Fitting the Speech Processor
(and Associated Assisted Listening Devices)

After approximately a four-week healing process following surgery, it is then time to activate the external component of the implant called the speech processor. Each child’s speech processor must be individually programmed. This is sometimes referred to as setting the child’s “map.” This process typically requires an initial appointment with an audiologist at the hospital implant center and several subsequent appointments during the following weeks. It is necessary to adjust the program frequently in the beginning as the brain adapts to incoming sound. Once a stable program has been obtained, the hospital implant center will determine how often to monitor a child in the coming months and years to assure that the program continues to provide adequate responses to sound. A child may be seen every two to three months for the first year and every six months for the second and third years depending on the recommendation of the hospital implant center.

Initial Sound Stimulation

Listening through the implant for the first time may or may not be a positive experience. Each child reacts in a different way based on his or her prior experiences with sound. It is important that the audiologist adequately prepare the family regarding what to expect during a child’s initial programming session, subsequent programming sessions, and early auditory responses. For more information, see:

Advanced Bionics:

- [Getting Ready for a Bionic Ear; What to Expect at Surgery and Initial Stimulation](#)

MED EL:

- [Your Child’s New Cochlear Implant; What to Do After the First Fitting](#)
Cochlear Corporation:

- Garber, A., & Nevins, M. E. (December, 2010) *HOPE Bulletin—The Newly Implanted School Age Child*
- HOPE Archived On-line Course (for professionals) [Partnering with Your CI Audiologist: Tips for Getting the Most from Your Programming Session]
- HOPE Archived On-line Course(for families): Partnering with Your CI Audiologist: How to Get the Best MAP Possible for Your Child

### Setting a Program

The basic components of determining a program include setting threshold levels (T levels), comfort levels (C Levels), and “flagging” (turning off) electrodes that may cause problems. A program is determined by setting each of the electrodes to be loud enough for a person to be aware of a sound, but not too loud as to cause discomfort.

During the initial programming session, an audiologist will determine and set the:

- Electrode stimulation program/map (more than one program may be stored in the speech processor)
- Volume setting
- Sensitivity setting
- Locks and controls (to prohibit children from changing settings inadvertently)

For young children, setting the program(s) of the speech processor is as much an art as a science. It is important that the audiologist doing the programming have experience working with young children. In addition to behavioral observation testing to document the child’s responses, objective assessment tools that do not require a child’s participation may also be utilized. Each manufacturer has software to objectively measure the responses of the neural fibers to electrical stimulation. These measures can confirm that the internal device is functioning and can help assist in setting the program of the external speech processor when it is activated. Not all hospital centers check neural responses during surgery or programming.

For more information about neural response tools:

- [Cochlear Americas: Neural Response Telemetry](#)
- [Advanced Bionics: Neural Response Imaging](#)
- [MED-EL: Impedance and Field Telemetry](#)
**About the Speech Processor Devices**
Each manufacturer continues to update the design of its speech processors.

- **Cochlear Corporation**—The current generation of the device is the *Nucleus 5*. The current speech processor is the Cochlear Nucleus CP810 Sound Processor. For more in-depth information, [see the on-line User’s Guide](http://www.cochlear.com), which offers a full description of the device features and troubleshooting information.

- **Advanced Bionics**—The current generation of the speech processor worn behind the ear is the Auria Harmony. The User’s Guide offers a full description of the device features. Advanced Bionics also has the Neptune which is a small processor that can be worn freestyle on various parts of the body. For more information about the Neptune: [www.advancedbionics.com/com/en/Neptune.html](http://www.advancedbionics.com/com/en/Neptune.html)


**Upgrades**

As each manufacturer develops new speech processors, it may be possible for individuals to replace older model processors with newer model processors while still maintaining the older generation of the internal device. It will be necessary to communicate with the hospital implant center to determine if an individual is eligible for the upgrade and if insurance will cover the cost. Currently the following upgrade opportunities are noted on the manufacturer websites:

- The [Cochlear™ Nucleus® 5 upgrade](http://www.cochlear.com) is available for Nucleus® 24 and Nucleus® Freedom™ implant recipients in the United States and Canada.

- **Advanced Bionics**—The Harmony behind-the-ear sound processor is available for first generation C1.0 and C1.2 cochlear implant recipients. The Neptune is not compatible with C1.0 internal devices.

- **MED-EL**—Check with the hospital implant center.

**Speech Processing Strategies**
The speech processor converts sound to electrical impulses that represent speech. The cochlea is “tonotopic,” with the base or bottom of the cochlea responsible for processing the high-frequency sounds and the apex of the cochlea responsible for processing the low-pitched sounds. The speech processor has the job of transforming sounds into electrical patterns to convey the sounds to the brain by stimulating the various parts of the cochlea. Each implant manufacturer uses speech processing strategies unique to its company.
For in-depth information on the strategies used by each manufacturer see:

- The Advanced Bionics speech processing strategy is called the HiRes® Fidelity 120® Sound. There are also other features available in this device to enhance sound quality called Auto Sound.
- The Cochlear Corporation speech processing package is called SmartSound™.
- The MED-EL speech processing strategy is called Automatic Sound Management.

Assistive Listening Devices
In addition to the implant device itself, there are many associated assistive listening devices that may be used in conjunction with each cochlear implant to enhance listening in noise, at a distance, and with electronic devices.

For more information about the assistive devices available:

Cochlear Corporation—

- Accessories and Assistive Listening Devices
- Easiest Connections

Advanced Bionics—

- Products and Accessories for the Speech Processor

MED-EL—

- Using Assistive Listening Devices; Getting Connected
- How to Guide: Getting Connected

Coupling a Cochlear Implant to a Frequency Modulation (FM) System or Infrared System
There are various assistive technologies available to improve listening in background noise and at a distance in school, public areas, and at home. Two types of systems are Frequency Modulation (FM) systems and infrared systems.

When using an FM system, a child may use either a soundfield FM system or a system that provides direct input to his or her cochlear implant. Both systems utilize a transmitter/microphone to transmit sound.

With the soundfield system, the sound is broadcast via a small speaker placed strategically near the child or elsewhere in the classroom. With this system, everyone in proximity of the system’s speakers will be listening as well. This may be a benefit or a distraction to others. If a child uses a soundfield system, there are no additional parts needed to couple the speaker to the cochlear implant or settings to change on the implant itself.
With a direct audio input system, sound is transmitted directly into the child’s cochlear implant. Depending on which speech processor a child is using, there are various connectors or setting changes involved in coupling the FM system to the child’s implant. There are a variety of FM manufacturers available that couple with each cochlear implant. While the benefits may be great, the setting and monitoring of a direct audio input FM system requires close care by the child’s implant audiologist, educational audiologist, teacher, family as well as feedback from the child to assure that both FM as well as cochlear implant components are functioning.

For more information about FM devices and considerations:

- **Cochlear Corporation—FM Options**
- **Phonak: FM solutions for Cochlear Implants**
- **Advanced Bionics: Cochlear Implants in the Classroom**
- **MED-EL—Using Direct Audio Input, Using direct connection with the FM Battery Pack Cover**
- **Oticon Amigo FM/MED EL Compatibility Guide**

With an infrared system, sound is transmitted using infrared light waves. Infrared systems can be used with microphones to transmit voice or can be connected to other sound equipment. For more information about the components of infrared systems:

- **Lightspeed:** [http://www.lightspeed-tek.com/how+it+works.aspx](http://www.lightspeed-tek.com/how+it+works.aspx) or
- **Williamssound:** [http://www.williamssound.com/infraredproducts.aspx](http://www.williamssound.com/infraredproducts.aspx)

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