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March 24, 2008

Cochlear Implants and Electromagnetic Interference

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A cochlear implant is a small, two-part electronic device used to stimulate auditory nerves to help people who are profoundly deaf or severely hard-of-hearing. The cochlear implant consists of a portion that is placed behind the ear, and a second portion that is surgically placed under the skin. The implant consists of a microphone to pick up external sounds and a speech processor, which arranges the sounds inputted. The implant also includes a transmitter and stimulator, which receive signals from the processor and convert them into electric impulses. Finally, the implant has an electrode array, which is a group of electrodes that stimulates different parts of the auditory nerve in response to the electric impulses sent from the stimulator. The cochlear implant is different from a hearing aid, as a hearing aid amplifies sound for damaged ears. The implant bypasses the damaged portions of the ear and directly works with the auditory nerve.

Signals generated by the stimulator are sent from the auditory nerve to the brain, which recognizes the impulse as sound. "Hearing" through the cochlear implant is different from normal hearing, and takes time to adjust to. The implant not only requires surgery for placement, but also therapy sessions for adjustment to the implant. The sounds heard are not necessary clear or at all on the same level as normal hearing, but most patients with cochlear implants are able to recognize warning signals, normal sounds of the environment, and to enjoy conversations in person or on the telephone. Patients with cochlear implants are able to enjoy everyday life with sound. They are able to be more social and no longer need to lip-read or use sign language.

Both children and adults who are deaf or severely hard-of-hearing are able to be fitted for cochlear implants. At the end of 2006, more than 112,000 people worldwide had received cochlear implants. In the US, about 23,000 adults and 15,500 children had received them by this time. The most popular time for children to receive implants is between two and six years old. The earlier implantation occurs, the greater success the cochlear implant usually has on the patient. In 2000, a cochlear implant was approved by the FDA for children as young as 12 months old.

Currently, a post-doctoral researcher at the University of Texas at Dallas is working to improve the cochlear implant and its most popular complaints. Most patients explain that the implant in quiet situations helps to hear conversations, but in noisy situations, such as stadiums or malls, the extra noise interferes with the conversation and the implant hardly works at all. With a three-year $225,000 award from the National Institutes of Health, the team of researchers is working with algorithms to filter out the background noise in loud places. This is possible because research shows that the bustling noise of a stadium or mall has the same time-frequencies in comparison to the time frequency of a quieter location. These frequencies are analyzed, averaged, and filtered out.

The cochlear implant is vulnerable to damage from electromagnetic interference (EMI) in many situations. Magnetic resonant imaging (MRI) is the most popular and most damaging circumstance to the cochlear implant. Many patients find themselves inhibited from being able to undergo an MRI, or turning to their doctors for updates in cochlear implant technology. Therapeutic ionizing radiation, electrosurgery, diathermy, neurostimulation, and electroconvulsive therapy are all examples that damage cochlear implants by means of EMI. Everyday products and technology cause EMI that cause damage to cochlear implants. These sources include cell phones, electronic article surveillance (EAS) systems, and metal detection devices. Any of these sources of EMI may interfere with the operation of the cochlear implant speech processor and cause distortion of the sounds processed by the cochlear implant. Even electrostatic discharge such that generated from removing clothes over the head, rubbing inflated balloons, or sliding down plastic slides may cause damage to the implant. The damage may not only alter the sound heard from the implant, but may also alter the program of the speech processor. Large amounts of EMI could cause the memory of the implant to reset, but overall any measure of EMI could cause damage to the many sensitive, expensive parts of the cochlear implant.

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