

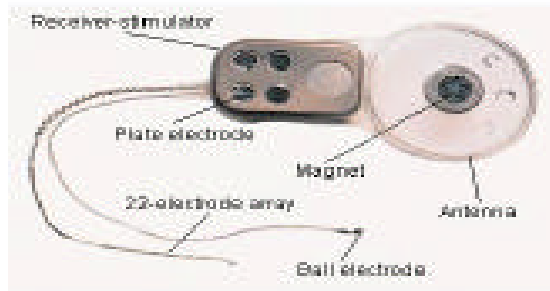
Cochlear Implants

ELE 482 Biomedical Engineering Seminar, April 2, 2001

Paul T. Cabral, Jr.

University of Rhode Island, Kingston, RI 02881, Email: cabralp@ele.uri.edu

Anatomy of the Ear



The ear is divided into three major areas: outer ear, middle ear, and inner ear. The outer ear and middle ear structures are involved with hearing only and are rather simply structured. The inner ear is extremely complex, however, because it functions in hearing and equilibrium. The inner (internal) ear is where the cochlea can be found. The cochlea is responsible for converting sounds which enter the ear canal, from mechanical vibrations into electrical signals. This process, known as transduction, is performed by specialized sensory cells within the cochlea. The electrical signals, which code the sound's characteristics, are carried to the brain by the auditory nerve.

What does the cochlear implant do?

A cochlear implant is an electronic device designed to provide useful hearing and improved communication ability to individuals who are severely to profoundly hearing impaired and gain limited benefit from hearing aids. Hearing aids make sounds louder and deliver the amplified sounds to the ear. For individuals with severe to profound hearing loss, even the most powerful hearing aids may provide little to no benefit. A severely to profoundly deaf ear is typically one in which the sensory receptors of the inner ear, called hair cells, are damaged or diminished. Making sounds louder or increasing the level of amplification does not enable such an ear to process sound. In contrast, cochlear implants bypass damaged hair cells and directly stimulate the hearing nerves with electrical current, allowing individuals who are severely to profoundly or totally deaf to receive sound. Many people have severe or profound hearing losses because they have damage to the inner ear, or cochlea. However, most people have nerve fibers remaining which, when stimulated electronically, may be capable of sending a signal from the ear to the brain. The cochlear implant is designed to stimulate remaining nerve fibers. It consists of a number

of electrodes placed in the inner ear and a stimulator placed on the bone behind the ear. An external receiver and processor are worn like a hearing aid. Patients who have a cochlear implant report that they can hear many important sounds such as doorbells or telephones ringing, car horns and background beats of music. They can monitor the loudness of their own voices and can hear speech information that helps them lip-read speech more easily. Many people can use the telephone to ask simple questions and some people can carry on conversations over the telephone and understand some words without lip-reading. An individual using a cochlear implant may not hear sound in the same way as persons with normal hearing. In addition, not all individuals receive equal benefit from cochlear implants.

Implant Procedure

The surgical procedure for a cochlear implant involves admission to the hospital. The surgery takes a few hours and involves a general anesthesia. A small tube containing the electrodes is placed in the inner ear and a case containing the stimulator is placed in the bone behind the ear. Since implanting the cochlear device requires surgery under general anesthesia, there are risks associated with such procedures. Though it is very rare, it is also possible that the cochlear implant, like a heart pacemaker, may fail which could necessitate surgery to replace the device. About four weeks are necessary for healing after the surgery. After this period the external device is programmed and patients receive training in how to use the implant. The training program has several goals: to fine-tune the function of the processor to the patient's particular needs, to teach the patient to use the unique signals from the implant, to improve a patient's communication skills, and to provide additional support for the patient and his/her family. Follow-up evaluations are performed as needed to maximize benefit from the cochlear implant.

Producers of cochlear implants

There are two FDA approved cochlear implants available in the United States today. **CLARION**, which is made in America, and **Nucleus® 24**, which is made in Australia. Because both safely and effectively treat deafness for appropriate candidates.

References:

www.medoto.unimelb.edu.au
www.cochlearimplant.com