Welcome. You may be wondering whether a cochlear implant is the best choice for you or someone in your life. This brochure is designed to address many of the questions you may have and to offer basic information on hearing, hearing loss and the stages of the cochlear implant journey.

If you have any questions or would like further information, please contact your local cochlear implant centre or MED-EL office. A list of cochlear implant centres and MED-EL offices is available at: medel.com
About Hearing

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**
- **Eardrum** (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 cells (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.
1. The outer ear collects sound waves and directs them to the eardrum.

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. Fluid movement causes the hair cells to bend. Neural signals are created which are picked up by the auditory nerve. Hair cells at one end of the cochlea send low-pitch sound information, and hair cells at the other end send high-pitch sound information.

5. The auditory nerve sends signals to the brain, where they are interpreted as sounds.
About Hearing Loss

The Audiogram

An audiogram is a graph illustrating a person’s usable hearing. It is a measure of the amount of hearing loss that an individual has for each ear. Along the top of the graph, the numbers, which correspond to frequencies, range from 125 to 8000 Hz.
Frequency is expressed in cycles per second, or Hertz. The higher the frequency, the higher the pitch of the sound. For example, 250 Hertz (Hz) sounds like the dripping of a faucet, while the high-pitched ringing of the telephone is about 8000 Hz.

Loudness is measured in units called decibels. Zero decibels (0 dB) doesn't mean “no sound”. It is just very soft. Conversational voice level is around 55 dB, and 120 dB is extremely loud – about as loud as a jet taking off when you are standing just 25 metres away. The numbers along the side of the graph are hearing levels in decibels.

During a hearing test, an audiologist presents sounds one frequency at a time. The softest tone at which a person can hear at each frequency is marked on the audiogram at that frequency and intensity. This is called the “hearing threshold”.

Your audiogram is a “picture” of your hearing. It indicates how much your hearing varies from normal. It also indicates if there is a hearing loss, what kind of hearing loss there may be and where the problem might be located.
Conductive Hearing Loss

Any problem in the outer or middle ear that prevents sound from being conducted properly is known as a conductive hearing loss. Conductive hearing losses are usually mild or moderate in degree, ranging from 10 to 70 decibels.

In some cases, a conductive hearing loss can be temporary. Depending on the specific cause of the problem, medication or surgery may be a solution. A conductive hearing loss may also be helped with hearing aids or a middle ear implant.

Sensorineural Hearing Loss

Sensorineural hearing loss results from missing or damaged sensory cells (hair cells) in the cochlea and is usually permanent. Also known as “nerve deafness”, sensorineural hearing loss can be mild, moderate, severe or profound.

Mild to severe sensorineural hearing loss can usually be helped with hearing aids or a middle ear implant. Severe or profound hearing loss can usually be helped with a cochlear implant.
Mixed Hearing Loss

A mixed hearing loss is a combination of a sensorineural and conductive hearing loss. It results from problems in both the inner and middle ear. Treatment options may include medication, surgery, hearing aids or a middle ear implant.

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 a profound hearing loss and is permanent.

Hearing aids and cochlear implants cannot help, because the nerve is not able to pass on sound information to the brain. In some cases, an auditory brainstem implant (ABI) may help.

The auditory nerve is damaged or missing. Neural impulses cannot be transmitted to the brain.
About Cochlear Implants
What is a Cochlear Implant System?

A cochlear implant system is a medical device for individuals with severe to profound sensorineural hearing loss. For individuals with this type of hearing impairment, hearing aids provide little or no benefit. A cochlear implant system bypasses the non-functioning part of the cochlea and delivers electrical signals directly to the auditory nerve. Cochlear implant systems can be used effectively by both prelingually and postlingually deafened children and adults.

Implant
*Internal – surgically placed under the skin*
The implant consists of a housing, which contains the electronics, and the electrode array as well as the receiving antenna and a magnet that holds the coil in place behind the ear.

Audio processor
*External – worn behind the ear*
The audio processor consists of a control unit, a battery pack, and a coil that transmits information through the skin to the implant.

Learn more about the features and benefits of the MAESTRO CI System on page 22 of this brochure.
How a Cochlear Implant System Works

Cochlear implant systems convert everyday sounds into coded electrical pulses. These electrical pulses stimulate nerve fibres in the cochlea. The auditory (hearing) nerve transmits the signals to the brain where they are interpreted as sound. The implant continuously stimulates at very high speed. As the brain receives sound information instantaneously, sounds are heard as they occur.

1. Sounds are picked up by the microphone in the audio processor.
2. The audio processor analyses and codes sounds into a special pattern of digital information.
3. This information is sent to the coil and is 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 the signals and sends them to the auditory centre in the brain. The brain recognises these signals as sound.

Check out medel.com for detailed 3D animations explaining how CI systems work.
Who Can Benefit from a Cochlear Implant System?

MED-EL cochlear implants are used successfully in over 90 countries worldwide by both prelingually and postlingually deafened children and adults. While it is not possible to predict exact benefits for each cochlear implant user, the following guidelines are helpful:

– Implantation at a young age is highly recommended because hearing is important for language development and because research has shown better outcomes for children implanted at an early age.
– Older children and adults with previous speech and language development generally perform better with a cochlear implant.
– A long period of profound hearing loss may limit the benefits of a cochlear implant.

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 at implantation may be as young as several months, depending on individual circumstances and local practices.
– Receive little or no benefit from hearing aids.
– No medical contraindications.
– High motivation and appropriate expectations.
– Access to education and (re)habilitation follow-up.
Understanding Cochlear Implants
Benefits of a Cochlear Implant System

In general, the improvement in performance following cochlear implantation varies widely from user to user and can range from speech perception to music enjoyment.

Results reported with today’s cochlear implants consistently indicate speech understanding for the majority of recipients. For most, speech skills improve over time and with practice. Additionally, many users are proficient with the telephone allowing them to communicate freely with colleagues or family. Many users also report that they are able to enjoy music!

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

Speech Understanding
Virtually all recipients hear speech sounds through their cochlear implant. It usually takes some time to begin to understand these sounds, especially for children. Learning to understand speech and speech in difficult situations allows many adults to return to work or to continue a career which was interrupted by hearing loss. For children, a hearing loss can make it difficult to learn or concentrate properly at school. Through an effective follow-up programme, learning to understand speech is achieved gradually, and many CI recipients go on to achieve speech understanding without lip-reading even in difficult listening situations.

Speech Skills
Hearing the speech of others as well as their own voice helps CI recipients to fine tune their speaking abilities. Recipients report that improved speech skills can open up new social, educational and career opportunities.

Telephone Use
MED-EL users report a significant improvement in their use of the telephone – both landline and mobile – after cochlear implantation. More users are able to have unassisted conversations, even with unfamiliar speakers.
Sophisticated Technologies Designed for Quality Music Perception

MED-EL’s exclusive technologies, Complete Cochlear Coverage and the next generation of FineHearing, provide cochlear implant users access to music closer to natural hearing than ever before.

Complete Cochlear Coverage: The complete insertion of an especially long electrode array into the cochlea allows electrical stimulation even in the apical, low-frequency region. By taking advantage of additional coding capabilities in low frequencies, Complete Cochlear Coverage allows for FineHearing and thus an improved, more complex perception of music.

FineHearing technology, featuring the latest coding strategies FS4 and FS4-p, introduces a new dimension to musical perception. The fine details of sound are processed in order to overcome the limitations of “traditional” envelope-based sound processing. FineHearing provides additional pitch information especially in the low frequencies that is essential for the appreciation of music. For bilateral users, FineHearing allows synchronised stimulation for more accurate binaural information.

For more details about FineHearing and Complete Cochlear Coverage, please see page 26 and 27 of this brochure.
When a Cochlear Implant May Not Be Suitable

Cochlear implant systems have been used successfully by thousands of individuals worldwide, but there are situations in which a CI may not be appropriate for a particular individual. Some factors include:

Other Available Option
If hearing aids provide good speech understanding, this is likely a better option than a CI system.

Profound Hearing Loss for a Very Long Time
If the auditory nerve has never been stimulated or has not been stimulated for a very long time, it may not be able to adequately pass sound information to the brain.

The Cochlea is not the Main Cause of Hearing Loss
A CI cannot help if the cause of the hearing loss lies elsewhere than in the inner ear, such as the auditory nerve.

Surgery is not Likely to be Successful
If the cochlea is in poor condition and cannot receive the electrode, or the auditory nerve is damaged or absent, a CI is unlikely to provide benefit.

Medical Problems
A patient needs to be healthy enough for the surgery. Patients also need to be able to take part in necessary follow-up/rehabilitation programmes and be able to wear the external parts of the device.

Unrealistic Expectations
It is essential for patients and their families to have realistic expectations concerning the benefits of the CI system.

Inadequate Support from Family or Caregivers
Support from caregivers and family is essential to CI system recipients. For children who receive cochlear implants, such support is vital.
Understanding Cochlear Implants

Receiving a Cochlear Implant

Contacting a Cochlear Implant Team

Cochlear implant surgery and follow-up takes place at special cochlear implant centres. Patients may be referred to a CI centre by their primary care physician or ENT (Ear, Nose and Throat) doctor. Cochlear implant team members may include:

Audiologists
Hearing evaluation, processor fitting, programming and follow-up

Cochlear Implant Specialists/Surgeons
Medical evaluation, surgery, post-op care

Speech and Language Therapists
Speech and language evaluation, rehabilitation and support

Educators/Teachers
Educational environment evaluation, learning style and rehabilitation options

Educational Psychologist
Psychological evaluation, family expectations and support system

Social Worker
Family and patient expectations, and guidance

Implant Team Coordinator
Coordination of services and other activities of the team

www.medel.com offers a clinic finder to help you connect with your personal MED-EL partner near you.
Assessment

Cochlear implant candidates undergo a number of routine assessments prior to surgery. The information gathered enables the cochlear implant team to identify any additional conditions or needs and helps candidates establish appropriate expectations.

**Audiological**
- Hearing levels with and without hearing aids
- Speech understanding with hearing aids
- Auditory nerve function

**Medical**
- Evaluation of cause of hearing loss
- General health

**Radiological**
- CT and/or MRI studies

**Speech & Language**
- Assessment of stage of speech and language development

**Psychological**
- Ability to cope with surgery
- Ability to participate in follow-up programme

**Educational**
- Assessment of educational needs
Surgery

Typically the operation takes between one and three hours. Risks involved in cochlear implant surgery are small and compare well with other ear surgeries.

— A general anesthetic is usually given.
— The hair is shaved in the area where the incision is to be made.
— Incision is made.
— A bed for the implant is made in the bone behind the ear.
— 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.
— Electrode functioning is tested before the incision is closed.
— There is usually some mild discomfort when the patient wakes up. Pain medication can be given when required.
— Patients are usually up and about the next day. The length of stay in the hospital can vary from one to several days, depending upon local practice.
First Sounds With a Cochlear Implant

An audio processor program, also known as a map, contains settings for pitch, loudness and timing. Programs are customised to meet each person’s particular needs during “fitting sessions” with an audiologist. The audio processor is fitted 3 to 6 weeks after surgery, and is set up individually for each user.

To Program the Processor:
— The user wears the processor.
— The processor is connected to the clinic’s fitting computer.
— The fitting computer generates signals at carefully controlled levels.
— The user indicates the quietest signal heard (threshold level) and the loudest comfortable signal heard (most comfortable level).
— These two levels are measured for all channels in the cochlea.
— Using this information, a program is created which allocates sounds between these two levels and ensures that sounds are loud enough to hear but not uncomfortably loud.
— The program is fine-tuned during following clinic sessions.

Everyday Precautions with Cochlear Implants

While CI systems are generally easy to use, certain precautions should be taken:
— Keep the external parts of the device dry.
— Reduce exposure to static electricity.
— Radio waves (e.g., mobile phones) can cause some temporary interference with sound for some users.
— Contact sports such as boxing or others that may result in severe blows to the head are not advised.
In order to attain the greatest benefit from a cochlear implant, candidates should be fully committed to the follow-up programme designed by their cochlear implant team. Follow-up programmes vary according to local practice and often include:

**Help, Advice and Support**
Assistance should be available for general questions, technical matters, and information on support groups for cochlear implant users and their families.

**Regular Medical Check-ups**
The implant site should be checked regularly by a physician.

**Regular Re-Programming of the Processor**
CI recipients should visit their clinic regularly for re-programming of the audio processor. This allows the audiologist to ensure that the implant is continuing to function properly. The audiologist can also make any small modifications or improvements to the program so that the user will continue to attain the greatest benefit.

**Speech and Language Therapy**
Regular speech and language therapy is usually recommended, especially for children.

**Educational Advice and Support (for Children)**
Children using cochlear implants usually have regular contact with an educational specialist qualified to work with persons with hearing loss. An educational specialist can offer advice and support as well as monitor the child’s progress.
BRIDGE to Better Communication

MED-EL understands that providing the best possible hearing implant solution is only one essential element for restoring hearing. Learning to use a cochlear implant requires motivation, readiness, and realistic goals. Experts are there to guide you long after the operation. MED-EL offers you a wide variety of materials to support you along your hearing journey.

BRIDGE to better communication, MED-EL’s comprehensive support programme, offers more support materials than any other hearing implant company. Developed with leading educational and hearing specialists from around the world, this programme consists of a wide variety of information and materials to meet the needs of adults, teens and children as well as their parents, audiologists, speech therapists and teachers.

Learning to use your new ears is a process. MED-EL is there to support you every step of the way.
The MAESTRO Cochlear Implant System features the OPUS 2 processor and CONCERTO cochlear implant. MAESTRO is designed to offer users even better hearing than ever before – all in a system that is efficient, easy to use, and comfortable to wear.

MAESTRO now enables the next generation of FineHearing, as well as Automatic Sound Management for an optimal listening experience in changing and challenging environments. Utilising the latest electronic circuitry, energy efficiency has been improved by up to 50% – making it the most efficient cochlear implant system available.

Thinner, lighter, stronger – the most sophisticated and powerful CI system available!
Electrode Options for Individual Needs
MED-EL leads the cochlear implant industry in manufacturing soft and flexible electrode arrays for deep insertion with maximum protection of the delicate inner ear structures. MED-EL's unique electrode design allows an insertion depth of 31.5 mm for stimulation of the entire length of the cochlea, including the deep areas that are responsible for low pitch tones. A wide variety of electrode options ensures an ideal match with each person's cochlea. Electrode options include solutions for cochlear ossification and malformation as well as for candidates with residual hearing.

Receiving an MRI
Users of MED-EL cochlear implants may undergo X-ray and CT scanning. In specified circumstances, MED-EL cochlear implant users may receive an MRI provided that they have been implanted for at least 6 months. MED-EL cochlear implants have been demonstrated to pose no known hazard under fields of strength of 0.2, 1.0, and 1.5 Tesla (without surgical removal of the internal magnet). Please contact MED-EL to obtain additional advice regarding the particular conditions surrounding an MRI scan.
Synchronised Stimulation
for more accurate hearing and sound location, especially for bilateral users.

The next generation of FineHearing Technology for even better music appreciation and hearing in noisy environments.

A standard input port for connection to FM systems, assistive listening devices, iPod and Bluetooth.

Multiple wearing styles and battery options as well as an ergonomic design for maximum comfort and cosmetic appeal.

Now extra small for all. The world’s smallest and lightest audio processor.

Featuring the slim and easy-to-use FineTuner remote control, allowing easy adjustment of your settings.

Up to 90 hours of continuous use with standard zinc-air batteries or a full day of use with the DaCapo rechargeable battery system using the new D Coil. Users receive up to 60 hours with the XS battery pack.

FineTuner
The OPUS 2 is the first processor worldwide to introduce a switch-free design. Users can make changes to settings “on the go”, without removing the processor from the ear and without interrupting hearing. The large buttons on the FineTuner make it very easy to use – particularly advantageous for people who have difficulties seeing or using small controls. For bilateral MED-EL users, one FineTuner makes adjustments independently to both audio processors.

The next generation of FineHearing Technology for even better music appreciation and hearing in noisy environments.
13 Exciting Colour Options
The OPUS 2 is available in a variety of exciting colours. Users can choose between White, Creme, Beige, Nordic Grey, Sienna Brown, Ebony and Anthracite. These colours are intended to closely match many different hair colours.

In addition, MED-EL offers an assortment of audio processor colours for children including Green, Orange, Pacific Blue, Bordeaux Red, Baby Pink and Baby Blue.

Upgrade to the New D Coil Today
By upgrading to the new D Coil, MED-EL’s newest and thinnest coil design, all current users of MED-EL behind-the-ear audio processors can boost their energy efficiency by up to 50%. More energy efficiency means fewer batteries purchased, less waste and significantly lower cost.

Automatic Sound Management
The Automatic Sound Management technology of the OPUS 2 Audio Processor automatically adapts to each listening situation, without special switches or settings. As a result, all sounds, both soft and loud, are heard clearly and comfortably in all environments, e.g., group situations, whispering or distant voices.

Safe and Reliable
MED-EL cochlear implant systems offer unique safety features, including the IRIS implant identification system, ensuring that the implant and audio processor match; SoundGuard, which continuously self-monitors all programmed data; a Status Light, providing a visual indication of audio processor function; and tamper-proof battery packs and earhooks.
The Next Generation of FineHearing® Technology

The Fine Details of Sound

FineHearing technology was developed to provide cochlear implant users the fine details of sound for a richer, more detailed hearing experience. These details, known as fine structure, contain pitch and timing cues that are especially important when listening to music or having conversations in noisy environments.

In simplified terms, a sound signal can be separated into two parts: the envelope and the fine structure. The envelope is a general outline of a sound signal that reflects changes in loudness (amplitude) over time. The fine structure contains more detailed information and reflects the rapidly changing pitch (frequency) details.

The latest generation of MED-EL’s exclusive FineHearing technology is designed to allow users to enjoy the subtle pitch and timing details of sound provided by fine structure sound information. The next generation of FineHearing technology includes the sound coding strategies FS4 and FS4-p. FS4 offers up to 4 times more accuracy while FS4-p offers up to 5 times more accuracy. Users can benefit from up to 1 kHz of detailed fine structure sound information. This increased temporal resolution is especially significant for users of bilateral implants. MAESTRO is the first system offering synchronised bilateral stimulation leading to more accurate directional hearing.
Complete Cochlear Coverage

Hand in hand with FineHearing, MED-EL's unique Complete Cochlear Coverage provides users with outstanding pitch perception in the lower frequencies. The particularly long electrode stimulates more nerve fibres allowing the fine details of sound to be heard. This offers an unsurpassed hearing experience closer to natural hearing.

Complete Cochlear Coverage means stimulating the entire frequency range of the cochlear from the base to the apical region (uppermost part) in order to closely mimic natural hearing. MED-EL manufactures the longest electrode arrays currently available, extending 31.5 mm (1.24 in) in order to stimulate the maximum number of nerve fibres. Most importantly, this includes the low frequencies, which could not otherwise be stimulated using electrodes that do not reach into the apical region.
### MED-EL

#### Who We Are

Internationally recognised as the driving force in the advancement of hearing implant technology, MED-EL is as true to its roots today as it was when it started with a handful of employees more than two decades ago. What started as a university project in the early 1970s in Vienna, is today an international company dedicated to “eliminating hearing loss as a barrier to communication and quality of life.” Under the steadfast leadership of Dr. Ingeborg Hochmair, who pioneered cochlear implants in 1977, the company continues to offer the most important innovations first. For expert-level attention to detail, groundbreaking technology and best-in-class hearing performance, we encourage you to trust the leader in implantable hearing solutions.

#### Humble beginnings, global reach

Founded in 1989, the company’s roots actually extend back to the early 70s. In 1977, founders Ingeborg and Erwin Hochmair developed the world’s first multi-channel cochlear implant. Working with volunteers, who were themselves hearing implant pioneers, Ingeborg and Erwin helped individuals with total hearing loss to understand and recognise complete sentences. With time, practice, and hard work these early breakthroughs helped to establish the promise of this fascinating new technology. The cochlear implant became the world’s first replacement for a human sense, the sense of hearing.

Today, the benchmarks for hearing with a cochlear implant have advanced from speech perception to music appreciation. The company’s strong foundation in research and development continues to be its major competitive strength.

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<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tr>
<td>1975</td>
<td>Cochlear implant development started by MED-EL founders Ingeborg and Erwin Hochmair.</td>
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<td>1977</td>
<td>Implantation of the world’s first hybrid multi-channel cochlear implant in Vienna.</td>
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<td>1979</td>
<td>Introduction of the COMFORT cochlear implant.</td>
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<td>1991</td>
<td>MED-EL launches the world’s first BTE (behind-the-ear) speech processor.</td>
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<td>1994</td>
<td>Introduction of the COMBI 40, the world’s first multi-channel high-rate cochlear implant.</td>
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<td>1995</td>
<td>Introduction of the CIS LINK system.</td>
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<tr>
<td>1996</td>
<td>Introduction of the COMBI 40+*, the thinnest cochlear implant available.</td>
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<tr>
<td>1999</td>
<td>Launch of the TEMPO+ behind-the-ear (BTE) speech processor.</td>
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<td>2003</td>
<td>Acquisition of the Vibrant Soundbridge®, the first implantable middle ear hearing device for mild-to-severe sensorineural hearing loss.</td>
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<td>2004</td>
<td>MED-EL launches the PULSAR cochlear implant, providing future-ready electronics in a ceramic housing.</td>
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2005
Introduction of the DUET EAS® Audio Processor in Europe, the first hearing implant system worldwide to integrate cochlear implant audio processing and acoustic amplification in one compact device.

2006
MED-EL launches the OPUS family of speech processors. The SONATA cochlear implant, with new small titanium housing, and the FLEX electrode arrays for all implant types are introduced.

2007
Approval of EAS®, the ideal solution for partial deafness, and the Vibrant Soundbridge® for conductive and mixed hearing losses in Europe. Launch of the DaCapo rechargeable battery system.

2009
EAS® in the 2nd generation. European launch of the DUET 2 Audio Processor. Amadé, the new audio processor of the Vibrant Soundbridge® is introduced in Europe.

2010
New MAESTRO® system introduced in Europe including the CONCERTO Cochlear Implant and MAESTRO System Software 4.0 featuring the new FS4 and FS4-p coding strategies.

2012

MED-EL was there at the beginning and they will be there for you today, tomorrow and in the future offering state-of-the-art hearing implant solutions that are comfortable to wear and easy to use.

Ensuring a Hearing Future®