What is a Cochlear Implant?

A cochlear implant is an electronic device that restores partial hearing to the deaf. It is surgically implanted in the inner ear and activated by a device worn outside the ear. Unlike a hearing aid, it does not make sound louder or clearer. Instead, the device bypasses damaged parts of the auditory system and directly stimulates the nerve of hearing, allowing individuals who are profoundly hearing impaired to receive sound.

What is normal hearing?

Your ear consists of three parts that play a vital role in hearing-the external ear, middle ear, and inner ear.

Conductive hearing: Sound travels along the ear canal of the external ear causing the eardrum to vibrate. Three small bones of the middle ear conduct this vibration from the eardrum to the cochlea (auditory chamber) of the inner ear.

Sensorineural hearing: When the three small bones move, they start waves of fluid in the cochlea, and these waves stimulate more than 16,000 delicate hearing cells (hair cells). As these hair cells move, they generate an electrical current in the auditory nerve. It travels through inter-connections to the brain area that recognizes it as sound.

How is hearing impaired?

If you have disease or obstruction in your external or middle ear, your conductive hearing may be impaired. Medical or surgical treatment can probably correct this.

An inner ear problem, however, can result in a sensorineural impairment or nerve deafness. In most cases, the hair cells are damaged and do not function. Although many auditory nerve fibers may be intact and can transmit electrical impulses to the brain, these nerve fibers are unresponsive because of hair cell damage. Since severe sensorineural hearing loss cannot be corrected with medicine, it can be treated only with a cochlear implant.

How do cochlear implants work?

Cochlear implants bypass damaged hair cells and convert speech and environmental sounds into electrical signals and send these signals to the hearing nerve.

The implant consists of a small electronic device, which is surgically implanted under the skin behind the ear and an external speech processor, which is usually worn on a belt or in a pocket. A microphone is also worn outside the body as a headpiece behind the ear to capture incoming sound. The speech processor translates the sound into distinctive electrical signals. These 'codes' travel up a thin cable to the headpiece and are transmitted across the skin via radio waves to the implanted electrodes in the cochlea. The electrodes' signals stimulate the auditory nerve fibers to send information to the brain where it is interpreted as meaningful sound.

Who can benefit from an implant?

Implants are designed only for individuals who attain almost no benefit from a hearing aid. Child must be one year of age or older (unless childhood meningitis is responsible for deafness).Older children and adults with severe to profound hearing loss who do not receive substantial benefit from hearing aids may also be candidates.

ENT surgeon(otolaryngologist) performs implant surgery, though not all of them do this procedure. Your local doctor can refer you to an implant clinic for an evaluation. The evaluation will be done by an implant team (an otolaryngologist, audiologist, nurse, and others) that will give you a series of tests:

Ear (otologic) evaluation: The otolaryngologist examines the middle and inner ear to ensure that no active infection or other abnormality precludes the implant surgery.

Hearing (audiologic) evaluation: The audiologist performs an extensive hearing test to find out how much you can hear with and without a hearing aid.

X-ray (radiographic) evaluation: Special X-rays are taken, usually computerized tomography (CT) or magnetic resonance imaging (MRI) scans, to evaluate your inner ear bone.

Psychological evaluation: Some patients may need a psychological evaluation to learn if they can cope with the implant.

Physical examination: Your otolaryngologist also gives a physical examination to identify any potential problems with the general anesthesia needed for the implant procedure.

What about surgery?

Implant surgery is performed under general anesthesia and lasts from two to three hours. An incision is made behind the ear to open the mastoid bone leading to the middle ear. The procedure may be done as an outpatient, or may require a stay in the hospital, overnight or for several days, depending on the device used and the anatomy of the inner ear.

Is there care and training after the operation?

About one month after surgery, your team places the signal processor, microphone, and implant transmitter outside your ear and adjusts them. They teach you how to look after the system and how to listen to sound through the implant. Some implants take longer to fit and require more training. Your team will probably ask you to come back to the clinic for regular checkups and readjustment of the speech processor as needed.

What can I expect from an implant?

Cochlear implants do not restore normal hearing, and benefits vary from one individual to another. Most users find that cochlear implants help them communicate better through improved lip-reading, and over half are able to discriminate speech without the use of visual cues. There are many factors that contribute to the degree of benefit a user receives from a cochlear implant, including:

How long a person has been deaf,

The number of surviving auditory nerve fibers, and

A patient's motivation to learn to hear.

Your team will explain what you can reasonably expect. Before deciding whether your implant is working well, you need to understand clearly how much time you must commit. A few patients do not benefit from implants.

How are new implant devices approved?

Who is a candidate?

Profoundly deaf infants may be screened in the second half of their first year of life and implanted at twelve months of age.

Older children and adults with severe to profound hearing loss who do not receive substantial benefit from hearing aids may also be candidates.

What are the expected outcomes?

Virtually all implant recipients benefit from increased environmental sound awareness and improved communication through auditory and visual cues. Depending on the age at implantation, the communication skills of the individual, and the motivation of the family, over half of the recipients become orally conversant and some can even communicate by telephone.

What is the process?

Families of individuals interested in receiving a cochlear implant can visit our website at www.umcent.com and download an application. They can also contact the Cochlear Implant Team at the Department of Otolaryngology and Communicative Sciences at the

University of Mississippi Medical Center by calling (601) 984-5160 to have an application mailed. Once we receive the completed application, the candidate or family will be contacted for evaluation.

Cochlear implant evaluation consists of testing with the audiologist and speech-language pathologist, as well as meeting with a social worker. The families are counseled that the implant is not a “magic bullet” that will instantly restore hearing, and rehabilitation is essential to success. Those who are deemed candidates and demonstrate realistic expectations as well as a commitment to fully participate in the rehabilitation process will then meet with the surgeon and undergo a CT scan of the temporal bones.

What happens after the surgery?

The implantation surgery lasts about two hours and is done as an outpatient or as an overnight stay.

Intraoperative testing is usually done to check the integrity of the device and at what stimulus level the cochlear nerve is stimulated.

About a month later, initial programming is done. Multiple sessions are required to “fine-tune” the processing and stimulus level of the implant.

The recipient also has multiple visits with a speech-language pathologist to assess progress and work on ongoing therapy. Pre-lingually deaf recipients are encouraged to enroll in an oral school for the deaf, or participate in oral classes as much as possible.

Before You Get Your Cochlear Implant

It is important that all your questions are answered!

Do not hesitate to ask about the surgery and postoperative course. The main risks are bleeding, infection, altered taste sensation, and device failure. Very rare risks include meningitis, infection requiring device removal, and facial nerve injury.

Vaccination:

All children under 2 years of age should receive the Prevnar® vaccine. Those aged 2-5 should receive Prevnar® and Pneumovax®. Those older than 5 should receive Pneumovax®. Your primary care doctor can usually administer these, but if there is a problem, tell your doctor. These vaccinations are recommended to reduce the risk of meningitis. Ideally, they should be given prior to surgery, but can be given afterwards.

CT Scanning:

A CT or CAT scan of the inner ears is necessary to see the anatomy of the cochlea to ensure the surgery can be done and to see if any special precautions are necessary. This is usually done at UMMC but can be done closer to home if this is more convenient. If the scan is done outside UMMC, it must be brought to our office for review before the surgery can be done. It is the responsibility of the patient or the family to get the films to our office.

Commitment:

You must be willing to commit to a number of office visits postoperatively! This is especially true for children who have not yet learned to talk! It may even be once or twice a month until the device is programmed well. Adults who can communicate orally will not need nearly as many visits. If you are concerned about transportation or work getting in the way of your post-operative plan, then cochlear implantation is probably not a good option for you or your child. We may ask you to sign a non-binding "contract" as a demonstration of your level of commitment.

What to Expect After Cochlear Implantation

Taking Care of the Ear:

A dressing is placed over the incision and ear to prevent swelling and keep the site clean. You can wash the incision with mild soap 2-3 days after surgery. Absorbable stitches, if present, do not require removal, and usually dissolve within 5 to 7 days. If the stitches are not covered with tape, apply an antibiotic ointment 2-3 times a day for 2 weeks.

The incision will have some slight redness and swelling. If the swelling gets worse after a few days, or the incision becomes redder or extremely painful, call your doctor. Drainage from the incision or fluid collecting under the incision is never normal and should be referred to the doctor immediately.

If an "ear-cup" dressing was used, it can be removed tomorrow morning. If it is not uncomfortable, it should be worn at night for a week to keep from lying on the ear.

It is normal to experience some dizziness and/or nausea and vomiting after surgery due to the drilling in the inner ear. This usually resolves within 24 hours, but may last a few days. If the dizziness worsens after a few days, call your doctor.

An abnormal or metallic taste in the mouth is common, and is usually temporary. On rare occasions, it can be permanent but becomes less bothersome over time.

Swimming is not allowed until your surgeon says it is okay.

Dealing with Pain:

Mild intermittent pain may occur during the first 2 weeks, particularly above or in from of the ear, when chewing. If the skin around the surgical area is sensitive, it may be covered with several fluffed-up gauze pads for cushioning. Acetaminophen (Tylenol) or ibuprofen products (Motrin, Advil) can be used as directed. Pain medicine may be prescribed as well.

Things Not to Worry About:

A hoarse or abnormal voice may occur for several days from the anesthesia tube. Numbness of the skin around the surgical incision is common, and should gradually subside within several days or weeks. Popping or clicking sounds may be heard, along with a feeling of fullness or liquid in the ear; these will resolve gradually as the healing process continues. A mild degree of dizziness may be present on head motion, and is not of concern unless it increases. Taste disturbance and mouth dryness may occur for a few weeks.

When to Call the Doctor:

(1) discharge from the ear that is more than a little blood, or shows signs of infection (yellow color, foul odor, or high fever), (2) dizziness becomes worse, not better, (3) the skin around the sutures becomes swollen, red, or very tender (please note that some redness of the incision itself is normal), (4) the stitches break or the incision begins to open up, or (5) you or your child seem to be getting worse-not better-as the days go by. Your doctor will arrange a postoperative visit to check the healing process and remove sutures (if necessary).

The Food and Drug Administration (FDA) regulates cochlear implant devices for both adults and children and approves them only after thorough clinical investigation.

Be sure to ask your otolaryngologist for written information, including brochures provided by the implant manufacturers. You need to be fully informed about the benefits and risks of cochlear implants, including how much is known about how safe, reliable, and effective a device is, how often you must come back to the clinic for checkups, and whether your insurance company pays for the procedure.

How much does an implant cost?

More expensive than a hearing aid, the total cost of a cochlear implant including evaluation, surgery, the device, and rehabilitation is between seven to twelve lacs. At present, most insurance companies in India do not cover the cost.