

## Cochlear Implant

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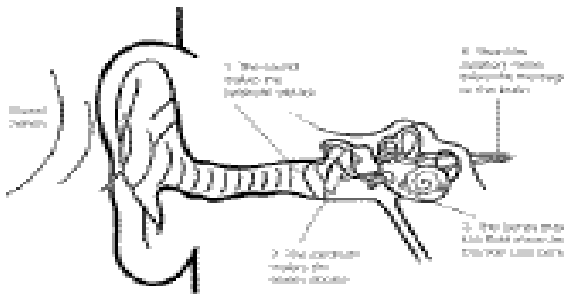
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### **How Do We Hear?**

Your ears pick up sound that travels in invisible waves through the air. Sound occurs when a moving or vibrating object causes the air around it to move.

Sound waves travel down the ear canal and hit the eardrum in the middle ear. This causes the eardrum to vibrate. Three tiny bones (anvil, Hammer, and stirrup) in your middle ear link the vibrating eardrum to the cochlea in the inner ear. The cochlea is filled with liquid that carries the vibrations to thousands of tiny hair cells sitting on a membrane that stretches the length of the cochlea. The hair cells on the membrane fire off tiny electrical signals. These electrical signals travel up the cochlea nerves of the auditory pathway to the brain. All this happens in a fraction of a second.



### **Hearing Loss and Cochlear Implants**

Hearing can become impaired if the hair cells in the cochlea become damaged. This causes the vibrations in the inner ear to be unable to be transformed into neural impulses and therefore don't get sent to the brain. This can be caused by certain diseases such as meningitis, or by congenital disorders, or certain drug treatments.

**Cochlear implant** is a surgically implanted electronic device that can help provide a sense of sound to a person who is profoundly deaf or severely hard of hearing. The cochlear implant is often referred to as a bionic ear. Unlike other kinds of hearing aids, the cochlear implant doesn't amplify sound, but works by directly stimulating any functioning auditory nerves inside the cochlea with electrical impulses. According to researchers at the University of Michigan, approximately 100,000 people worldwide have received cochlear implants; roughly half are children and half adults.

The discovery that electrical stimulation to the auditory system can create a perception of sound occurred around 1790, when Alessandro Volta (the developer of the electric battery) placed metal rods in his own ears and connected them to a 50-volt circuit, experiencing a jolt and hearing a noise "like a thick boiling soup". On August 1, 1978, Melbourne resident Rod Saunders became the first person in the world to receive a multi-channel cochlear implant. In December 1984, the Australian cochlear implant was approved by the United States Food and Drug Admin

to be implanted into adults in the United States. Today (2006), most school-age children and adults use a small behind-the-ear (BTE) speech processor about the size of a power hearing aid. The implant is surgically placed under the skin behind the ear. The basic parts of the device include: **External:** a microphone, a speech processor which selectively filters sound to prioritize audible speech and sends the electrical sound signals through a thin cable to the transmitter, a transmitter, which is a magnetic pad placed behind the external ear, and transmits the processed sound signals to the internal device by electromagnetic induction, **Internal:** a receiver and stimulator secured in bone beneath the skin, which converts the signals into electric impulses and sends them through an internal cable to electrodes, an array of up to 24 electrodes wound through the cochlea, which send the impulses directly into the brain.

### **Implantation surgery**

During surgery, an incision is made behind the ear after giving general anesthesia to the patient. A layer is removed from the mastoid bone. The receiver is put into place in the inner ear and the skin is closed and sewn back together. The procedure takes about 1<sup>1/2</sup> hours. About one week later the stitches will be removed. After about one month the sound processor, microphone, and transmitter will be placed outside the ear and the processor will be adjusted to fit the patient. Results may not be immediate, and therapy is required as well as time for the brain to adapt to hearing new sounds. In the United States, medical costs run from USD\$45,000 to \$70,000; this includes evaluation, the surgery itself, hardware (device), and rehabilitation. Some of this can be covered by health insurance. A cochlear implant will not cure deafness or hearing impairment, but is a prosthetic substitute for hearing. Some recipients find them very effective, others somewhat effective and some feel overall worse off with the implant than without. For people already functional in spoken language who lose their hearing, cochlear implants can be a great help in restoring functional comprehension of speech, especially if they have only lost their hearing for a short time.

### **Risks and disadvantages**

As with every medical procedure, the surgery involves a certain amount of risk; the risks include skin infection, onset of tinnitus, damage to the vestibular system, and damage to facial nerves that can cause muscle weakness, or, in worst cases, disfiguring paralysis. The operation also usually destroys any residual hearing the patient may have; as a result, some doctors advise single-ear implantation, saving the other ear in case a biological treatment becomes available in future. The FDA reports that cochlear implant recipients may be at risk for meningitis and that minorities of these cases, worldwide, have resulted in death.