What are the treatment options for hearing loss?

Now that you have a better understanding of hearing loss and how to read the audiogram you may be wondering what can be done to improve your child's ability to hear. There are many different solutions for treating hearing loss. Most children with permanent hearing loss benefit from using hearing aids or cochlear implants. These devices improve hearing sensitivity and help your child to hear the world around them.

What is the difference between a Hearing Aid and a Cochlear Implant?

A hearing aid makes sounds louder and delivers these sounds to the hearing system through sound waves. The sounds delivered pass through both the healthy and damaged parts of the hearing system before reaching the brain. The loudness and clarity of the sounds depends on the number of functioning hair cells inside the cochlea and the integrity of the auditory nerve and pathway. For many children hearing aids are sufficient to improve hearing to an acceptable level of benefit. Cochlear implantation is considered for individuals who require access to sound that hearing aids cannot provide.

A cochlear implant works differently than a hearing aid. It delivers electrical signals that represent sounds directly to the auditory system. The electrical signals bypass damaged areas of the auditory system and stimulate the hearing nerve directly. Cochlear implants are usually recommended for ears with severe to profound hearing loss and can significantly improve hearing.

How do I know which treatment option is right for my child?

Make an appointment with a pediatric audiologist and ear doctor to get more information about the best treatment option for your child. Keep in mind that the recommendations may change as these professionals learn more about your child and his or her specific hearing loss and overall needs.

How can I help my child succeed?

Make sure your child wears his or her hearing devices during all waking hours every day. Find a mentor or support organization who can answer questions and provide support. View yourself as your child's primary language teacher. Enroll your child in listening and spoken language therapy and commit to attending on a regular basis.

What is listening and spoken language therapy?

A young child who has just received his or her hearing aids or cochlear implants is suddenly experiencing a world of sound. A baby or toddler will need to learn how to recognize and give meaning to these sounds. Listening and spoken language therapy transforms these meaningless sounds into an understandable language. It is a key factor to maximize success.

You can learn more about listening and spoken language at TheListeningRoom.com.

The Listening Room™

Provides families and professionals with interactive and uniquely designed activities to support the development of speech, language, and listening skills in babies, toddlers, and children.

Visit TheListeningRoom.com to explore and download the many **FREE** resources available.

Where can I find more information and support?

CONNECT TO A MENTOR

- Bionic Ear Association – hear@advancedbionics.com, AdvancedBionics.com/BEA
- Hands and Voices – handsandvoices.org
- Guide By Your Side – handsandvoices.org/gbys
- Family Voices – familyvoices.org

ACCESS FREE RESOURCES

- Tools for Toddlers – helps babies and toddlers get a strong start after the identification of hearing loss. Get connected to tools to support a child's success in their early years. AdvancedBionics.com/ToolsForToddlers
- The Listening Room — supports the development of language and listening skills for all ages and environments. Activities can be practiced independently, with others, at school, or with a listening coach. TheListeningRoom.com

FIND SUPPORT

- AG Bell – helps to ensure that every child and adult with hearing loss has the opportunity to listen, talk and thrive in mainstream society through advocacy, education, research and financial aid. agbell.org
- Hearing First – an educational endeavor of the Oberkotter Foundation that is dedicated to ensuring that children who are deaf or hard of hearing have opportunities to reach their full potential. hearingfirst.org

ADVANCED BIONICS LLC
28515 Westinghouse Place
Valencia, CA 91355, United States
T: +1.877.829.0026
T: +1.661.362.1400
F: +1.661.362.1500
info.us@advancedbionics.com

ADVANCED BIONICS AG
Laubisrütistrasse 28
8712 Stäfa, Switzerland
T: +41.58.928.78.00
F: +41.58.928.78.90
info.switzerland@advancedbionics.com

For information on additional AB locations, please visit *advancedbionics.com/contact*

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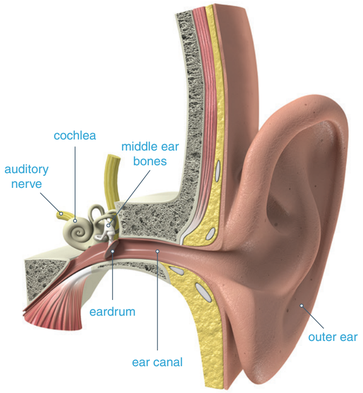
028-Q053-03 Rev A

TOOLS for TODDLERS

HELPING BABIES AND TODDLERS GET A STRONG START

UNDERSTANDING HEARING LOSS

You have recently been told that your child has a hearing loss. You may feel emotional and overwhelmed as you begin to learn more about your child's diagnosis. There is a lot of new information to learn. This guide is intended to help you understand basic information about hearing and hearing loss, the audiogram, and the treatment options available. Please consult with a pediatric audiologist for any specific questions you have about your child's hearing loss. Additionally, you may find it helpful to connect with other parents who have children with hearing loss. A parent mentor is a wonderful way to get support and guidance. Email hear@advancedbionics.com to learn more.



How the ear works?

For sound to be heard, the ear needs to convey the message to the brain. The ear consists of four main parts: the outer ear, middle ear, inner ear, and the auditory nerve. Each of these parts plays a key role in transmitting sound to the brain.

1. The Outer Ear

The outer ear captures sound and then directs the sound down the ear canal to the ear drum. The shape of the outer ear amplifies important sounds and helps to reduce competing noise.

2. The Middle Ear

Sound traveling down the ear canal reaches the eardrum causing it to vibrate. These vibrations are transmitted to the middle ear bones, the malleus, incus, and stapes causing them to move back and forth and push against the inner ear.

3. The Inner Ear

The inner ear is a snail shaped organ called the cochlea that contains sensory cells called hair cells. As the middle ear bones vibrate and push against the cochlea, fluid in the cochlea moves causing the hair cells to bend and sway. As they move, they communicate information about pitch and loudness in an electrochemical code to the auditory nerve.

4. The Auditory Nerve

The auditory nerve (or hearing nerve) is responsible for transmitting the sound information from the inner ear to the brain. The brain is responsible for interpreting sound.

What is "Normal" Hearing?

Hearing is considered normal when all parts of the hearing system are working properly and children can hear sound that is very soft to very loud over a wide range of pitches. Audiologists use special terms to describe pitch and loudness. These terms are defined below.

- Frequency – describes the pitch of sound. The unit of measurement used to describe frequency is Hertz (Hz). A low pitched sound like thunder has a frequency of about 100 Hz. A high pitched sound like a bird singing has a frequency of about 8,000 Hz.
- Decibels – describes the loudness of sound. The unit of measurement is written on the audiogram as dBHL. A very soft sound like a whisper has a dB level of about 20 dBHL. A very loud sound like an airplane taking off has a dB level of about 120 dBHL. Using these terms audiologists define normal hearing as the ability to hear sounds as soft as 0 dBHL between 125-8000 Hz. You may be wondering how an audiologist is able to determine the frequencies and decibel levels your child is able to hear. Audiologists use special tests to gather this information. Let's learn more about them.

TOOLS for TODDLERS

HELPING BABIES AND TODDLERS GET A STRONG START

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How do Audiologists test hearing?

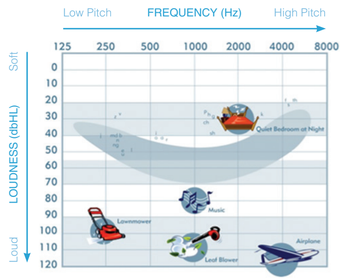
There are several ways an audiologist can test the hearing of children. In fact, your child probably had a screening version of one of the test methods described below before they even left the hospital as a newborn. The first two methods described do not require your child to be an active participant and are commonly used with babies and toddlers. The last method described, the Audiogram, does require your child to participate and is considered the most accurate and specific way to test hearing. Typically pediatric audiologists will use a combination of several tests to understand your child's type and degree of hearing loss.

- Auditory Brainstem Response Test (ABR) and Auditory Steady State Response Test (ASSR) – These tests use a special computer program in combination with electrodes that are placed close to the ears and on the head to measure the brain's response to sound. As sounds are played through headphones or insert earphones, the electrodes measure how the brain responds. The audiologist uses the computer program to assist in determining the degree of hearing loss.
- Otoacoustic Emissions (OAE's) – This test measures soft sounds, called otoacoustic emissions, given off by the inner ear. The measurement is done by placing a small microphone in the ear canal. Individuals with hearing loss greater than 25-30dBHL do not produce these soft sounds. The OAE test is part of a battery of tests and cannot be used to identify the type and degree of hearing loss on its own.
- Audiogram – An audiogram is a graph that shows a child's type and degree of hearing loss. The audiologist plots the graph by recording the softest level your child can hear different sounds that vary in loudness and pitch. Testing is done in a sound proof booth.

It is important for you to understand the audiogram as it is the way professionals describe your child's hearing loss. Let's use the Audiogram of Familiar Sounds below to learn more about how to read and understand your child's hearing loss.

As mentioned above, an audiogram is a graph that plots a child's type and degree of hearing loss. The horizontal axis of the graph indicates the pitch also known as frequency (Hz). Sounds become higher in pitch as you move from left to right in the direction of the arrow. The vertical axis of the graph indicates loudness, measured in (dBHL). The sounds increase in loudness level as you move down the graph in the direction of the arrow.

This audiogram is called the Audiogram of Familiar Sounds as it plots common sounds as well as speech sounds according to the pitch and loudness level they most commonly occur. For example, the sound of an airplane occurs at a frequency of about 4,000Hz at about 120dBHL and is extremely loud. Compare this to the "p" sound which occurs at a frequency of about 1,500Hz at about 25dBHL which is very soft. The Audiogram of Familiar Sounds is a great way teach family members and friends about the sounds your child can and cannot hear.



Visit AdvancedBionics.com/ToolsForToddlers and print your free Audiogram of Familiar Sounds under the "tools after identification of hearing loss" tab.

What do the symbols on the audiogram mean?

The audiogram contains several symbols that represent responses to sound in the right ear (O), left ear (X), soundfield (S), and bone conduction (< >). The type of response plotted is determined by the person's age and ability to sit and complete testing. Since most adults and older children can sit wearing headphones and participate in a full length hearing test, the audiologist is able to collect right ear (O), left ear (X), and bone conduction responses (< >) during a single evaluation. Audiograms are typically completed in one session and the audiologist will be able to diagnose the type and degree of hearing loss for each ear.

Getting a complete audiogram for babies and very young children, however, is not as simple. Young patients typically have short attention spans and will not tolerate wearing headphones. The goal of testing is to collect as much information as possible about how well a baby or very young child hears before the child tires and can longer participate. Typically, audiologists will record soundfield (S) responses as they can be collected quickly and without headphones. They give audiologists some information about how well your child hears. Soundfield responses must be interpreted carefully as they may not be the softest level at which your child can hear and must be evaluated in terms of reliability Additionally, soundfield responses are not ear specific. They indicate your child's ability to hear sound in the test booth in the better hearing ear (if there is a difference in hearing between the two ears).

Audiogram Symbols

- O **Right ear** – softest sound heard through headphones in the right ear
- X **Left ear** – softest sound heard through headphones in the left ear
- S **Soundfield** – softest sound heard when sound is presented through a speaker to both ears
- < **Right ear bone conduction** – softest sound heard when sound is presented directly to the right inner ear system
- > **Left ear bone conduction** – softest sound heard when sound is presented directly to the left inner ear system

Degrees of Hearing Loss

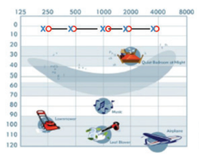
Normal	0-20 dBHL
Mild	25-40 dBHL
Moderate	40-70 dBHL
Severe	70-90 dBHL
Profound	90 dBHL and higher

Your child's audiologist will be able obtain a complete audiogram for your child as he or she becomes more familiar with the testing situation and matures. In the meantime, results from all the different types of hearing tests (ABR/ASSR/OAE/Audiogram) will be used in combination to gain the best understanding of your child's type and degree of hearing loss.

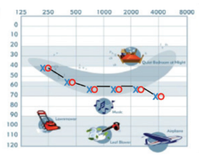
What are the different degrees of hearing loss?

Hearing loss is discussed in terms of degrees. See the box to the right as well as example audiograms below to learn more about interpreting different degrees of hearing loss. There are five degrees used to describe hearing. Normal, Mild, Moderate, Severe and Profound.

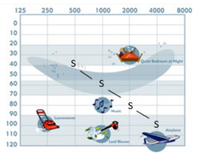
NORMAL HEARING



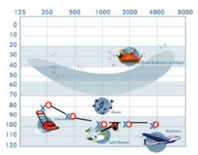
MODERATE – TO – SEVERE



MODERATE – TO – PROFOUND



PROFOUND



What are the different types of hearing loss?

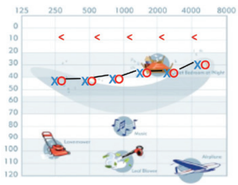
There are 3 different types of hearing loss.

- Conductive – This type of hearing loss is usually caused by a problem in the outer or middle ear. This type of hearing loss can be temporary or permanent. An ear infection that causes temporary hearing loss until treated is an example of a conductive hearing loss. The treatment for conductive hearing loss varies widely depending on the cause but may include options such as taking antibiotics or receiving ear tubes.
- Sensorineural – This type of hearing loss is due to damage to the inner ear (cochlea and hair cells), and/or the auditory nerve pathway from the inner ear to the brain. This type of hearing loss is almost always permanent and depending on the degree of hearing loss is typically treated by fitting hearing aids or receiving a cochlear implant.
- Mixed – This type of hearing loss results from a combination of conductive and sensorineural components. The conductive part of the hearing loss can be temporary or permanent. The sensorineural part of the hearing loss is almost always permanent. An ear infection that occurs in a child who already has a sensorineural hearing loss is an example of a mixed hearing loss. This type of hearing loss may be treated with hearing aids, cochlear implants, or other methods, depending on several factors which are beyond the scope of this document.

How is the type of hearing loss noted on the audiogram?

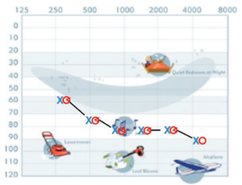
On the audiograms below you see the right ear response (O) and the left ear response (X) symbols. There is an added symbol (< >) which represents bone conduction. A bone conduction response is obtained when a tone is presented via a special headphone that stimulates the cochlea directly. This response bypasses the outer and middle ear. Bone conduction responses indicate how well the inner ear system can hear.

Follow along with each audiogram as you read the descriptions below to learn how to interpret the different types of hearing loss.



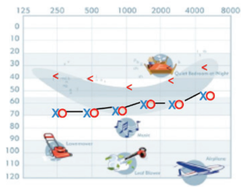
CONDUCTIVE HEARING LOSS

- Bone conduction responses (< >)will be in the normal hearing range (0-20 dBHL).
- Right ear (O), left ear (X), or soundfield responses (S) denote hearing loss (25 dBHL or higher).
- There will be a gap between bone conduction responses (< >) and right and/or eft ear responses (O and X) or soundfield responses (S).



SENSORINEURAL

- Bone conduction responses (< >) indicate hearing loss (25 dBHL or higher).
- Right ear (O), left ear (X), or soundfield responses (S) denote hearing loss (25 dBHL or higher).
- Bone conduction responses (< >) and right and left ear responses (O and X), or soundfield (S) responses overlap.



MIXED

- Bone conduction responses (< >) indicate hearing loss (25 dBHL or higher)
- Right ear (O), left ear (X), or soundfield responses (S) denote hearing loss (25 dBHL or higher).
- There will be a gap between bone conduction responses (< >) and right and left ear responses (O and X), or soundfield responses (S).