Central Manchester University Hospitals NHS
NHS Foundation Trust

Manchester Royal Infirmary

Manchester Paediatric Cochlear Implant Programme

Information for Patients and Professionals

INVESTOR IN PEOPLE

POSITIVE ABOUT DISABLED PEOPLE

Contents

Introduction

This booklet has been written to provide general information about cochlear implants and the process of assessment and habilitation (therapy) offered by the Manchester Cochlear Implant Programme.

History

The Manchester Paediatric Cochlear Implant Programme was established in 1991 and an average of 50 children a year receive a cochlear implant. Members of the team have experience working with children of different ages, ability levels, cultural and educational backgrounds. The team have developed particular expertise with children under the age of two and those with additional disabilities.

Who are we?

The team consists of many professionals including:

- Administrative Staff
- Audiological Scientists & Audiologists
- Consultant Otolaryngologists
- Specialist Speech and Language Therapists
- Teachers of the Deaf

The normal ear

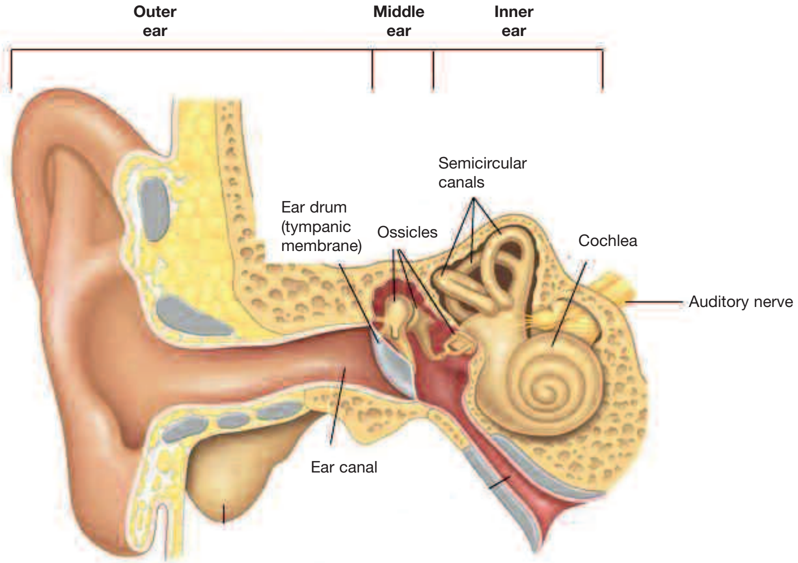


Figure 1.
A cross section of the ear

In order to understand how a cochlear implant works, it is important to understand how a normal ear hears sound. Figure 1 illustrates the structure of the ear.

Sound is transmitted as sound waves that are generated by the outer ear and sent down the ear canal to the eardrum. The sound waves cause the eardrum to vibrate which sets the three tiny bones (the 'ossicles') in the middle ear in motion. The motion of these bones causes fluid in the inner ear (the 'cochlea') to move. The movement of the inner ear fluid causes tiny hair cells in the cochlea to move. The hair cells change this movement into electrical impulses. These electrical impulses are transmitted to the hearing (auditory) nerve and up to the brain where they are interpreted as sound.

In some cases of severe or profound hearing loss, the hair cells in the cochlea may become damaged or may be missing, and as a result, the auditory nerve cannot be stimulated and sound is not heard or becomes distorted.

The cochlear implant

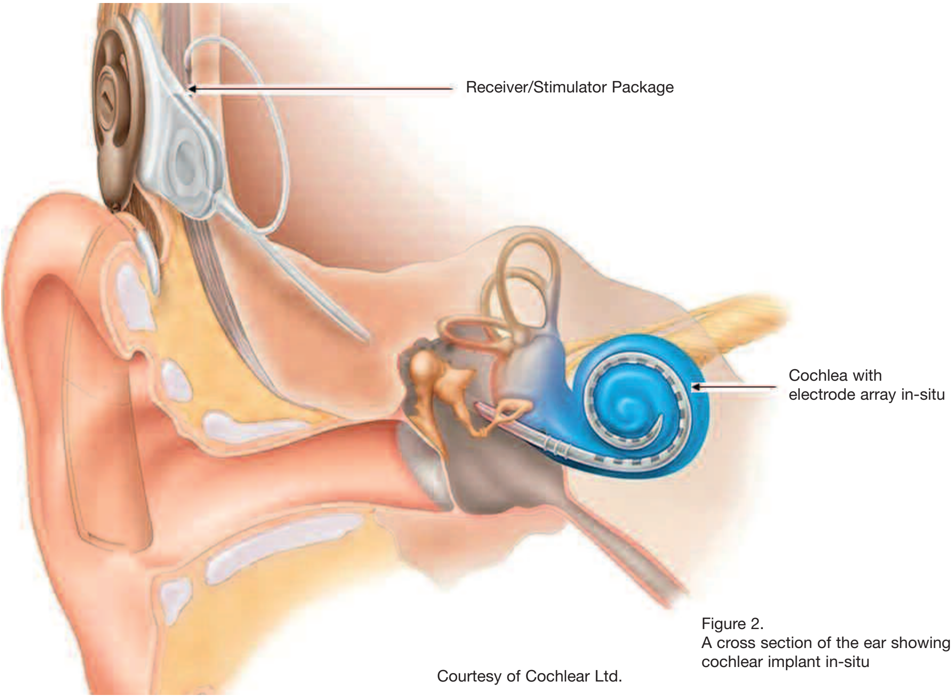
A cochlear implant is a device which attempts to replace the function of the damaged cochlea by electrically stimulating the auditory nerve to produce a sensation of sound.

A cochlear implant can help a severely or profoundly deaf person to become more aware of everyday sounds and understand speech better. At first, the new sensation of sound produced by the cochlear implant will be very different from any previous experiences of sound. It can take several months to retrain the brain to make sense of the sounds.

A cochlear implant consists of internal and external components. The internal component (the receiver/stimulator and electrode array) is inserted during an operation which lasts approximately 2 hours. The external components allow the internal component to receive sound and is generally fitted approximately 4 weeks after surgery. The external components include:

- **A microphone (part of the speech processor),** which picks up the sounds
- **A speech processor**, which encodes the signal into an electrical signal
- **A transmitter coil,** which transmits the signal to the internal components and is held in place by a magnet

How does a cochlear implant work ?



Courtesy of Cochlear Ltd.

Figure 2.
A cross section of the ear showing the cochlear implant in-situ

Sound is received by the microphone which is worn behind the ear. The sound travels to the speech processor which processes the signal and sends the signal to the transmitter coil. The coil sends the signal across the skin to the internal implant (receiver/ stimulator) where it is converted to electrical signals. This signal then travels down the electrode array to stimulate the hearing nerve fibres in the cochlea and the auditory nerve. These signals are interpreted by the brain as sound.

An audiogram (figure 3) shows the different hearing levels as a result of hearing loss. It also shows the level of hearing attainable with a cochlear implant.

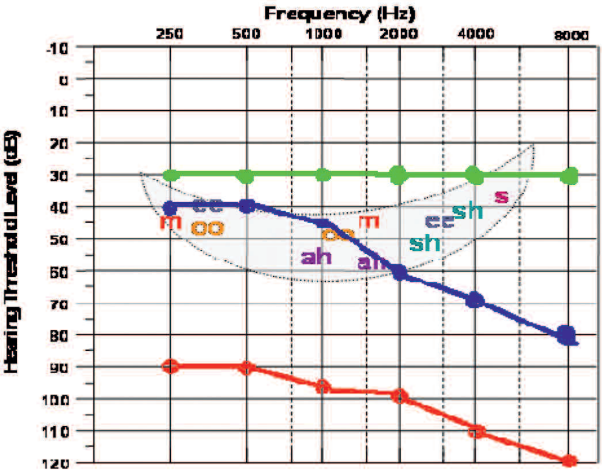


Figure 3.
Audiogram including speech banana

* profound hearing loss * hearing levels with hearing aids * hearing levels with a cochlear implant

Med-el Opus

Cochlear Freedom

Advanced Bionics Auria

The assessment process

Referral guidelines

We are happy to consider a range of children for assessments. Some children may have a progressive or acquired hearing loss while others may have been born with a profound sensori-neural hearing loss. Referrals should be made by a medical professional such as an Ear, Nose and Throat (ENT) Consultant, Audiological Physician, Audiologist or Senior Medical Officer.

1. **Congenital severe to profound hearing loss** Children who were born with a severe to profound sensori-neural hearing loss and who receive limited or no benefit from hearing aids and are under the age of 4 years are accepted for referral. Early referral is recommended because we know that the earlier a child receives an implant the better their outcome is likely to be. It would be very difficult for a child who receives an implant after the age of four years to develop the ability to use spoken language if they have never used speech before.

   Children over the age of four with congenital hearing loss should only be referred if they have utilized powerful hearing aids for development of spoken language. Such children will be considered on an individual basis, and if it is felt that a cochlear implant may provide them with more benefit than their current hearing aids, they may be considered for candidacy.

2. **Sudden, acquired hearing loss** Children with a sudden hearing loss should be referred to the programme immediately. For children whose hearing loss has been as a result of meningitis, their referral is given priority. This is due to the risk of ossification (bony growth in the cochlea) after meningitis, which can lead to surgical problems.

There is no minimum age limit for referral. The programme welcomes referrals of children who are suspected of having a significant hearing impairment even if they are very young and the extent of their hearing loss or progress with hearing aids is still unknown. This allows us to begin the assessment process and be able to determine candidacy as early as possible.

3. **Progressive hearing loss** Children who have had some benefit from hearing aids in the past but whose hearing has deteriorated to a point where hearing aids are no longer useful will be accepted. Children who are about to enter, or are in secondary school should be referred to the Adolescent Cochlear Implant Programme

Candidacy

A number of issues must be considered when deciding if a cochlear implant is a suitable option for a child. If we feel that a cochlear implant offers a better chance for learning spoken language, then we consider it a suitable option. The main areas we test when determining candidacy are:

1. **Medical candidacy** This includes assessment of the auditory system by an MRI or CT scan. In order for a child to benefit from a cochlear implant the cochlea must be patent (or open) and an auditory nerve must be present. A child is also evaluated for their fitness for surgery.
2. **Audiological candidacy** Hearing tests are performed on all candidates to determine the type and severity of hearing loss. Tests are also done to determine the amount of auditory benefit a child is receiving from their hearing aids and compares this with the performance that would be expected with a cochlear implant.

3. **Hearing aid trial** Every child must complete a hearing aid trial before their candidacy can be determined. This trial should consist of full time hearing aid use with an aid that is suitable for the type and degree of hearing loss. A child does not need to finish this hearing aid trial prior to referral to the team and we can offer the family help to encourage full time hearing aid use if needed.

4. **Speech and language development** A child's speech and language performance is probably the most important factor in determining candidacy. It is necessary to have a full and accurate picture of a child's speech and language development with traditional hearing aids. We can then make a prediction about their ability to develop language with a cochlear implant. For the youngest patients, this may not be a separate formal assessment, but an informal evaluation. For older children, this may consist of standardised tests in a more formal setting.

5. **Family** Throughout the assessment process families will be fully involved to ensure they gain a full understanding of the benefits and limitations of a cochlear implant. Families will be made aware of the outcome of each appointment and the next stage in the assessment process, as well as the extent and importance of post implant appointments.

Pre-operative visits

Several visits will be needed to determine if a cochlear implant is the right choice for a child and their family. The following list is not exhaustive, but it does outline many of the visits that patients will make before surgery. Every child is different and the assessment process is tailored to suit individual children. It will include:

1. **Initial meeting** Once a referral has been made to the centre, the family will be scheduled for an initial meeting. The purpose of this visit is to:

- obtain a full history
- describe the assessment process to the family
- discuss the cochlear implant and some of the limitations and benefits
- if appropriate, begin preliminary hearing tests.

Parents will be given the opportunity to ask questions at every visit.

2. **Audiology assessment** Usually, the child will be scheduled for further testing of their hearing after the initial meeting. Information will be gathered about the type and severity of hearing loss and the benefit of their current hearing aids. This will take place over several sessions if necessary. An appropriate selection of tests will be completed including pure tone air and bone conduction audiology, tympanometry, hearing aid assessment, otoacoustic emissions and any other measures felt to be necessary.

3. **Speech and language assessment/diagnostic habilitation** In order to determine if a cochlear implant is a suitable option for a child, their current level of speech and language development must be assessed. In very young children, this assessment may consist only of parental report and observation during hearing testing. For older children, a more formal assessment may be scheduled. If a child has some access to speech with hearing aids and is not making the expected progress they may be scheduled for diagnostic habilitation sessions.

   The purpose of these sessions is to evaluate a child's ability to learn through listening and identify any factors which may affect their ability to succeed with a cochlear implant.

4. **Scan** If necessary, children will be listed for a scan following their first appointment. A scan is required before the consultant can determine if a child is suitable for a cochlear implant. The cause of the hearing loss and residual hearing levels will determine if an MRI or CT scan is required. Most young children will need to be sedated under general anaesthesia for this test. If scans are performed locally prior to referral or during the assessment process, these can be reviewed by our consultants and usually they will not need to be repeated.

5. **Parent information session** All parents will attend an information session. The purpose of this session is to provide information about the pre-implant process and the cochlear implant itself without the distraction of children being present. Members of the extended family are encouraged to attend these sessions. Generally, this session takes place with a group, although if necessary we may schedule parents to attend on their own.

6. **Meeting with a consultant** All children referred to the programme will be offered a meeting with the ENT consultant even if they are not going to get a cochlear implant. If they are a candidate and if the family elects to proceed with implantation, a formal decision will be made at this visit and the child will be listed for surgery. The consultant will also discuss the surgery itself and its risks.

7. **Vaccination requirement** All children will be given guidance on the type of vaccinations that are recommended prior to surgery. These vaccinations must be started before the child's operation.

8. **Other assessments** may include vision testing, psychological testing, developmental assessment, or other specialist referrals as necessary. Vaccination records will also be checked and any further vaccinations that may be required will be requested from the child's own GP. Parents will be given details of this at their pre-operative visits

Surgery

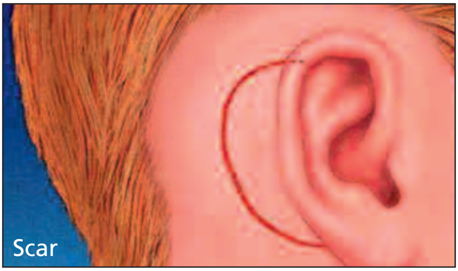
Parents will be advised of the risks of surgery in full prior to signing consent forms. The surgical procedure will be discussed in detail during both the information session and consultant appointment. Parents will be able to ask questions about all stages of the pre-operative process.

In general, cochlear implant surgery takes between two and four hours. Children are in hospital for one to two days depending on the time of their surgery. Surgery will take place at St. Mary's Children's Hospital in Manchester and parents may stay on the ward with children while they are in hospital.

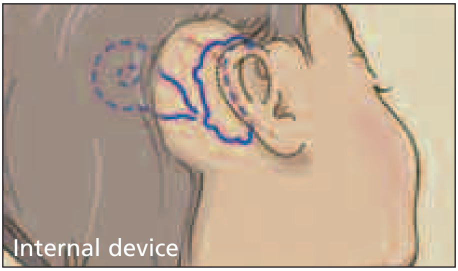
What does surgery involve?

- The hair is shaved around where the incision is to be made
- A shallow bed is drilled in the bone behind the ear
- A hole is drilled into the cochlea
- The electrode array is inserted into the cochlea
- The electrode array and the implant itself are secured in place
- The wound is stitched up using dissolvable stitches

There is usually little discomfort when the child wakes up and most children recover quickly from the operation. A follow-up appointment at ENT will ensure that the wound is healing well.



Scar



Internal device

Post-operative visits

3-4 weeks after the operation the child returns to the implant centre to have the external components fitted and switched on.

Mapping

1. **Initial programming:** Three to four weeks after surgery, the external equipment is fitted and the device is switched on for the first time. This is an exciting day for families as it is the first time the child will hear through the implant. This visit generally takes about two hours. The first half of the visit is spent programming the device. During the second half of the visit, the family is instructed on device use and care and issued the equipment they will need. At the initial visit, the Audiologist will decide on what further visits are required and schedule them accordingly.
2. **Follow up mapping sessions:** Over the first three months of implant use, the device will be programmed several times. The exact number of appointments will vary on an individual basis, but most children are seen once or twice a month during the initial period. The purpose of these sessions is to create an appropriate programme for the child which allows them to hear all the sounds of speech but which is comfortable for them to use.
3. **Regular mapping sessions:** After the initial period of device use, children will be seen regularly for programming. Generally, they are seen at 3 months, 6 months, 12 months and 24 months post implant. Following that they will have a mapping review after 3 and a half years and 5 years of implant use, and then every 2 years until they transfer to the adolescent programme. Children with complex maps may continue to receive annual mapping appointments.

At these mapping sessions, all equipment will be checked, measurements of the internal device will be performed to ensure it is working to specification, and a new programme may be created for the child to maximize their hearing potential. Soundfield hearing tests will also be performed to ensure that sound is being heard across the speech frequencies.

4. **Additional programming sessions:** If there are any concerns about a child's progress, either from the family, school or the cochlear implant programme, they may be scheduled more frequently for programming sessions. Sessions may be added whenever they are needed.

Habilitation

Following receiving the implant, children must learn to listen with their new device. For some children, this process will happen quite naturally, but for others, a significant amount of habilitation will be required. These issues will be discussed with the family prior to implantation and families will be aware of what to expect in their child's case prior to surgery.

1. **Initial follow-up care:** In the early period just after the device is switched on, children will be seen fortnightly for individual therapy by a Teacher of the Deaf or Speech and Language Therapist. In these sessions, focus will be on learning to use the new device and learning the fundamentals of listening. The therapy is focused on the family, not just on the child, and the parent is an active member of the therapy sessions. A decision will be made about which type of therapy package to offer in the early days following implantation.

2. **Habilitation:** Habilitation takes the form of individual sessions twice a month in the first year of implant use, and once a month in the second year. This can be discussed further with the therapist. Individual therapy allows families to discuss their child’s own progress and learn about ways to help their child continue to develop. Parents are expected to work with the child at home to supplement and continue the therapy during daily activities.

3. **Auditory verbal therapy:** Auditory Verbal Therapy (or AVT) is a unique and specific therapy technique that is especially suitable for children who have received cochlear implants. The Manchester Cochlear Implant Programme has adopted an AV approach to habilitation, applying techniques and strategies to help children who are deaf and hard of hearing develop spoken language skills via normal auditory development. Parents are the primary caregivers and are thus trained to be the primary “therapist” for their child.

Liaison with local professionals

The process of receiving a cochlear implant involves many different professionals, both within and outside the cochlear implant team. A great deal of information is shared between the cochlear implant team and local professionals such as teachers of the deaf, local audiologists, paediatricians, local ENT consultants and speech and language therapists.

Home / school visits

In the first two years of implant use, school visits are generally offered at least once a term for school-aged children in the programme who require them. They are offered more frequently if necessary. We are also able to offer home visits for information sessions prior to implantation and therapy following implantation to families who require this assistance. These visits are decided with the family on a case by case basis.

After two years of cochlear implant use the children will continue to be monitored. Local professionals will have sole responsibility for habilitation but support, in terms of equipment repairs and maintenance, will be available from the Cochlear Implant Programme.

Further reading

Cole, E. (1992).
Listening and Talking. A Guide to Promoting Spoken Language in Young Hearing Impaired Children.
AG Bell Association, Washington DC

Cole, E. & Flexer, C. (2007).
Children with Hearing Loss, Developing Listening and Talking.
Plural Publishing Inc., San Diego

Estabrooks, W. (1998).
Cochlear Implants for Kids.
AG Bell Association, Washington DC

Estabrooks, W. (2006).
Auditory-Verbal Therapy and Practice.
AG Bell Association, Washington DC.

Manolson, A. (2004).
It Takes Two to Talk. A Practical Guide for Parents of Children with Language Delays.
A Hanen Centre Publication

Stokes, J. (Ed.) (1999).
Hearing Impaired Infants, Support for the First 18 months.
Whurr Publishers Ltd, London

Websites

The following websites are offered for those who would like more information about cochlear implants

- The British Cochlear Implant Group:
  www.bcig.org.uk
- Cochlear Implanted Children's Support Group :
  www.cicsgroup.org.uk
- The Ear Foundation :
  www.earfoundation.org.uk
- Manchester Cochlear Implant Team:
  www.cmmc.nhs.uk/cochlear
- Manufacterer Links:
  www.bionicear-europe.com
  www.cochlear.co.uk
  www.medel.com
- The National Deaf Children's Society :
  www.ndcs.org.uk
- The Royal National Institute for the Deaf :
  www.rnid.org.uk

How to contact us

Enquiries and referrals for assessment :

The Co-ordinator
Manchester Paediatric Cochlear Implant Programme
Ellen Wilkinson Building Phase 2 (wing B),
Devas Street
The University of Manchester
Oxford Road
Manchester
M13 9PL

Tel: 0161 275 3364 (Secretary)

Tel: 0161 275 3554 (Paediatric office)

Fax: 0161 275 3795

Email: lise.henderson@manchester.ac.uk

Further information can be found on our website:

www.cmmc.nhs.uk/cochlear

Notes

Notes

Translation and Interpretation Service

Do you have difficulty speaking or understanding English?

আপনি কি ইংরেজীতে বুঝতে কিংবা বুঝাতে পেরেছেন ? (BENGALI)

क्या आपको अंग्रेजी बोलने या समझने में कठिनाई है ? (HINDI)

તમે ભાષા કારણે વાતચીત કરવામાં મુશ્કેલી આવે છે ? (GUJARATI)

ਕਿ ਤੁਹਾਨੂੰ ਅੰਗ੍ਰੇਜ਼ੀ ਬੋਲਣ ਜਾਂ ਸਮਝਣ ਵਿਚ ਦਿੱਕਤ ਹੈ ? (PUNJABI)

Miyey ku adagtahay inaad ku hadasho Ingriisida aad sahamto (SOMALI)

هل لديك مشاكل في فهم اوالتكلم باللغة الأنجليزية ؟ (ARABIC)

你有困難講英語或明白英語嗎？ (CANTONESE)

کیا آپکو انگریزی سمجھنے اور سمجھانے میں دِقت پیش آتی ہے ؟ (URDU)

☎ 0161 276 6202/6342

SF Taylor CM7613