Cochlear Implant Basics

What is a cochlear implant?

A cochlear implant is a device that provides sound to individuals with severe to profound sensorineural hearing loss. The implant is designed to bypass the damaged structures in the inner ear, and provides electrical stimulation to the hearing nerve fibers directly. The brain is then able to recognize this stimulation as sound.

How does normal hearing work?

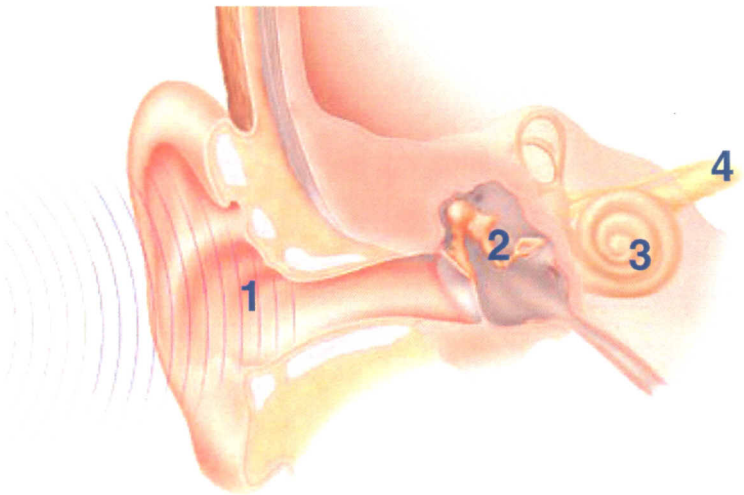
In order to understand how a cochlear implant works, it is helpful to have a basic understanding of how normal hearing operates:

1. The outer ear collects sound waves as they pass through the air and sends them down the ear canal.

2. The sound waves cause the eardrum and the three tiny ear bones to vibrate. This vibration is passed down the chain of the ear bones to the cochlea.

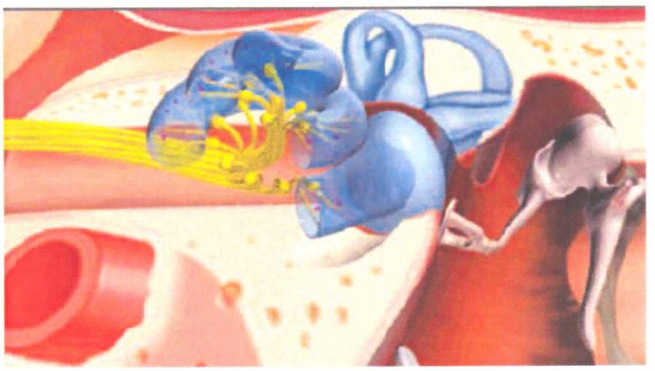
3. The vibration causes the tiny little hair cells in the cochlea to move, which in turn send electrical signals to the hearing nerve.

4. The signal travels up the hearing nerve to the brain where it is interpreted as sound



Picture courtesy of Cochlear Americas

In this cross-section of the cochlea, you can see how the bones in the middle ear (A) vibrate the tiny hairs of the sensory cells in the inner ear (B). These vibrations are then converted to an electrical signal that is sent through the hearing (C) nerve to the brain.



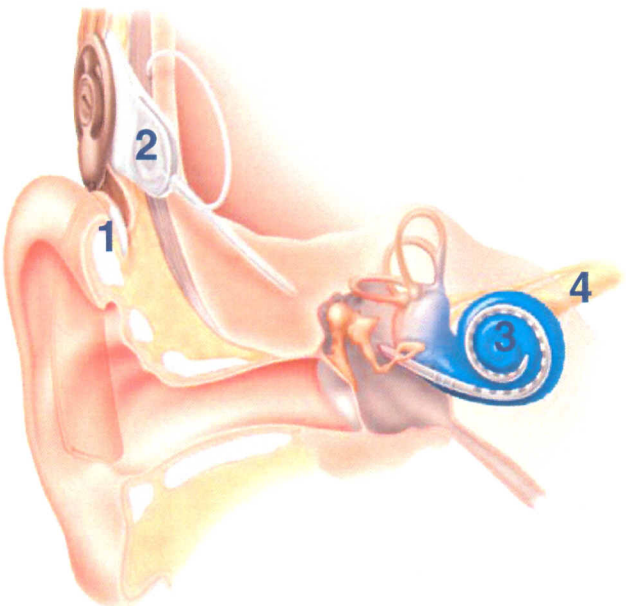
Picture Courtesy of Advanced Bionics

How does a cochlear implant work?

A cochlear implant consists of both surgically implanted components and an externally worn speech processor.

1. Sounds are picked up by the microphone of the speech processor, which analyzes sound and turns it into coded signals.
2. The coded signal is sent across the skin to the internal device where it is converted into electrical signals.
3. The electrical signals are sent down the electrode array which has been implanted inside the cochlea
4. The signals from the array stimulate the nerve fibers of the auditory nerve directly and are recognized by the brain as sound.

Each individual perceives the electrical signals/sound differently. Therefore, the external speech processor is programmed to meet each patient's hearing needs.



External
Speech Processor

Internal Device

Pictures courtesy of Cochlear Americas

What cochlear implant systems are available?

A cochlear implant system consists of an internally implanted electrode array, and an external speech processor. Currently there are three manufacturers that offer cochlear implant devices approved by the Federal Drug Administration (FDA). All three companies have excellent implant systems. The OHSU cochlear implant program offers patients a choice between all three device options. More information on these can be found at the websites listed below:

Cochlear Americas: www.cochlear.com
Advanced Bionics: www.bionicear.com
Medel Corporation: www.medel.com

Who can benefit from a cochlear implant?

There are many different factors to consider when determining if you or your child is a candidate for a cochlear implant. At OHSU, our team collectively looks at various medical, audiological, developmental, and psychological factors for each patient, to determine if cochlear implantation is the best and most appropriate option. A cochlear implant candidacy evaluation should be considered if you answer yes to one of the categories below:

Children 12 months to 17 years old

Does your child have:

- Severe to profound sensorineural hearing loss in both ears?
- Receive little to no benefit from hearing aids?
- Poor progress in development of auditory skills with hearing aids?
- High motivation, realistic expectations, and a understanding of the necessary follow-up? (both family and child when appropriate)
- Other existing medical problems or conditions that won't interfere with the cochlear implant procedure?

Adults 18 years and older

Do you:

- Have severe to profound sensorineural hearing loss in both ears?
- Receive little to no benefit from appropriately fit hearing aids?
- Struggle with communication and conversation even when wearing hearing aids?
- Have difficulty hearing on the telephone even with hearing aids?
- Have no medical contraindications to surgery?
- Have a desire to be a part of the hearing world?

What are typical benefits of cochlear implantation?

The benefits a patient can expect vary considerably on a number of factors including:

- The degree of hearing loss
- How old you or your child were when the hearing loss began
- How long the hearing loss has been present
- History of hearing aid use prior to implantation
- Access to sound during the critical language learning period (before age 5)
- Age at time of implantation
- The status of the inner ear (cochlea) and the hearing nerve
- History of meningitis prior to receiving a cochlear implant
- Motivation and commitment of the recipient and supporting family members

At a minimum, a cochlear implant will provide for the ability to hear and detect the presence of sound. Most patients will hear speech and environmental sound and see an improvement in lipreading skills. Many patients will see improvements beyond the minimum, including some understanding of speech without visual cues, and even the ability to use the telephone. It is impossible to predict how well an individual will be able to understand speech after receiving a cochlear implant. For this reason, we continue to research to try and understand why there is such variability in patient performance post-implantation.