



# Doctor, Please Explain Cochlear Implants

A cochlear implant is an electronic device that restores partial hearing to people with extensive hearing loss who do not benefit from a regular hearing aid. It is surgically placed in the inner ear and started by a device worn outside the ear.

Unlike a hearing aid, it does not only make sound louder. Rather, it bypasses the damaged hearing systems and directly activates the hearing nerve, allowing people with hearing loss to pick up sound and understand speaking better.

## How Does Normal Hearing Work?

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 eardrum to vibrate. Three small middle ear bones carry this pulse from the eardrum to the cochlea of the inner ear.
- **Sensorineural hearing:** When the three small bones move, they start waves of fluid in the cochlea; these waves stimulate more than 16,000 delicate hearing cells (hair cells). As these hair cells move, they generate an electrical current in the hearing nerve. The electrical signal travels through connectors in the brain to the areas that understand it as sound.

### How is hearing impaired?

If you have a diseased or blocked outer or middle ear, your conductive hearing may be impaired, which medical or surgical treatment can probably correct.

An inner ear problem, however, can result in sensorineural hearing loss. Although many parts of the hearing system and the nerve may be working and can send sound pulses to the brain, the hair cells are not reacting. Since medicine cannot correct severe sensorineural hearing loss, only a cochlear implant can treat it.

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## How Do Cochlear Implants Work?

Cochlear implants pass damaged hair cells, change speech and everyday sounds into electrical signals and send these signals to the hearing nerve.

### A cochlear implant has two main components:

1. An inside part consisting of a small electronic device, which is surgically placed under the skin behind the ear, connected to electrodes put inside the cochlea
2. An outside unit usually worn behind the ear that has a speech processor, microphone and battery compartment.
3. The microphone picks up the sound, allowing the speech processor to change the sound into separate electrical signals. These signals travel up a thin cable to the headpiece and across the skin via radio waves to the inserted electrodes in the cochlea. The electrodes signal the auditory nerve fibers to send information to the brain, where it is understood as sound.

### Cochlear implant benefits

Cochlear implants are designed only for individuals with hearing loss who can't benefit from hearing aids.

Otolaryngologists (ear, nose and throat specialists) do this implant surgery. Your local doctor can refer you for an opinion. The implant team (otolaryngologist, audiologist, nurse and others) will determine if a cochlear implant is right for you and what result you can expect.

## Implant Evaluation and Preparations

The implant team will complete tests, including:

- Ear (otologic) evaluation: The otolaryngologist examines the middle and inner ear to ensure you have no active infections or other problems that would affect the implant surgery.
- Hearing (audiologic) evaluation: The audiologist performs extensive hearing tests 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), to view your inner ear anatomy.
- Physical examination: Your otolaryngologist also examines you to identify any problems with using general anesthesia for the implant procedure.
- Vaccinations: Since having a cochlear implant slightly increases the risk of developing meningitis, your otolaryngologist will ensure your shots are up to date and may give or suggest additional shots.

## Cochlear Implant Surgery

You usually do not need to stay overnight in a hospital for cochlear implant surgery, which is often done with general anesthesia. The surgeon makes an opening behind the ear to the mastoid bone, leading to the middle ear space. Once the middle ear space is available, they place electrodes into the cochlea and insert the implant. The electronic device at the base of the electrode group is then placed behind the ear under the skin.

### Is care and training needed after the operation?

Several weeks after surgery, your cochlear implant team puts the signal processor, microphone and implant transmitter outside your ear and adjusts them. They teach you how to care for the system and listen to sound with the implant. Some patients may take longer to fit and need more training—your team will ask you to return to the clinic for regular checkups and adjustments as needed.

### What can I expect from an implant?

Most adult cochlear implant users notice an immediate improvement. Children who have never spoken require more time to benefit since they need to learn spoken language. While cochlear implants do not restore normal hearing and benefits vary by individual, most users find they help them talk better through improved lip-reading. Also, 90% of adult cochlear implant users can understand talking without lip-reading. Many things impact the benefit a user gets from a cochlear implant, including:

- How long a person has been deaf
- The number of working auditory nerve fibers
- Your motivation to learn to hear

Your team will explain what to reasonably expect. Before deciding whether your implant works well, you should understand how much time you will need to work with it. Rarely do individuals not benefit from a cochlear implant.

### FDA approval for implants

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

Ask your otolaryngologist for written information about your implants, including information provided by the implant maker. You need to be fully informed about the benefits and risks of cochlear implants, including how much is known about their safety, reliability and effectiveness, how often to return to the clinic for checkups and whether your insurance pays for the procedure.

### Cost of implants

More expensive than a hearing aid, the total cost of a cochlear implant, including evaluation, surgery, the device and training, is as much as \$100,000. Fortunately, most insurance companies and Medicare cover it.

