



# Ear I-II

## Objectives:

- Anatomy of the ear.
- Physiology of the External, Middle, Inner ear.
- Otitis Externa
- Malignant Otitis Externa
- Otitis Media

**Resources:** 436 slides and notes, 435 Team

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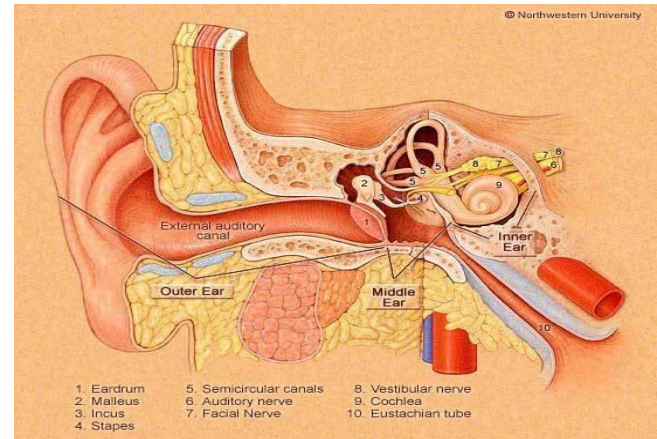
**Edited by:** Khalid Alhusainan

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## Anatomy of the ear

it has 3 parts:

- **External ear:** From the outer part till the eardrum (tympanic membrane). It contains the Squamous part of tympanic membrane.
- **Middle ear:** (tympanic cavity); From the eardrum till the stapes footplate. It contains the mucosal part of tympanic membrane.
- **Internal ear:** Cochlea and vestibule (semicircular canals for angular acceleration and the saccule for linear acceleration).



Those are simple vedios can summries the anatomy of [external](#), [middle](#), [inner ear](#) (recommended)

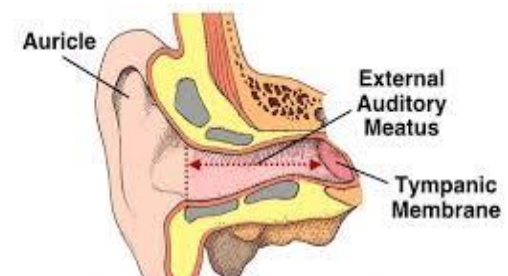
### External ear:

Formed of **Auricles (pinna)** and **External auditory meatus** (auditory canal) and both are lined by skin (Auricle and meatus).

#### • Auricle:

is fibrous cartilage "thin" (except lobule area-no cartilage) lined by skin ... what is its significance?

- In case of Perichondritis (lobule is intact) but in case of any skin problem like Erysipelas, all of auricle is affected. - Auricle is attached to temporomandibular joint (so, movement of this joint will aggravate the pain in case of inflammation of pinna)



**External auditory meatus**

#### • The external auditory meatus (External Auditory Canal (EAC)):

(2.5 cm long) is an S shape canal

- In pediatric it might be straight but in adult it's curved (it's also could be straight if canaloplasty was done)
- (to protect the eardrum and middle ear. Normally we must hump one anterior and one posterior. So, at examination you should pull the auricle posteriorly and superiorly to straighten the canal "Push the pinna upward, backward and lateral". In infant downward and backward.



Erysipelas



Perichondritis

Perichondritis: redness, discharge

Erysipelas: skin infection with staph and there is redness

- **External Auditory Canal consists of:**

- **Cartilaginous part (outer 1/3) of canal length:**

- Contains small amount of subcutaneous tissue
- appendages formed by elastic cartilage and contains ceruminous glands (secrete wax), hair follicles, sebaceous and apocrine glands all together called (**apopilosebaceous unit**).

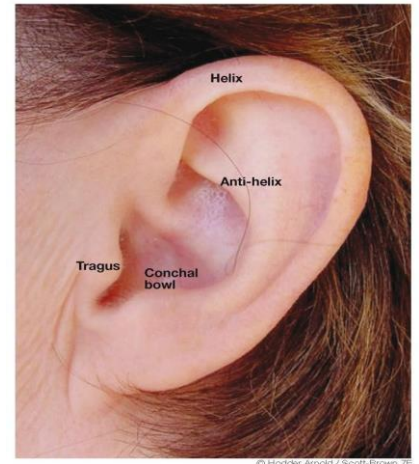
- Best place to take cartilage as grafting from, without affecting the shape, are: **TARGUS** (especially in rhinoplasty because it's straight) **Concha and Scaphia** (for tympanoplasty).

- **If No anti-helix what's the shape of ear? Bat ear.**

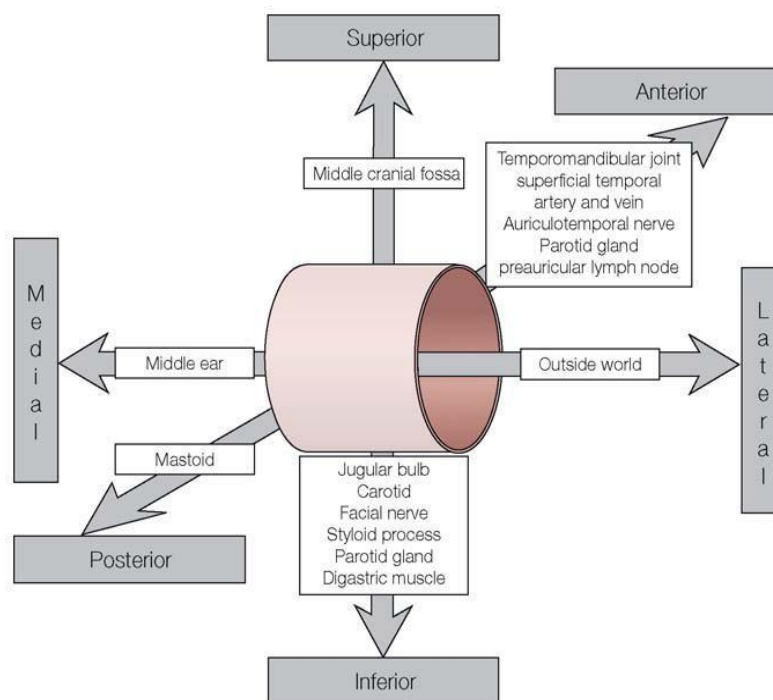
- **Bony part (inner 2/3) is osseous:**

The narrowest portion is at the bony-cartilaginous junction. No subcutaneous tissue or appendages developed after birth. **No hair or wax here! Unless pt pushes it inside and if so, it won't go out, he most came for wash.**

- The skin is thin(0.2mm) **skin over bone** and easy to be injured during examination. Natural constriction. Another area of constriction is at the tympanic membrane.



- **Anatomical relations of external auditory canal: IMPORTANT**



- كثير يجون يشتكون من أذنانهم والمشكلة تكون ب (temporomandibular joint) TMJ علشان كذا يعتبر واحد من ال DDX لألم الأذن

- الباروتيد بتجي انتيريوبرولي وانفيريوبرولي

## Tympanic membrane (TM):

- it separates the external ear from middle ear
- the Tympanic Membrane is divided into **2 parts**:
  - **Pars Tensa. 80%**
  - **Pars Flaccida. 20%** (thin and weak. it goes with negative pressure inside & if you do Valsalva it will go outside)

### And consist of three layers:

- **Outer layer** stratified squamous epithelium (skin), ectodermal origin. [epithelial layer](#)
- **The middle layer** or lamina propria fibrous layer, mesodermal origin. (**present only in pars tensa which makes pars flaccida more prone for perforation**) [fibrous layer](#)
- **The inner layer** of endodermal origin, comprising the middle ear mucosa. [Mucosal layer](#)

➤ **TM supplied mainly** by V3 (Mandibular) anterior, and X (Vagus) posterior on lateral (outer) aspect, IX (Glossopharyngeal) on medial (inner) aspect.

### ➤ How can we determine this is right or left ear?

By the angle of cone of light and handle of malleus If right-> right ear .... Left -> left ear.

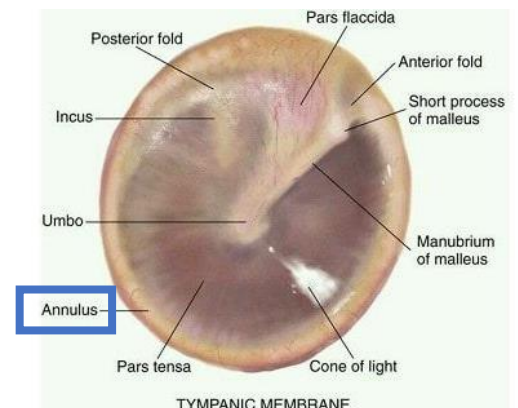
- In case there was retraction of the tympanic membrane > narrowing of the light cone, and if it was bulging (fusion) > widening of the light cone

Annulus is a fibrous band around the pars tensa that holds the tympanic membrane. if it's affected through marginal perforation that means the (stratified squamous) skin that is inside the external ear canal can go inside and induce a cholesteatoma

**Cholesteatoma** is not a tumor or high cholesterol, basically it's a normal skin in abnormal place (mucosa.) It will eat the bone. Pars flaccida has no annulus so cholesteatoma can happen through it also.



**Figure 1.2** The normal tympanic membrane (left). The shape of the incus is visible through the drum at 2 o'clock. The 'pars flaccida' is the part of the eardrum that covers the upper section of the middle ear. The drum is more 'tense' in the lower section – hence it is called the 'pars tensa'.





## Middle ear:

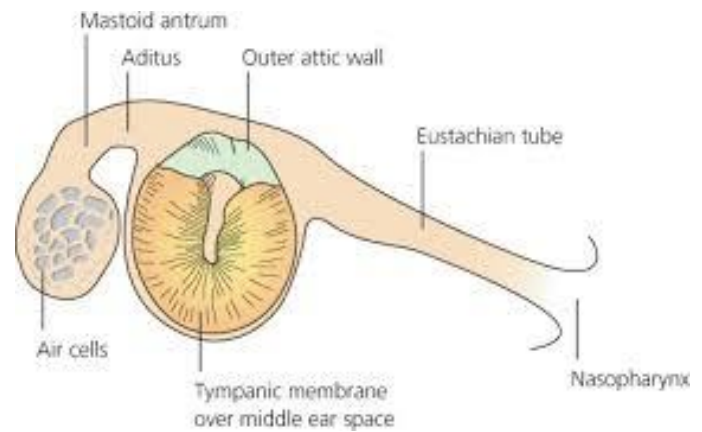
### ● Lining of the middle ear:

ciliated columnar anteriorly, and cuboidal or flat elsewhere. Mucous membrane of the middle ear space consists of stratified cuboidal epithelium, which changes to pseudostratified ciliated epithelium around the mouth of the Eustachian tube.

### ● Middle ear cleft formed of: **important**

- Eustachian (Pharyngo-tympanic) Tube.
- Tympanum (Middle Ear Cavity/proper).
- Mastoid Antrum and Air Cells.

In OR you see opening from middle ear to mastoid is called Aditus (bridge). But From mastoid to middle ear is called antrum (largest air cell in mastoid)



### ❖ Eustachian (Pharyngo-tympanic) Tube<sup>1</sup> :

- Connect the middle ear cavity with nasopharynx “nasal cavity” (upper aerodigestive tract).
- Lies adjacent to the ICA (internal carotid artery).
- 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
- open at torus tubarius<sup>2</sup>.

#### ➤ Parts of Eustachian Tube:

- Proximal 1/3 is bone.
- distal 2/3 is fibrocartilaginous. **That is collapsed at rest**
- \* Junction between 2 parts is isthmus, **narrowest part of the tube.**

#### ➤ Physiology of Eustachian tube:

- Opens actively by contraction of tensor veli palatine and passively by contraction of levator veli palatine (it releases the tension in tubal cartilage).
  - Closed by elastic recoil of elastin hinge + deforming force of Ostmann’s fat pad.
  - Protection, Drainage, **Ventilation** “air entry” (**most important function**): - The tube protect from anything comes from the nasopharynx to go to the middle ear
  - The tube permits aeration of the middle ear and if it is obstructed fluid may accumulate in the middle ear causing deafness.
  - The tube equalizes the air pressure during breathing with the external environment
- عشان كذا لما تهبط الطائرة يكون الضغط عالي فنحاول نقله عن طريق العمليات الي تفتح الانبوب هذا منها (Valsalva)

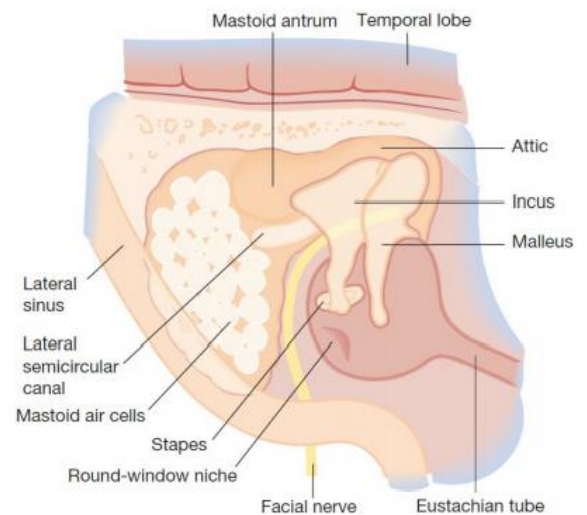


Figure 1.3 Diagram to show the anatomy of the middle ear and mastoid air cells.

<sup>1</sup> The Eustachian tube connects the middle ear with the nasopharynx at the back of the nasal cavity. Any fluid in middle ear it will drain into nasopharynx

<sup>2</sup> Torus tubarius of the auditory canal is a mucosal elevation in the lateral aspect of the nasopharynx

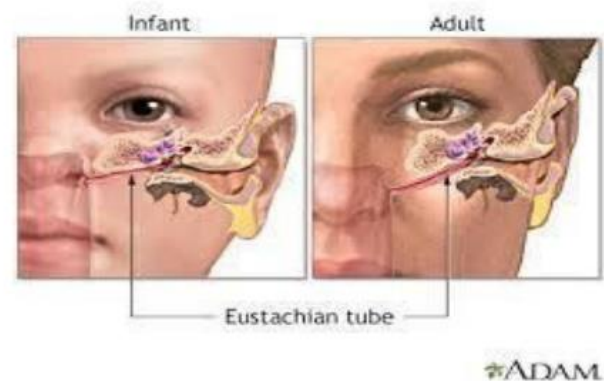
The tube is shorter, wider and more horizontal in the infant than in the adult.

- 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 who often develop accumulation of middle-ear fluid (otitis media with effusion).

Adult vs INFANT

	ADULT	INFANT
Length	36 mm	18 mm
Angle with horizontal	45 °	10 °
Lumen	Narrower	Wider
Angulation at isthmus	Present	Absent
Cartilage	Rigid	Flaccid
Elastic recoil	Effective	Ineffective
Ostmann's fat	More	Less



## ❖ Tympanic cavity (Middle ear cavity):

### ➤ Contents of tympanic cavity:

○ Ossicles: the malleus, incus and stapes (The smallest bone in the body)

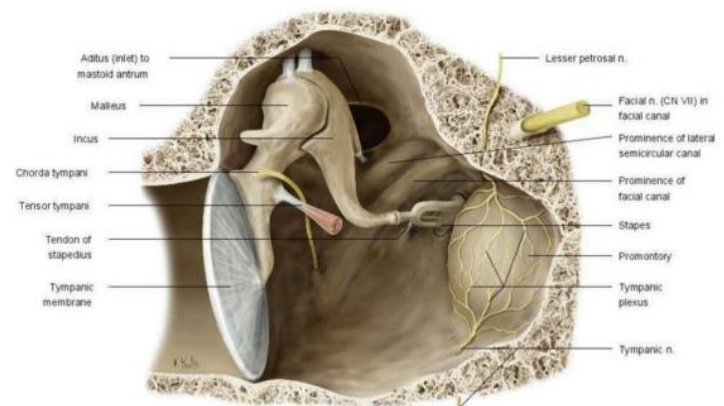
○ Intratympanic muscles: Tensor tympani<sup>3</sup>, Stapedius<sup>4</sup>

○ Chorda tympanim.

○ Tympanic plexus.

- The neck of Stapes receives the insertion of stapedius muscle. 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 (Attenuation reflex).

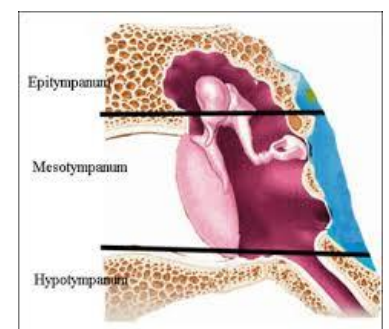
- Neck of Malleus receives the insertion of Tensor tympani muscle.



- **Epitympanum**: area above the tympanic membrane is the place where the most acquired cholesteatoma happens because the pars flaccida is here, so when retraction happens this is the first place to get affected called: **Prussak's Space**.

- **Mesotympanum**: area adjacent to tympanic membrane, the one we see it once we open tympanic membrane.

- **Hypotympanum**: area below the tympanic membrane



<sup>3</sup> Attached to neck of malleus has a lowering effect

<sup>4</sup> Main power for stabilizing sound.

### ➤ 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 muscle** supplied by the mandibular division of the **trigeminal nerve**.

### ➤ Clinical importance of walls of middle ear:

- Fracture of temporal bone (roof of middle ear cavity) will be presented by either CSF otorrhea or rhinorrhea.
- Lateral sinus thrombosis secondary to otitis media (posterior wall).

– The middle cranial fossa of the brain is separated from the middle ear by the tegmen tympani.

– 1 st turn of the cochlea forms the promontory

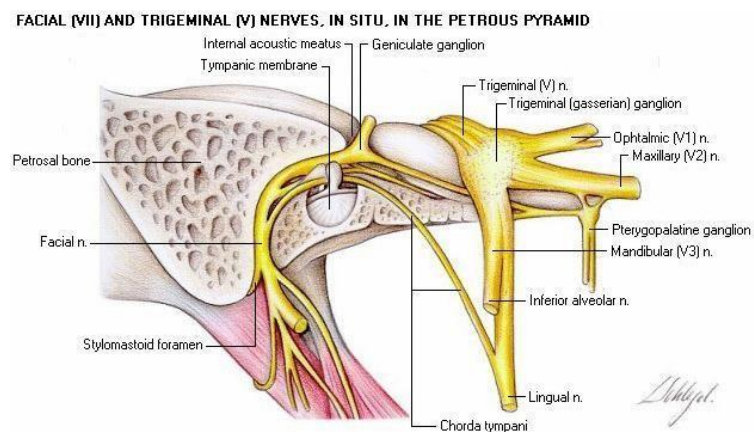
– Chordae tympani is a branch of CN7

– The canal of the carotid a. doesn't go into the middle ear but it's adjacent to it.

How many nerves passes through? **Facial, Jacobson (branch of 9th CN), chordae tympani.** Facial pass on top of the stapes, Jacobson passing through promontory, chorda tympani in the middle ear and supply the lingual nerve for anterior  $\frac{2}{3}$  of the tongue.

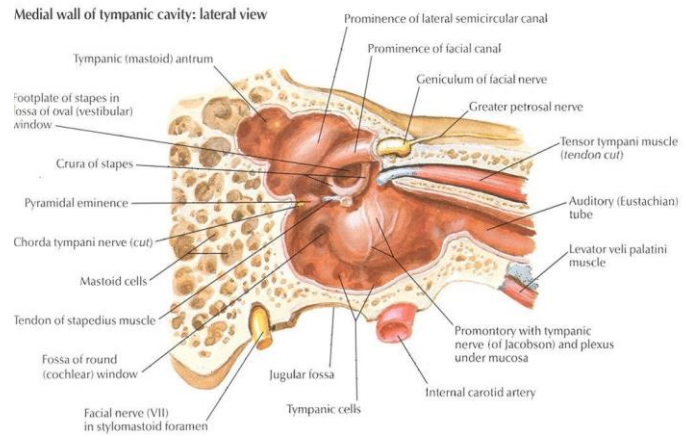
Facial nerve come from nucleus in pons go to **internal auditory canal along with 8th CN** , then passes into three canals (Labyrinth, tympanic “the most dehiscent [without bone coverage] part of the facial nerve” , mastoid) then it leaves the canal through stylomastoid foramen and turns into 5 branches (temporal, zygomatic, buccal, marginal mandibular, cervical).

- Why this is important? During any ear surgery especially in the stapes, the adhesive part of the facial nerve could be collapsed preventing the surgery<sup>5</sup>

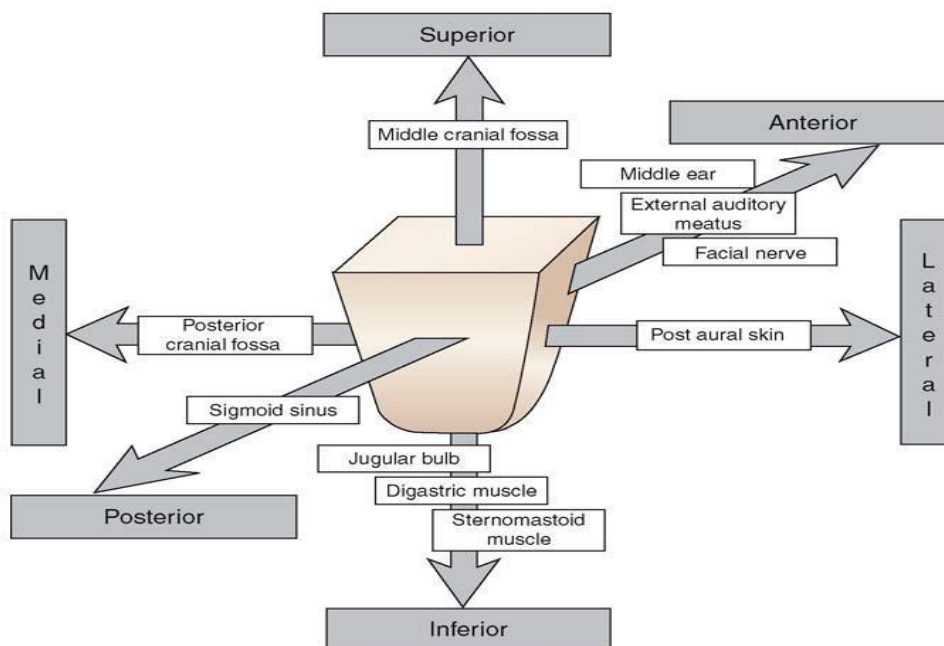


## ❖ Mastoid<sup>6</sup> antrum and air cells:

- 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.

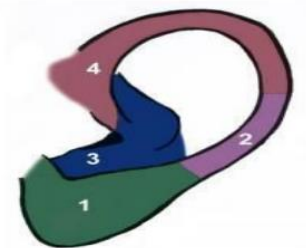


## ➤ Relationships of the mastoid antrum:

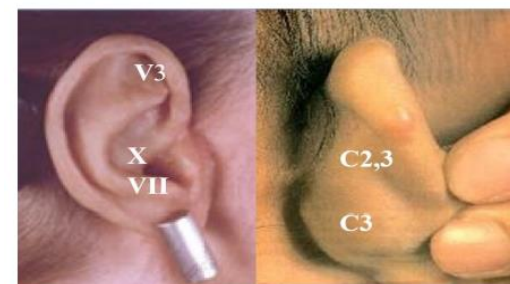


## ❖ SUPPLY OF MIDDLE AND EXTERNAL EAR:

- **Great auricular nerve (C2, C3):** lobule, lateral/inferior auricle
- **Lesser occipital (C2):** medial surface of pinna
- **Auricular branch of vagus (Arnold's):** concha, Post canal wall **important** ( if you put cotton inside the ear you will feel tingling in pharynx this is vagus )
- **Auriculotemporal nerve (V3):** tragus. anterior helix, Ant canal wall
- **Facial nerve:** concha, Post canal wall (if you have infection in facial nerve palsy you have to look in the ear you may see vesicles)



- Key:**
1. Great auricular nerve
  2. Lesser occipital nerve
  3. Auricular branch of vagus nerve
  4. Auriculotemporal nerve



<sup>6</sup> Mastoid is an air cavity behind the middle ear to mastoid tip, in children less than 2 years it's filled with bone marrow so if we drill there it's going to be bloody. Also, it gets elongated when the child begins to rise his head by sternocleidomastoid muscle.



## ❖ Referred Earache<sup>7</sup>: **important**

50% of ear pain is from outside the ear.

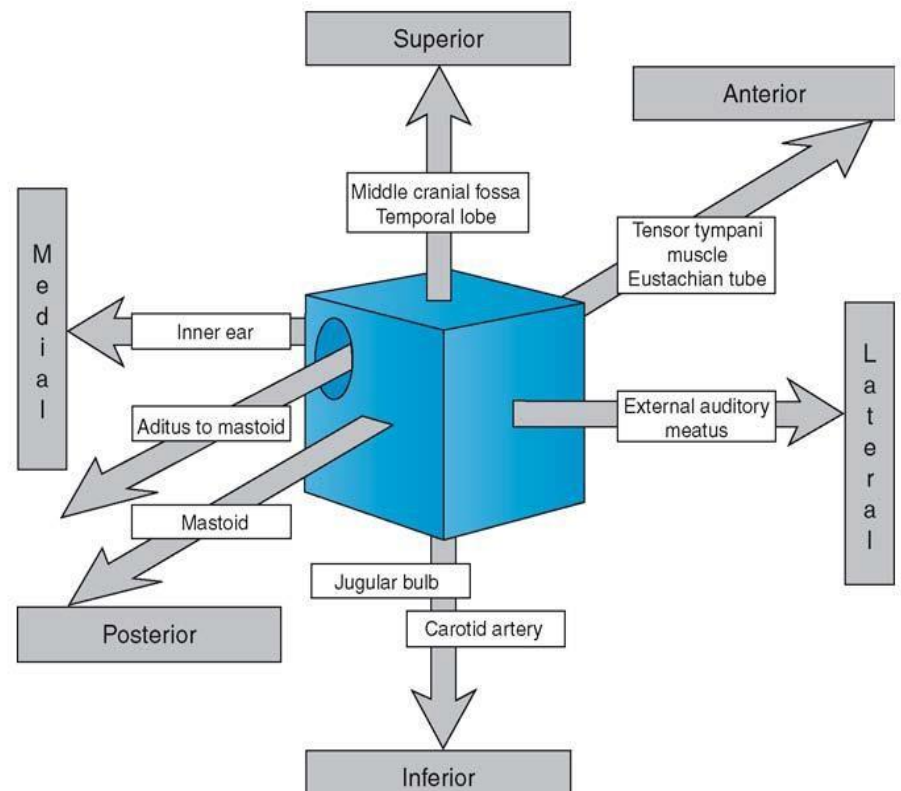
➤ Pain in the ear due to a disease in an area supplied by a nerve that also supply the ear.

○ **Cervical II & III**: Cervical spondylosis, neck injury (**disc, muscle spasm**) etc.

○ **V (Trigeminal) cranial nerve**: Dental infections, sinonasal diseases etc.

○ **IX (Glossopharyngeal) cranial nerve** (**branch of CN 9 called Jacobson in the promontory**): Tonsillitis, pharyngitis, 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.**



### Important!

- Floor: internal jugular vein and common carotid
- Lateral: tympanic membrane
- Medial: promontory of the cochlea

<sup>7</sup> During examination of the ear the pt may cough (glossopharyngeal reflex) or vasovagal attack (vagus nerve)

## Inner ear

### • Consists of:

- Osseous Labyrinth
- Internal auditory canal.

### A) Labyrinth

consists of:

#### ○ Bony Labyrinth

its parts:

- Bony Cochlea 35 mm long, 2.5 turns.
- Vestibule
- Bony semicircular canals.

Its contents:

- **Perilymph fluid:** extracellular-like fluid; found in scala tympani and vestibuli

✓  $K^+ = 4 \text{ mEq/L}$

✓  $Na^+ = 139 \text{ mEq/L}$ .

#### ○ Membranous labyrinth

##### ■ Cochlear duct

■ Sacculle (inferior) and utricle (superior) > both form the **endolymphatic duct** extended to the dura laterally (its important in meniere's disease "increased perilymph" we used it for shunt placement).

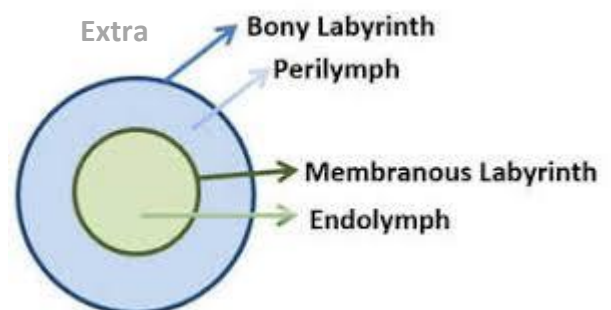
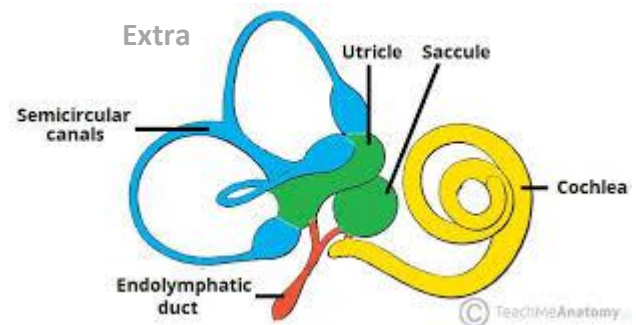
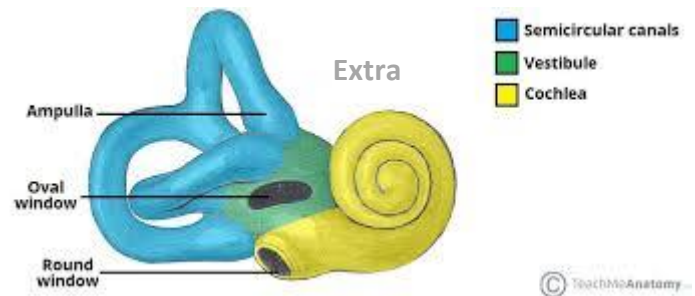
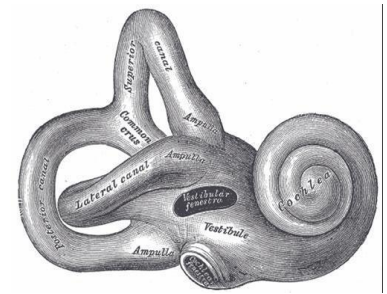
##### ■ Membranous semicircular ducts.

Its contents:

- **Endolymph:** intracellular-like fluid; found in scala media; contributes to positive DC resting potential of 80 mV in scala media; produced from perilymph by marginal Membranous Labyrinth cells of stria vascularis; absorbed within the endolymphatic sac.

✓  $K^+ = 144 \text{ mEq/L}$

✓  $Na^+ = 13 \text{ mEq/L}$



## - Sensory epithelium:

☒ Cochlea:

○ **Organ of Corti**<sup>8</sup>: rests on basilar membrane and osseous spiral lamina; major components include:

- Outer and inner hair cells.
- Supporting cells: provide structural and metabolic support.
- Tectorial membrane.
- Reticular lamina.

☒ Utricle & saccule: **maculae**.<sup>9</sup>

☒ Semicircular canals: **cristae** (angular acceleration). Fluid can move both way that's why responsible for angular acceleration.

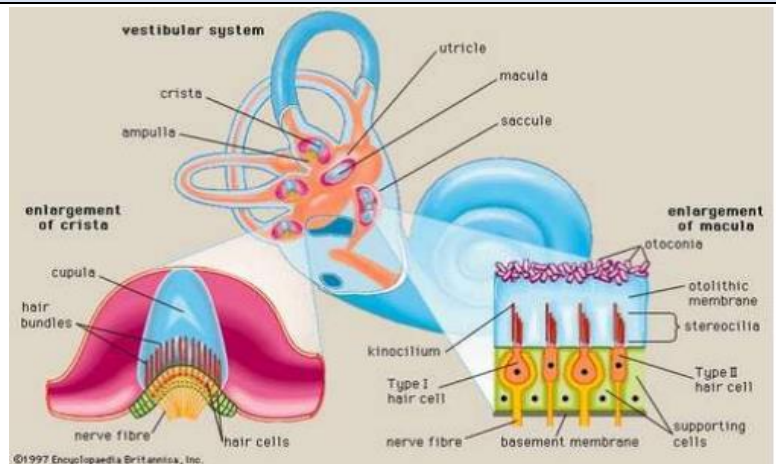
### Utricle & saccule and cristae of the Semicircular canals:

How many factors our balance depends on?  
1- proprioception 2- vision 3- cerebellum

○ So, you have to make sure when someone came to you with imbalance it's not b/c of the cerebellum by testing it, then roll 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.

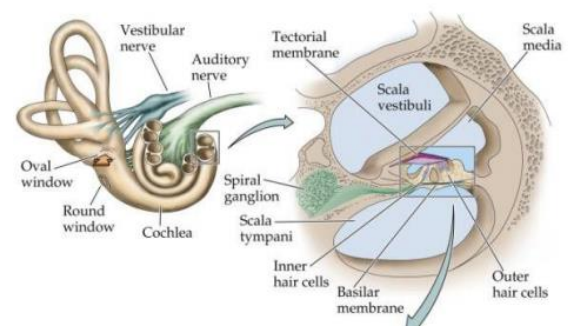
- In case of dizziness related to ear problem; it's either due to effect in the vestibular nerve (called vestibular neuritis due to URI) or Benign positional vertigo ( inside the vestibule there are fluid and gelatinous material that has Ca particles within it ; with minor trauma or any minor head concussion these Ca particles will go out from the gelatinous material to the fluid > once the pt. Moves his head up > movement of these Ca particles rapidly "when it was in the gelatinous material its movement was slowly" > vertigo not imbalance > treated by repositioning exercise after checking the type of nystagmus "horizontal = lateral Semicircular canal , rotatory= superior (geogravic) and posterior (ageogravic) Semicircular canals the pt. have)



### Cochlea:

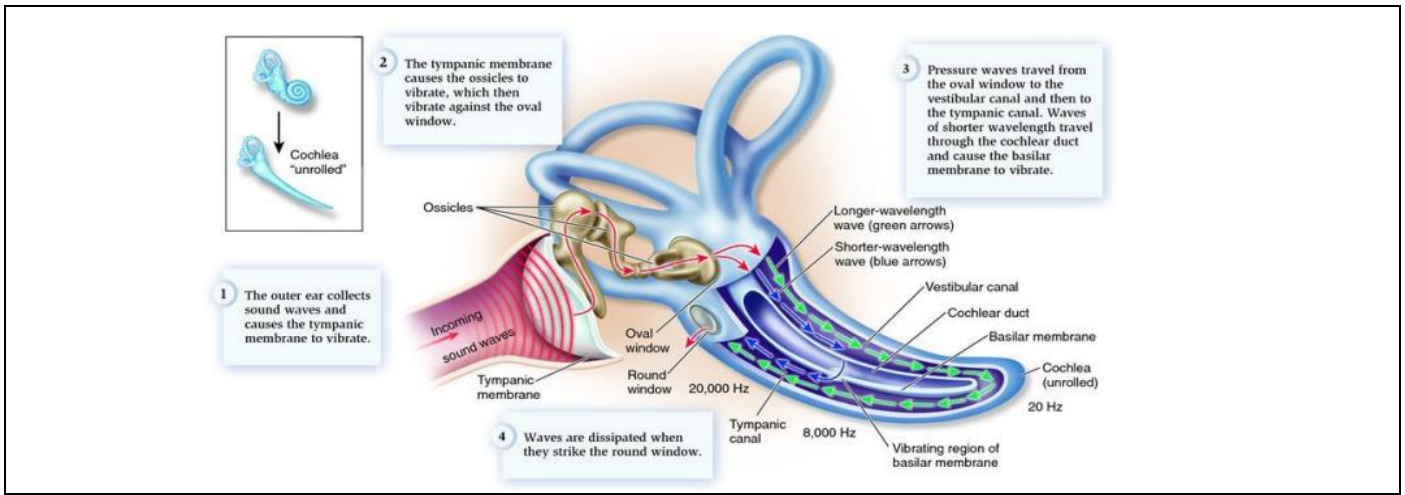
The cochlea is divided into 3 rooms (scala tympani, scala media, scala vestibuli)

- Most important is scala media; where hearing takes place. It contains hair cells and tectorial membrane.
- The sounds wave vibrate the Tympanic membrane -> the ossicles move ( stapes act as a piston in scala vestibuli) it pushes the fluid away , and at the apical part (helicotrema) the fluid back to scala media so the wave of fluid will push the hair cells in it and it will touch tectorial membrane and will produce electrical stimulus and pass it to through the spiral ganglion to the 8th nerve.



<sup>8</sup> (has inner and outer hair cells → **responsible for hearing**) – (each part of the cochlea responds to specific kHz to conduct to the nerve) - responsible for linear acceleration

<sup>9</sup> The saccule tells you when you stop moving and the utricle is responsible for head tilting) - linear acceleration

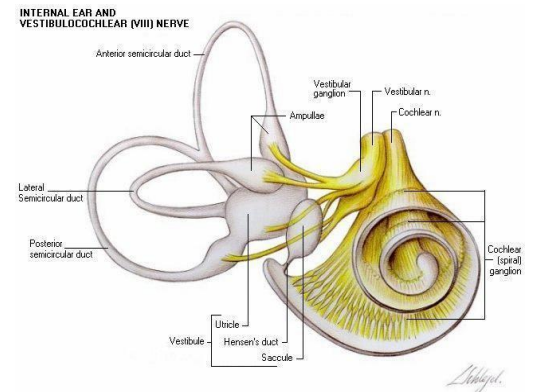


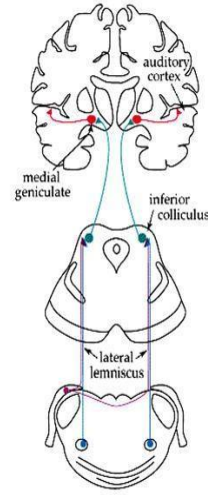
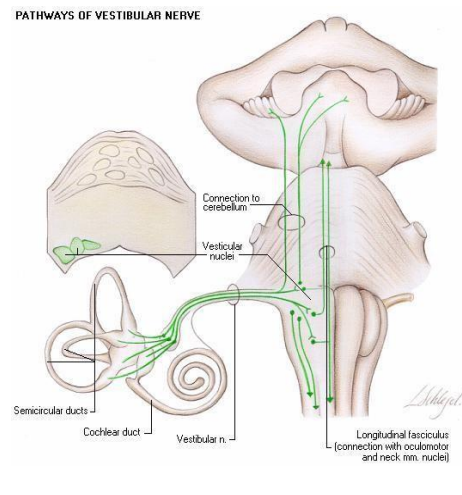
Sound of High frequency affects the basal portion of Cochlea

Sounds of Low frequency affect the apical portion of Cochlea

### B) Internal Auditory Canal

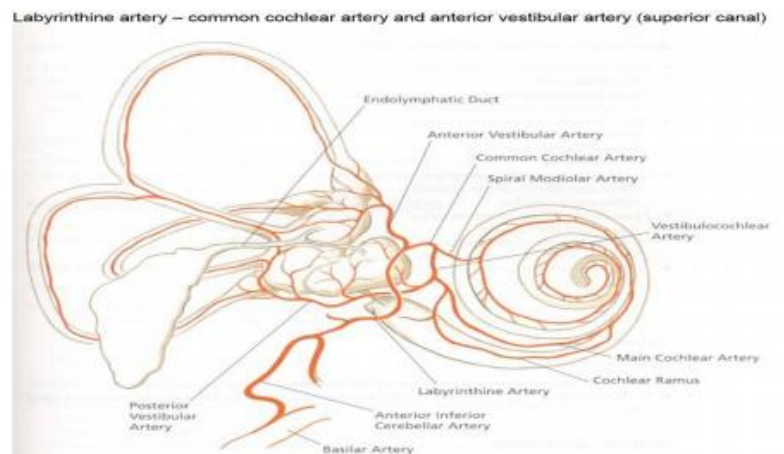
Contains: o Cochleovestibular nerve o Facial nerve



CENTRAL CONNECTIONS OF COCHLEAR NERVE	CENTRAL CONNECTIONS OF VESTIBULAR NERVE
<p>The principal human auditory cortex is located deep within the sylvian fissure on the superior surface of the temporal lobe</p> <p>The primary auditory cortex is often referred to as Brodmann .area 41</p> 	<p>PATHWAYS OF VESTIBULAR NERVE</p> 

### ➤ Blood supply of inner ear:

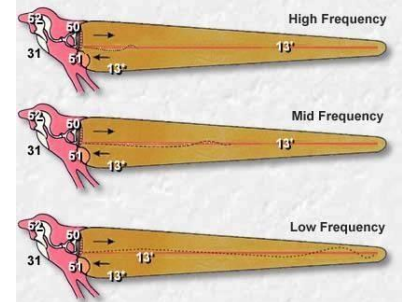
- Anterior inferior cerebellar artery
- Labyrinthine artery→ common cochlear and anterior vestibular



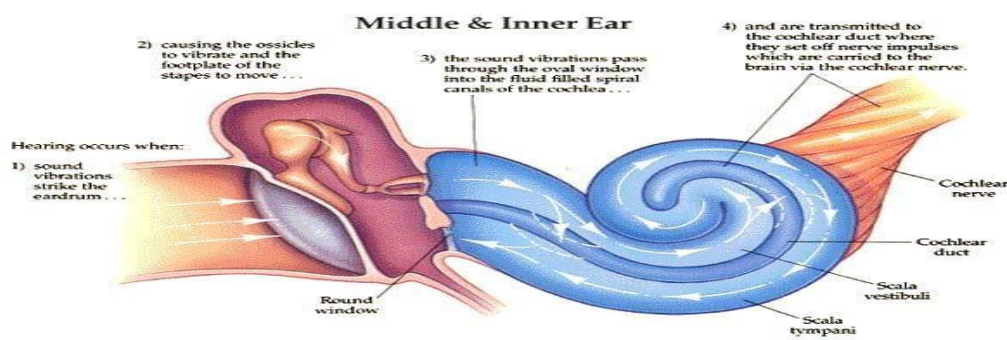
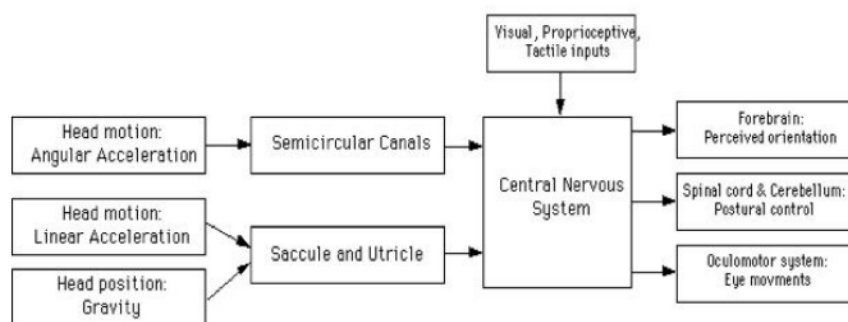


## Physiology of the ear

	Function
External Ear	<ul style="list-style-type: none"> <li>● <b>Protection of the middle ear:</b> - Cerumen (wax), - Curvature.</li> <li>● <b>Auditory functions:</b> – Sound Conduction. – Increase sound pressure by the resonance function</li> </ul>
Eustachian Tube	<ul style="list-style-type: none"> <li>● <b>Protection.</b></li> <li>● <b>Ventilation.</b></li> <li>● <b>Drainage</b></li> </ul>
Middle Ear <sup>11</sup>	<ul style="list-style-type: none"> <li>● <b>Conduction of sound</b><sup>10</sup></li> <li>● <b>Transformer mechanism:</b> - Hydraulic action, - Ossicular leverage</li> <li>● <b>Protection to the inner ear.</b> - Stapedial reflex, If the sound very loud it contracts to reduce the sound energy</li> </ul>
Inner Ear	<ul style="list-style-type: none"> <li>● <b>Hearing Function:</b> ○ Transduction of sound to action potentials<sup>12</sup></li> <li>● <b>Vestibular Function</b><sup>13</sup>:               <ul style="list-style-type: none"> <li>○ Participate in maintaining body balance, the mechanisms of maintaining body balance: (see up for more info)</li> <li>○ Brain stem: is the center of balance. It's connected to:                   <ul style="list-style-type: none"> <li>■ Cerebellum to coordinate muscle tone and Cerebral cortex for the feeling of space.</li> <li>■ Input: Proprioceptive (sensation) Visual Vestibular</li> <li>■ Output: gives information to: Postural muscles and Ocular muscle.</li> </ul> </li> </ul> </li> </ul>



### VESTIBULAR SYSTEM



<sup>10</sup> there is amplification of the sounds when it transferred from big area to smaller one (tympanic membrane about 8mm and the stapes 2mm) also the difference in length b/w the malleus "longer" and incus "shorter" (about 1.3) increases the amplification; that's why the sound which we receive increases in almost 500-800 db - If there is reflection of the round window that's means the ossicle function is good,

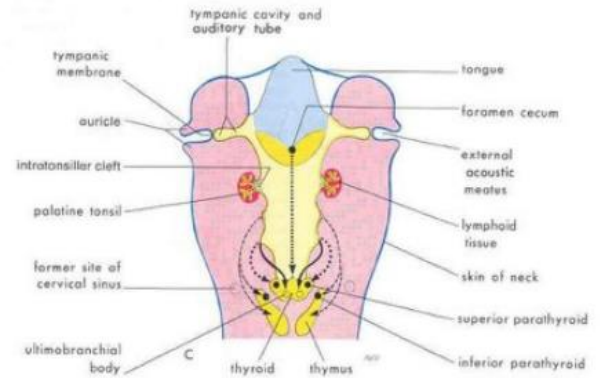
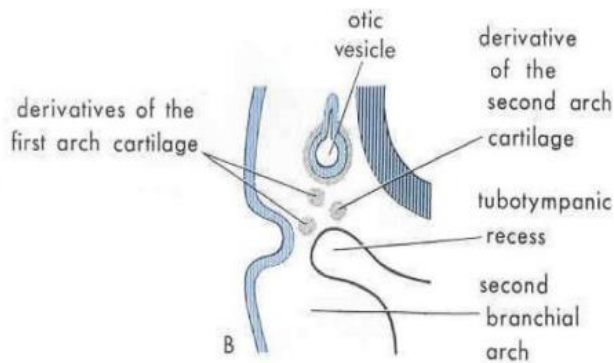
<sup>11</sup> middle ear plays an important role in the process of impedance matching between the air-filled middle ear and the fluid-filled inner ear to allow for efficient sound transmission (**Impedance matching**-amplification-): Area ratio between the TM and the stapes footplate (20:1), Ossicular Coupling: lever ratio

<sup>12</sup> Any disease lead to closure of the round window will result in conductive hearing loss in the inner ear

<sup>13</sup> Balance is central and peripheral. Central: brain stem, cerebellum and cerebral cortex. Peripheral: vision, vestibular and proprioception. How to examine it? Gait, Eye movement (nystagmus).

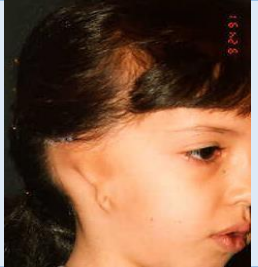


## Development of the ear

- **External ear:** 1st pharyngeal cleft & arch
- **Middle ear:** 1st pharyngeal pouch & 1st and 2nd arches
- **Inner ear:** Ectoderm of hindbrain



## Diseases of the external ear

### congenital diseases

Anotia (Atresia):	<ul style="list-style-type: none"> <li>● It's the total absence of the auricle most often with narrowing or absence of the external auditory meatus.</li> <li>● CT; to check if there is other malformations (internally).</li> </ul> <p><b>Bone conduction is preserved Treatment: bone hearing aid B.A.H.A (on mastoid).</b></p>	
Microtia:	<ul style="list-style-type: none"> <li>● 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</li> <li>● Any kind of remnant</li> </ul>	
Accessory auricle:	<ul style="list-style-type: none"> <li>● It's a type of ear anomaly in the tragus area.</li> <li>● Treatment: Plastic reconstruction, B.A.H.A (bone anchored hearing aid). <b>It can present with no effect.</b></li> </ul>	

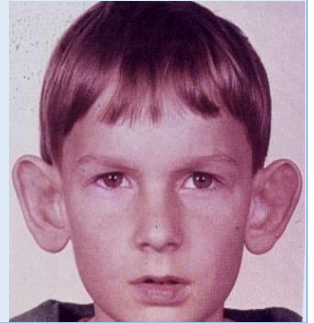
## Preauricular sinus:

- It's a common congenital malformation characterized by a nodule, dent or dimple located anywhere adjacent to the external ear.
- **Susceptible to infection**
- **Management:** systemic antibiotics. If an abscess is present, it must be incised and drained (If got infected twice you must take it out by first testing its pathway through methylene blue injection or CT scan with contrast, but in the time of inflammation we do incision and drainage.)



## Protruding Ear: Bat ear:

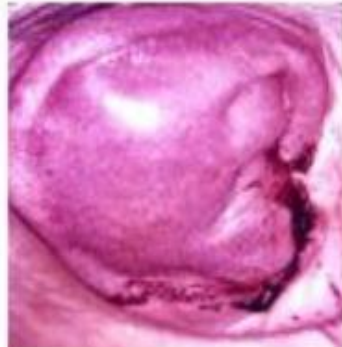
- management:** "cosmetic" Pinnaplasty or otoplasty. Do if after age of school. Note: There is no direct blood supply to the cartilage!
- Antihelix pulls ear back while helix pushes it forward; Antihelix is absent



## ❖ Trauma to The Auricle:

- Lacerations - Hematoma auris
- 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)**.



Cauliflower ear

## ❖ PERICHONDritis OF THE PENNA:

○ **Perichondritis** is inflammation of the perichondrium, a layer of connective tissue, which surrounds cartilage. (with spared lobule area)

○ 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).

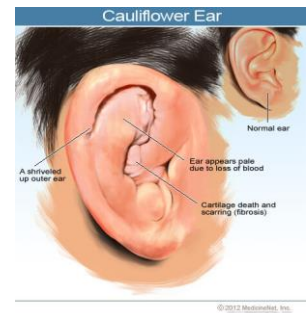
○ Commonly caused by **Pseudomonas**.



- Fever, pain, redness and swelling (causes narrowing and further low hearing level).
- Treatment: must be vigorous and **immediately** by parenteral antibiotics & Evacuation (incision & drainage, removal of necrotic tissue.)
- (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:**

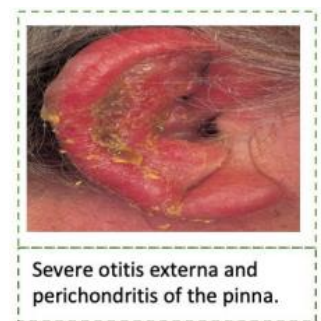
- **Cauliflower ear** (End stage of untreated haematoma). The ear can be exposed to trauma and lacerations leading to the **formation of Hematoma**, so if anything happens between the skin and cartilage → Hematoma (Number 1 killer of the cartilage, why? Because the blood will not be able to reach the cartilage) → Ischemia → Necrosis → Ear deformity



❖ **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.**

An acute or chronic infection of the whole or a part of the skin of the external ear canal.

- Organisms enter the apopilosebaceous 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



○ **Pathophysiology:** – Aggressive washing of wax or retention water, Microtrauma (cotton swabs, fingernails).

Investive	Reactive
<ul style="list-style-type: none"> <li>– <b>Bacterial:</b> <b>Pseudomonas</b> (commonly in immunocompromised like diabetic, post radio or chemotherapy and it has a very bad smell if it presents with Cholesteatoma), <b>Staphylococcus aureus</b> (furuncle) most common, like in swimming ear. <b>Proteus mirabilis</b>.</li> <li>– <b>Fungal:</b> (newspaper appearance) <b>Aspergillus Niger</b> (spores forming, hyphae), <b>Candida albicans</b> (whitish and cheesy, cotton like) dx by seeing it.</li> <li>– <b>Viral:</b> <b>Herpes Zoster</b><sup>14</sup> ... Others</li> </ul>	<ul style="list-style-type: none"> <li>■ <b>Seborrhea:</b> A disease of the sebaceous glands characterized by <b>excessive secretion of sebum</b> or an alteration in its quality, resulting in an oily coating, crusts, or scales on the skin. It's usually painless</li> <li>■ <b>Eczema/Dermatitis:</b> A <b>non-contagious inflammation</b> of the skin, characterized chiefly by redness, itching.</li> </ul>

<sup>14</sup> Ramsay Hunt syndrome (RHS): facial nerve palsy (weakness) and vesicles.



## ○ Clinical features of Otitis Externa:

### History:

#### – 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:** No discharge or 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:** 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)

### Physical exam:

Redness, swelling **sometimes you can't see the TM because of the swelling**, protrusion: discharge, preauricular or face or neck extension

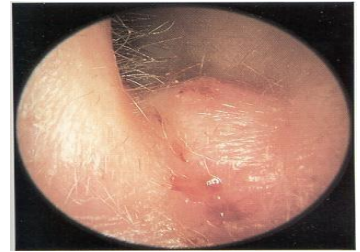
Gently tug up and back: if true AOE, **patient will not tolerate**

Clean canal thoroughly and examine under Microscope

## Clinical types of otitis externa

### ❖ Localize O.E (furuncle):

- small rounded swelling in the external canal.



### ❖ Diffuse infective O.E.: swimming ear

- General narrowing of the canal. (on Ex we can't see the external canal b\c of the edema) The canal will close, and you will not be able to pass anything through it

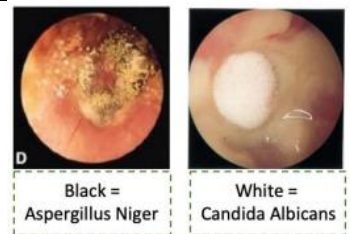


علشان كذا لما نبي ندخل لهم قطرات نستخدم شاش ندخله داخل الأذن ونصير نبلة بالقطرات  
علشان توصل داخل وقت الانفيكشن ما نسوي أي تدخل جراحي لأنه يسبب ادهيجن وفايروسيس

### ❖ Otomycosis: fungal infection (More in those who take Abx for a long time)

- Fungal vs. Bacterial
- Fungal: Less pain, more itching & NO fever.

**Management:** suction then antifungal cream.



Black =  
Aspergillus Niger

White =  
Candida Albicans

### ❖ BULLOUS MYRINGITIS:

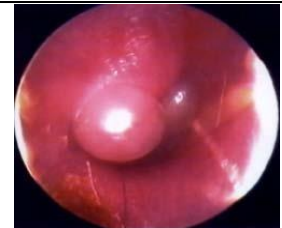
- Inflammatory condition involves the lateral surface of the TM and the medial portion of the canal wall.
- It typically occurs in association with upper respiratory infections and is more common in winter.

(separation of one layer of the tympanic membrane "bullous" > viral infection > pain)

- Clinical manifestations:

- Severe otalgia;
- Serosanguinous otorrhea;
- Hearing loss.

- Treatment includes analgesics, topical antibiotic/steroid drops to prevent bacterial superinfection.



The hallmark clinical finding is: **bullae** over the TM and medial canal with serous or serosanguinous fluid

### ❖ Herpetic O.E: ○ 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. paralyti



### ❖ Eczematous and seborrheic: O.E. painless



## ○ Management (to all clinical types):

- History and Physical examination.
- antibiotics: Anti-pseudomonal drops – Ciprodex
- Swab for culture and sensitivity for ABx.
- Ear toilet: cleaning the ear. 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 debris out.

- Ear wick<sup>15</sup> (best used after shower not in dry ear without pushing more than the length of the cotton > to avoid injury, infection and cotton dislodge<sup>16</sup>)

-Local Medication and analgesia to control pain. Not all E.O need oral or parenteral tx.

-Systemic medications: as in diabetics.

-Surgery may be required in chronic cases and failure of treatment because there is usually thickening in of the skin and closure of the canal.

-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.

## ❖ Acute necrotizing (malignant is not a cancer) otitis externa / Skull base Osteomyelitis (last approved name): Important

○ An acute Pseudomonas infection of the skin of the external ear canal (skull base), which spread to the adjacent bone. (Deep seated pain for more than a month).

-Life-threatening; osteomyelitis of temporal bone

-AOE can spread via fissures of Santorini or tympanomastoid fissure

○ It has a triad:

- 1- ear discharge "Several weeks of purulent otorrhea with granulations",
- 2- headache (esp at night),
- 3- Immunocompromised pt.



Ear wick

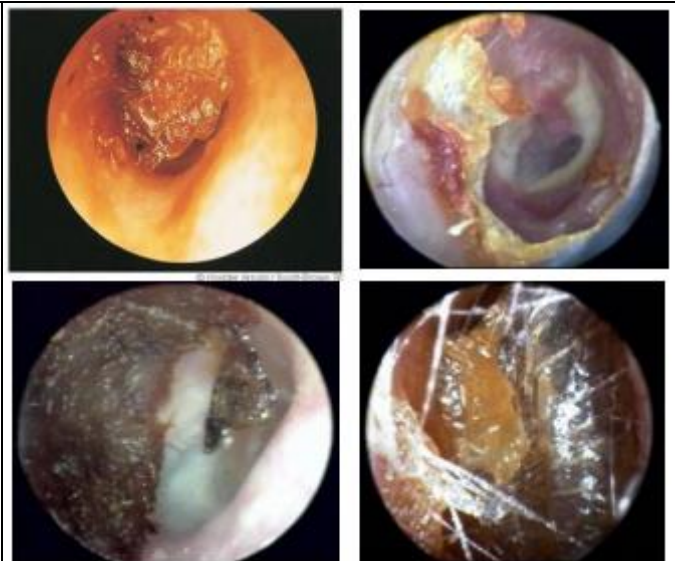


<sup>15</sup> زي ما قلنا نستخدمه أحيانا لو كانت القناة ضيقة علشان ندخل قطرات الإذن، لو استخدمنا باكينق لازمنا نخليه أكثر من يومين ، ضروري نغيره ١٤ ولو ما غيرناه وكمل فيها يومين لازم نعطيه مضاد حيوي  
<sup>16</sup> و أحد سالك اقدر استخدم زيت الزيتون ، الإجابة بتكون نعم خصوصا لو كانت إذنه الخارجية جافة جدا بس بشرط ما يكون عندي ثقب لانه خطير، أيضا الخل بقدرتون يستخدمونه بحالات معينة مثل تسوس الأذن بس بمقدار ١:١ ماء مع خل تفاح علشان يشيل كل السكين دبيري

- It occurs mostly in **elderly diabetic patients**. (Immunocompromised) **Important!**
- **Severe otalgia**. Earache in early stage. > 1 month
- 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
- Radiology: **always we do CT although it doesn't tell us the definitive dx, that's why we rely on nuclear scan Bone<sup>17</sup> (Petrous) scan to rule out osteomyelitis**. Bony erosion on contrast-enhanced CT
- MRI useful for soft-tissue diagnosis, but not for F-U
- Bone scan is sensitive, but not specific (Tc-99m most sensitive)
- Granulation tissue at the junction of the bony and cartilaginous portions of the canal + - immunocompromised pt → Dx as Malignant Otitis Externa!
- culture and biopsy
- **Treatment:**
  - **Control of diabetes (most important part of treatment)**
  - Anti-Pseudomonas antibiotics. **At least 6 weeks**
  - Local treatment and debridement anti-pseudomonal ear drops. The role of surgery remains **controversial (mostly if there was a complication)**. Surgical treatment reserved for clear failures of above medical treatment

## MISCELLANEOUS CONDITIONS OF THE EXTERNAL EAR:

- ❖ **Wax:** ○ Mixture of ceruminous and sebaceous glands secretion
  - **Could be liquidy , hard or thick**
  - Normally is expelled from the canal aided by movements of the jaw
  - When accumulated it may cause deafness, earache or tinnitus
  - 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

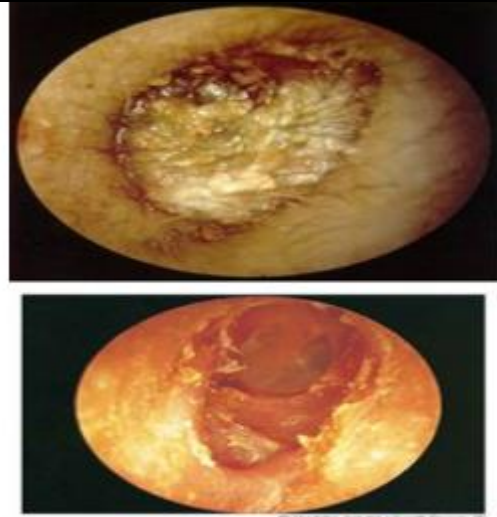


<sup>17</sup> Technetium 99: for diagnosis and gallium: for follow up. So we do them first both, the gallium we do it to know the baseline and after the treatment we do it "gallium" again to know the progress.



### ❖ KERATOSIS OBTURANS:

- Accumulation of desquamated epithelium (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 may be associated with Sinusitis, Bronchiectasis, Primary ciliary dyskinesia. (it doesn't cause bony erosion but it lead to compression "pressure like effect" and widening of the canal)
- Usually cause deafness and pain.
- Treatment: periodic removal.



## Acute otitis media

18

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 of normal inflammation.

### ● Predisposing factors:

- **Age:** common in children as their Eustachian tube is more horizontal, wider and shorter in relation to their head.

- Male sex
- Allergic Rhinitis
- Smoking within the home

- **Bottle feeding:** more likely to have milk regurgitation (because children tend to drink while lying) in middle ear

- Climate
- Crowded living conditions (one infected will infect others)
- Heredity

### ● Associated conditions:

cleft palate why? tensor palatini muscle is absent in cleft palate and its job to open ET when you swallow, immunodeficiency, ciliary dyskinesia, Down syndrome, and cystic fibrosis<sup>19</sup>.

- **Route of infection:**
  - Eustachian tube.
  - External auditory canal(rupture): rare.
  - Blood borne.

### ● **Bacteriology:**

- Streptococcus pneumonia (Most common)

- Haemophilus influenzae

- moraxella catarrhalis

- Streptococcus pyogenes

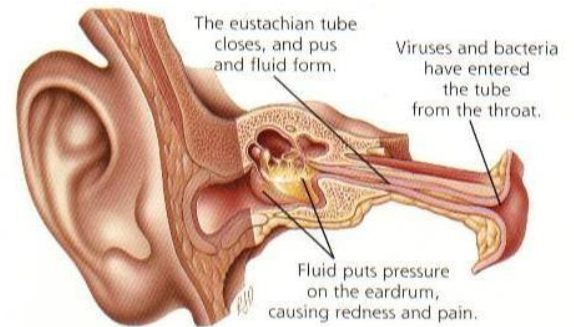
- Staphylococcus aureus

<sup>18</sup> Trick, External ear is very painful, middle ear is painless or less painful

<sup>19</sup> fluids are thick in those pts it is like glue

### ● Pathophysiology:

○ 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.



### ● Clinical picture:

<p>○ Tubal occlusion: produces early signs of acute otitis media. Discomfort, <b>autophony</b> (feeling own sounds), retracted drum (opposite of bulging) caused by pressure difference.</p> <p>○ There is mild deafness. Tinnitus in children, not adults.</p>	
<p>Suppurative inflammation of the middle ear: <b>Fever</b>, severe earache, deafness, <b>congestion</b> and bulging drum (<b>pus behind it</b>).</p>	
<p><b>Tympanic membrane rupture:</b> Otorrhea, Temperature subside. &amp; earache subside (pain relief), <b>perforated drum</b> and <b>Mucopurulent discharge</b> (if not treated)</p>	
<p>Resolution: Either <b>the rupture</b> will persist, and it will discharge from time to time (chronic otitis media) Or close spontaneously "<b>retraction</b>" (common)</p> <p>○ Tympanosclerosis "<b>if not treated will retract if it was severe &gt; adhesive otitis media</b> (tympanic membrane reaching the promontory or the cochlea"</p>	

➤ 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

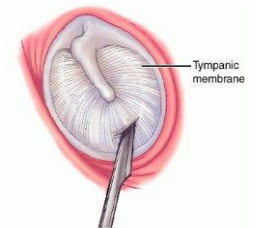
### Complication of acute and chronic OM:

- **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

### ● Treatment:

- Symptomatic
- Antimicrobials.
  - Amoxicillin ( 1st line) if allergic to penicillin & cephalosporins you give clarithromycin
  - Amoxicillin/clavulanic acid (B-lactamase bacteria) 2nd line.
  - Trimethoprim.
  - Sulfamethoxazole.
  - Cefaclor, cefixime.
- Decongestant. (opening in case of bulging with severe pain to relieve it and in congestion)
- Myringotomy +/- tube.
- Ear toilet and local antibiotics.



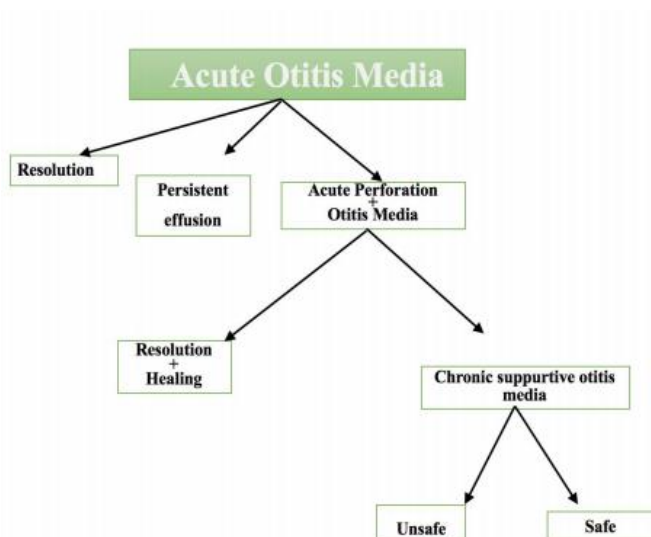
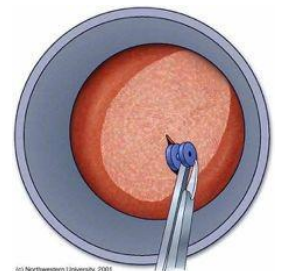
### ● Recurrent Acute Otitis Media:

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:

- Long-term low dose antimicrobials
- **Ventilation tube insertion** "it allows the air to enter the middle ear and drainage of fluid from the Eustachian tube" (Myringotomy with pressure equalization tube)



**Note:** Most OM in pediatrics is viral in origin, so we don't always need to rush to give Abx. Unless: high grade fever, fever for more than 48h, Complications start to occur, pus seen in the oral cavity, other signs of bacterial OM.