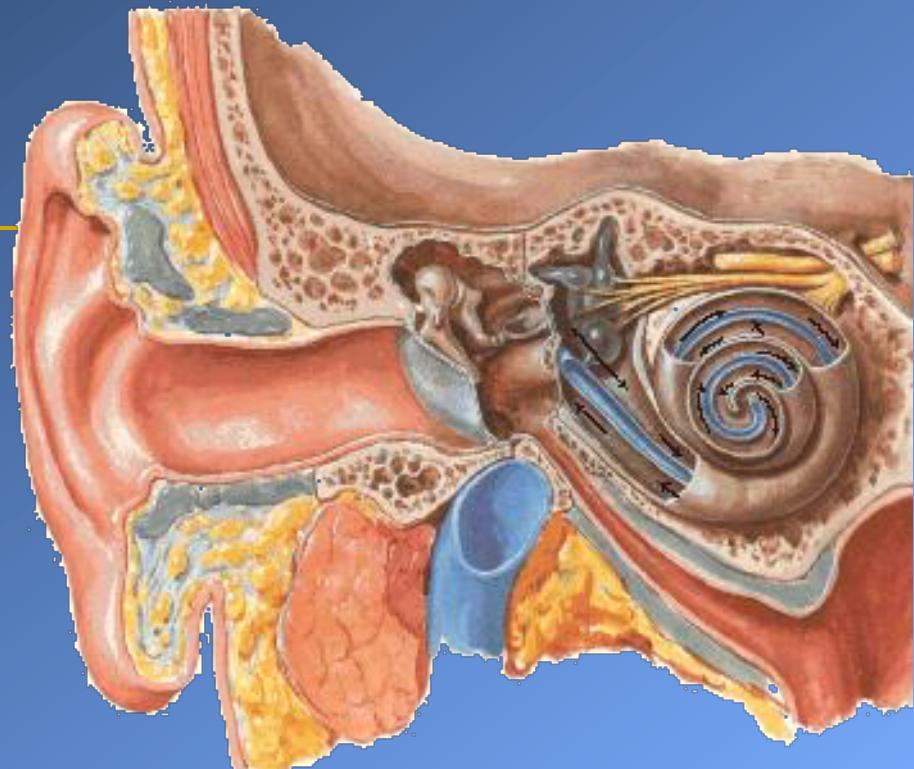




Anatomy of the Ear

Otitis Externa and Otitis Media

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Cochlear Implant Consultant*



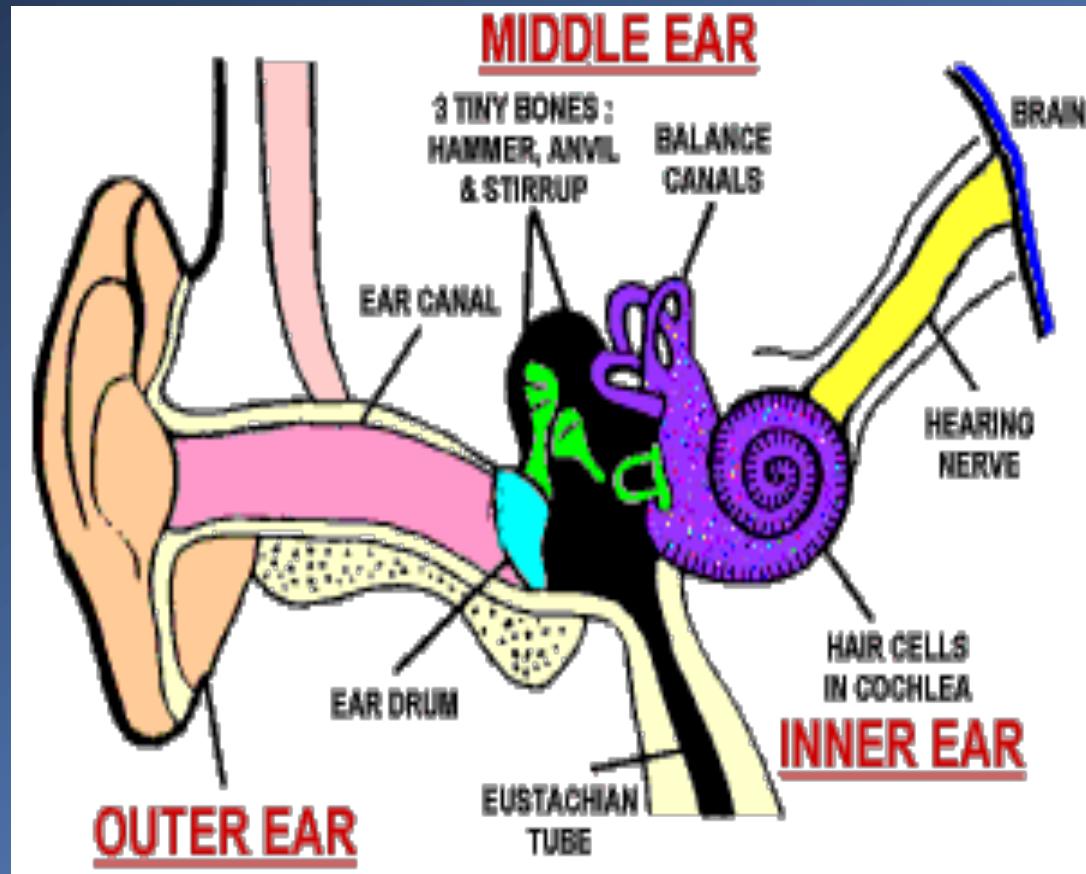
Objectives

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

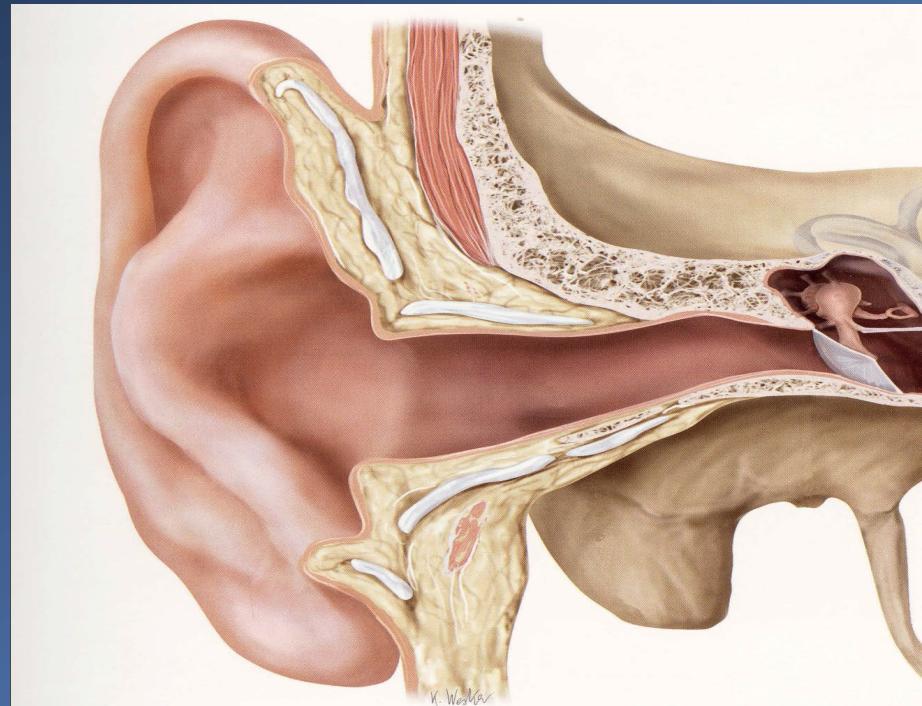
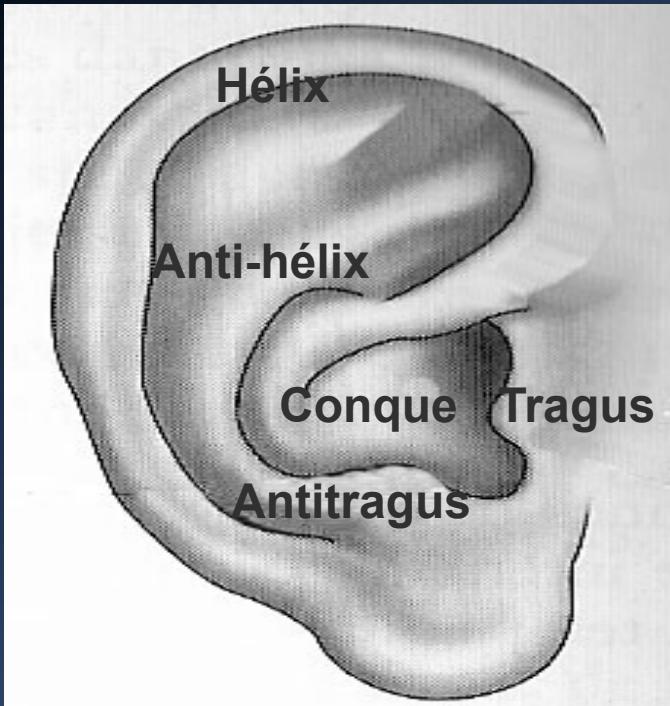
Anatomy

- It has 3 parts:

- External ear
- Middle ear
- Inner ear



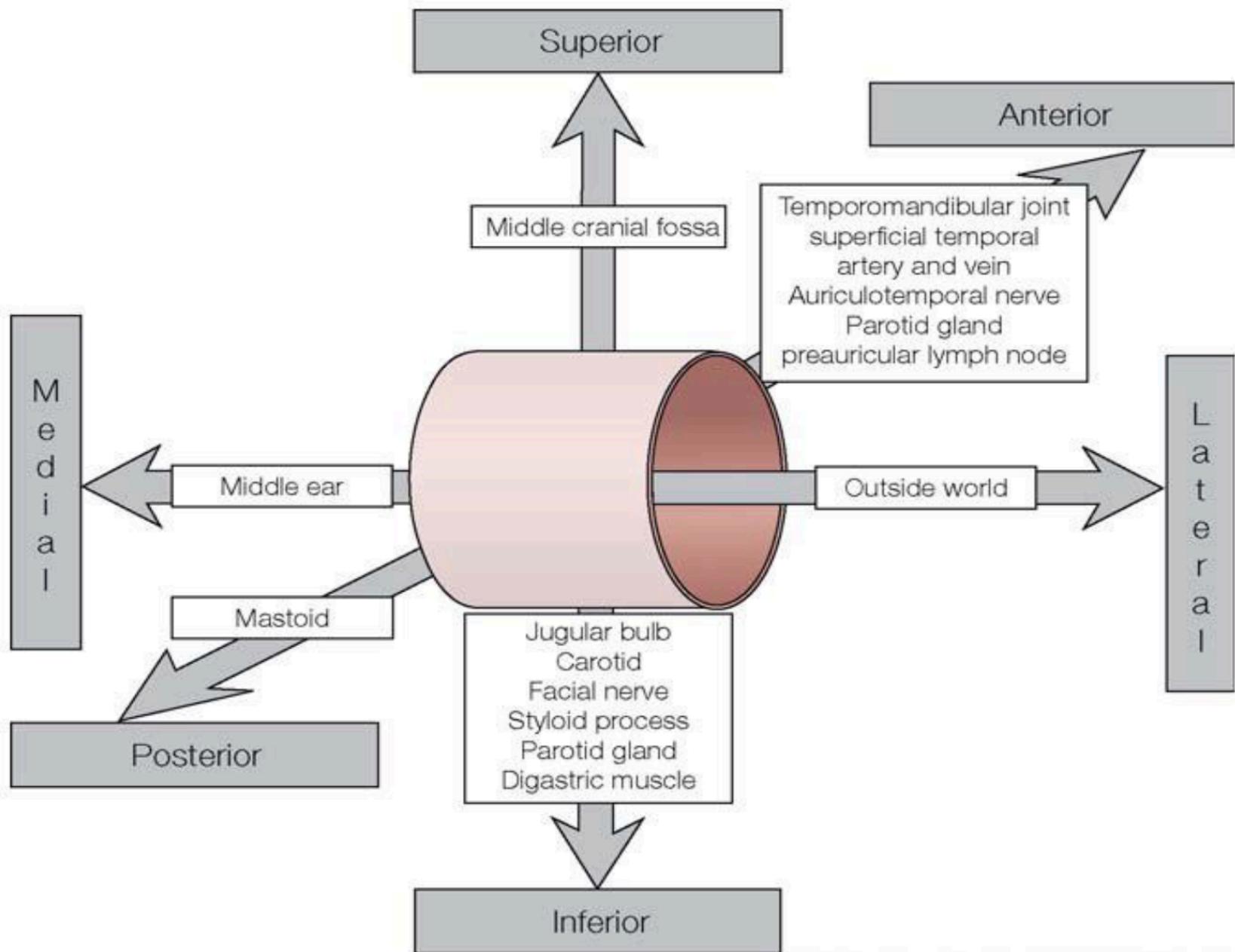
External Auditory Canal



External Auditory Canal (EAC)

EAC is 2.5 cm long;

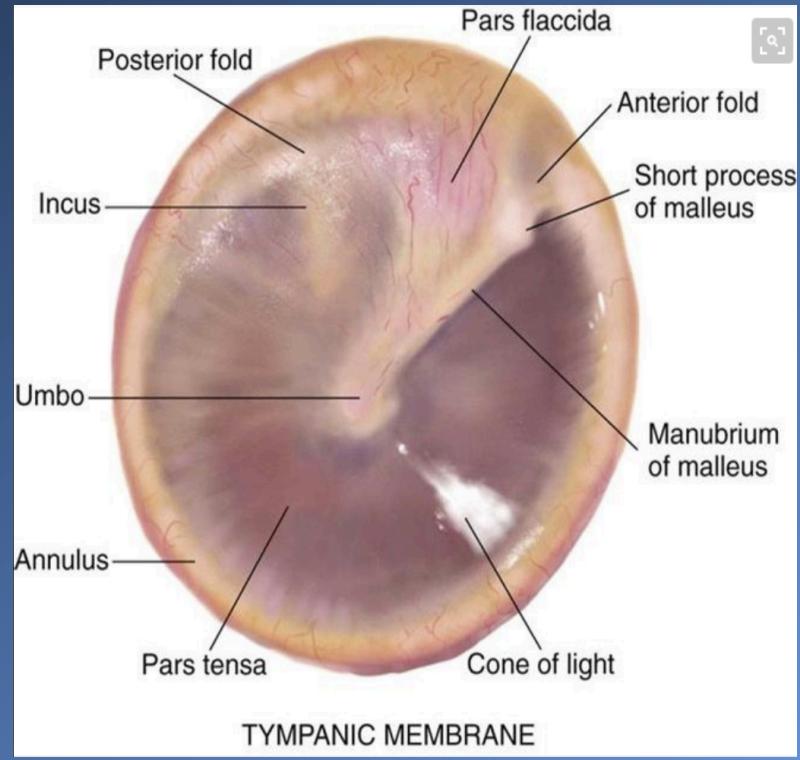
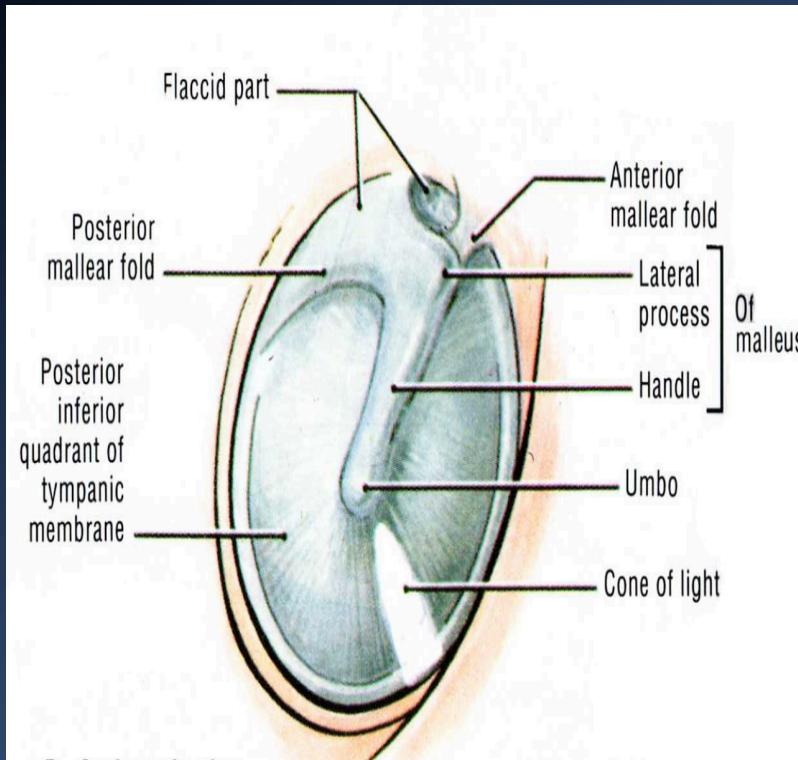
- ◆ Outer cartilaginous canal is 1/3 of canal length:
 - Contains small amount of sub-Q tissue
 - Appendages include hair cells, sebaceous and apocrine glands (together called the ***apopilosebaceous unit***)
- ◆ Medial 2/3 is osseous:
 - Skin lining is just 0.2 mm thick
 - No sub-Q tissue or appendages



Function Of The External Ear

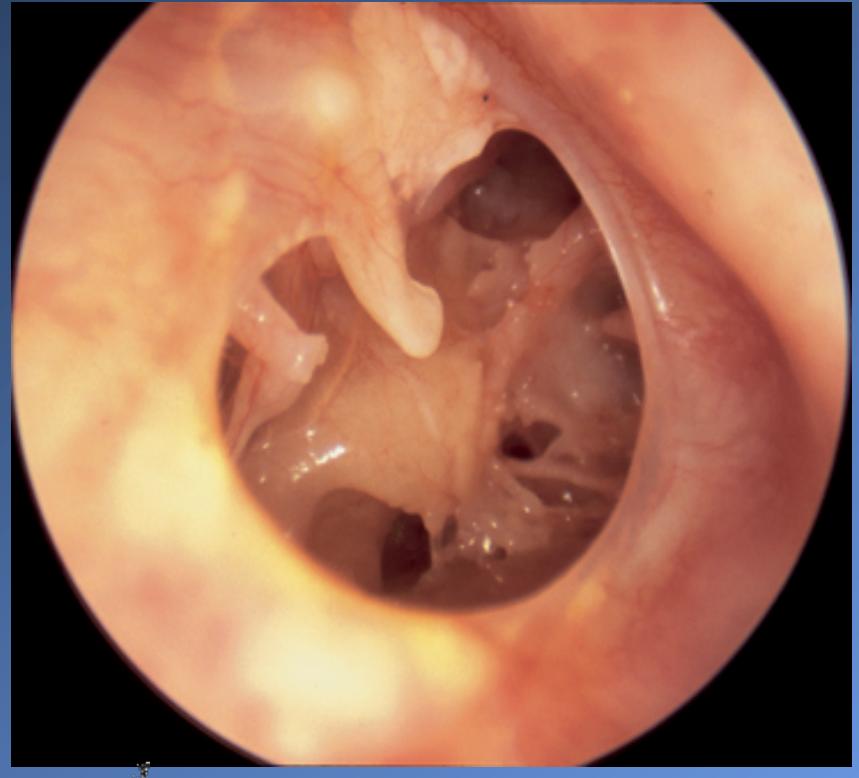
- Protection of the middle ear
 - Wax
- Auditory functions:
 - Sound conduction
 - Increase sound pressure by the resonance function

Tympanic membrane

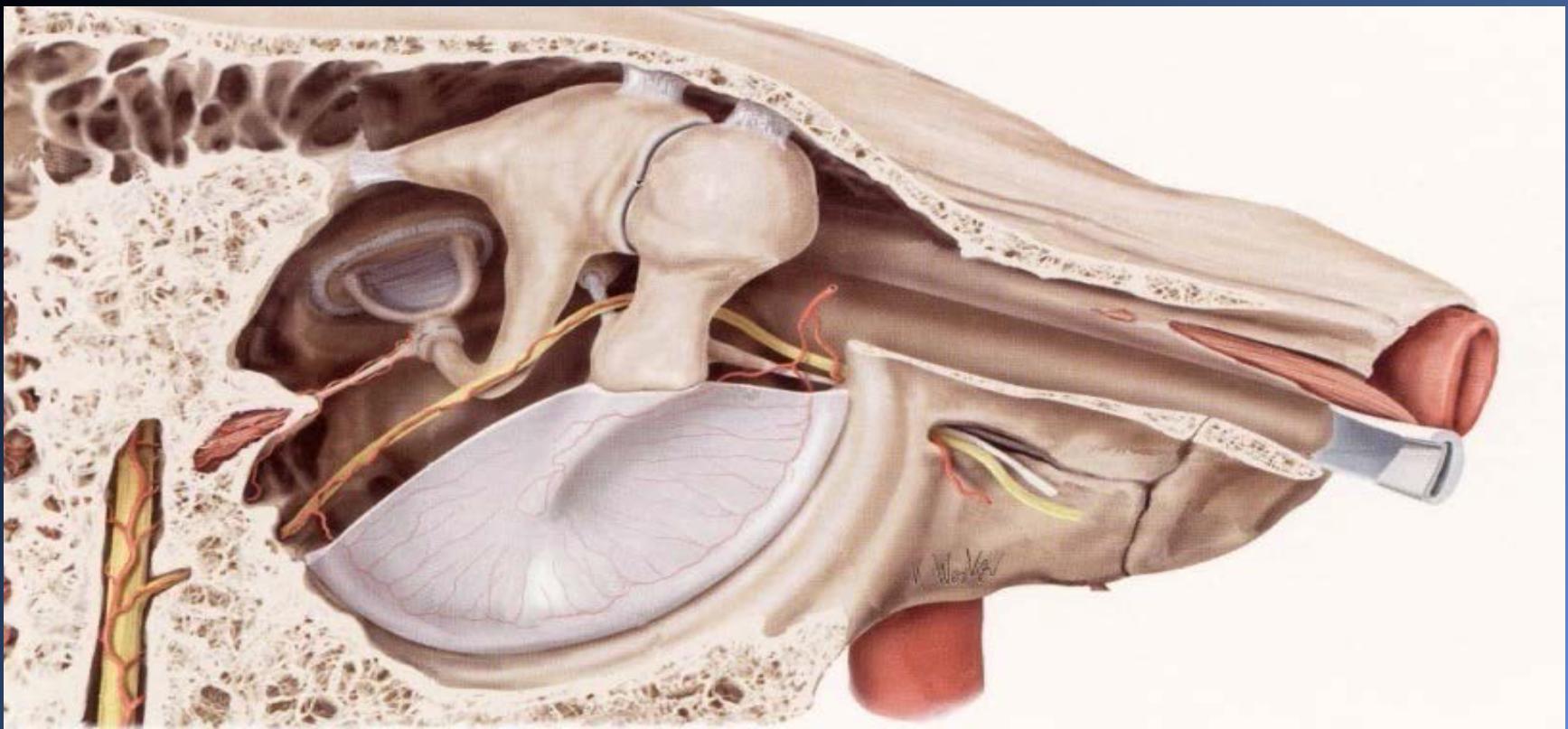


- Fibroelastic Membrane has 3 layers (epidemic, fibrous, mucous).
- Divided in 2 parts : pars flaccida et pars tensa
- It separate the external ear from the middle ear

Middle Ear



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

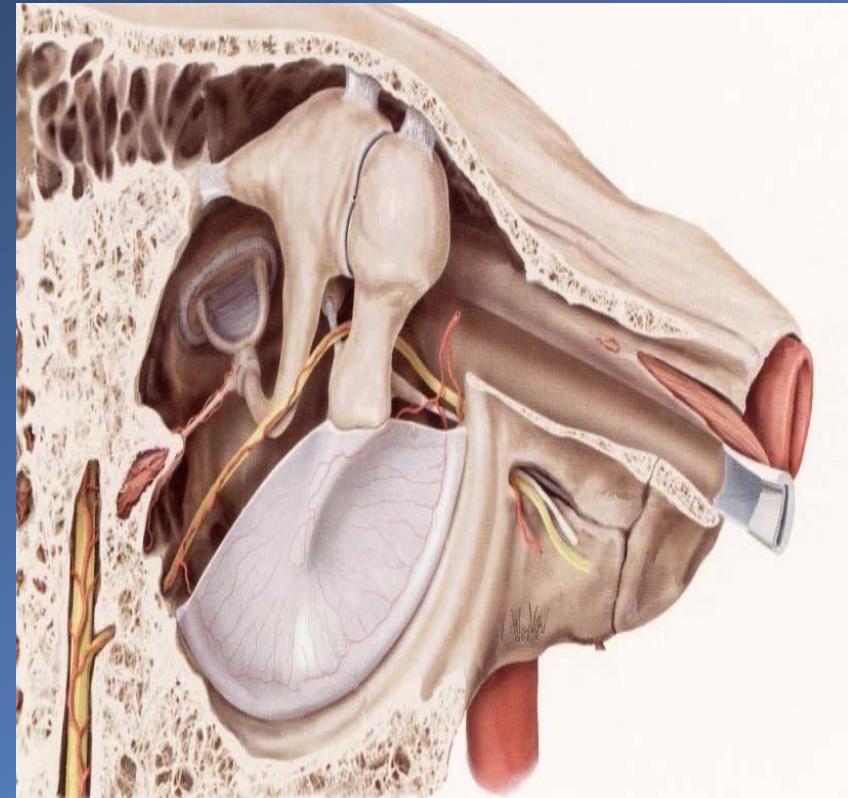


Middle Ear Cleft :

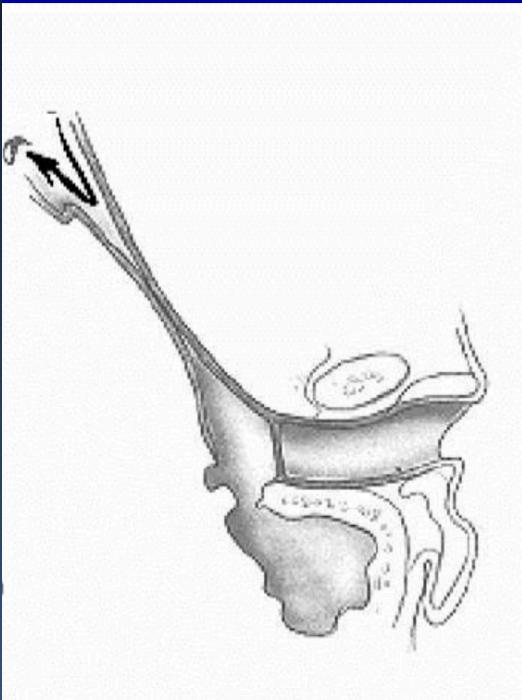
- Eustachian (Pharyngo-tympanic) Tube
- Tympanic (Middle Ear) Cavity
- Mastoid antrum and air cells

Eustachian Tube

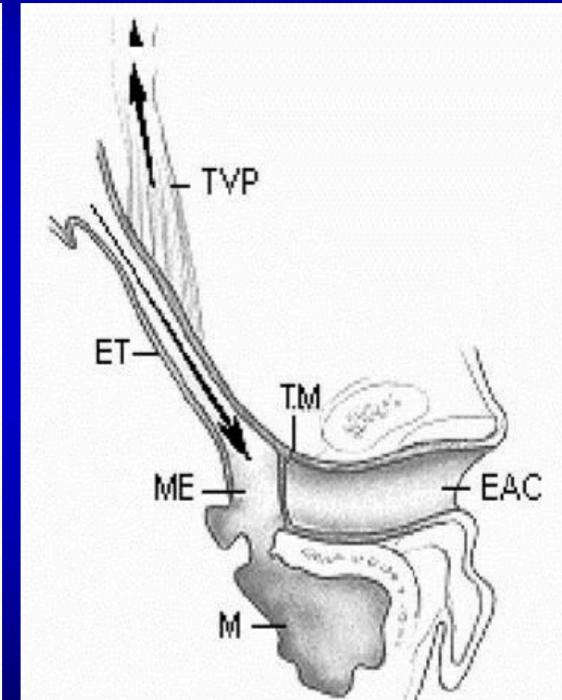
- Is the conduit through which air is exchanged between the middle ear space and upper aerodigestive tract.
- Open at the torus tubarius.
- Proximal 1/3 formed in petrous bone
- Distal 2/3, the distal segment, is a fibrocartilaginous tube that is collapsed at rest



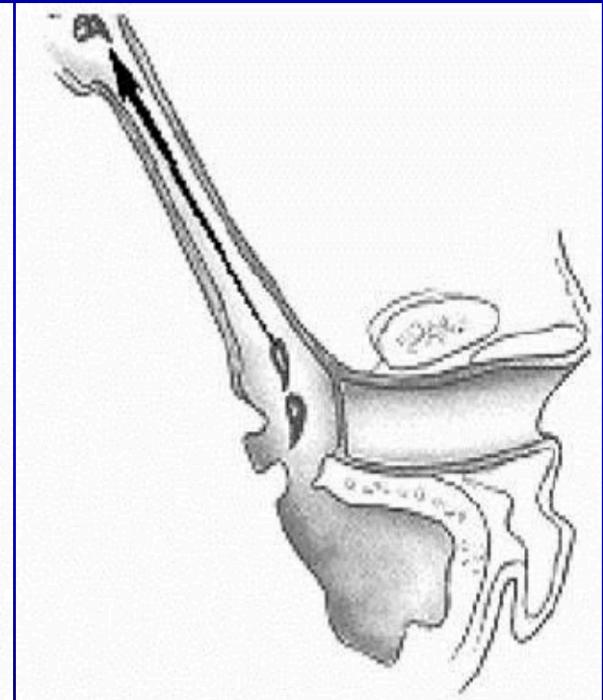
FUNCTIONS OF THE EUSTACHIAN TUBE



Protection

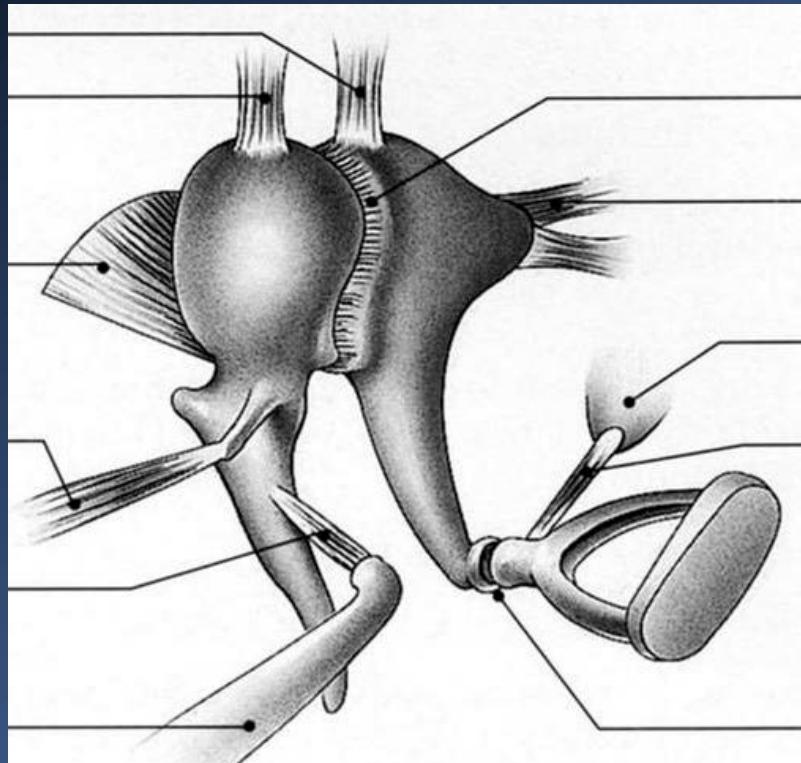


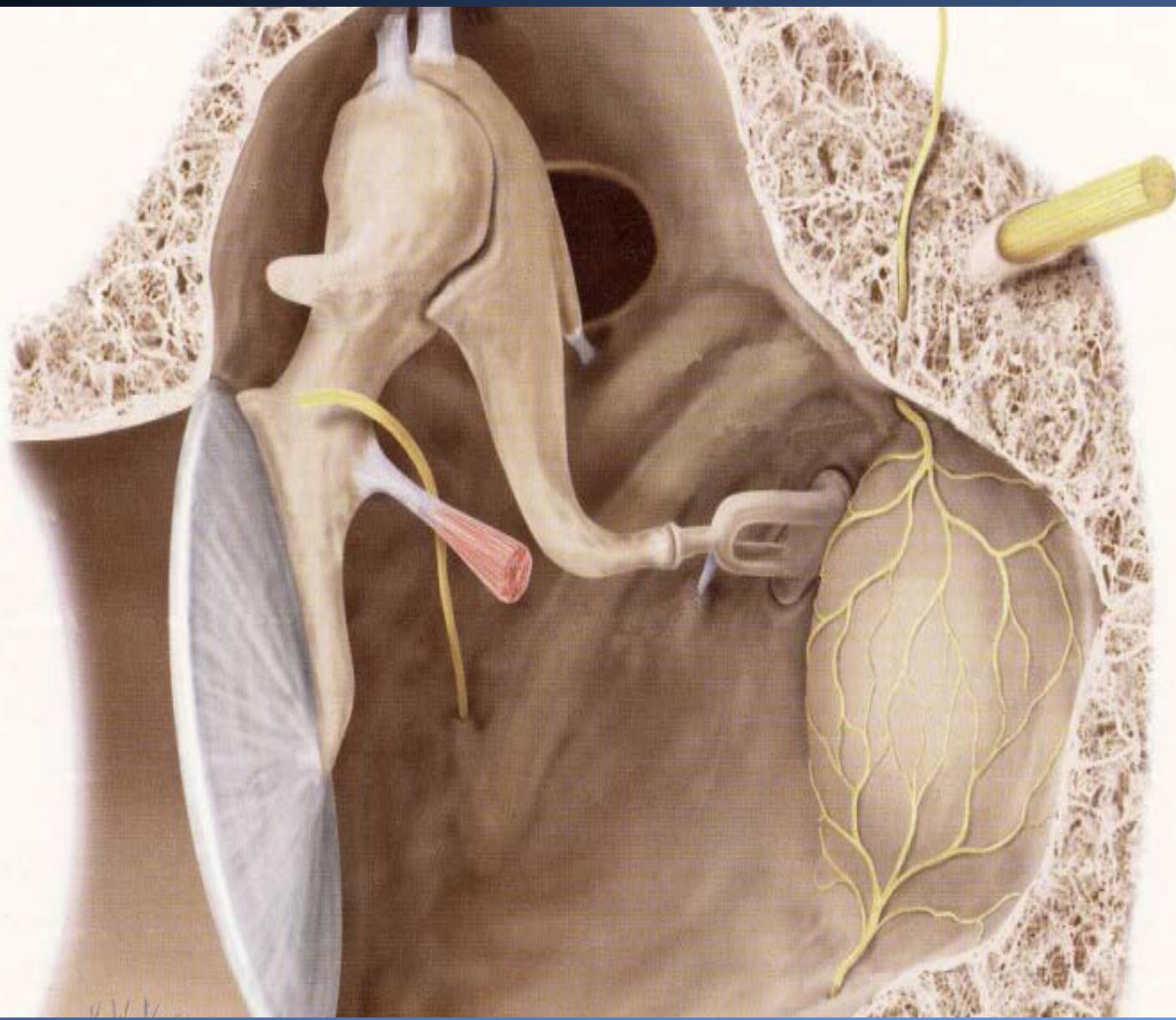
Ventilation

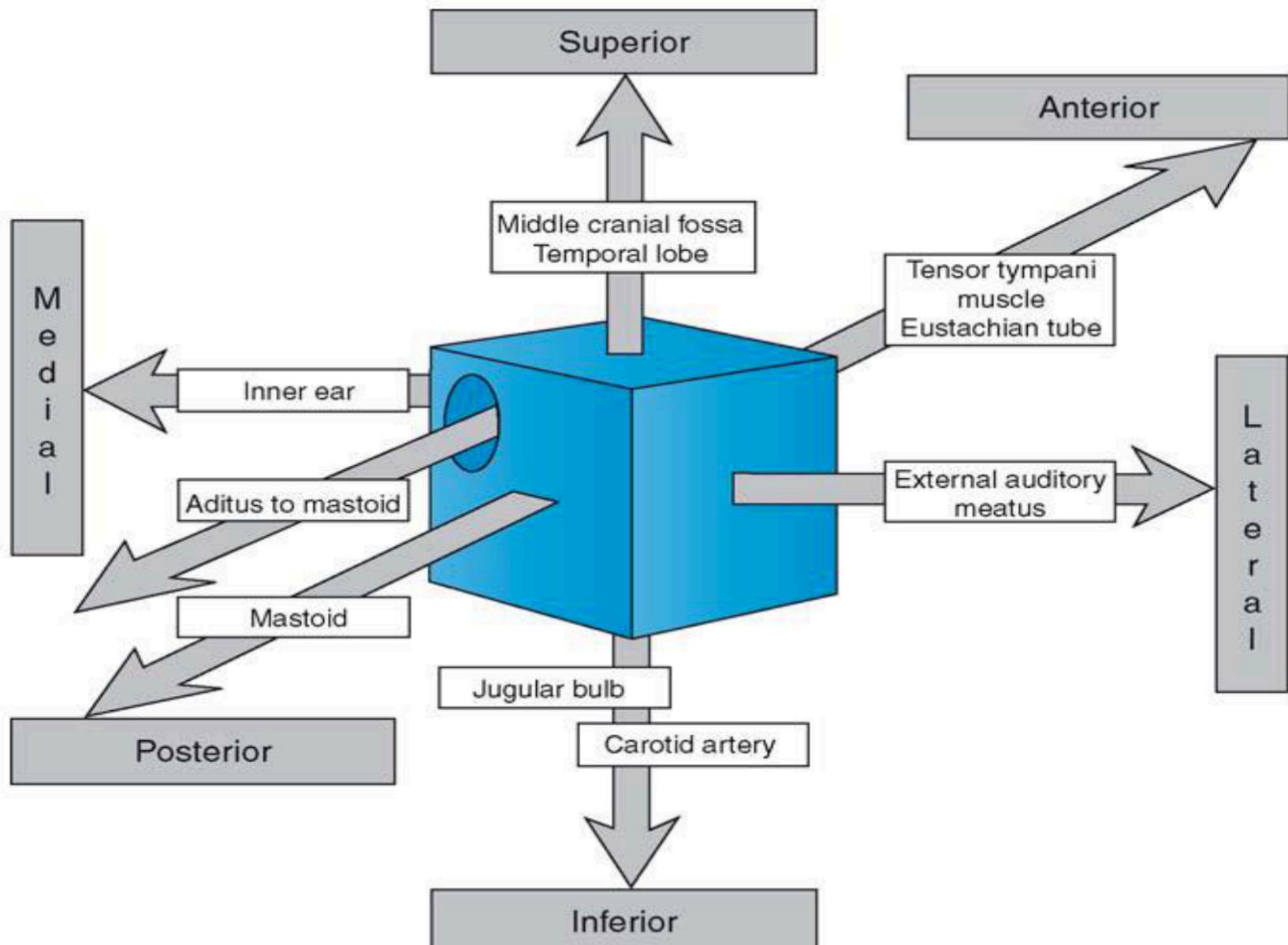


Drainage

Ossicles

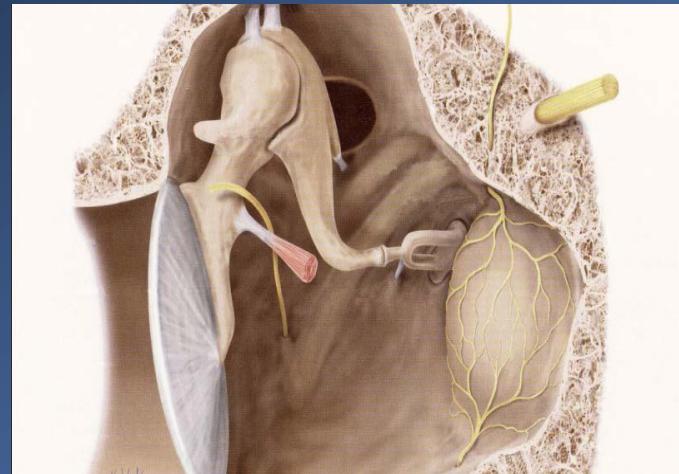




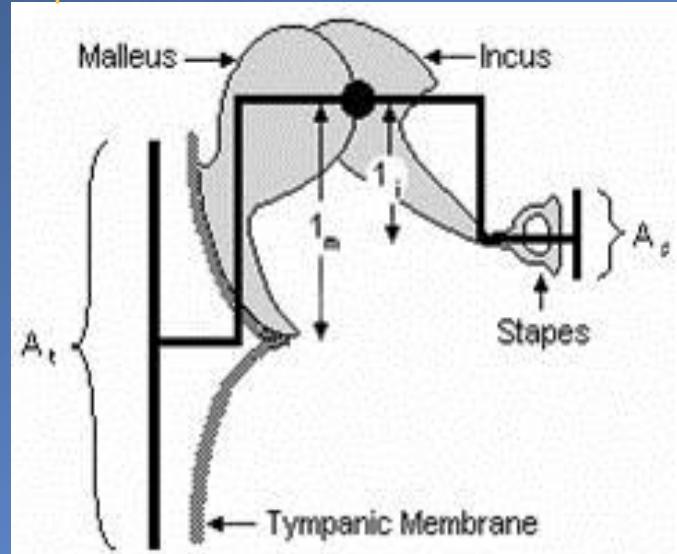


FUNCTIONS OF THE MIDDLE EAR

- 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

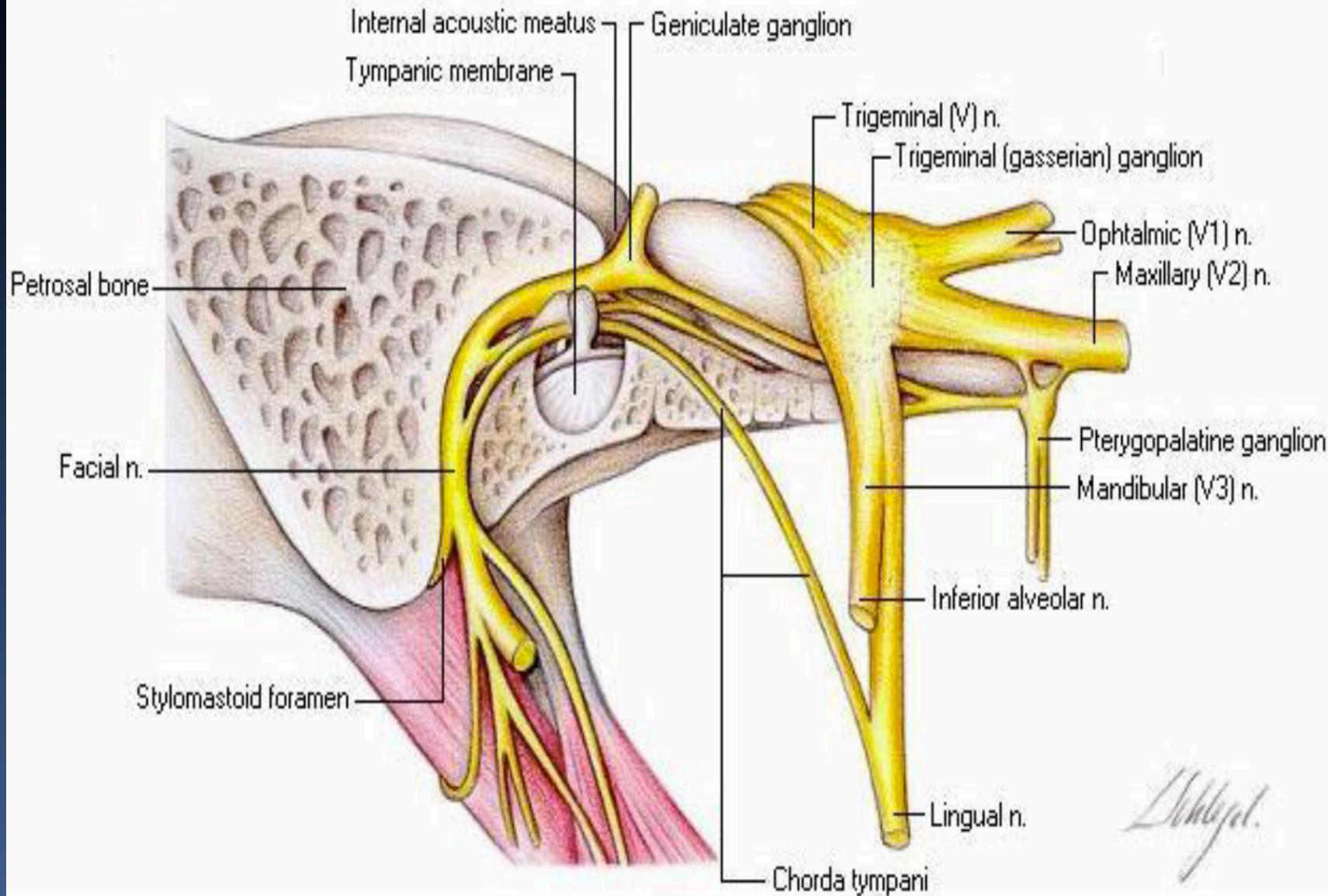


Sensibility



- 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

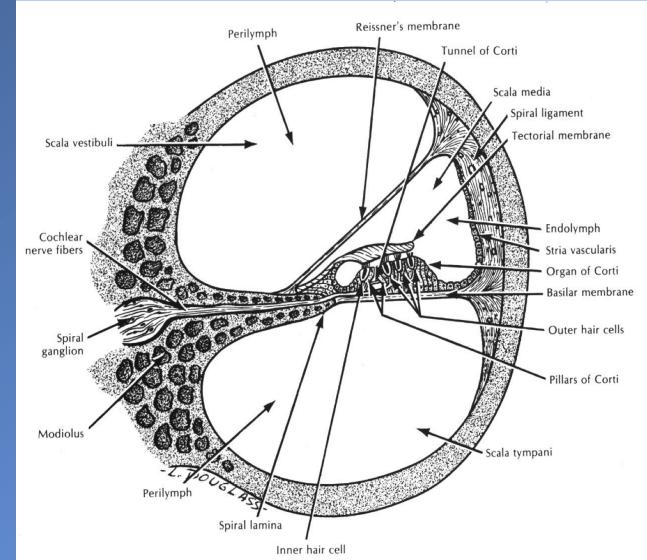
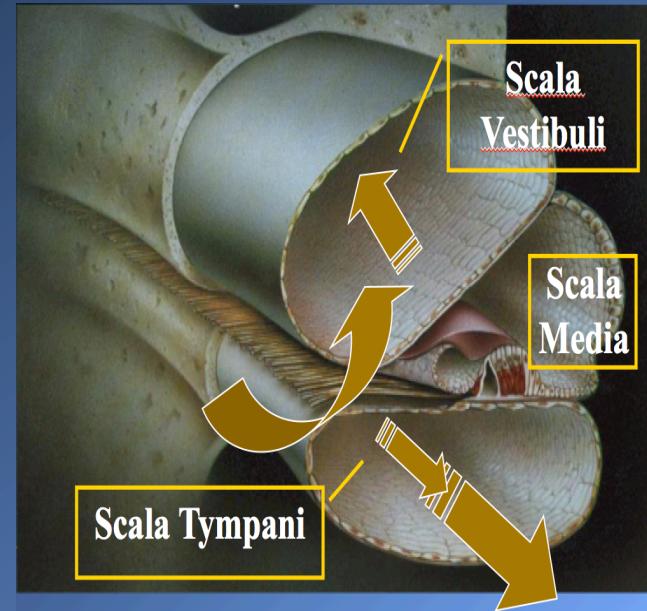
$K^+ = 4 \text{ mEq/L}$

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

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

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

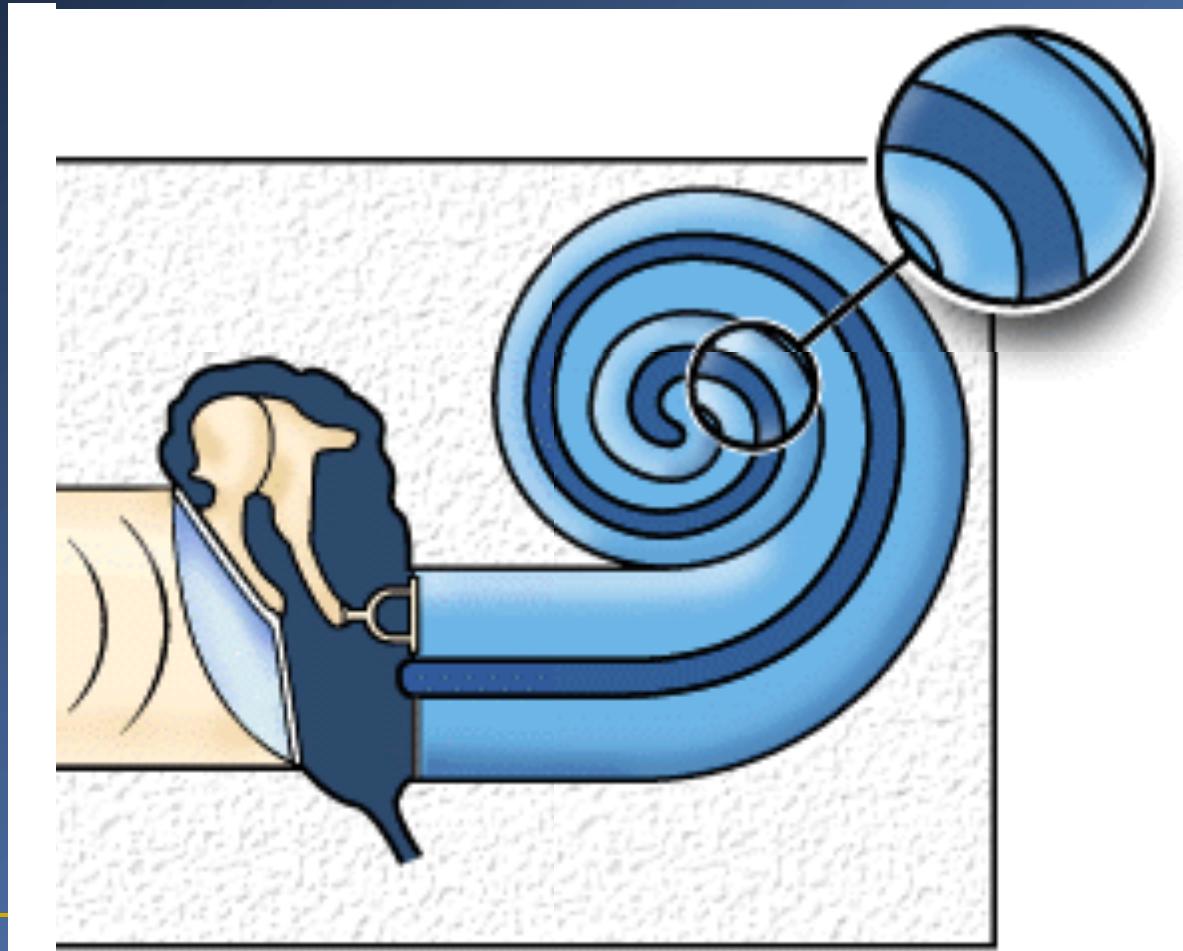
$Na^+ = 13 \text{ mEq/L}$



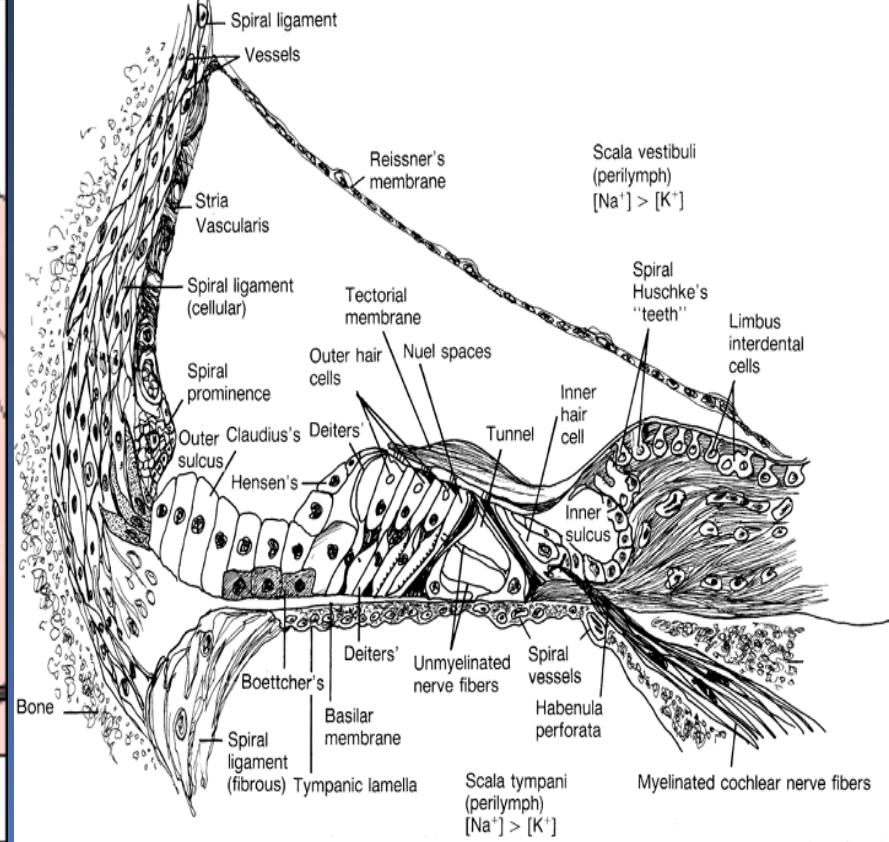
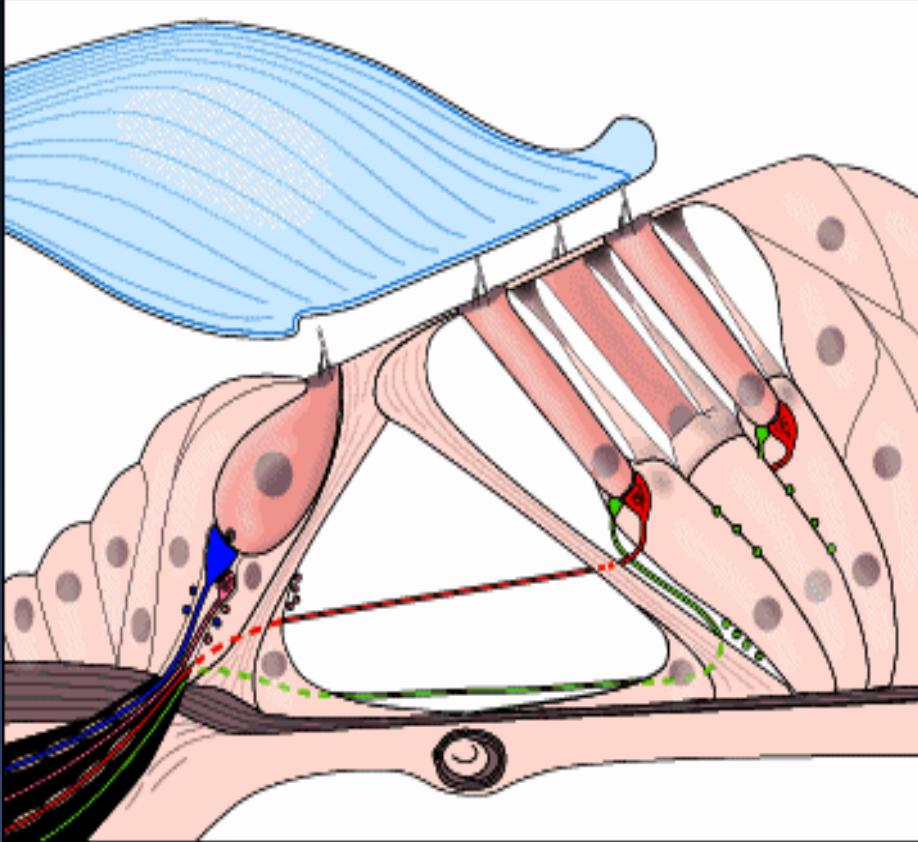
Sound of High frequency affect the basal portion of the Cochlea



Sounds of Low frequency affect the apical portion of the Cochlea



Inner Ear

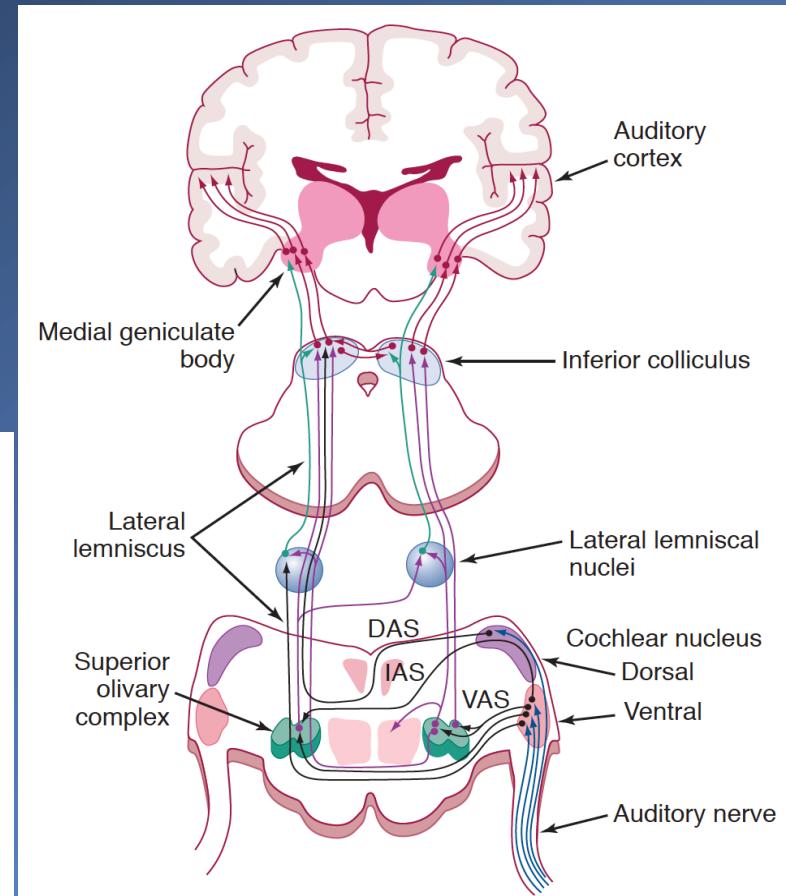
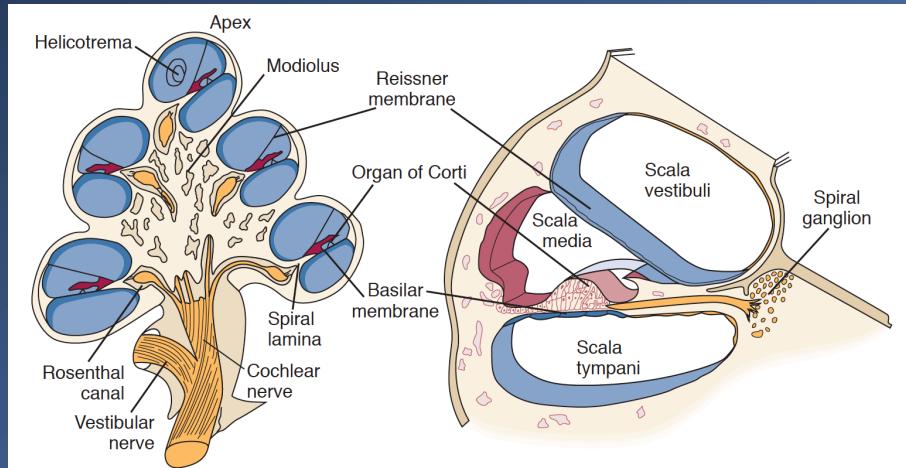


Organ of Corti: rests on basilar membrane and osseous spiral lamina; major components include:

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

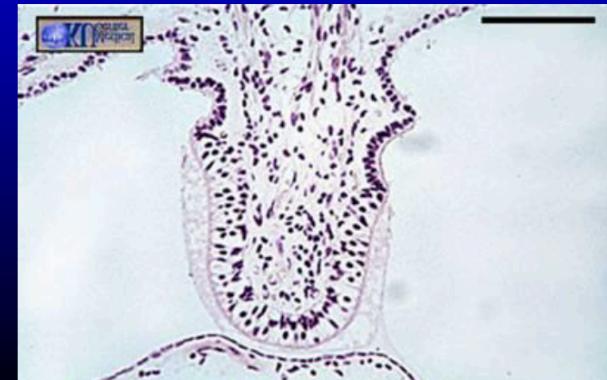
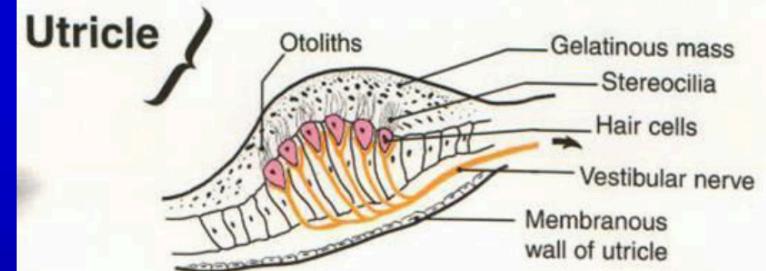
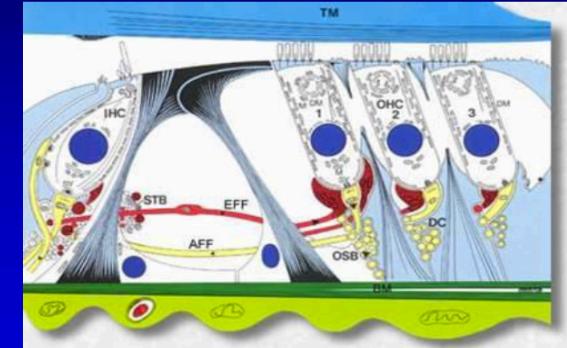
Central Auditory System

- 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.



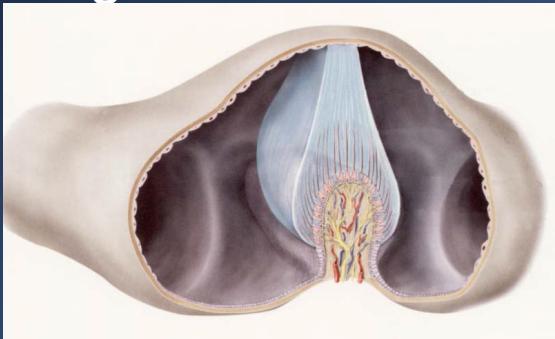
INNER EAR SENSORY EPITHELIUM

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

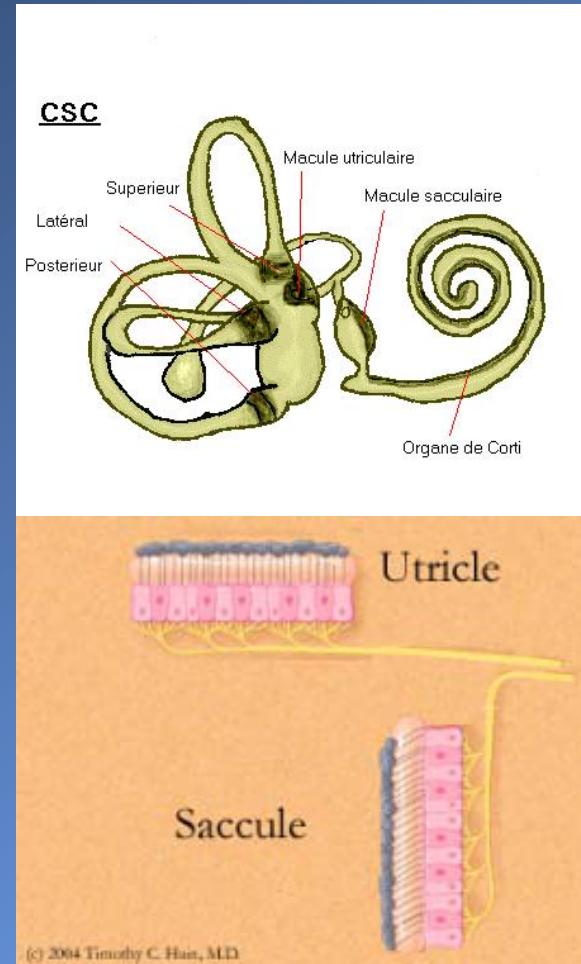


Vestibular System

■ Semi-circular Canals Angular Acceleration

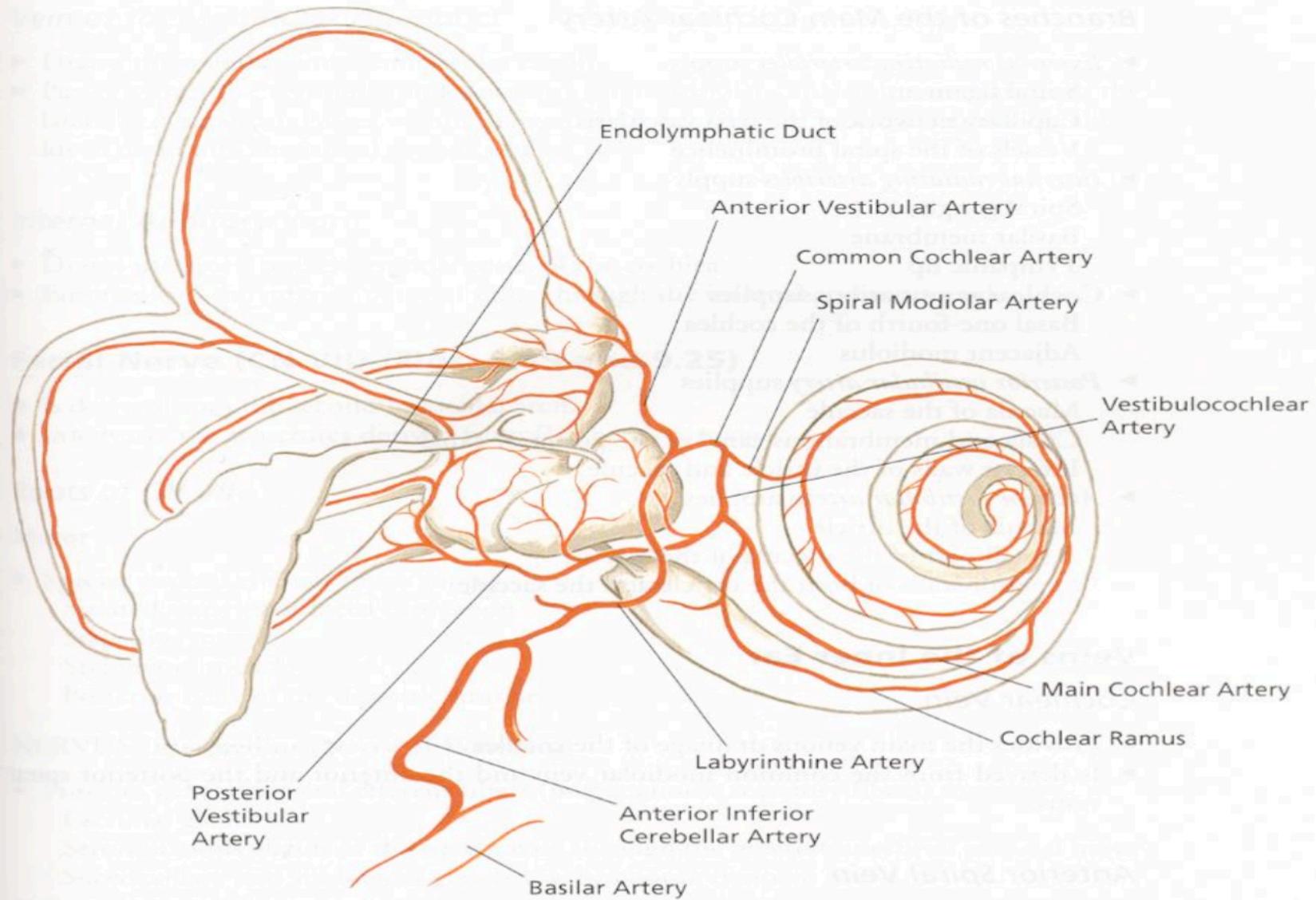


- ## ■ Utricle & Saccule:
1. Macule of the utricle : plan horizontal
 2. Macule of the saccule: plan vertical
 3. Linear acceleration horizontal & Vertical (gravity)



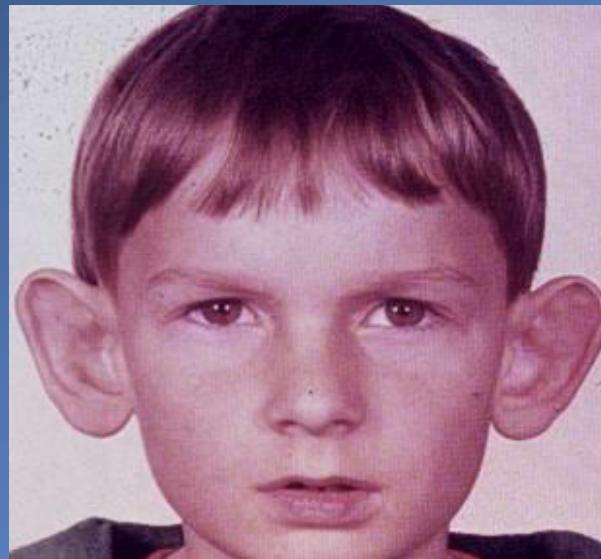
(© 2004 Timothy C. Hain, M.D.)

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



Congenital Malformations

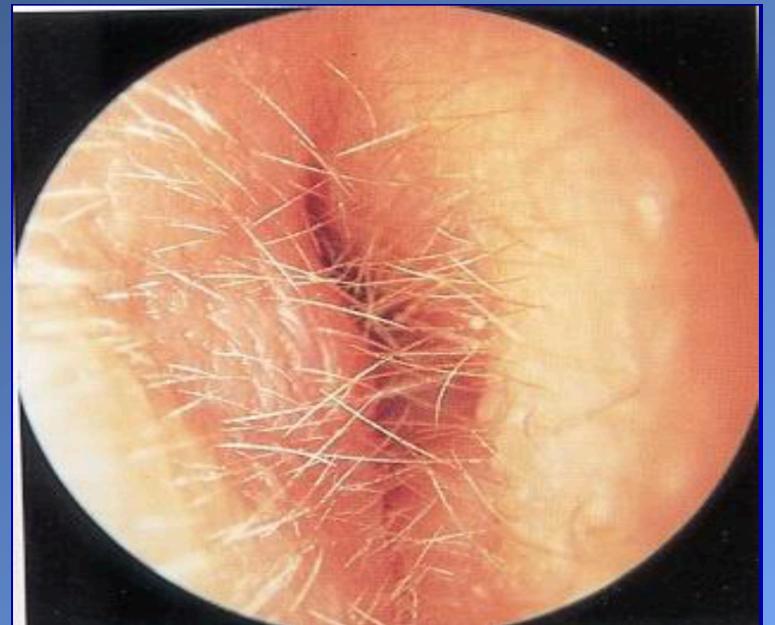
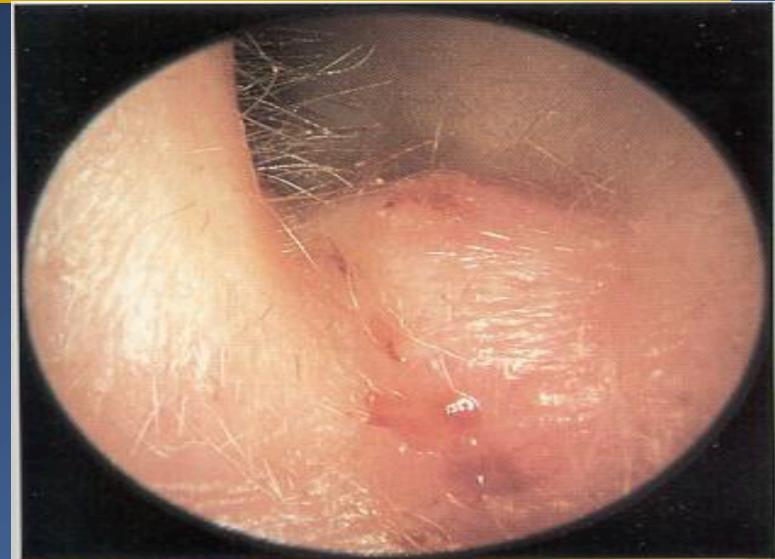
- Anotia & microtia
- Accessory auricle
- Preauricular sinus
- Protruding ear



Otitis Externa

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

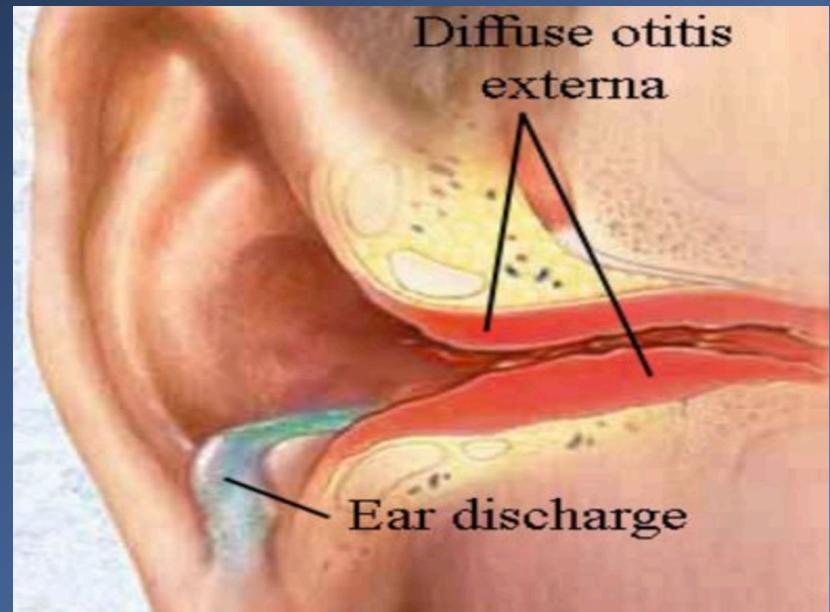


Otitis Externa (OE)

- 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



© Dr R. Vincent - Clinique Causse

Otomycosis

Otitis Externa (OE)

■ Medical treatment:

- Frequent cleaning
 - Meticulous debridement of debris, pus and cerumen
- antibiotics
 - Anti-pseudomonal drops – Ciprorex
- Treatment of pain
- Recommendations regarding prevention
 - Avoid instrumentation
 - Keep H₂O 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

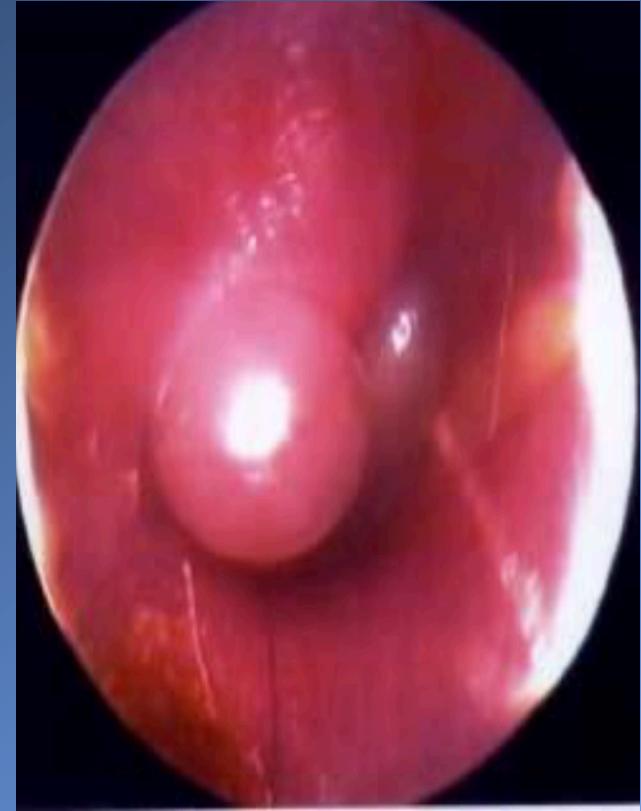


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BULLOUS MYRINGITIS

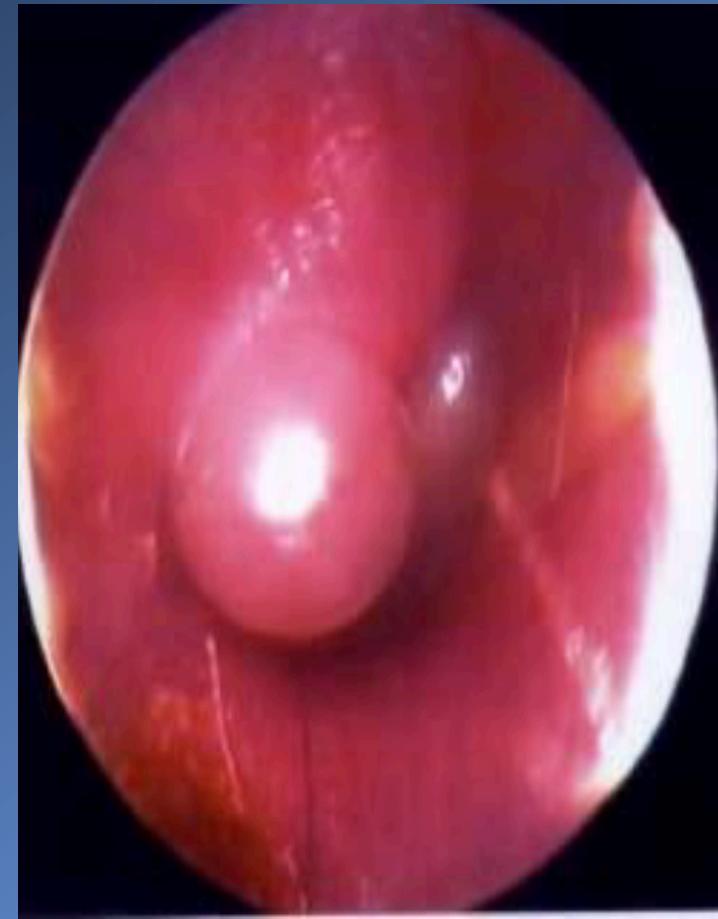
BULLOUS MYRINGITIS

- 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 : **bulla** over the TM and medial canal with serous or serosanguinous fluid



Otitis Media

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



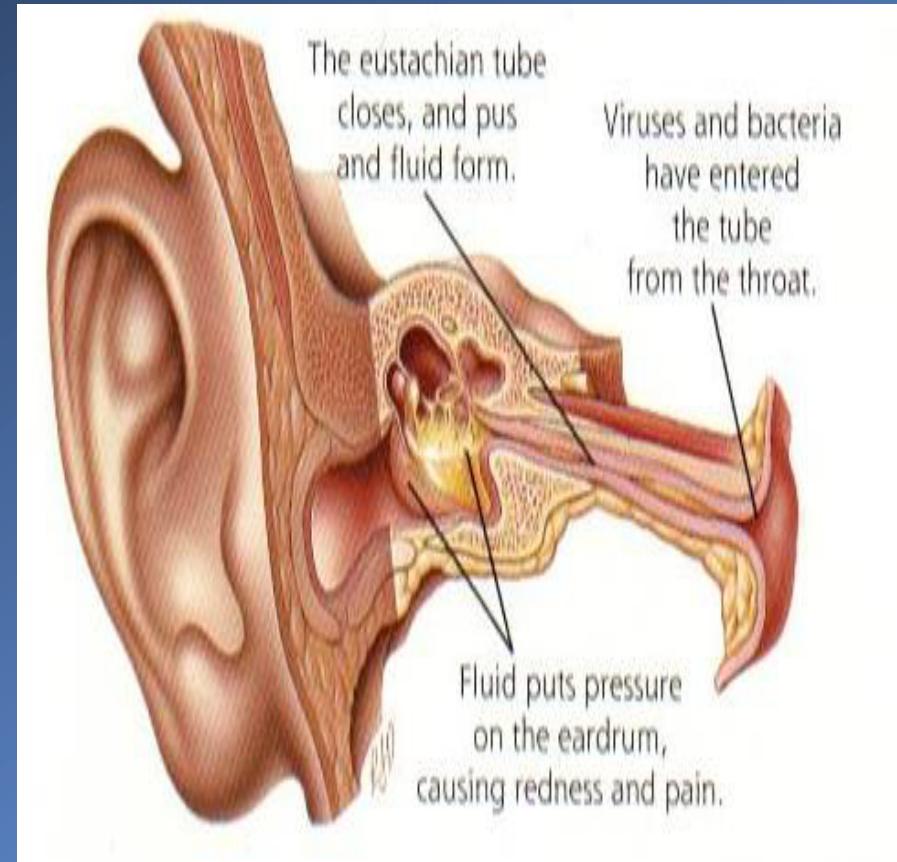
Otitis Media

■ ROUTE OF INFECTION

- Eustachian tube
- External auditory canal
- Blood borne

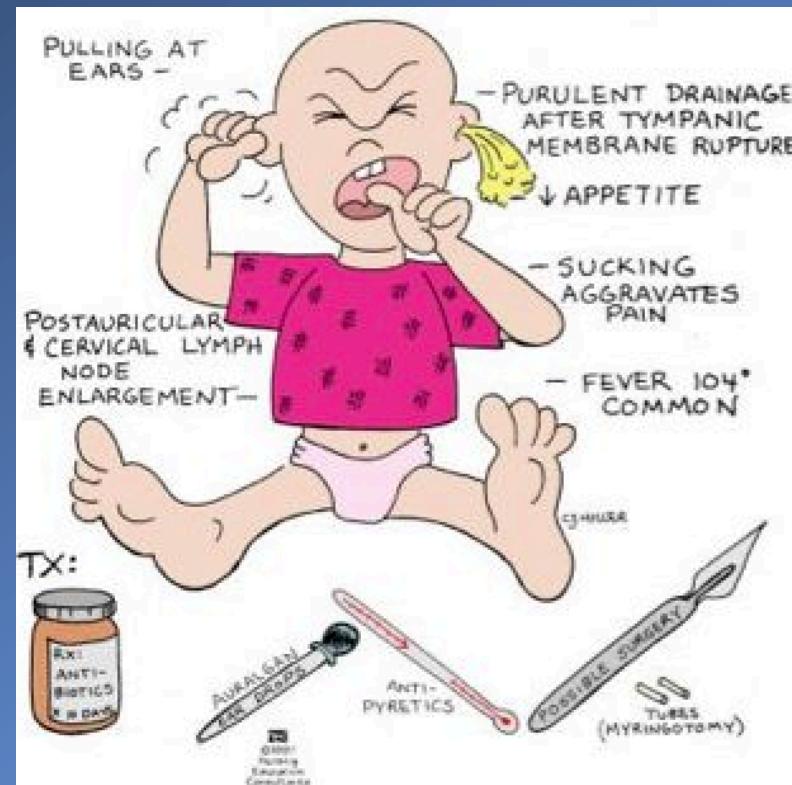
■ BACTERIOLOGY:

- 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

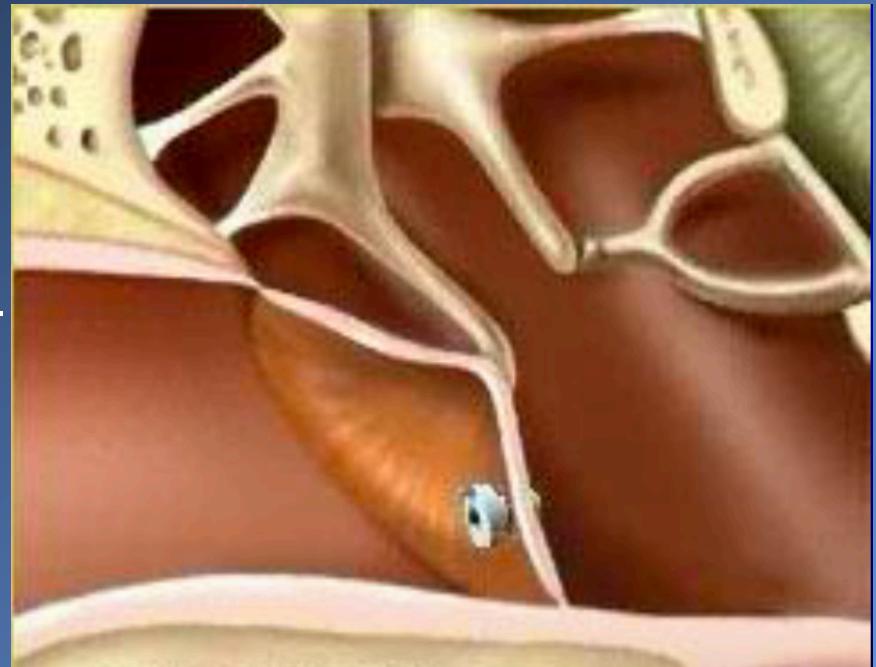
- Acute mastoiditis
- Chronic mastoiditis
- Postauricular abscess
- Bezold abscess
- Temporal abscess
- Petrous apicitis
- Labyrinthine fistula
- Facial nerve paralysis
- Acute suppurative labyrinthitis

■ Intracranial

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

TREATMENT

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



Thank you