AUDIOVISUALS ON NORMAL AND ABNORMAL CONDITIONS OF THE EAR

Reg.No.M9007

AN INDEPENDENT PROJECT IN PART FULFILMENT FOR THE FIRST YEAR M.SC.(SPEECH AND HEARING), UNIVERSITY OF MYSORE, MYSORE-6.

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1991

Baba and Ma for all their love and understanding
throughout the years.
Dadu, for his pride and faith in me.
Two little bundles of mischief who
showed roe the tiny delights of life

CERTIFICATE

This is to certify that the Independent Project entitled: **Audiovisuals on Normal and abnormal Conditions of the Ear** is the bonafide work in part fulfilment for M.Sc, in Speech and Hearing, of the student with Reg.No.M90G7.

Mysore

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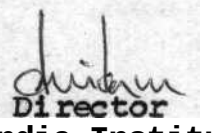

All India Institute of Speech and Hearing
Mysore-6

C E R T I F I C A T E

This is to certify that the Independent Project entitled: **AUDIOVISUALS ON NORMALS AND ABNORMAL CONDITIONS OF THE EAR** has been prepared under my supervision and guidance.

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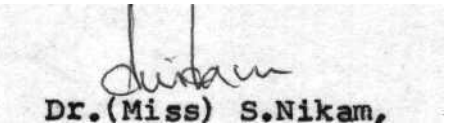

GUIDE

DECLARATION

this Independent Project entitled: **Audiovisuals on Normals and Abnormals conditions of the Ear** is the result of my own study undertaken under the guidance of Dr.(Miss) S.Nikam, Prof, and Head of the Department of Audiology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any University for any other Diploma or Degree.

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To all my teachers who have unravelled the mysteries in the wonderful sphere of speech and hearing I express my gratitude.

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INTRODUCTION

Not able to hear is a condition Which roost of us hearing individuals can never fully understand or appreciate. As Helen Keller said "The problems of deafness are deeper and more complex, if not more important, than those of blindness. Deafness is a much worse misfortune. For it means the loss of the most vital stimulus-the sound of the voice that brings language sets thoughts astir, and keeps us in the intellectual company of man".

For such children,intellectual development, speech development, memory, learning and several others processes are abruptly ceased, mainly because are of the main channels of sensory input-hearing-is lost. A normal child hears the words spoken by others, uses words to communicate and then goes on to recognize their representations on the printed page. A hearing impaired child, however, remains an outcast in the world of words. Every step he takes is only with the combined help of a team of professionals who aim at rehabilitating or habilitating him in the world of hearing.

It is a fact that the degree of rehabilitation is directly proportional to the age at which hearing loss is detected. To talk professionally, it would imply "early

identifications The earlier a child is identified, the less handicapped he is. Rehabilitation of the hearing impaired was attempted as long ago as the mid 18th century. Despite all efforts however, rehabilitation has proved to be futile with the exception of a few individuals. One of the reasons attributed to this failure in rehabilitation is due to difficulty in detection of hearing loss at an earlier age. Much of our hearing impaired population in India is concentrated in the rural areas. Lack of trained professionals and advanced technology in those areas make it impossible to detect hearing loss early in the rural areas. The Government of India is carrying out several programs to bring an awareness to the people in the rural areas and is also training recruits from these areas to detect hearing loss and then recommend for further interve-ntion. As a part of their training, these individuals are taught about the normal appearance and function of the ear and results of deviations from these structures and functions.

As a speech and hearing professional one realises the usefulness of providing optimum information through the sensory channels available. Audiovisuals have been used successfully to facilitate retention of information. An attempt has been make in this project to use slides and cassettes to deal with early identifiable features of a child

with hearing loss. This set of audiovisuals can be used to train recruits in the detection of hearing loss. It could also be used in several programs aimed at creating awareness among the people about the importance of hearing and the need to preserve and protect this invaluable sense organ. Lastly, this set could be used as self-study for beginners in the field of speech and hearing.

COMMENTARY

Ask a child about the ear, and he will immediately point to the side of the head. To him, and indeed to most other people, the ear serves only an ornamental purpose. Our ear infact consists of 3 parts - the outer ear, the middle ear, and the inner ear. It is the outer ear which is visible and thus recognised by most people. We will now journey down the most fascinating sense organ of the human body - the ear.

Slide-I: Parts of the ear

The outer ear comprises of a flap like structure called the pinna and a long, curving tunnel, called the external auditory meatus. At the end of this tunnel is the tympanic membrane - commonly referred to as the ear drum. The ear drum separates the outer ear from the middle ear. The middle ear is shaped like a match-box and contains 3 of the smallest bones of our body and 2 important muscles. These structures act like a bridge for sound to travel from the outer to inner ear. The inner ear is coiled like a snail shell and is the seat of the "hearing organ" - the cochlea. From the cochlea emerges a nerve - the auditory nerve and this is the final connecting link between our cochlea and the super-organ of our body-the brain.

That was a brief overview of the structures of the ear. Let us now look at these structures in detail.

slide-2; Parts of pinna

The pinna is the only fully visible structure of our ear. It is roughly oval in shape and has several irregular surfaces which helps in its function as a sound collector. You will be surprised to know that the pinna is the largest part of our auditory system. In some animals like dogs, the

pinna has a specialized function - it turns towards sound to identify the source of sound. The softest part of the pinna is the lobule or ear lobe which serve an ornamental purpose. The outer margin of the pinna is the helix. Another ridge runs parallel to the helix and thus called the antihelix. The concha is the largest depression in the pinna and this opens into the ear canal. A small flap like structure which closes over the ear is called the tragus. Its counterpart, the antitragus is present inferiorly before the termination of the antihelix.

Slide-3: External auditory meatus (cross section)

The external auditory meatus or ear canal opens out into the concha and is oval in shape at the entrance. This canal is 'S' shaped and helps in directing the sound from the pinna towards the eardrum. The canal actually comprises of 2 parts -2/3 of the canal is made up of cartilage while the inner l/3rd is bony. The junction of the bony and cartilagenous part is called the isthmus and this is the narrowest portion of the ear canal. The ear canal contains several hair cells and cells secreting wax. These together help to trap foreign bodies, thus protecting our ear. The meandering course of the canal ends when the ear drum or tympanic membrane is reached at the end of the bony portion of the ear canal.

Slide-4: Tympanic membrane

It is commonly referred to as the ear drum because it has the appearance of the drum sheet. The tympanic membrane is made up of 3 layers - the outer layer which is continuous with the skin of the external auditory meatus, the middle layer consisting of muscle fibres and the inner layer which is continued into the middle ear. The tympanic membrane can be further divided into 2 different parts - the upper loose part called the pars flaccida and a lower stiff part called the pars tensa. A short process of one of the ear ossicles - the maleus is seen prominently in the pars flaccida. From this prominence, two folds called the anterior and posterior malleolar folds arise and these form the limits of the pars flaccida. The drum is slightly concave because it is also attached to the handle of the malleus. This point of concavity is called the umbo. On examining the ear drum, one can also see a triangular shaped cone of light passing downwards from the umbo.

It is interesting to note that the drum has the ability to repair a tear by itself. It is also extremely sensitive to very small sounds that strike it and thus acts as the first link in the bridge which transmits sound to the inner ear.

Slide-5: Middle ear cavity and its boundaries

The eardrum bounds the middle ear cavity on one side. The middle ear is an air-filled cavity and has 6 sides. These 6 sides or walls are the lateral, medial, anterior. posterior, roof and floor. The middle ear also contains 3 important ossicles and 2 muscles. The tympanic membrane described earlier, forms the lateral wall of the cavity and is the only wall which is not bony. The medial walls consists of 2 opening - the oval window and round window. The oval window opens into the cochlear fluids and is covered by the footplate of another ossicle - the stapes. The medial wall also has a prominence called the promontary, on the anterior wall is an opening which leads out into the eustachian tube. This tube opens into the nasal cavity thus helping to ventilate the middle ear and maintain atmospheric pressure in the middle ear. An important muscle the tensor tympani also has its origin in this wall. The posterior wall has an opening leading to the mastoid air cells - these are air filled cavities present in the mastoid bone. It also contains a projection through which the second muscle called the stapedius enters the middle ear. The floor of the cavity is made up of a thin plate of bones covering a part of an artery-the jugular artery. The roof separates the middle ear from other cranial structures.

Slide-6: Middle ear ossicles and muscles

The 3 smallest bones of oar body, called the middle ear ossicles are suspended in this air filled cavity. These bones are the malleus, the incus and the stapes. They are named after objects they resemble - the hammer, the anvil and the stirrup respectively. The malleus has a handle, a head, a lateral process and an anterior process. The head or the malleus articulates with the body of the incus. The incus has a body, a long process and a short process. The long process of the incus articulates with the smallest bone of our body - the stapes. The stapes has a neck, two arms and a footplate. The footplate, as you know, covers the oval window. The action of these tiny ossicles are modified by 2 muscles - tensor tympani which is connected to the handle of the malleus and the stapedius which is attached to the neck of the stapes. Several ligaments are also present which hold these ossicles in position in the middle ear cleft. Thus, a bridge is formed by the ossicles* for the sound to travel from the outer ear to inner ear.

Slide-7: Our inner ear - Gross anatomy

The footplate of the stapes opens into the inner ear structures. The inner ear is also called the labyrinth

and is divided into the bony labyrinth and the membranous labyrinth. The membranous labyrinth is completely contained within the bony labyrinth. One of the structures ofthe bony labyrinth is the vestibule. This is a small, avoid chamber immediately behind the oval window. Posterior to this vestibule is the organ of balance - the vestibular system. This system consists primarily of 3 semicircular canals and the utricle and saccule. Anteriorly to the vestibule, is the cochlea which is the organ of baring. The cochlea is about 35 mm in length and coiled upon itself in 2 5/Bth of a turn around a central pillar of bone called the modiolus. The modiolus carries the nerve responsible for the sensation of hearing - the auditory nerve. This organ of hearing can be divided into 3 parts - the scala vestibuli, the scale media and the scala tympani. The scala vestibuli and scala tympani are parts of the bony labyrinth where as scala media is a part of the membranous labyrinth. The scala media is filled with a fluid called endolymph whereas the other two parts are filled with a fluid called perilymph.

The cochlea, despite its miniature size, has perhaps the most important role to play in the perception of sound. What you saw in the last slide was a gross anatomy of the cochlea. We will now study a cut section of the cochlea and acquaint ourselves with a structures within the cochlea.

Slide-8: Section of cochlear structures

This slide shows a cut section of the cochlea. Here you ean see the 3 divisions of the cochlea which are separated by several membranes. The scala vestibuli and scala media is separated by the Reissner's membrane. The basilar membrane separated the scala media from the scala tympani. The scala vestibuli and scala tympani communicate at the apex through an opening called the helicotrema. Some of the other boundaries of the scala media are also important. The spiral lamina is a shelf of bone on the inner margin of the scala media through which nerve fibres pass out. On the outer margin of the cochlear duct is a vascular structures called the stria vasoularis. It is this structure which secretes the endolymph. The spiral ligament is also present in the outer wall of the cochlea and it is from here that the basilar membrane extends. On the basilar membrane rests the sensory cells, essential to hearing. Two groups of cells are present - inner hair cells and outer hair cells, which are cupped in supporting cells. The inner and outer hair cells are separated by a tunnel of cortl which is bounded by the inner and outer rods of corti. The hair cells are embedded in a membrane called reticular lamina and is further overlaid by another membrane called the tectorial membrane.

Slide-9: Hair cells microanatomy

The inner and outer hair cells vary both in structure and function. This slide shows the rows of inner and outer hair cell as seen through on electron microscope. The inner hair cells are around 3000-3500 in number and these are arranged in a single row. The outer hair cells are arranged in 3-4 rows and number 9000-12000. Both the inner and outer hair cells run parallel to each other from the base to the apex. These are several hairs or cilia which project from each hair cell. The cilia of the outer hair cells are arranged in a 'W' shaped pattern while those on the inner hair cells are arranged in a 'V' shaped pattern. The rods of corti can also be seen between the rows of inner and outer hair cells.

From the hair cells, nerve fibres which emerge through a small tunnel called the internal auditory meatus. The fibres that move up the brain in a sort of a relay and this entire course of fibres is referred to as the auditory pathway.

Slide-10: Working of the ear

The hearing process begins when sound is collected by pinna and the waves enter the canal of the outer ear. The

canal conveys them to the tightly stretched drum which then vibrates. These vibrations of the drum are conveyed to the inner ear by the vibrations of the ossicles. Thus sound energy is converted to mechanical energy. The force exerted by the ossicles is then passed into the inner ear which is filled with fluids. The waves created in these fluids will stimulate the sensitive organ of corti which is the most important element in the entire hearing mechanism. The activities of the organ of corti is picked up by thousands of nerve fibres and sent to the brain. Thus it is in the brain that the journey of sound ends an instant after it begins and this brings about a sensation of hearing.

It is important to remember that any abnormality in the structure and function of the ear could result in a hearing loss. The question which then arises is "what causes these abnormalities?". The ear is a complex organ and can be affected in many different ways. All these causes can be grouped into 3 main categories.

- pre natal causes
- perinatal causes
- post natal causes

Slide-11: Prenatal causes of hearing logs

Prenatal causes of hearing loss occurs due to a variety of influences on *the* growing baby in the mother's womb.

Some of the prenatal causes are;

1. Blood group complications - Rh incompatibility
2. Marriage among relatives consanguinity
3. Exposure to x-ray during first trimester of pregnancy.
4. Maternal infections
   a) Rashes with fever
   b) Tuberculosis
   c) Malaria
   d) Urinary tract infection
   e) Diabetes
   f) Syphilis
5. Drugs taken during pregnancy
6. History of childhood deafness in close relation of child

Slide-12: Perinatal causes of hearing loss

In the perinatal group are a variety of causes due to accidents/difficulties immediately before birth, during birth and immediately after birth.

These causes include:

1. Prolonged or difficult labour
2. Instrumental delivery
3. Premature birth-period of gestation 32-34 weeks or less
4. Asphyxia at birth-blue baby
5. Delayed birth cry
6. Low birth weight (less than 2500 gm)
7. Neonatal jaundice
8. Convulsions immediately after birth.

Slide-13: Post natal causes of hearing loss

Postnatal causes include those causes which give rise to hearing loss in early childhood or even later. These causes may be -

- Infections like meningitis and encephalitis
- Mumps and measles in childhood
- Upper respiratory tract infections
- Otitis media or infection of the middle ear
- Use of drugs which have toxic effects on the ear
- Mead injuries with fracture of the skull
- Exposure to loud noise

Slide-14: Symptoms of ear disease

Some of the common symptoms of ear disease are easy to detect. If any of these symptoms are reported by any person be sure to recommend him to the nearest ENT doctor. Some of the trouble signs are:

- Ear pain
- Ear discharge
- Tinnitus - ringing sound in the ear
- Giddiness or vertigo
- Headache
- Weakness of the face

You will now ask "What do we do if there is a hearing loss"? or more importantly, you might want to know. "Is hearing loss curable?". There are two main types of hearing loss conductive hearing loss and sensori-neural hearing loss.

Conductive hearing loss leads to a loss of loudness. This type of loss occurs due to affectation of outer ear or middle ear and can usually helped by medical or surgical means. Sensorineural hearing loss occurs due to damage to the inner ear and cannot be caused by medicines or surgery. People with sensorineural hearing loss have to immediately consult an audiologist for further guidance.

Let us now, see a few slides on the abnormal conditions of the ear with that brief introduction on the normal aspects of the ear.

Slide-15: Anotia

This is a condition of the pinna in which there is a total absence of the pinna. If the pinna is grossly deformed then it is termed as microtia. This condition does not occur by itself but is often associated with total closure of external auditory meatus and also abnormalities of the bones of the middle ear. This condition is caused by faulty development during pregnancy.

Slide-16: Perichondritis

In this slide, you can see an extremely red and swollen pinna. This condition of the pinna is called perichondritis. It is commonly seen in boxers because they receive repeated blows to their ears. If untreated, this could lead to another condition called "cauliflower pinna". Here, the pinna changes its shape and has an ugly, shrivelled appearance.

Slide-17: Wax

Wax or cerumen is the normal secretion of the cells situated in the external auditory meatus. Usually wax can be easily removed using a cotton cloth. Sometimes wax may

harden and the canal may be blocked causing a hearing loss. Wax should never be removed using a hair pin or other home remedies. Remember to always consult a doctor for removal of wax.

Slide-18: Foreign body

Children commonly put beads, pips and other objects into the ear. In this picture, you can see a foreign body in the childs ear. Foreign bodies can be easily removed by a doctor, however, the danger of foreign bodies lies in its careless removal. Sometimes, an insect may enter the ear and in such a case also, one should consult a doctor immediately. A foreign body may be big enough to obstruct the external auditory meatus and cause a hearing loss. If there is a damage to the delicate skin of the external auditory canal while careless removal, bleeding can also occur from the ear.

Slide-19: External otitis

This slide shows the external auditory canal almost closed by swelling of the skin. This swelling is caused due to infection by bacteria or fungus. The most common complaint is pain in the ear, itching and hearing loss. Swimmers are extremely prone to this condition because the water may carry these infections into the ear.

Slide-20: Furunculosis

Sometimes boils may occur in the ear called furunculosis and these may be very painful. These occur due to infection of the hair cells in external auditory meatus. Usually symptoms are pain and hearing loss. These boils are dangerous because if they are excised by unsterilized instruments, they can lead to further infections. Care should be taken to see that these boils are treated only by an otologist.

Slide-21: Perforation of tympanic membrane

This picture reveals a tympanic membrane which is torn. These perforations or tearing of the drum can be due to several reasons. It might be caused by clumsy attempts to remove wax or a foreign body. In such cases the ossicles may also get damaged and become discontinuities. Thus, there is a break in the conducting mechanism causing hearing loss. More common causes of perforated drum is a loud blast near the ear like crackers or gunshot. Small perforations may heal leaving a small scar but for larger perforations one may have to undergo surgery to close the perforation.

Slide-22: Otitis media

Ear discharge is probably the most common symptom which is seen in India, and it indicates a dysfunction of the ear. The middle ear may often get infected with various germs via the eustachian tube. So, a common cold could also lead to ear infection. In children, improper feeding causes milk and other liquids to go into the eustachian tube. Later, infection occurs, in which there is the presence of fluid in the middle ear. The drum may rupture when the middle ear is full of pus and causes a discharge. This process may continue over a long period of time and is called chronic suppurative otitis media - chronic referring to the long duration of the disease, suppuration refers to discharge and otitis media implying swelling of middle ear. This condition is easily treated initially. If ignored, it can lead to damage of inner ear also.

slide-23: Serous otitis media:

Serous otitis media is another condition which is commonly seen in children and it is a dangerous condition because it is a -silent disease". This means that there is no discharge occuring. It is often referred to as "glue ear" because, on

examination by doctor, one can see fluids level in the middle ear as shown in this slide. The drum may also appear either brown or blue. This condition occurs when the eustachian tube is blocked or closed thus reducing ventilation of middle ear. Treatment very early on is recommended.

Slide-24: Cholesteotoma

One of the most common sequelae to a discharging ear is the formation of a cholesteotoma. The term cholesteotoma simply refers to ' skin in the wrong place'. Sometimes, the growing skin of the ear canal may enter via a perforation into the middle ear and form a whitish mass as seen in this picture. Moisture and bacteria may affect this growth and lead to further discharge which is foul-smelling and greenish in colour. The appearance of a cholesteotoma is a dangerous sign since it frequently leads to inner ear damage and also other complications involving the brain.

Slide-25: Tympanosclerosis

Sometimes, following a perforation, the drum may heal but may also form white areas of chalky patches as shown here. These may not cause a noticeable loss of hearing but when these patches are severe or if it affects the ossicles the loss increases and immediate consultation with a doctor is advised.

Slide-26: Otosclerosis

In this picture, you see a stapes on the thumb of a person. This bone aay often get fixed on the oval window and this condition is called otosclerosis. Hearing loss is the most common symptom of this disease, though people can also hear ringing sounds in the ear. Hearing can easily be restored by an operation.

Often children are born with a hearing impairment. These defects are often caused by prenatal misfortunes. The organ to be affected may be only the hearing organ but sometimes multiple defects appear together affecting other organs like eyes, nose, mouth etc. These children can be then described in terms of a syndrome. The next eight slides shows children with different syndrome and who also have hearing loss co-exissting.

Slide-27: Syndromes -apert' s

Here is the picture of a child who has a set of abnormality collectively called Apert[1] s syndrome. This syndrome can be easily identified by the following feature.

- large protruding eyes
- saddle like nose
- fusion of fingers and toes of both hand and feet

- characteristic "tower-like" skull is seen.
-it is also associated with congenital stapedial footplate fixation.
- Hearing loss is usually conductive but at times, sensori-neural hearing loss may also be present,

Slide-28: Syndromes - Cleft lip and palate

This congenital malformation is very common. Incidence of conductive hearing loss is very high and is as great as 90%. This is because of poor eustachian tube function which results in inadequate middle ear ventilation, tympanic membrane retraction and hearing loss.

Slide-29: Syndromes - Downs

This syndrome again is very common. Mental retardation is the most universal feature. These children are usually very worm, friendly and affectionate. As you can see, they usually have flattened facial features, short hands and legs and a short little finger which curves inwards. They also have small pinnae, narrow external canal, sometimes the bones of the middle ear may also be affected. The hearing loss can be conductive or sensorineural .

Slide-30: Syndromes - Waardenburq' s

Major features of this syndrome include a white fore-lock, bicoloured eyes, and a prominent lower jaw. Severe sensorlneural hearing loss is usually seen. Sometimes, on examination, one finds absence of organ of corti.

Slide-31: Syndrome - Treachers collins

Here is a picture of a child with treacher collins syndrome. This syndrome is easily recognized because of the following features:

- Depressed cheek bones
- Deformed or absent pinna
- Small chin
- Large fish-like mouth
- Deafness is usually conductive hearing loss but may be sensori-neural

Slide-32: Syndrome -Klippel Fell

This syndrome shows children with a characteristic short neck and limited movement and it appears that the head sits on the shoulders. Club foot and cleft palate may also be seen. Severe sensorinairal hearing loss is common but conductive loss may be seen in a few cases.

Slide-33: Syndrome - Goldenhars

Another syndrome which is quite common is the Golden Hars syndrome. This syndrome is characterised by eye, ear, mouth and musculoskeletal abnormality. Eye defects include cleft of upper eyelid or defects of eye muscles. Ear abnormalities include abnormality of pinna or total closure of ear canal. Abnormality of mouth include unilateral facial defect especially of the mandible. Clubfoot and congenital heart disease are also very common. Conductive hearing loss is usually present.

Slide-34: Syndrome - Crouzon's

Here, the child has an abnormal shaped head characterized by a prominence in the front. They also have a beak shaped nose with extremely protruding eyes. Mental retardation is also fairly common. This child may have conductive hearing loss because of deformed bones of the middle ear. The ear canal may also be completely closed.

Slide-35: Menieres disease:

Another common disease of the inner ear is Heniere's disease. This disease is characterised by 3 prominent symptoms - hearing loss, tinnitus and vertigo. All these symptoms are

fluctuating in nature. Tinnitus can be the most troublesome symptoms and also the most difficult to treat. Immediate consultation with the ENT doctor is imperative.

Slide No.36: Asha ki kiran

We have now described the entity of hearing loss. Now, we must busy ourselves with the prevention of its devastating effects on children for prevention is always better than cure. In the event of a hearing loss look out for this symbol "ASHA KI KIRAN" which is a symbol of hope for the hearing impaired population. Help is available at all places where this symbol is displayed.

I do hope that this session of audiovisuals has been enlightening. For further information please contact us at

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