

► Cochlear Implants in Children

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Introduction, how do we hear?

The ear has three sections: the outer ear, the middle ear and the inner ear. When a sound is made, vibrations are set off into the air. These vibrations travel to the ear, down the ear canal to the ear drum. Behind the ear drum is the middle ear, which is an air filled space containing tiny bones called the ossicles. The vibrations travel across these ossicles and into the inner ear, where it reaches the cochlea. The cochlea is a small structure, shell-like in appearance—and is filled with fluid and thousands of tiny hair cells, which act like electrical switches. The vibrations cause waves in the fluid which trigger the hair cells to send signals along the auditory nerve to the brain, where sound can then be interpreted.

Hearing Impairment

Damage to any part of the system described above, can result in a hearing loss. Any blockage in the ear canal or middle ear can cause a conductive hearing loss. In this case, hearing can be improved by removing the obstruction.

If there is damage at the level of the inner ear or cochlea, the result is a sensori-neural hearing loss. This could mean that either the hair cells in the cochlea are not working properly or there is damage to the auditory nerve. In both cases, signals about the sounds cannot be sent through the auditory nerve to the brain. Sensori-neural hearing losses can be mild, moderate, severe or profound.

Aiding hearing

For some individuals with a hearing impairment, a hearing aid can amplify the sounds entering the ear so that they are strong enough even for a damaged cochlea, with only few of the hair cells working, to send a signal to the brain. Although the signal may not be perfect, it can still give the wearer a lot of useful information about speech and environmental sounds.

For some individuals with a profound sensori-neural hearing loss, even the most powerful hearing aid may not provide enough information about sound. This situation arises because the hair cells in the cochlea are so badly damaged that no signal is transmitted to the brain.

The cochlear implant is a sophisticated hearing aid, whose function is to do the work of the damaged hair cells, by stimulating the auditory nerve. The signal is transmitted to the brain.

How do cochlear implants work?

The cochlear implant is made up of two components: one part is internal and is surgically placed under the skin on the side of the head; the second part is worn externally and is similar to a conventional hearing aid. The outside part is what provides the power and the signal.

1. Sound is picked up by the microphone, worn behind the ear
2. A thin cord carries the sound from the microphone to the speech processor.
3. The speech processor processes this sound into coded signals.
4. The signals are sent from the speech processor, through the transmitting coil, to the internal part.
5. The electrodes in the cochlea receive the signals and stimulate the auditory nerve.
6. Sound information is sent to the brain.

The cochlear implant does not provide normal hearing, but it can provide useful information about sound and language to a profoundly deaf person who gets no benefit from a conventional hearing aid. It allows the wearer to access sounds at conversational levels.

The assessment process

Before one can decide whether the cochlear implant is the right choice for them, they need a lot of information about it and possible alternatives. The child then needs to be assessed by a specialist team in order to determine whether it would be a suitable option for the child. Assessment gives everyone involved the opportunity to gather all of the information that is needed.

Typically the assessment would involve hearing tests. The most important information that is needed is how much the child can hear when wearing the best possible hearing aids.

A scan of the cochlea is necessary to ensure that the surgeon will be able to insert the internal part of the system. A brainstem test is also carried out to measure the response of the auditory nerve.

Other multiple disabilities may need to be assessed and managed in order for the team to learn about the child's learning programme and how the cochlear implant would fit into that programme.

Individuals involved on a team typically include an ENT surgeon, an audiologist, a speech-language pathologist, the teacher of the deaf and the class teacher as well as the parents.

Habilitation and outcome

This is the process by which professionals support the child and family in adapting to a hearing loss, getting used to the device and developing the child's language and communication skills.

Children without hearing impairment acquire language "naturally", without special instruction.

The presence of profound hearing impairment can delay the communicative milestones.

In order to come to par with their hearing peers, children must achieve skills in the following areas, at an accelerated rate.

<i>Auditory detection</i>	increasing awareness of sounds.
<i>Auditory imitation</i>	matching vocal productions with the new sounds.
<i>Auditory integration</i>	associating sounds with symbols or objects.
<i>Auditory Discrimination</i>	distinguishing between the finer aspects of vowel and consonant sounds.
<i>Auditory comprehension</i>	match meaning to sounds and words heard

Although the implant gives the child access to speech at conversational levels, every sound a child hears is new. It is important to remember that the nerve is stimulated electrically therefore sounds may be different. The child needs time to adjust to this new world of sound.

It is unrealistic to expect a 2 year old with no residual hearing prior to implantation to use single words immediately. The child's hearing experience at the time of 'switch on' is equivalent to that

of a newborn. Therefore it is realistic to expect the child to go through the same stages of development as mentioned above, with a delay equal to the time prior to intervention.

Do's and Don'ts

1. Don't initially expect a child to recognise a word or sound – the child needs to hear it many times before recognizing it.
2. Do encourage auditory awareness by calling attention to sounds.
3. Do WAIT and give the child a chance to LISTEN
4. Do provide a good listening environment with minimal background noise
5. Don't set goals that are too overwhelming. They should be challenging but achievable
6. Do provide a context rich environment so that the child can learn through everyday routines.

Local associations and useful links

- ❖ Malta Cochlear Implant Association, P.O. Box 56, Valletta
- ❖ ENT-Out Patients, St. Luke's Hospital, Malta
- ❖ Manchester Cochlear Implant Programme, CHCD, Manchester University, Oxford Road, Manchester M139PL
- ❖ <http://www.cochlear.com>