

What is a hearing aid?

A hearing aid is an electronic, battery-operated device that amplifies and changes sound to allow for improved communication. Hearing aids receive sound through a microphone, which then converts the sound waves to electrical signals. The amplifier increases the loudness of the signals and then sends the sound to the ear through a speaker.

Hearing Loss Overview

To understand hearing loss it is important to understand how normal hearing takes place. There are 2 different pathways by which sound waves produce the sensation of hearing: air conduction and bone conduction.

- In air conduction, sound waves move through the air in the external auditory canal (the "ear canal" between the outside air and your eardrum). The sound waves hit the tympanic membrane (eardrum) and cause the tympanic membrane to move.
- The bones in the middle ear are connected to the tympanic membrane. When the tympanic membrane moves, this movement is transmitted to the bones. These 3 bones are called the malleus, the incus, and the stapes. Movement of the stapes causes pressure waves in the fluid-filled inner ear.
- The cochlea is an inner ear structure surrounded by fluid. It contains multiple small hairs. Pressure waves in the fluid cause the hairs to move. This movement stimulates the auditory nerve. Different frequencies of noises stimulate different hairs on the cochlea, which translate to the sensation of sounds of different pitch.
- Hearing by bone conduction occurs when a sound wave or other source of vibration causes the bones of the skull to vibrate. These vibrations are transmitted to the fluid surrounding the cochlea and hearing results.

Hearing Loss Causes

There are 2 basic types of hearing loss, which are called conductive and sensorineural.

- **Conductive causes:** Conductive hearing losses result from physical problems with the movement of the sound wave through the ear. A simple example is blockage of the ear canal.
 - Obstructed external ear canal - Cerumen (wax) build-up, hematoma (blood collection), or foreign body in the ear canal. This is one of the most common causes of hearing loss and the easiest to fix.
 - Perforated tympanic membrane - Caused by direct trauma such as a finger or cotton swab, middle-ear infections (otitis media), or explosions (blast injury)
 - Dislocated ossicle (malleus, incus, or stapes) - Usually from trauma to the ear

- Otitis media - Middle ear infection
- Otitis externa - Infection of the ear canal that causes it to swell
- **Sensorineural causes:** Sensorineural causes are from damage to the hair cells or nerves that sense sound waves.
 - Acoustic trauma - Prolonged exposure to loud noises causes the hair cells on the cochlea to become less sensitive.
 - Barotrauma (pressure trauma) or ear squeeze - Usually in divers
 - Head trauma - A fracture of the temporal bone can disrupt the nerves of the auditory system
 - Ototoxic drugs - Certain drugs can affect hearing by damaging the nerves involved in hearing. Usually this occurs when large or toxic doses are used but may also occur with lower doses.
 - Antibiotics including aminoglycosides (gentamicin, vancomycin), erythromycins, and minocycline
 - Diuretics including furosemide and ethacrynic acid
 - Salicylates (aspirin) and nonsteroidal anti-inflammatories (NSAIDs) such as ibuprofen and naproxen
 - Antineoplastics (cancer drugs)
 - Vascular diseases (problems with blood vessels) include sickle cell disease, diabetes, leukemia, polycythemia, and diseases in which excessive blood clotting occurs.
 - Children and adults with kidney problems are more susceptible to sensorineural hearing loss.
 - Ménière disease - A disease that affects hearing and balance. It is usually associated with tinnitus (ringing in the ears). It has a gradual onset and often progresses to deafness and severe vertigo. The cause is unknown.
 - Acoustic neuroma - A tumor in the auditory nerve. Usually associated with ringing in the ears.
 - Infections
 - Mumps
 - Measles
 - Influenza
 - Herpes simplex
 - Herpes zoster
 - Mononucleosis
 - Syphilis
 - Meningitis
 - Aging (presbycusis)

People with hearing loss may experience some or all of the following problems:

- Difficulty hearing conversations, especially when there is background noise.
- Hissing, roaring, or ringing in the ears (tinnitus).
- Difficulty hearing the television or radio at a normal volume.
- Fatigue and irritation caused by the effort to hear.
- Dizziness or problems with balance.

How can I find out if I have hearing loss?

If you think you might have hearing loss, visit your physician, who may refer you to an otolaryngologist or audiologist. An otolaryngologist is a physician who specializes in ear, nose, and throat disorders, and will investigate the cause of the hearing loss. An audiologist is a hearing health professional who identifies and measures hearing loss and will perform a hearing test to assess the type and degree of loss.

How can hearing aids help?

On the basis of the hearing test results, the audiologist can determine whether hearing aids will help. Hearing aids are particularly useful in improving the hearing and speech comprehension of people with sensorineural hearing loss. When choosing a hearing aid, the audiologist will consider your hearing ability, work and home activities, physical limitations, medical conditions, and cosmetic preferences. For many people, cost is also an important factor. You and your audiologist must decide whether one or two hearing aids will be best for you. Wearing two hearing aids may help balance sounds, improve your understanding of words in noisy situations, and make it easier to locate the source of sounds.

Exams and Tests

In most medical offices or in the emergency department, doctors do not have access to equipment to directly test your hearing (an audiometer). In these settings the doctor will most likely evaluate your hearing with a tuning fork. The examination may include the following:

- Each ear will be tested separately to see if you can hear the sound coming from a tuning fork.
- The ear canal and tympanic membrane will be inspected with an otoscope (a special instrument with a light and a tip to look into the ear canal).
- The nose, nasopharynx (the part of your throat that your ears drain into, located just above your soft palate), and upper respiratory tract usually will be carefully examined.
- A general neurologic exam, which includes tests of the nerves that control movement, sensation, and reflexes, will be done.
- If a process inside the brain (such as an acoustic neuroma) is suspected, a CT scan of the brain may be performed.
- If an infection, vascular problem, or drug interaction is suspected, blood tests may be performed.
- Tympanometry may be indicated if a problem with the tympanic membrane (eardrum) is suspected. This test evaluates the middle ear's ability to receive sound waves.

What are the different kinds of hearing aids?

There are several types of hearing aids. Each type offers different advantages, depending on its design, levels of amplification, and size. Before purchasing any hearing aid, ask whether it has a warranty that will allow you to try it out. Most manufacturers allow a 30- to 60-day trial period during which aids can be returned for a refund.

There are four basic styles of hearing aids for people with sensorineural hearing loss:

- **In-the-Ear (ITE)** hearing aids fit completely in the outer ear and are used for mild to severe hearing loss. The case, which holds the components, is made of hard plastic. ITE aids can accommodate added technical mechanisms such as a telecoil, a small magnetic coil contained in the hearing aid that improves sound transmission during telephone calls. ITE aids can be damaged by earwax and ear drainage, and their small size can cause adjustment problems and feedback. They are not usually worn by children because the casings need to be replaced as the ear grows.
- **Behind-the-Ear (BTE)** hearing aids are worn behind the ear and are connected to a plastic earmold that fits inside the outer ear. The components are held in a case behind the ear. Sound travels through the earmold into the ear. BTE aids are used by people of all ages for mild to profound hearing loss. Poorly fitting BTE earmolds may cause feedback, a whistle sound caused by the fit of the hearing aid or by buildup of earwax or fluid.
- **Canal Aids** fit into the ear canal and are available in two sizes. The **In-the-Canal (ITC)** hearing aid is customized to fit the size and shape of the ear canal and is used for mild or moderately severe hearing loss. A **Completely-in-Canal (CIC)** hearing aid is largely concealed in the ear canal and is used for mild to moderately severe hearing loss. Because of their small size, canal aids may be difficult for the user to adjust and remove, and may not be able to hold additional devices, such as a telecoil. Canal aids can also be damaged by earwax and ear drainage. They are not typically recommended for children.
- **Body Aids** are used by people with profound hearing loss. The aid is attached to a belt or a pocket and connected to the ear by a wire. Because of its large size, it is able to incorporate many signal processing options, but it is usually used only when other types of aids cannot be used.

Do all hearing aids work the same way?

The inside mechanisms of hearing aids vary among devices, even if they are the same style. Three types of circuitry, or electronics, are used:

- **Analog/Adjustable:** The audiologist determines the volume and other specifications you need in your hearing aid, and then a laboratory builds the aid to meet those specifications. The audiologist retains some flexibility to make adjustments. This type of circuitry is generally the least expensive.
- **Analog/Programmable:** The audiologist uses a computer to program your hearing aid. The circuitry of analog/programmable hearing aids will accommodate more than one

program or setting. If the aid is equipped with a remote control device, the wearer can change the program to accommodate a given listening environment. Analog/programmable circuitry can be used in all types of hearing aids.

- **Digital/Programmable:** The audiologist programs the hearing aid with a computer and can adjust the sound quality and response time on an individual basis. Digital hearing aids use a microphone, receiver, battery, and computer chip. Digital circuitry provides the most flexibility for the audiologist to make adjustments for the hearing aid. Digital circuitry can be used in all types of hearing aids and is typically the most expensive.

