Physiology of Hearing

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Recommended Videos!

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Parts of Ear :

- External ear (Hearing
- Middle ear (Hearing)
- Internal ear (Hearing and balance)

External ear :

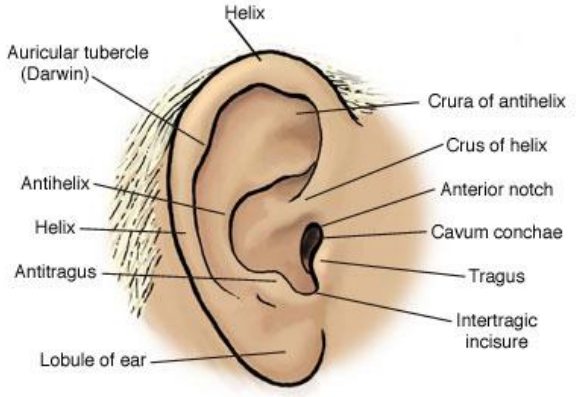
Contains Pinna, External canal and Tympanic Membrane (funnel shaped, pointing inward)

Functions :

Act as funnel to collect sound

Sound localisation (front, back, high, low)

Protection



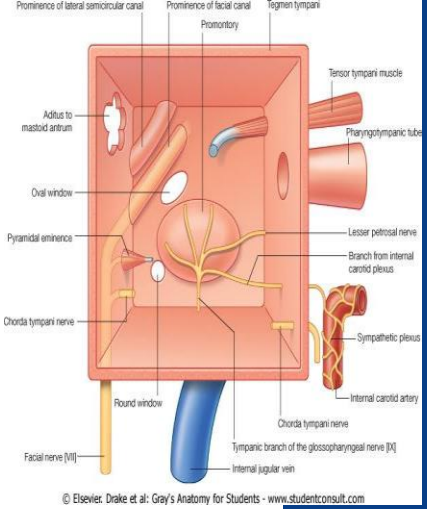
Middle ear

Middle ear: it is a space between tympanic membrane and the inner ear (opens via Eustachian tube into nasopharynx) contains:-

1- Air (so mille air is air filled cavity)

2- Ossicles(bones): Malleus, Incus and Stapes (with its foot sitting on the oval window of the inner ear)

3- Muscles : 1- Tensor tympani 2- Stepedius



Function

1- Ossicles:

1-Manbrium of the malleus attached to the back of the tympanic membrane and its short process attached to the incus.

2-The incus then articulates with the head of the stapes, and its foot plate attached to the oval window

2- Muscles: 1- Muscles contract reflexly in response to loud sound (over 70dB).

2- Contraction of the tensor tympani pulls the manubruim & makes the tympanic m. tens. Thus decreasing the vibration.

3- Contraction of the stapeduis pull the foot plate outward so that vibration are reduced.

4-protection from constant loud noise, but not sudden noise, latency of 40-80 msec.

Sound is produced from alternate compression and rarefaction of air molecules by vibrating body and its characteristics are :-

1- Pitch (Tone) depend on No. of cycle/sec. Human ear can detect sound waves with freq.. 20-20000 cycle /sec

- 2- Intensity (Loudness) depend on amplitude

- 3- Quality depend on the over tone or interference

transmission of sound through the middle ear

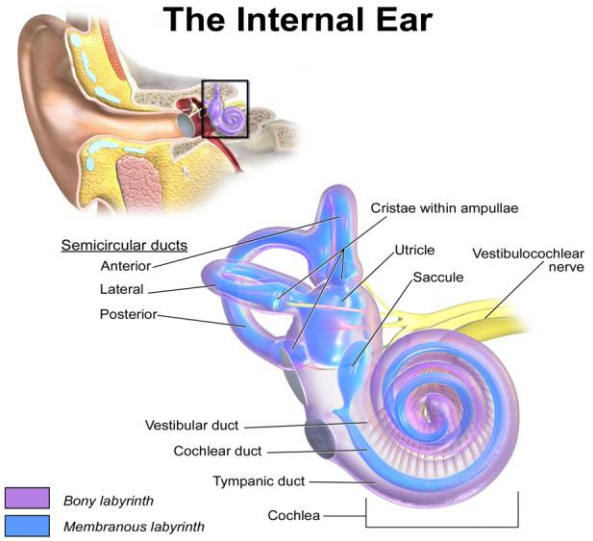
1-sound waves vibrate the tympanic m.
2-Tympanic m moves the handle of malleus
3-Incus moves
4- Stapes move in & out of the oval window. The pressure transmitted through cochlea cause stimulation of hair cells in the organ of corti, which will stimulate the auditory nerve

1- The force from a large surface area (Tympanic m.) are concentrated to a small (oval window) the ratio is 17=1.
2- Lever action of ossicles = the lever action of ossicles increase the force of movement 1.3 times
▲ the total increase 17 X 1.3 = 22 times

Middle ear magnifying effect

Inner ear

Membranous labyrinth
Bony labyrinth : vestibule, semicircular canals and cochlea



cochlea

1-It is a system of three coiled tubes through its length
2-The basilar m. & the reissners m divide it into three canals:

- Scala Vestibuli: Na high K low
- Scala Tympani: Na high K low
- Scala Media : Na low K high

organ of corti :-

1-Located (resting) on the basilar m.
2-Contain inner & outer hair cells
3-Extend from base to apex

Inner hair cells

1-Striocellia not embedded in tectorial m. but bent by fluid movement under the tectorial m.
2-They are primary receptors for sound, transducing fluid movement in cochlea into action potential in the auditory nerve

Outer hair cells

1-Large number, but stimulate only small fraction of nerve fibres in the cochlear nerve.
2-If damaged, significant loss of hearing (they control the sensitivity of inner hair cells to particular sound frequency).

Receptors & Endocochlear potentials

Sound transmission into the inner ear cause upper & lower movements of the reticular m. (tectorial m.) .That leads to produce bending of steriocillia of the hair cells alternatively open & close cation channels at the tip of the steriocillia.
»»»»»» (inward current) depolarization »»»»»» (outward current) hyperpolarisation »»»»»» the net results is depolarization.
Production of cells receptors potentials »»»»»» release of neurotransmitter»»»»»» production of action potentials

Central auditory pathway

1-This pathway begins in the organ of corti
2-End in the primary auditory cortex (are 41& 42) superior temporal gyrus in the temporal lobe of the brain)
3-Fibres end in the auditory area, where it is heard, then interpretation occurs in the auditory association areas (wernikes area)
4-There is a bilateral cortical connection of auditory area
5-Thus damage to one side only slightly reduces hearing

masking effect

Presence of background noise affect the ability to hear another sound, due to some receptors are in refractory period.
Masking is more clear if two sound are having the same frequencies
Noise pollution is an environmental hazard
Exposure to sound intensity above 80dB may damage outer hair cells

sound localization

- Differences in the time arrival of the sound wave at the ears (time-lag)
- Differences in the loudness

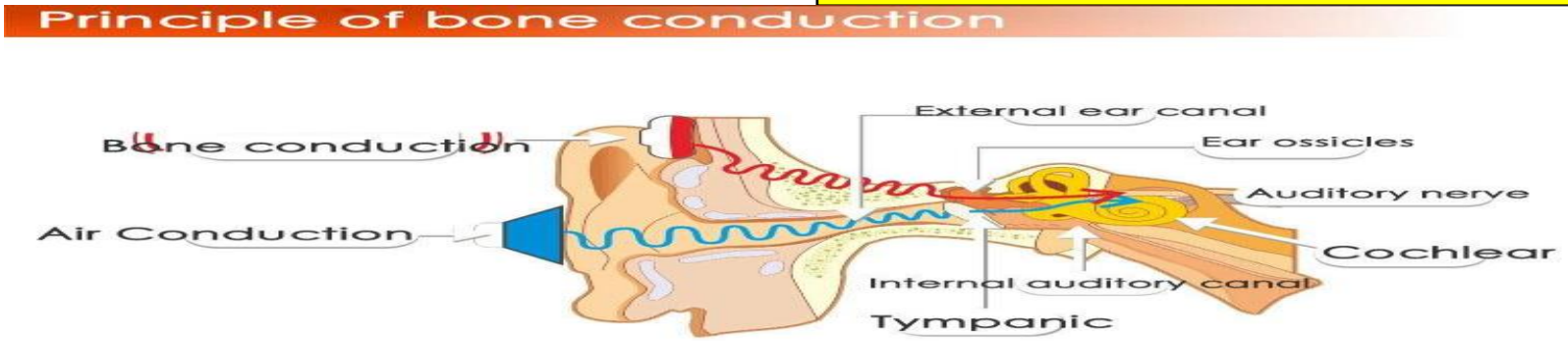
Conduction of sound wave

Air conduction

Normal situation of hearing, sound travel in air causes vibration of Tympanic m., transmitted by ossicles to the oval window

bone conduction

Sound cause vibration of skull bones directly transmitting the sound vibration to the cochlea (eg when placing tuning fork on the head or mastoid process)



Conductive deafness

Conductive deafness

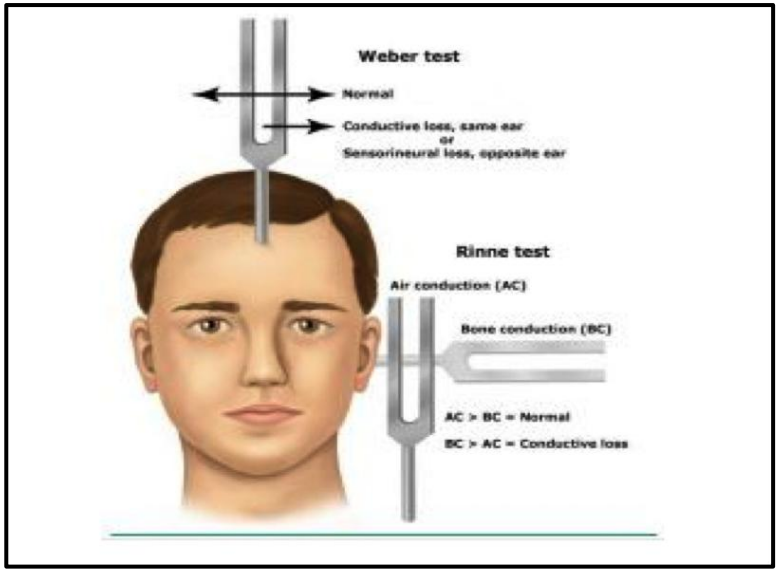
Impairment of sound transmission through external or middle ear due to:
Wax ,Repeated infection ,Perforated drum ,Destruction of ossicles and Osteosclerosis (pathological fixation of stapes on the oval window).
All sound frequencies are equally affected .
Bone conduction is better than air conduction.

Perceptive deafness

Due to congenital or damage to cochlea or auditory nerve pathway due to:
Toxins (antibiotics, gentamycine), Inflammation ,Vascular and Tumour.
Both air and bone conduction are affected

test of hearing

- Audiometer
- Weber test
- Rinnes test



- The base of the tuning fork placed on mastoid process until the sound is not heard
- Then the prongs of the fork held in air near the ear
- Normal subject continue to hear near ear (positive test)
- If not reveres the test (if heard near the mastoid process, negative test)

1- External ear contains :
A. Air
B. Pinna
C. Ossicles
D. vestibule

2-:- Muscles of the middle ear are contract in response to :
A. Medium sound
B. Loud sound
C. Low sound
D. A & B

3- cochlea is a system of :
A. One coiled tube
B. Two coiled tube
C. Three coiled tube
D. Four coiled tube

4-organ of corti is located in
A. Basilar M
B. Reticular M
C. Tympanic M
D. Ossicles

5- conduction of sound wave is transmitted by
A. Air conductive
B. Bone conductive
C. Muscle conductive
D. A & B

6- conductive deafness is Impairment of sound transmission in
A. Inner ear
B. External ear
C. Middle ear
D. B & C

1.B
2. C
3. C
4. A
5. D
6. D
7.
8.

MCQs

1- name two bones of Ossicles

Malleus, Incus and Stapes

2- When the Tympanic membrane vibrate it moves

malleus

3- name 2 causes of conductive deafness

Wax,
Repeated infection,
Perforated drum,
Destruction of ossicles
Osteosclerosis

4- name 2 tests used for hearing

Audiometer
Weber test
Rinnes test

THANK YOU FOR CHECKING OUR WORK!

BEST OF LUCK

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