Hearing Tests And Your Child

How Early Can A Child’s Hearing Be Tested?

Most parents can remember the moment they first realized that their child could not hear. Louise Tracy has often told other parents of the time she went onto the patio while John was sleeping and when the door slammed, he did not awaken. At that moment she knew her child was deaf. She commenced to make many other noises, including banging on pots and pans to watch for a response that never happened. You, as parents of a deaf baby, probably also remember that moment when you knew that your child could not hear.

Like Mrs. Tracy, you probably then took your child to a pediatrician. Hopefully your pediatrician realized that a baby is never too young for a hearing test and you were referred to an audiologist. The audiologist may be on the staff of the audiology department of a hospital or medical center, at an independent center, or working with an otologist. Whether your pediatrician made a referral, or you located an audiologist on your own, it is most important that the audiologist has had experience testing children as young as yours. If an audiologist tests your child and you are not comfortable with the test, or the audiologist did not explain the results adequately, find another person to test your child. You must build a comfortable relationship with your audiologist, for your baby will be tested frequently. You need someone who will listen to you, respect your thoughts and explain information in a manner that you will easily understand.

In the next few pages, we discuss the kinds of tests ordinarily used with babies and young children. We also explain the meaning of those test results. You may see differences or similarities in the procedures followed with your child and with our descriptions. There are different approaches in this field, as in any other.

How A Baby Or Young Child’s Hearing Is Tested

There are two methods to test hearing: objective and subjective. Objective hearing tests do not require responses or co-operation from a child. They consist of Auditory Brainstem Response (ABR), and Otoacoustic Emissions (OAE) testing. Subjective testing does require a behavioral response. These tests are done in the test booth by watching the baby’s responses to sounds or by playing a “listening game” with the child. Each of these tests are necessary for a complete audiological evaluation.

Auditory Brainstem Response (ABR) Testing

ABR testing is a measurement of the response to sounds from the lowest part of the brain (the brainstem). This response measures degree of hearing and neurologic function. Because a child must be quite still for the test, sedation is generally necessary if a little one is more than three months old. Small electrodes are placed behind the child’s ears and a ground electrode is placed on top of the head. These electrodes are secured with a paste substance. There is no discomfort or pain at all. Earphones are then placed over the ears and very fast click sounds are presented. The electrodes pick up the response from the brainstem and send it to a computer screen. A normal response consists of waves as shown in the example on the next page.
Often a parent is told that this test indicates no response. An example of this is as follows.

If an ABR test indicates no response, that does not mean that the child has no hearing. Most ABR test equipment only presents sounds up to a level of 100 dB, and only at high frequencies (tones) of approximately 3000 Hz. Many children have hearing above 100 dB and their amplification will provide good benefit for these sounds. Also, many children have different hearing levels at other frequencies, so what is heard at 3000 Hz does not reflect hearing for low or mid-frequency tones.

**OTOACOUSTIC EMISSIONS (OAE) TESTING**

The cochlea, the sense organ for sound, is located in the inner ear as shown in the drawing below.

Otoacoustic emissions are sounds generated from the cochlea of a person with normal hearing or with a mild hearing loss.

Otoacoustic emissions are measured by a probe which is placed in the ear canal. The probe generates a sound that is perceived by the cochlea. The cochlea then responds with its emission (sound) which is picked up by a microphone in the probe. The response is displayed on a computer screen. The following picture shows an example of this response.

Unlike ABR testing, this test does not provide information about exact hearing levels. Rather, it indicates whether the person has hearing better or worse than approximately 35 dB. The importance of this test is that it shows a response from the cochlea and enables the audiologist to determine if the hearing loss is actually in the cochlea or in the nerve that takes the sound into the brain. This information is very important because location of the hearing loss helps determine if the individual will benefit from hearing aids.

ABR and OAE testing generally do not need to be repeated once reliable responses have been obtained.
Sound Booth Testing:

There are three basic methods of testing babies and young children in the audiometric test booth. From birth until approximately nine months of age, a child is tested by behavioral observation. From nine months of age until approximately three years, visual reinforcement is used. And after three years of age, play testing procedures are used.

Testing is generally accomplished with earphones or through loudspeakers. Many children under the age of three years refuse to use earphones. Testing is then done through loudspeakers, and this is referred to as sound field testing. Sound field testing is restricted only in that it is not ear specific: both ears are tested simultaneously so it is not possible to determine if one ear hears better than the other. So it is advantageous to use earphones as soon as the child will accept them.

Sounds are presented at hearing levels louder than the child can hear and made softer as the child responds. The softest sound to which a child responds is referred to as the “hearing threshold.” This hearing threshold is obtained at each frequency. Most reliable results are obtained if a test assistant sits across from the child. The test assistant will keep the child’s attention on the task and provide praise for each response.

Symbols are used to record this information on a graph. In general, audiologists use an O to indicate responses under earphones from the right ear, and an X to record responses from the left. Other symbols, such as those used for sound field testing or testing while wearing hearing aids, are not universal and it is important always to check the key before reading any audiogram.

Behavioral Observation:

When a baby hears a sound, it is possible to observe his response by looking carefully at his face. This is called behavioral observation. Responses might consist of eye-widening or eyebrow scrunching, or if the baby has a pacifier, he may suck faster or he may stop sucking.

Norms are used to determine if the baby has normal hearing or a hearing loss. However, if there is a hearing loss, it is not possible to determine the exact degree of that loss.
That is why this test must be combined with ABR and OAE results to provide more precise hearing levels. The experience and skill of the audiologist in presenting a variety of sounds and in observing the child's response determines the success of the test.

**Visual Reinforcement Audiometry**

When a child is approximately nine months old, he begins to turn his head to “look for” a sound. Testing then consists of reinforcing the child's response to sound by visual stimuli. In the test booth, a dark plexiglass box is mounted on the wall beside a loud speaker. When a tone is presented and the child looks in the direction of that sound, the box is lit and the child sees a clown or other character beating on a drum. The child learns that if he looks when the sound is presented, the clown will be lit. If he looks when there is no sound, nothing will happen. For this test, norms are no longer used, and degree of hearing loss (mild, moderate, etc.) is recorded as they would be for an adult.

However, even if these results are reliable, ABR and OAE testing are also important if this is the child’s first hearing test, since those tests will help to determine the type of hearing loss.

**Play Audiology**

When a child is approximately three years of age, he can be taught to put a block into a bucket or peg in a hole every time he hears a sound. As with the other tests, it is very helpful to have a test assistant who will teach the child this “listening game.” Children at this age will usually accept earphones so that responses can be obtained for each ear individually. Most children enjoy doing this test until they are five or six years of age, at which time they can raise their hand when they hear the sound in the same manner as an adult is tested.

**Understanding An Audiogram**

**Pitch: From Low To High**

An audiogram is a graph on which responses to various sounds, from low to high pitch, at various levels of loudness are recorded. This indicates the softest sound a person can hear. The numbers across the top of the audiogram indicate pitch, from deep, low tones on the left, to very high squeaky tones on the right. A more common word used in audiology for pitch is “frequency.” Frequency is measured in “Hertz” (abbreviated Hz), a measurement of cycles per second. Human hearing can go up to 20,000 Hz; however, the range for hearing speech lies between 300 and 3000 Hz. Because a child’s great need is to understand and to learn to say words, these frequencies in the speech range are the most important to test.

**Intensity: From Soft To Loud**

The numbers that begin with 0 and go to 120 on the left side of the audiogram show the measurement of loudness. The unit of measurement is the “decibel,” which is abbreviated “dB.” If a child hears tones in the speech range between 0 and 15
dB, he has hearing within the normal range for conversation. A whisper is heard at about 25 to 30 dB, and a jet plane in close proximity is heard at a painful level of 140 dB or louder. How a child hears in the important frequencies from 300 to 3000 Hz is the determining factor in describing his hearing level.

**Defining a Hearing Loss**

Hearing loss is generally described by degree: slight, mild, moderate, moderately-severe, severe and profound. These are related to decibel level as follows:

- 0 – 15 dB – normal hearing
- 15 – 25 dB – slight hearing loss
- 25 – 40 dB – mild hearing loss
- 40 – 55 dB – moderate hearing loss
- 55 – 70 dB – moderately-severe hearing loss
- 70 – 90 dB – severe hearing loss
- 90 dB + – profound hearing loss

If a child has a slight hearing loss (responses in the 15 to 25 dB range), speech will be slightly muffled. Therefore, his own spoken words will not be clear. This child will miss portions of fast-paced speech, and he will also have difficulty in noisy classroom environments.

As mentioned above, to a child with a mild hearing loss, speech will be quite muffled. This child will acquire single words and some word combinations. Often parents report that this child leaves off beginnings and endings of words. In the classroom, this child will miss a significant amount of instruction.

If the hearing loss is moderate in degree, speech will not be clear and much of soft-spoken speech will not be audible. The child will be aware of voice, intonation and inflection, but speech will sound like a mumble. A child with a moderate hearing loss will probably only develop a vocabulary of a few words.

Speech will not be intelligible for a child with a moderately-severe hearing loss. There will be an awareness of sound, but virtually none of the speech sounds will be clear, and it will be very difficult for a child to develop spoken language.

Speech will not be audible to a youngster who has a severe or profound hearing loss. The child will only hear his own voice if he is screaming, and often these children will shriek to hear themselves.

**What Will Hearing Aids Do?**

In general, hearing aids will bring hearing levels to approximately one-half of the hearing loss. Therefore, if the loss is 100 dB, hearing aids will bring hearing to approximately 50 dB. A hearing loss of that degree cannot be brought up to 0 dB because that amount of amplification would be uncomfortable and even painful. Because a hearing loss is generally in the cochlea, the sense organ for sound, loud amplification can create pain from the nerve which transmits the sound to the brain.
Using the example of a severe-to-profound hearing loss, amplified test responses might be noted as follows:

Because a child can be tested in a sound proof booth at any age, **it is important that all children are tested while wearing their hearing aids.** This is important for two reasons. The first is to confirm that the hearing aids are set appropriately for the hearing loss. Even if the hearing aids are set by a computer, the responses in a sound proof test booth will confirm that the child’s hearing levels match those settings. The second reason is to determine which speech sounds the child can hear. All parents want to know if their hearing impaired child will be able to talk. Although aided audiologic evaluations cannot predict speech clarity, they can provide information about the speech sounds which are audible to the child.

**HEARING TESTS AND COCHLEAR IMPLANTS**

The most important test for a child who wears a cochlear implant is the Ling Six Sound Test. If a child is able to discriminate each of these sounds, it is assumed that his implant is functioning appropriately. Often audiologists will present these speech sounds in the test booth and so determine the softest level at which the child can hear them.

While wearing a cochlear implant, a child will respond to tones in the test booth between 15 to 40 dB. Although the Ling Six Sounds are more important to verify benefit from the implant, tones across the frequencies provide the knowledge that the child has sound awareness.

**A FINAL THOUGHT**

It is important to remember that follow-up hearing tests are very important to determine that hearing levels have not changed and that the hearing aids are functioning properly. Very small babies should be tested in the test booth every three or four months both with and without hearing aids, and older children should be tested twice a year.

You should be confident and optimistic about the benefits your child can derive from carefully selected amplification. But you must also be aware that early educational help is equally as important as the early introduction of amplification. Underlying this is the necessity of good audiologic evaluations.