deafness research uk

Cochlear Implants – Your Questions Answered

This factsheet covers the basic information about cochlear implants. It is aimed at people who are wondering whether a cochlear implant might be suitable for them or for their child. It may also be of interest to a general reader who is interested in the technological developments taking place in this area. The factsheet covers the following topics:

- What is a cochlear implant?
- What are the benefits of an implant?
- How does an implant work?
- Who can be considered for an implant?
- How is an implant fitted?
- How many people have received cochlear implants?
- Are there different types of cochlear implant?
- What research is being done into cochlear implants?

WHAT IS A COCHLEAR IMPLANT?

A cochlear implant is a device that helps improve the hearing abilities of many profoundly or totally deaf people by electrically stimulating the auditory nerve (the nerve of hearing). Older devices consisted of a small body-worn sound processor; a transmitter located behind the ear, and implanted electrodes. However, the majority of patients are now fitted with devices in which the sound processor is worn behind the ear like a hearing aid.

WHAT ARE THE BENEFITS OF AN IMPLANT?

An implant cannot restore hearing to normal but it does give the sensation of sounds. Although at first the sounds are not as the person remembers them, with training they become more natural and meaningful. Implants work particularly well for adults and children who have lost their hearing after acquiring spoken language and for young children who were born deaf.

Environmental sounds are easily heard and soon become distinguishable. However, most people find that the greatest gain is hearing the human voice. The sound that is heard complements lipreading to give greater and easier understanding. More than half of those who receive an implant find they can also understand speech without lipreading to a useful extent.

After receiving an implant people are better able to regulate the volume and pitch of their own voice. Conversation is easier as it becomes possible to hear when others are speaking and understand better what is said. The vast majority of users of implants find their confidence is boosted.

HOW DOES AN IMPLANT WORK?

In a healthy ear sound waves are transmitted across the eardrum and through the middle ear to the cochlea (inner ear). Highly specialised cells within the cochlea convert these mechanical vibrations into electrical signals which travel along the auditory nerve to the brain.

Most people with sensorineural deafness, the most common form of deafness in the UK, have a functioning auditory nerve but damaged cochlear hair cells. Implants work by bypassing the damaged cells and stimulating the auditory nerve directly.

A tiny microphone worn on the outer ear picks up sound and sends electrical impulses along a cord to a sophisticated sound processor. This modifies the signal according to the individual's needs before returning it along the cord to a transmitter. The transmitter's signal is picked up by a receiver inside the skull and converted to electrical signals which are sent to electrodes to stimulate the auditory nerve.

WHO CAN BE CONSIDERED FOR AN IMPLANT?

Cochlear implants are suitable for those who cannot benefit from hearing aids and who rely instead on lipreading to understand speech. Implants are of great benefit to those who have had hearing and so remember sound. However in recent years many young children who have been born deaf have received implants and benefited to a sufficient degree to have integrated into mainstream education. As the technology develops, the criteria for deciding whether somebody might be a suitable candidate for a cochlear implant also change.

There are now more than 20 cochlear implant centres in the UK, but if you would like to find out whether you (or your child) might be a suitable candidate for a cochlear implant, you should talk to your family doctor first. If you are an adult and are referred to a cochlear implant centre, you can expect to take part in a thorough assessment, which will look at many factors including your hearing, speech and lipreading skills, your expectations, lifestyle and general health, and may involve questionnaires, tests and medical examinations. Children who are potential candidates for cochlear implants also go through a full assessment process.

HOW IS AN IMPLANT FITTED?

The internal parts of the implant are inserted under general anaesthetic. The operation can take from two to four hours involving a few days' stay in hospital. About four to six weeks after surgery, the speech processor is activated and programmed to suit the individual's needs. The process is known as "switch on" and is followed by an intensive period of training and testing to ensure that maximum benefit is obtained from the device.

HOW MANY PEOPLE HAVE RECEIVED A COCHLEAR IMPLANT?

- There are currently about 5000 cochlear implant users in the UK.
- In 2006, nearly 300 adults and 375 children were implanted.
- At the end of 2006, it was estimated that around 130,000 people had received a cochlear implant worldwide. 4,000 of these had been implanted in both ears.

HOW MUCH DOES THE OPERATION COST?

Cochlear implantation is available free-of-charge on the NHS for many people fitting the criteria. Though the cochlear implant device alone costs around £16,500, the actual costs, including assessment, implantation and rehabilitation, are actually much higher:

- The total cost per adult cochlear implantation after the first year is around £27,000.
- The total cost per adult cochlear implantation projected over the thirty years of expected use is around £44,000.
- Costs for childhood implants can be higher due to more intensive rehabilitation.
- The total cost per childhood cochlear implantation after the first year is around £30,000.
- The total cost per childhood cochlear implantation projected over the thirty years of expected use is £60,000.

ARE THERE DIFFERENT TYPES OF COCHLEAR IMPLANT?

"Ear-level" vs. "Body-worn" processors

An ear-level processor looks like a 'behind-the-ear' hearing aid. Body-worn processors are like a small box, worn in a pocket or on a belt. The ear-level devices are much smaller and many people prefer the way they look. Most implant users can now be fitted with behind-the-ear processors, but for some people the body-worn processor is most suitable.

Processing

All the manufacturers offer a range of processing strategies (that is, the way that external sound is translated into the sensations of sound that the user experiences), of which "Continuously interleaved sampling" is one. Although there are differences in processing strategies, the difference in effectiveness between them is less significant than the large individual differences in outcome between patients. When you first get a cochlear implant, the team will try to find the processing strategy that suits you best.

WHAT RESEARCH IS BEING CONDUCTED INTO COCHLEAR IMPLANTS?

'Modiolus Hugging'

A potentially major technological advance currently undergoing clinical testing is called the "modiolus hugging" electrode array.

The aim of the implant is to use an electrode to excite the 'spiral ganglion cells' and, in principle, the closer the electrode can get to these cells, the better. Put simply, the new technique should enable electrode arrays to 'wrap' themselves around the central hub of the cochlear where the spiral ganglion cells are located. Each of the major manufacturers is working on such an array, although the "hugging" is achieved in different ways.

Neural response telemetry

One of the latest cochlear implantation systems can measure the activity of the auditory nerve in the vicinity of each electrode shortly after a stimulating electric pulse is delivered. In principle, this allows clinicians to check that each electrode is actually stimulating the auditory nervous system and should help improve the ability to tune the device to suit the patients' needs. An objective measure such as this is particularly useful when tuning an implant for a young child.

Bilateral implants

Bilateral implantation has been shown to have additional advantages, such as locating where sounds are coming from and thus establishing who is talking. In the UK, one multi-centre study to investigate the benefits of bilateral implants has been completed, and the results are expected soon.

Short electrode arrays

Some researchers are working on the development of techniques which can provide high-frequency hearing via an implant whilst allowing conventional amplification (such as that provided by a hearing aid) to provide low-frequency hearing. Such a technique could be beneficial for many millions of hearing-impaired people who are affected by poor high-frequency hearing whilst retaining good low-frequency hearing. For the foreseeable future, this option is likely to be available only through private health care because of the high cost involved.

LOOKING TO THE FUTURE

A small number of researchers are currently pursuing the exciting possibilities now being opened by the use of combined acoustic and electrical stimulation. In a few cases, people with considerable hearing sensitivity at low frequencies, but a total loss of hearing at high frequencies, have received a modified cochlear implant in which the electrode array is much shorter than usual. The short electrode stimulates only those regions of the cochlea that are normally responsive to high-frequency sounds. Improved surgical techniques employed when the electrode is inserted may reduce the likelihood that damage will occur to the low-frequency regions of the cochlea where that most hearing sensitivity remains.

Although this research is too new for definite conclusions to be drawn at this time, it does appear feasible to implant an electrode whilst substantially preserving existing hearing. If continuing research confirms the benefits of combining acoustic and electric hearing in this way, the number of potential cochlear implant recipients may grow dramatically.

THE CONTRIBUTION OF DEAFNESS RESEARCH UK

The development of more effective cochlear implant devices and services is one of the main priorities of Deafness Research UK.

Projects we have funded include the development of improved assessment and rehabilitation processes, a trial of a ‘through the skin’ connector made of a new material, and a device with electrodes positioned on the outside wall of the cochlea which could offer special benefits to certain groups, including those with some residual hearing.

More recently, Deafness Research UK announced a £200,000 study to improve cochlear implantation services for children. The research, supported by The National Lottery Charities Board, is comparing the long-term progress of deaf children who have received an implant with those who have not, providing invaluable information about which children stand to gain the most. The research will also help to shape future cochlear implant services in this country, maximising the benefits of this remarkable technology for deaf children and their families.

WHO SHOULD I CONTACT FOR MORE INFORMATION?

Contact the Deafness Research UK Information Service for further information about research into cochlear implants.

If any of your questions concerning cochlear implants have not been answered by reading this factsheet, contact the Deafness Research UK Information Service for further assistance. Our Information team will either answer your enquiry directly or refer it to one of our scientific or medical advisers.

Open: 9.00 a.m. to 5.00 p.m., Monday to Friday (a message can be left at other times).

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Textphone: 020 7915 1412

E-mail: info@deafnessresearch.org.uk

or click the 'ask question' option from our website homepage:
www.deafnessresearch.org.uk

You may also like to contact:

British Cochlear Implant Group
Website: www.bcig.org.uk

National Cochlear Implant Users Association (NCIUA).
70 Sycamore Road, Amersham, Buckinghamshire, HD6 5DR
Website: www.nciua.org.uk

Deafness Research UK is the only national medical research charity dedicated to helping people with deafness, tinnitus or other hearing problems.

Scientists are now predicting that within the next ten to fifteen years there could be a cure for some forms of deafness and much more effective treatments for tinnitus. Deafness Research UK is at the forefront of this work.

You can support us by making a donation or joining the Deafness Research UK League of Friends. For more information call us on 0207 833 1733 or write to:

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