Ear Exam and Hearing Tests

Test Overview

A thorough evaluation of a person's hearing requires an ear exam and hearing tests. In children, normal hearing is important for language to develop correctly. Some speech, behavior, and learning problems in children can be related to problems with hearing. For this reason many schools routinely provide hearing tests when children first begin school. Even young infants can be evaluated for hearing loss.

During an ear exam, the ear is examined with an instrument called an otoscope that allows the doctor to view the outer ear canal and eardrum. An ear exam can detect problems in the ear canal, eardrum, and the middle ear (such as infection, excessive earwax, or a foreign object).

Hearing tests help detect hearing loss, identify how severe it is, and determine what is causing it. They measure the ability of sound to reach the brain. Sounds are actually vibrations of different frequencies and intensities in the air around us; air in the ear canals and bones in the ears and skull help these vibrations travel from the ear to the brain, where you “hear” them. By measuring a person's ability to hear air-conducted sounds and bone-conducted sounds, hearing tests can also help determine what kind of hearing loss a person has.

Most hearing tests require the person to respond to a series of tones or words. These tests include:

- Whispered speech testing, which is a simple screening test that assesses a person's ability to hear whispered speech across a short distance.
- Pure tone audiometry, which uses a machine to produce tones that the person hears through earphones. This test measures the person's ability to hear sounds that reach the inner ear through the ear canal (air conduction).
- Tuning fork testing, which use metal tuning forks to produce tones. These tests can assess both air and bone conduction.
- Speech reception and word recognition testing, which measure the person's ability to hear and understand speech.

Hearing tests that do not require the person to respond include:

- Otoacoustic emissions (OAE) testing, which measures the inner ear's response to sound. Otoacoustic emissions are sounds produced by the cochlea, a fluid-filled coiled structure in the inner ear that converts sound vibrations into electrical signals that go to
the brain. The cochlea produces otoacoustic emissions spontaneously in response to a sound, such as a tone or click. Otoacoustic emissions can be recorded in the external ear canal and do not require the person to consciously respond or indicate whether the tones or clicks are heard. OAE testing is often used to screen newborns for hearing problems.

- Auditory brainstem evoked potential (ABEP) testing, which evaluates the function of nerve pathways in the brain that are needed to hear. In this test, clicking noises or tones are sent through earphones to the person being tested, and each response is recorded from brain waves by using electrodes taped to the head. When hearing is stimulated by listening to a test click or tone, the electrical response in the brain is called an auditory brainstem evoked response or potential. Like otoacoustic emissions testing, ABEP testing is often used to screen newborns for hearing problems. It is also called brainstem auditory evoked response (BAER) testing.

A hearing evaluation may involve one or more of these routine hearing tests.

**Ear Exam and Hearing Tests**

**Why It Is Done**

**Ear exam**

An ear exam may be done:

- As part of a routine physical exam.
- To determine the cause of symptoms such as earache, a feeling of pressure or fullness in the ear, or hearing loss.
- To detect excess wax or a foreign object in the ear canal.
- To detect the location of an ear infection. The infection may involve only the external ear canal (external otitis) or the middle ear behind the eardrum (otitis media).
- To monitor how well treatment for an ear problem is working.
Hearing (audiometric) tests

Hearing tests may be done:

- As part of a routine physical exam. In general, unless hearing loss is suspected, only a simple whispered speech test will be done during a routine physical exam.
- To evaluate possible hearing loss in anyone who has noticed a persistent hearing loss in one or both ears or has had problems understanding words in conversation.
- To screen young children for hearing problems that might interfere with learning, speech, and language development. The American Speech-Language-Hearing Association recommends yearly hearing checks for all children from preschool to grade 3, an age group with a high rate of hearing loss.
- To screen for hearing problems in older people. Hearing loss in older people is often mistaken for diminished mental capacity (for instance, if the person does not seem to listen or respond to conversation).
- To screen for hearing loss in people who are repeatedly exposed to loud noises or who are taking certain antibiotics.

Ear Exam and Hearing Tests

Results

Normal

Ear exam

Ear canals vary in size, shape, and color. Normally, the ear canal is skin-colored with small hairs and usually some yellowish brown earwax. The eardrum is normally pearly white or light gray, and you can see through it. The surface of a normal eardrum will reveal the tiny bones of the middle ear pushing on the eardrum. Unless the person has had one or more severe ear infections, a cone of light, known as the "light reflex," will reflect off the surface of the eardrum at the 5-o'clock position in the right ear and the 7-o'clock position in the left ear.

Hearing tests

Sound is described in terms of frequency and intensity. A person's hearing threshold is how loud a sound of a certain frequency must be for the person to hear it. The results of hearing tests, especially pure tone audiometry, use these terms to describe a person's ability to hear different sounds.
Frequency, or pitch (whether a sound is low or high), is measured in vibrations per second, or hertz (Hz). The human ear can normally hear sounds from a very low rumble of 16 Hz to a high-pitched whine of 20,000 Hz. The frequencies of normal conversations in a quiet place are 500 to 2,000 Hz.

Intensity, or loudness, is measured in decibels (dB). The loudness levels of some common sounds are 15 to 25 dB for a whisper, 40 to 60 dB for background noise in the home or office, 100 to 120 dB for loud music, and 140 to 180 dB for a jet airplane.

For adults, the normal range of hearing is 0 to 25 dB. For children, the normal range is 0 to 15 dB. If a person’s hearing is normal, the person will be able to hear what the examiner whispers. Audiometry testing will show that he or she hears within these ranges in both ears.

Normal results in the tuning fork tests include:

- The person hears the tones at equal loudness in both ears (Weber test).
- The tones when the tuning fork is held next to (but not touching) the ear last longer or are louder than when the tuning fork is placed on the bone behind the ear (Rinne test). In other words, the air-conducted sound lasts longer or is louder than the bone-conducted sound.
- The person hears the tones for about the same amount of time as the examiner hears them (Schwabach test).

The results of speech reception tests should nearly match (within 10 dB) the results of audiometry testing with pure tones. In word recognition tests, people with normal hearing are able to repeat more than 90% to 95% of the words.

In otoacoustic emissions (OAE) testing, the microphone will detect emissions from the inner ear, indicating normal hearing.

For auditory brainstem evoked potential (ABEP) testing, the values recorded on the graph indicate normal functioning of the nerves in the brain responsible for hearing.
Abnormal

Ear exam

If wiggling or pulling on the outer ear produces pain, the person may have an external ear infection (external otitis or "swimmer's ear"). A canal that is red, tender, swollen, or filled with yellowish green pus also indicates an external ear infection.

In a middle ear infection (otitis media), the light reflex on the eardrum may be dull or absent and the eardrum may be red and bulging. If fluid collects in the middle ear (serous otitis media), an amber liquid or bubbles can be seen behind the eardrum.

A hole in the eardrum (perforation) or whitish scars on the surface of the drum are signs of previous infections. If a child has had tubes placed in his or her ear, a tiny plastic tube (usually blue or green-colored) may be seen. Doctors sometimes place these tubes through the eardrum to help manage frequent ear infections.

Hearing tests

If a person has a hearing loss, he or she may not be able to hear the words the examiner whispers during a whispered speech test. The person may be able to hear the examiner when one ear is tested but not when the other is tested.

Audiometry testing will show that the person's hearing does not fall within the normal range of hearing in one or both ears. The person will be able to hear certain sounds only when they are at high decibel levels. For example, a person who has a hearing loss may be able to hear low-frequency sounds at 10 decibels but can hear high-frequency sounds only at 70 or more decibels.

In otoacoustic emissions (OAE) testing, no emissions are detected from the inner ear, indicating hearing loss.

Auditory brainstem evoked potential (ABEP) testing indicates that nerves in the brain responsible for hearing are not functioning normally, resulting in hearing loss.

The following table relates hearing thresholds (how loud a sound of certain frequency must be for a person to hear it) to the degree of hearing loss for adults:
<table>
<thead>
<tr>
<th>Hearing threshold (in decibels, dB)</th>
<th>Degree of hearing loss</th>
<th>Ability to hear speech</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–25 dB</td>
<td>none</td>
<td>no significant difficulty</td>
</tr>
<tr>
<td>26–40 dB</td>
<td>mild</td>
<td>difficulty with faint or distant speech</td>
</tr>
<tr>
<td>41–55 dB</td>
<td>moderate</td>
<td>difficulty with conversational speech</td>
</tr>
<tr>
<td>56–70 dB</td>
<td>moderate to severe</td>
<td>speech must be loud; difficulty with group conversation</td>
</tr>
<tr>
<td>71–90 dB</td>
<td>severe</td>
<td>difficulty with loud speech; understands only shouted or amplified speech</td>
</tr>
<tr>
<td>91+ dB</td>
<td>profound</td>
<td>may not understand amplified speech</td>
</tr>
</tbody>
</table>

Abnormal results in tuning fork tests include the following:

- The tone is louder in one ear than in the other (Weber test).
- The tone lasts longer or is louder when the tuning fork is placed on the bone behind the ear than when the tuning fork is held next to the ear (Rinne test). In other words, the bone-conducted sound lasts longer or is louder than the air-conducted sound.
- The person hears the tone for a longer or shorter time than the examiner (Schwabach test).

Abnormal results in speech reception and word recognition tests include the following:

- The person’s speech reception threshold is more than 10 dB greater or lesser than the threshold determined by pure tone audiometry.
- In word recognition tests, the person can hear the sounds but cannot understand the words, no matter how loud they are.
- The person cannot understand the words at normal decibel levels but can understand them if they are spoken more loudly (at a higher decibel level).
- The score for one ear is much higher than for the other ear.