMPLANT

A New Hope for the Totally Deaf

A Program of the ILSHF
(Iowa Lions
Sight and Hearing Foundation)

Department of Otolaryngology—
Head and Neck Surgery

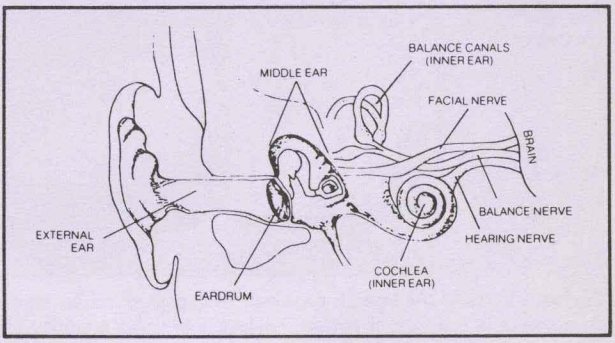
Deafness and the Cochlear Implant

Hearing handicaps are hidden and often go unnoticed. An estimated 10 percent of the population in the United States, or over 20 million persons, have significant hearing loss. These numbers are likely to increase with declining infant mortality and an increasing older population. The large majority of hearing-impaired persons have sensorineural deafness, which is not curable with medical or surgical treatments. This pamphlet describes a new treatment that is helping totally deaf people who are unable to benefit from conventional hearing aids.

The cochlear implant may be described as a "bionic ear." Part of this electronic device is implanted in the temporal (ear) bone and part is worn externally like a pocket-type hearing aid. It enables the user to distinguish a variety of environmental sounds, greatly aids lipreading, and helps the patient to modulate his or her own voice.

Function of the Normal Ear

The ear is divided into three parts, each performing an important function in the process of hearing. The external ear consists of a visible ear and the ear canal, structures that gather sound and direct it toward the eardrum. The middle ear chamber lies between the external and inner ear and consists of an eardrum and three small bones. These structures amplify sound vibrations and transmit them to the *inner ear*, or cochlea, where endings of the hearing nerve lie. These delicate nerve endings, or hair cells, generate current when stimulated. This electrical current is then transmitted by the hearing nerve through the auditory brain stem to the brain where the electrical impulses are interpreted as sound.

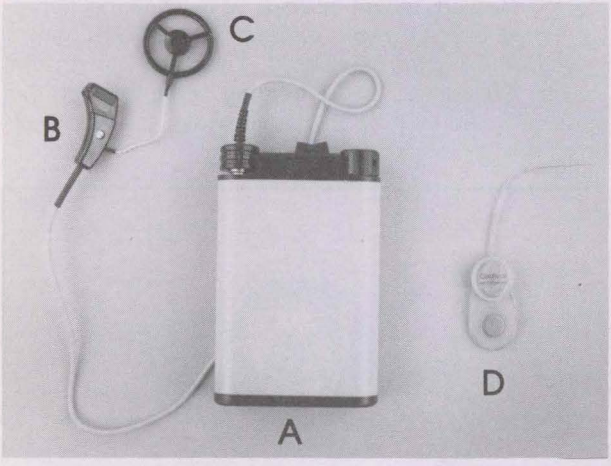


Types of Hearing Impairment

When there are diseases or obstructions in the external ear or middle ear, a conductive hearing impairment results. It often may be corrected by medical or surgical treatment. When the problem is in the inner ear, a sensorineural impairment results. Most cases of sensorineural deafness are due to damage of the hair cells in the cochlea. This damage may have been caused by virus, infection, drugs, head injury, or hereditary factors. In the case of congenital (present at birth) sensorineural loss, the cause is often unknown.

The Cochlear Implant

Cochlear implants are used to help deaf persons with a sensorineural type of impairment. The part of the cochlear implant device that is surgically implanted in the temporal bone partially replaces the function of damaged hair cells. The implanted parts consist of a receiver coil that interfaces with externally worn components, and an electrode array that provides electrical current to the hearing nerve. The externally worn components consist of an ear level microphone that picks up sound and a wearable speech processor that codes the sound into electrical signals. This information is then carried to a transmitter that is coupled to the head by a magnet and is worn behind the ear. The electrical signal passes through the skin to the implant receiver and electrode array.



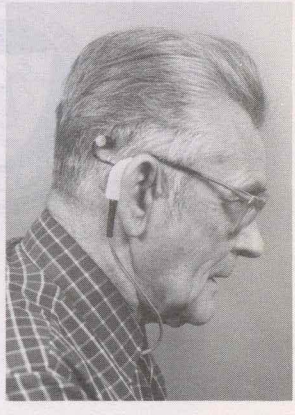
Cochlear Implant. (A) Speech processor (compact, portable, worn on a belt or in a pouch or pocket)—selects and codes sounds most useful for speech; (B) Directional microphone—picks up sounds; (C) Transmitter (frame of black plastic coated wires with a magnet centered in the frame)—relays coded signals to the receiver; (D) Electrode array (surgically inserted into the inner ear)—set of 22 electrical contacts that carry signals to remaining nerve fibers.

Kinds of Sounds Produced

Most of our adult patients who use multichannel cochlear implants report they can hear normal levels of conversational speech, but the amount they understand varies greatly from one user to another. Most receive very significant enhancement of their lipreading skills from the sounds they hear through the implant. A person who achieves 0 percent comprehension from sound alone might achieve 50 percent to 100 percent comprehension with those same sound cues plus lipreading. So, although some of our patients do not understand any speech with their device alone, they certainly can communicate better with lipreading than before they were implanted. All patients can identify many environmental sounds, an ability that helps them in their daily routines. Most adults claim that sound through the implant is very artificial-sounding but that speech begins to sound more and more "normal" as time goes on.

How the Device Is Implanted and Activated

In order to hear with an implant, the person must undergo an operation in which the tiny electrode is implanted in the inner ear. This operation usually takes one to three hours and requires hospitalization for four to six days. The wound behind the ear must then heal for about one month before the implant can be "hooked up" to the external speech processor. (This "hook-up" or connection involves setting the loudness of sound going into each channel and usually takes one to two days to complete with an adult.) Once the user is receiving sound through the implant, the real work begins. Extensive auditory habilitation is necessary to train the user to interpret speech and environmental sounds. It means the person must essentially start over in the hearing world.



Who Is a Candidate?

We are looking for adults eighteen and over who are profoundly deaf. "Profoundly deaf" covers a rather wide range of auditory skills. Basically we are looking for the person who receives minimal benefit from appropriately fitted hearing aids. With hearing aids, the candidate must be unable to achieve a binaural score for open-set sentence recognition greater than 30 percent. Also, the candidate should be of normal intelligence. Age at the onset of deafness is not a criterion for implantation, although we predict that the earlier a person receives an implant after the onset of deafness, the greater the benefit is likely to be.

Candidates must be in generally good health in order to undergo the operation and willing to wear the external microphone and speech processor and participate in extensive auditory habilitation.

Cochlear implants in adults are no longer in the investigational stages. Over 2,000 adults throughout the world have received the benefits of a cochlear implant. We are committed to long-term follow-up of all our cochlear implant users. We invite you to visit our facility. If you have further questions, please contact us at any time.

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