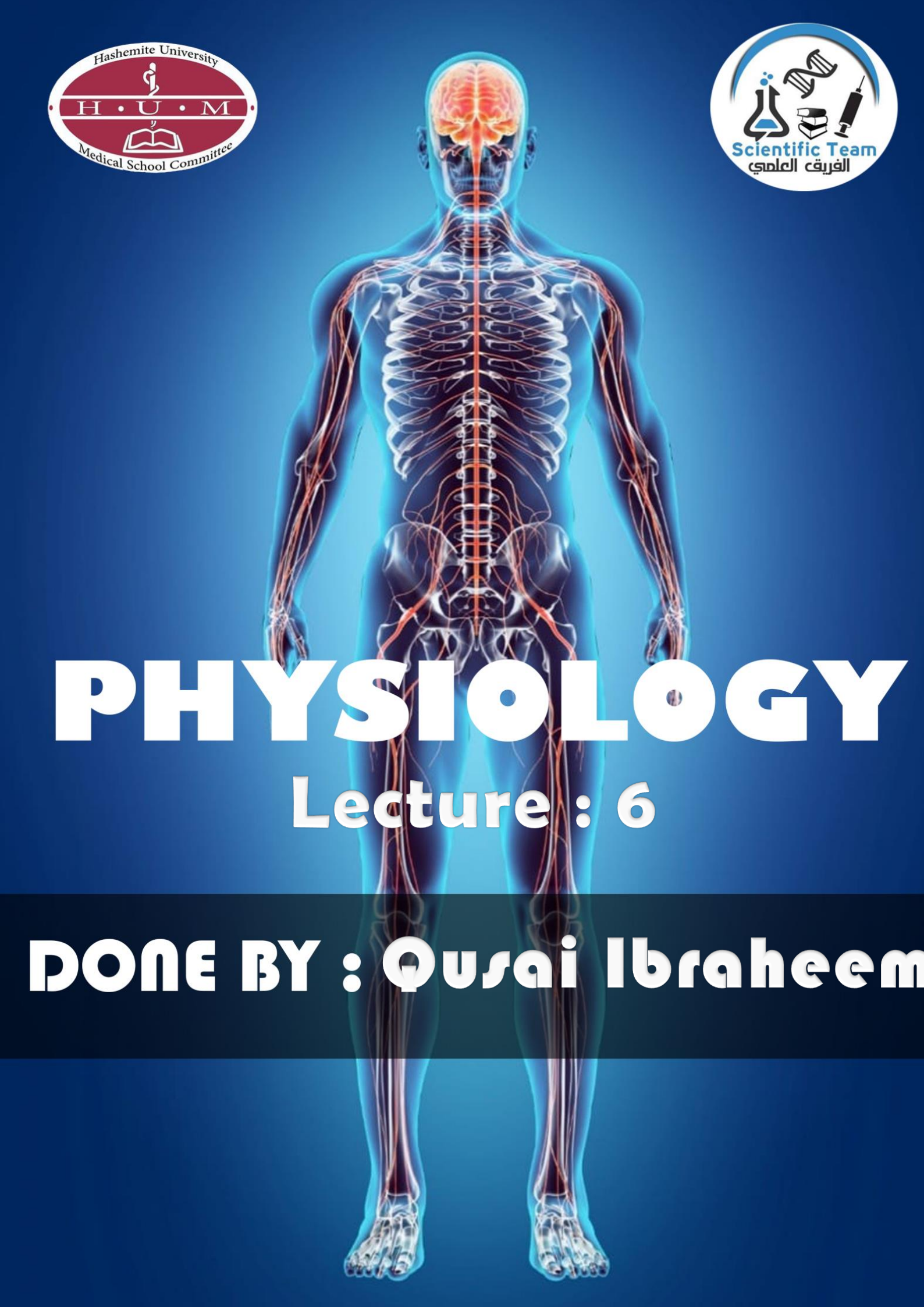


PHYSIOLOGY

Lecture : 6

DONE BY : Qusai Ibraheem

The sense of hearing

Audition

Sound is the wave of compression (increase in pressure) and decompression (decrease in pressure)

-No vacuum transmission

هسا معروف انو الصوت لا ينتقل بالفراغ لكن الضوء ينتقل بالفراغ(vacuum)

-highest speed-solid

هسا الصوت اسرع ما يكون في الsolid بعدين بالliquid بعدين بالgas على عكس الضوء اسرع اشي بالgas بعدسن بالliquid بعدين بالsolid

Loudness or intensity

-depend upon amplitude of sound waves

-units for expression sound amplitude/loudness/intensity are decibels(dB)

الintensity بتعبر عن شدة الصوت و هاض بغتمد على الamplitude of sound wave كل ما زادت بتزيد الintensity والعكس ....هسا احنا كيف بنحسب الintensity ؟ بنحسبها عن طريق انو بنحسب شدة الصوت (amplitude or pressure of sound) بالنسبة لreference يعني اشي ثابت

حسب المعادلة هاي:

dB=20 log p/p0

dp=decibels

p=sound pressure being measured

p0=reference pressure measured

for example :if the sound pressure is 10 time the refrence pressure, the intensity:

dp=20 log p/p0

dp=20 log 10p0/p0

dp=20 log 10

dp=20*1=20

if 0 dp ,it is not mean the sound not hearing but it is mean the pressure sound is equal to reference because log1=0

reference is the average threshold for hearing at 1000Hz

اقل pressure بنقدر نسمعه لما يكون الfrequency بتساوي 1000Hz

Sound frequency(pitch/tone) is measured in cycle/second or hertz(Hz)

هسا الfrequency هي ما بتعتمد على طول الموجة هي بتعتمد على الcycle per second وما بتعبر اذا الصوت عالي او واطي بتعتبر عن حدة الصوت اذا الصوت كان حاد(high pitch) او الصوت غليظ(low pitch)

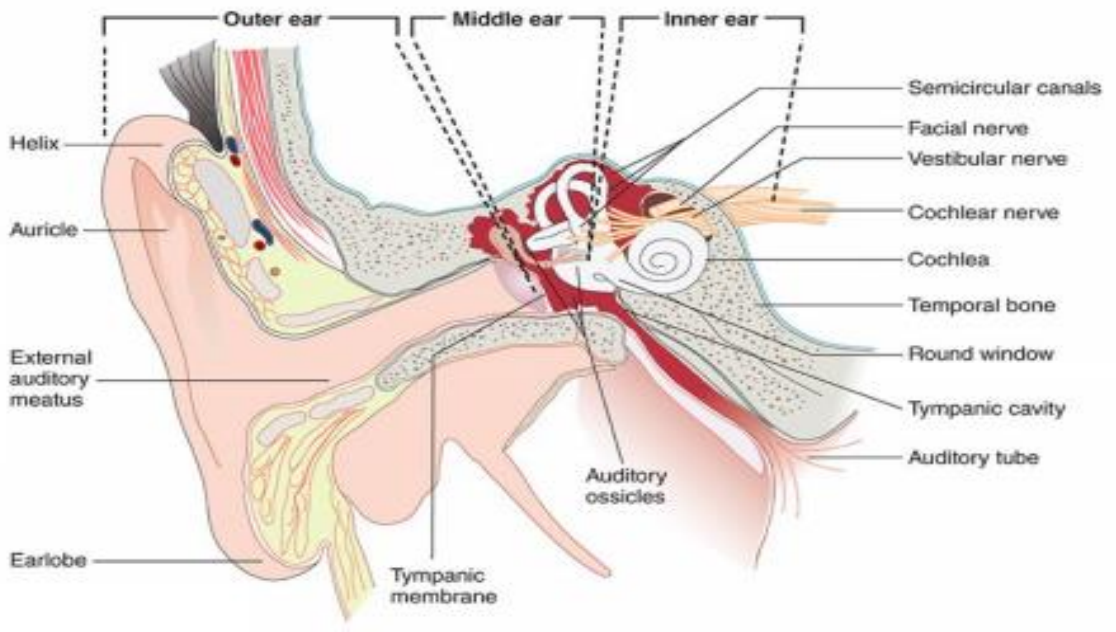
Human ear is sensitive frequencies between 20 and 20000Hz and is most sensitive between 2000 and 5000Hz

هسا الانسان ما بسمع كل الاصوات هو بتسطيع انو يسمع الاصوات الي ترددها بين ال20-20000 واكثر sensitive للاصوات بين 2000-5000

The usual range of frequency of human speech is between 300 and 3500Hz and the sound intensity is about 65dB

Sound intensity>100dB can damage the auidatory apparatus and >120 dB can cause pain

Structure of ear



1-external ear: auricle and external auditory meatus

-Auricle which capture and direct sound wave towards external acoustic meatus

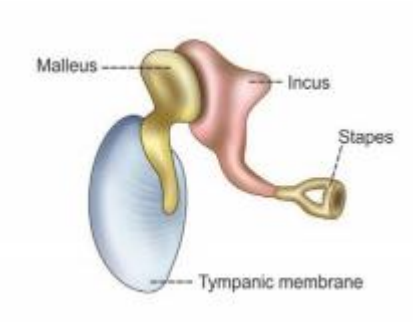
-external auditory meatus conduct sound wav to tympanic membrane

الauricle الي هو صيوان الاذن مسؤول انو يجمع الwave sound وينقلها لل external acoustic meatus الي بتمرر الsound wave لل tympanic membrane

-sebaceous gland and ceruminous gland: secrete brown pigment granules and fat droplets

Secretion of sebaceous & ceruminous gland and desquamated epithelial cell form earwax(شمع الاذن)

2-middle ear: tympanic membrane and ossicular system



Tympanic membrane

-transmit vibration in the air to the cochlea through ossicles

It is vibrate with sound and if the sound stop ,vibrate stop

-Kept tensed by tensor tympani muscle

-tympanic membrane connected to ossicles

Malleus

Incuse

Stapes

-ossicles are combined as single lever by ligaments articulation of incus with stapes pushes cochlear fluid forward and backward on tympanic membrane movement

Attachment to the tympanic membrane is the handle of the malleus and the malleus is bound to incus by minute ligament so when the malleus move ,the incus move

The end of incus attachment to stapes and the stapes lies against the cochlear in the opening of oval window

The tip end of the malleus is attachment to the center of tympanic membrane and this point of attachment is constantly pulled by tensor tympani muscle which keep tympanic membrane tensed

The articulation of the incus with stapes cause the stapes push forward on the cochlear fluid every time tympanic membrane move inward

And pull fluid backward every time malleus move outward

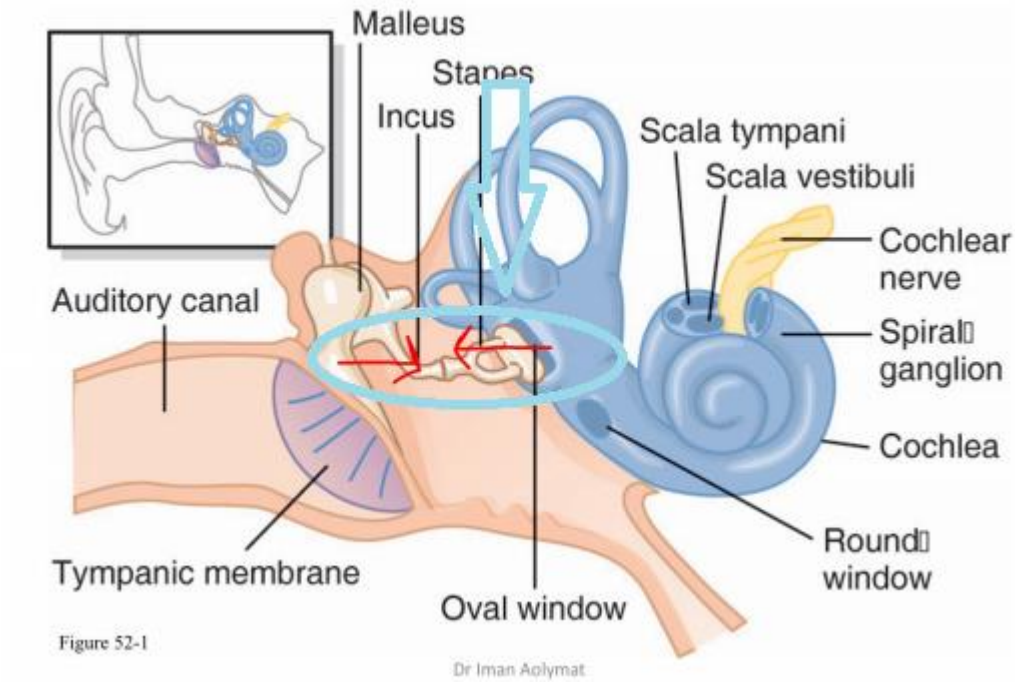
يعني هسا الossicles مرتبطين ك single lever متى اهتزت الطبلة لجو راح تهز الstapes لinward وتهز
الcochlear fluid ومتى ما رجعو الmalleus outward راح يصيير pull fluid backward

Attenuation sound by muscle contraction

When loud sound transmitted through the ossicular system and from there into the central nervous system then reflex occur after later period from 40-80ms to cause contraction of stapedius muscle and tensor tympani muscle

The tensor tympani (which innervated by mandibular nerve)pull the handling of the malleus inward while the stapedius(which innervated by mandibular nerve) muscle pull the stapes outward

These tow forces oppose each other and thereby cause the ossicle system to develop increase rigidity so reduce ossicular conduction so attenuation vibration going to cochlear



To:

1-To protect cochlear from damaging due to excessively loud sound

2-to mask(damps) low frequency sound ,,your own sound

Impedance matching

Impedance opposition to passage

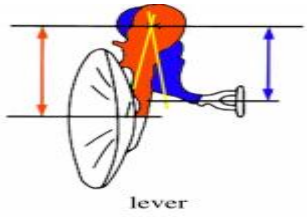
- perilymph in cochlear offers impedance to sound wave due its own inertia

Impedance matching is the process by which tympanic membrane and auditory ossicles are capable of converting energy into mechanical vibration in cochlear fluid with minimal loss of energy /intensity

How?

1-surface area of tympanic membrane (55sq mm)>footplate of stapes(23sq mm) so these lea to amolifies the signale because the area of tympanic membrane is 17 time longer than oval window

2-ossicles act as a lever system so these lead to amolifies the signal 1.5 time



اثناء مرور الsound wave من الexternal auidatory meatus للmiddle ear بحصل loss of energy ولحتى ما يضيع الصوت في اشي اسمو impedance matching in middle ear بزيد ال efficient of sound wave فحتى لو صار loss in energy بخافظ على الsound intensity وبضاعفها حتى بوصل بشكل سليم للcochlear

بطريقتين الولى انو الsurface of tympanic membrane اكبر بـ 17 time من الsurface of oval window هاض الفرق بعملampilfication of sound wave

والشغلة الثانية الossicule بشتغلو as lever هاي بتزود الintensity بالsound wave تقريبا 1.5

In the abnormal of middle ear in the ossicular system (like fluid in middle ear or osteosclrosis)and tympanic membrane, these lead to loss of energy so loss of sound intensity

-eustachian tube connect middle ear with nose to nasopharnex

-equalize pressure on both side of tympanic membrane

-usually close

-opens with jaw movement& ascend

-descend still close

- have cilia to drainage fluid to nasopharynx

-shorter, wider& more strait in children these lead to otitis media

هسا الeustacian tube بربط بين الmiddle ear والnosopharunx وظيفتو هي انو يعمل equalize pressure on both side of tympanic membrane هسا بالعادة هاي القناة بتكون مسكرة وما بتفتح الى اذا حركنا الفك مثلا اكلت علكة او تثاوبت بتفتح القناة وكمان بتفتح لو طلعنا لمكان مرتفع

هسا لو انزلنا لمكان منخفض بزيد الضغط الجوي على الtympanic membrane بس ها القناة بتضل مسكرة وعشان هيك بنحس بوجع او زي تشويش وممكن يصير rupture of tympanic membrane ولحتى نحل المشكلة لتحرك الفك بانو نوكل علكة او...

هسا هاي القناة بالاطفال بتكون صغيرة وعريضة more strait لذلك it is common in children when have infection in nasopharynx to develop otitis media وممكن ينتج عنها complication like perforation of tympanic membrane and other..

Inner ear: cochlea

Thre cochlea is asystem of colied tube .it consiste of tree colied tubeseperated by membrane:

1-scala tympani contain perilymph

2-scala media(its also called cochlear duct, membranous cochlear or otic cochlear) contain endolymph

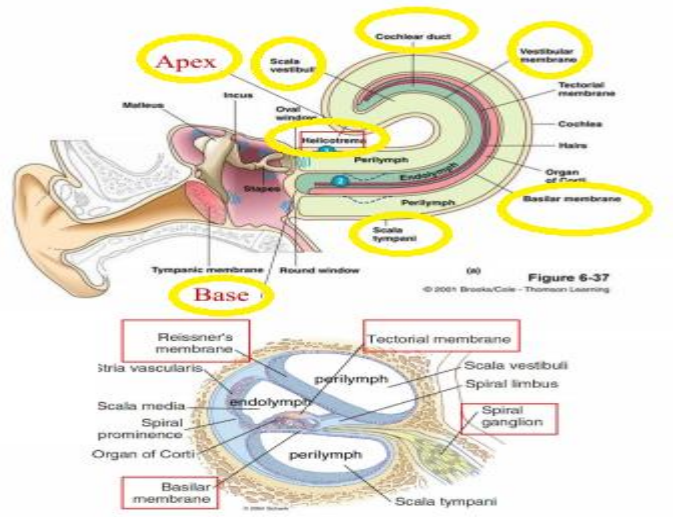
3-scala vestibule contain perilymph

The scala vestibule and scala media is separated from each other by Reissner's membrane(also called vestibular membrane)

And scala tympani and sacal media separated by each other by basilar membrane

On the surface of basilar membrane lies the organ of coti

The fluid of scala tympani and scala vestibule is open on each other by helicterma at the apex



Perilymph: it is high Na and low K as extracellular fluid

Endolymph: it is high K and low Na similar to CSF ,these generated by continual of K into scala media by stria vascularis

Basilar membrane

Contains about 20,000-30,000 basilar fiber

Characteristics of basilar fibers:

1-different size and shape

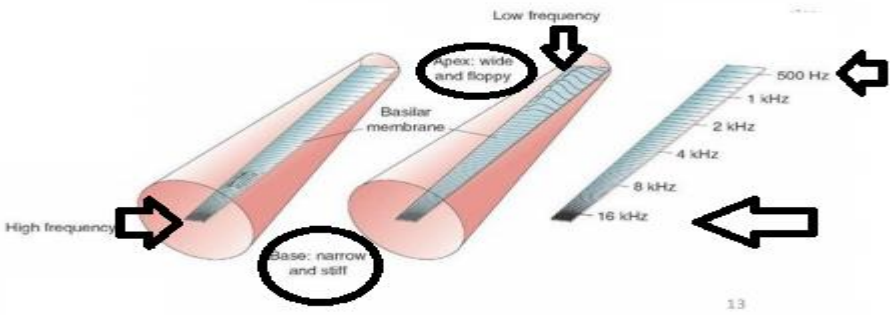
2-fixaed to modiolus and free at one end so they can vibrate

3-elastic

Near base: it is short, thick & stiff,,, it is vibrate by high frequency

Near apex: it is long, thin& soft,,, it is vibrate by low frequency sounds

The length of basilar fiber is increase beginning from the base of cochlear to the apex and the diameter is decrease from base to apex and this important distinguish between high frequency and low which discus later



Organ of corti

-Receptor organ

-On the surface of the basilar membrane

-Contain row of electromechanically sensitive cell with stereocilliay called hair cells

-2 type of hair cell: outer -3row(12,000)& inner- single row (3,000)

-Hair cells synapse with cochlear nerve ending

-90-95% of cochlear nerve ending on inner hair cell-receptor

-Outer: larger diameter-efferent-increase amplitude and sharpness of sound

-Gelatinous tectoria membrane lies above the stereoclia of the hair cell

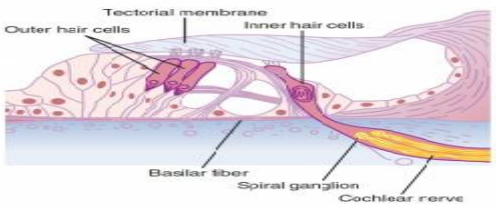
-Movement of the basilar membrane cause sterecilia of the hair cells to shear back and fourth against the tectorial membrane to tectorial membrane

الorgan of corti عبارة عن receptor cell موجودة على الsurface of the basilar membrane وهي عبارة عن electromechanically sensitive cell وstereocilliay موجود على سطح الخلية ملامس لل tectorial membrane وحركة هاي ال cilia على الtectorial membrane بؤدي لtectorial membrane

هسا الorgan of corti هو نوعين outer and inner hair cell

هسا الinner hair cell هو متصل عن90-995% للcochlear nerve ending يعني هو مسؤول عن نقل الصوت للcortex

اما الouter فهو بيجله efferent fiber هاض مسؤول عنcontrol sensitivity of inner cell يعني يزيد الamplitude and sharpness of sound يعني مثلا حولي في اكثر من صوت مثلا صوت مروحة وناس بحكو وانا بدي احضر عالتلفزيون الouter cell بتخلي يركز على صوت التلفزيون وبقلل الاصوات المحيطة لذلك اذا صارdamage to outer hair cell lead to loss of hearing لانو ما بقدر يركزعلى الاصوات



نهاية التلخيص سامحونا على اي اخطاء