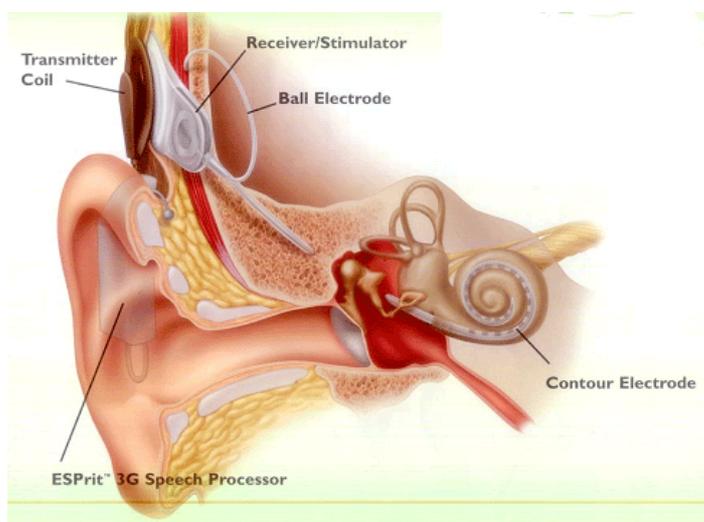


The National Adult Cochlear Implant Programme at Beaumont Hospital



*Improving quality of life by facilitating
hearing and communication.*

WHO'S WHO ON THE COCHLEAR IMPLANT PROGRAMME

Implant Programme Director: The Implant Programme Director is the leader amongst the Team.

Implant Programme Co-ordinators: The Implant Programme Co-ordinator is the main point of contact for any enquiries you may have about the programme.

E.N.T. Consultant: The Cochlear Implant team will include a Consultant Ear Nose and Throat Surgeon who has experience in cochlear implant surgery.

Audiological Scientist: He/she will assess your hearing levels, suggesting a trial with different hearing aids if necessary. It is important to decide whether or not the most up-to-date hearing aids could offer the same or better results for you as an implant. During surgery, the audiological scientist will make recordings of nerve responses to check the function of the implant. After the operation, the audiological scientist will be responsible for tuning the device. This can involve a lot of time and requires much co-operation. Regular return visits will be made, when the audiological scientist will monitor progress using various types of hearing test. They will deal with any technical concerns you may have about the implant.

Speech and Language Therapist: The speech and language therapists can be involved in both paediatric and adult cochlear implant programmes. With adults, the speech and language therapist will be involved in the assessment of suitability for cochlear implantation. He/She will also be involved in the rehabilitation following implantation. The aim is to assist the adult to obtain the maximum benefit from the implant

Clinical Psychologist: A clinical psychologist is on staff, though not all patients will see the team psychologist. Referral to an outside professional to discuss concerns/expectations can be provided.

Administration Staff: The administration staff plays an important role in the organization and functioning of the implant team. They are at the frontline of all communication coming into the department.

Teamwork

No member of the team works in isolation. All team members meet regularly and share the important information relating to your case.

STAFF CONTACT DETAILS

The National Cochlear Implant Programme

Beaumont Hospital Ireland

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The Team:

Ms. Laura Viani	Consultant ENT Surgeon, Director of the Cochlear Implant Programme
Mr. Peter Walshe	Consultant ENT Surgeon
Dr. Jesudus Dayalan	Chief Audiological Scientist / Coordinator Paediatric Assessments
Dr. Jaclyn Smith	Senior Audiological Scientist / Coordinator Adult CI Programme
Ms. Shivanthie Mendis	Senior Audiological Scientist / Coordinator Paediatric CI Programme
Ms. Jyoti Thapa	Audiological Scientist
Ms. Jennifer Robertson	Senior Speech & Language Therapist (paediatric programme)
Ms. Sinead McClay	Senior Speech & Language Therapist (paediatric programme)
Ms. Catherine Percival	Senior Speech & Language Therapist (adult programme)
Ms. Rosemary O'Halpin	Teacher of the Deaf (paediatric programme)

Secretaries:

Ms. Susan Gray (admin team leader)
Ms. Rosaleen Casey (adult programme admin)
Ms. Deborah Peyton (adult programme admin)
Ms. Nicola Flynn (paediatric programme admin)
Ms. Leigh-Anne McByran (general admin)

Who is suitable to go onto the Beaumont Hospital Cochlear Implant Programme?

In order to be seen by the cochlear implant programme you will need to be referred to the Beaumont Hospital Implant Centre by your family doctor, ENT doctor or Audiologist. If you have any problems obtaining a referral you may wish to contact the cochlear implant centre for further advice.

Referral Criteria: The referral criteria for cochlear implantation may differ slightly from centre to centre however cases are assessed on an individual basis. Below are some summary guidelines for adults used by Beaumont Hospital Cochlear Implant Programme:

Acquired Hearing Loss: If you have acquired your hearing loss **after** you learned to speak the summary guidelines are as follows:

- Have a severe to profound sensori-neural hearing loss in both ears (see audiogram)
- Receive little or no benefit from **appropriate** hearing aids
- Desire to be part of the hearing world
- Have no medical contraindications

Pre-Lingual or Congenital Hearing Loss

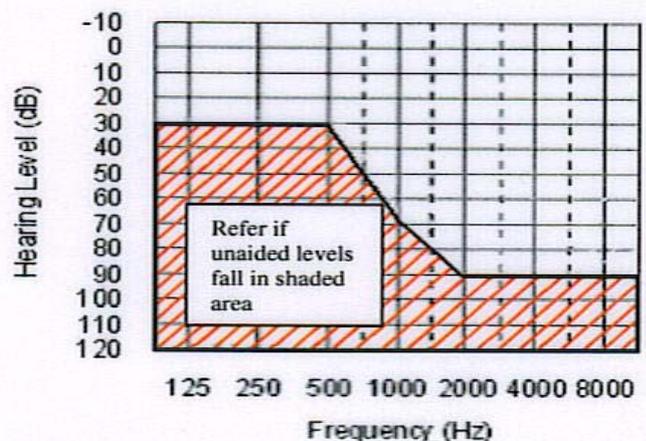
If you were born deaf or lost your hearing before you developed spoken language a cochlear implant will be of little benefit.

Screening Clinic/CI Clinic: Once we have received your referral you will be placed on a list to be scheduled for a screening clinic/CI clinic appointment. During the clinic you will have your hearing tested. Depending on your degree of hearing loss a decision will be made to place you on the cochlear implant programme for assessment or refer you to an outside audiologist/audiological scientist for further follow-up and management.

Assessments: If you are found to be suitable to go onto the cochlear implant programme a number of hearing assessments will be completed. This will help to determine whether a cochlear implant is an option for you. See below for more information on the assessment process.

The evaluation process can be stopped at any time if you or the cochlear implant team feels that it is not appropriate to continue.

Funding: The Beaumont Hospital Cochlear Implant Programme is publically funded and at no time is any cost incurred by a patient. If a cochlear implant is found to be a suitable option for you then you will be placed on a surgery list to await the operation. Due to a lack of resources (funding &/or staff) a limited number of implant operations can be performed each year. There will typically be a number of adults awaiting the implant operation. Priority is given to people based on medial need (ie loss of vision as well as having a profound hearing loss) then people are prioritized based on date of referral. You can be awaiting the surgery for some time despite completing the assessment process. The Cochlear Implant Programme will advise you as to how long you are likely to have to wait for surgery as funding circumstances are continually changing.

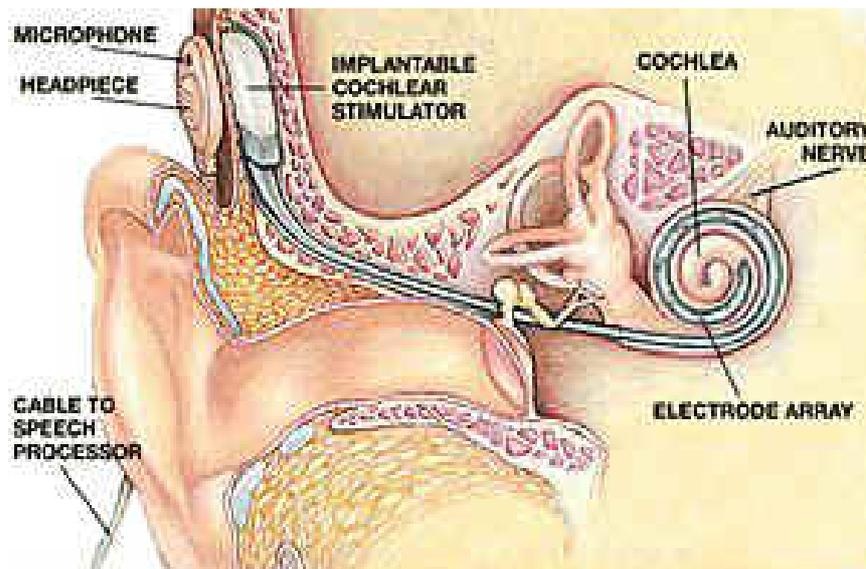


Ears, Hearing & Cochlear Implants

How a cochlear implant enables deaf people to hear.

In a hearing ear, sound waves pass along the ear canal and bounce against the ear drum. This causes the eardrum and the three little bones in the middle ear to vibrate. The vibrations ripple through the fluid in the inner ear or cochlea, and trigger an electrical response in thousands of tiny hair cells. The electrical response is sent up the hearing nerve to the brain, and the sound is heard.

The tiny hair cells are a vital link in the chain. In people with a severe or profound hearing loss, they are usually significantly damaged or absent. A cochlear implant does the job of the hair cells, by sending signals to the brain via the hearing nerve (auditory nerve).



What is a cochlear implant and how does it work?

General information

A cochlear implant is an electronic device which may be suitable for persons who receive no useful benefit from appropriately fit hearing aids. Hearing aids work by making sounds louder. A cochlear implant is different because sounds are turned into tiny electrical pulses, which are sent directly to the nerve of hearing. The implant can therefore bypass some of the inner ear structures which are not working. Naturally it is important to remember that no electronic device can be expected to restore function to the levels experienced by a normally hearing ear.

A cochlear implant has several different parts, some of which are internal (cannot be seen) and some of which are external (worn outside the body).

The external components -(worn outside the body)



These look very similar to a body-worn hearing aid, but actually work quite differently. They consist of a microphone, a sound processor and an external transmitter coil, with cables to connect them.

With a cochlear implant, the microphone is placed either behind the ear, like a hearing aid, or is on the headpiece itself. Cables connect the microphone to the speech processor.

The microphone picks up incoming sounds and changes them into electrical signals, which are sent to the processor's internal parts for interpretation. The processor contains the batteries which power the entire cochlear implant, and these must be changed regularly. During programming sessions, the processor will have been carefully set to make the signal just right. The signal is then sent back up the lead, and then to the external transmitter coil and magnet. This looks like a light-weight plastic disc or circle, with the magnet in the middle. The signal passes through the skin using radio waves to meet the internal parts of the implant (see next section).

NOTE: Beaumont Hospital Cochlear Implant Programme stocks brown and beige processors ONLY.

The internal components -(under the skin)



These are the parts of the device implanted by the surgeon during the cochlear implant operation. They include the internal receiver/ stimulator package (with the internal magnet). It lies under the skin behind the ear, and can be felt if touched gently.

The receiver/ stimulator package picks up the radio signal from the outside transmitter coil (see above). From here, the signal is taken via a thin wire to the cochlea (inner ear). The end of the wire (called the electrode array) is threaded into the cochlea by the surgeon. Because the shape of the cochlea is a spiral (like a tiny snail's shell), inserting the electrode array requires considerable delicacy and skill.

On the electrode array itself, there are several points at which the electrical signals are delivered, these are called the electrodes. The different electrodes each take a part of the signal (depending on whether a particular electrode is tuned for high or low pitches), so that different sounds can stimulate different areas in the cochlea. The signal from the electrodes activates the nerve of hearing, which then takes the message along the usual pathway to the brain. At this stage, the signal may be interpreted by the brain as "a sound".

Experience and practice should help people to begin to tell the difference between some of the sounds the implant is giving them. Obviously this will take a lot of work and time, and this is where the re/habilitation team will be able to assist and support you, hopefully making the whole experience interesting and fun.

What happens during the assessment process?

Medical Examination: You will be sent an appointment to see a Consultant ENT Surgeon, who has cochlear implant experience. He/She will carry out an examination of the ears, and assess your overall medical fitness.

Scans: An MRI Scan and sometimes a CT Scan will be required, since it is important to find out whether it will be possible to insert an electrode into your cochlea. The scans are similar to having an x-ray taken and are completed by the radiology department at Beaumont Hospital. The radiologist and ENT Surgeon will review your scans and the ENT Surgeon will discuss the results with you during a clinic.

The ENT Surgeon may want to refer you to specialists outside the Cochlear Implant Programme (ie geneticist, cardiologist, ophthalmologist, etc) if he/she feels there is a need for further medical investigations.

Hearing Tests: You will, of course, have a number of hearing tests, and you will undergo a hearing aid trial. It is important to find out whether a hearing aid can offer more benefit than a cochlear implant. In some cases, the hearing aid trial can take many weeks or even months. Many people find that modern hearing aids are a great improvement over the aids that they tried years ago, and relieved to discover that cochlear implant surgery is not necessary.

The audiological scientist on the Cochlear Implant Programme will determine if your current hearing aids are sufficient or he/she will dispense you with different hearing aids. The Cochlear Implant Programme provides hearing aids only to those people found to be suitable to be on the programme and are under cochlear implant assessment.

Auditory Brainstem Response: This special hearing test involves recording the electrical activity of your hearing pathway. It is useful for assessing people with profound hearing loss though not always used in all assessment cases.

Your responses are measured by placing small recording pads onto the head whilst loud clicks are played to you via headphones. You are required to lie still during this procedure, and you may even go to sleep if you wish! The procedure is painless.

Promontory Stimulation Test: This test is designed to check the functioning of your hearing nerve. It involves stimulating the promontory (a protrusion in the middle ear) with small pulses. A doctor inserts an electrode through the eardrum. This is carried out under general or local anaesthetic. The audiological scientist delivers small amounts of electrical current at different frequencies to the electrode. If awake you indicate when you hear a sound or a computer records your brain activity to the stimulation. This test helps us predict whether or not an implant is appropriate for you. **Not everyone needs to have this test done, and you will be informed as your assessment progresses.**

Do not allow water to enter your ear canal for three days after this test as there will be a tiny hole in your eardrum.

Hearing Aid Benefit and Lipreading Assessment: You may be asked to take part in an evaluation of your lipreading skills. You will be asked to watch and/or listen to a person speaking who will say various sentences, and you repeat back what you have heard/seen. You will be tested using lipreading alone and then lipreading and sound together. This will tell us how much you rely on lipreading to understand speech and how much your hearing aid(s) support your lipreading. We will also test your ability to understand speech without lipreading to evaluate your hearing aid benefit. These tests give us baseline measurements for later comparisons with your implant.

Questionnaires: You may be asked to complete a number of different questionnaires. The questionnaires are an opportunity for you to tell us how you feel about your deafness, how you think it affects the quality of your life, and what you are expecting from a cochlear implant.

All replies are treated completely confidentially.

Discussions about the cochlear implant and expectations: You will have your own expectations and hopes about what the implant can do. Most implant users do experience improved hearing. However it is impossible to predict beforehand how well any one person will do with the implant. The amount of benefit varies from person to person. Do not expect 'normal' hearing. Some situations will still be difficult eg background noise.

There is a range of benefit: some CI users can talk on the phone, others cannot. For others, the implant provides only improved lip-reading. As time goes by you may have to adjust your expectations upward or downward.

During the assessment process you will be given contact information of a person who has received a cochlear implant. At your leisure you can communicate with this person and discuss their experience and your expectations of the cochlear implant.

Psychology: It is important to consider your psychological status before implantation. Some cochlear implant teams will refer you to a Clinical Psychologist or Psychiatrist.

At this appointment you will be able to discuss your reasons for wanting an implant. Cochlear Implant Teams need to be sure that you fully understand about all that is involved in having a cochlear implant as well as establishing that your expectations are realistic. The purpose of these discussions is to help you to make up your mind whether or not you want an implant and whether you would really benefit from one.

Group Information Session: Once the majority of the assessment process is completed and the Implant Team finds you to be a suitable cochlear implant candidate you and a few of your family/friends will be invited to a group information session. Other suitable candidates will be in attendance with their family/friends. During the session a member(s) of the Implant Team will discuss topics relating to the implant surgery and post-implant information. Two individuals who have received a cochlear implant will come and speak to the group. This helps to develop realistic expectations as well as providing information about the commitment from someone considering a cochlear implant.

The Operation - Adults

The Operation: Before the operation, you will be given a general anaesthetic. After which the hair behind the ear is shaved in an area about four inches from your hairline. The operation takes place in theatre and will take approximately two hours. You will wake up with a large bandage (like a turban) on your head. 24 - 48 hours later this will be changed for a small dressing.

Recovery: Recovery after the operation is variable but most patients feel better very quickly. Most patients do not suffer significant pain after the operation. You are required to check into the ward the day before surgery and you will remain in hospital for up to one week after the surgery. The team will be able to better advise you on specific time scales closer to your surgery date. It is recommended that you take two weeks rest at home. Once your hair has grown back and your scar has healed, the only evidence of the operation will be a small scar behind your ear that tends to fade over time and a bump just behind the ear.

Risks and side effects: A cochlear implant operation carries the same slight risk as other ear surgery. You should, however, be aware of the following possible side effects:-

- The risks associated with having a general anaesthetic
- Temporary dizziness and/or temporary disturbance of balance
- Temporary increase in tinnitus
- Numbness in area of scar
- Change in taste sensation
- A risk of infection

Facial nerve bruising: This nerve running near the site of surgery is carefully monitored throughout the operation. This ensures that bruising of the facial nerve is highly unlikely however is a possible risk associated with a cochlear implant surgery.

The possibility of implant breakdown in the future, in which case a further operation would be necessary to replace it.

Because the operation is relatively new (clinically available since 1970's), the long term effects of electrical stimulation are not known. The amount of electricity involved however, is minimal and during the years in which people have received cochlear implants there have been no indications of adverse long term effects of the low level electrical stimulation.

If you are particularly concerned about any of the above risks you should discuss them with a member of the implant team.

Post operation: While you are on the ward a member of the implant team will visit you and provide you with post operative instructions. You need to take care to keep the wound dry and be very gentle with that area for the first month. After the first few months, treat the wound as normal and if you are a keen swimmer you can restart then. Flying should be avoided for the first few months following surgery. The team will advise you when it is ok to resume swimming and flying.

Before leaving hospital you will be given an appointment to attend the Cochlear Implant Department for 'Switch On'. This will be 4-6wks after surgery. During the 'Switch On' appointment you will be receiving your processor (external device) and

having it tuned/programmed. Prior to this time you will not hear anything in the implanted ear.

Take care of yourself: We advise you to **avoid all activities that might cause a blow to the head**, e.g. rugby, football and boxing as these could potentially cause damage to the implant. Also, we would advise against doing such activities as scuba diving as the pressure changes involved in deep water diving could damage the implant.

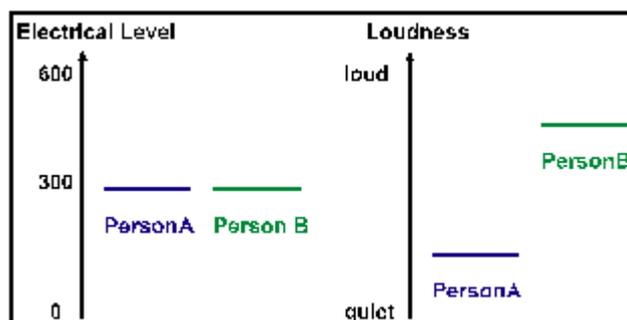
The Rehabilitation Process

When a person is beginning to think about cochlear implantation it is natural to focus on the assessment and surgery phases of the process. However it is important to remember that following these there is an ongoing process of rehabilitation.

This takes the form of two main streams: Programming the device - so the user can hear sounds through it, and a Rehabilitation process - teaching the user to "make sense of" the sounds they're hearing

Programming: Programming can also be referred to as "tuning", or "mapping". (This section assumes basic knowledge of what a cochlear implant is).

All implant users' hearing nerves will respond slightly differently to the electrical signals generated by the implant electrodes. Therefore "one size does not fit all". This is why programming sessions are important to receive optimal benefit from your cochlear implant. Consider two people with identical implants: for one person an electrical signal level may represent a quiet sound. For the other person this same level could be very loud, or even uncomfortably loud. It all depends on their nerve's response to the signals.



Each implant user therefore needs a personalized set of information regarding their nerve's response. This information is termed a "Map" (or Programme) and is held in the speech processor's memory. The Map "tells" the processor that for this person, a specified electrical unit sounds quiet and another electrical unit is loud. In this way the level (or loudness) of sounds the processor receives are mapped to the electrical levels that should be sent to the implant. However sound has another important characteristic: it's frequency, or pitch. In cochlear implants this is represented primarily by using channels: Nearly all modern implants have a number of channels corresponding to the individual electrodes in the array. The speech processor splits the sound signal into these channels depending on the sound's pitch. Lower pitch sounds will be sent to electrodes deeper within the cochlea, and high pitch sounds to more shallowly placed electrodes. This mimics the way that the fully functioning inner ear responds, and helps to transmit information about the pitch of the sound to the implant user. Not only do the quiet / loud levels differ between people, they also differ to some degree between these channels. Therefore as above a specified electrical unit on one channel could be quiet but on another loud, even for the same person. So information on each channel is required.

Determining these levels

Who does the task? Programming is carried out by an audiological scientist.

How are the levels found?

In most cases behavioural methods are used. This means that the CI user responds in some way to signals sent to their implant. The speech processor will be connected to a computer, via a cable, running specialised software. Some automated tests can be carried out which check the implant itself and the persons nerve response to different electrical signals. The user then wears their transmitting coil as normal. However they will not hear external sounds at this point, instead the computer generates electrical signals that are sent to the implant under the control of the audiologist.

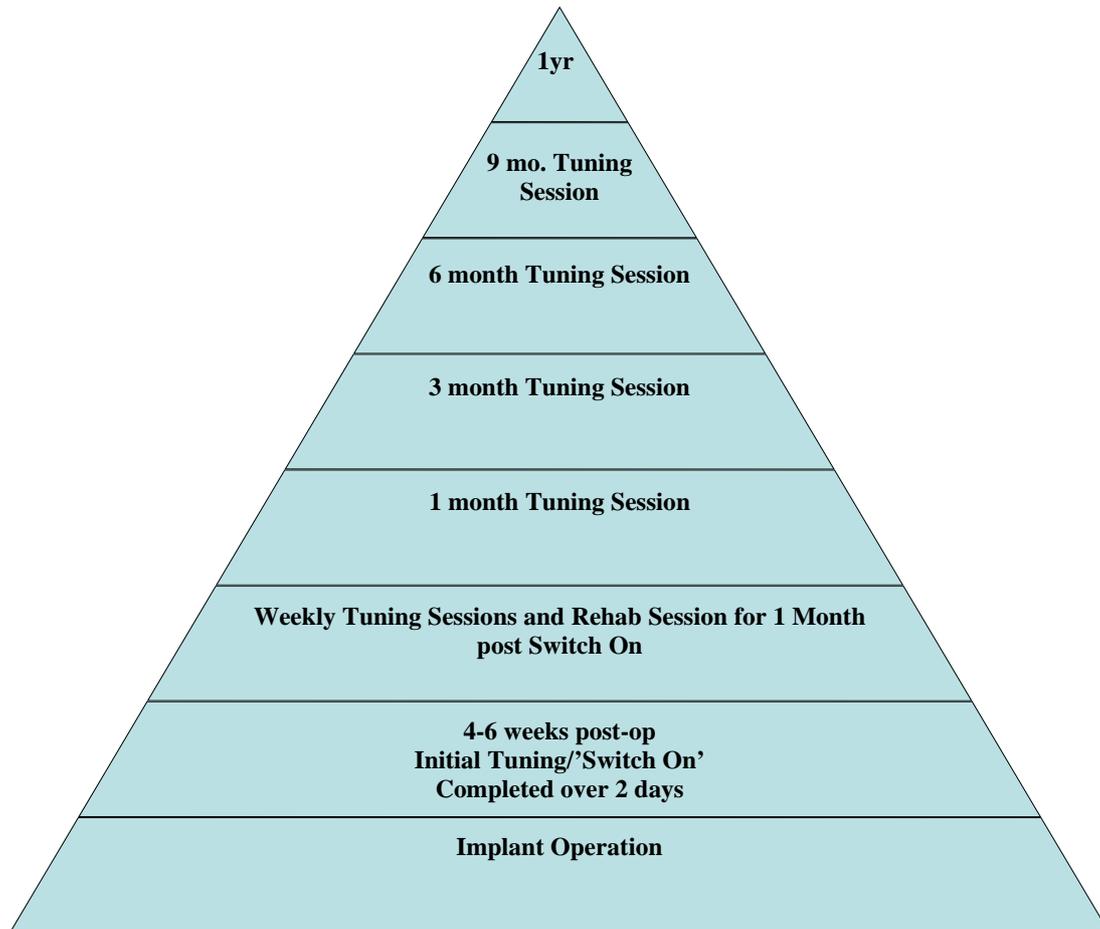
Threshold: The user responds whenever they hear a sound by telling the audiologist they heard it. Similar to a hearing test. The audiologist adjusts the level until the lowest level at which the signal is detected is found. The process is repeated for the different channels.

Comfortable levels: With adults, the audiologist will increase the level and ask the user to indicate when it becomes loud but still comfortable. Alternatively the user can rate the sounds on a scale, i.e. quiet / medium / loud and comfortable / too loud, or similar.

There are some alternatives to behavioural measures. Sometimes comfortable levels can be estimated by finding at what level a middle ear reflex occurs (Electrical Stapedial Reflex Thresholds - ESRT). This is done by placing a soft probe into the ear. Nerve and brain responses to stimulation can be recorded from small disc electrodes attached to the head, allowing estimation of levels (Electrical Auditory Brainstem Response - EABR). However these methods have certain technical limitations so behavioural methods are favoured in most cases.

Time frame for programming: Usually quite a few appointments will be necessary in the first few months post-implantation, as a cautious approach is required. In addition some levels can change as the user adapts to the new stimulation - particularly the comfortable levels. As time goes on the appointments become less frequent. It is common though not always required for even well established users to attend yearly review appointments. Once all levels have stabilised and the audiologist is sure that the levels are correct the map is said to be optimal. There is no set time by which this has to be reached - again, it depends on the individual.

Below is an approximate time scale for appointments post operatively. Keep in mind the graph below represents the minimum implant programming sessions only. Other medical and rehabilitation sessions will also be scheduled post-operatively. For persons living in counties a significant distance from the hospital efforts is made to make joint appointments whenever possible. See graph for approximate time commitment post-operatively:



**Annual medical review and programming is completed for the recipients lifetime on an annual basis after the 1st year

Rehabilitation

In many cases, the user will have been without sound stimulation for some time. Even for someone only recently hearing impaired it is likely that sound through the implant will, at least at first, be very different to what they remember. It takes some time for the brain to become acclimatised to the new stimulation. To aid this process, and make sounds meaningful to the user is the goal of the rehabilitation programme.

Who carries out rehabilitation? This is usually a team consisting of specialist speech and language therapists and specialist teachers of the deaf. Other professionals with appropriate skills will commonly be involved.

What is it? The rehabilitation programme is a structured set of exercises designed to facilitate the CI user making sense of the sound signal. It might begin with exercises exploring how the user can simply detect sounds. Some users report that when they first

begin to use the implant, many things sound the same. One of the goals of the process is to help the user differentiate between sounds, and then words in speech.

The person's own speech and language stage is also looked at. The speech therapist can design a programme to help advance the speech development, appropriate to each individual.

The overall rehabilitation programme is tailored to the needs of the individual. As with programming it is usual that more visits/appointments will be required in the earlier stages of the process.

Learning to listen with a Cochlear Implant - Adults

GENERAL LISTENING TIPS

1. Relearn the trick of concentration. Pay attention. Listen.
2. Avoid pretending you have understood what was said.
3. Do not be afraid to ask people to repeat, rephrase, or speak louder or more slowly.
4. Remind people to speak directly to you and to look at you when they speak.
5. Watch the speakers. Pay careful attention to the lips, facial expressions, gestures, and body language. Position yourself to take advantage of good lighting.
6. Realise that hearing in noisy places is a problem for all listeners.
7. When listening over the telephone, position the receiver carefully over the microphone of your speech processor or use the telephone adapter.

Remember – talk to your implant service and they will give you guidance and support to help you develop your listening skill. You can improve with practice.