Getting a Cochlear Implant
the journey to better hearing
All of life’s journeys depend on taking the first step – determining how to get from where you are to where you want to go. This booklet details the journey to getting a cochlear implant, answering questions about hearing loss, expanding your understanding of how implants work, and summarizing what to expect during assessment, surgery and ongoing follow-up.

Keep reading inside and find out how far the latest advances in technology from MED-EL can take you.

We’re with you every step of the way.

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How We Hear

The Anatomy of the Ear

Outer Ear
- **Pinna (auricle)** - collects and funnels sound into the ear canal
- **Ear canal (external auditory meatus)** - directs sound into the ear

Middle Ear
- **Ear drum (tympanic membrane)** - changes sound into vibrations
- **Chain of three small bones (ossicles)** - hammer, anvil and stirrup (malleus, incus and stapes) - transfers vibrations to the inner ear

Inner Ear
- **Inner ear (cochlea)** - contains fluid and highly sensitive hair cells with tiny hairlike structures that move with sound vibrations
- **Vestibular system** - contains cells that control balance
- **Auditory nerve** - leads from the cochlea to the brain
The Hearing Process

1. Sound funnels into the ear canal and causes the eardrum to move.
2. The eardrum vibrates with sound.
3. Sound vibrations move through the ossicles to the cochlea.
4. Sound vibrations cause the fluid in the cochlea to move.
5. Fluid movement causes the hair cells to bend. Hair cells create neural signals, which are picked up by the auditory nerve.
6. The auditory nerve sends signals to the brain, where they are interpreted as sounds.

Explaining Hearing Loss

The Audiogram

Each sound has a certain pitch or frequency. Frequency is measured by the number of waves or cycles that a sound makes in a single second. The scale used to designate cycles per second is called Hertz (Hz). Loudness of a sound, or intensity, is measured in units called decibels (dB).

An audiogram is a graph that helps illustrate usable hearing and the amount of hearing loss for each ear.

On the audiogram above, pitch or frequency of the sounds is charted from left to right (low to high pitch) by numbers at the top of the grid. Loudness or intensity of the sounds is measured from top to bottom (soft to loud).

The audiologist presents tones one frequency at a time. The softest tone a person can hear at each frequency is marked on the audiogram. This is called a hearing threshold.
Journey to a Cochlear Implant

Conductive Hearing Loss

A problem in the outer or middle ear can prevent sound from moving to the inner ear and, potentially, results in a conductive hearing loss.

A conductive hearing loss limits the ear from conducting sound properly.

A conductive hearing loss is usually mild or moderate (hearing loss up to 60 decibels) and can be temporary or permanent.

A conductive hearing loss may be helped by medication or surgery, depending on the cause of the problem.

If conductive hearing loss cannot be resolved medically or surgically, a hearing aid can usually help.

Neural Hearing Loss

A problem that results in the absence of or damage to the auditory nerve can cause a neural hearing loss.

Neural hearing loss is usually a profound hearing loss and is permanent.

Hearing aids and cochlear implants cannot help neural hearing loss because the auditory nerve is not able to pass on enough sound information to the brain.

Sensorineural Hearing Loss

A problem in the cochlea can cause sensorineural hearing loss.

Sensorineural hearing loss can be mild, moderate, severe, or profound and is usually permanent.

Surgical procedures cannot cure sensorineural hearing loss. Medication may be helpful in some cases.

Mild to moderately severe sensorineural hearing loss can usually be helped with hearing aids.

Severe or profound hearing loss can usually be helped with cochlear implants.

Implantable Solutions

MED-EL offers a variety of hearing implant systems in order to provide optimized solutions for various degrees of hearing loss, including the MAESTRO™ Cochlear Implant System and the Vibrant Soundbridge® Middle Ear Implant System.
Understanding the cochlear implant system

A cochlear implant system is a medical option for individuals with severe to profound sensorineural hearing loss, when hearing aids provide limited or no benefit.

A cochlear implant system has two main parts:

INTERNAL - (IMPLANT)  
(surgically placed under the skin)  
Housing  
Contains the electronics  
Electrode Array

EXTERNAL - (AUDIO PROCESSOR)  
(worn behind the ear)  
Control Unit  
Contains the microphone, and the electronics that process sound  
Cable and transmitting coil  
Battery pack

An audio processor program (map) controls pitch, loudness and timing. Maps are customized for each cochlear implant user’s listening needs during “fitting sessions” with an audiologist.
How a Cochlear Implant Works

Cochlear implant systems convert everyday sounds into coded electrical pulses. These electrical pulses stimulate the auditory nerve, and the brain interprets the pulses as sound (see diagram). The brain receives sound information within microseconds, so sounds are heard as they occur.

1. Sound is picked up by the microphone of the audio processor.
2. The audio processor analyzes and converts sounds into a special code.
3. This code is sent to the coil and transmitted across the skin to the implant.
4. The implant interprets the code and sends electrical pulses to the electrodes in the cochlea.
5. The auditory nerve picks up this signal and sends it to the auditory center in the brain. The brain recognizes these signals as sound.

Candidates for Cochlear Implant Systems

Cochlear implants are an accepted medical option for children and adults.

General Candidacy Criteria

- For children, a profound sensorineural hearing loss in both ears
- For adults, a severe to profound sensorineural hearing loss in both ears
- Age 12 months and older
- Receive little or no benefit from hearing aids
- No medical contraindications
- High motivation and appropriate expectations
- Access to education and rehabilitation follow-up

The sky is the limit for our daughter, and the cochlear implants are truly a miracle.

ALLISON W.
Benefits of a Cochlear Implant

Cochlear implants enhance auditory information, including speech, environmental sounds and music. Current studies indicate successful speech understanding for the majority of cochlear implant users.

Bilateral cochlear implant users have demonstrated benefits related to restoration of “directional hearing.” This results in the ability to localize sounds, detect different voices in noisy environments and in better speech understanding in difficult listening situations.

Conditions Limiting Cochlear Implant Success

Cochlear implant systems have been used successfully by thousands of people worldwide, but there are situations when a cochlear implant system may not be appropriate. Some factors include:

Hearing Is "Too Good"
If hearing aids provide good speech understanding, they may be a better option.

Profound Hearing Loss for a Very Long Time
If an adult was born with a profound hearing loss or has been deaf for many years, the auditory nerve may not effectively carry sound information to the brain. Optimal benefit of a cochlear implant may not be possible.

Medical Problems
If an individual is not healthy enough to tolerate anesthesia and surgery or participate in the follow-up programs, a cochlear implant may not be advisable.

Inappropriate Expectations
If individuals and families have unrealistic expectations, results may be disappointing.

Lack of Support from Family or Caregivers
If support from family and caregivers is not available, success with a cochlear implant system may be compromised.

Factors Affecting Benefit
Maximum benefit from a cochlear implant depends on a variety of factors, including age, duration of hearing loss, status of the cochlea, and other medical and personal issues.

Hearing Everyday Sounds
Nearly all cochlear implant users hear environmental sounds, keeping them in touch with their surroundings – including traffic, sirens, alarms, etc.

Hearing Speech and Improving Speech Skills
The majority of cochlear implant users hear speech sounds. With time and an effective follow-up program, recipients learn to understand these sounds. Many cochlear implant users understand speech without speechreading.

Hearing speech sounds helps refine a cochlear implant user’s own speech skills.

Phone Use
Many cochlear implant users effectively use standard and cell phones.

Music Appreciation
FineHearing™, a unique MED-EL technology, has been developed to provide users the fine details of sounds. This is especially important for the enjoyment of music.

Cochlear Malformations
If the cochlea is absent or not fully formed, it may not be possible to surgically place a cochlear implant.
MED-EL draws upon a research heritage spanning 30 years, and continues to pioneer cochlear implant technology and research worldwide. Cochlear implant users in over 80 countries benefit from the advanced technology of MED-EL cochlear implant systems. These systems are designed according to the highest safety and reliability standards and integrate the latest technological advancements.

**MED-EL Cochlear Implant**

**Thin Implant Profile**
This is especially important for young children, so the device can be placed in a comfortable location behind a small ear.

**Complete Cochlear Coverage**
An electrode array that extends the entire length of the cochlea provides a full range of sounds that are important for optimal speech understanding. MED-EL is the only cochlear implant that can provide electrical stimulation to the entire cochlea.

**Soft Electrode Array**
The small diameter and soft, flexible electrode minimizes trauma to the delicate structures of the cochlea.

**Electrode Options**
MED-EL offers electrodes designed for special conditions – such as ossification or cochlear malformations – to meet the unique needs of many cochlear implant users.

**MED-EL Audio Processor**
MED-EL’s OPUS 2 audio processors are the smallest BTE (behind-the-ear) ever developed and provide excellent performance with maximum comfort and convenience during daily activities.

**Switch-Free Design with Integrated Telecoil and Wireless FM Connectivity**
The OPUS 2 audio processor has a switch-free design. Changes to the program, volume or sensitivity are made using the FineTuner™ remote control which is similar in size to a credit card. The FineTuner™ also allows the user to engage a built-in telecoil with or without using the audio processor microphone. A telecoil may help some users to hear on the phone, especially in noisy environments.

With the OPUS 2, direct connectivity to wireless devices such as FM systems is achieved using a special battery pack cover.

**Child-Friendly Features**
Special safety features for children – such as lockable earhooks, tamper-proof battery packs and an indicator light – give parents peace of mind.

**Less Expensive to Operate**
MED-EL offers the most power-efficient and cost-effective BTE available. Batteries usually last 5 to 7 days.

**Unique Flexible Wearing Options for All Ages**
MED-EL offers the first system to provide a variety of wearing options – all of which are lightweight and secure enough for babies and robust enough for the most active user. Unique wearing options for children, such as the BabyBTE™, are available to meet young children’s individual needs.

**Never Without Sound**
With battery pack options that use either readily available disposable or rechargeable batteries, MED-EL audio processors can be powered anywhere – any time. MED-EL offers environmentally-friendly choices with rechargeable AA batteries or its DaCapo system, an ear-level rechargeable battery pack.
Understanding Sound Coding Strategies

A sound processing strategy, or sound coding strategy, is a code that converts sound waves into patterns of electrical pulses. These electrical pulses are generated by the implant to stimulate the auditory nerve via an electrode array within the cochlea.

MED-EL’s sound coding strategy integrates its innovative FineHearing™3 technology, which overcomes the limitations of envelope-based “traditional” coding strategies of other systems. Similar to frequency coding in normal hearing, FineHearing™ codes a sound signal using both envelope and fine structure cues. The additional rate coding in low to mid frequencies mimics natural hearing better than ever before and provides fine structure information important for more complex listening tasks and situations. In addition, the fine structure information of a sound is highly important for good music perception and sound localization.

**“Hearing in High Definition” with FineHearing™3**

A visual representation of the details provided by FineHearing™3 technology

MED-EL’s systems also use an advanced mathematic algorithm – the Hilbert Transform – to provide High Definition Digital Signal Processing. The Hilbert Transform tracks incoming sounds more closely than other methods, and allows the most accurate representation of sound.

Successful Results

Recent clinical studies report successful results with the MED-EL Cochlear Implant System:

- A comparative study with various cochlear implant systems indicates that the MED-EL audio processors provide excellent performance on measures of speech perception in quiet and in noise.
- In a “Quality of Life” survey, 84 percent of adult MED-EL cochlear implant users report that their cochlear implant ‘quite positively’ or ‘very positively’ affects their lifestyle.
- A telephone study indicates that the majority of MED-EL cochlear implant users (85 percent) are able to use a standard or cellular telephone.

Recent clinical studies report successful results with the MED-EL Cochlear Implant System:

A visual representation of the details provided by FineHearing™3 technology


3 High Definition Continuous Interleaved Sampling (HDCIS) and Fine Structure Processing (FSP) are the two speech coding strategies offered in the MAESTRO 2.0.1 software. The safety and effectiveness of the FSP speech coding strategy has not been established in pre-lingually deaf children. The FSP strategy should only be used by CI users with at least 6 months experience with the CIS+ or HDCIS programming options, and who have the cognitive ability to choose among the speech coding strategy options provided in the MAESTRO 2.0.1 software.


Contacting a Cochlear Implant Team

Cochlear implant surgery and follow-up takes place at specialized cochlear implant centers. Cochlear implant candidates may be referred to a center by primary care physicians (PCP) or Ear, Nose and Throat (ENT) specialists. Cochlear Implant Team members may include:

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities</th>
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<tbody>
<tr>
<td>Audiologists</td>
<td>Hearing evaluation, processor fitting, programming and follow-up</td>
</tr>
<tr>
<td>Cochlear Implant Specialists/Surgeons</td>
<td>Medical evaluation, surgery, post-op care</td>
</tr>
<tr>
<td>Speech &amp; Language Therapists</td>
<td>Speech and language evaluation, rehabilitation and support</td>
</tr>
<tr>
<td>Educational Specialists/Teachers</td>
<td>Educational environment evaluation, learning style and rehabilitation assessment</td>
</tr>
<tr>
<td>Educational Psychologist</td>
<td>Psychological evaluation, family expectations and support system</td>
</tr>
<tr>
<td>Social Worker</td>
<td>Family and patient expectations, and guidance</td>
</tr>
<tr>
<td>Implant Team Coordinator</td>
<td>Coordination of services and other activities of the team</td>
</tr>
<tr>
<td>Administrative Staff</td>
<td>Insurance, billing, reimbursement assistance</td>
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Assessment

Cochlear implant candidates undergo tests before surgery that help the Cochlear Implant Team:
- Identify specific conditions or needs of the candidate and family
- Explain benefits and set appropriate expectations for the candidate and family

Candidacy evaluations not only help to determine whether a cochlear implant is appropriate, but also help to plan the services and follow-up that will support the best possible outcome.

Surgery

Surgery usually takes between two and four hours. The risks of cochlear implant surgery are small and are comparable to other ear surgeries.
- A general anesthetic is usually given.
- The hair is shaved in the area where the incision is to be made.
- An incision is made.
- A “bed” is made in the mastoid bone behind the ear. The implant will be placed in this bed.
- An opening is made into the cochlea.
- The electrode array is inserted into the cochlea.
- The electrode array and the implant are secured in place.
- The electrode function is tested.
- The incision is closed.
- There is usually some discomfort after surgery. Pain medication can be given if necessary. Patients are usually up and about the next day. The hospital stay depends upon local practice and can be as short as one day.

First Sounds – Initial Programming

The audio processor is programmed three to six weeks after surgery. Special software is used to create unique programs (maps) for each cochlear implant user.

To Program the Audio processor:
- The audio processor and coil are correctly placed on the cochlear implant user’s ear and head.
- The audio processor is linked to the clinic computer.
- The audiologist uses the clinic computer software to generate sound signals at carefully controlled levels.
- The cochlear implant user indicates 1) the quietest sound heard (threshold level) and, 2) the loudest comfortable sound heard (most comfortable level).
- These two levels are measured for all electrodes in the cochlea.
- The audiologist adjusts other audio processor settings for comfort and effective listening.
- A program (map) is created.

Follow-Up Programming

During follow-up programming, the audiologist makes modifications and improvements to the program (map) to provide the greatest listening benefit.

Cochlear implant users must be committed to the follow-up program in order to attain optimal performance. The follow-up schedule depends on local practices. Services may include:

- Help, Advice and Support
  Assistance for technical issues, answers to questions, and information on support groups for cochlear implant users and their families

- Regular Re-Programming of the Audio Processor
  Scheduled re-programming of the audio processor to ensure that the implant is functioning properly and that the map remains optimal

- Speech and Language Therapy
  Speech and language therapy and aural rehabilitation, especially for children

Each electrode is mapped with the quietest and loudest sounds heard by the CI user.
Your journey to a cochlear implant can begin today.

If you have questions or would like additional information, please contact your local cochlear implant center, or the industry-leading experts of MED-EL at 888-633-3524 or implants-usa@medel.com.

Connect with HearPeers at www.hearpeers.com to meet with a MED-EL cochlear implant user with a similar background to yours.

You’ll also find a list of cochlear implant centers on our website at www.medel.com.