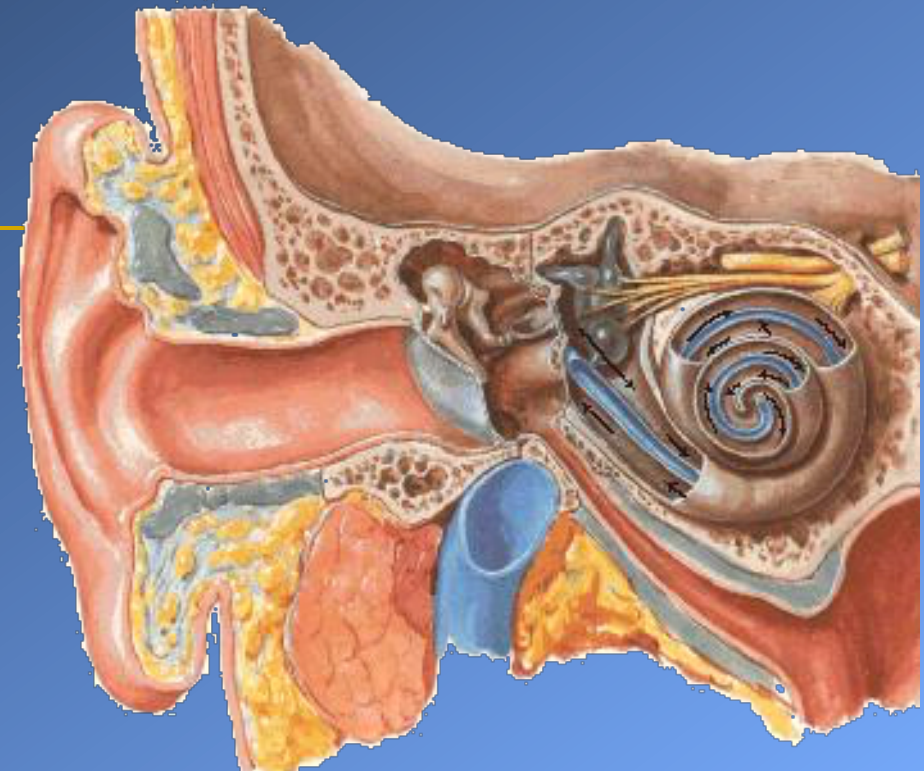




# Anatomy of the Ear

## Otitis Externa and Otitis Media



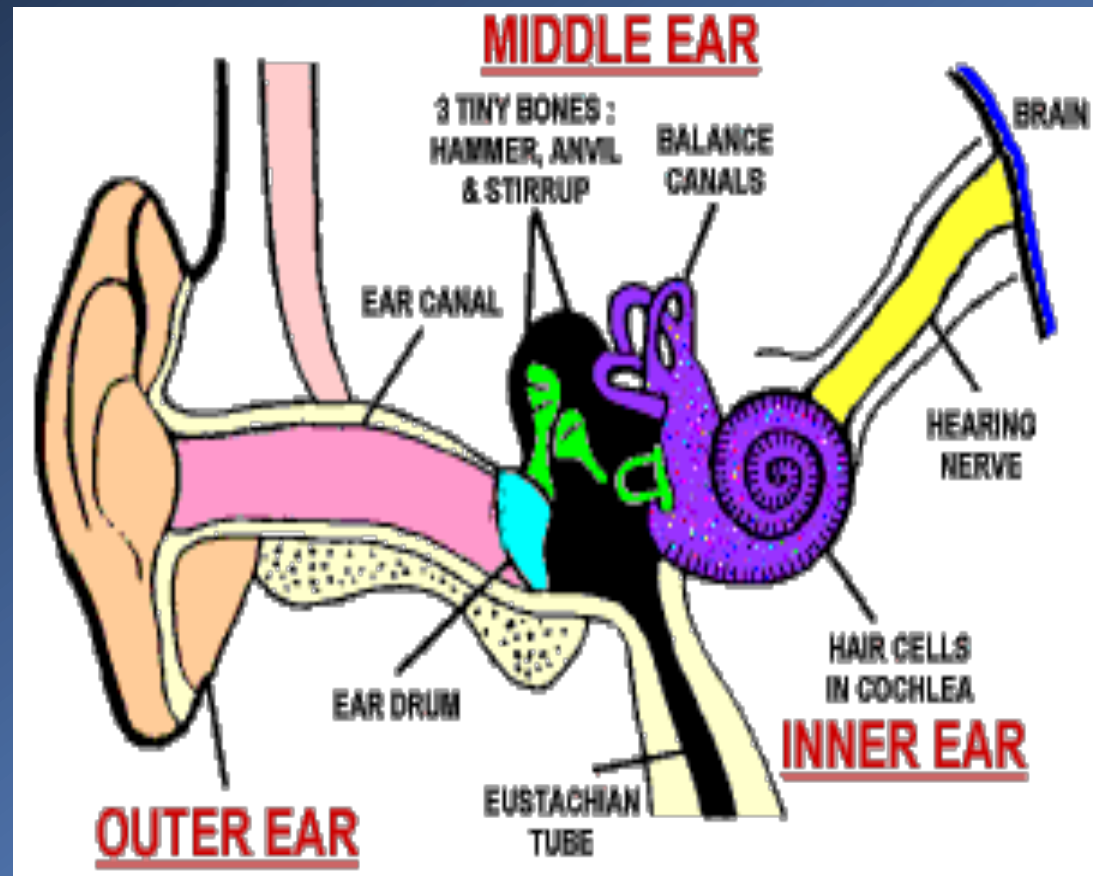
*ALHABIB Salman MBBS , DES*  
*Assistant Professor KSU*  
*Otology, Neurotology and*  
*Cochlear Implant Consultant*

# Objectives

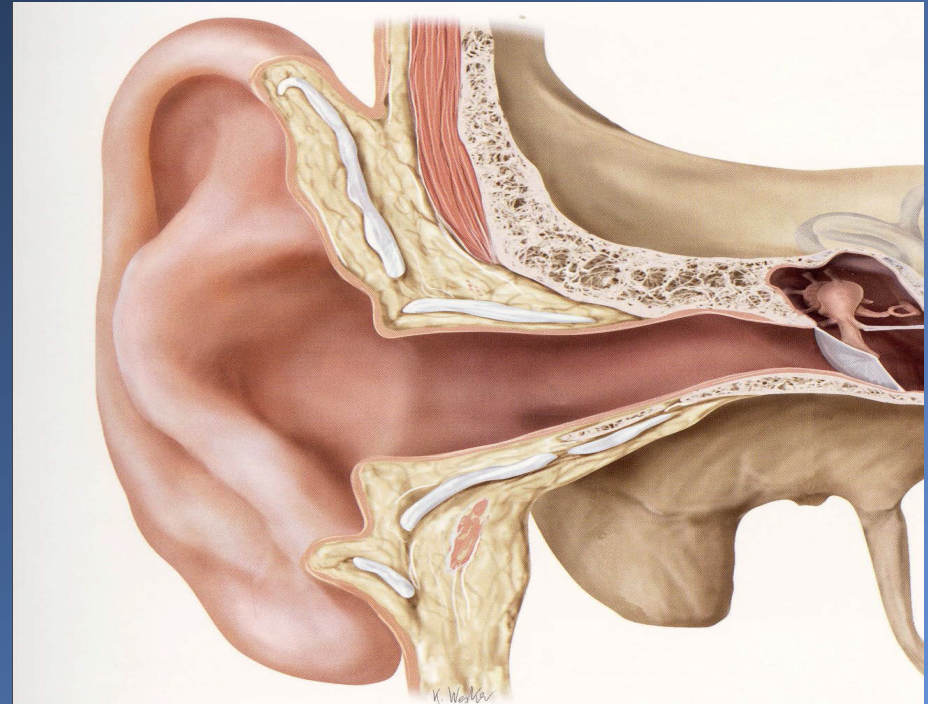
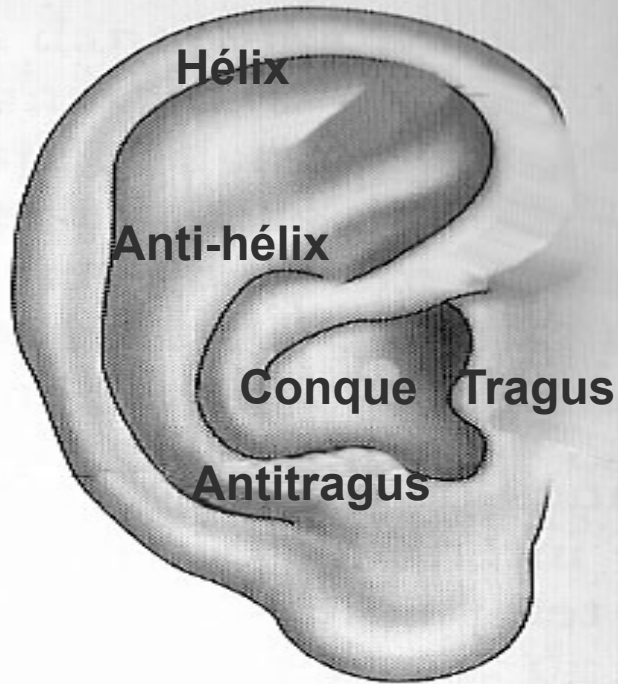
- Anatomy of the ear
- Physiology of the
  - External,
  - Middle,
  - Inner ear
- Otitis Externa
- Malignant Otitis Externa
- Otitis Media

# Anatomy

- It has 3 parts:
  - External ear
  - Middle ear
  - Inner ear



# External Auditory Canal



## External Auditory Canal (EAC)

EAC is 2.5 cm long;

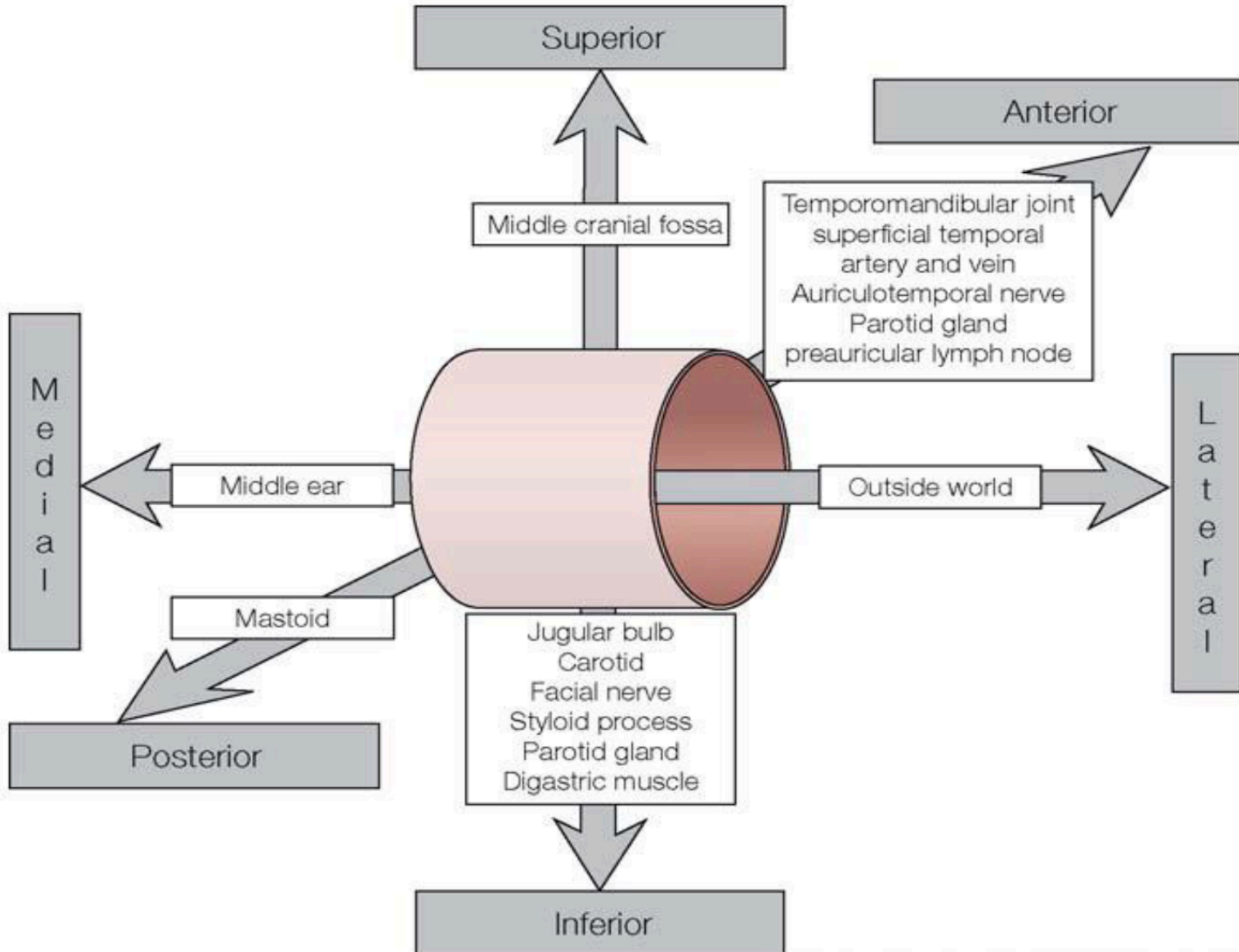
### ◆ Outer cartilaginous canal is 1/3 of canal length:

- Contains small amount of sub-Q tissue
- Appendages include hair cells, sebaceous and apocrine glands (together called the ***apopilosebaceous unit*** )

### ◆ Medial 2/3 is osseous:

- Skin lining is just 0.2 mm thick
- No sub-Q tissue or appendages

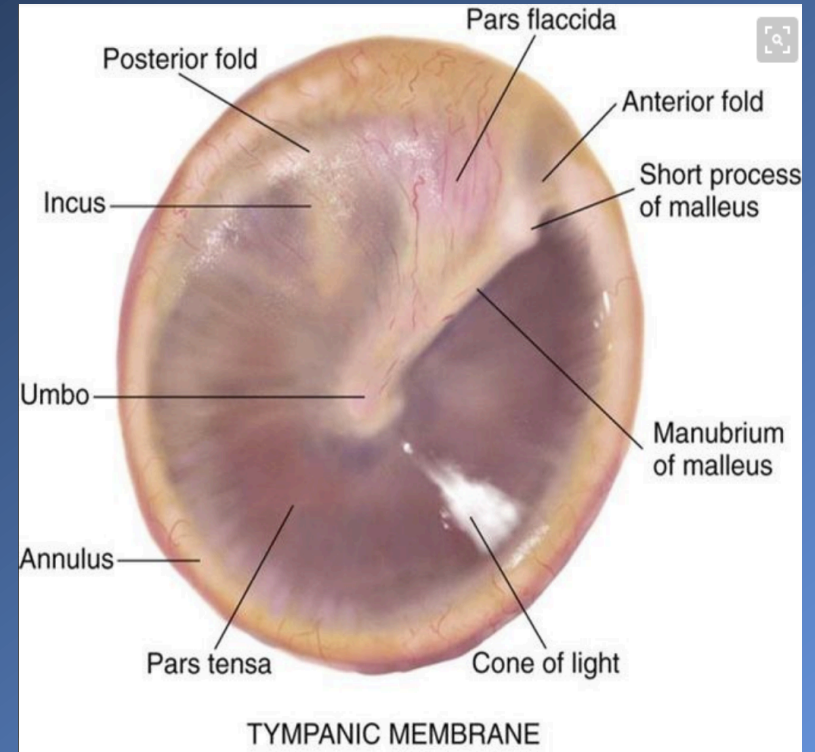
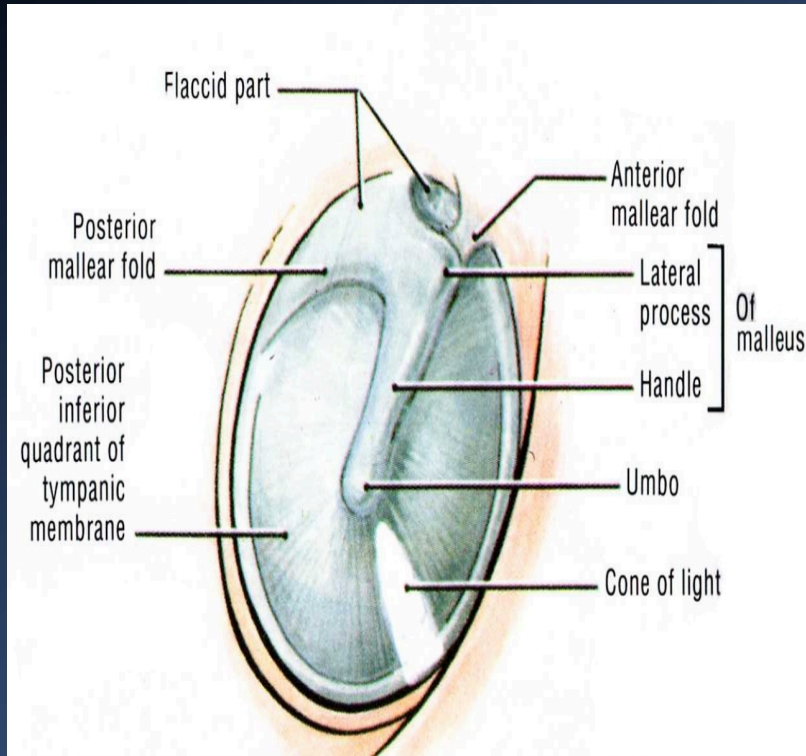




# Function Of The External Ear

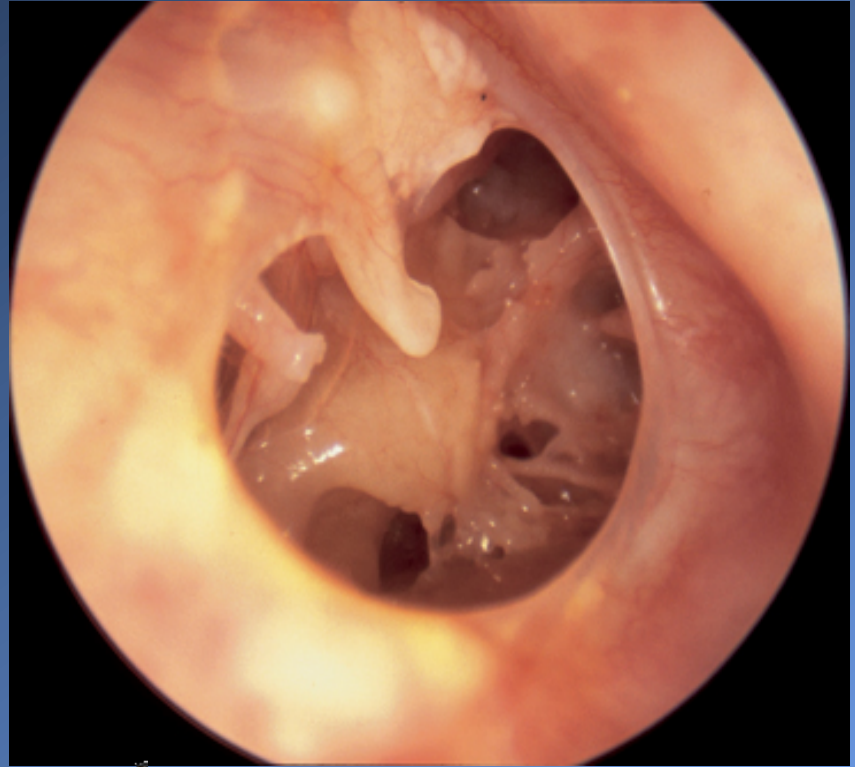
- Protection of the middle ear
    - Wax
  - Auditory functions:
    - Sound conduction
    - Increase sound pressure by the resonance function
-

# Tympanic membrane



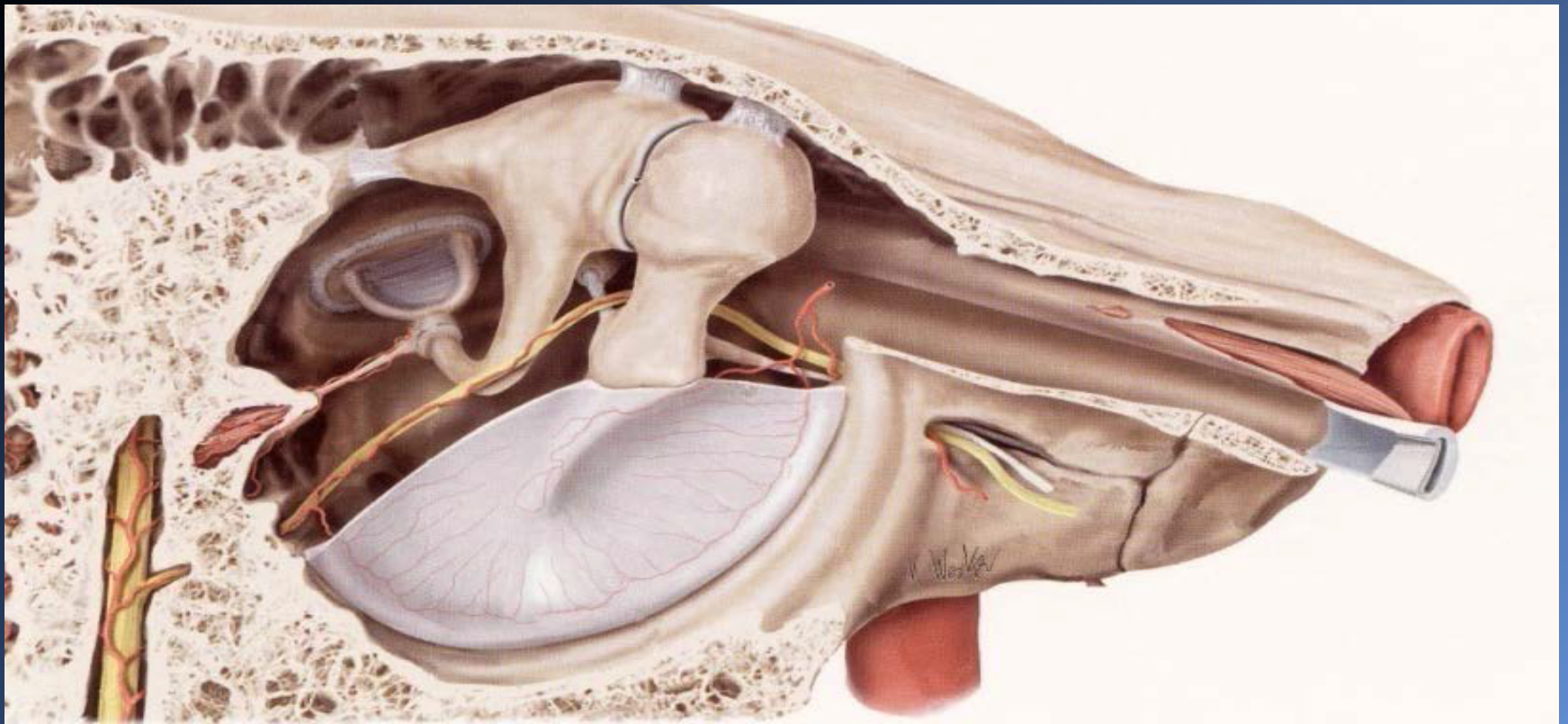
- Fibroelastic Membrane has 3 layers (epidemic, fibrous, mucous).
- Divided in 2 parts : pars flaccida et pars tensa
- It separate the external ear from the middle ear

# Middle Ear



Lining of middle ear: Ciliated columnar anteriorly and cuboidal or flat elsewhere



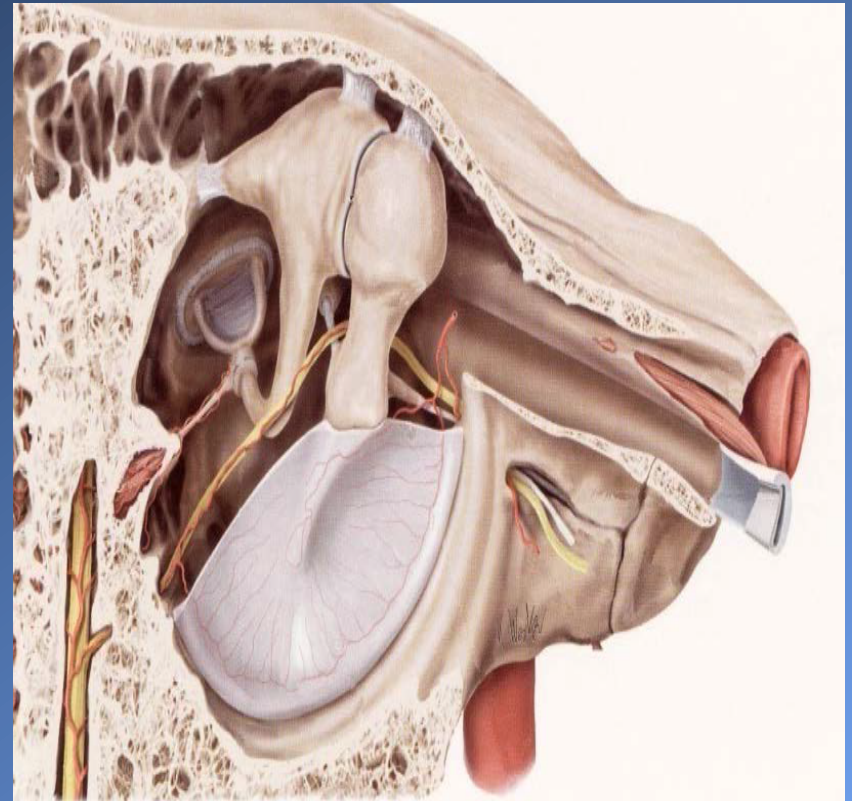


### Middle Ear Cleft :

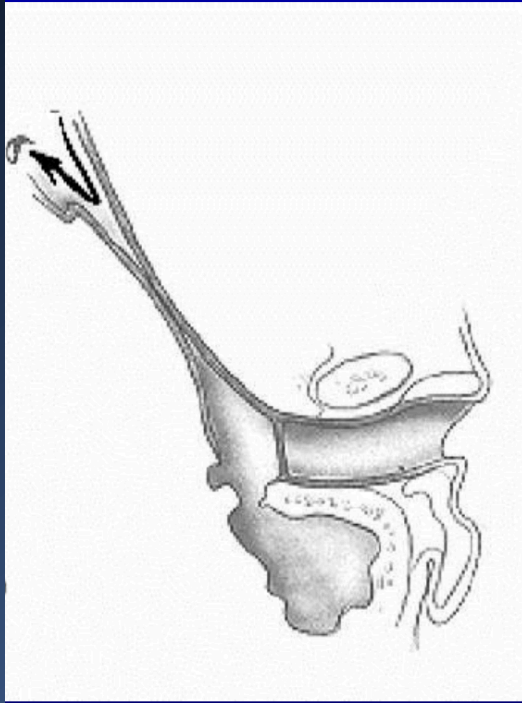
- Eustachian (Pharyngo-tympanic) Tube
- Tympanic (Middle Ear) Cavity
- Mastoid antrum and air cells

# Eustachian Tube

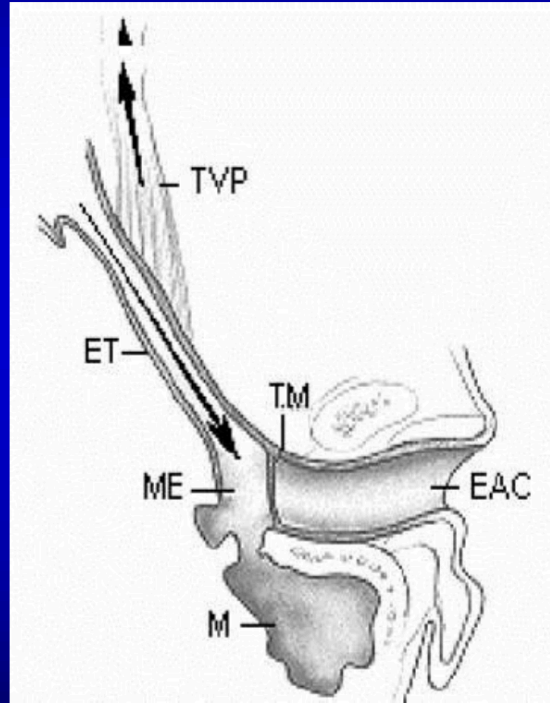
- Is the conduit through which air is exchanged between the middle ear space and upper aerodigestive tract.
- Open at the torus tubarius.
- Proximal 1/3 formed in petrous bone
- Distal 2/3, the distal segment, is a fibrocartilaginous tube that is collapsed at rest



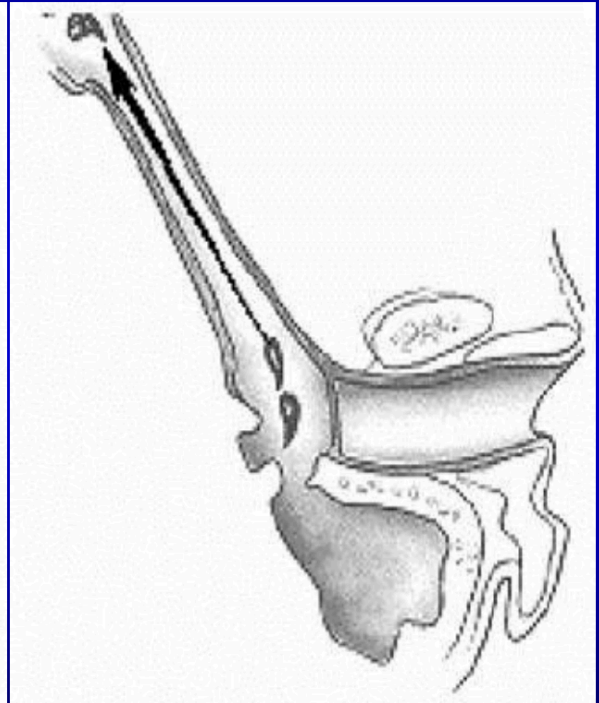
# FUNCTIONS OF THE EUSTACHIAN TUBE



Protection



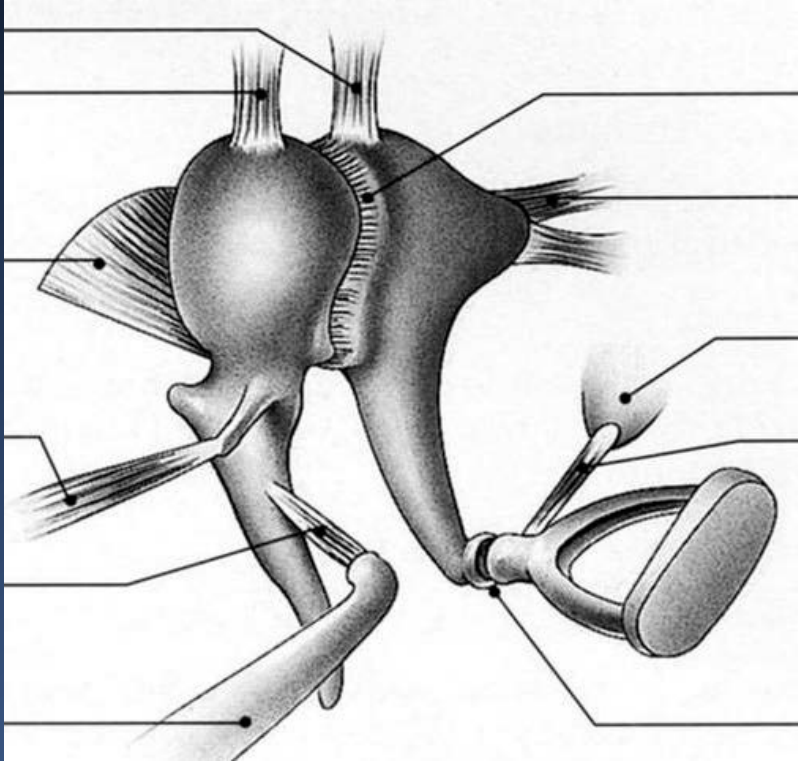
**Ventilation**



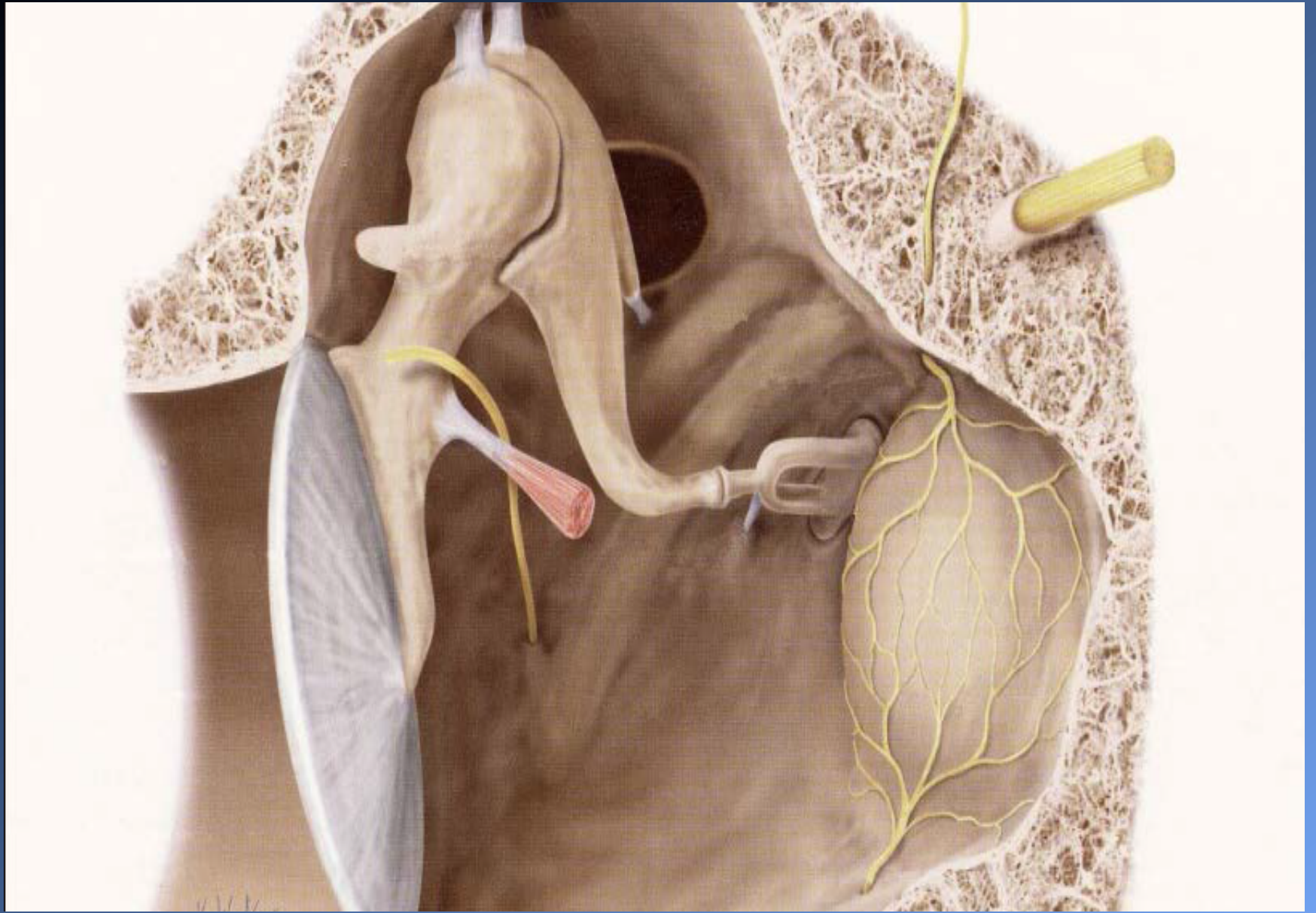
Drainage



# Ossicles







Superior

Anterior

Middle cranial fossa  
Temporal lobe

Tensor tympani  
muscle  
Eustachian tube

M  
e  
d  
i  
a  
l

Inner ear

External auditory  
meatus

L  
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Aditus to mastoid

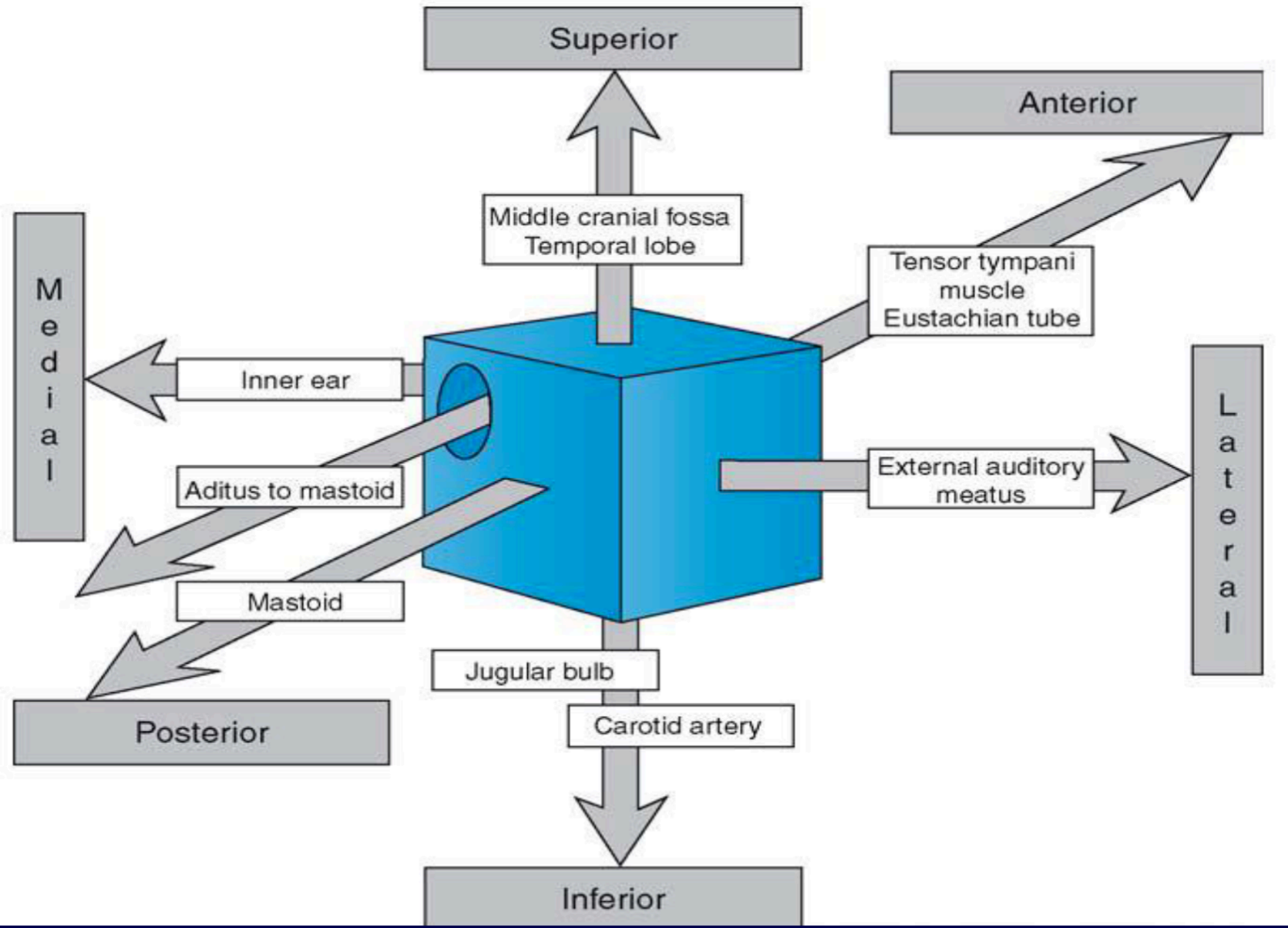
Mastoid

Jugular bulb

Carotid artery

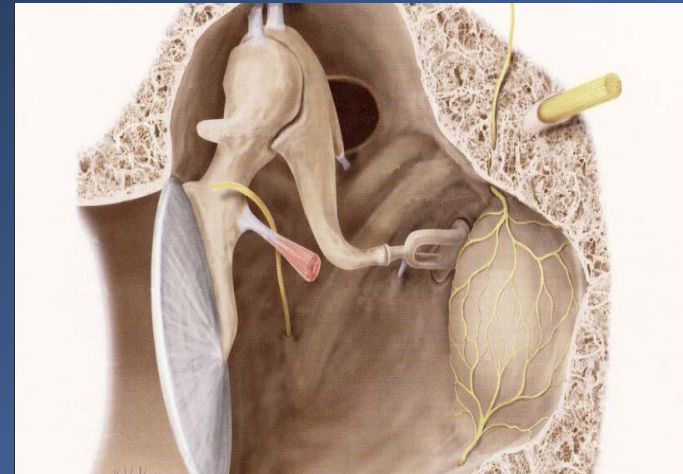
Posterior

Inferior

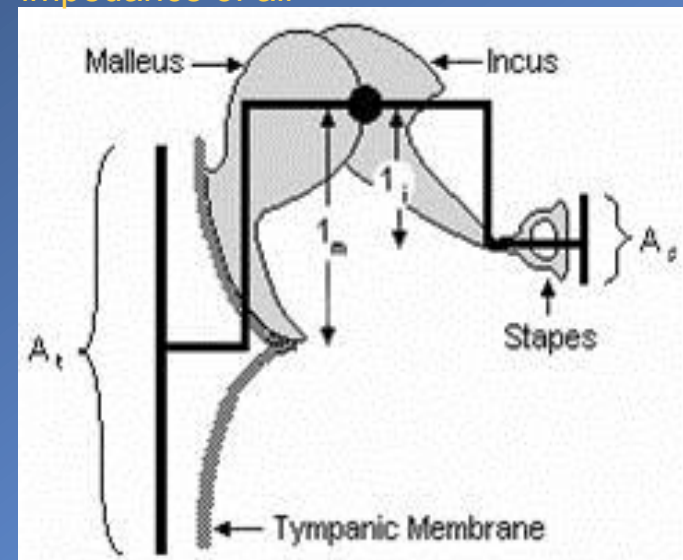


# FUNCIONES OF THE MIDDLE EAR

- Conduction of sound
- The 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**):
  - Area ratio between the TM and the stapes footplate(20:1)
  - Ossicular Coupling : lever ratio
- Protection to the inner ear
  - Stapedial reflex



Impedance of fluid is much greater than the impedance of air





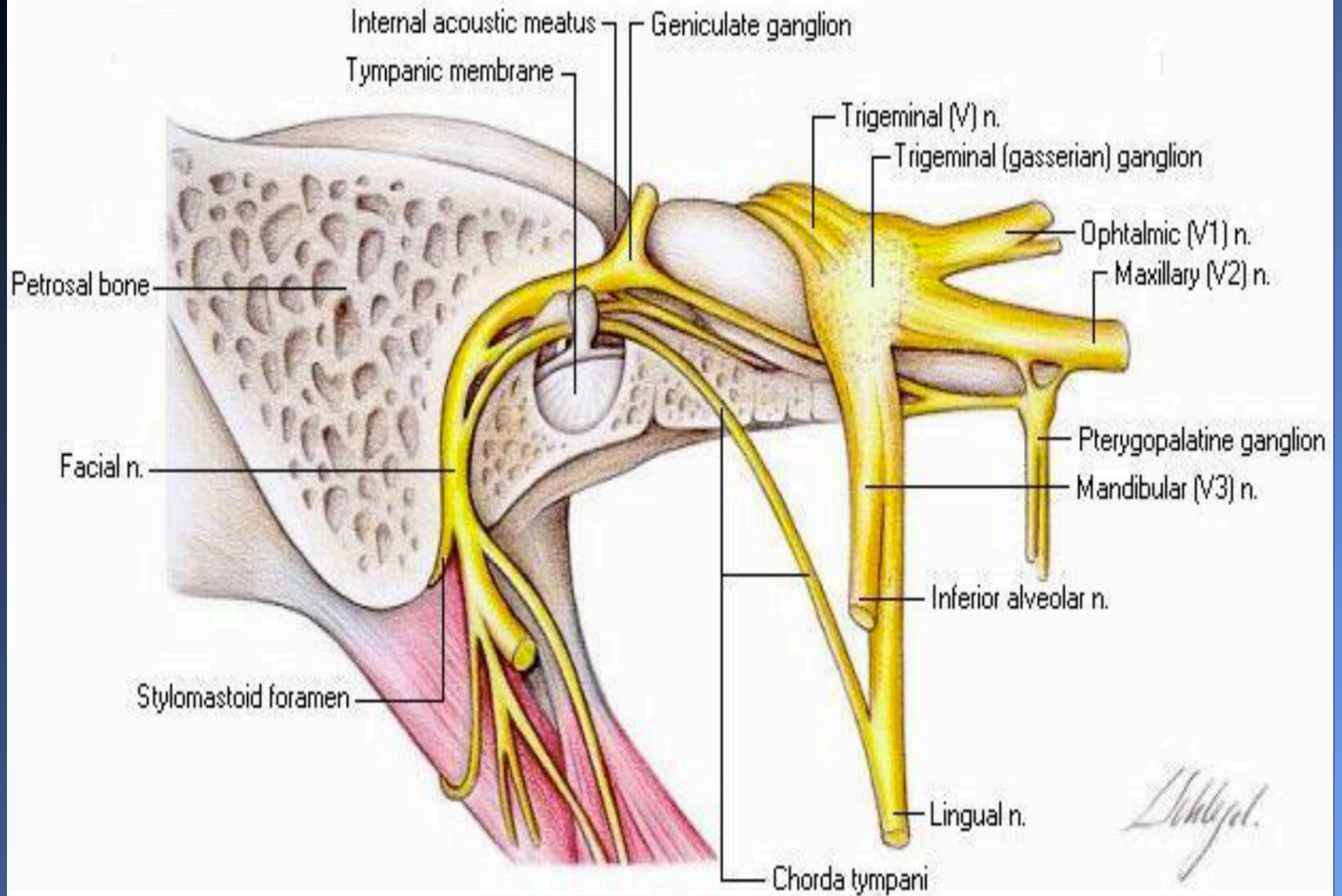
# Sensibility



- Great auricular nerve (C2,C3) : lobule, lateral/inferior auricle
  - Auricular branch of vagus (Arnold's) : concha, Post canal wall
  - Auriculotemporal nerve (V3) : tragus, anterior helix, Ant canal wall
  - Lesser occipital (C2) : medial surface of pinna
  - TM supplied mainly by V3 (anterior) and X (posterior) on lateral aspect, IX on medial aspect
  - Facial nerve: concha, Post canal wall
-



# FACIAL (VII) AND TRIGEMINAL (V) NERVES, IN SITU, IN THE PETROUS PYRAMID



# Referred Earache

**Referred Earache:** 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 etc.
- **V cranial nerve:** Dental infections, sinonasal diseases etc.
- **IX cranial nerve:** Tonsillitis, post-tonsillectomy, carcinoma etc.
- **X cranial nerve:** Tumors of hyopharynx, larynx & esophagus

# Inner Ear



Cochlea: Coiled, bony tube; 35 mm long

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

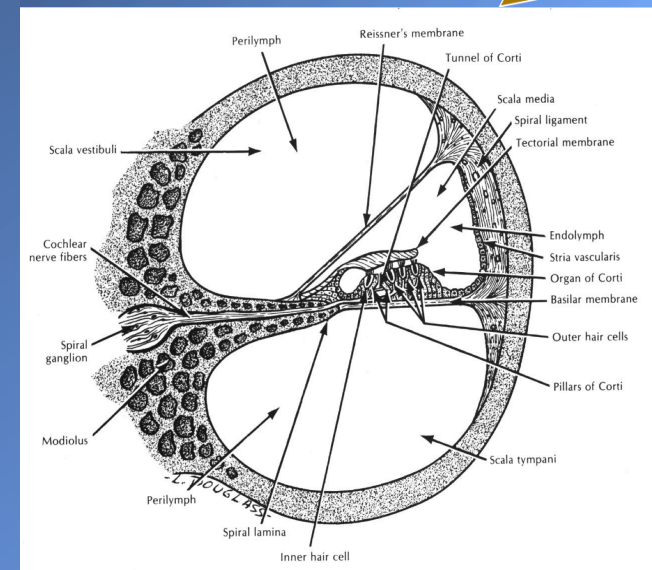
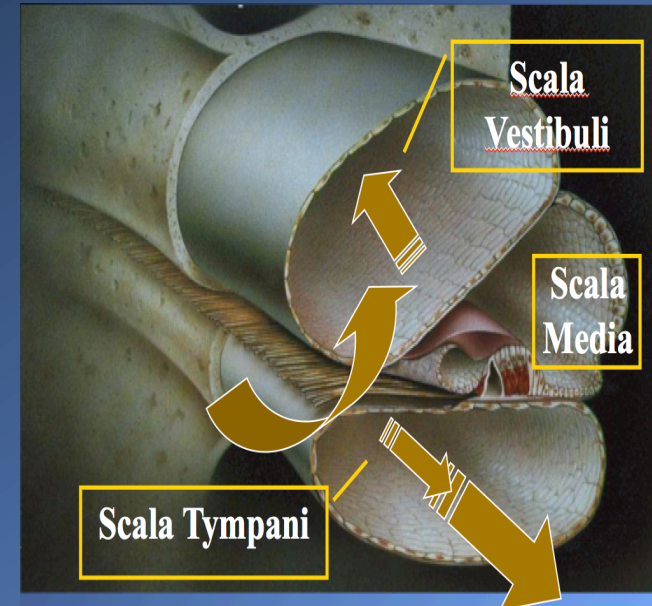
$K^+ = 4 \text{ mEq/L}$

$Na^+ = 139 \text{ mEq/L}$

**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 cells of stria vascularis**; absorbed within the endolymphatic sac

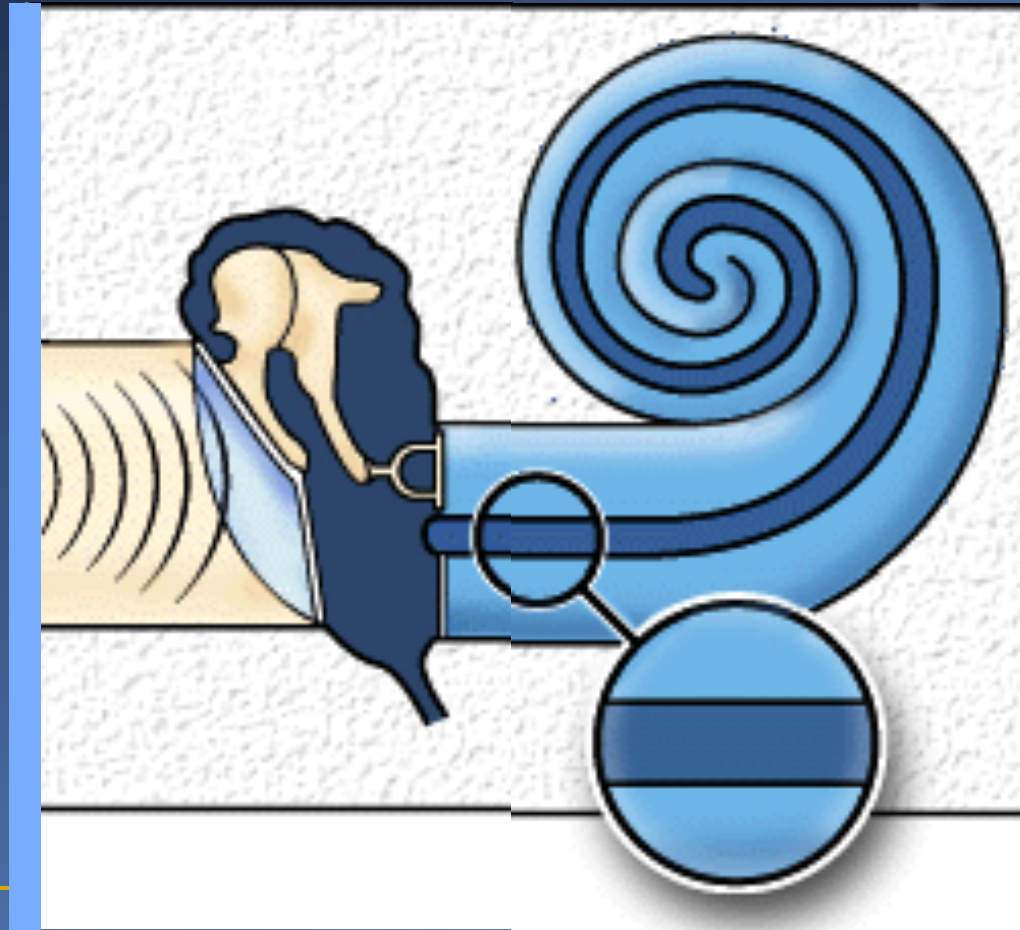
$K^+ = 144 \text{ mEq/L}$

$Na^+ = 13 \text{ mEq/L}$



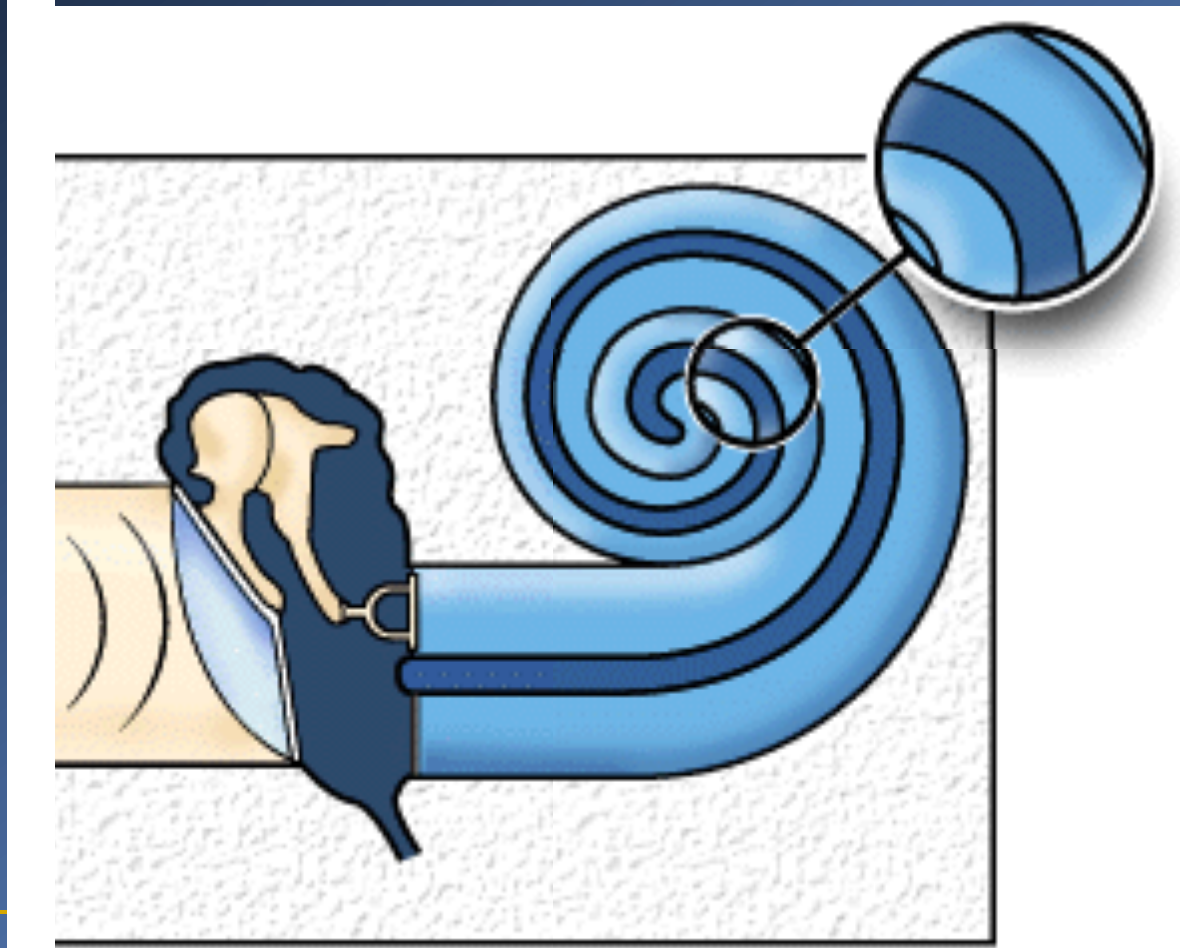


Sound of High frequency affect the basal portion of the Cochlea

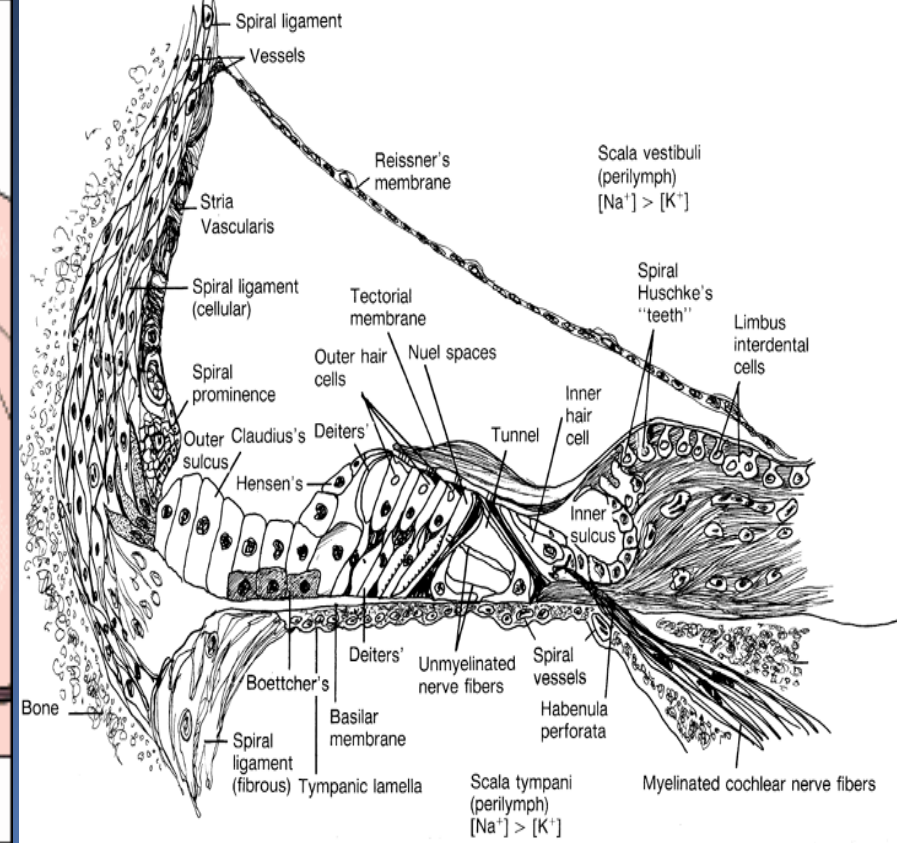
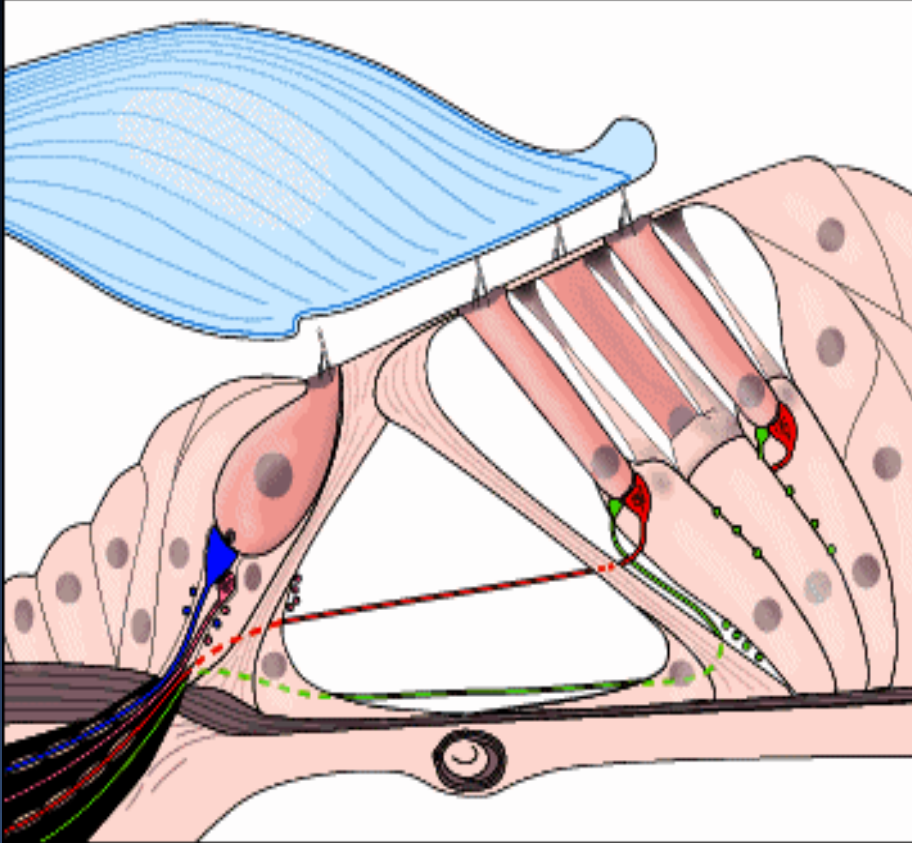




Sounds of Low frequency affect the apical portion of the Cochlea



# Inner Ear

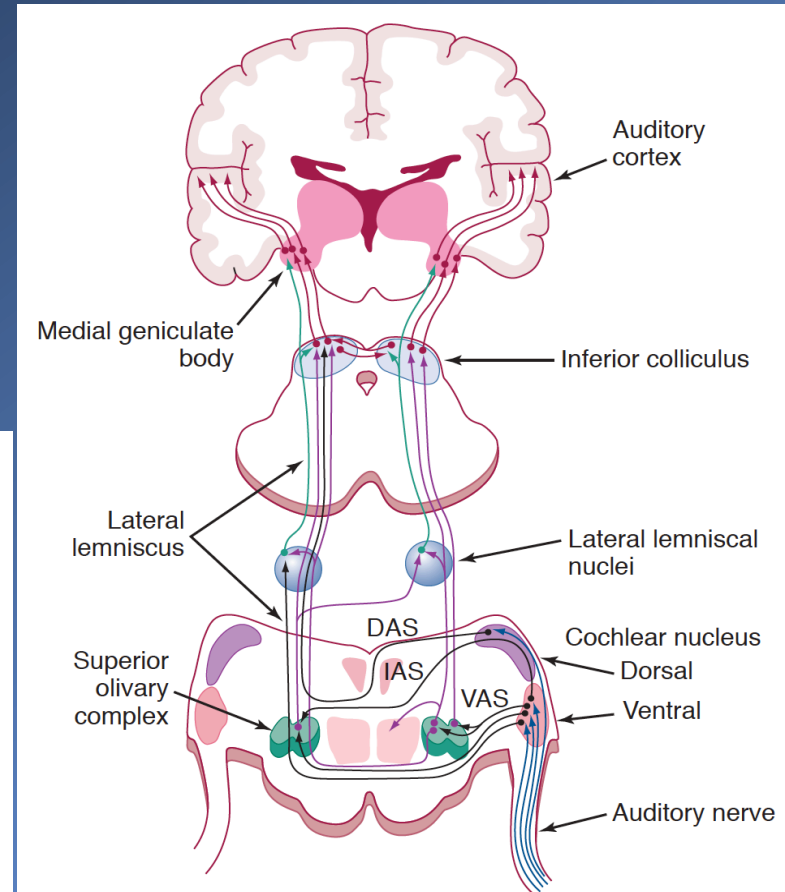
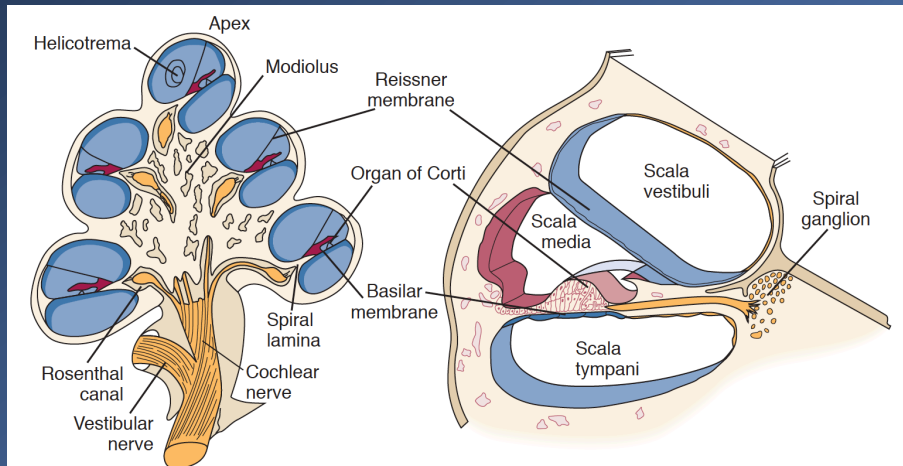


**Organ of Corti:** rests on basilar membrane and osseous spiral lamina; major components include:

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

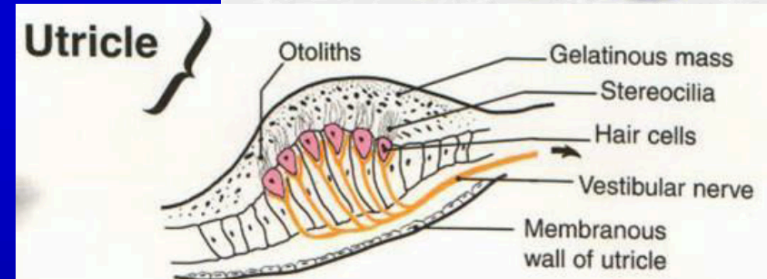
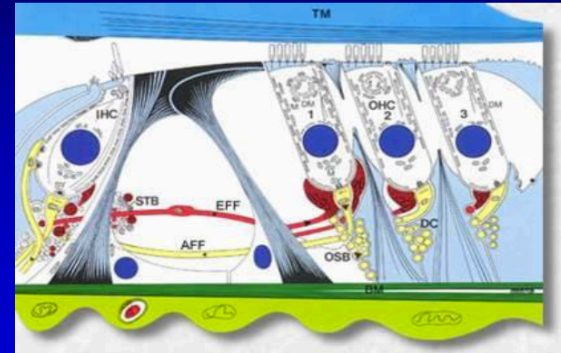
# Central Auditory System

- 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.



# INNER EAR SENSORY EPITHELIUM

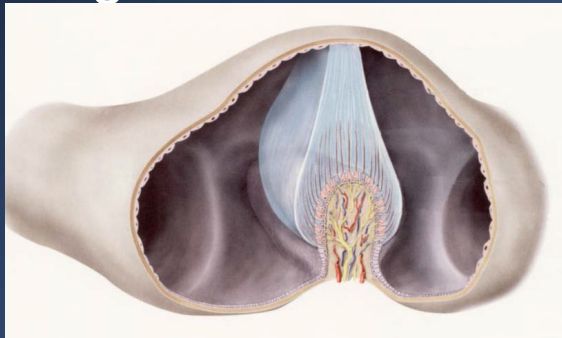
- Cochlea: *organ of Corti*
- Utricle & saccule: *maculae*
- Semicircular canals: *crisetae*





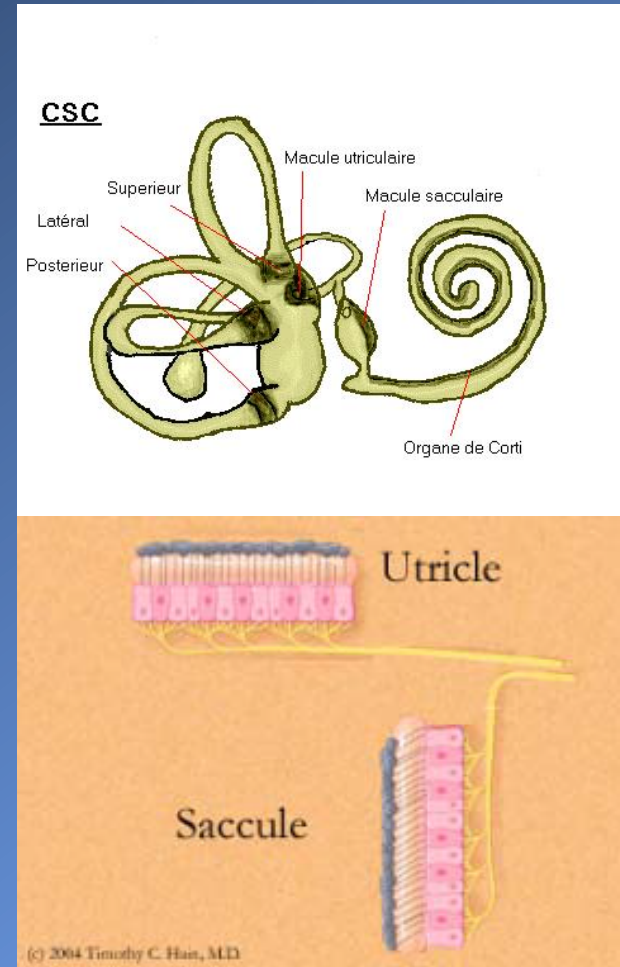
# Vestibular System

## ■ Semi-circular Canals Angular Acceleration

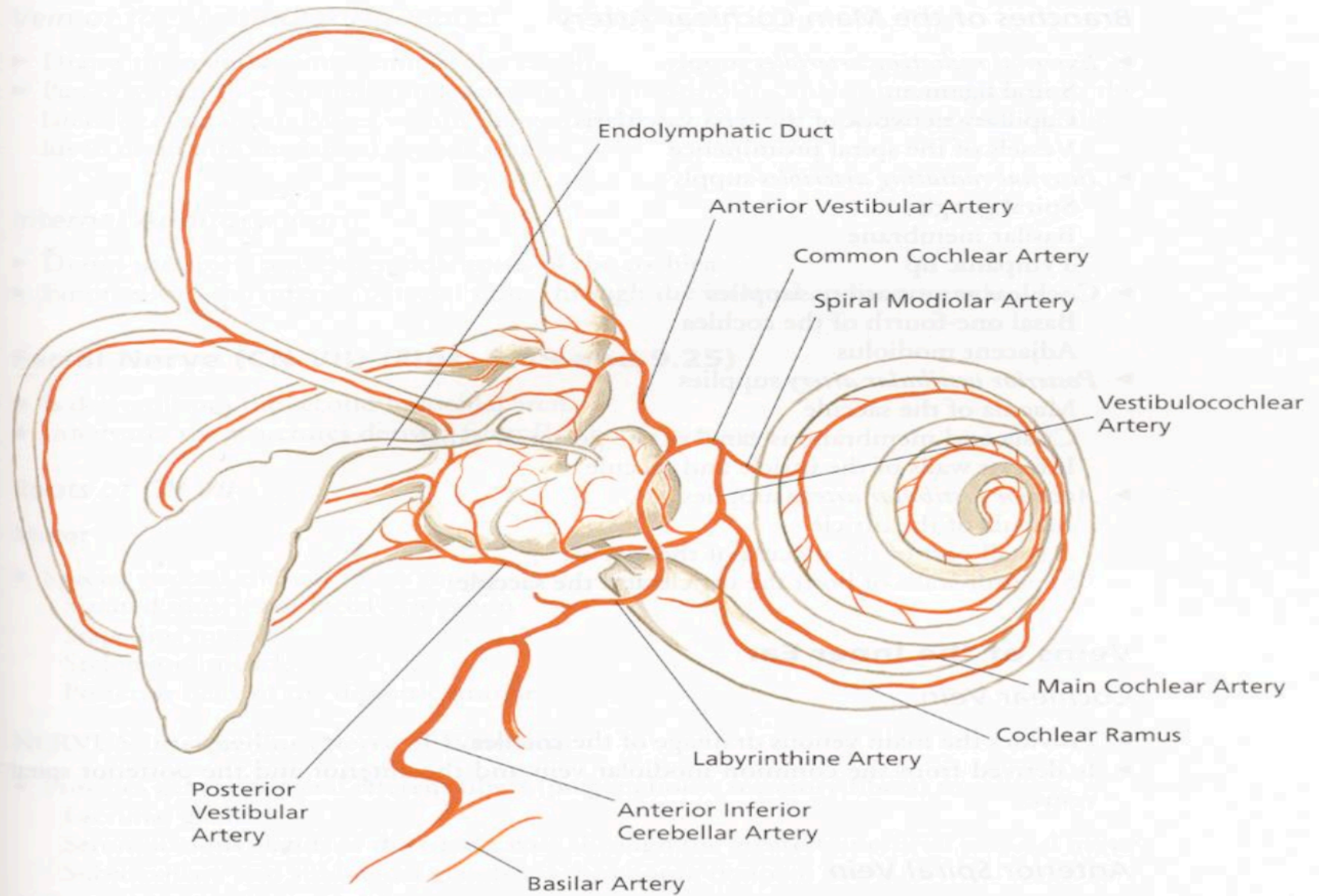


## ■ Utricule & Saccule:

1. Macule of the utricule : plan horizontal
2. Macule of the saccule: plan vertical
3. Linear acceleration horizontal & Vertical (gravity)



Labyrinthine artery – common cochlear artery and anterior vestibular artery (superior canal)



# Congenital Malformations

- Anotia & microtia
- Accessory auricle
- Preauricular sinus
- Protruding ear





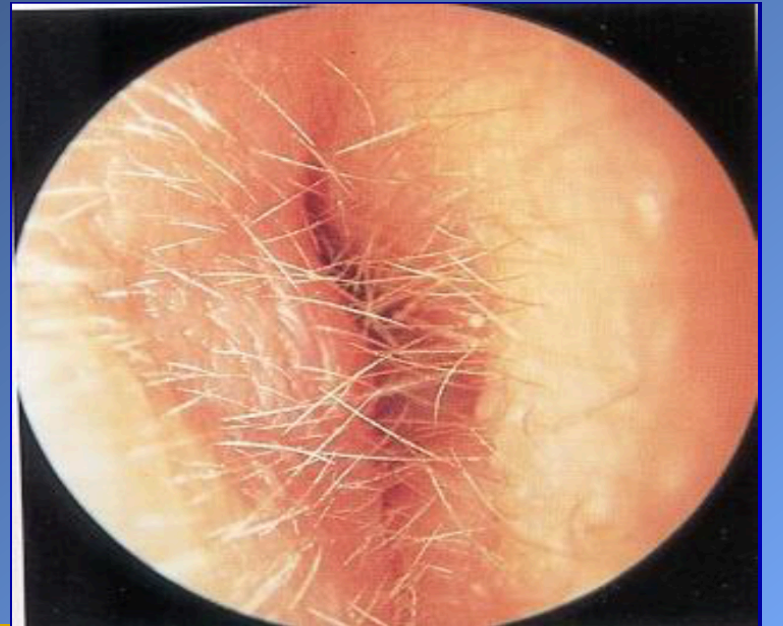
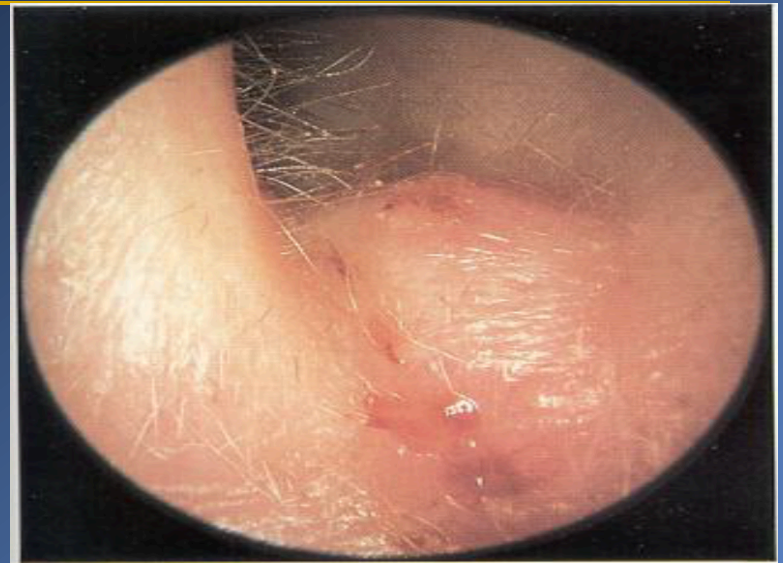
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# Otitis Externa

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# Acute Otitis Externa (AOE)

- 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



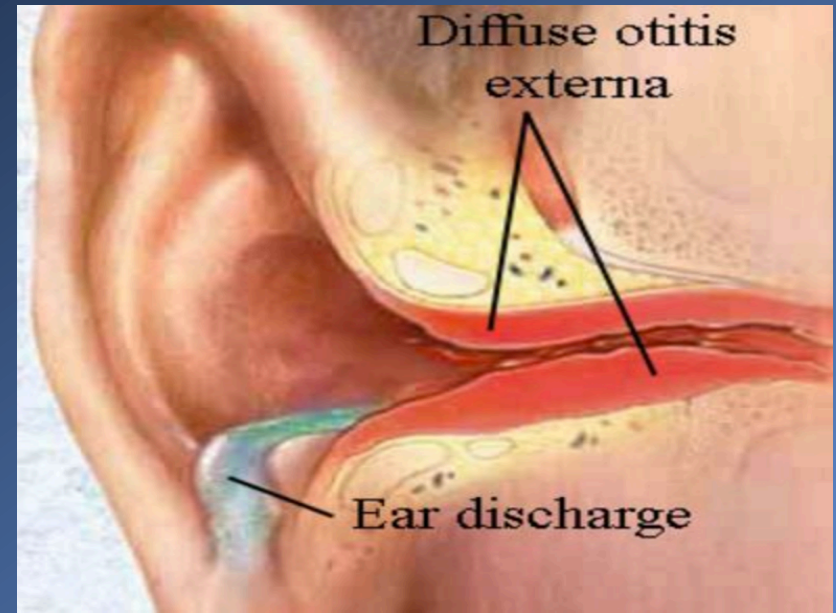
# Otitis Externa (OE)

## ■ History:

- Pain,
- Itching,
- Fullness
- Hearing loss

## ■ Physical exam:

- Redness, 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





# Otitis Externa (OE)

## ■ Bacteriology

- Typically *Pseudomonas aeruginosa*, *Proteus mirabilis*, staph, strep and various gram negative bacilli
- Culture not typically needed unless resistant to treatment

## ■ Otomycosis : Fungal infection



Otomycosis

# Otitis Externa (OE)

- **Medical treatment:**
  - Frequent cleaning
    - Meticulous debridement of debris, pus and cerumen
  - antibiotics
    - Anti-pseudomonal drops – Ciprodex
  - Treatment of pain
  - Recommendations regarding prevention
    - Avoid instrumentation
    - Keep H<sub>2</sub>O out of the ear when possible

# Necrotizing (Malignant) External Otitis

- Life-threatening; osteomyelitis of temporal bone
- AOE can spread via fissures of Santorini or tympanomastoid fissure
- **Diagnosis:**
  - Otalgia > 1 month
  - Several weeks of purulent otorrhea with granulations
  - **Diabetes Mellitus** , immunocompromised, HIV or elderly
  - Cranial nerve involvement



# Necrotizing (Malignant) External Otitis

## ■ Clinical/radiographic findings

- granulations tissue in EAC
- Almost always caused by *Pseudomonas*; can be **fungal** – **HIV**
- 25% have CN VII involvement; IX, X or XI possible
- 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)

## Surgical treatment:

- Reserved for clear failures of above medical treatment
-



# Necrotizing (Malignant) External Otitis

- Medical treatment
    - Should culture and biopsy
    - Anti Pseudomonas antibiotics
    - Blood-sugar control
    - Frequent debridement and anti-pseudomonal ear drops
  - ID and Endocrinologist should be involved
-

# KERATOSIS OBTURANS

- Accumulation of desquamated epithelium in the bony canal
- It may be associated with
  - Sinusitis,
  - Bronchiectasis
  - Primary ciliary dyskinesia
- Usually cause deafness and pain
- **Treatment** : periodic removal



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# BULLOUS MYRINGITIS

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# BULLOUS MYRINGITIS

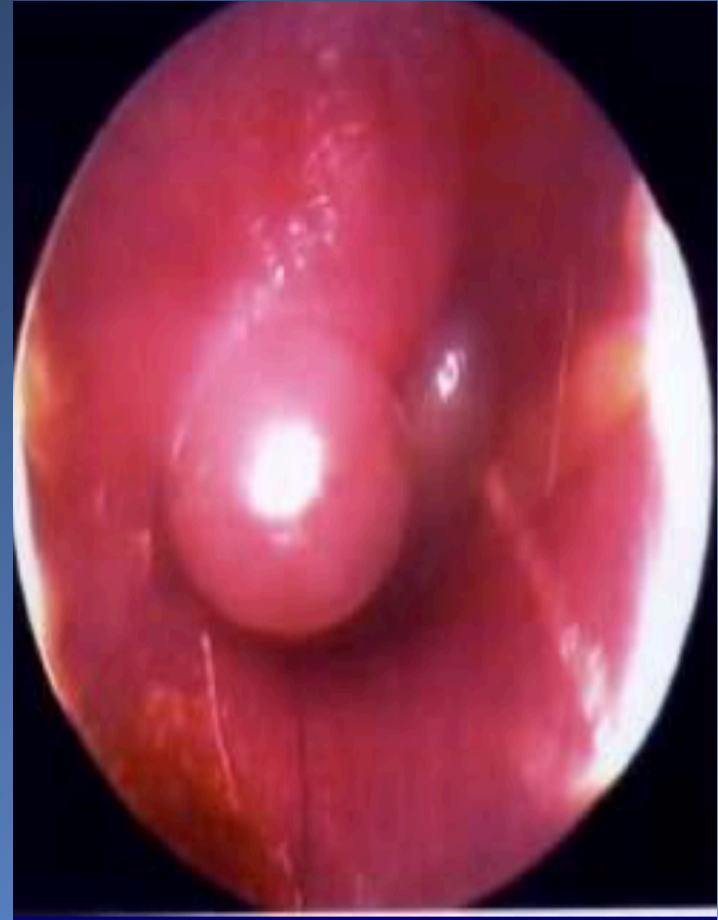
- Inflammatory condition involves the lateral surface of the TM and the medial portion of the canal wall.
- It typically occurs in association with upper respiratory infections and is more common in winter.
- Clinical manifestations:
  - Severe otalgia;
  - Serosanguinous otorrhea;
  - Hearing loss.
- Treatment includes analgesics, topical antibiotic/steroid drops to prevent bacterial superinfection





# BULLOUS MYRINGITIS

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



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# Otitis Media

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# Otitis Media

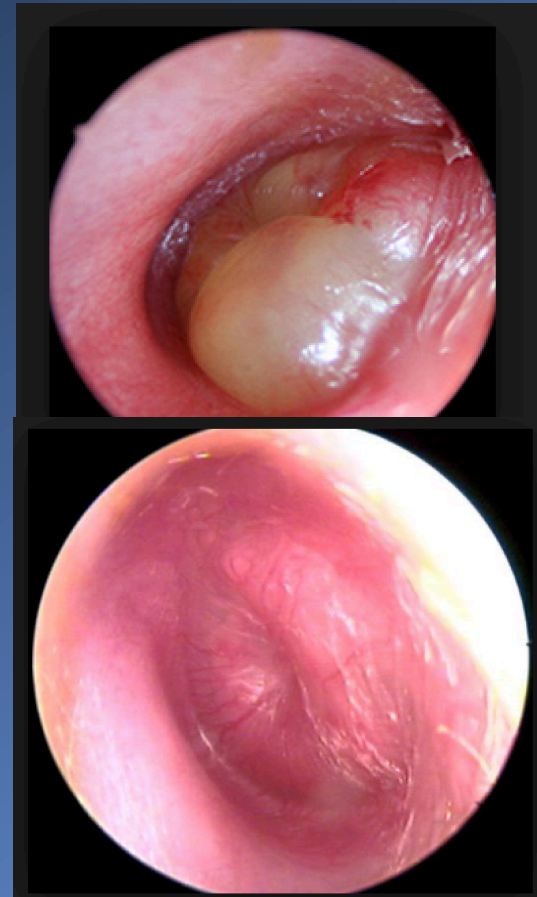
- Acute infection of the mucous membrane lining of the middle ear cleft
- estimated 85% of all children experience at least one episode of AOM
- Most common bacterial infection of childhood.



# Otitis Media

## ■ Predisposing Factors:

- Young Age
- Male sex
- Bottle feeding,
- Allergic Rhinitis
- Crowded living conditions
- Smoking within the home
- Associated conditions: cleft palate, immunodeficiency, ciliary dyskinesia, Down syndrome, and cystic fibrosis





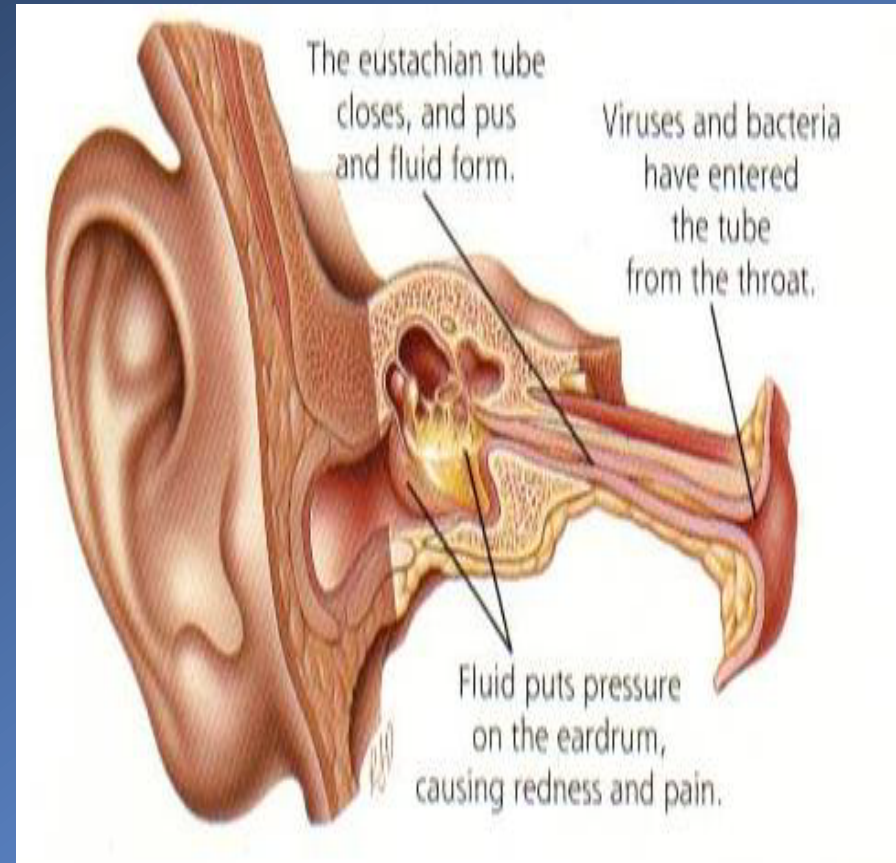
# Otitis Media

## ■ ROUTE OF INFECTION

- ❑ Eustachian tube
- ❑ External auditory canal
- ❑ Blood borne

## ■ BACTERIOLOGY:

- ❑ Streptococcus pneumonia
- ❑ Haemophilus influenzae
- ❑ M. catarrhalis
- ❑ Streptococcus pyogens
- ❑ Staphylococcus aureus



# Clinical Picture

- ❑ Discomfort,
- ❑ Autophony,
- ❑ Fever,
- ❑ Severe earache,
- ❑ Deafness,
- ❑ Bulging drum
- Tympanic membrane rupture: Otorrhea... temp. & earache subside



# COMPLICATIONS OF ACUTE AND CHRONIC OTITIS MEDIA

## ■ Extracranial

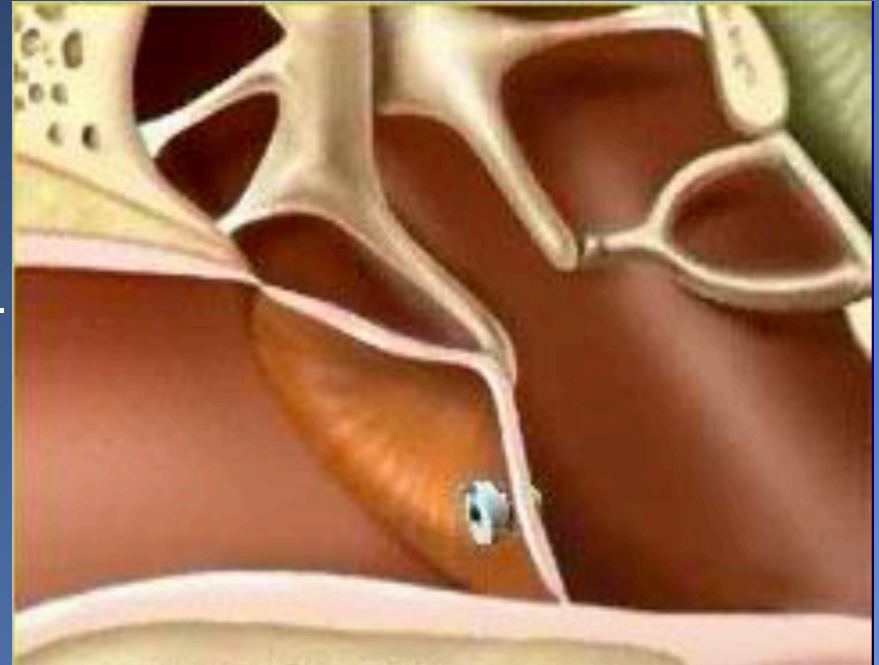
- Acute mastoiditis
- Chronic mastoiditis
- Postauricular abscess
- Bezold abscess
- Temporal abscess
- Petrous apicitis
- Labyrinthine fistula
- Facial nerve paralysis
- Acute suppurative labyrinthitis

## ■ Intracranial

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

# TREATMENT

- Symptomatic
- Antimicrobials
  - Amoxicillin
  - Amoxicillin/clavulanic acid (B-lactamase bacteria)
  - Tri-methoprim-sulphamethoxazole
  - Cefaclor, cefixime
- Decongestant
- Myringotomy +/- tube
- Ear toilet and local antibiotics





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Thank you

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