Lecture 2,3

Editing File

Ear I & II

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Lecture Objectives:

★ **Ear I**
- anatomy physiology of the ear
- gross anatomy of the external, middle and inner ears
- nerve supply and earache(in brief)
- physiology of hearing and balance.(function of the Eustachian tube in brief)

★ **Ear II**
- diseases of external ear and acute otitis media
- congenital anomalies of the external ear (in brief), (protruding ear, preauricular Sinus, microtia and atresia)
- wax, ear wash
- otitis externa (classification and management)
- acute otitis media (in detail) and recurrent acute otitis media

Color Index:

Important Original content Doctor's notes
Golden Notes Extra

Anatomy of the Ear

1. External ear: Composed of the auricle, external auditory meatus, tympanic membrane (squamous part), develops from 1st pharyngeal cleft & arch

2. Middle ear: (tympanic cavity); Composed of tympanic membrane (mucosal part), eustachian tube, ossicles, nerves (tympanic plexus, chorda tympani), muscles (tensor tympani, stapedius), develops from 1st pharyngeal pouch & 1st and 2nd arches

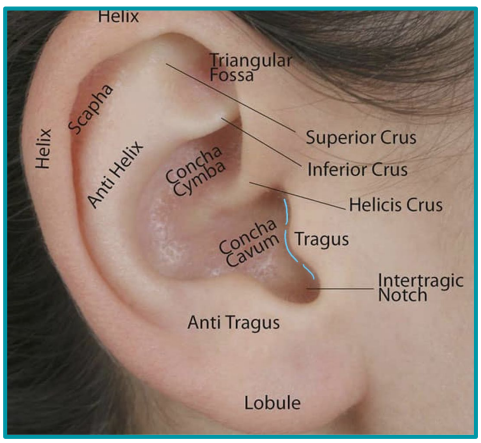
3. Inner ear: Composed of Cochlea, vestibule and semicircular canals (semicircular canals for angular acceleration and the saccule for linear acceleration). develops from Ectoderm of hindbrain

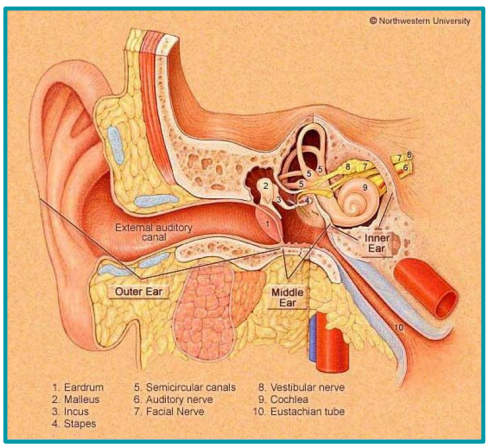
◀ External Ear

Pinna/Auricle:

- Lobule: has no cartilage, less risk of infection or spread of infection to the perichondrium and causing deformity, hence perichondritis can affect the whole ear except the lobule
- Helix: gives us the firmness of the ear
- Anti Helix: its importance prevent us from having protruding ear (Bat ear), also helps in hearing
- Tragus: can be taken and used in tympanoplasty but we leave the seen 2 mm (see pic) to not change the shape of the ear
- Concha & Cymba: cartilages supporting th pinna on the skull, also can be taken and used in Tympanoplasty (بروبع الطبله) and Rhinoplasty procedures because these cartilages can be used without changing the shape of the ear

External auditory meatus: The ear canal is not straight but has an anterior hump. What if the ear canal is straight with no hump? Water will enter easily while swimming, air entry will cause the patient to have dizziness

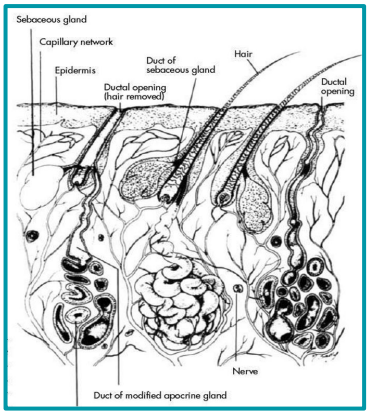




To examine the ear you need to push the ear upward and backward to make it straight, if you do it correctly the patient won't feel any pain when you examine

Anatomy of the Ear Con.

01 Lateral third (outer ⅓) of canal length:



- Cartilaginous.
- Hair follicles.
- Ceruminous glands which produces wax.
- Sebaceous glands.

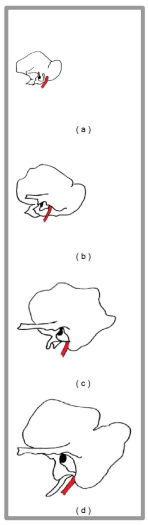
02 Medial two thirds (inner ⅔) is osseous:

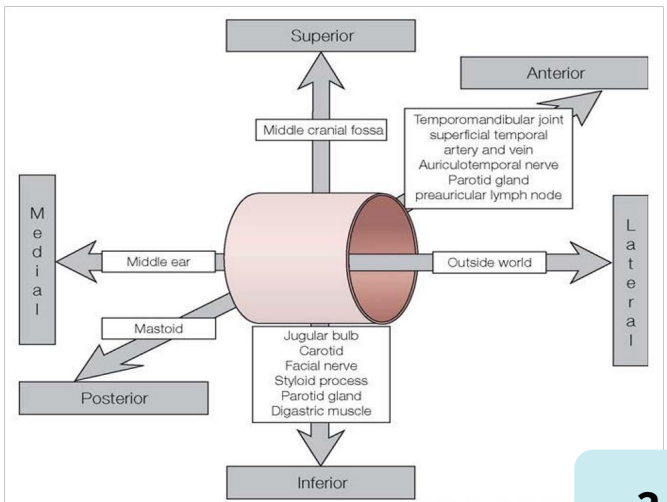
- Bony.
- Develops after birth.
- If we see wax in the medial part of the external ear this will usually mean that the patient used a q-tip for example and pushed the wax inside. However there's diseases like keratosis obturans where the ear produce excessive amounts of the wax when the lateral part if filled it starts to go into the medial part

◀ Anatomical Relations of External Auditory Canal

- **Superior :** Middle cranial fossa when immunocompromised pt develop otitis externa, it might invade the skull base causing Osteomyelitis
- **Posterior:** Mastoid
- **Anterior** : Temporomandibular joint (Imp for radiated pain bc any pain from the joint or teeth may radiate to the ear & cause ear ache) - superficial temporal artery & vein - Auriculotemporal nerve - Parotid gland (Superficial part) - preauricular lymph node
- **Inferior** : Jugular bulb - Carotid Artery - Facial nerve - styloid process - Parotid gland (Deep part) - Digastric muscle
- **Medial** : Middle ear (Tympanic membrane)
- **Lateral** : Outside world (In some people the anterior wall is absent like in goldenhar syndrome or hemifacial microsomia or could be normal variation in these pts we can see the condyle of mandible inside the external canal when we ask theme to open their mouth)

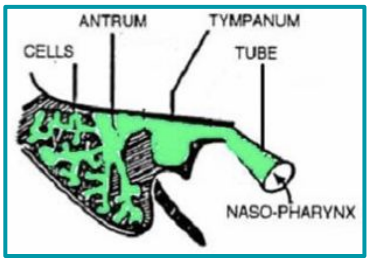
Posterior belly of Digastric muscle originate from the mastoid process of temporal bony
The digastric muscle is weak in infants before they become able to elevate their heads because at birth the mastoid bone is flat with time it will become more prominent and tightens the digastric muscle which is attached to it
The importance of this is during surgery in infants below 2 years if you open behind the ear you might face the facial nerve which exits between the mastoid and the styloid but once the mastoid becomes bigger and well formed it will protect the facial nerve

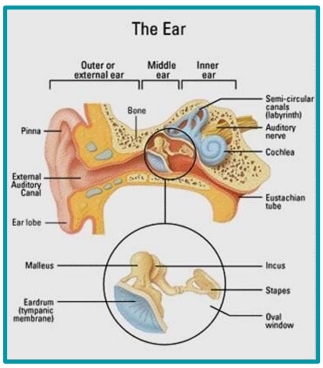




Anatomy of the Ear Con.

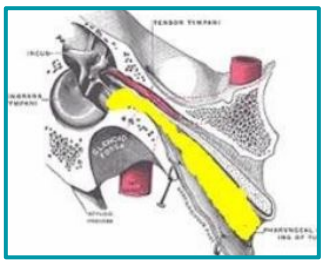
◀ Middle Ear Cleft

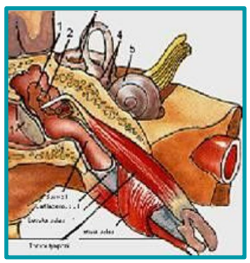




- Eustachian (Pharyngo-tympanic) Tube.
- Tympanum (Middle Ear Cavity).
- Mastoid Antrum and Air Cells.
- Middle ear cleft vs middle ear cavity: middle ear cleft is the middle ear cavity + Eustachian Tube + mastoid
- Barotrauma → retraction → perforation

◀ Eustachian tube

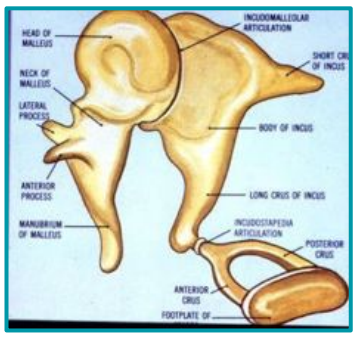




- **Connect the middle ear cavity with nasopharynx "nasal cavity" (upper aerodigestive tract)**.
- Lies adjacent to the ICA (internal carotid artery).
- Is the conduit through which air is exchanged between the middle ear space and upper aerodigestive tract & open at torus tubarius.
- Parts of Eustachian Tube:
    1. Proximal 1/3 is bone.
    2. Distal 2/3 is fibrocartilaginous, That is collapsed at rest
    3. Junction between 2 parts is isthmus, narrowest part of the tube.
- When you are at the plane and have URTI, and the pilot landed very fast, so what can we do ? chew, steroid or atropine spray (decongestant)
- The tube permits aeration of the middle ear and if it is obstructed fluid may accumulate in the middle ear causing deafness.
- **Normally always closed. But in case of: Yawning, eating, Swallowing (When you swallow sometimes your ear make sound this is ET)** → the ET open up actively by contraction of salpingopharyngeus muscle & passively by Tensor tympani. (it releases the tension in tubal cartilage).
- What are the muscles that control the opening of the eustachian tube? (1) tensor veli palatini, (2) levator veli palatini, (3) salpingopharyngeus muscle.
- **It also opens when there's change in pressure to equalize the pressure in the middle ear** e.g., while on airplanes or while diving**.**
- Closed by elastic recoil of elastin hinge + deforming force of Ostmann's fat pad.
- Patulous Eustachian Tube is when the eustachian tube is opened all the times and it sometimes occur in people who undergo sleeve surgery, bc they'll lose a lot of weight, thus losing the fat. We first wait for a couple of months until they gain a bit more weight and it will become better. But in case it doesn't we will treat them with fat injection at the site or fillers
- The tube is shorter, wider and more horizontal in the infant than in the adult.
- Secretions or food may enter the tympanic cavity more easily when the baby is supine particularly during feeding.
- The tube is normally closed and opens on swallowing because of movement of the muscles of the palate. This movement is impaired in cleft palate children "bc the absence of tensor palatini muscle" who often develop accumulation of middle-ear fluid (otitis media with effusion).
- Barotrauma is trauma related to the pressure it either happens at the level of the eustachian tube and affect the tympanic membrane or at the level of the inner ear affecting the oval window and cause dizziness and hearing loss.

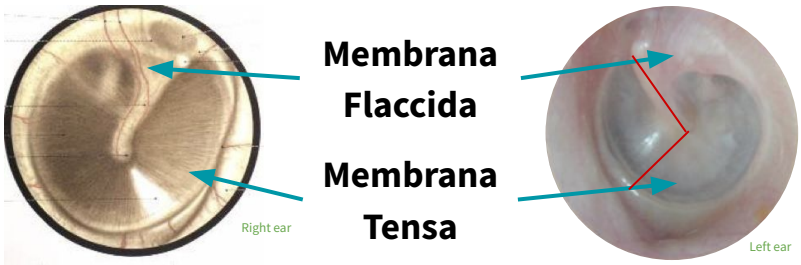
Anatomy of the Ear Con.

◀ Contents of the Middle Ear Cavity



- Air.
- Ossicles (Malleus, Incus, & Stapes).
  - Stapedius is attached to the neck of stapes
  - Tensor tympani is attached to the neck of the malleus
  - Incus is the most common bone to get eroded in case of trauma and blood supply got affected, also the weakest part to get fractured
- Muscles (Tensor Tympani & Stapedius).
  - Stapedius muscle is more powerful in controlling the noise than tensor tympani muscle
  - If the noise exceed the normal limit of muscle contraction you might start hearing the contractions of the muscle
- Nerves (Chorda Tympani & Tympanic Plexus).
  - **Chorda tympani is a branch of the facial nerve and it innervates the anterior ⅔ of the tongue** this is why when we injure both nerves (right & left) the patient will lose taste sensations
  - Tympanic plexus is the reason why we have radiating pain to the ear for example from the throat or the occiput

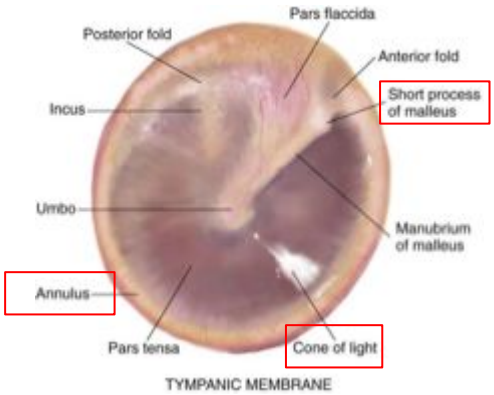
◀ Tympanic membrane



- Normally is transparent you might be able to see the ossicles
- The tympanic membrane is divided into 2 parts:
- Pars Tensa (80%), Has 3 layers: skin, fibrous tissue and mucosa
- Pars Flaccida (20%), Has no fibrous tissue only squamous mucosa
  - Clinical correlation: if we had a chronic eustachian tube dysfunction the first part to get retracted is the pars flaccida causing retraction pocket which can enter the middle ear and cause acquired cholesteatoma
  - The most common cause of acquired cholesteatoma is eustachian tube dysfunction
- We could also divide the TM to 3 parts:
  - Epitympanum: superior aspect of the tympanic membrane. Most common site for acquired cholesteatoma.
  - Mesotympanum: area of the middle ear medial to the tympanic membrane. Most common site for congenital cholesteatoma (not related to -ve pressure).
  - Hypotympanum: area of the middle ear inferior to the tympanic membrane. cholesteatoma may extend to it, which is an area we might forget to check.

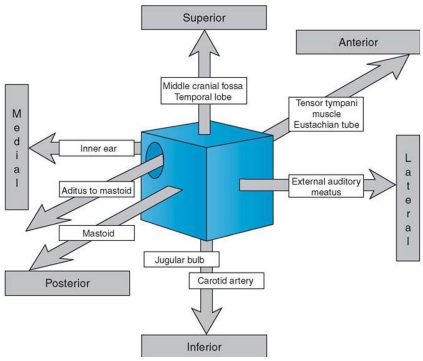
Anatomy of the Ear Con.

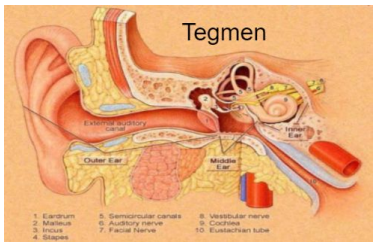
Tympanic membrane



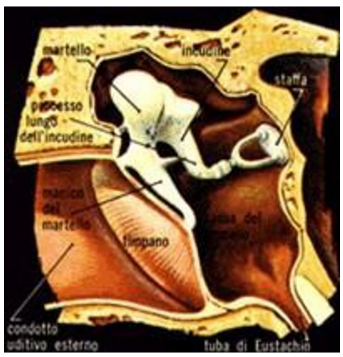
- How to know if the tympanic membrane is for a left or right ear?
  1) you look for the malleus and the reflection of light forming an arrow the direction where the opening of the arrow is pointing toward (left or right) is your answer
  2) you can look for the anterior hump which is formed by TMJ if it's on the right then this is the right ear
- Central perforation (intact annulus): safe type
- Marginal perforation (perforated annulus): unsafe type can lead to cholesteatoma

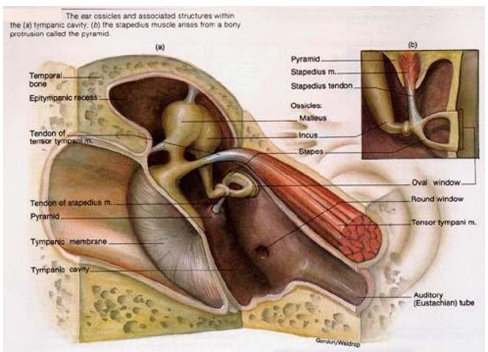
Walls of Tympanic Cavity

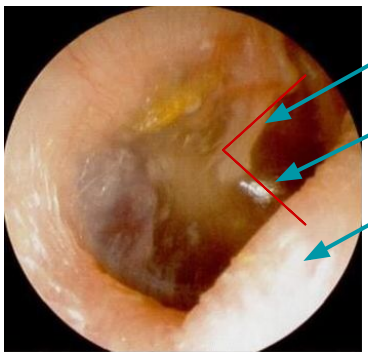




- Roof skull base "Tegmen".
- Floor.
- Anterior wall.
- Posterior wall. Mastoid
- Lateral wall. Tympanic membrane
- Medial wall. Cochlea
- The function of muscles of the middle ear is to control the sound, how? when there's a loud sound, these muscles will contract (the stapedius' contractions are stronger) to decrease the vibrations reaching the ossicle to prevent noise trauma
- Contraction of the stapedius muscle restrict the movement of the stapes (this is considered as a physiologic reflex that protects the inner ear from very loud sounds (stapedial reflex or acoustic or attenuation reflex).
- Importance? We sometimes want to to check whether the stapes is fixed, stable or if it has otosclerosis, therefore we do stapedial reflex test. The presence of involuntary muscles contractions in response to loud sound means the patient is normal or might have mild conductive hearing loss. if it's absent it means the patient might have severe conductive hearing loss (25-30 dB).
- Conduction hearing loss : tympanic membrane + bones
- Sensorineural hearing loss: cochlea + nerves







Malleus

Cone of light

Anterior hump (TMJ)

Right ear

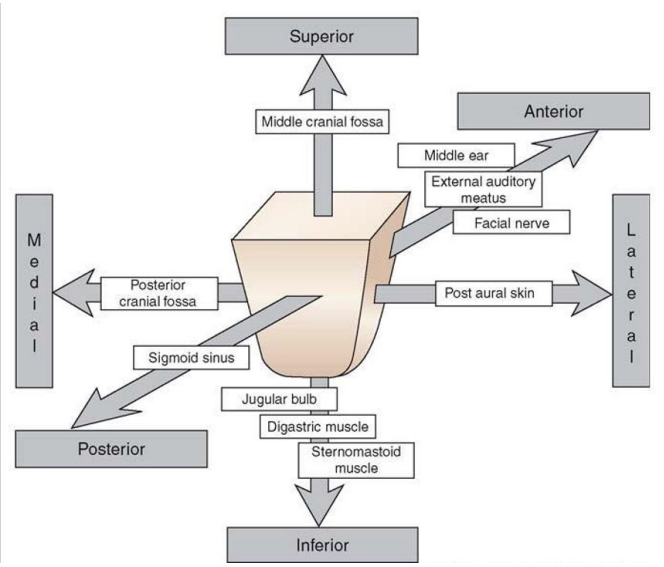
Anatomy of the Ear Con.

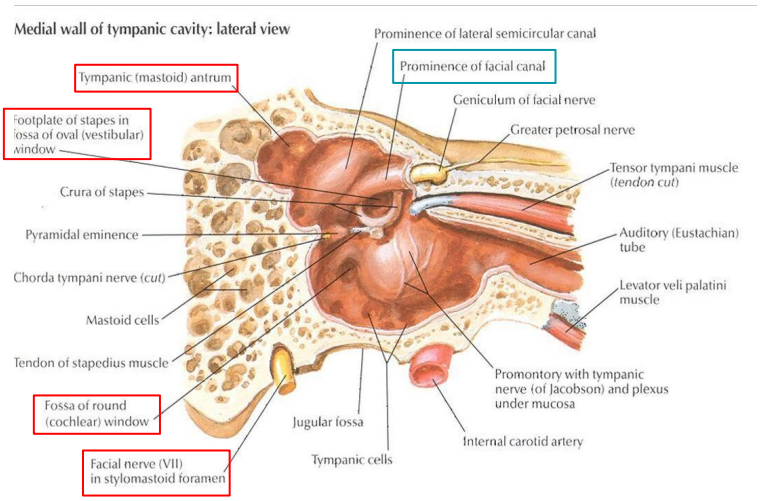
◀ Mastoid Antrum & Air cells

- Air-containing cells of the mastoid process are continuous with the air in the middle ear.
- Pneumatization is complete between the sixth and twelfth years of life.
- Normal tubal function is a prerequisite for biologically active, healthy middle ear mucosa, and thus for the normal process of pneumatization.
- Attic: opening between the middle ear from the epitympanum to the mastoid bone
- The first area to get eroded in acquired cholesteatoma is the attic and it's seen on CT
- Antrum: air space in the mastoid which contain the largest air cells
- Aditus: the entrance to the antrum behind flasidis para
- Why do we have air cells/sinuses? to make the skull light

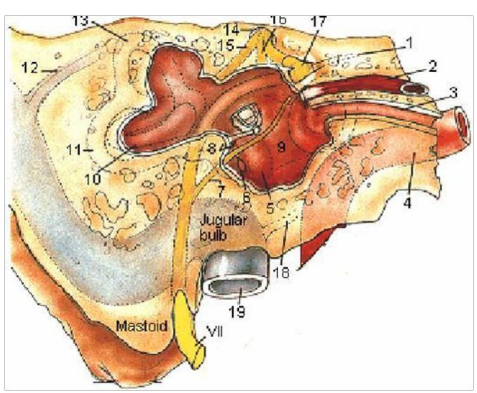
◀ Anatomical relation of Mastoid Antrum

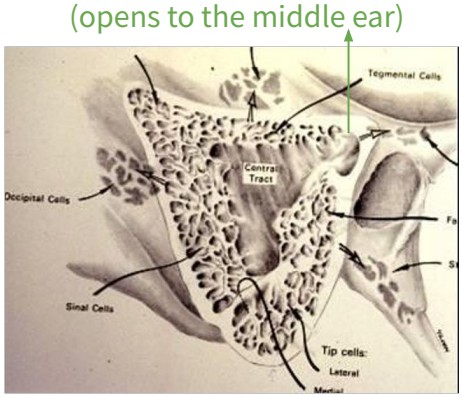
- Round window is below the oval window by 2 mm
- The facial nerve passes above the oval window and is dehiscent here (see pic) in 40% of people and has risk of injury that's why in the OR we put facial nerve monitor while operating
- Cochlear window: bulges from the cochlea with sound

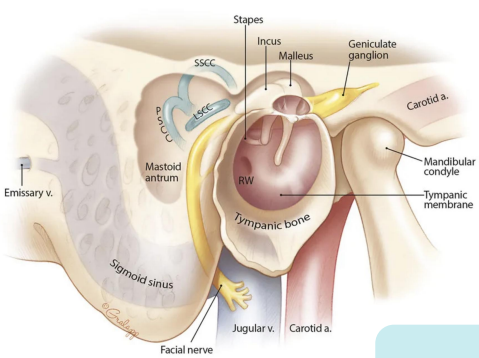




Opens on the epitympanum (opens to the middle ear)







Anatomy of the Ear Con.

◀ Lining of the Middle Ear

Mucous membrane: Ciliated columnar anteriorly and cuboidal or flat elsewhere.

◀ Anatomical relation of Middle Ear (not mentioned in slides)

- Floor: internal jugular vein and common carotid
- Roof: skull
- Lateral: tympanic membrane
- Posterior: mastoid air cells
- Medial: promontory of the cochlea

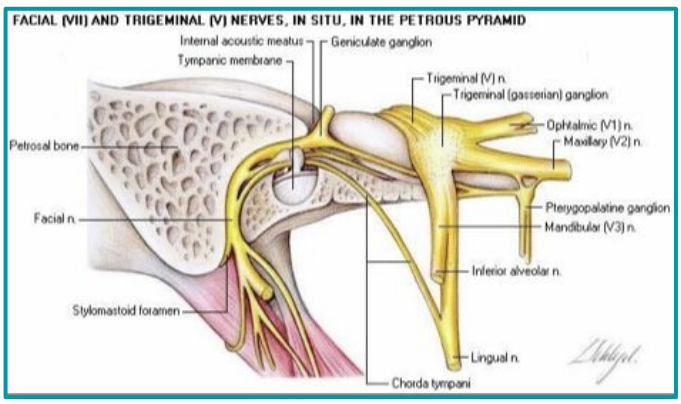
◀ Sensory Supply of the External & Middle Ear

*The doctor asked about these nerves at the end of the lecture.

- Cervical II & III (great auricular and lesser occipital).
- V cranial nerve (auriculotemporal).
- IX cranial nerve (tympanic or Jacobson's).
- X cranial nerve (auricular or Arnold's).
- VII cranial nerve.
- TM is supplied by V3 (mandibular) anterior, and Vagus posterior on lateral (outer) aspect, (Glossopharyngeal) on medial (inner) aspect.

Nerve supply:

- Sensory nerve supply of the middle ear mucosa:
  - Tympanic branch of the glossopharyngeal nerve.
  - Auriculotemporal branch of the trigeminal nerve.
- Motor nerve supply of the middle ear muscles:
  - Stapedius muscle supplied by the stapedial branch of the facial nerve.
  - Tensor tympani supplied by the mandibular division of the trigeminal nerve.



Facial nerve pathway: exit the brain and enter internal auditory canal (meatal part of facial nerve) then travel across the bones in the ear (1) labyrinthine segment: most narrow area, 2) tympanic segment: most dehiscent area, 3) mastoid segment: most iatrogenically injured (usually not direct injury rather it's the heat from the drill that might affect the nerve)
The nerve terminates by splitting into five branches:
Temporal, Zygomatic, Buccal, Marginal mandibular and Cervical

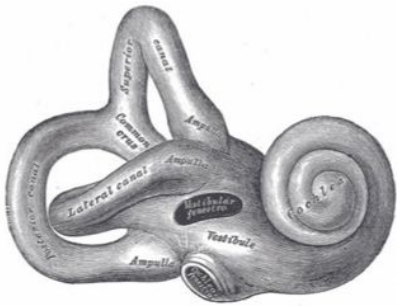
Anatomy of the Ear Con.

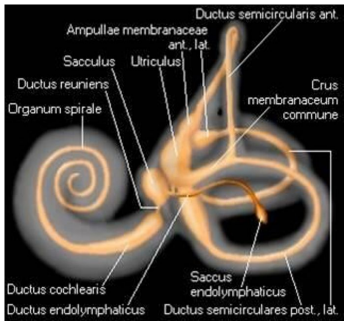
◀ Referred Earache not an ear problem

Pain in the ear due to a disease in an area supplied by a nerve that also supply the ear.

- Cervical II & III: Cervical spondylosis, neck injury (disc, muscle spasm) etc.
- V (Trigeminal) cranial nerve: Dental infections, sinonasal diseases “maxillary sinus” etc.
- IX (Glossopharyngeal) cranial nerve (branch of CN 9 called jacobson in the promontory): **Tonsillitis**, pharyngitis, laryngitis, laryngeal cancer, esophageal foreign body, post-tonsillectomy, carcinoma etc.
- X (Vagus) cranial nerve: Tumors of hypopharynx, larynx & esophagus.
  - One of the signs of recurrence tumors in larynx & pharynx is ear pain.
  - Auriculotemporal nerve (V3): any patient that has dental issue or TMJ, tonsillitis ,URTI so when they present with ear pain I have to examine those, dental, pharynx, oropharynx, cervical

● Inner Ear





◀ Osseous Labyrinth parts

- Bony Cochlea.
- Vestibule.
- Bony semicircular canals.Circular motion

◀ Contents of the Bony Labyrinth

- Perilymph: (outside the inner ear) extracellular like fluid; found in scala tympani and vestibuli.
- Between the bony and membranous labyrinths

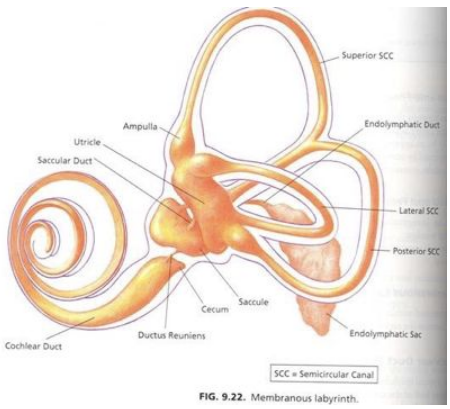


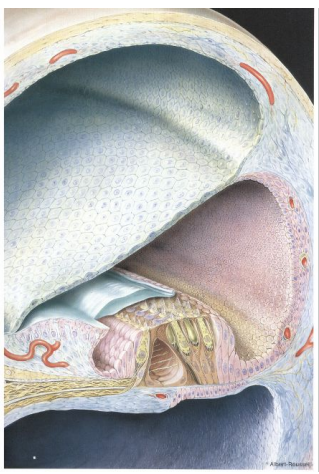
FIG. 9.22. Membranous labyrinth.

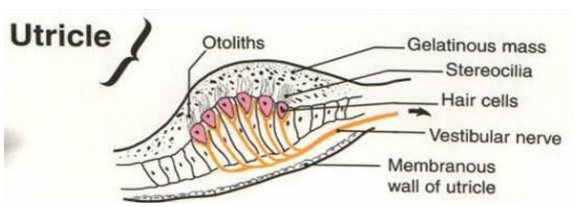
◀ Membranous Labyrinth parts

- Cochlear duct
- Saccule and utricle
- Membranous semicircular canals

◀ Contents of Membranous Labyrinth

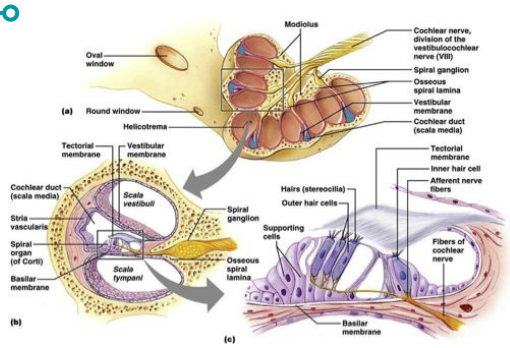
- Endolymph (fluid in membranous labyrinth)
- Sensory Epithelium:
  - Cochlea : Organ of Corti.
  - Utricle & Saccule (vestibule): Maculae. Respond to changes in the position of the head with respect to gravity and speed (linear acceleration) e.g., in the elevator, utricle”horizontal” & saccule”vertical”. Fluid can move right & left
  - Semicircular Canals: Cristae. Respond to rotational movements (angular acceleration). Fluid can move right & left





Anatomy of the Ear Con.

• Inner Ear



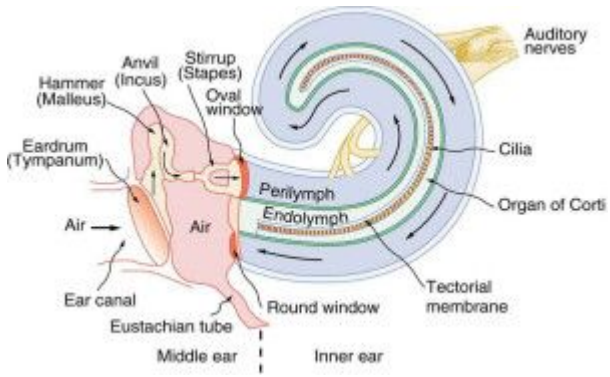
Blood supply of inner ear:
Anterior inferior cerebellar artery → Labyrinthine artery → Common cochlear & anterior vestibular

Inner canal

- Cochlea has two windows (round & oval)
- The bony cochlea contains three compartments:

(a) Scala vestibuli, (b) Scala tympani, (c) Scala media or the membranous cochlea or cochlear duct

- Scala media is the most important one because it contains the organ of corti
- How do we hear? See this video exactly as the doctor explained ;) cause I'm tired writing notes
- The scala vestibuli and scala tympani are filled with perilymph and communicate with each other at the apex of cochlea through an opening called helicotrema. Scala vestibuli is closed by the footplate of stapes which separates it from the air-filled middle ear. The scala tympani is closed by secondary tympanic membrane; it is also connected with the subarachnoid space through the aqueduct of cochlea. The scala media is filled with endolymph.



- Scala media has ticlorial membrane and hair cells so with the fluid movement it will move and produce sound
- In the utricle and saccule we have organ that moves and cause inflation and deflation with up & down movement its called Macula
- semicircular canal has bulla at the end that had crystal
- the lateral Semicircular canal is the most prominent one so it's the first can be affected by diseases because the most close to external so any ear diseases that eat the bone or cholesteatoma it is the first to be effected.
- Benign positional vertigo in people who had road traffic accident or prolonged surgery and during transportation the head has been shaken forcefully. Trauma to the head concussion of the inner ear: each semicircular canal contains fluid and below the fluid there is gelatinous material which contains crystals "calcium tubercles", They give the sense of going up & down depending on gravity .
- What if one of these crystals gets out of the gelatinous material and flows in the fluid above? If we are sitting still there will be no problem but if we start moving, it will make the patient feels dizziness, for example if the patient turned from left to right he may start feeling like spinning because that crystal that got out is floating in fluid also the patient might feel nauseated, why nauseated? Because his eyes will tell him that the image is not moving but the ears are saying that the image is moving leading to feeling discrepancy which leads to nausea that's why these patients tend to close their eyes in order to stop the nausea

However we should advice them not to close their eyes instead they should activate the other parameters which are proprioception and vision this will overcome the nausea in a shorter period

- so we do maneuvers to put them back in place (epley maneuvers)

reflex is very - المانوفرز منتو مطالبين تعرفون كيف تتسوى بس حلو تفهمون معناها، نثبت الراس على حسب السمي سيركلر كنال ونلف high 45 درجة وننزلة تحت السرير نشوف اذا عنده سنتاقمس او لا العين والاذن مشتبكين مع بعض فلما يصير عندنا اي امبالس للكرستلز نشوف النستاقمس بعده اتهدا ونغير البوزشن نرجعها مكانها لما vestibulo-ocular نعيد التست وماطلعت النستاقمس معناها انها تعدلت

- So its not medical treatment its re-positioning
- So what will happen (for the vestibule) once we have stimulation its goes to the brain stem the to the brain it gives two part one to the spine and one to the oracular muscle
- So we have nystagmus and imbalance this is for the vestibule
- So how can I know that it's only vestibular diseases?
- We know balance is dependent on three thing: proprioception (joint & muscle) & vision & vestibule Stand on pillow or spongy thing and close the eye. you are testing the vestibule alone you. If you did not find anything you can ask him to step. It is called "Vocada test". One of the vestibular examination
- Gentamicin is vestibulotoxic but that doesn't mean it will affect the balance alone it can also cause hearing loss if used on the long term

Anatomy & Physiology of the Ear Con.

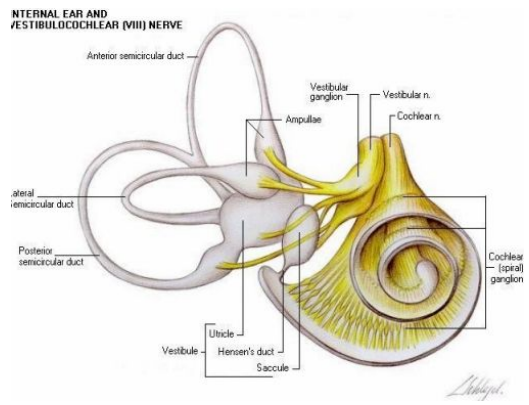
◀ The vestibulo-cochlear nerve

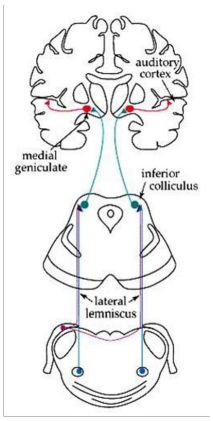
➔ **Central Connections of Cochlear Nerve**

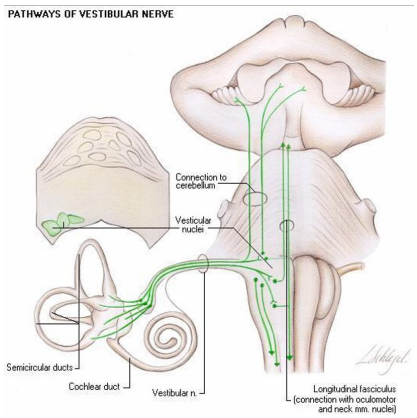
- The principal human auditory cortex is located deep within the sylvian fissure on the superior surface of the temporal lobe The primary auditory cortex is often referred to as Brodmann area 41.

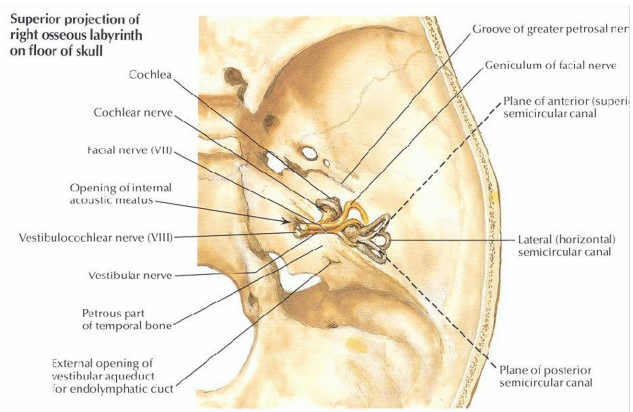
➔ **Central Connections of Vestibular Nerve**

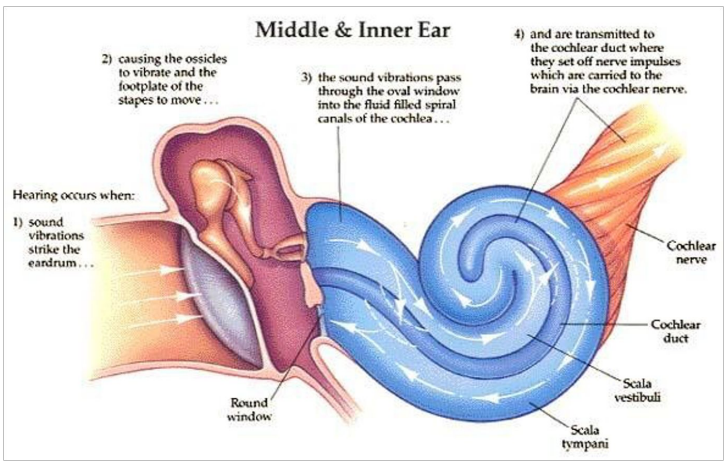
- 2 parts superior & inferior: the inferior supplies the sternocleidomastoid and ocular muscle.
- Superior innervates anterior and lateral semicircular canals and utricle.
- Inferior innervates posterior semicircular canal and saccule.
- How can we test the vestibular nerve? by testing the sternocleidomastoid & inferior ocular muscle





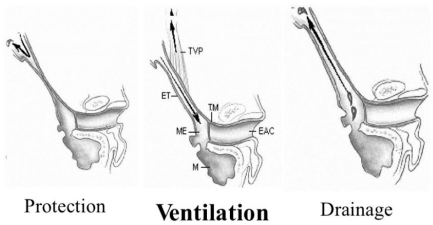
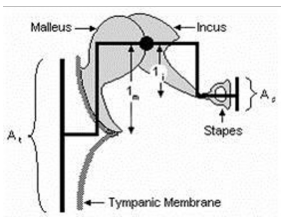
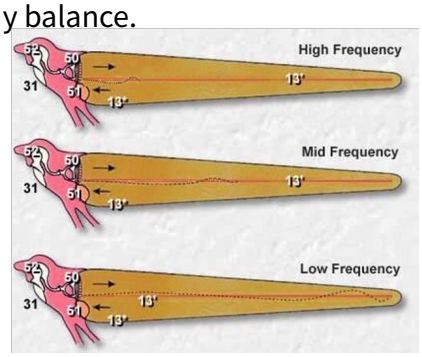






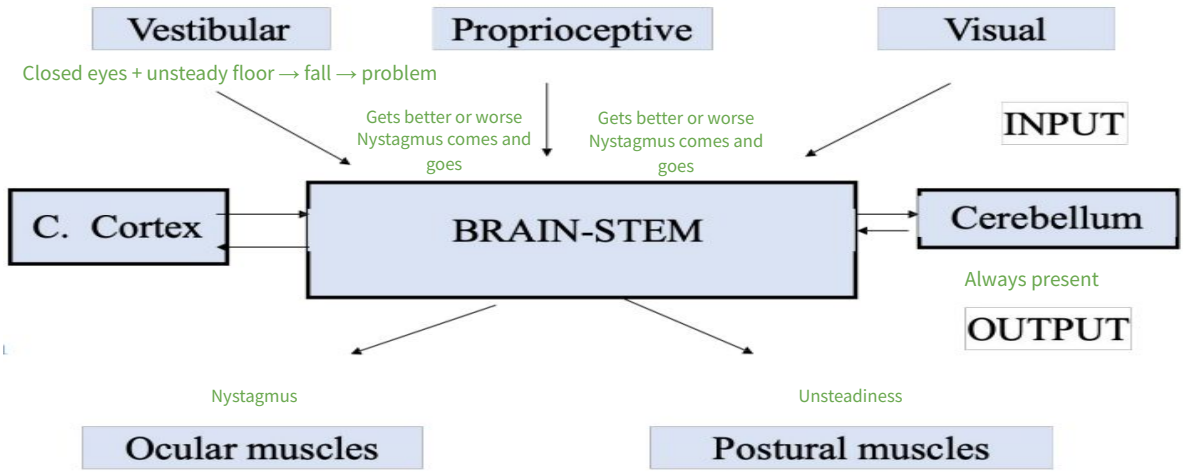
Anatomy & Physiology of the Ear Con.

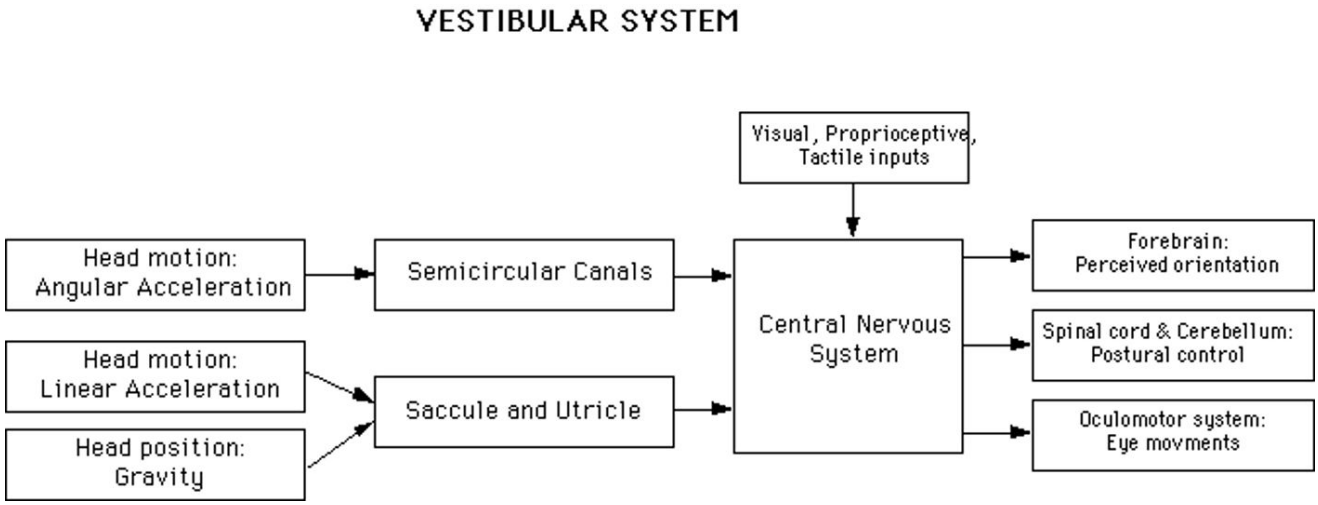
◀ Physiology of the Ear

	Function
External Ear	• Protection of the middle ear: Curvature, Cerumen. • Auditory functions: Sound conduction and amplification (500 Hz), Increase sound pressure by the resonance function.
Eustachian Tube	• Protection: From anything that comes from the nasopharynx to go into the middle ear (any nasal secretion). • Ventilation: to equalize the pressure. • Drainage: in case of acute OM or any regular discharge from the middle it won't go to the nose but down to the nasopharynx.  Protection **Ventilation** Drainage
Middle Ear	• Conduction of sound. Magnification of sound (2000 Hz) as,we get closer to the cochlea ○ Because the tympanic membrane is a big space going into the oval window which is a much smaller space this will cause magnification of sound • Transformer mechanism: Hydraulic action, Ossicular leverage. • Protection to the inner ear: ○ (Stapedial reflex): In case of loud sound the muscle will contract to reduce the sound reaching the inner ear to avoid noise trauma. 
Inner Ear	• Hearing Function: Transduction of sound to action potentials • Vestibular Function: Participate in maintaining body balance. • Basal cochlea movement→ high frequency e.g.,: with toxic drugs - surgeries - noise induced hearing trauma • Apical part movement → low frequency, If audiogram shows a problem with the low frequency sounds this means the problem is in the apical part 

Physiology of the Ear Con.

◀ The Balance System





- Dix - hallpike maneuver → diagnostic
- Epley maneuver → relieve (management)

Brain stem: is the center of balance. It's connected to: - Cerebellum to coordinate muscle tone and Cerebral cortex for the feeling of space.

- Input: Proprioceptive (sensation), visual & vestibular
- Output: gives information to: postural muscles and ocular muscle
  So, you have to make sure when someone comes to you with imbalance it's not b/c of the cerebellum by testing it, then rule out the (peripheral) proprioception

➔ Testing the vision: by closing the eye

➔ Testing the proprioception: by asking him - to stand on sponge
When you do so (closing the pt. Eyes and making him stand on sponge) you're eliminating the vision and the proprioception effects and after it you can make sure you're testing only the vestibule.

Diseases of the External Ear

◀ Congenital Diseases of the External Ear

➔ Anotia (Atresia):

- Definition: It's the total absence of the (pinna) auricle most often with narrowing or absence of the external auditory meatus.
- CT; to check if there is other malformations (internally).
- Bone conduction is preserved
- No auricles + canal atresia. (no external ear)
- Treatment:
  - We reconstruct the ear.
  - Prosthetic ear (otoplasty), usually used in tumor patients
  - **Good sensory hearing → bone hearing aid.**

➔ Microtia:

- Definition: underdeveloped pinna.
- It's a condition in which the external portion of the ear (the auricle) is malformed.
- There is also narrowing or absence of the external auditory canal.(a little pedicle)

➔ Accessory Auricle:

- It's a type of ear anomaly in the **tragus** area. as if skin tag
- Treatment: Plastic reconstruction, B.A.H.A (bone anchored hearing aid).
- It can present with no effect. usually in syndromes

➔ Preauricular Sinus:

- Most common embryological defect,run in families. About 20% of the population.
- Characterized by a nodule, dent or dimple located adjacent to external ear
- The manifestation depends on the depth of the sinus.
- Susceptible to infection.
- Indication for surgery:
  - Repeated infections, at least two.
- Treatment: (If got infected twice you must take out the whole tract by first testing its pathway through methylene blue injection
  or CT scan with contrast, but in the time of inflammation (abscess)
  we do incision and drainage).
  - Systemic antibiotics.

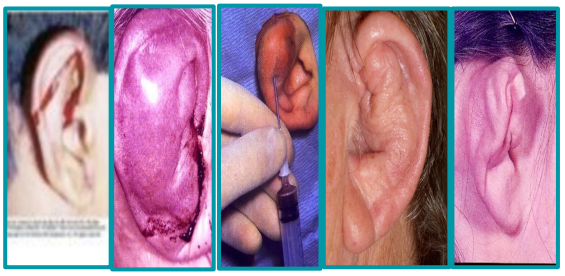
Diseases of the External Ear Con.

➔ Protruding Ear (Bat Ear):

- The scaphoid fossa is concave instead of it's normal convex shape
- Antihelix pulls ear back while helix pushes it forward; **Antihelix is absent.**
- Cosmetic" Pinnaplasty or otoplasty. Do if after age of school.
- Note: There is no direct blood supply to the cartilage!
- Treatment: An incision behind the ear is made to reshape the cartilage (setback otoplasty)

➔ Trauma to the Auricle:

- Lacerations.
- Hematoma auris **blood inside has to be drained to prevent necrosis to the cartilage**
- **Complication : Cauliflower ear.**
- Treatment: Excise fibrous tissue, apply pressure, dressing, drain.
- When we treat hematoma? Immediate incision and drainage! So, don't develop into cauliflower ear (necrosed cartilage).



➔ Perichondritis of the Pinna:

- Definition: Perichondritis is inflammation of the perichondrium, a layer of **connective tissue**, which surrounds cartilage(helix, anti-helix,and concha) with spared lobule area IMP, while in case of Erysipelas the whole auricle is affected.
- Usually follow trauma to the cartilage (hematoma auris, surgical "mastoid surgery", frostbite, burn) or otitis externa **& piercing** (particularly with the modern trend for multiple perforations that go through the cartilage).
- Etiology: commonly caused by **Pseudomonas** & staph aureus.
- Symptoms: Fever, pain, redness and swelling (causes narrowing and further low hearing level).
- Treatment: immediately by parenteral antibiotics & drainage.
- Any cartilaginous organ that forms a hematoma must be drained as early as possible).
- If it is due to piercing the stud should be removed.
- Complications of Perichondritis or Trauma:
  - Cauliflower ear (End stage of untreated haematoma).
  - The ear can be exposed to trauma and lacerations leading to the formation of Hematoma, so if anything happens between the skin and cartilage →Hematoma (Number 1 killer of the cartilage, why? Because the blood will not be able to reach the cartilage) → Ischemia → Necrosis → Ear deformity.

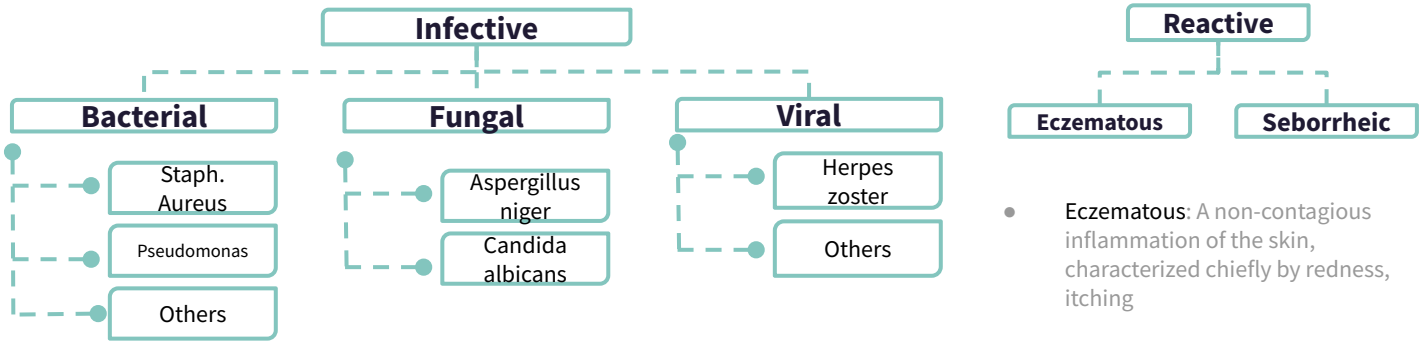
➔ Erysipelas of the Pinna:

- Definition: skin infection with staph and there is redness.
- **includes all the skin**

Diseases of the External Ear Con.

◀ Otitis Externa

- An acute (Less than 3 months) or chronic (more than 3 months) infection of the whole or a part of the skin of the external ear canal. Any pathology affecting skin can also affect external ear.
- Organisms enter the apo pilosebaceous unit by break in skin.
- Commonly caused by fingernail or Q-tip to relieve itching.
- Periosteal lining of bony canal displaced by swelling.
- Subacute or chronic develops if AOE not treated adequately.



- Eczematous: A non-contagious inflammation of the skin, characterized chiefly by redness, itching
- Seborrheic: A disease of the sebaceous glands characterized by excessive secretion of sebum or an alteration in its quality, resulting in an oily coating, crusts, or scales on the skin. It's usually painless

◀ Clinical Features of Otitis Externa

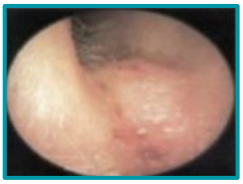
- Itching
- Pain: could be very severe because of underlying cartilage, evoked by movement of the jaw, because the ear auricle and external canal is attached to the TMJ (temporomandibular joint) pain can radiate to the throat!
- Fullness.
- Tenderness and swelling, absent in otitis media.
- Otorrhea: Ear discharge (very little and scanty, not mucoid. Large discharge in otitis media. Not mucus discharge because the skin does not contain mucus-secreting cells. If the discharge doesn't contain mucus, then it is from the External ear however if it contains mucus it is originating from the middle ear).
- Deafness (Hearing loss): deafness caused by external ear needs to be completely obstructed, which is rare in otitis externa.
- Changes in the lumen and skin of EAM (external auditory meatus).
- Fever and facial weakness

Physical Exam:

- Redness, swelling, sometimes you can't see the TM because of the swelling, protrusion, discharge, preauricular or face or neck extension.
- Gently tug up and back: if true AOE, patient will not tolerate.
- Clean canal thoroughly and examine under Microscope.

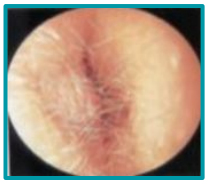
Diseases of the External Ear Con.

◀ Clinical Types of the External Ear Infections



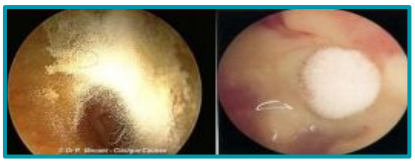
Localize O.E (furuncle)

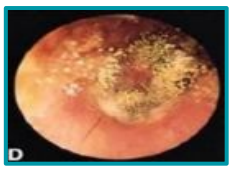
- Small rounded swelling in the external canal & it's localized to the hair follicle
- Furunculosis: ear hair infection
- Staphylococcus aureus
- Treatment, incision and drainage if there's an abscess and local antibiotics



Diffuse infective O.E.: (swimmer's ear)

- Staphylococcus aureus.
- Put a sponge that sucks the antibiotic drops





Otomycosis:

- Fungal infection (More in those who take Abx for a long time)
- How to differentiate between aspergillus & candida?
  - Aspergillus has black heads (spores forming, hyphae) while candida is totally white (cheesy, cotton like)
- Fungal vs. Bacterial
  - Fungal: Less pain, more itching & NO fever.
- Management: suction then antifungal cream. Cleaning is the most imp step.

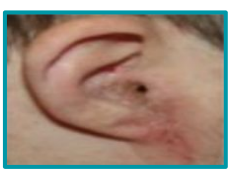
Bullous Myringitis:

- Inflammatory condition involves the lateral surface of the TM and the medial portion of the canal wall causing separation of one layer of the tympanic membrane "bullous".
- It typically occurs in association with upper respiratory (viral) infections and is more common in winter.
- Clinical feature: Severe otalgia Serosanguinous otorrhea - Hearing loss
- It is very painful so we will not drain it, we give local analgesic until it spontaneously resolves. Antibiotics are ineffective.
- Treatment: analgesics, topical antibiotic/steroid drops to prevent bacterial superinfection. Do not touch, if we open we will make it bacterial.

The hallmark clinical finding is: Bulla over TM and medial canal with serous or serosanguinous fluid.

Herpetic O.E:

- **A reaction happen in the nerve supplying the auricle**
- Herpes zoster oticus is a specific form of herpes zoster that presents with pre-eruptive ("pre-herpetic") lesion reactivated from either the trigeminal or cervical ganglions. Characterized by: **PAINFUL vesicles**
- Management: Steroids + Acyclovir
- Complications: Facial n. paralysis.
- Small vesicles + facial weakness + discharge = Ramsay Hunt syndrome or HSV.



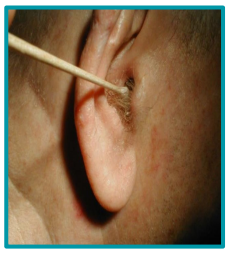
Eczematous and seborrheic: O.E.

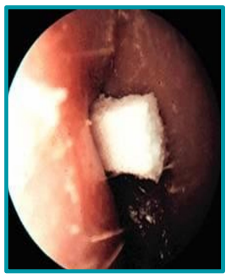
- Swelling, redness, crust formation and oozing of discharge.
- If the eczema is only in the canal, keep on mind tympanic membrane perforation due to discharge. Painless.

Diseases of the External Ear Con.

◀ Management of the External Ear Infection

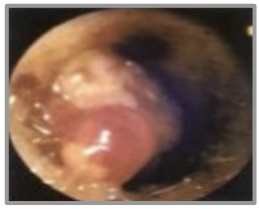
- History and Physical examination.
- Swab for culture and sensitivity.
- Ear toilet: frequent cleaning of any discharge. Meticulous debridement of debris, pus and cerumen.
- Keep the ear dry. Suction cleaning (especially the fungal infection = Suction, Suction, Suction) the antifungal won't go inside so we have to take the deprea out.
- Local medications: antibiotics: Anti-pseudomonal drops – Ciprodex.
  - Ear wick (best used after shower not in dry ear without pushing more than the length of the cotton > to avoid injury, infection and cotton dislodge).
  - Local analgesia to control pain. Not all O.E need oral or parenteral tx.
- Systemic medications: in immunocompromised as in diabetics.
- Surgery may be required in chronic cases (narrowing, fibrosis or medialization of the TM) because of failure of treatment because there is usually thickening in the skin and closure of the canal.
- Avoid using Q-tips and if you must use it don't insert it further into the bony part.
- Recommendations regarding prevention.
  - 1. Avoid instrumentation.
  - 2. Keep H2O out of the ear when possible.
- IN CASE OF:
  - Aspergillus Niger ➔ Give antifungal drops.
  - Herpetic O.E Tx: ➔ Acyclovir if < 3 days, Steroids to reduce inflammation.
- If it's reactive local steroids.





◀ Necrotizing (Malignant) Otitis Externa

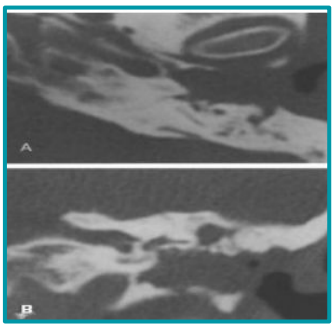
- An acute Pseudomonas infection of the skin of the external ear canal which has spread to the adjacent bone. (Deep seated pain for more than a month).
- skull base osteomyelitis is the new name.
- It is a malignant but NOT a cancer.
- Clinical Features: Diabetes, advanced age, severe otalgia > 1 month **(at night)Nocturnal headache** , granulation tissue, **cranial nerve involvement** (can involve the trigeminal or hypoglossal nerve with absent gag reflex) ,
- It has a triad:
  - Ear discharge "Several weeks of purulent otorrhea with granulations",
  - Headache (esp at night),
  - Immunocompromised patients: HIV, uncontrolled DM or elderly.
- It occurs mostly in elderly diabetic patients especially uncontrolled . (Immunocompromised) Important!



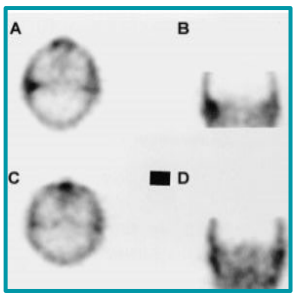
Diseases of the External Ear Con.

◀ Necrotizing (Malignant) Otitis Externa

- Clinical Findings:
  - Lower Cranial nerve palsies (VIII, IX, X, XI, XII) (check the gag reflex), and 25% VII
  - No signs of acute inflammation & No swelling.
  - On Ex: Granulation tissue in EAC, sequestra and Foul-smelling discharge from the floor of the external Auditory canal.
  - It can infect the base of the skull, the cranium Causing meningitis, brain abscess.
  - Almost always caused by Pseudomonas; can be fungal in HIV
  - Granulation tissue at the junction of the bony and cartilaginous portions of the canal + -immunocompromised pt ➔ Dx as Malignant Otitis Externa!



- Diagnosis:
  - always we do CT although it doesn't tell us the definitive dx, that's why we rely on nuclear scan Bone (Petrous) scan to rule out osteomyelitis.
  - Bony erosion on contrast-enhanced CT and bone scan showing active infection to rule out other pathology such as cholesteatoma
  - MRI useful for soft-tissue diagnosis, but not for F-U
  - Bone scan is sensitive, but not specific (Tc-99m most sensitive)



A: high uptake → increase in activity

◀ Treatment

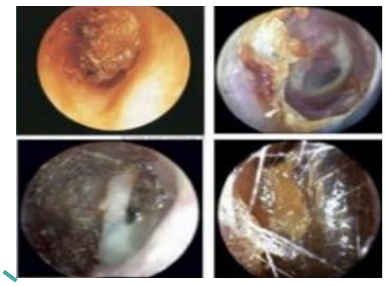
- Medical Treatment:
  - Should culture and biopsy.
  - Antipseudomonal antibiotic. At least 6 weeks.
  - Blood-sugar control. (most important part of treatment).
  - Frequent debridement for granulation tissue and anti-pseudomonal ear drops (local treatment).
  - ID and Endocrinologist should be involved.
- Surgical Treatment:
  - Reserved for clear failures of above medical treatment.
  - The role of surgery remains controversial (e.g. if we need to take biopsy).

Diseases of the External Ear Con.

◀ Miscellaneous Conditions of External Ear

Wax

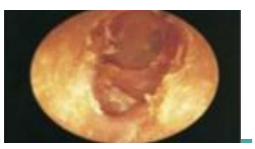
- Mixture of ceruminous and sebaceous glands secretion
- We always remove wax before examination
- Could be liquidy soft, scaly, hard
- Normally is expelled from the canal aided by movements of the jaw
- When accumulated it may cause deafness, earache or tinnitus
- **Function:** Protect the ear from some bacterial & fungal infections (its acidic)
- Irritive cleaning of the ear may result in eczematous or seborrheic otitis externa
- Wax on tympanic membrane is very dangerous, it could be hiding retraction behind especially in parus flaccida or cholesteatoma
- **Treatment:** is by removal using syringing very rare nowadays → anything you do it in ear will (cause vasovagal + there will be stimulation to the lateral semicircular canal bc of the water temperature that we are using), suction or instrumentation
- In irrigation-hard wax- we insert water in the ear to washout the wax but we have to make sure of the temperature of the water is the same as the body temperature to avoid dizziness (if it is more or less than body temp by 7 degrees it will cause dizziness). It can cause vasovagal attack in some.
- Crocodile forceps/ ear forceps Hock.

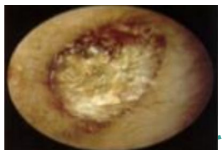


Crocodile forceps

Keratosis Obturans

- Excessive accumulation of desquamated epithelium dead skin (skin not wax) in the bony canal. (the difference b\w it and cholesteatoma that in the later one we have normal skin in abnormal place).
- It is excessive scaling of the skin causing very hard wax
- This is how we differentiate with external ear cholesteatoma
- It may be associated with sinusitis, bronchiectasis, or primary ciliary dyskinesia. (hair cell syndromes) hair is immotile so dead skin will accumulate.
- Unlike cholesteatoma, it doesn't cause bony erosions but it lead to compression **"pressure necrosis"** and widening of the canal. so, periosteum and cortex is intact.
- Usually cause deafness and pain.
- Treatment is periodic removal





Diseases of the Middle Ear

◀ Acute Otitis Media

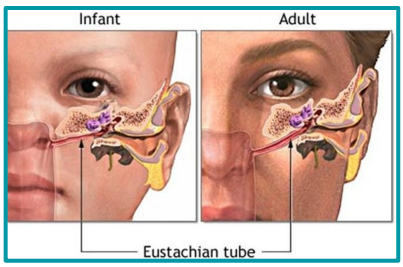
- Acute infection of the mucous membrane lining of the middle ear cleft.
- The definition is specific to infection because in chronic Otitis media it can be due to infection or normal inflammation.
- Most common bacterial infection of childhood. Estimated 85% of all children experience at least one episode of AOM (Acute Otitis Media).

◀ Predisposing Factors of the Middle Ear Infection

- Age: common in children as their Eustachian tube is more horizontal, wider and shorter in relation to their head.
- Male sex
- Bottle feeding: more likely to have milk regurgitation (because children tend to drink while lying) in middle ear
- Climate: increase in humidity increase the risk
- Allergic Rhinitis
- Crowded living conditions (one infected will infect others)
  - For example in kindergarten bc the infection rate is increased
- Smoking within the home
- Heredity
- Associated conditions:
  - Cleft palate, why? tensor palatini muscle is absent in cleft palate and its job to open ET?? When you swallow. The muscles of the palate are affected and not well developed, so in cleft palate surgery ENT come to put tube to avoid otitis media with effusion for life.
  - Immunodeficiency, ciliary dyskinesia, down syndrome (muscle is weak) & cystic fibrosis.

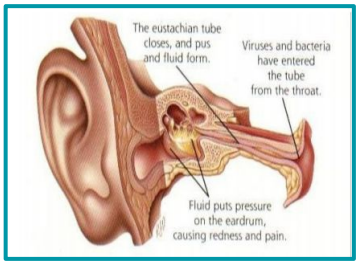
◀ Route of the Middle Ear Infection

- Eustachian tube (very common) URTI through Eustachian tube to middle ear.
- External auditory canal (rupture).
- bloodborne.



◀ Bacteriology of the Middle Ear Infection (acute)

- Streptococcus pneumonia
- Haemophilus influenzae
- Moraxella (branhamella) catarrhalis
- Streptococcus pyogenes & Staphylococcus aureus related to the skin
- Pseudomonas related to immunocompromised



Diseases of the Middle Ear Con.

◀ Clinical Pictures of the Middle Ear Infection

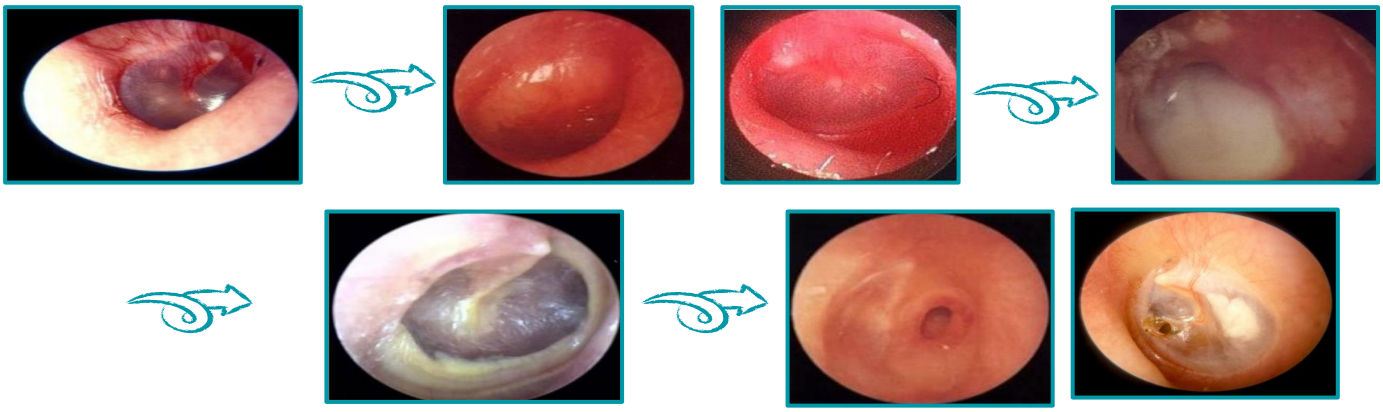
1. Tubal occlusion: produces early signs of acute otitis media.
   a. Discomfort / **Autophony** (hearing own voice louder) / Retracted drum (opposite of bulging) caused by pressure difference / There is mild deafness / Tinnitus in children, not adults.
   b. First thing to happen in otitis media is redness/congestion → bulge (severe pain) → rupture if untreated → pus → abnormal/normal healing or perforation.
2. Exudative inflammation: fever, earache, deafness, congested drum
3. Suppurative inflammation of the middle ear: Fever, severe earache, deafness, and bulging drum, pus behind it.
4. Tympanic membrane rupture: Otorrhea, Temperature and earache subside (pain relief), perforated drum and Mucopurulent (discharge) if not treated
5. Resolution: Either the rupture will persist, and it will discharge from time to time (chronic otitis media) Or close spontaneously ("retraction") common

- Tympanosclerosis "if not treated will retract if it was severe > adhesive otitis media (tympanic membrane reaching the promontory "or the cochlea
- The patient can present to you at any stage (mostly the congestion and bulging) and the treatment will be the same. However, the complications are different.
- The patient will be in severe pain before the rupture of tympanic membrane due to the nerve stimulation and irritation by tension.

Complication of acute and chronic OM:

- Extracranial: Acute mastoiditis ,Chronic mastoiditis, Postauricular abscess, Bezold abscess, Temporal abscess, Petrous apicitis, Labyrinthine fistula, Facial nerve paralysis, Acute suppurative labyrinthitis.

- Intracranial: Meningitis, Brain abscess, Subdural empyema, Epidural abscess, Lateral sinus thrombosis, Otitic hydrocephalus, Encephalocele and cerebrospinal fluid leakage.



Tubal occlusion → Bulging → Suppurative inflammation (redness) → Rupture of the tympanic membrane (discharge) → It either resolve totally with minimal retraction or it is still perforated.

Diseases of the Middle Ear Con.

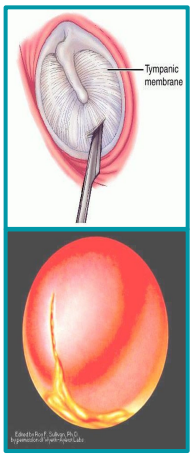
◀ Pathophysiology of the Middle Ear Infection

Inflammation of the Eustachian tube lead to narrowing lead to block no ventilation to middle ear lead to congestion of mucosal lining lead to accumulation of fluid if its small amount it resolve if not this fluid has 2 ways to go : rupture the tympanic membrane or go to the mastoid.

The patient has an antecedent event (viral URI or allergy) → the event results in Congestion of the respiratory mucosa of the nose, nasopharynx, and Eustachian tube → Congestion of the mucosa in the Eustachian tube obstructs the narrowest portion of the tube, the isthmus → obstruction of the isthmus causes negative pressure followed by accumulation of secretions produced by the mucosa of the middle ear → these secretions Have no egress and accumulate in the middle ear space → viruses and bacteria that colonize the upper respiratory tract can reach the middle ear via aspiration, reflux, or insufflation → microbial growth in the middle ear secretions may result in suppuration.

◀ Treatment of the Middle Ear Infection

- Symptomatic
- Antimicrobials.
  - Amoxicillin (1st line) if allergic to penicillin & cephalosporins you give clarithromycin.
  - Amoxycillin/clavulanic acid (B-lactamase bacteria) 2nd line.
  - Trimethoprim-Sulfamethoxazole.
  - Cefaclor, cefixime.
  - Erythromycin-sulfisoxazole.
- Decongestant.
  (to help open the eustachian tube and get rid of the pus in the middle ear).
- Myringotomy
  (tympanic membrane controlled incision in severe cases) +/- tube.
  If the incision Is parallel to the fibers the healing will be faster
- Ear toilet and local antibiotics.
- Bulging + severe pain + adult > open small opening to relieve the pain.
- If not → nasal steroid spray so eustachian tube opens and remove the pus + oral ABx.

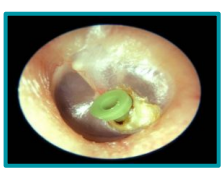
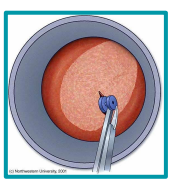
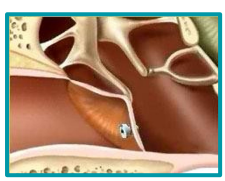


◀ Recurrent Otitis Media

- Three or more attacks over a 6-months period or (six attacks in a year).
- O.M. + diffusion > sterile fluid in the middle ear, or dysfunctioning Eustachian tube like in down syndrome or cleft palate.

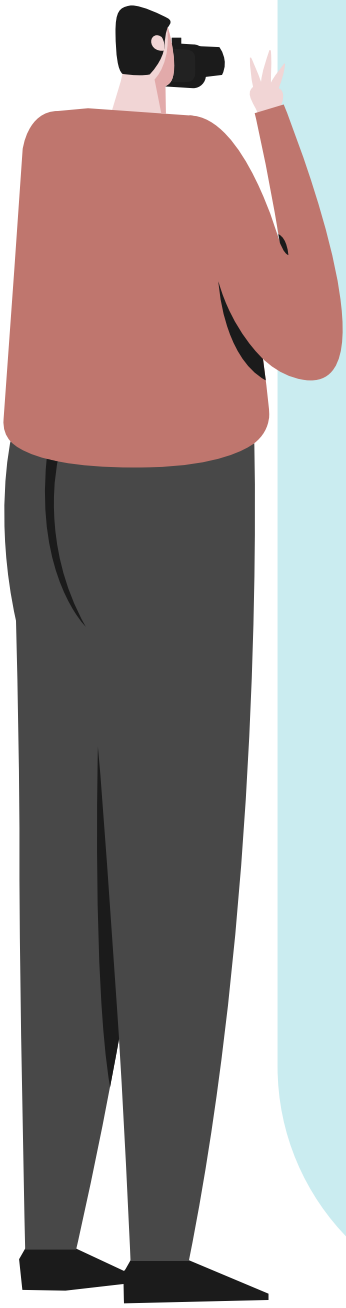
◀ Treatment of the Recurrent Middle Ear Infection

- Long-term low dose antimicrobials.
- Ventilation tube insertion, in the inferior part which allows the air to enter the middle ear and drainage (open) of fluid from the Eustachian tube.
- The ventilation tube is inserted inferiorly to avoid injury to the ossicles.

EXTRA: (Myringotomy with pressure equalization tube) Most common in acute otitis media after resolving there will be fluids. Pediatrics last for 3-6 weeks if more it will affect speech, so we drain through eustachian tube

THANK YOU!



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