Bionic Ear

Nicole Normandin
April 19th, 2004
Biomedical Engineering Seminar
ELE 282

The Bionic Ear was first conceived by Professor Graeme Clark in the late 1960s. Clark worked at the University of Melbourne in Australia and at the time of his work scientists said that a successful Bionic Ear, or cochlear implant, was not possible in the foreseeable future.

A Bionic Ear, otherwise known as a cochlear implant, is an artificial hearing device, designed to produce useful hearing sensations by electrically stimulating nerves inside the inner ear. The present day multi-channel cochlear implants consist of 2 main components:
1) The cochlear implant package and electrode array (or receiver-stimulator)
2) The speech processor and headset.

Speech and other sounds are picked up by the microphone and sent to the speech processor. The processor codes the sounds into an electrical signal which is sent via a cable to the transmitting coil. The coil then passes the signal through the skin via radio waves to the implant which transforms the signal to electrical pulses. The radio waves also provide power to the implant, as there is no battery in the internal part. The pulses pass from the electrode array and stimulate hearing nerve fibers within the cochlea.

The speech processor does not just make sounds louder like a hearing aid. Instead, it selects out some of the important information in the speech signal and then produces a pattern of electrical pulses in the patient's ear. This pattern is selected to be as close as possible to the original speech sound. It is not possible to make sounds completely natural, because there are only 22 electrodes that are replacing the function of tens of thousands of hair cells in a normally hearing ear.

The electrical patterns are different for each person and need to be programmed into the speech processor by a trained clinician. The differences arise because the electrodes are not always in the same position relative to the surviving nerves and the nerves vary in sensitivity to electrical currents. The clinician must measure the lowest and greatest current for every electrode to determine the softest and loudest sounds that will be heard. The different electrodes produce sounds with different pitch. The speech processor combines sounds on different electrodes with different loudness, to build up something as close to the original sound as possible. It is thought that the future of the Bionic Ear lies within improving the clarity of sound. A profoundly/entirely deaf person should be able to function at the same capacity as a fully hearing person. Children who are deaf will be able to enter mainstream schools and interact normally with other children. Future goals include only simple things such as smaller size and complete sub-dermal implantations.

Sources:

- http://www.bionicear.org/mhg/cicaboutcochlearimplants.html
- http://www.med.harvard.edu/publications/On_The_Brain/Volume3/Number4/Cochlear.html
- http://www.nidcd.nih.gov/health/hearing/coch.asp#c