

Hearing Impairment: An Introduction

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I. INTRODUCTION

Disability is part of the human condition. Almost everyone will be temporarily or permanently impaired at some point in life, and those who survive to old age will experience increasing difficulties in functioning. Most extended families have a disabled member, and many non-disabled people take responsibility for supporting and caring for their relatives and friends with disabilities. Every epoch has faced the moral and political issue of how best to include and support people with disabilities. This issue will become more acute as the demographics of societies change and more people live to an old age.

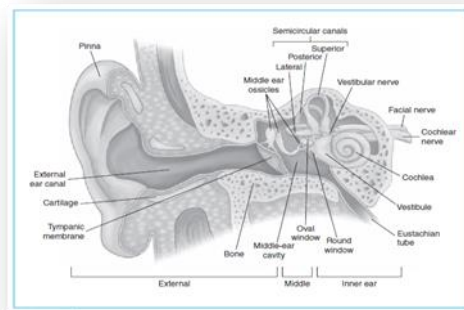
Human ear, organ of [hearing](#) and [equilibrium](#) that detects and analyzes [sound](#) by [transduction](#) (or the conversion of sound waves into electrochemical impulses) and maintains the sense of balance (equilibrium). The ear is the part of the body that is used for hearing information about the world is acquired through hearing. Anybody that hears nothing around him, no matter how loud the sound is should be seen as having ear problem. It is a condition or rather an impairment which is a physical, observable condition of tissue that can affect the function of the organ system of which that tissue is a part. Hearing impairment is a disability that can affect the effective functioning of the total personality no matter the period of onset (Okeke, 2001).

Hearing impairment means loss of 60dB or more in the better ear in the conventional range of frequencies. Hearing is the ability to perceive sound. A person suffering from hearing impairment has difficulty in perceiving or identifying sound clearly due to auditory problems. The impairment may be unilateral or bilateral. Hearing disorder results from a number of causes and is usually characterized by the type and degree of hearing loss. Type of hearing loss is related to the site of the disorder within the auditory system, and degree of loss is related to the extent that the disorder is infringing on normal function. Defining both the type and degree of hearing loss is a cornerstone of audiology. This study covers types of hearing disorder and their functional consequences.

Hearing is one of the major senses and like vision is important for distant warning and communication. It can be used to alert, to communicate pleasure and fear. It is a conscious appreciation of vibration perceived as sound. In

order to do this, the appropriate signal must reach the higher parts of the brain. The function of the ear is to convert physical vibration into an encoded nervous impulse. It can be thought of as a biological microphone. Like a microphone the ear is stimulated by vibration: in the microphone the vibration is transduced into an electrical signal, in the ear into a nervous impulse which in turn is then processed by the central auditory pathways of the brain. The mechanism to achieve this is complex.

Anatomy of the Ear:



The ear is a complex part of an even more complex sensory system. It is situated bilaterally on the [human skull](#), at the same level as the nose. The main functions of the ear are, of course, hearing, as well as constantly maintaining balance. The ear is anatomically divided into three portions:

1. [External ear](#)
2. [Middle ear](#)
3. [Internal ear](#)

1. **External ear:** The **external ear** serves to collect and resonate sound, assist in sound localization, and function as a protective mechanism for the middle ear. The outer ear has three main components:

- a. **The auricle:** The **auricle** is the visible portion of the ear, consisting of skin covered cartilage. The upper rim of the ear is often referred to as the **helix** and the lower flabby portion as the **lobule**. The bowl at the entrance to the external auditory meatus is known as the **concha**.
- b. The external auditory meatus is a narrow channel leading from an opening in the side of the head

that measures 23–29 mm in length. The outer two thirds of the canal is composed of skin-covered cartilage. The inner one third is skin-covered bone. The canal is elliptical in shape and takes a downward bend as it approaches the tympanic membrane. The skin in the cartilaginous portion of the canal contains glands that secrete earwax or cerumen.

- c. The **tympanic membrane** lies at the end of the external auditory canal. It is a membrane made of several layers of skin embedded into the bony portion of the canal. The membrane is fairly taut, much like the head of a drum. Its shape is concave, curving slightly inward.

2. **The middle ear:** It is an air filled space connected to the back of the nose by a long, thin tube called the Eustachian tube. The middle ear space houses three little bones, **the hammer, anvil and stirrup** (malleus, incus and stapes) which conduct sound from the tympanic membrane to the inner ear. The outer wall of the middle ear is the tympanic membrane, the inner wall is the cochlea. The middle-ear structures function as an impedance matching device, providing a bridge between the airborne pressure waves striking the tympanic membrane and the fluid-borne traveling waves of the cochlea.

- The eardrum serves as a divider between the outer ear and the middle ear structures. It is gray-pink in color when healthy and consists of three very thin layers of living tissue. The eardrum is very sensitive to sound waves and vibrates back and forth as the sound waves strike it. The eardrum transmits the airborne vibrations from the outer to the middle ear and also assists in the protection of the delicate structures of the middle ear cavity and inner ear.
- The middle ear cavity is located in the mastoid process of the temporal bone. The middle ear cavity extends from the tympanic membrane to the inner ear. It is approximately two cubic centimeters in volume and is lined with mucous membrane. The middle ear cavity is actually an extension of the nasopharynx via the eustachian tube.
- The Eustachian tube acts as an air pressure equalizer and ventilates the middle ear. Normally the tube is closed but opens while chewing or swallowing. When the eustachian tube opens, the air pressure between the outer and middle ear is equalized. The transmission of sound through the eardrum is optimal when the air pressure is equalized between the outer and middle ear. When the air pressure between the outer and middle ear is unequal, the eardrum is

forced outward or inward causing discomfort and the ability of the eardrum to transmit sound is reduced.

3. **The middle ear** is connected and transmits sound to the inner ear via the Ossicular chain. The ossicular chain amplifies a signal approximately 25 decibels as it transfers signals from the tympanic membrane to the inner ear. The ossicular chain consists of the three smallest bones in the body: the malleus, incus, and stapes. The malleus is attached to the tympanic membrane. The footplate of the stapes inserts into the oval window of the inner ear. The incus is between the malleus and the stapes.
4. **Inner Ear:** It is also known as labyrinth of the ear, part of the ear that contains organs of the senses of hearing and equilibrium. The bony labyrinth, a cavity in the temporal bone, is divided into three sections: the vestibule, the semicircular canals, and the cochlea. Within the bony labyrinth is a membranous labyrinth, which is also divided into three parts: the semicircular ducts; two saclike structures, the saccule and utricle, located in the vestibule; and the cochlear duct, which is the only part of the inner ear involved in hearing. The cochlear duct forms a shelf across the cochlea dividing it into two sections, the scala vestibuli and the scala tympani. The entire inner ear is bathed in a cushioning fluid, called the endolymph when it lies within the membranous labyrinth and the perilymph when it separates the bony and membranous labyrinths.

Physiology of Human Ear: The physiology of hearing, just like its anatomy, is very complex indeed and is best understood by looking at the role played by each part of our hearing system described above. The function of each auditory peripheral can be studied through physiology, while its structures and parts can be studied through anatomy. The anatomy of human ears based on their location and form of signal inside it (acoustic, vibration, or electric) can be divided into three parts: the outer ear, middle ear and inner ear.

Sound waves, which are really vibrations in the air around us, are collected by the pinna on each side of our head and are funneled into the ear canals. These sound waves make the eardrum vibrate. The eardrum is so sensitive to sound vibrations in the ear canal that it can detect even the faintest sound as well as replicating even the most complex of sound vibration patterns.

The eardrum vibrations caused by sound waves move the chain of tiny bones (the ossicles – malleus, incus and stapes) in the middle ear transferring the sound vibrations into the cochlea of the inner ear.

This happens because the last of the three bones in this chain, the stapes, sits in a membrane-covered window in the bony wall which separates the middle ear from the cochlea of the inner ear. As the stapes vibrates, it makes the fluids in the cochlea move in a wave-like manner, stimulating the microscopically small ‘hair cells’.

Remarkably, the ‘hair cells’ in the cochlea are tuned to respond to different sounds based on their pitch or frequency of sounds. High-pitched sounds will stimulate ‘hair cells’ in the lower part of the cochlea and low-pitched sounds in the upper part of the cochlea. When each ‘hair cell’ detects the pitch or frequency of sound to which it’s tuned to respond, it generates nerve impulses which travel instantaneously along the auditory nerve.

These nerve impulses follow a complicated pathway in the brainstem before arriving at the hearing centres of the brain, the auditory cortex. This is where the streams of nerve impulses are converted into meaningful sound.

All of this happens within a tiny fraction of a second...almost instantaneously after sound waves first enter our ear canals. It is very true to say that, ultimately, we hear with our brain.

The level of normal conversational speech is approximately 65dB SPL. Thus, for a person with hearing impairment of 60dB HL or more, verbal communication would be difficult. This level of hearing impairment has been equated as 40% hearing impairment as in **Persons with Disability (Full Participation, Equal Opportunity and Protection of Rights) Act, 1995**. The definition of hearing disabled as stipulated in the **PWD Act, 1995** is a person who has a minimum of 60dB HL of hearing impairment in the better ear in speech conversation frequencies.

Types of Hearing Impairment

There are four types of hearing impairment:-

- Conductive hearing impairment,
- Sensorineural hearing impairment,
- Mixed hearing impairment and
- Central hearing impairment,

If any part of the hearing system is unable to function the result is hearing loss.

1.1. Conductive Hearing Impairment

It means that something in the outer or middle ear is stopping the sound from reaching the inner ear and the hearing nerve. Conductive hearing loss is often corrigible or capricious. Possible causes of conductive hearing loss include ear infections, a hole in the ear drum, wax accumulation in the ear canal, and abnormalities of the outer and/or middle ear.

1.2. Sensorineural Hearing Impairment

It means there is damage to the inner ear or hearing nerve. Sensorineural hearing loss is usually permanent. Those with sensorineural hearing loss often benefit from hearing aids or other types of amplification. Possible causes of sensorineural hearing loss include certain medications or medical treatments, noise exposure, and trauma.

1.3. Mixed Hearing Impairment

Mixed hearing loss means that the loss of hearing is due to a combination of conductive and sensorineural factors. A mixed hearing loss can be thought of as a sensorineural hearing loss with a conductive component overlaying all or part of the audiometric range tested. So, in addition to some irreversible hearing loss caused by an inner ear or auditory nerve disorder, there is also a dysfunction of the middle ear mechanism that makes the hearing worse than the sensorineural loss alone.

1.4. Central Hearing Impairment

Central hearing loss is caused by a problem with the auditory nerve or sound centers. Sounds waves may travel through the ear but this nerve pathway is unable to send electrical impulses to the brain. As a result the hearing centers do not receive the signals correctly. Central hearing loss can be a result of a head injury or disease. A common symptom is the ability to detect sound but not being able to understand it.

II. DEGREE OF HEARING LOSS

Degrees of hearing loss refer to the severity of the loss and are generally described as mild, moderate, severe, or profound. Hearing loss that borders between two categories is typically labeled as a combination of the two categories (for example, thresholds at 60 dB HL might be called moderate-to-severe). An audiologist can determine the severity of your hearing loss by conducting one of the [five types of hearing tests](#).

| Degree of hearing loss | Hearing loss range (dB HL) |
|------------------------|----------------------------|
| Normal | -10 to 15 |
| Slight | 16 to 25 |
| Mild | 26 to 40 |
| Moderate | 41 to 55 |
| Moderately severe | 56 to 70 |
| Severe | 70 to 90 |
| Profound | 91 and above |

Source: Clark, J. G. (1981). *Uses and abuses of hearing loss classification*. Asha, 23, 493–500.

2.1 Mild hearing loss (26-40 dB)

This loss is defined by being unable to hear sounds that are quieter than about 25 decibels (dB) for adults and 15 dB for children. This includes sounds like whispered conversations, dripping water, leaves rustling, feet shuffling on floors/carpets, and birds chirping. You may struggle with hearing both low-pitched and high-pitched sounds (known as frequency) in that sound range, though most people stop hearing [high-frequency pitches](#) first.

[Degrees of hearing loss](#) include normal, mild, moderate, moderately severe, severe and profound. These ranges are identified on an [audiogram](#), one of the [tests](#) you'll undergo as part of a hearing evaluation. An adult's normal hearing range is between 0-25 dB across the frequency range. Normal hearing for children is between 0-15 dB.

2.2 Moderate hearing loss (41-55 dB)

Listening is a strain for children with moderate hearing loss. While they can understand what a person says if the person is close, it can be difficult for them to hear someone else in a noisy environment. Children with moderate hearing loss may miss 50 – 75% of speech in a conversation, and often need to have part of the conversation repeated. Children with moderate hearing loss usually can benefit from hearing aids and other hearing assistive technologies.

2.3 Moderately- severe hearing loss (56 – 70 dB)

At the moderate to severe level, only face-to-face communication will be effective and you'll probably rely on reading visual cues such as body language and lip movements. If you are communicating with a group of people, speech will likely become hard to isolate. After some time, straining to hear those around you can lead to mental fatigue, which has been linked to an increased risk for dementia and other cognitive disorders.

2.4 Severe hearing loss (71-90 dB)

Severe hearing loss makes average conversations nearly impossible to hear, and in some cases loud clarifications or repeated statements will still be confusing. Being fitted with a [premium Rexton product](#) may help prevent the present hearing loss from worsening, but more serious treatment such as communication therapy may be required.

2.5 Profound hearing loss (over 90 dB)

With a threshold of at least 91 decibels, those with profound hearing loss are almost entirely incapable of hearing on their own. Only extremely loud sounds such as jet engines, chainsaws, and screams may be heard at this level. Unfortunately, a profound hearing loss is often only treatable through an invasive surgery such as a cochlear implant.

Management of hearing loss: If the child's hearing loss is not controlled even by early identification and prevention, intervention, etc., then the following types of management can be done keeping in view their need and future.

1. **Aarranging accessories/ Hearing aids:** On the basis of the hearing acuity of the child, he is given a hearing aid which is of the following type, which has better benefits by using it regularly for maximum period of time.
 - a. **Pocket type hearing aid,**
 - b. **Behind the ear hearing aid,**
 - c. **In-the ear hearing aid,**
 - d. **In-the canal hearing aid,**
 - e. **Spectacled hearing aid,**
2. **Special Education:** Special education for hearing-impaired children should be given by a special teacher trained in the hearing-impaired. A special curriculum is designed for children, depending on their level. First of all, special teachers used to use common signs and signs while teaching, due to which the development of children's language was inhibited. Therefore, the signage or manual method is being removed. Children should be exposed to a large number of attractive books so that they can sit and observe them in a designated place for reading in their spare time. Sometimes it may be possible to just look at the color pictures or read them yourself without any help from the teacher. The teacher should make available a variety of readable books for the children. Where necessary, the teacher should supervise and help the children and understand the new words and concepts encountered while reading. The learning experience thus

provided will prepare the child to read at the primary level.

3. Speech therapy and auditory training: Speech therapy is necessary for hearing impaired child which is provided by trained post-doctor. This speech therapy can be given individually or in a group. The speech therapist should pay attention that he does not have the arrival of sounds in the medical room. Hearing training is given to such children. Having the following points:

- a. Ability to accept sound input.
- b. Ability to recognize the direction of sound.
- c. Ability to detect subtle similarities and contrasts between words, using only the auditory system.
- d. The ability to sense the order in which the sound is coming.
- e. The ability to describe a stated concept verbally and respond accordingly.
- f. Memorizing auditory stimuli sequentially and presenting them back through recall.

4. Differentiation of Sounds: Hearing impaired children should be exposed to different types of sounds in different environments and differentiate between them so that children can identify different sounds according to the need. And the danger can be avoided by this love, while training sentences to make more pictures, they are asked to remain silent suddenly, later the children are made aware that we have heard the dog's voice etc.

5. Use of teaching materials: While teaching hearing impaired children, it should be given special attention that any lesson plan should be taught using as many pictures, models and real objects as possible so that children can learn well naturally.

6. Vocational Training & Employment: Vocational training is given to hearing impaired children like normal children. After getting vocational training, the person is registered in the special employment office. The Government of India provides employment to them by giving 1% reservation in employment. Apart from this, special facility is available in software in the field of computer for the employment of hearing impaired children. This software is taught by sound synthesizer equipment.

The ear is known as the sense of hearing. Being a sensory organ, the ear conveys the sound of the environment, with the help of which there is an ability to adjust to the environment. Along with environmental adjustment, it plays an important role in social adjustment. When the child is deaf

from birth or from the time of birth if he goes, he does not have the feeling of the coriander of the external environment, due to which he is unable to express any kind of reaction. Due to which there is a big problem due to the impact on the production process at that time, due to which the child becomes infected. There is a hole in the eardrum. Due to which pus starts coming, this is also a reason for the problem of deafness. Apart from this, there are also some hereditary reasons, which gradually decreases the hearing ability of a person around the age of 25. The main reason for which is the joining of the Malleus and Incus bones. Which is the cause of deafness. Therefore, early identification is very important for the diagnosis of all the above mentioned problems. By which the problem can be solved in time by the intervention method.

If a child becomes hearing impaired, then it is necessary to take necessary steps towards social adjustment along with necessary screening, teaching, training, employment-oriented training. Therefore, for all these services, a proper role should be played by the parents / guardians, social workers and subject experts so that the hearing impaired person can be rehabilitated in the right direction.

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