Cochlear Implants

A cochlear implant is an electronic device that restores partial hearing to the deaf. It is surgically implanted in the inner ear and activated by a device worn outside the ear. Unlike a hearing aid, it does not make sound louder or clearer. Instead, the device bypasses damaged parts of the auditory system and directly stimulates the nerve of hearing, allowing individuals who are profoundly hearing impaired to receive sound.

Read more about cochlear implants and meningitis.

What is normal hearing?

Your ear consists of three parts that play a vital role in hearing—the external ear, middle ear, and inner ear.

Conductive hearing: Sound travels along the ear canal of the external ear causing the ear drum to vibrate. Three small bones of the middle ear conduct this vibration from the ear drum to the cochlea (auditory chamber) of the inner ear.

Sensorineural hearing: When the three small bones move, they start waves of fluid in the cochlea, and these waves stimulate more than 16,000 delicate hearing cells (hair cells). As these hair cells move, they generate an electrical current in the auditory nerve. It travels through inter-connections to the brain area that recognizes it as sound.

How is hearing impaired?

If you have disease or obstruction in your external or middle ear, your conductive hearing may be impaired. Medical or surgical treatment can probably correct this.

An inner ear problem, however, can result in a sensorineural impairment or nerve deafness. In most cases, the hair cells are damaged and do not function. Although many auditory nerve fibers may be intact and can transmit electrical impulses to the brain, these nerve fibers are unresponsive because of hair cell damage. Since severe sensorineural hearing loss cannot be corrected with medicine, it can be treated only with a cochlear implant.

How do cochlear implants work?

Cochlear implants bypass damaged hair cells and convert speech and environmental sounds into electrical signals and send these signals to the hearing nerve.

The implant consists of a small electronic device, which is surgically implanted under the skin behind the ear and an external speech processor, which is usually worn on a belt or in a pocket. A microphone is also worn outside the body as a headpiece behind the ear to capture incoming

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sound. The speech processor translates the sound into distictive electrical signals. These 'codes' travel up a thin cable to the headpiece and are transmitted across the skin via radio waves to the implanted electrodes in the cochlea. The electrodes' signals stimulate the auditory nerve fibers to send information to the brain where it is interpreted as meaningful sound.

Cochlear implant benefits

Implants are designed only for individuals who attain almost no benefit from a hearing aid. They must be 12 months of age or older (unless childhood meningitis is responsible for deafness).

Otolaryngologists (ear, nose, and throat specialists) perform implant surgery, though not all of them do this procedure. Your local doctor can refer you to an implant clinic for an evaluation. The evaluation will be done by an implant team (an otolaryngologist, audiologist, nurse, and others) that will give you a series of tests:

Ear (otologic) evaluation: The otolaryngologist examines the middle and inner ear to ensure that no active infection or other abnormality precludes the implant surgery.

Hearing (audiologic) evaluation: The audiologist performs an extensive hearing test to find out how much you can hear with and without a hearing aid.

X-ray (radiographic) evaluation: Special X-rays are taken, usually computerized tomography (CT) or magnetic resonance imaging (MRI) scans, to evaluate your inner ear bone.

Psychological evaluation: Some patients may need a psychological evaluation to learn if they can cope with the implant.

Physical examination: Your otolaryngologist also gives a physical examination to identify any potential problems with the general anesthesia needed for the implant procedure.

Cochlear surgery

Implant surgery is performed under general anesthesia and lasts from two to three hours. An incision is made behind the ear to open the mastoid bone leading to the middle ear. The procedure may be done as an outpatient, or may require a stay in the hospital, overnight or for several days, depending on the device used and the anatomy of the inner ear.

Is there care and training after the operation?

About one month after surgery, your team places the signal processor, microphone, and implant transmitter outside your ear and adjusts them. They teach you how to look after the system and how to listen to sound through the implant. Some implants take longer to fit and require more training. Your team will probably ask you to come back to the clinic for regular checkups and readjustment of the speech processor as needed.

What can I expect from an implant?

Cochlear implants do not restore normal hearing, and benefits vary from one individual to another. Most users find that cochlear implants help them communicate better through improved

lipreading, and over half are able to discriminate speech without the use of visual cues. There are many factors that contribute to the degree of benefit a user receives from a cochlear implant, including:

- How long a person has been deaf,
- The number of surviving auditory nerve fibers, and
- A patient's motivation to learn to hear.

Your team will explain what you can reasonably expect. Before deciding whether your implant is working well, you need to understand clearly how much time you must commit. A few patients do not benefit from implants.

FDA approval for implants

The Food and Drug Administration (FDA) regulates cochlear implant devices for both adults and children and approves them only after thorough clinical investigation.

Be sure to ask your otolaryngologist for written information, including brochures provided by the implant manufacturers. You need to be fully informed about the benefits and risks of cochlear implants, including how much is known about how safe, reliable, and effective a device is, how often you must come back to the clinic for checkups, and whether your insurance company pays for the procedure.

Costs of implants

More expensive than a hearing aid, the total cost of a cochlear implant including evaluation, surgery, the device, and rehabilitation is around $40,000. Most insurance companies provide benefits that cover the cost. (This is true whether or not the device has received FDA clearance or is still in trial.)