Boston Children's Hospital
Deaf and Hard of Hearing Program

GALLAUDET UNIVERSITY | LAURENT CLERC NATIONAL DEAF EDUCATION CENTER

Setting Language in Motion: Family Supports and Early Intervention for Babies Who are Deaf or Hard of Hearing

Testing Hearing in Infants

Hearing evaluations are important in determining a child's auditory skills in a variety of areas. This information can provide guidance when developing the most appropriate intervention plan. Below is a list of hearing tests infants and young children may experience.

Auditory Brainstem Response (ABR) Evoke Potential Test

This hearing test measures the activity of the auditory (hearing) nerve in response to sound. Three or four small monitors are gently taped to the child's head. Sounds are presented through an earphone to each ear separately while a computer looks for any changes in the brain wave pattern in response to sounds. When the nerve is able to detect the sound, a predictable wave pattern appears on the computer screen. When the nerve does not receive the sound, a flat or near flat line appears. The purpose of the test is to determine the softest level at which the ear is able to detect sound.

Typically children must be asleep during testing so that their movements do not affect the test response. (Note: There is a newer piece of test equipment that some facilities use which does not require sleep.) Many children under the age of 6 months can be tested in a natural sleep state. The child is brought to the clinic hungry and ready to nap. After feeding by the parent, many babies will fall asleep naturally and testing can begin. For older children, or for children who don't fall asleep on their own, a mild sedative can be used to ensure that the child sleeps long enough for testing to be completed.

This test is very accurate. Each ear is tested separately, and responses to specific

MODULE TWO
Understanding Hearing: How the Ear Works and How to Test Hearing in Infants

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frequencies (or pitches) of sound can be obtained to determine the child's hearing level. Testing can be done by both air and bone conduction. (Please see Module 2 for more information.) The results can be used to program hearing aids and/or determine candidacy for a cochlear implant.

Otoacoustic Emission (OAE) Testing

This test can be used to assess the presence or absence of a hearing loss. A series of soft sounds is presented to the ear, and a sensitive recording microphone measures an "echo" in response to that sound. If the echo, or emission, is present, the outer hair cells of the cochlea (the auditory portion of the inner ear) are working. The emission will not be present in children with middle ear problems (e.g., fluid, congestion) and/or children with a mild or greater hearing loss.

For this test the child can be awake but must be quiet. This test can be used to determine the likely presence or absence of hearing loss but cannot determine the severity of a

hearing loss. It can be helpful in identifying children with auditory dyssynchrony (auditory neuropathy), where sound is not reliably transmitted to the auditory nerve and brain properly.

Tympanometry

This test is used to screen the health of the ear. A sound is presented to the ear while a gentle change in air pressure is introduced. The reflection of the sound off the eardrum is recorded. When the space behind the eardrum (the middle ear space) is full of air, the sound will be reflected on a graph that looks like a mountain peak. This means that the ear is likely healthy. When the middle ear space is full of fluid then a flat line appears, meaning the eardrum is unable to move with the change in air pressure. This test can also identify a perforation (hole) in the eardrum and tell if an ear tube is open. In this situation, a flat line will again appear but the volume measurement in the ear will be large.

Middle ear muscle (or acoustic) reflex testing can be included with tympanometry. This measures the tightening of the small muscles in the ear when louder sounds are presented (similar to when a physician hits your knee with the rubber hammer and your foot kicks out). The loudness level at which the reflex occurs is recorded and can aid in determining the part of the ear that may be causing the hearing loss.

This test does not measure hearing but can aid in identifying the cause of a hearing loss found by other test measures.

Behavioral Observation Audiometry (BOA)

This test can be used with children ages 6-9 months or with those functioning at that developmental level. The child should be well rested, fed, and alert. The child is typically seated on his or her parent's lap.

Sounds are presented through speakers in the room, and changes in the child's behavior in response to the sounds are observed. Typical behavior changes include a child stopping movement or a quiet child starting to move. Some children will have a change in facial expression or in their sucking pattern (e.g., start or stop sucking on a pacifier or bottle). Louder sounds may cause the child to startle. The child is initially observed at a loud enough sound that it can be easily heard. The loudness level is then decreased in order to identify the softest level of sound to which the child consistently reacts.

Visual Reinforcement Audiometry (VRA)

This test is typically used with children ages 8-30 months or with those functioning at that developmental level. The child should be well rested, fed, and alert. The child typically is seated on his or her parent's lap.

Sounds are presented through speakers in the room. When the child looks to the sound source, a visual reinforcer or reward is presented. The reinforcer can be a stuffed toy that is illuminated or an animated picture on a video screen. The child is initially conditioned to a loud sound, and then the loudness level is decreased in order to determine the softest level of sound to which the child consistently responds.

Conditioned Play Audiometry (CPA)

Many children ages 2-1/2 years old and older can reliably perform this test task. The child should be well rested, fed, and alert. Some children are comfortable sitting in their own chair, while others are more comfortable on their parent's lap. Sounds can be presented through speakers in the room or through earphones.

The child is taught to perform a play task such as dropping a block or stacking a cup in response to sound. He or she is initially conditioned to a sound that is loud enough to easily hear. The loudness level is then decreased in order to identify the softest level of sound to which the child consistently responds. The game can be changed frequently to maintain the child's attention for a longer period of time.

Objective vs. Subjective Hearing Testing

ABR, OAE, and Tympanometry testing are objective test measures because the child does not need to actively respond in order to obtain results. BOA, VRA, and CPA testing are subjective test measures because the child must actively engage in the test in order to get responses.

Subjective tests are dependent on the child's developmental level and physical and mental states as well as on his or her willingness to participate. Many subjective tests are performed with sounds coming through speakers in the room (referred to as the *sound field*). Although the sound is coming from one side or the other, both ears participate in the response. If one ear is hearing sound better than the other, then that is the ear that will respond; however, it is not possible to determine with sound field testing which ear has responded. When the child is willing and able to tolerate wearing earphones, then responses from which specific ear can be determined.

For Additional Resources

Please refer to the Module 2 video for more tips and information as well as for additional resources. Also, visit our websites at *www.bostonchildrenshospital.org/dhhp* and *http://clerccenter.gallaudet.edu*.

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