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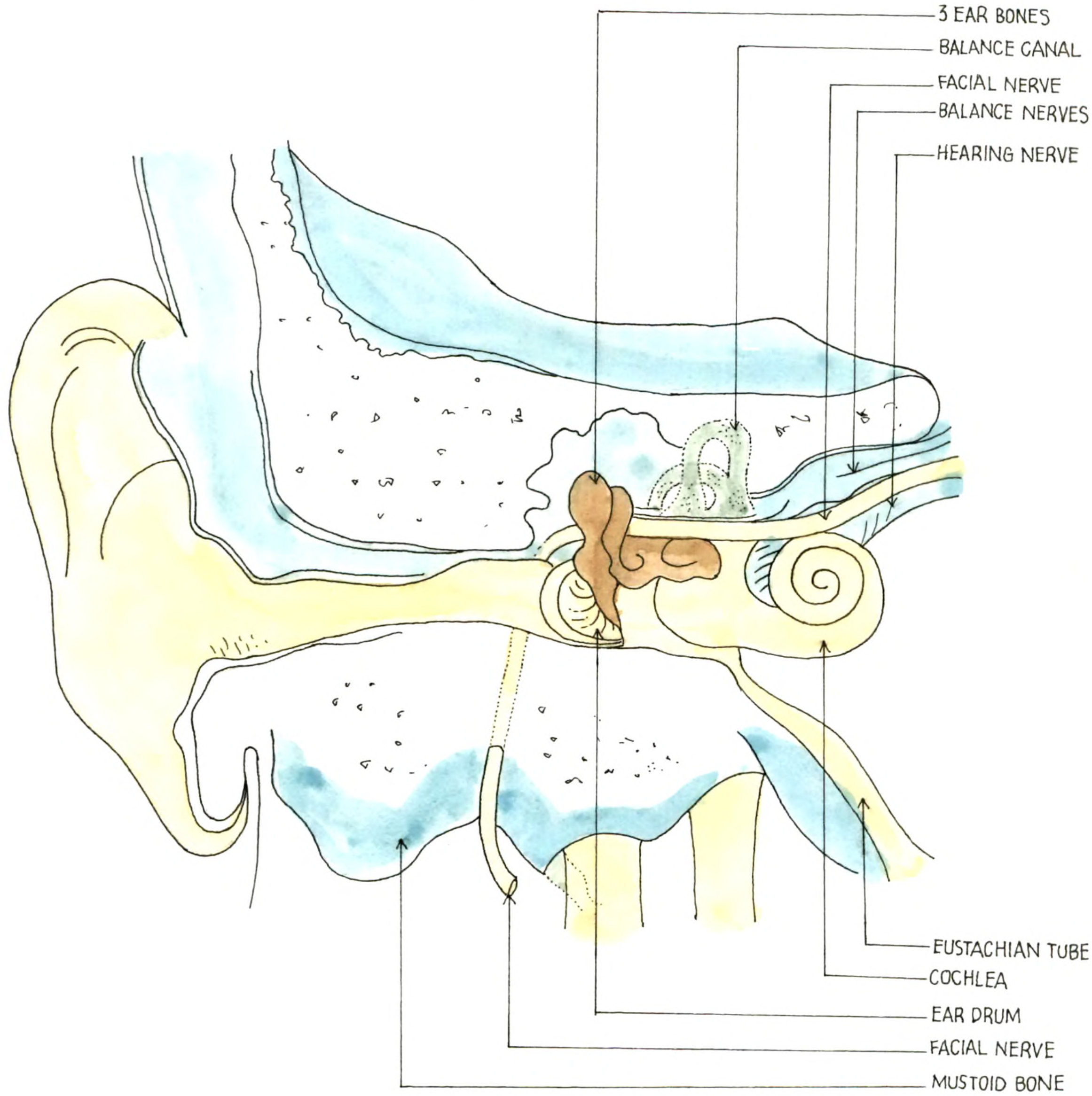
PARTS OF THE EAR



Appendix No.1

ANATOMY AND PHYSIOLOGY OF THE EAR.

The ear is one of the most complex organs of the body. The many elements that make up the hearing mechanism are divided into three major sections the outer, middle and inner ear. The outer ear is the least complex and least important for hearing; the inner ear is the most complex and most important for hearing.

The Outer Ear.

The outer ear consists of the auricle and the external auditory canal. The canal ends with the tympanic membrane (eardrum), which is the boundary between the outer and middle ear. The auricle is the part of the ear that protrudes from the side of the head. The part that the outer ear plays in the transmission of sound is relatively minor. Sound is collected by the auricle and is funneled on to the eardrum, which vibrates, sending the sound waves on to the middle ear.

The Middle Ear

The middle ear is composed of the eardrum and three very tiny bones (ossicles) called the **malleus** (hammer) **incus** (anvil), and **stapes** (strirrup) contained within an air-filled space. It is here that the transmission of sound begins to get sophisticated. The chain of the malleus, incus, and stapes conducts the vibrations of the eardrum along to the **oval window**, which is the connecting link between the middle and inner ear. To prevent a significant loss of energy between the vibration of the eardrum and the vibration of the oval window, the chain of bones is constructed in such a way that it takes advantage of the physical laws of leverage. Because of this there is an efficient transfer of energy from the air-filled cavity of the middle ear to the dense, fluid-filled inner ear.

The Inner Ear

About the size of a pea, the inner ear is an intricate mechanism of thousand of moving parts. Because it looks like maze of passage way and because of its complexity, this part of the ear is often called **Labyrinth.** The inner ear can be divided into two sections according to function: The **vestibular mechanism** and the **Cochlea.** These sections, however, do not function totally independently of each other.

The Vestibular Mechanism

The vestibular mechanism, located in the upper portion of the inner ear, is responsible for the sense of balance. Its most prominent organs are three soft, fluid-filled semicircular canals. The solution in these canals and two other small organs connected to them is extremely sensitive to such things as acceleration, head movement, and head position. Information regarding movement is fed to the brain through the vestibular nerve.

The Cochlea

By far the most important organ for hearing is the cochlea. Lying below the vestibular mechanism, this snail-shaped organ contains the parts necessary to convert the mechanical action of the middle ear into an electrical signal in the inner ear that is transmitted to the brain. In the normally functioning ear, sound causes the malleus, incus, and stapes of the middle ear to move. When the stapes moves, it pushes the oval window in causing the fluid in the Cochlea of the inner ear to flow. The movement of the fuild in turn causes a complex chain of events in the cochela ultimately resulting in excitation of the chochlear nerve. With stimulation of the Cochlear nerve, an electrical impulse is sent to the brain and the heart.

Appendix No.2

Measurement of Hearing Ability

Hearing ability can be measured in several ways, some more precise than others. For example, someone who suspects a hearing problem in a child can place himself or herself behind the child and softly whisper the child's name to try to find out how well the youngster can hear. Another example of a crude measure of hearing is "Watch test". Here an examiner slowly moves a watch toward each of the child's ears, and the child is asked to tell when he or she first hears ticking. Besides the chance that the "Whisper test" will cause the child to wonder at the weird behavior of the adult, both tests lack accuracy. Most important, they lack an appropriate standard with which responses can be compared. Whispering or the ticking of a watch can vary considerably, as can background noise. Furthermore, the child's responses cannot be compared with those of other children.

Audiologists use tests of hearing that are considerably more accurate. Their methods are also relatively uniform, so that results would be about the same even if several examination were conducted by different audiologists.

There are three different general types of scientific hearing test: pure-tone audiometry, speech audiometery, and specialized tests for very young children. Depending upon the characteristics of the examinee and the use to which the results will be put, the audiologist may choose to give any number of tests from any one or a combination of these three categories.

In a sientific assessment of hearing ability, hearing is measured in two dimensions. The response to the intensity of the sound is measure, that is how loud it is, and also the frequencey, that is how loud it is for different frequencies. Deviation from the normal in each of the two dimensions have markedly different effects upon the nature of the impairement. The effect of loss of loudness upon hearing is more obvious than the effect of an imbalance of hearing for different frequencies.

Pure-Tone Audiometry

Pure-tone Audiometry is desgined to establish the individual's threshold in **Hertz (Hz) Units,** has to do with the number of vibrations per unit of time of a sound wave; the pitch is higher with more vibrations, lower with fewer. A person's thershold for hearing is simply the level at which he or she can first detect a sound; it refers to how intense a sound must be before the person can detect it. Itensity is measured in units known as decibels (dB).

Pure-tone audiometers are designed to present tones of various intensities (dB levels) at various frequencies (Hz). Audiologists are usually concerned with measuring sensitivity to sounds ranging from 0 to about 110 dB. A person with average-normal hearing is barely able to hear sounds at a sound pressure level of 0 dB. The zero decibel level is frequently called the zero hearing threshold level (HTL) or **Audiometric zero.**

Hertz are usually measured from 125 Hz ("Low" sounds) to 8000 Hz ("high" sounds). Sounds below 125 Hz or above 8000 Hz are not measured because most speech does not fall within this range. Frequencies contained in speech range, from 80 to 8000 Hz, but most speech sounds have energy in the 500 to 2000 Hz range. therefore the child's sensitivity within this latter range is particularly important.

The procedure for testing a person's sensitivity to pure tones is relatively simple. Each ear is tested separately. The audiologist persents a variety of tones within the range of 0 to about 110 dB and 125 to 8000 Hz until he or she establishes at what level of intensity (dB) the individual can detect the tone at a number of frequencies - 125 Hz, 250 Hz, 500 Hz, 1000Hz, 2000 Hz, 4000 Hz, and 8000 Hz. For each of these frequencies there is a measure of degree of hearing of hearing impairment. A 50 dB hearing loss at 500 Hz, for example means the individual is able to detect the 500 Hz sound when it is given at an intensity level of 50 dB, whereas the normal person would have heard it at 0 dB.

Speech Audiometry

The ability to detect and understand speech is of prime importance, a technique called **Speech Audiometry** has been developed to test a person's detection and understanding of speech. Speech detection is defined as the lowest level (in dB) at which the individual can detect speech without understanding. More important is the determination of the dB level at which one is able to understand speech. This is known as the **Speech reception threshold (SRT)**. One way to measure SRT is to present the person with a list of two-syllable words, testing each ear separately. The dB level at which he or she can understand half the words is often used as an estimate of SRT level.

Test for Young and Hard to Test Children

A basic assumption of pure-tone and speech audiometry is that the person being tested understands what is expected of him or her. The individual must be able to comprehend the instructions and to show with a head nod or raised hand that he or she has heard the tone or word. He or she must also be cooperative. None of this may be possible for very young children (under about 4 years of age) or for children with other handicaps.

Play Audiometry

This technique is primarily used to establish rapport with the child and to motivate him or her to respond. The testing situation is set up as a game. Using pure tones or speech, the examiner teaches the child to do various activities whenever he/she hears a signal. The activities are designed to be attractive to the young child.

Reflex Audiometry

Infants normally possess some reflexive behaviors to loud sounds, which are useful for the testing of hearing. Present at birth is the Moro refex, which is defined as a movement of the face, body, arms, and legs and a blinking of the eyes. Another response that may be used to determine hearing ability is the orienting response. This response is evident when the infant turns his/her head and body toward the source of a sound.

Evoked-Response Audiometry.

This involves measuring changes in brain-wave activity by using an electroencephalograph (EEG). All sounds heard by an individual result in electrical signals within the brain, so this method has become more popular with the development of sophisticated computers. It can be used during sleep, and the child can be sedated and thus not be aware he/she is being tested.

In India, pure-tone audiometry is the popular method in practice. In all schools of Gujarat only pure-tone audiometry is carried out whether by specialists or by teachers.