Cochlear Implants

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11/23/05
ELE 282

Normal hearing is composed of conductive hearing and sensorineural hearing. In conductive hearing sound enters the ear canal as air waves and travels to the ear drum causing it to contract. This sends it to the 3 bones. In sensorineural hearing the 3 bones, the malleus, incus, and stapes, convert it to mechanical vibrations which generates fluid waves inside of the cochlea. This moves the hair cells which then transform the waves into nerve impulses that travel through the auditory nerve to the brain. 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 implants are electronic devices that are implanted in the inner ear and restore partial hearing. They are helpful for adults and children who are severely to profoundly deaf. Currently there are more than 59,000 people in the world who have cochlear implants.
Consist of two main components:
1. External Part ~ microphone, sound processor, transmitting system
2. Implanted Part ~ receiver and electrode system
Sound is picked up by the external microphone and is interpreted by the sound processor. It is then sent to the transmitting system which sends the signal through radio waves to the implanted receiver. The wire electrode system delivers the signal to the cochlea. This stimulates the auditory nerve causing it to send the signal to the brain. The brain then interprets this signal as sound.

Pre-surgery ear, nose, and throat doctors perform tests on patients to make sure they are eligible for implantation. These tests include examination of entire ear for signs of infection or abnormality, hearing tests, hearing aid trial, CT scan and MRI scan to evaluate structures of middle and inner ear, psychological exam, physical exam. During surgery the patient is given general anesthesia. An incision is made in the skin behind the ear. 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 2 to 3 hours. Immediately after waking the patient may experience discomfort over the implanted ear, dizziness, nausea, and sore throat.
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. The patient will be taught how to listen to sound using the implant and will have to return for regular checkups and readjustment of the processor.
There are several factors that contribute to the effectiveness of the implant. One is the duration of deafness. Patients who have been deaf for a shorter period of time respond better. Another is age at implantation. Adults usually respond faster, but younger patients typically achieve a higher performance level. The age the patient became deaf is another factor. Patients who became deaf after learning speech and language respond better. Another is the health and structure of the cochlea because the more nerve cells there are the better. Patient's ability and dedication to learning, and the intelligence of the patient are also contributing factors. Cochlear implants may help patients be able to speak more clearly, understand speech more easily without relying on lip-reading, perceive a variety of sounds, such as soft or loud, talk on the telephone, and enjoy music and television. There are however some surgical risks that include injury to facial nerve, meningitis, fluid leaks, infection of skin at incision, ringing or buzzing sound in ear, injury to taste sensation nerve, numbness around ear, and localized inflammation. Some other risks include potential loss of residual hearing, implant failure, external parts cannot get wet, and may not be able to undergo treatments such as MRI imaging and ionic radiation therapy.
The total cost to receive a cochlear implant is around $60,000. This cost includes the device, surgery, evaluation, and rehabilitation. This cost is covered by most insurance companies.
Cochlear implants are constantly updating with the rapid change of technology.
Scientists are always researching ways of improvement.

Sources

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