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HOW DO WE HEAR?

Hearing is the sensing of sound vibrations in the air. When a sound occurs (people speaking, doorbell ringing, birds chirping, music playing) it produces a vibration that travels through the air displacing it. The displaced air is called a sound wave. Sound waves are collected by the outer ear and delivered to the eardrum to vibrate. This vibration in turn sets the three tiny bones (ossicles) of the middle ear in motion, transferring the eardrum vibrations to the inner ear (cochlea). Thousands of hair cells lining the inside of the cochlea move in response to this displacement. When the hair cells "bend", they send neural impulses along the hearing (auditory) nerve to the brain (cerebral cortex) where these impulses are perceived as "sound".

WHAT GOES WRONG WITH HEARING?

Problems occurring anywhere along the hearing chain, from the outer ear to the brain, can produce a hearing loss. Usually hearing loss is either conductive or sensorineural. Occasionally it can be a combination of both (mixed hearing loss).

Conductive hearing losses occur when sound waves are prevented from entering the inner ear due to difficulties in the outer ear canal or the middle ear. Individuals with conductive hearing loss will hear sounds perfectly if they are made loud enough to overcome the difficulty in the outer or middle ear. Medical or surgical intervention can improve a conductive hearing loss. Common causes of conductive losses are ear wax plugging the outer ear canal; fluid in the middle ear that inhibits the vibration of the ear drum (eustachian tube dysfunction); damage to the ear drum or middle ear bones caused by trauma, infection, or tumors; or abnormal bone growth that restricts the vibration of the middle ear bones (otosclerosis).

A person with a conductive hearing loss may notice that their ears may seem to be full or plugged. This person may speak softly because they hear their own voice quite loudly. Crunchy foods, such as celery or carrots, sound very loud and this person may have to stop chewing to hear what is being said. An audiologist and a physician to explore medical and surgical options should evaluate all conductive hearing losses.

Sensorineural hearing losses, also referred to as nerve deafness, usually result from a loss of hair cells in the inner ear. Sound waves are delivered to the inner ear, but due to missing hair cells, impulses are not delivered to the brain and so the sound is not perceived. Individuals with sensorineural hearing loss will hear sound but it may be distorted. Often people with this type loss will say, "I can hear people talking. I just don't understand what they are saying." Hearing aids can help improve understanding of speech for individuals with sensorineural hearing loss. Common causes of sensorineural losses are noise exposure, aging, infection, or genetic defects. Additionally, abnormal fluid pressure in the inner ear can cause a sensorineural hearing loss. Examples include Meniere's disease - too much fluid pressure and perilymph fistula (hole in the cochlea) - too little fluid pressure. Occasionally, a small benign tumor (acoustic neuroma) may be pressing on the auditory nerve causing hearing loss.

Sensorineural hearing loss is the most common type of hearing loss. More than 90 percent of all hearing aid wearers have sensorineural hearing loss. The most common causes of sensorineural hearing loss are age-related changes and noise exposure. A sensorineural hearing loss may also result from disturbance of inner ear circulation, increased inner fluid pressure or from disturbances of nerve transmission. Sensorineural hearing loss is also called "cochlear loss," an "inner ear loss" and is also commonly called "nerve loss." Years ago, many professionals said there was nothing that could be done for sensorineural hearing loss – that is totally incorrect today. There are many excellent options for the patient with sensorineural hearing loss.

A person with a sensorineural hearing loss may report that they can hear people talking, but they can't understand what they are saying. An increase in the loudness of speech may only add to their confusion. This

person will usually hear better in quiet places and may have difficulty understanding what is said over the telephone.

Central hearing impairment occurs when auditory centers of the brain are affected by injury, disease, tumor, hereditary, or unknown causes. Loudness of sound is not necessarily affected, although understanding of speech also thought of as the "clarity" of speech may be affected. Certainly both loudness and clarity may be affected as well.

Mixed hearing losses occur when there is a difficulty in the outer or middle ear that prevents sound from entering the inner ear and there is a loss of transmission of the impulses to the brain from the inner ear (usually due to a loss of hair cells). Even when sounds are made loud enough to overcome the conductive portion of this hearing loss, individuals will still have difficulty understanding speech due to the sensorineural portion of the hearing loss. Medical or surgical intervention can improve the conductive portion of the hearing loss and a hearing aid can help improve understanding for the sensorineural portion of the hearing loss. Common causes of mixed hearing losses are any combination of the above causes for conductive and sensorineural hearing losses.

DEGREE of HEARING LOSS:

Results of the audiometric evaluation are plotted on a chart called an audiogram. Loudness is plotted from top to bottom. Frequency, from low to high, is plotted from left to right. Hearing loss (HL) is measured in decibels (dB) and is described in general categories. Hearing loss is not measured in percentages. The general hearing loss categories used by most hearing professionals are as follows:

- Normal hearing (0 to 25 dB HL)
- Mild hearing loss (26 to 40 dB HL)
- Moderate hearing loss (41 to 70 dB HL)
- Severe hearing loss (71 to 90 dB HL)
- Profound hearing loss (greater than 91 dB HL)

HOW DO WE RESTORE HEARING?

First, a physician specializing in disorders of the ear must determine the type of hearing loss you have. The type of hearing loss can only be determined through microscopic examination of your ears and a thorough audiometric test (a hearing test that includes testing with pure tones through both air and bone conduction, speech testing, and middle ear pressure tests). Once a diagnosis has been made, treatment can be decided. Nearly all types of conductive hearing losses can be repaired with surgery. Do not become discouraged if you have had previous surgery to repair your hearing and it was unsuccessful. Many patients have had their hearing successfully restored even though they had undergone one or more previous unsuccessful operations prior to referral to my clinic.

Sensorineural hearing losses caused by a loss of hair cells can only be improved with modern hearing aids. Many patients with this type of hearing loss come to the clinic because they are dissatisfied with their present hearing aids. Dr. Huang is able to fit such individuals with the new generation of hearing aids. In the past several years, hearing aids have been developed that process sound digitally much the same way that a computer processes information. This allows for infinite programming possibilities which make the sounds coming through the hearing aid sound more natural and which provides better clarity for speech both in quiet and noise (see hearing aids).