Complete Cochlear Coverage

WITH MED-EL’S DEEP INSERTION ELECTRODE
When choosing a cochlear implant, numerous factors go into the decision-making process. For many people, the size of the speech processor is very important. For others, battery life is a major consideration. However, there are other issues to consider when selecting an implant for yourself or your child. One important factor that is often overlooked is the length of the electrode array.

**A long electrode array that is safely inserted ensures coverage of the entire cochlea.**

Complete coverage means the ability to stimulate all the available auditory nerve fibers. The neural tissues that can be stimulated by a cochlear implant extend all the way to the uppermost region of the cochlea (apex) via long nerve fibers. Since the auditory nerve fibers located all along the cochlea spiral are each specialized for processing specific pitches, the ability to stimulate all of them provides the implant user a richer, more natural sound quality¹. Additionally, complete cochlear coverage may provide a more extensive opportunity for the development and maturation of the auditory system in young children².
Complete cochlear coverage may provide the best opportunity for the development and maturation of the auditory system in young children.
To appreciate the importance of full cochlear coverage, it is helpful to understand how the cochlea works in the normal hearing process. The cochlea is a small (pea-sized), spiral-shaped structure located in the inner ear. It is responsible for converting sounds from mechanical vibrations into signals that are passed on to the brain via the cochlear nerve. This process is performed by specialized sensory cells (hair cells) within the cochlea.

Like the keys of a piano, the cochlea is arranged in order of pitch (frequency). One end of the cochlea sends high-pitched information to the brain, while the other end sends low-pitched information. In other words, a high-pitched sound causes the sensory cells in the bottom (base) of the cochlea to vibrate. A low-pitched sound causes the sensory cells in the uppermost part of the cochlea (apex) to vibrate. Speech, music, noise and all other sounds contain many different pitches. As a result, the stimulation of the entire cochlea, from base to apex is needed to provide the rich sound experience that characterizes normal hearing.
To best mimic natural hearing, it is important for a cochlear implant to be able to stimulate the entire length of the cochlea.

Cochlea Dissection and Photo C.G. Wright, Ph.D., University of Texas Southwestern Medical Center, Dallas
Cochlear implants work by imitating the natural hearing process. They convert sounds into electrical signals that are used to stimulate the cochlea. The electrode array, which is placed into the cochlea during implantation, contains small metallic surfaces (electrode contacts) that electrically stimulate various areas of the cochlea. As in the natural hearing process, the pitch of the incoming sound determines the area of stimulation in the cochlea. For high-pitched sounds, the electrode array should ideally stimulate the bottom area (base) of the cochlea. Similarly, for low-pitched sounds, the electrode should ideally stimulate the upper area (apex).

To best mimic natural hearing, it is important for a cochlear implant to be able to stimulate the entire length of the cochlea. Special electrodes designed for deep insertion into the cochlea ensure that a wide range of pitches (frequencies) stimulate their corresponding neural structures, much like they would in the normal hearing ear.
MED-EL’s cochlear implants feature the longest electrode array available, which extends 31.5 mm into the cochlea.
Complete cochlear coverage means that the entire length of the cochlea, from the top (apical) region all the way to the bottom (base) is stimulated by the cochlear implant electrode array. This coverage is achieved by the deep insertion of a long electrode array which results in a richer, more natural sound quality for the user. MED-EL’s cochlear implants feature the longest electrode array available, which extends 31.5 mm into the cochlea. This is only possible through MED-EL’s unique and extremely flexible electrode design. The advantage of this design is that the electrode covers all areas of the cochlea, including the deepest areas that are responsible for hearing low pitch sounds.

Other commercially available electrode arrays are shorter and are only able to stimulate approximately two-thirds of the cochlea. As a result, short electrode arrays ignore the parts of the cochlea responsible for low pitch hearing. The MED-EL deep insertion electrode array allows the cochlea to be stimulated along its entire length, much like the normal hearing ear. The electrode array covers the widest pitch range while ensuring the best possible pitch discrimination among the various electrode contacts¹.
Benefits of MED-EL’s deep insertion electrodes

Numerous studies have shown that MED-EL cochlear implant users experience improved speech understanding and more natural sound quality when the entire length of the cochlea is stimulated.\(^1\)\(^2\) There is also evidence of better speech discrimination in a shorter period of time following initial activation of the implant. By stimulating the low pitch region, the implanted cochlea responds more like the normal cochlea, enabling the user to hear a broad spectrum of pitches. This improved hearing experience is thought to contribute to a faster learning curve when beginning to interpret speech and other sounds with a new cochlear implant.

Complete cochlear coverage also demonstrates distinct advantages for very young children, when the brain is best suited for developing regions dedicated to the five senses. Stimulation of the cochlea during the critical time window for auditory development (up to an age of 3 1/2) allows more normal brain development and maturation of the auditory system than children implanted later in their life\(^2\). A brain that receives stimulation of the entire cochlea has a better opportunity to fully develop the neural connections that are responsible for hearing.

What does this mean?
The length of the electrode array determines how completely the cochlea can be stimulated by the cochlear implant. A long electrode array ensures that the entire cochlea is stimulated, as occurs in the normal hearing process. Studies show that full cochlear coverage offers clear advantages in speech understanding in noise, music enjoyment and in auditory development of young children. Complete cochlear stimulation provides a richness and fullness of sound that partial cochlear coverage cannot achieve. These factors should be a major consideration when choosing a cochlear implant system.

Please contact your local MED-EL representative for more information.
In one study, users of the MED-EL standard electrode array featuring 12 pairs of electrode contacts were investigated. Participants were divided into two groups:

The first group listened to speech with only 8 electrodes pairs active: the 4 electrode pairs in the low frequency portion of the cochlea were turned off (see diagram below).

The second group listened with 8 electrode pairs that were spread out along the electrode array, from the base to the apex.

People who listened with 8 electrodes spread out over the cochlea experienced a richer, more natural sound quality and their performance was much better than the first group. In the restricted condition, with stimulation of 8 electrode pairs in the basal region only, sound was described as “tinny” and “unnatural.”


To learn more about complete cochlear coverage and what it means for you or your child, please visit our website [www.medel.com](http://www.medel.com). Or call toll-free 888-633-3524 to speak with an audiologist.
Founded by industry-leading scientists and engineers, MED-EL provides innovative solutions for those dealing with hearing loss. By advancing the field of hearing implant technology, MED-EL’s people and products connect individuals around the globe to the rich world of sound.