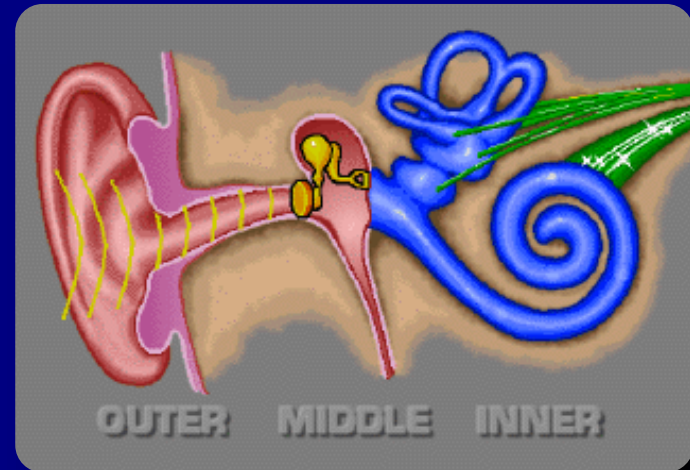


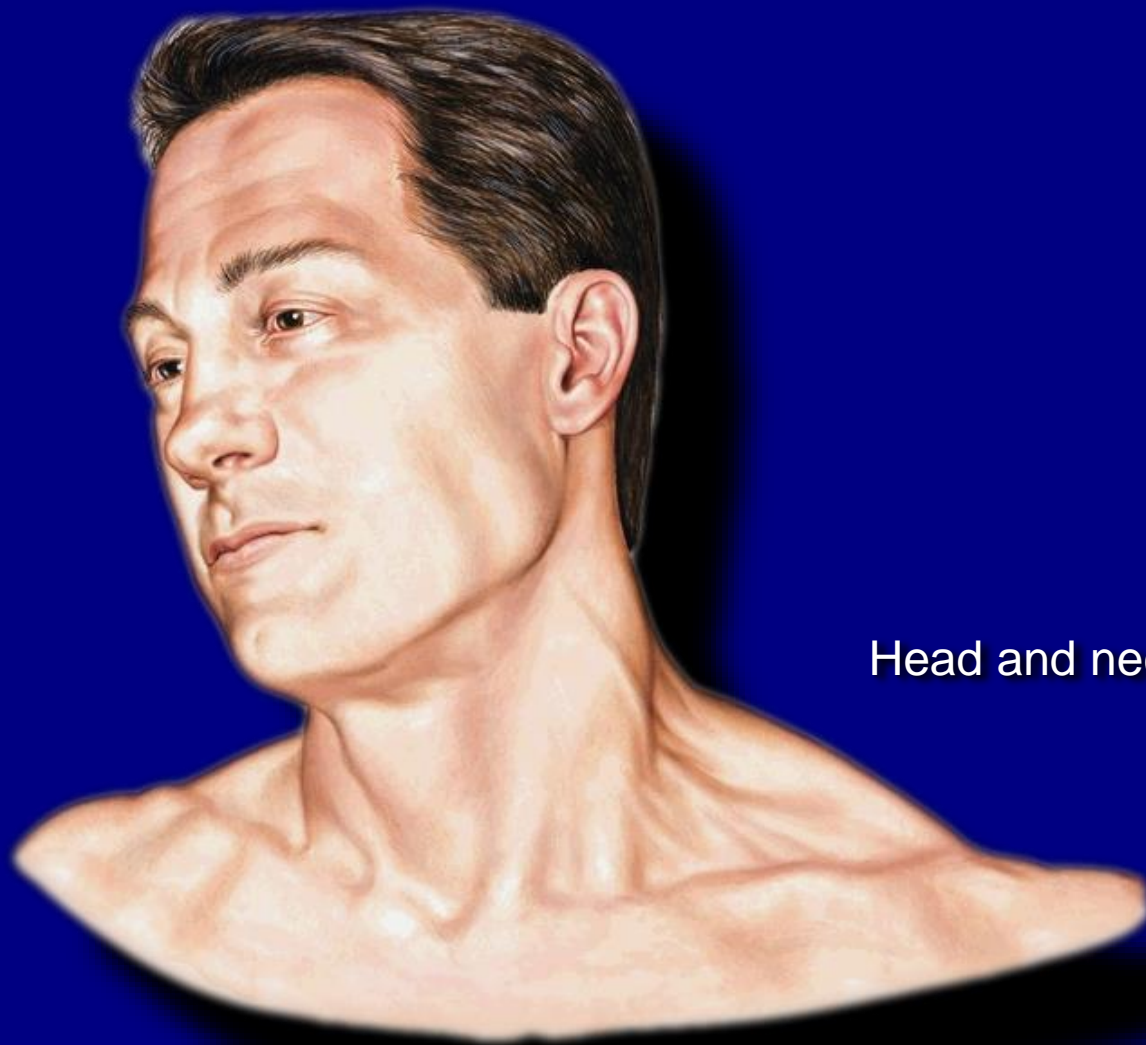


# THE EAR – CLINICAL NOTES





**THE BEAUTY OF VARIATION!**



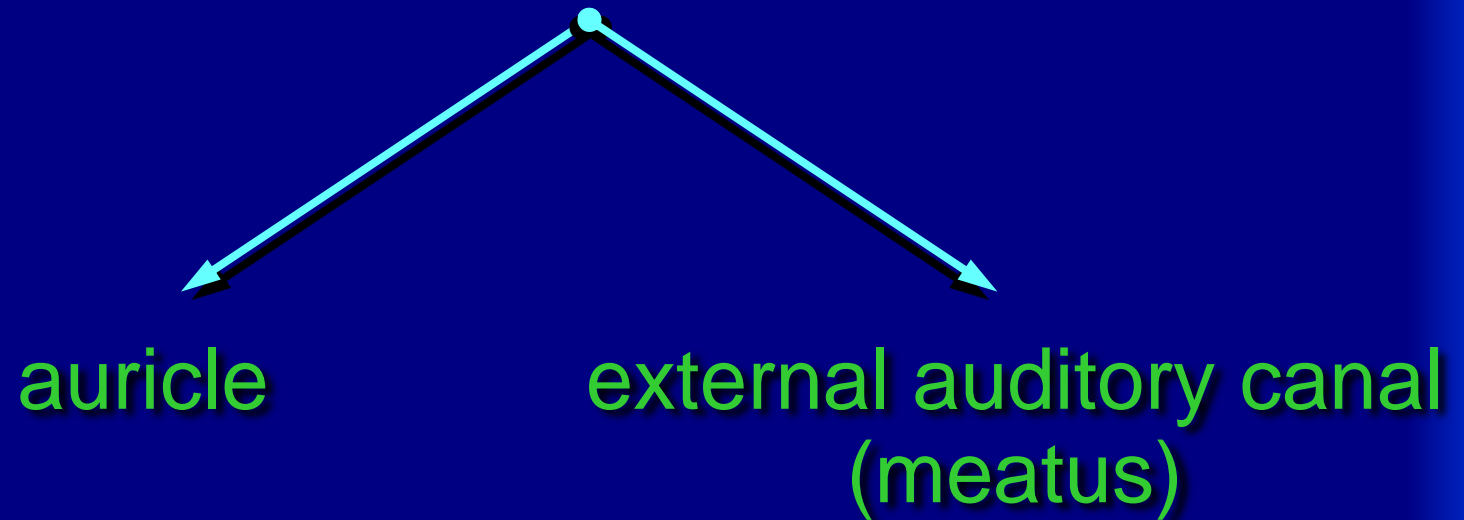
Head and neck

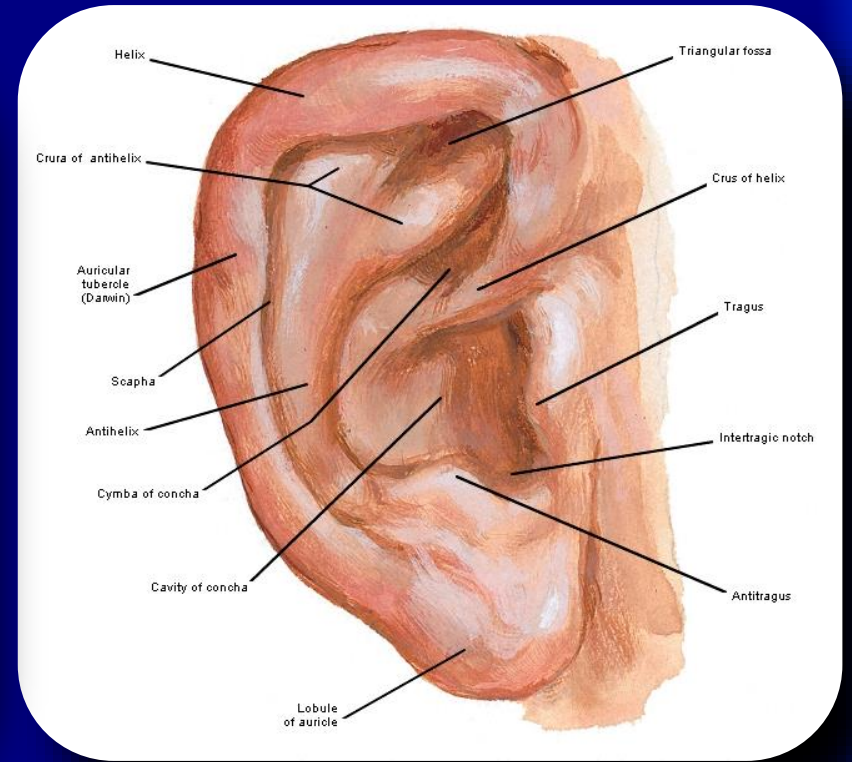
## Human ear consists of:

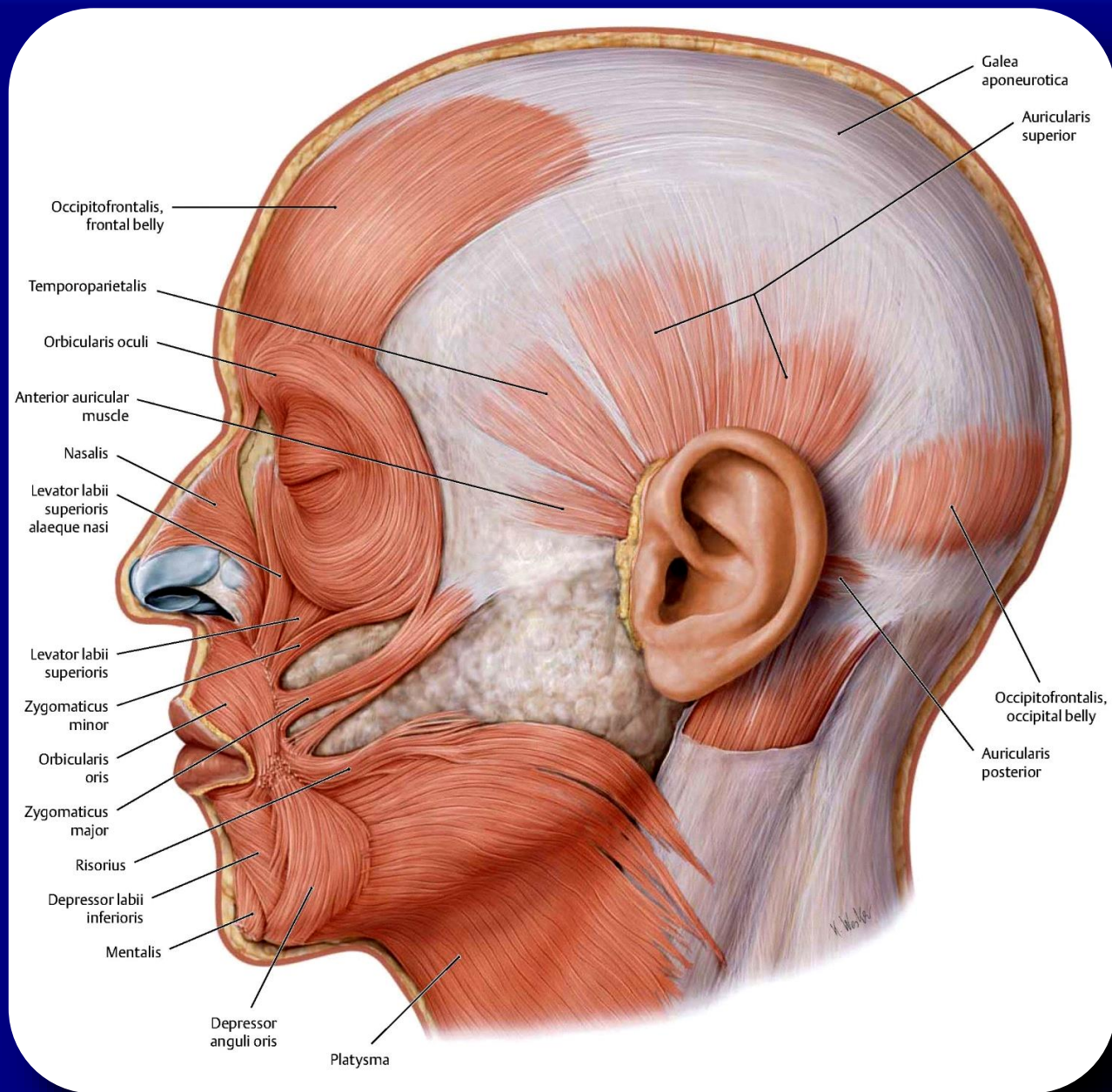
- external ear
- middle ear
- internal ear



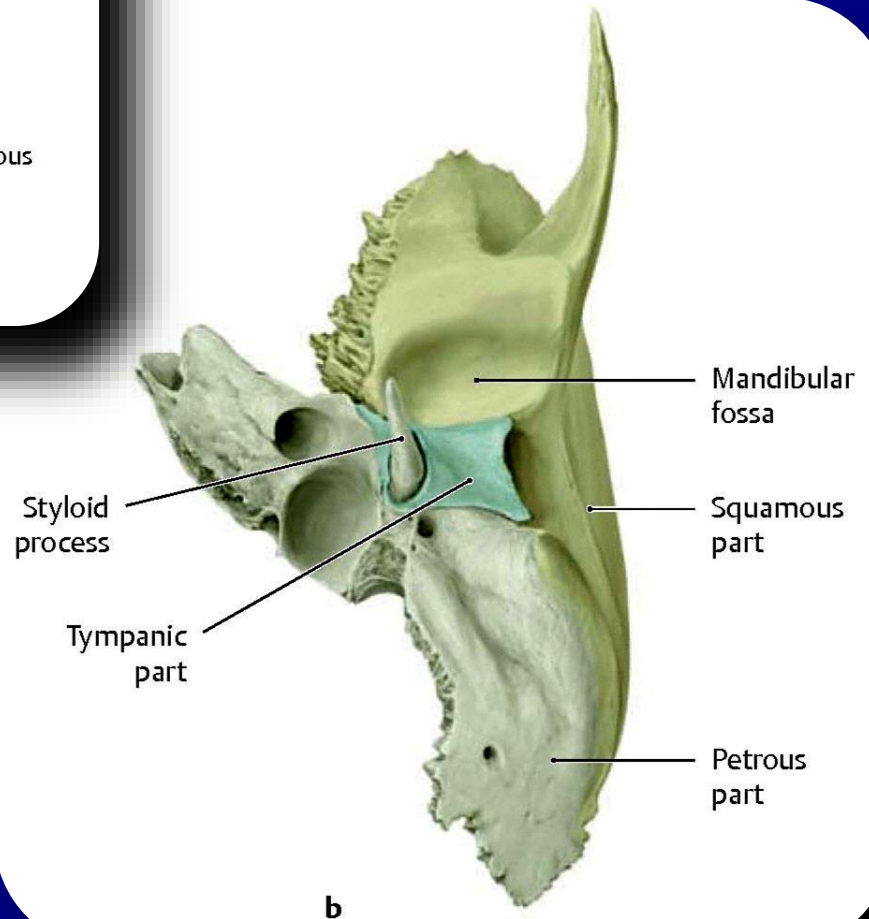
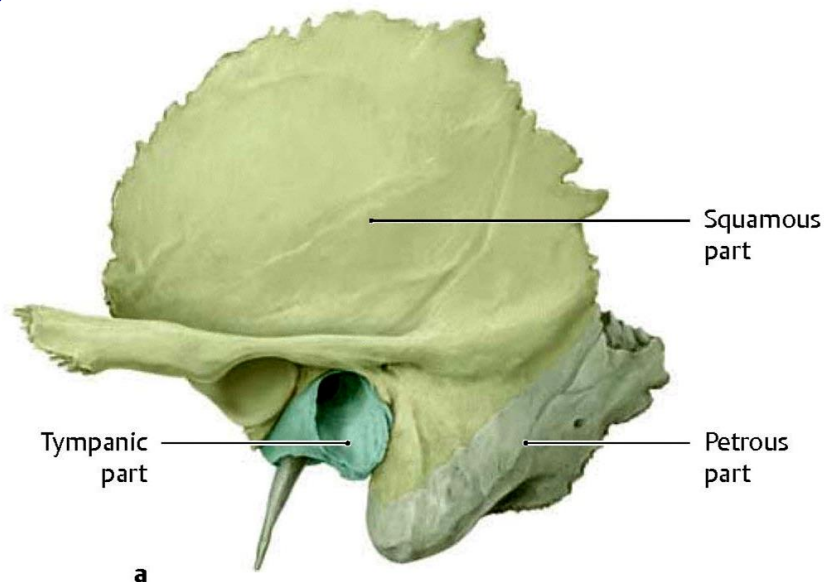
# External ear

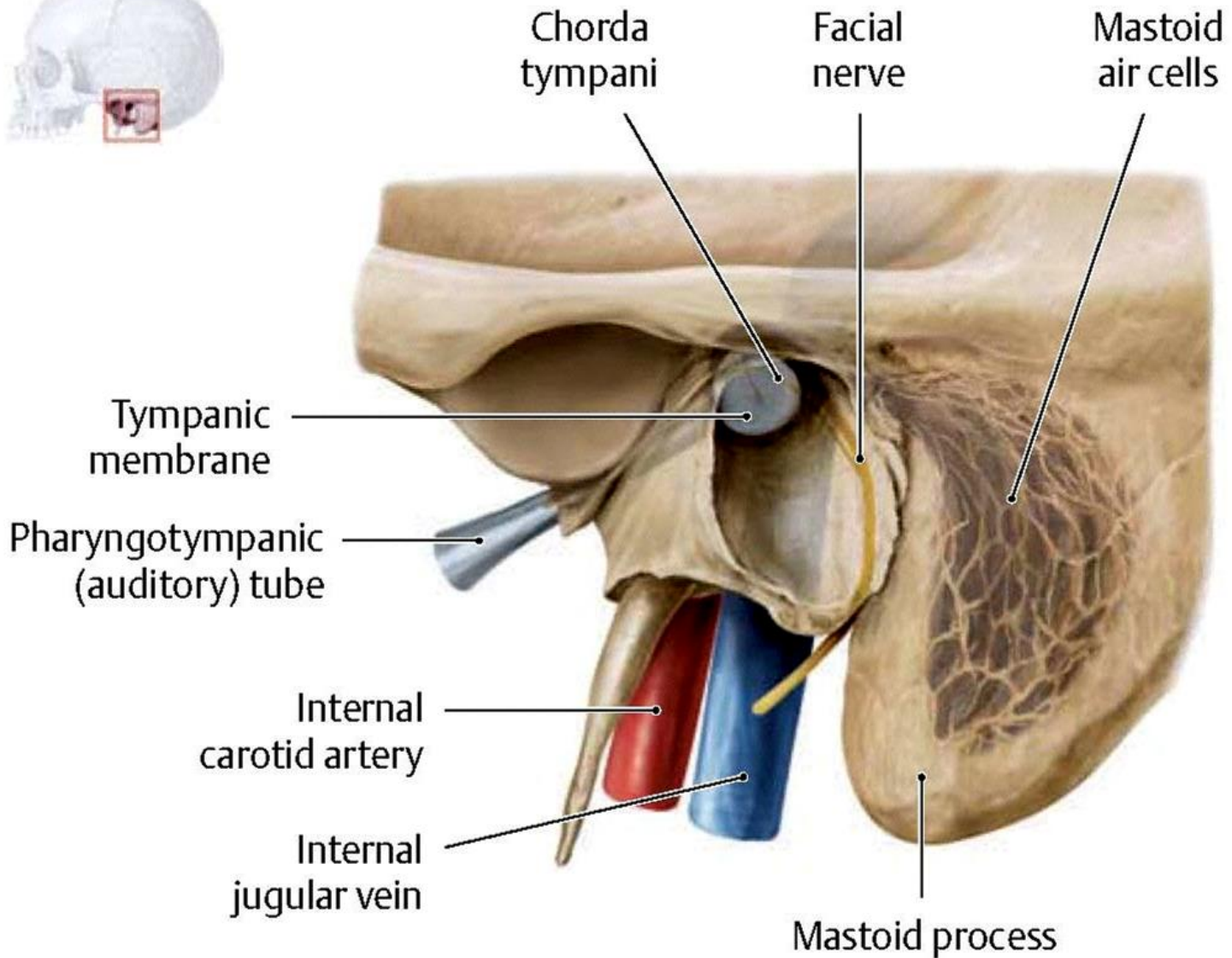




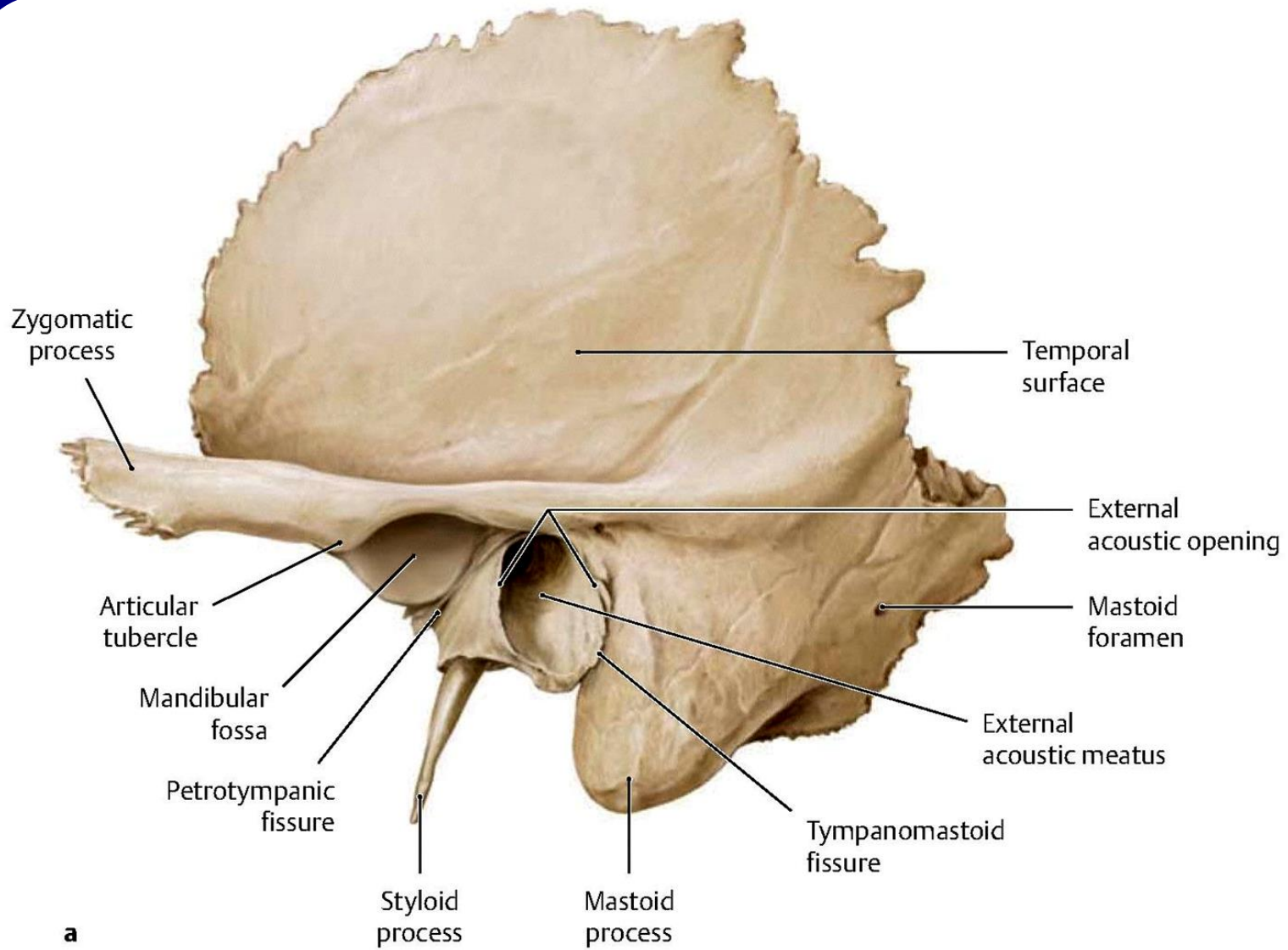


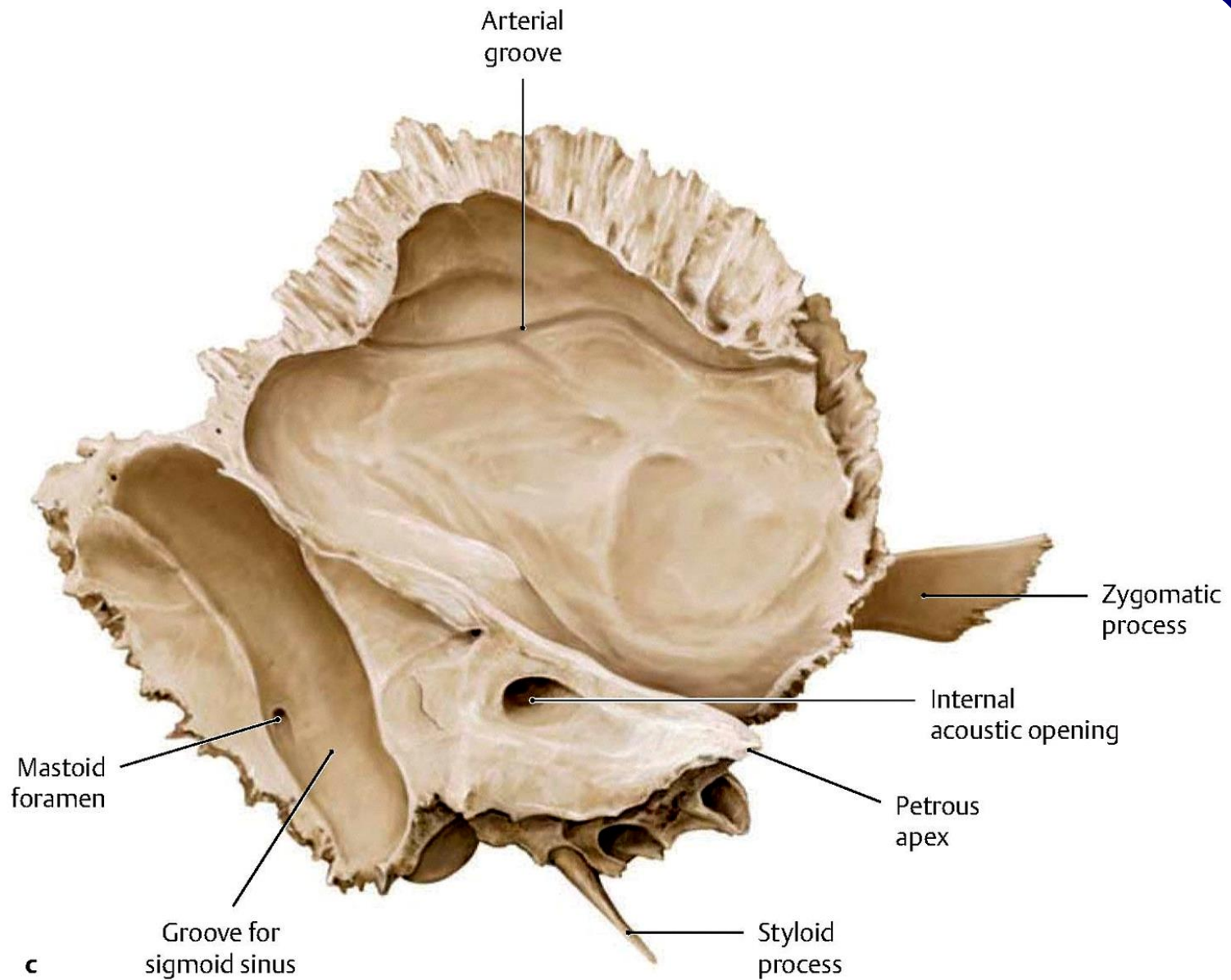


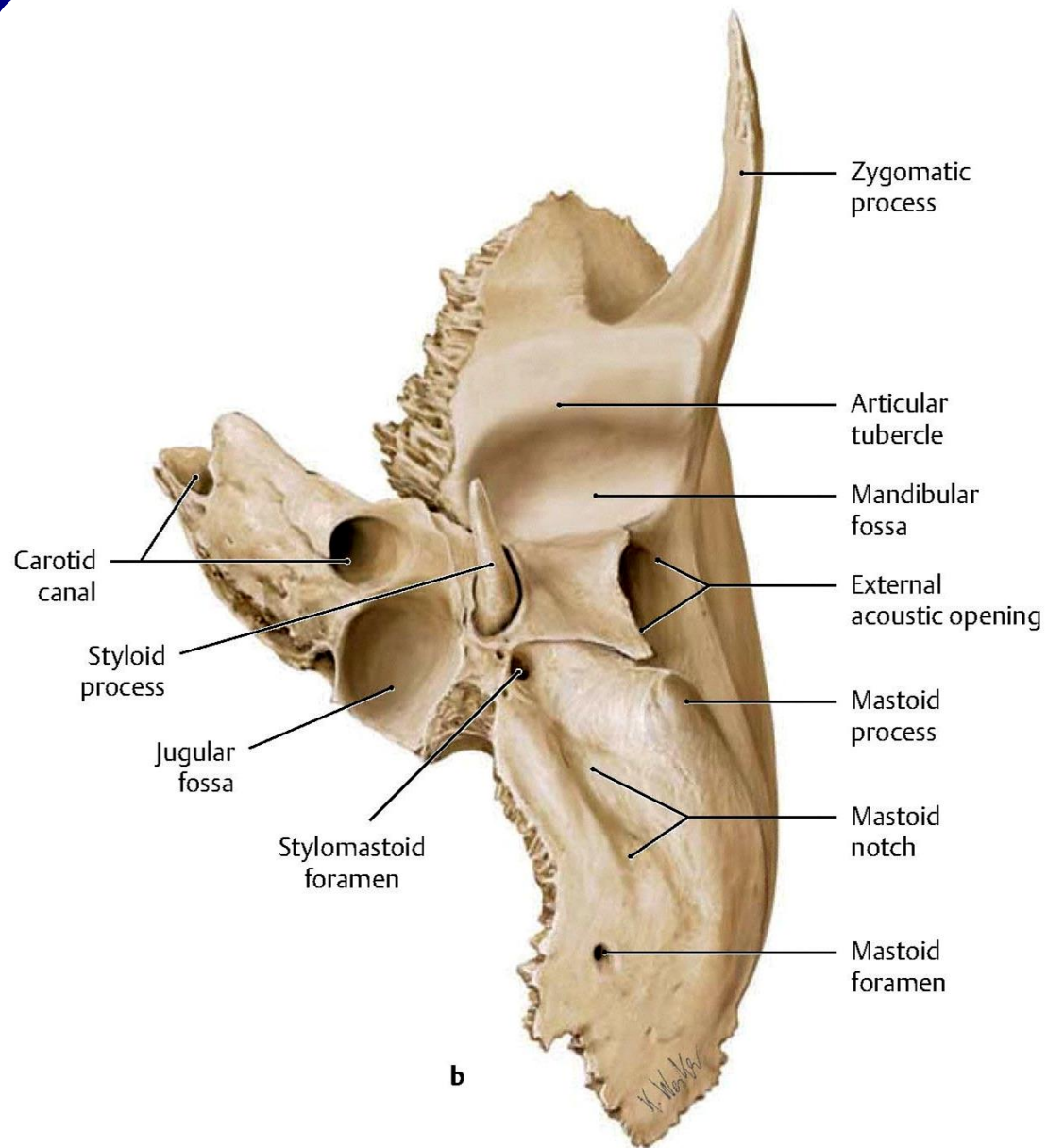




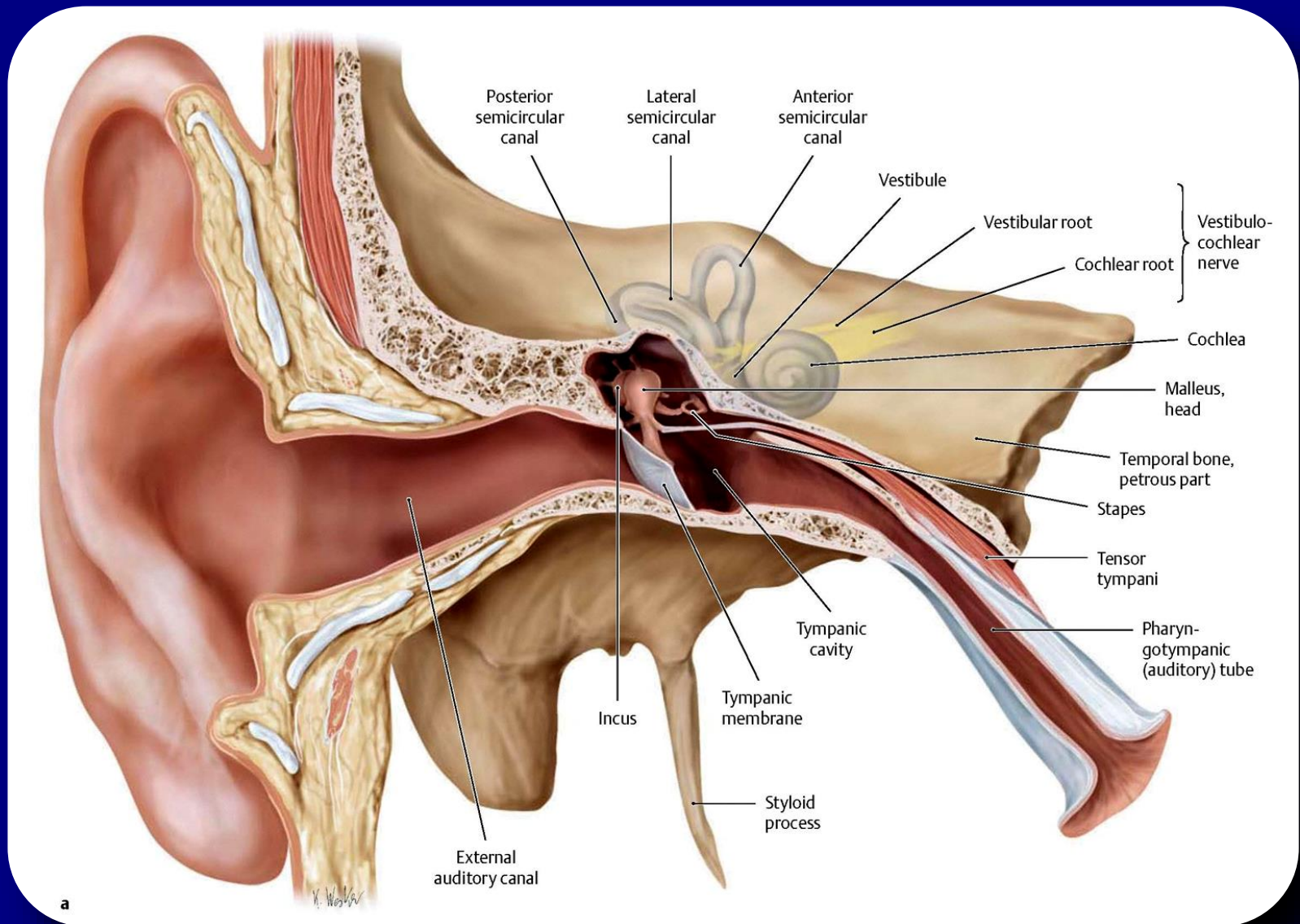




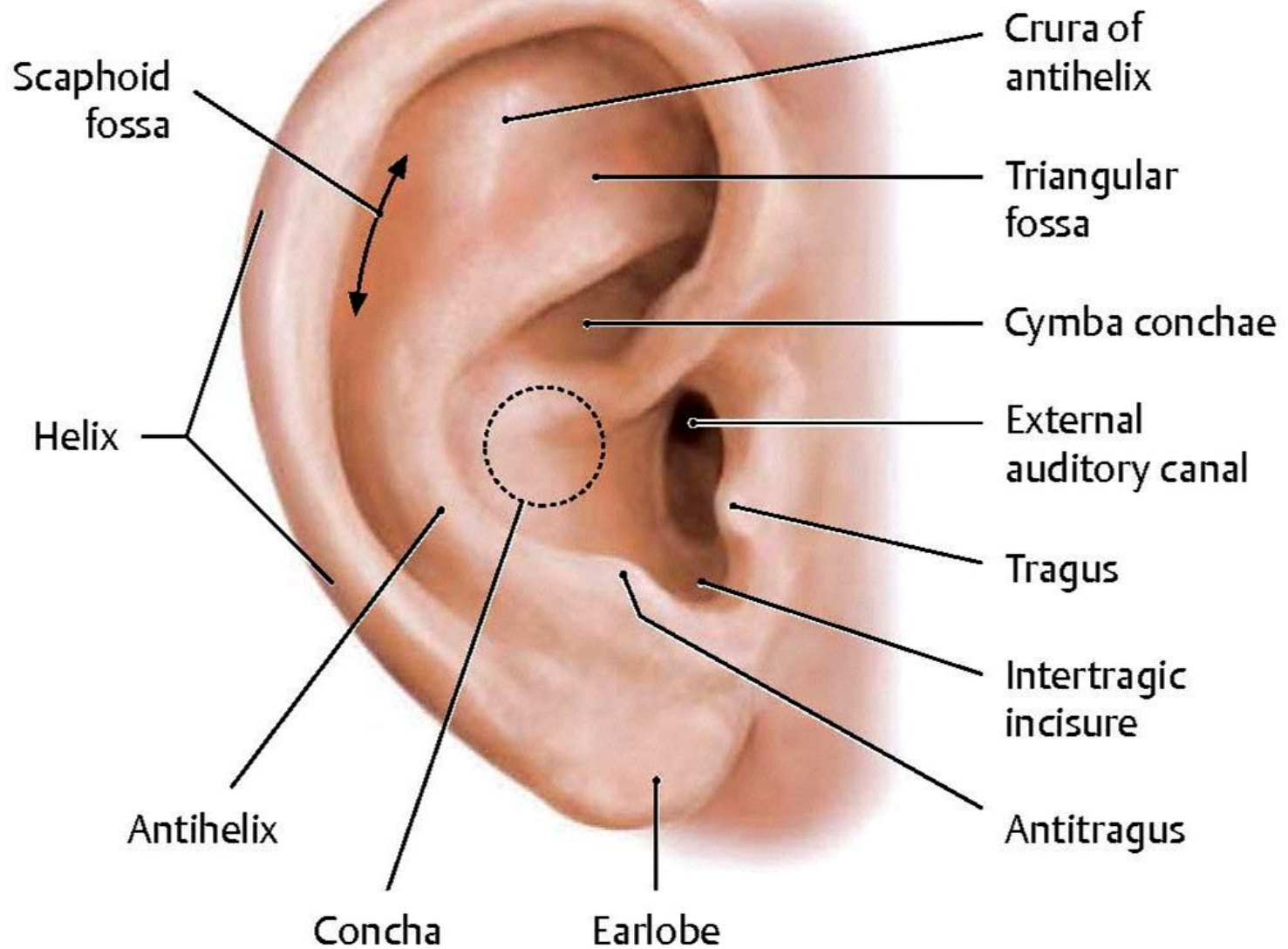




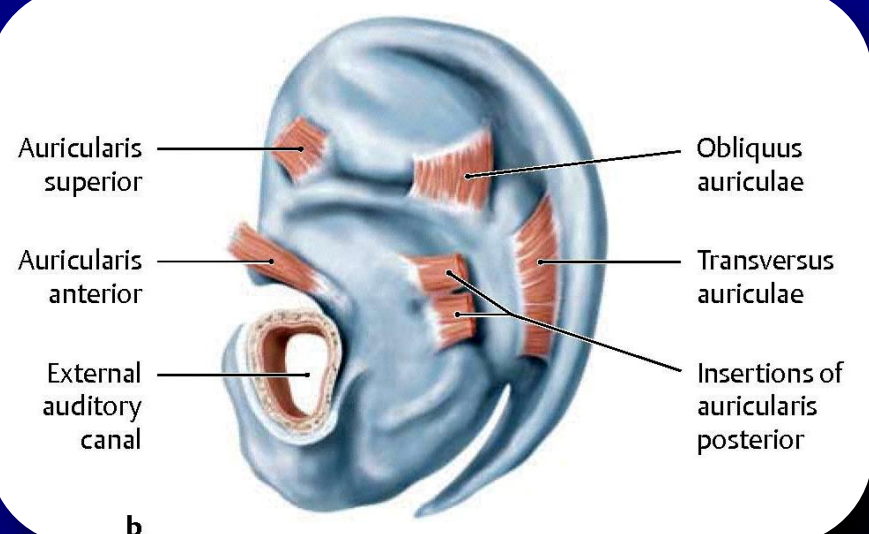
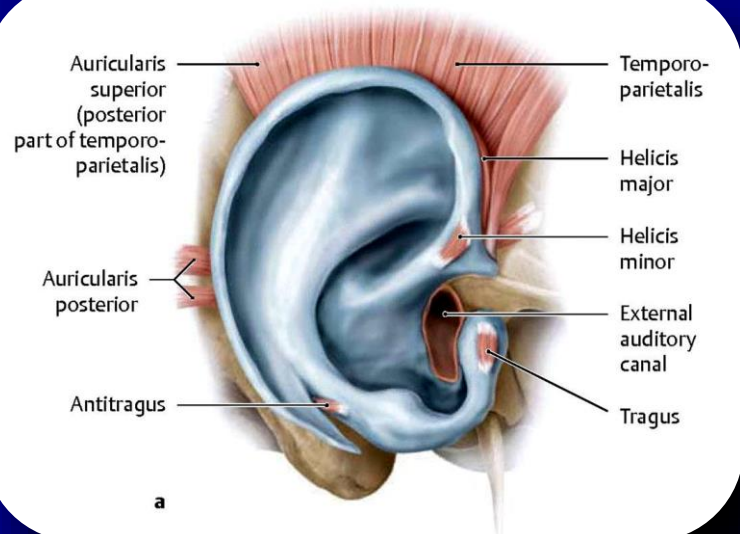




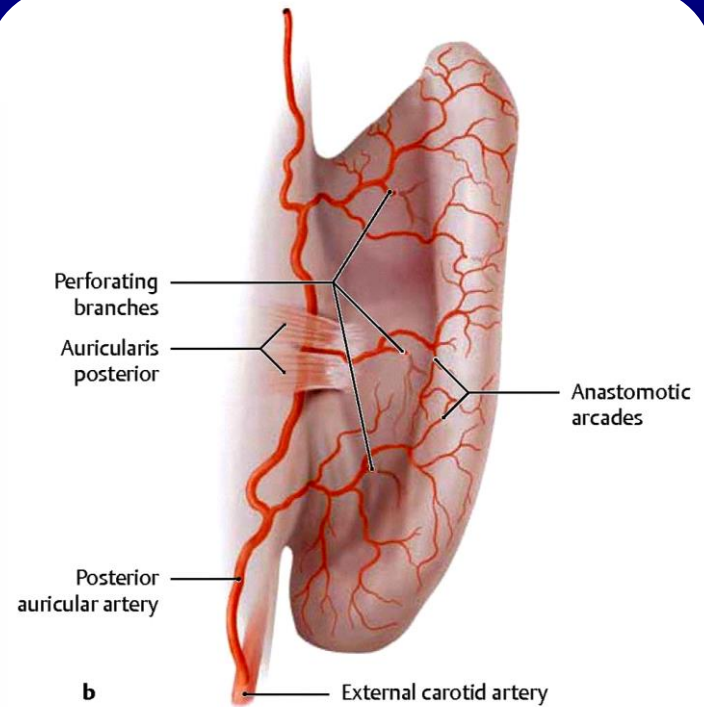
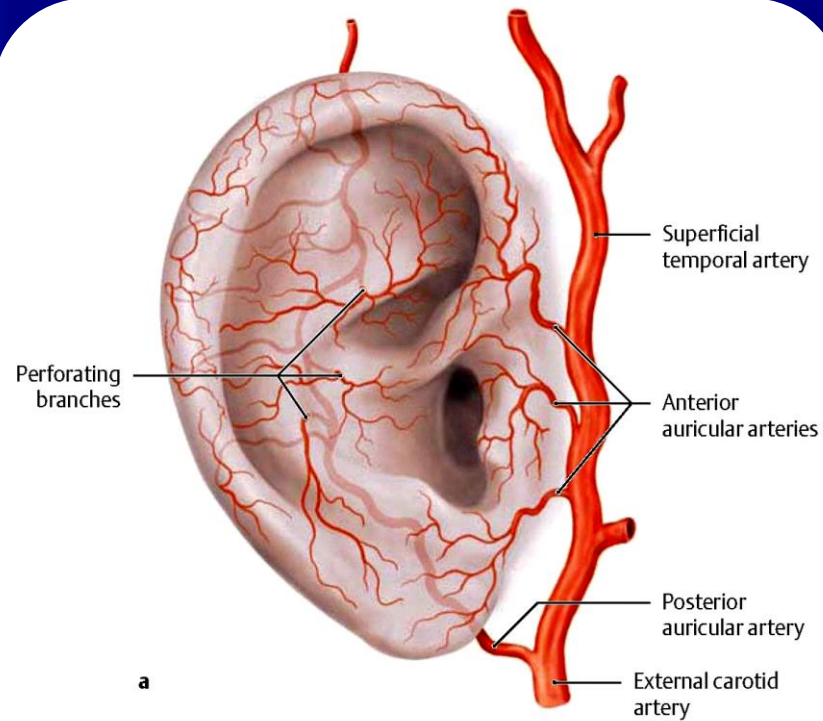
Auditory and vestibular apparatus in situ



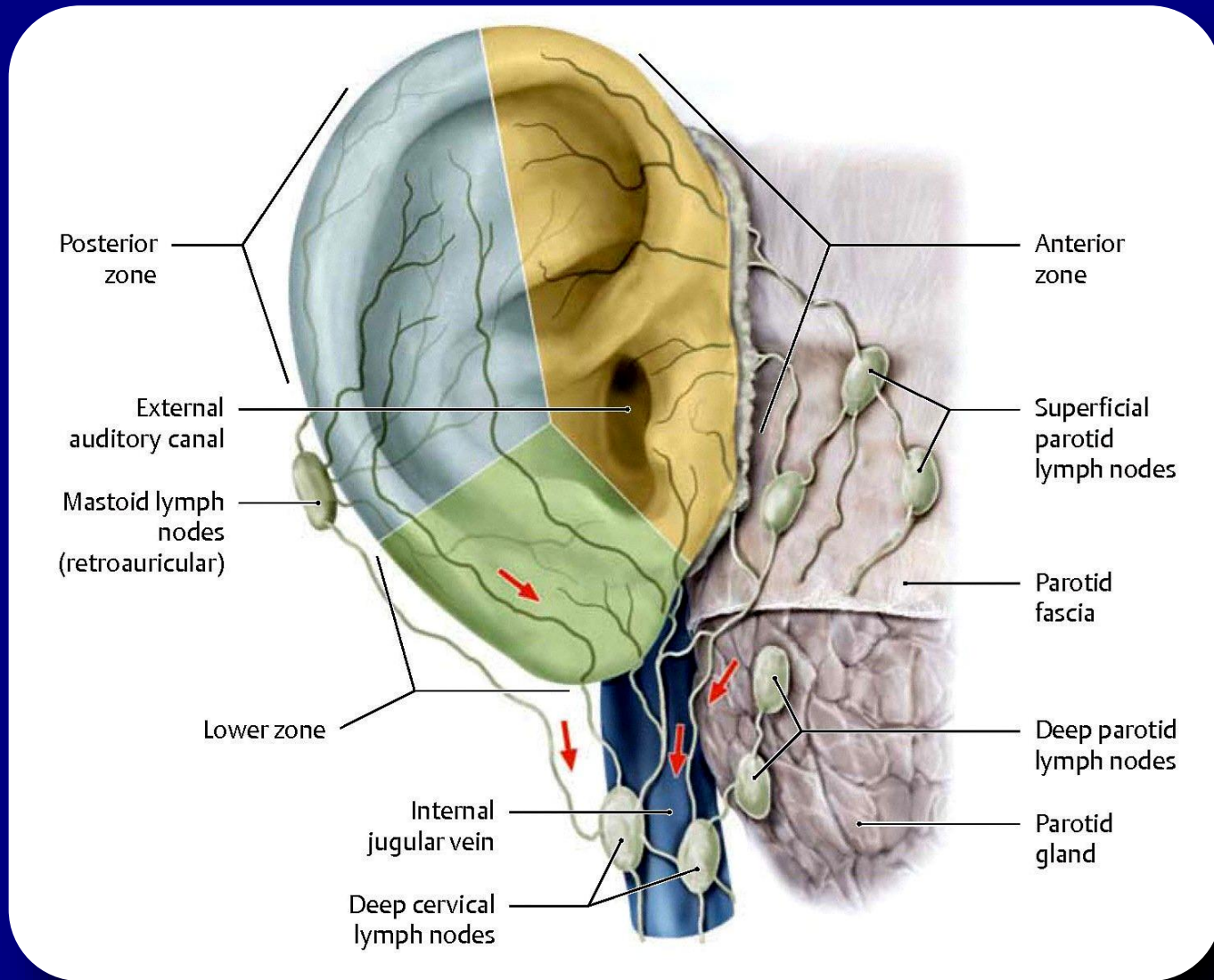




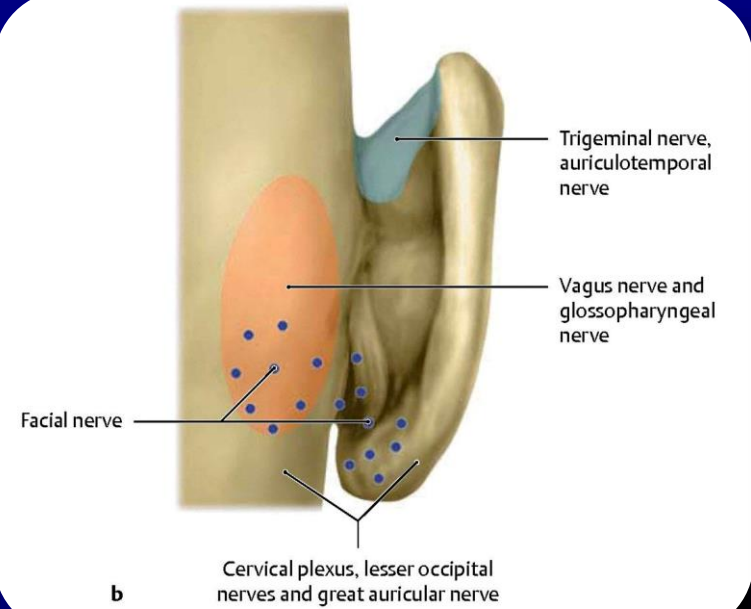
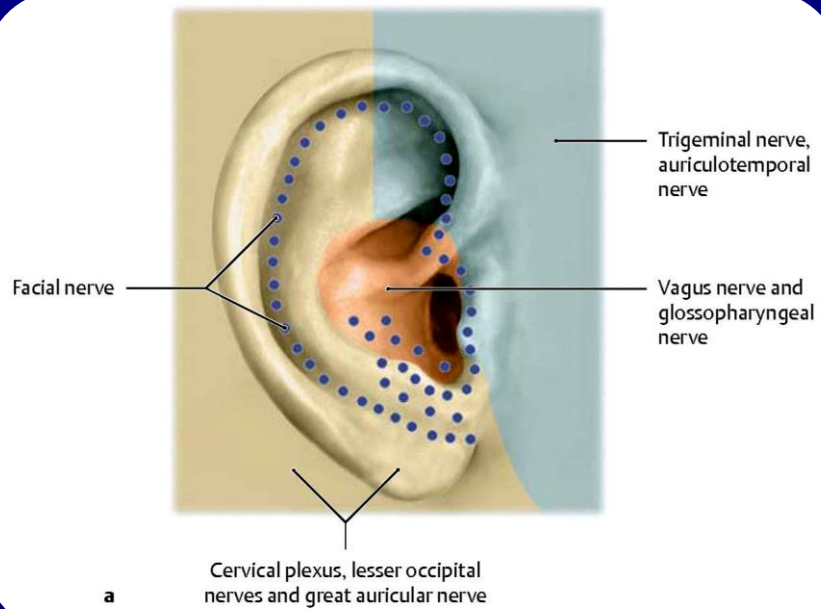
Cartilage and muscles of the auricle



Arterial supply of the right auricle



Auricle and external auditory canal: lymphatic drainage and regional groups of lymph nodes



Sensory innervation of the auricle



**Grade 1**

Smaller than normal,  
but the ear has mostly  
normal anatomy



**Grade 2**

Part of the ear looks  
normal, usually the  
lower half

The canal may be  
normal, small or  
completely closed



**Grade 3**

Just a small remnant  
of "peanut-shaped"  
skin and cartilage

There is no canal,  
which is called aural  
atresia



**Grade 4**

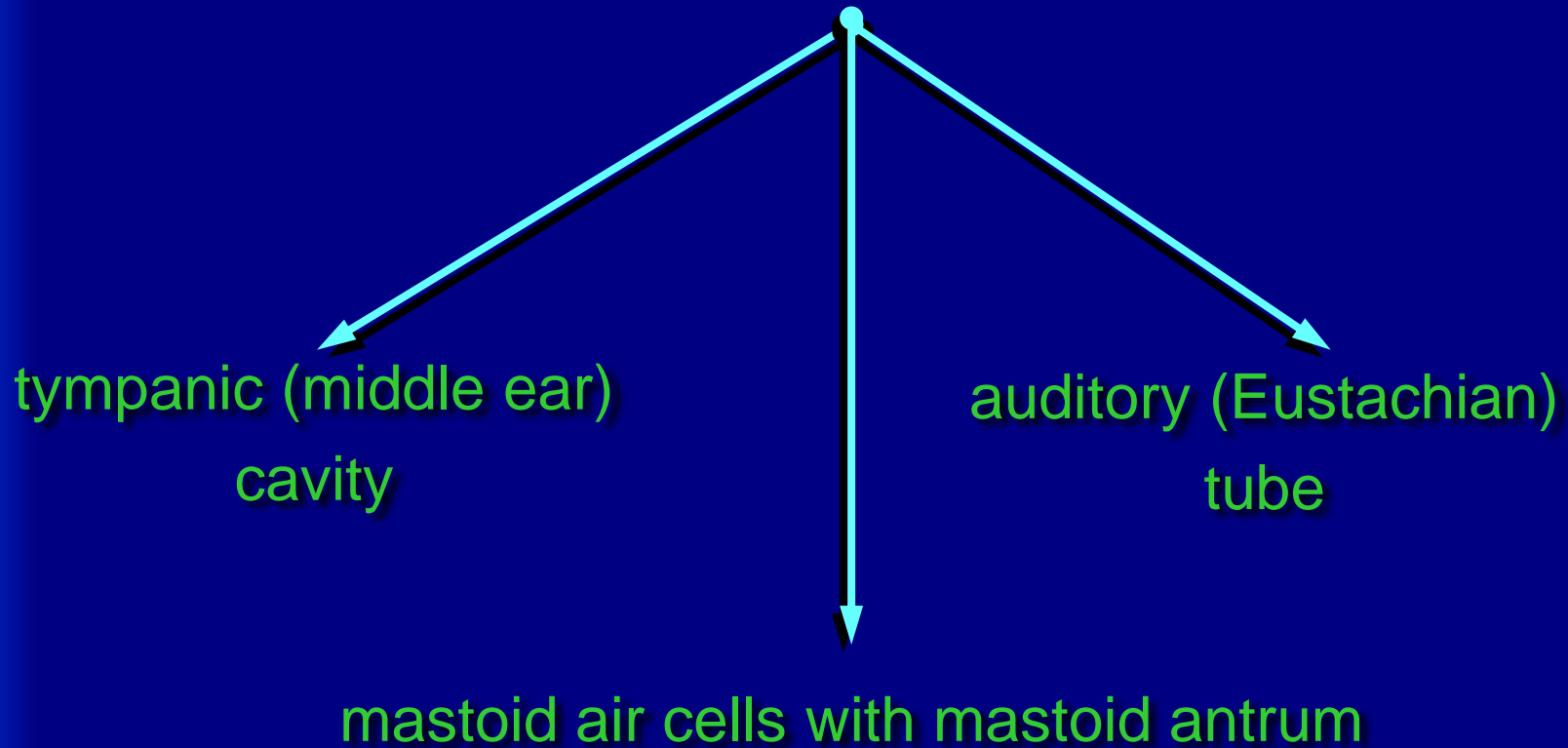
Complete absence of  
both the external ear  
and the ear canal,  
also called "anotia"

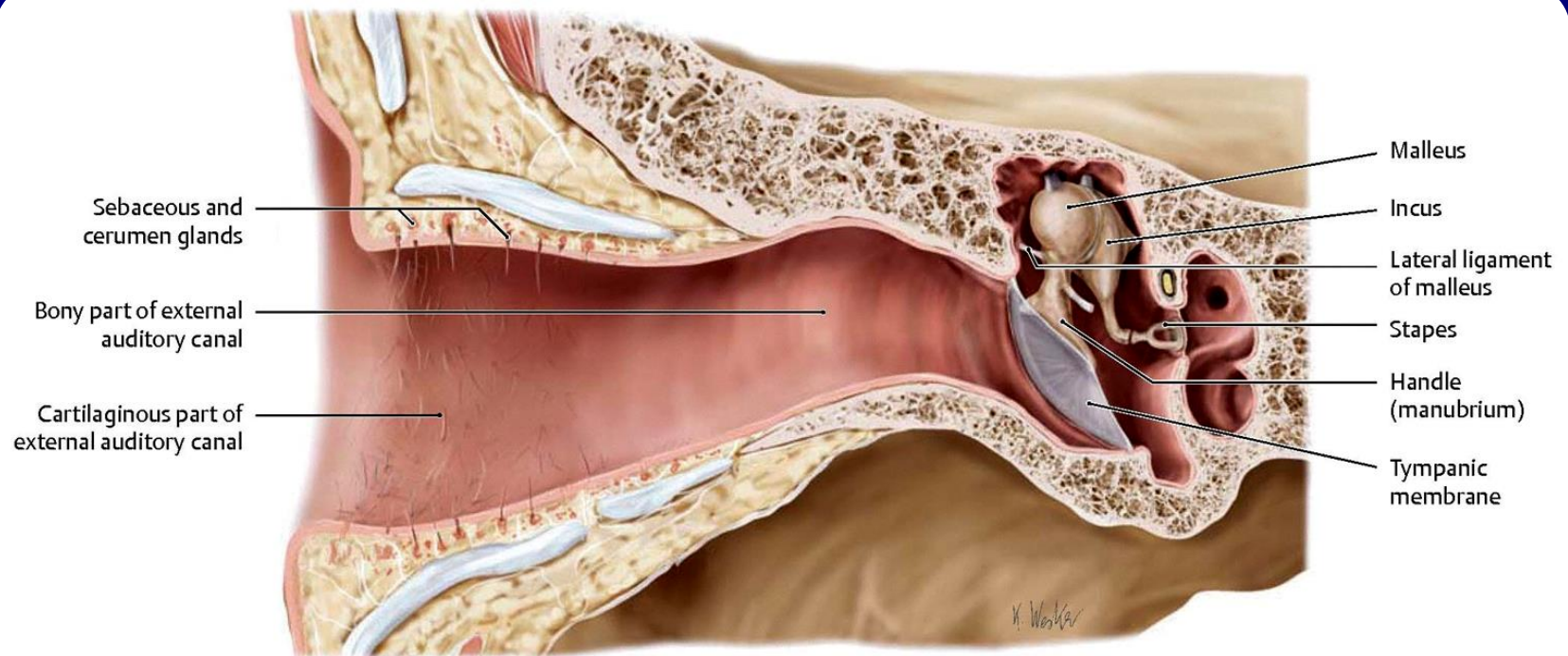






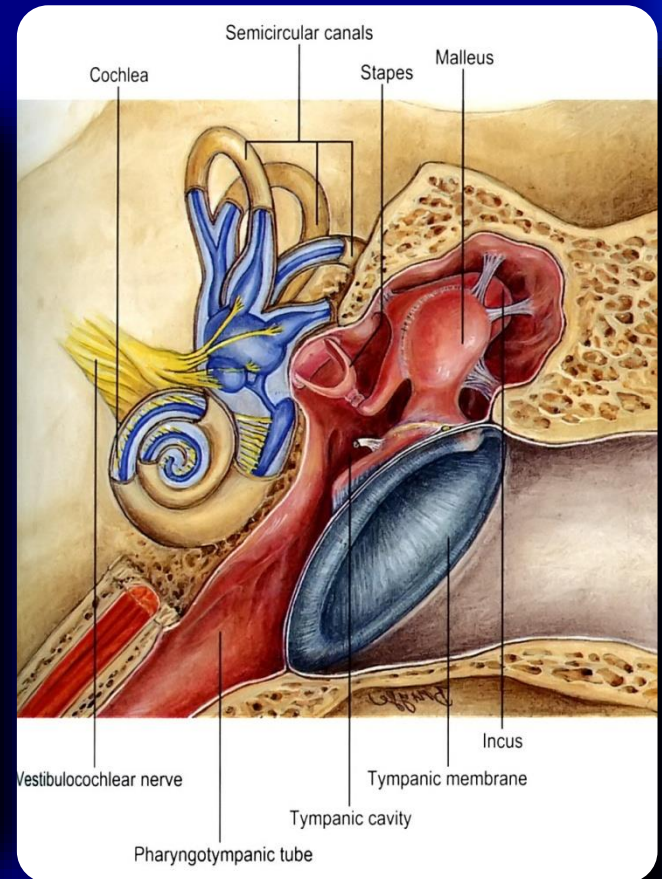
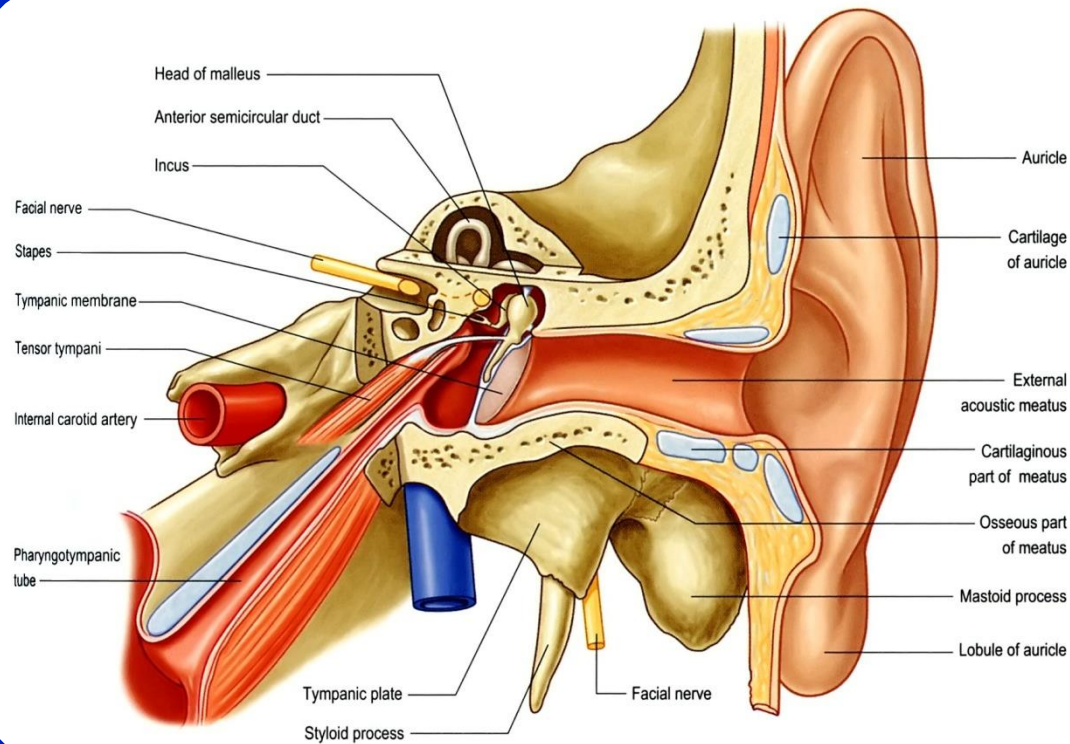
# Middle ear consists of:



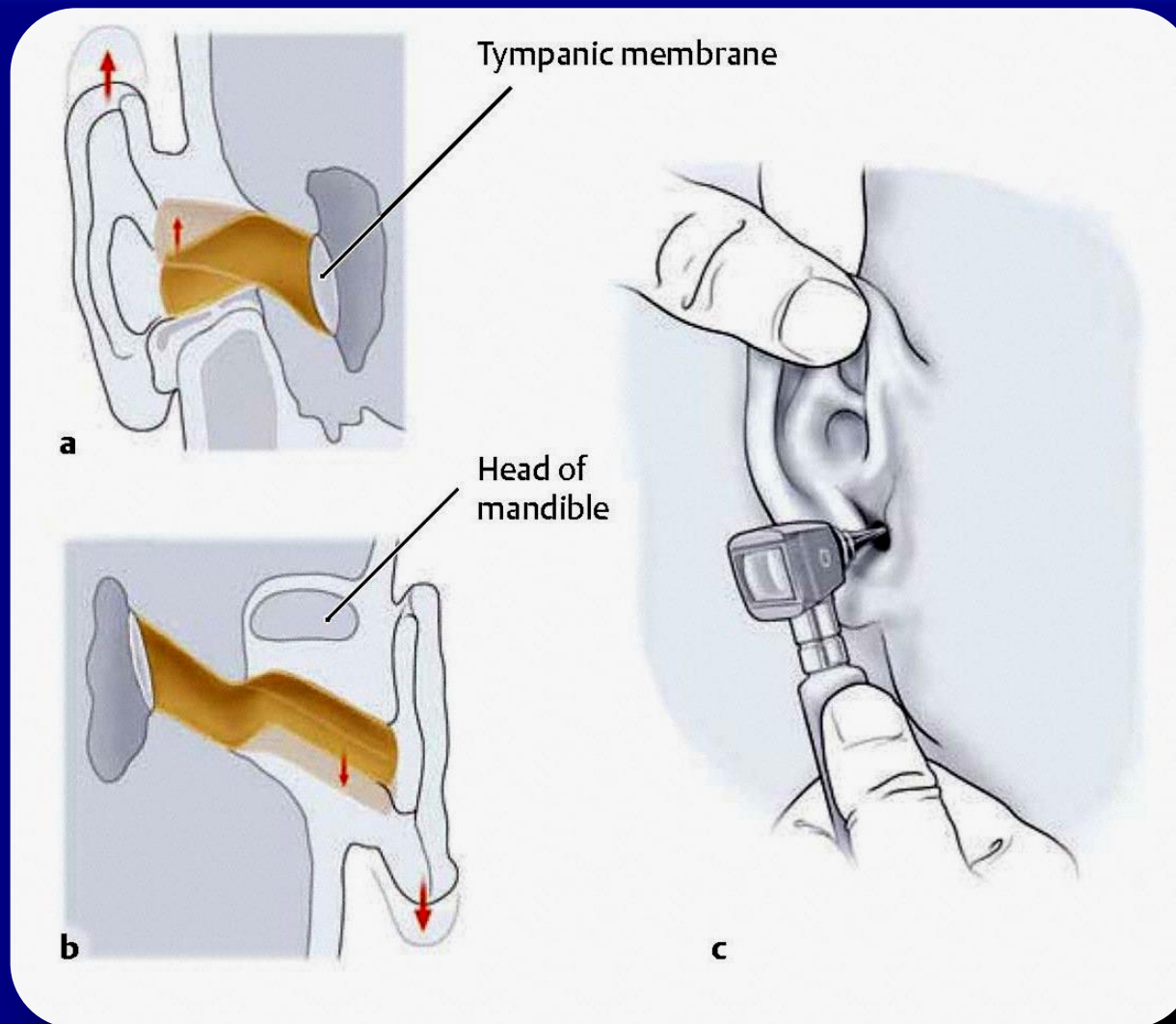


External auditory canal, tympanic membrane, and tympanic cavity

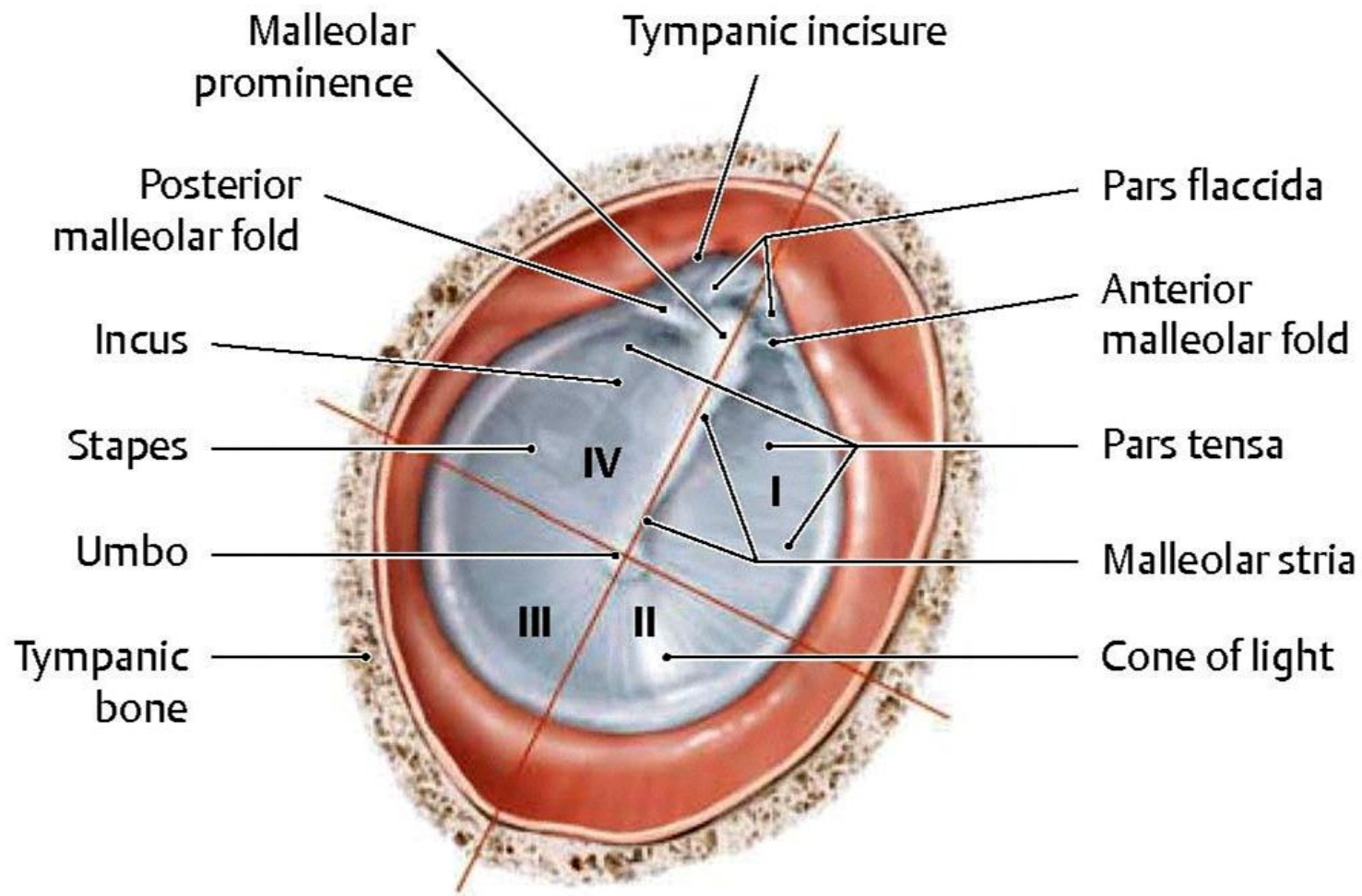




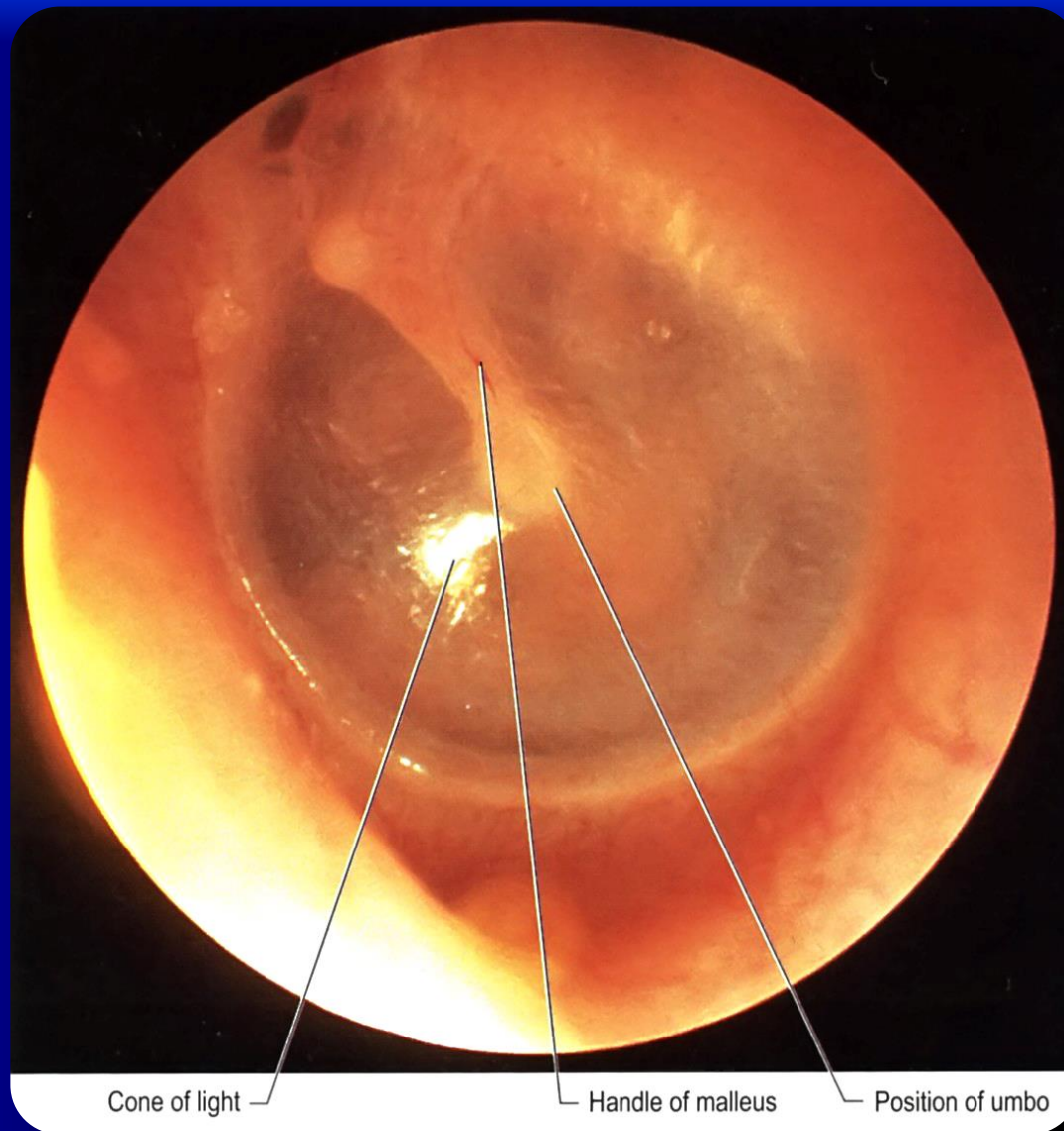




Curvature of the external auditory canal

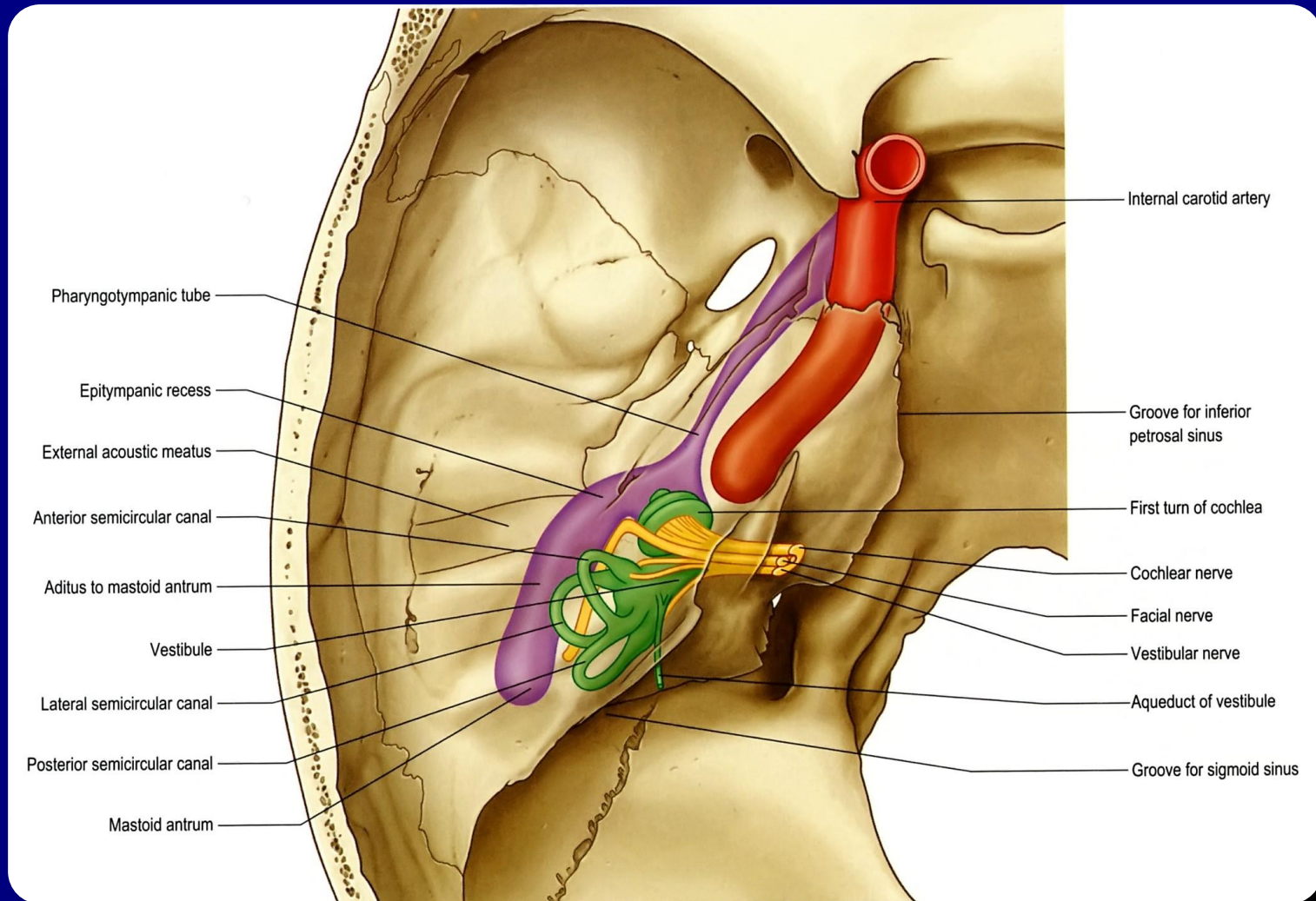


Tympanic membrane



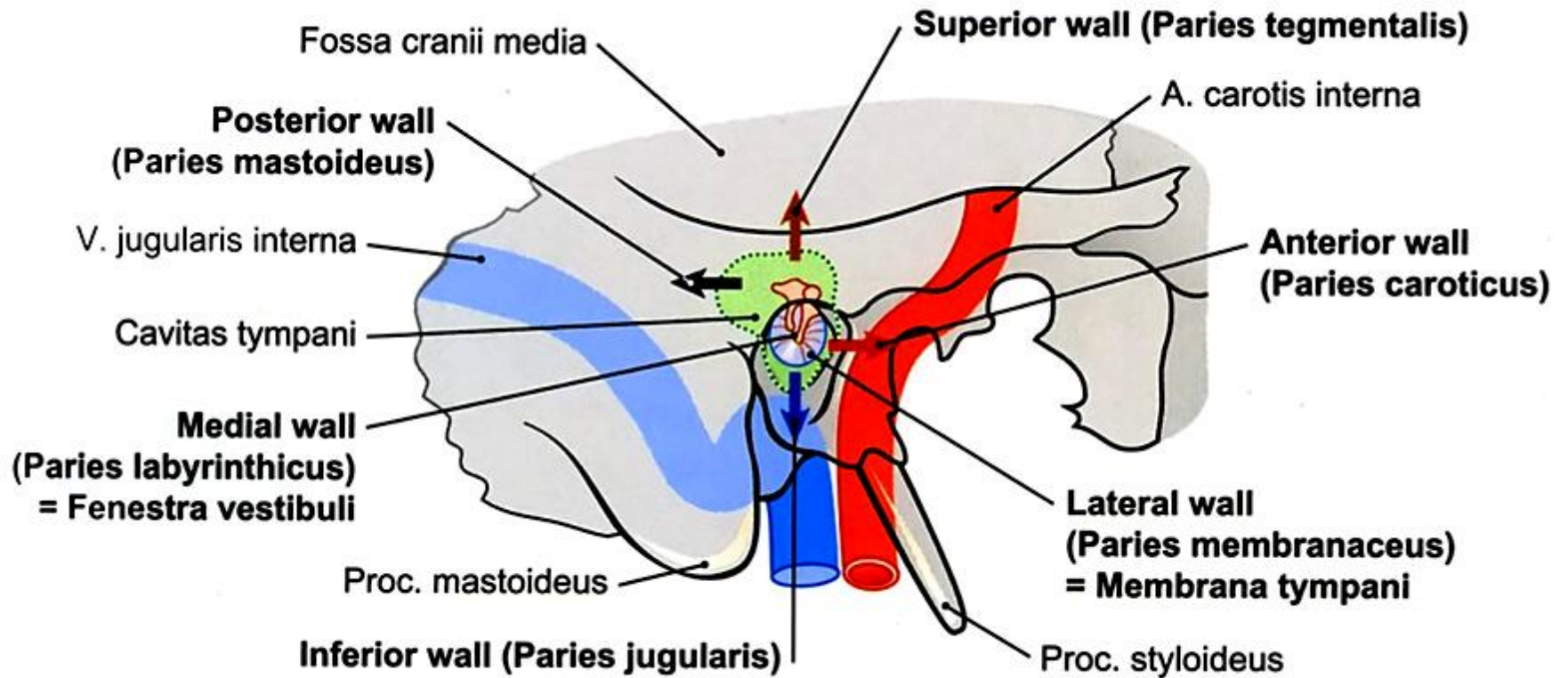
Auroscopic view of left tympanic membrane. Note that a bright cone of light is seen in the anteroinferior quadrant of the membrane when it is illuminated.





The left auditory apparatus as if viewed through a semi-transparent temporal bone.  
Note the genu in the facial nerve at the site of the geniculate ganglion.





## Tympanic Cavity (Cavitas tympani)

mastoid process  
(Paries mastoideus)

posterior wall  
(Proc. mastoideus)



V. jugularis  
(Paries jugularis)

inferior wall  
(Fossa jugularis)



A. carotis interna  
(Paries caroticus)

anterior wall  
(carotid canal)



middle cranial fossa  
(Paries tegmentalis)

superior wall  
(middle cranial fossa)



oval window  
(Paries labyrinthicus)

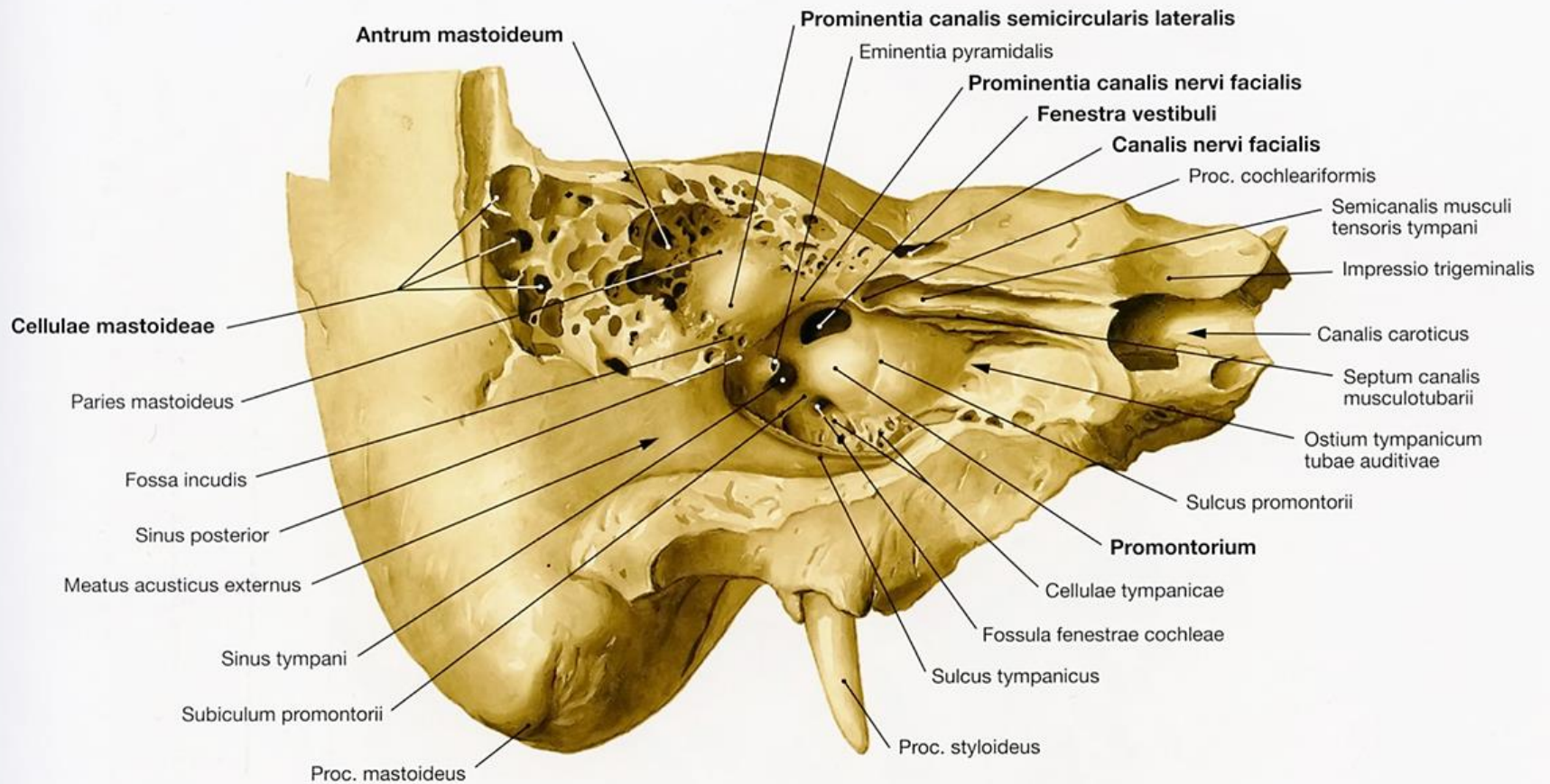
medial wall  
(labyrinth)



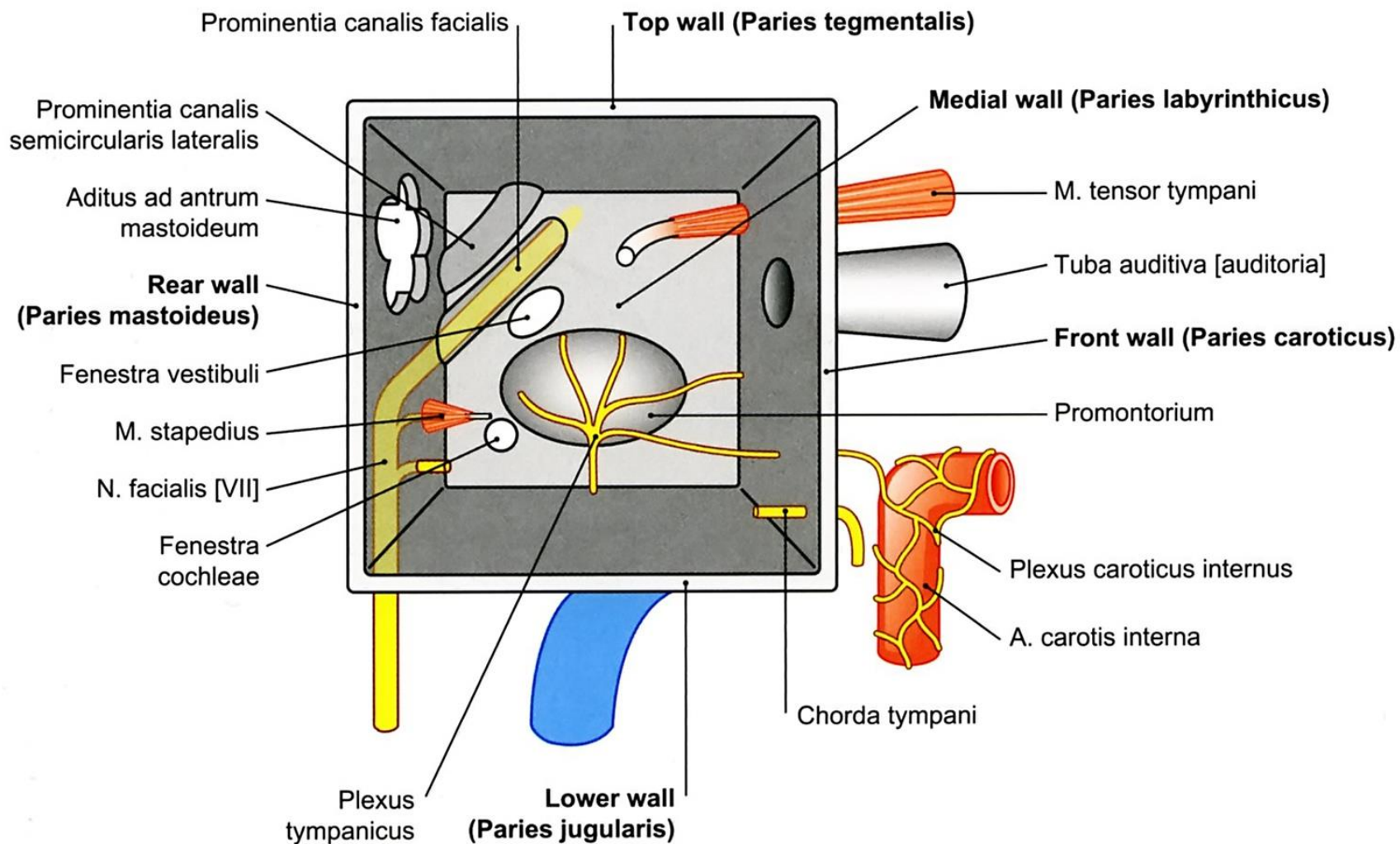
tympanic membrane  
(Paries membranaceus)

lateral wall  
(tympanic membrane)

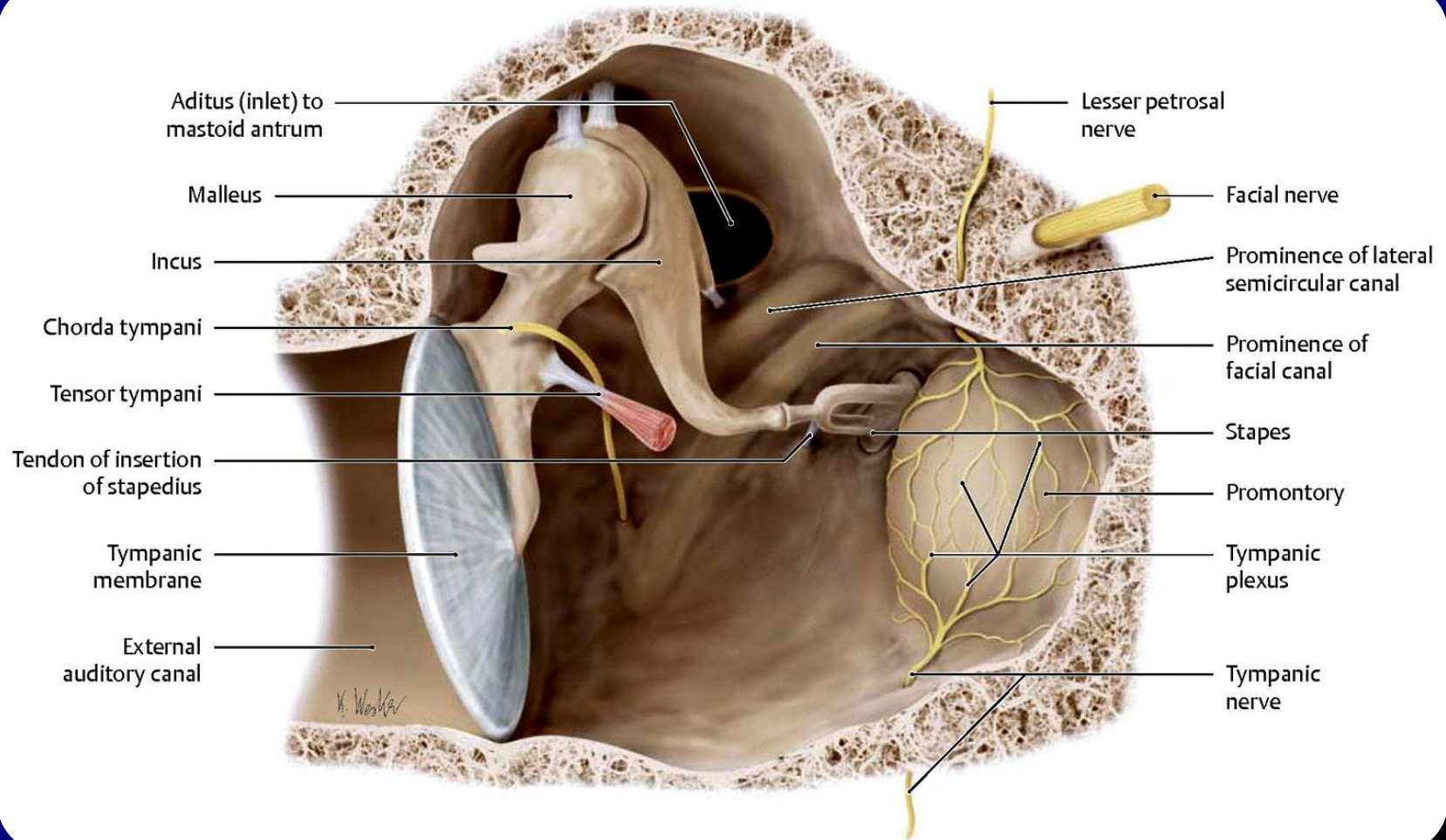




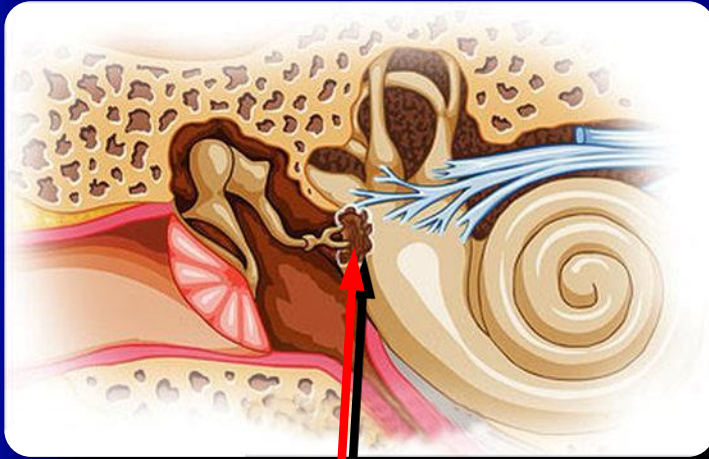








Walls of the tympanic cavity

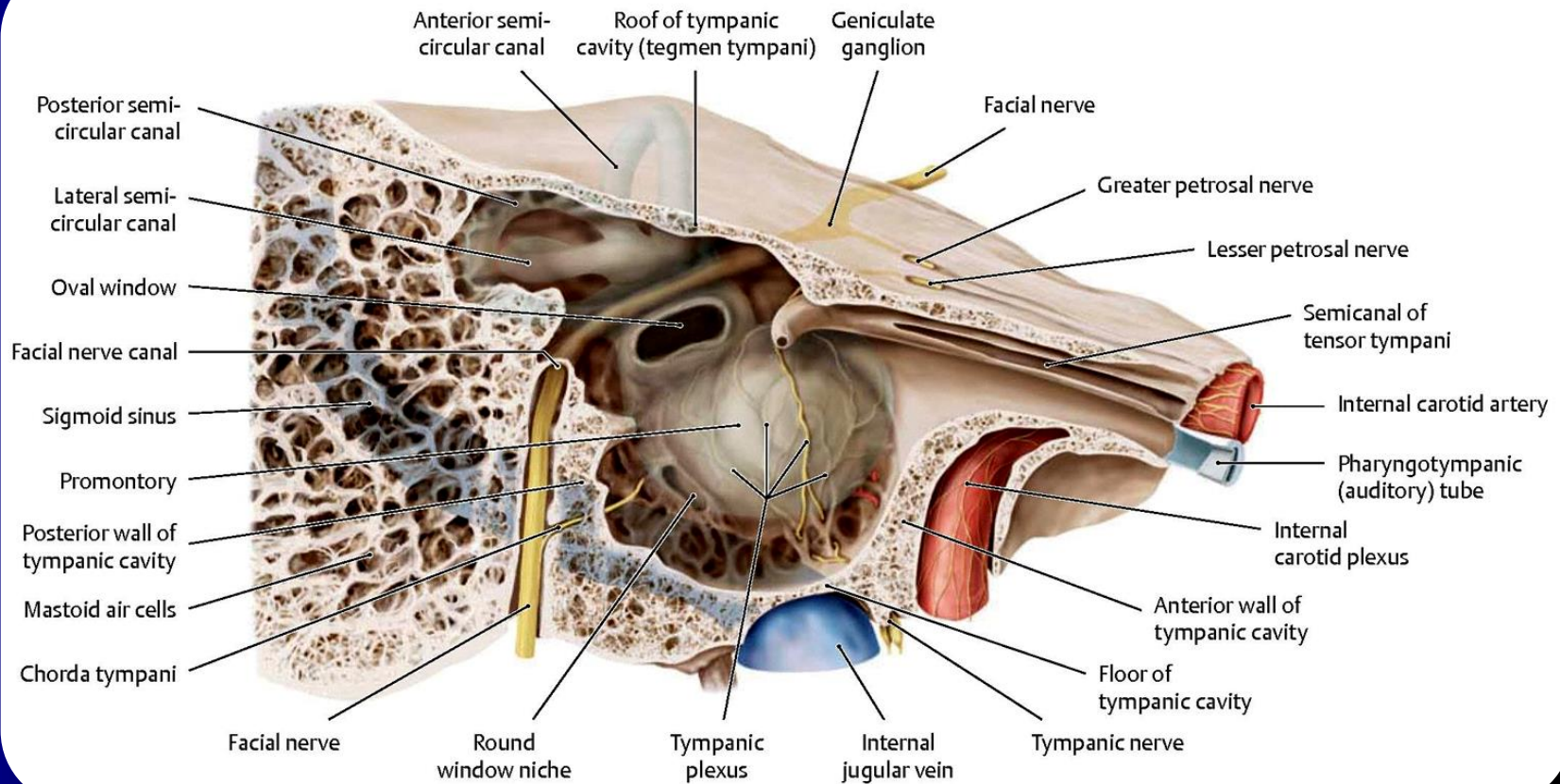


**Otosclerosis** – this is an inherited disease. The primary form of hearing loss in otosclerosis is conductive hearing loss (CHL) whereby sounds reach the ear drum but are incompletely transferred via the ossicular chain in the middle ear, and thus partly fail to reach the inner ear (cochlea). This usually will begin in one ear but will eventually affect both ears with a variable course. On audiometry, the hearing loss is characteristically low-frequency, with higher frequencies being affected later.

**Conductive hearing loss** occurs when there is a problem conducting sound waves anywhere along the route through the outer ear, tympanic membrane (eardrum), or middle ear (ossicles). This type of hearing loss may occur in conjunction with sensorineural hearing loss (mixed hearing loss) or alone.

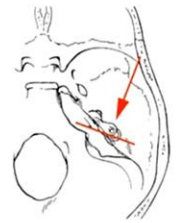
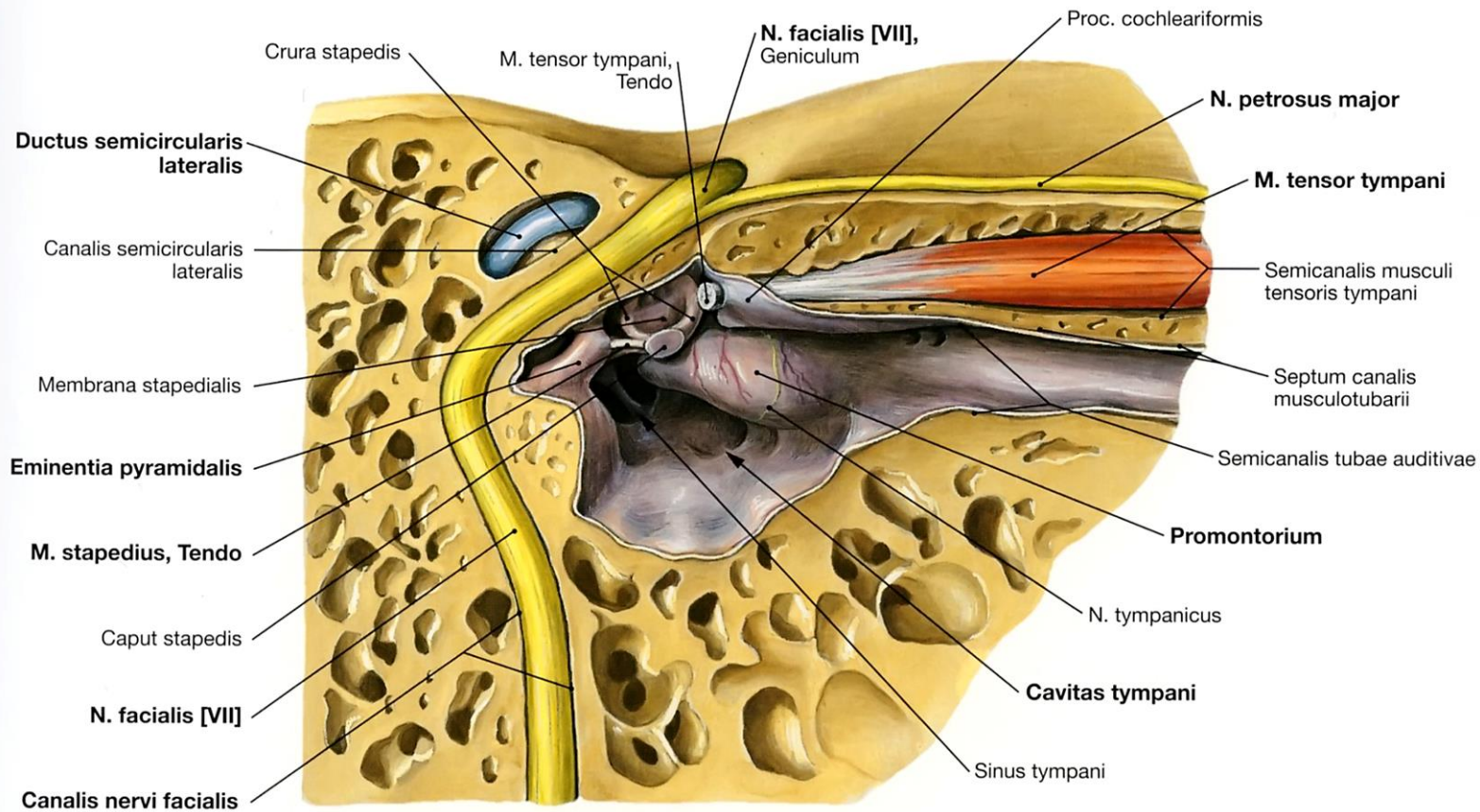


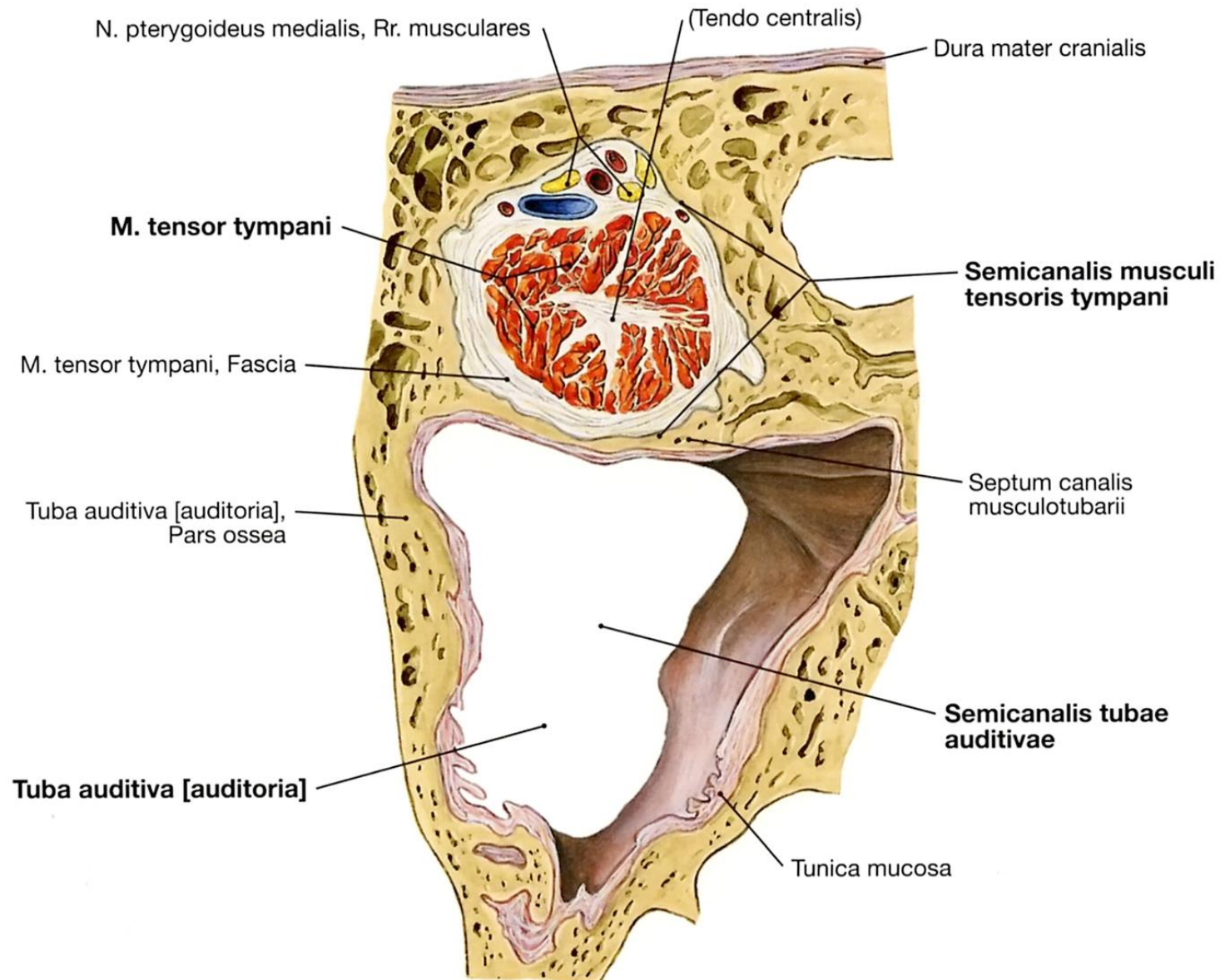


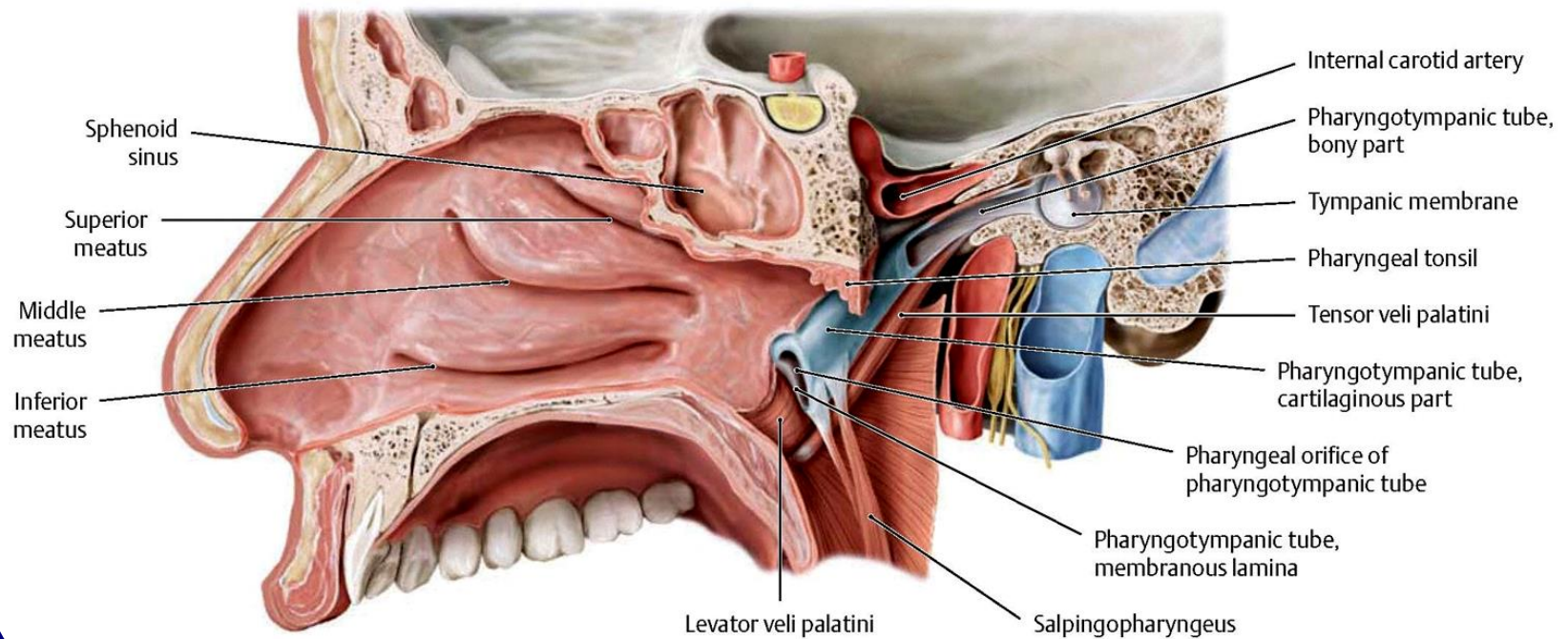


Tympanic cavity: clinically important anatomical relationships



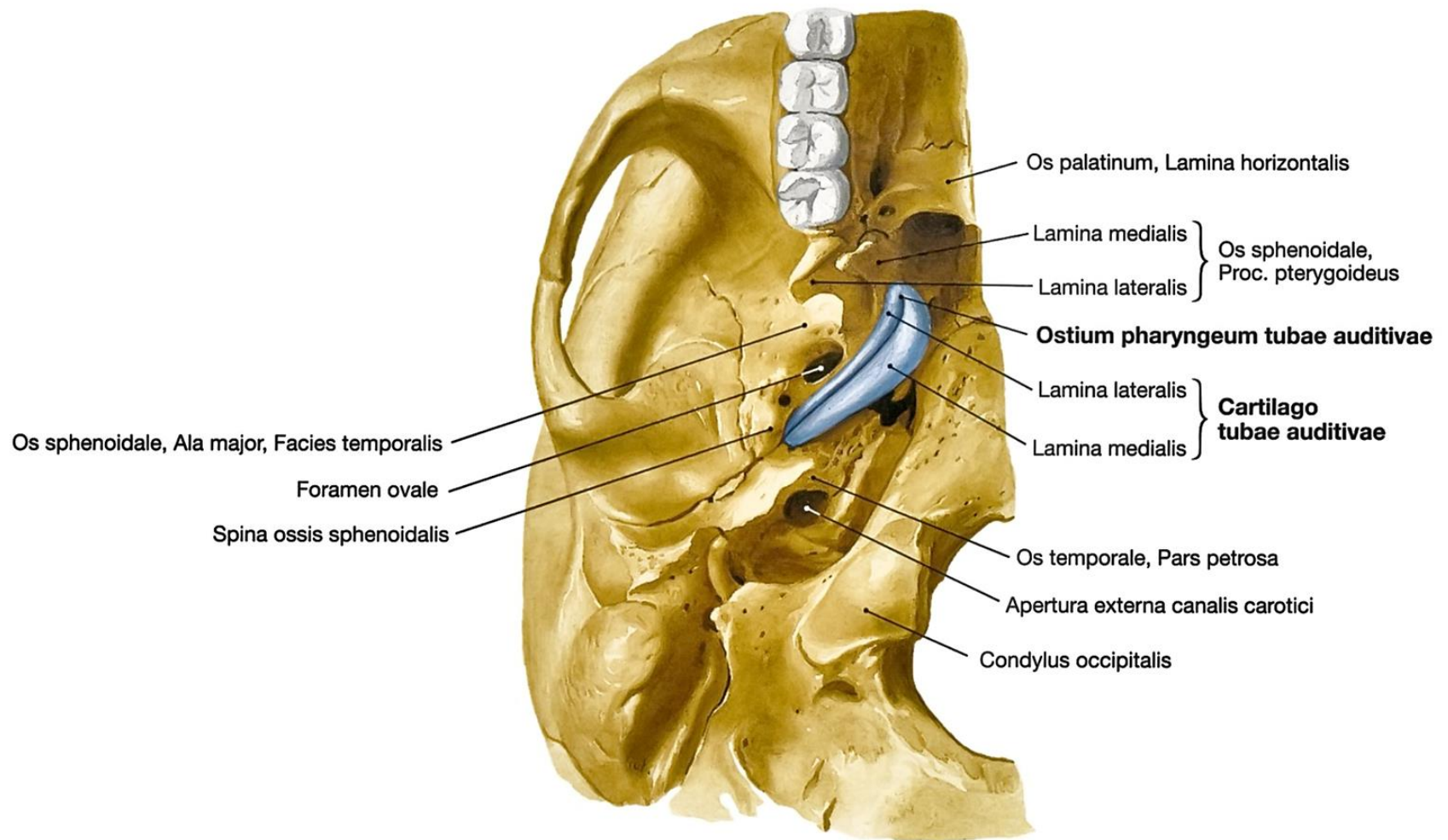




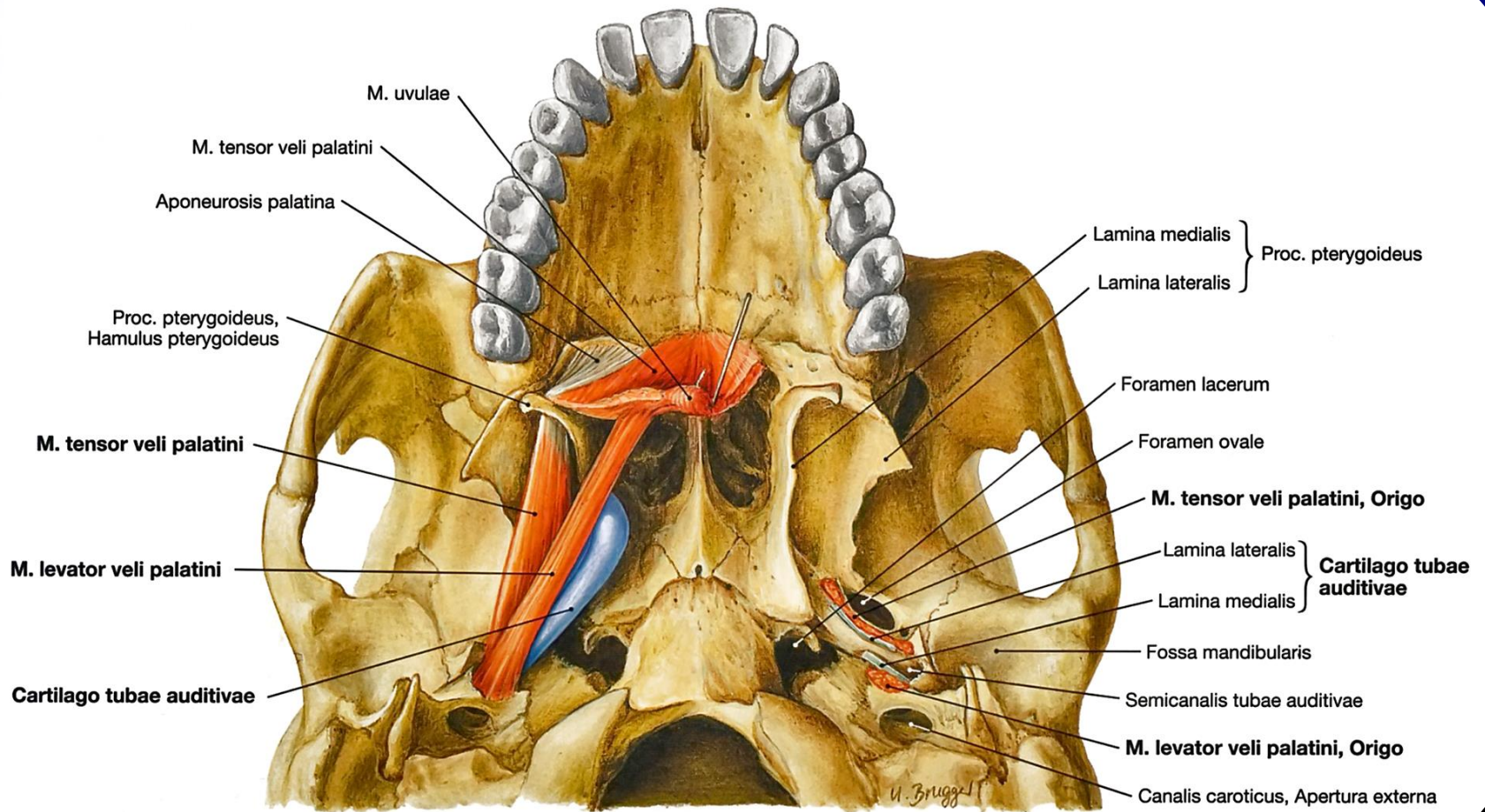


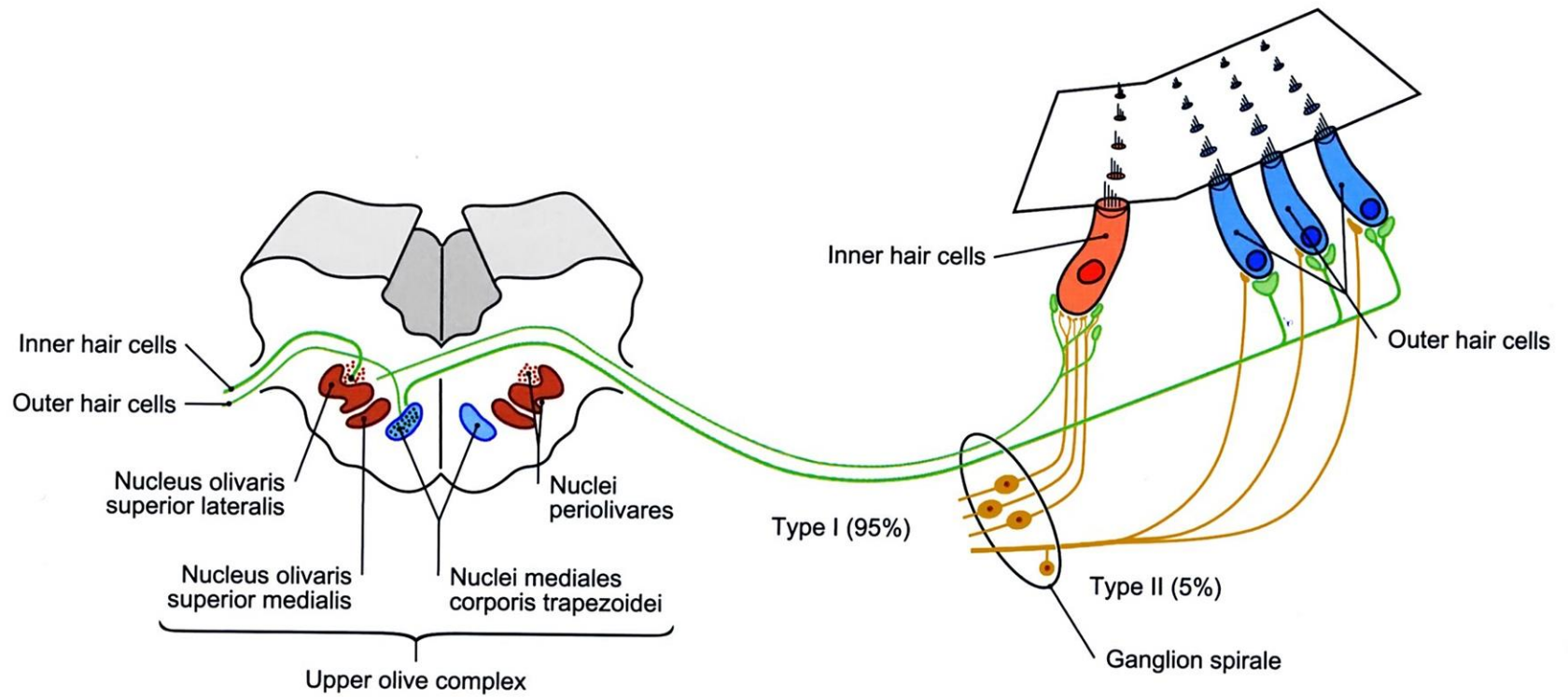
Pharyngotympanic (auditory) tube

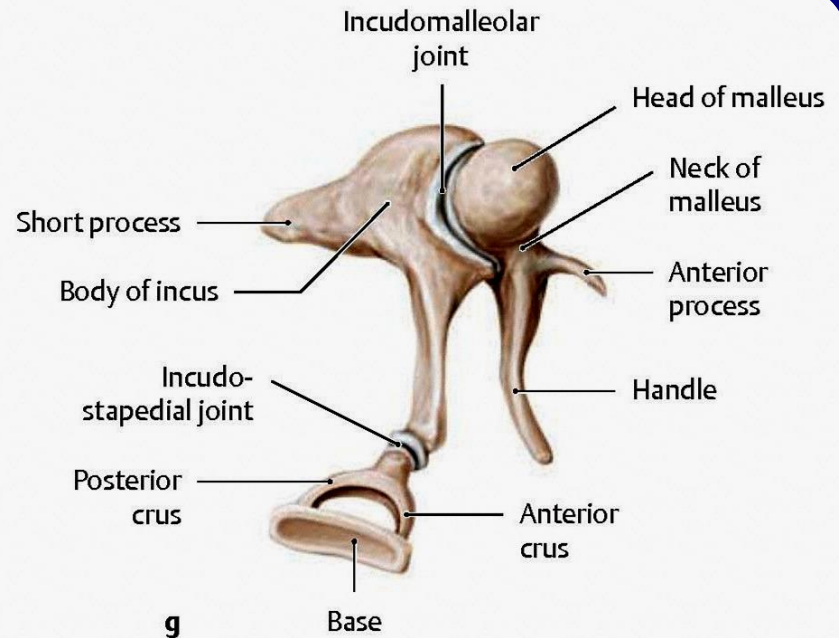
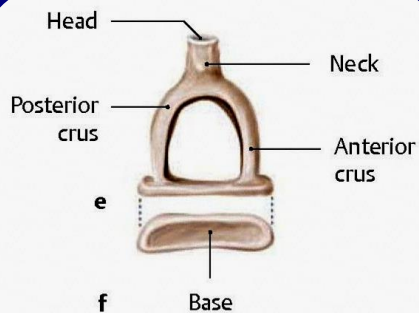
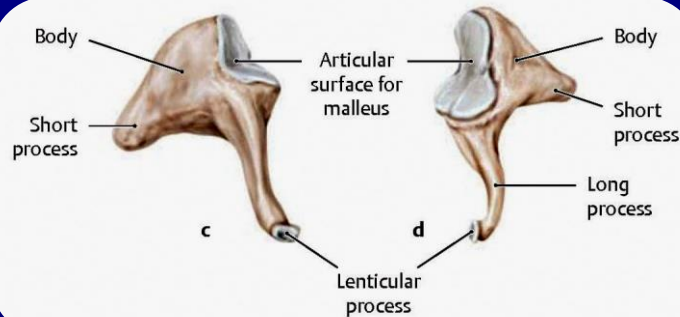
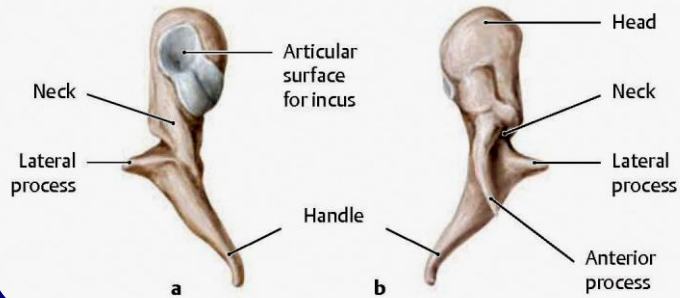




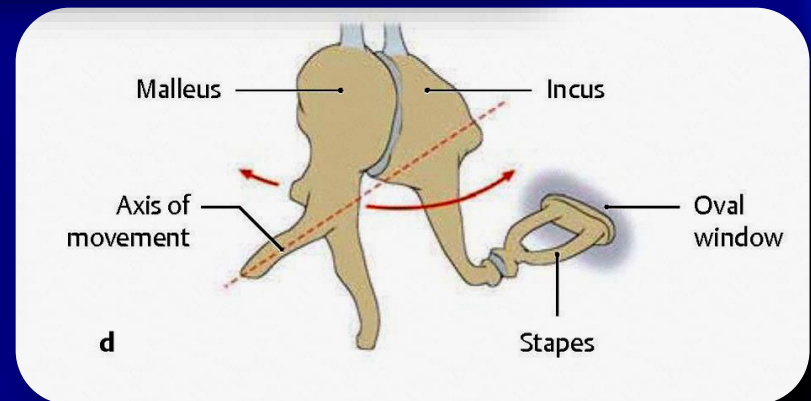
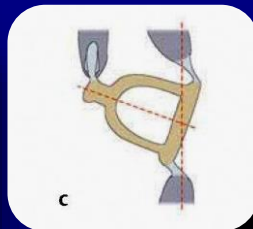
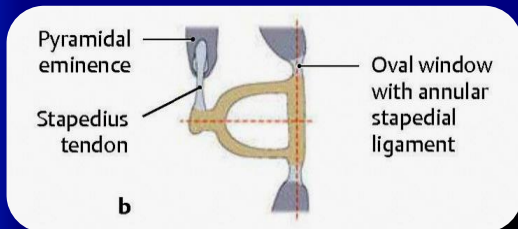
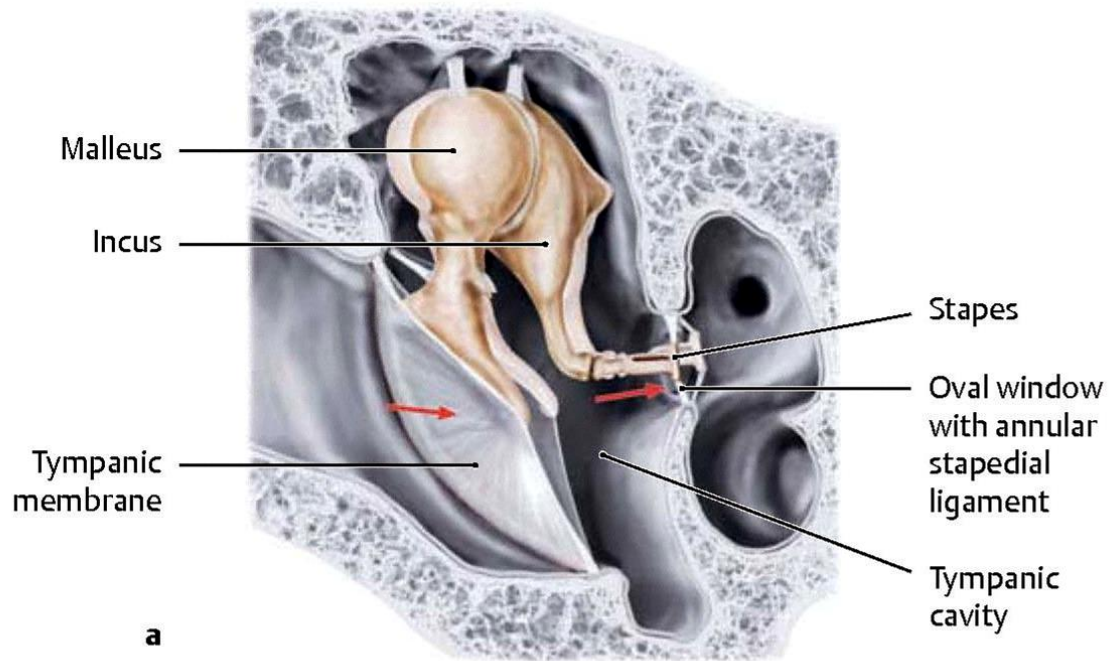






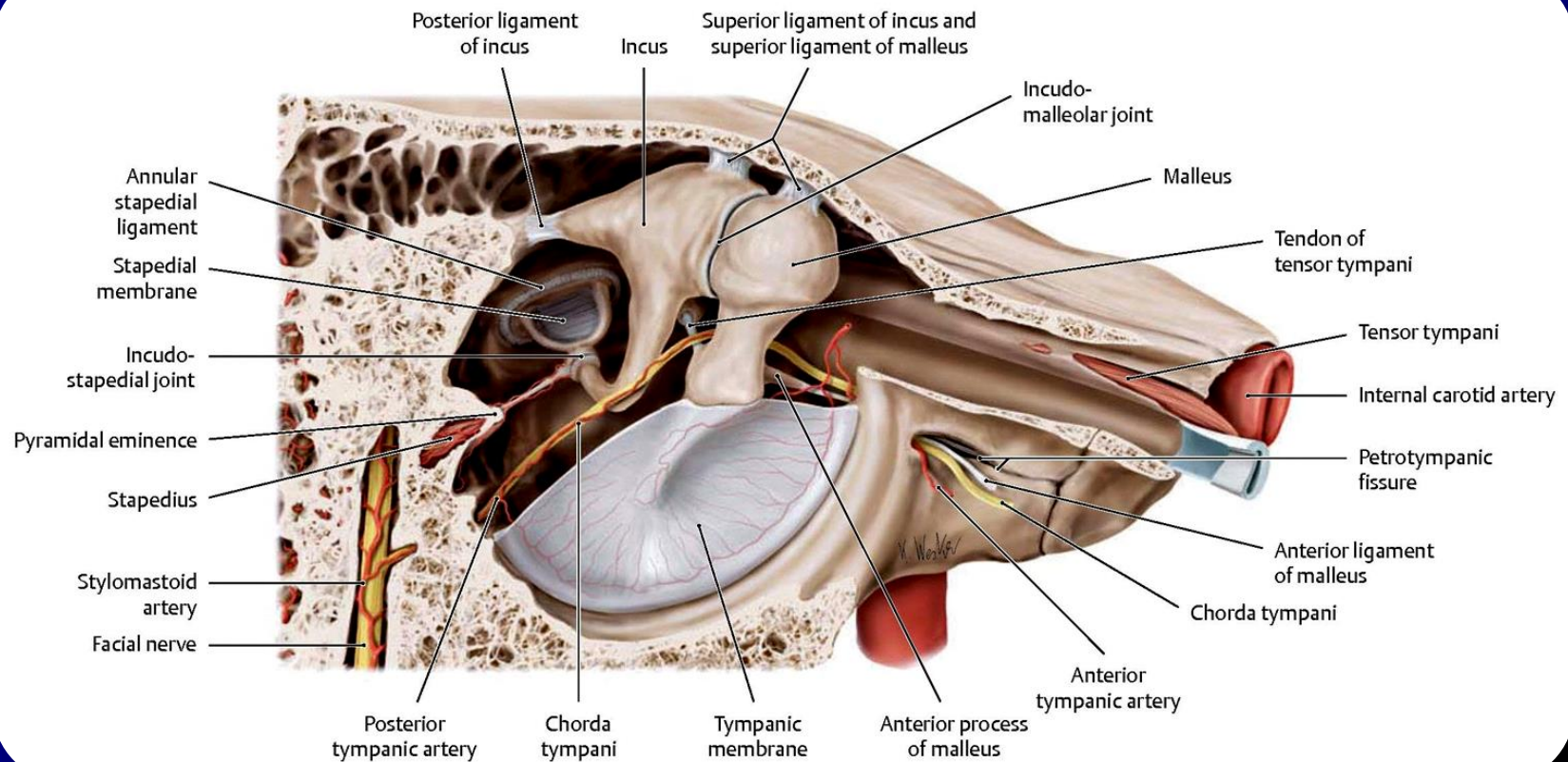


Auditory ossicles

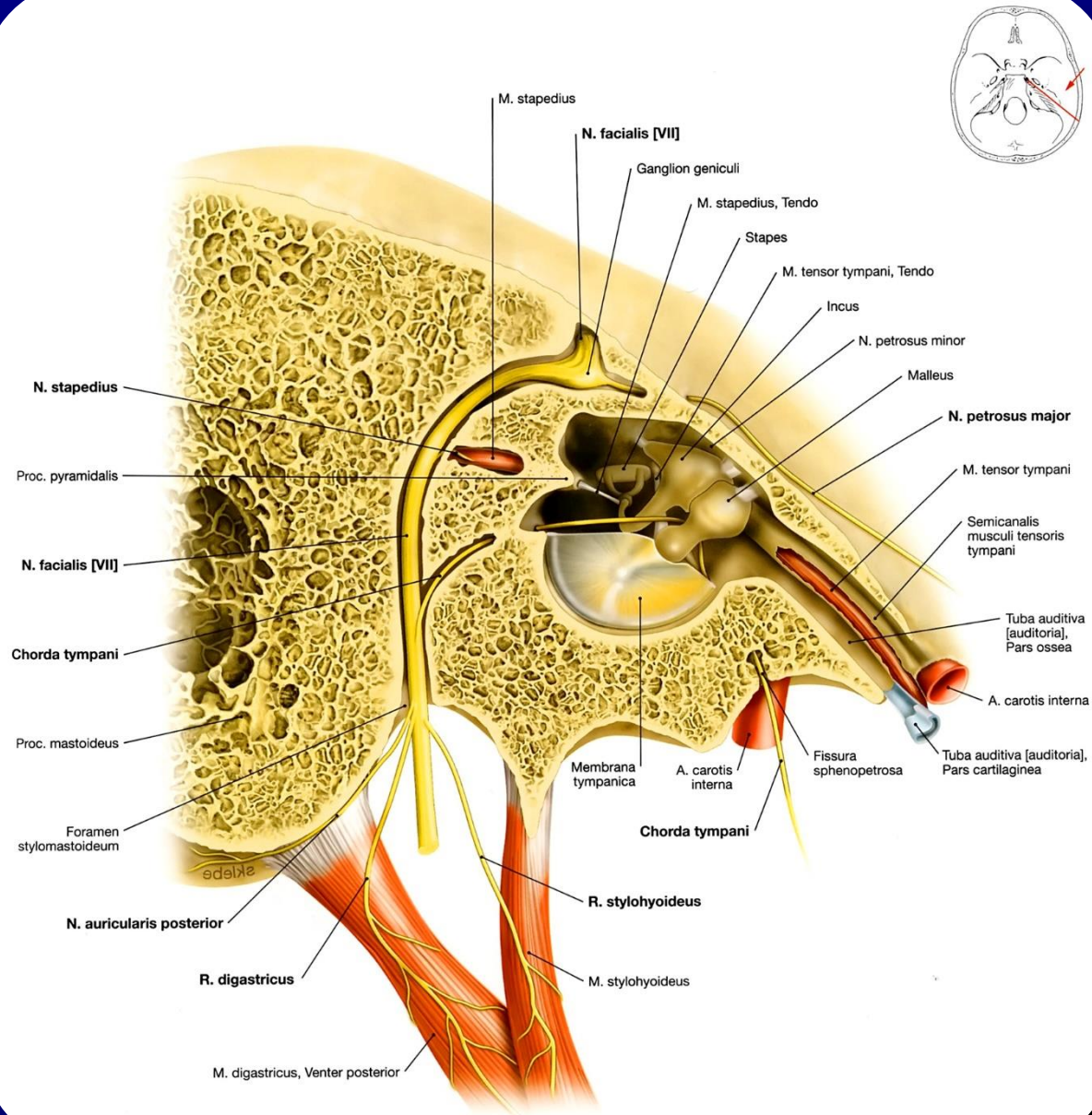


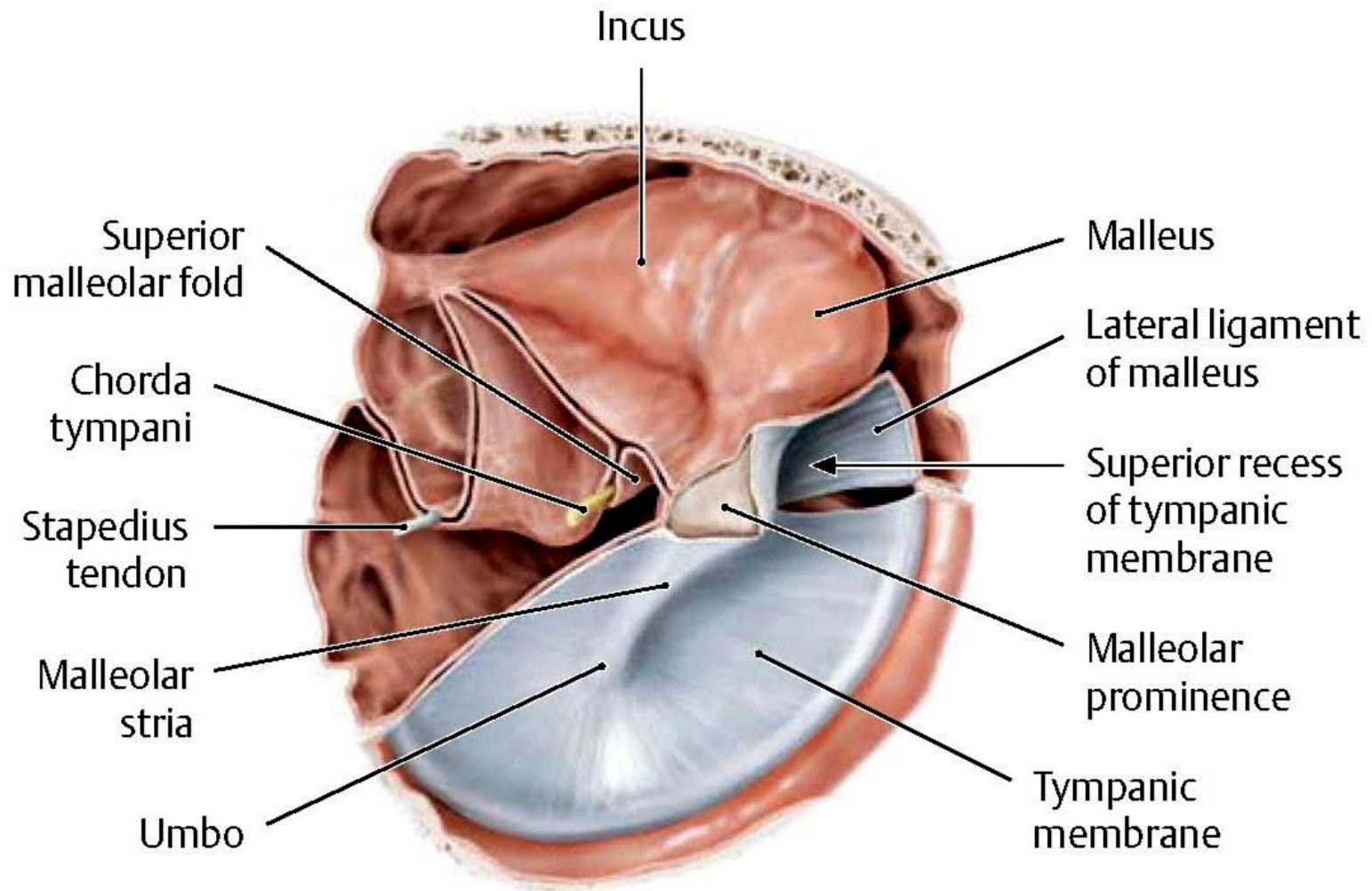
Function of the ossicular chain





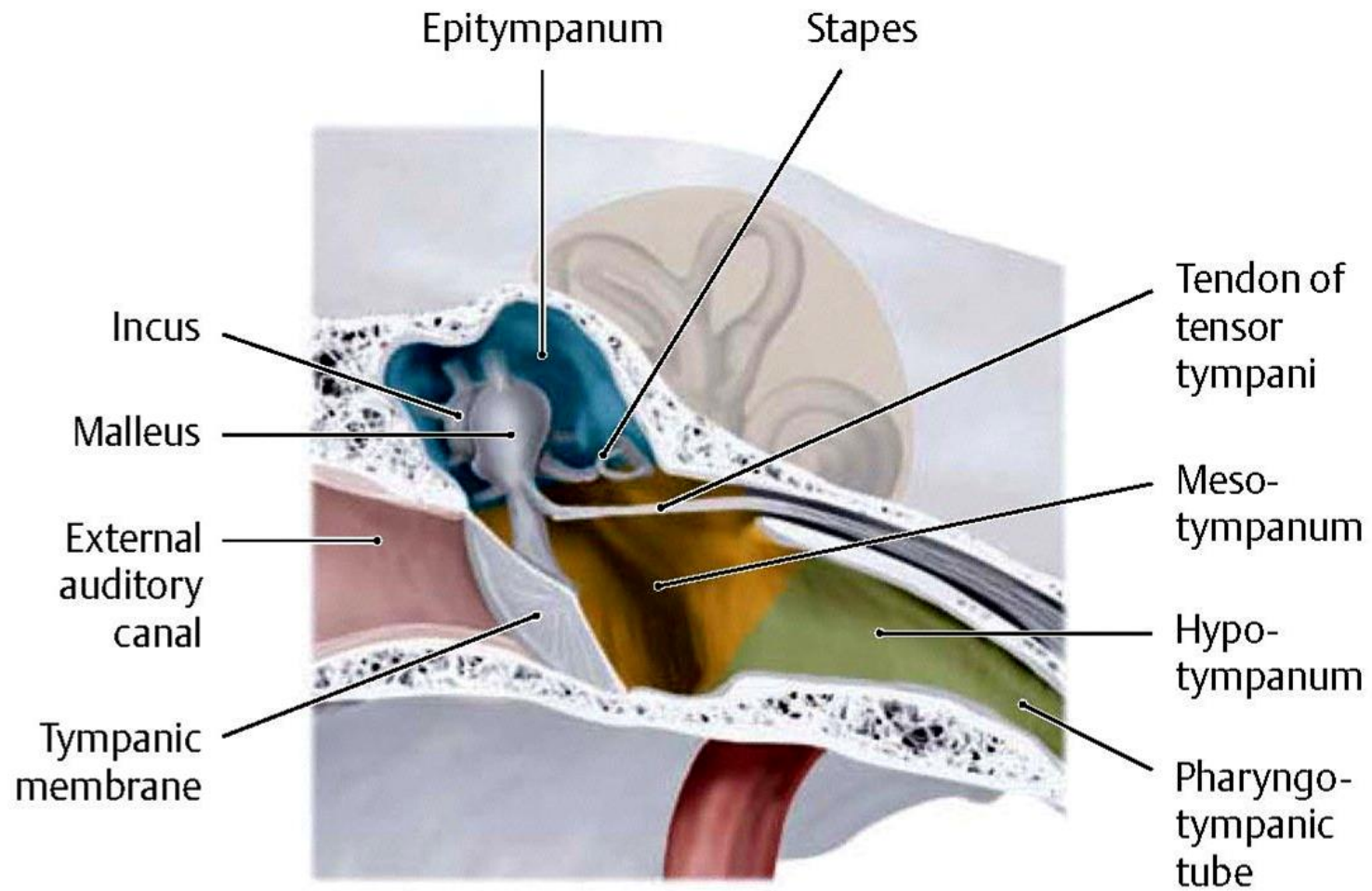
Ossicular chain in the tympanic cavity





Mucosal lining of the tympanic cavity

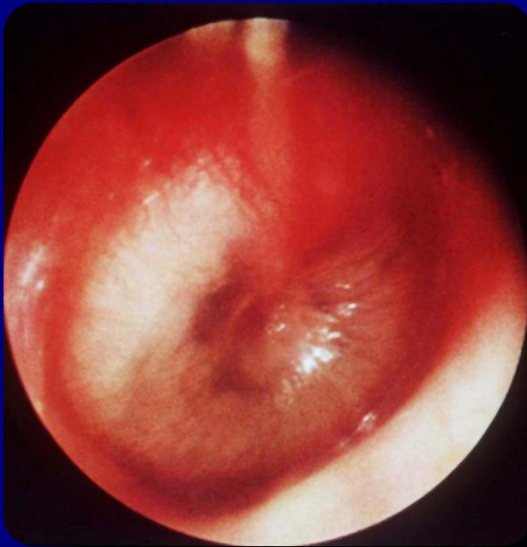




Clinically important levels of the tympanic cavity

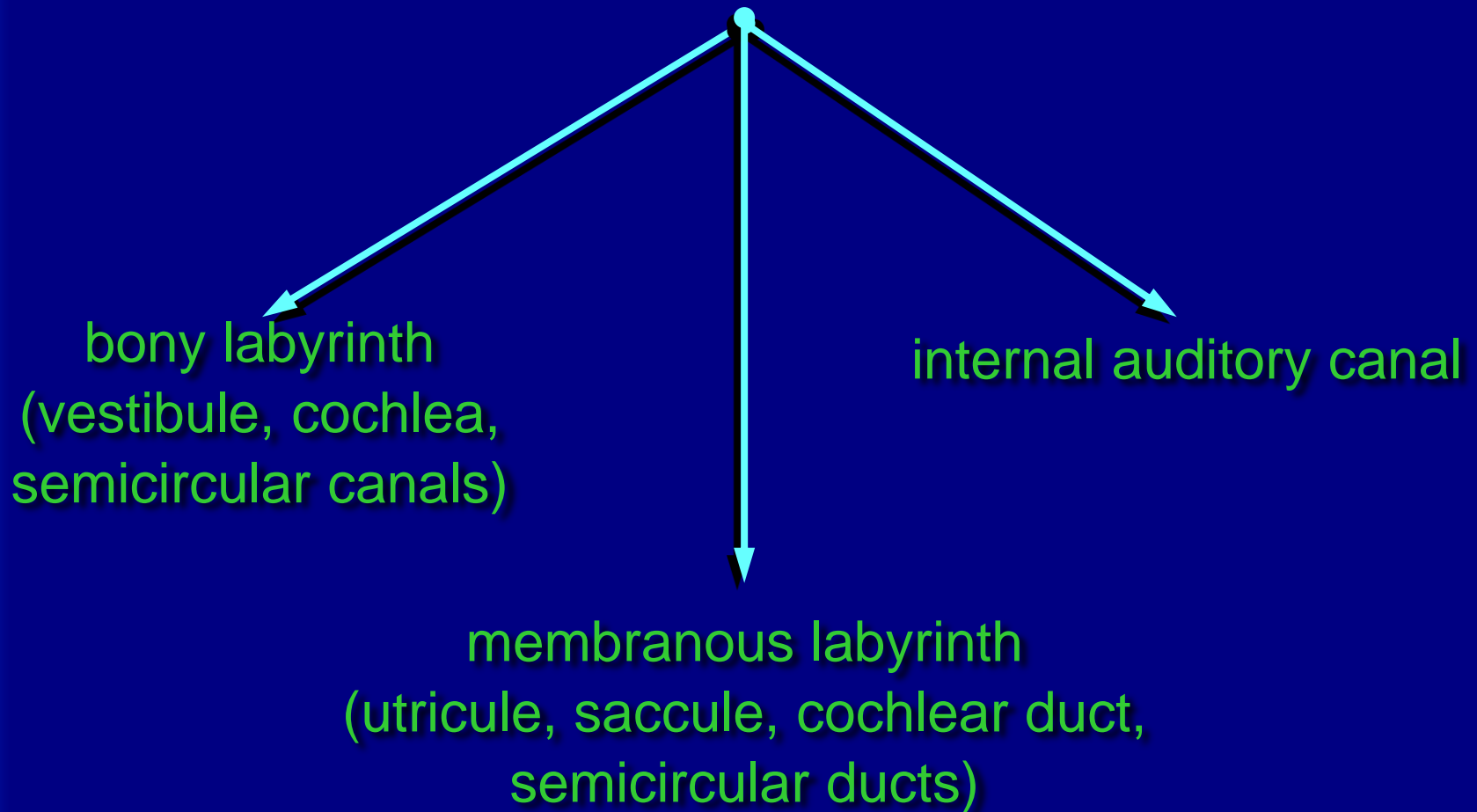


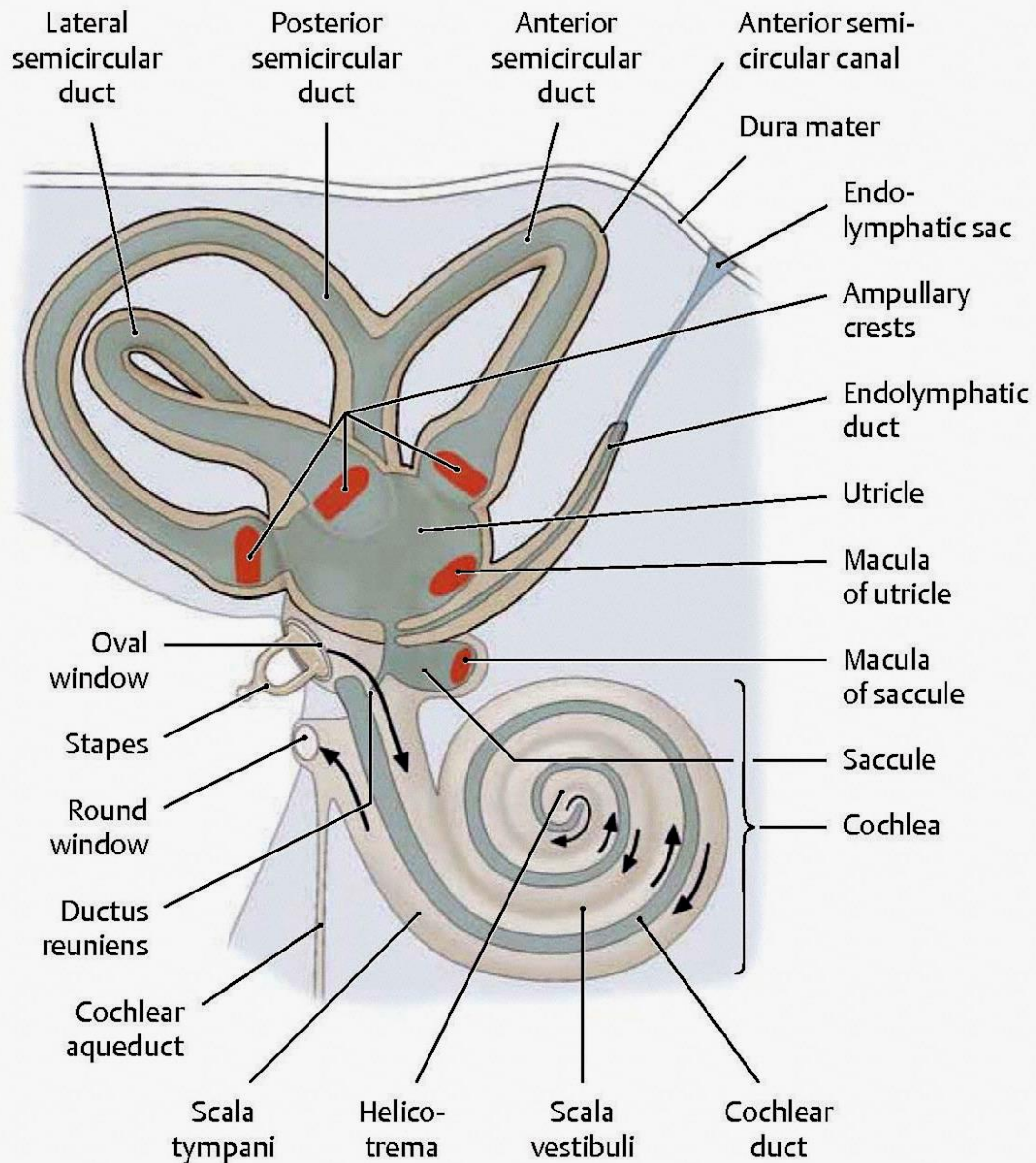
**Otitis media** – is a group of inflammatory diseases of the middle ear – *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, and *Staphylococcus aureus*.



Acute otitis media is very common in childhood. It is the most common condition for which medical care is provided in children under five years of age in the US.

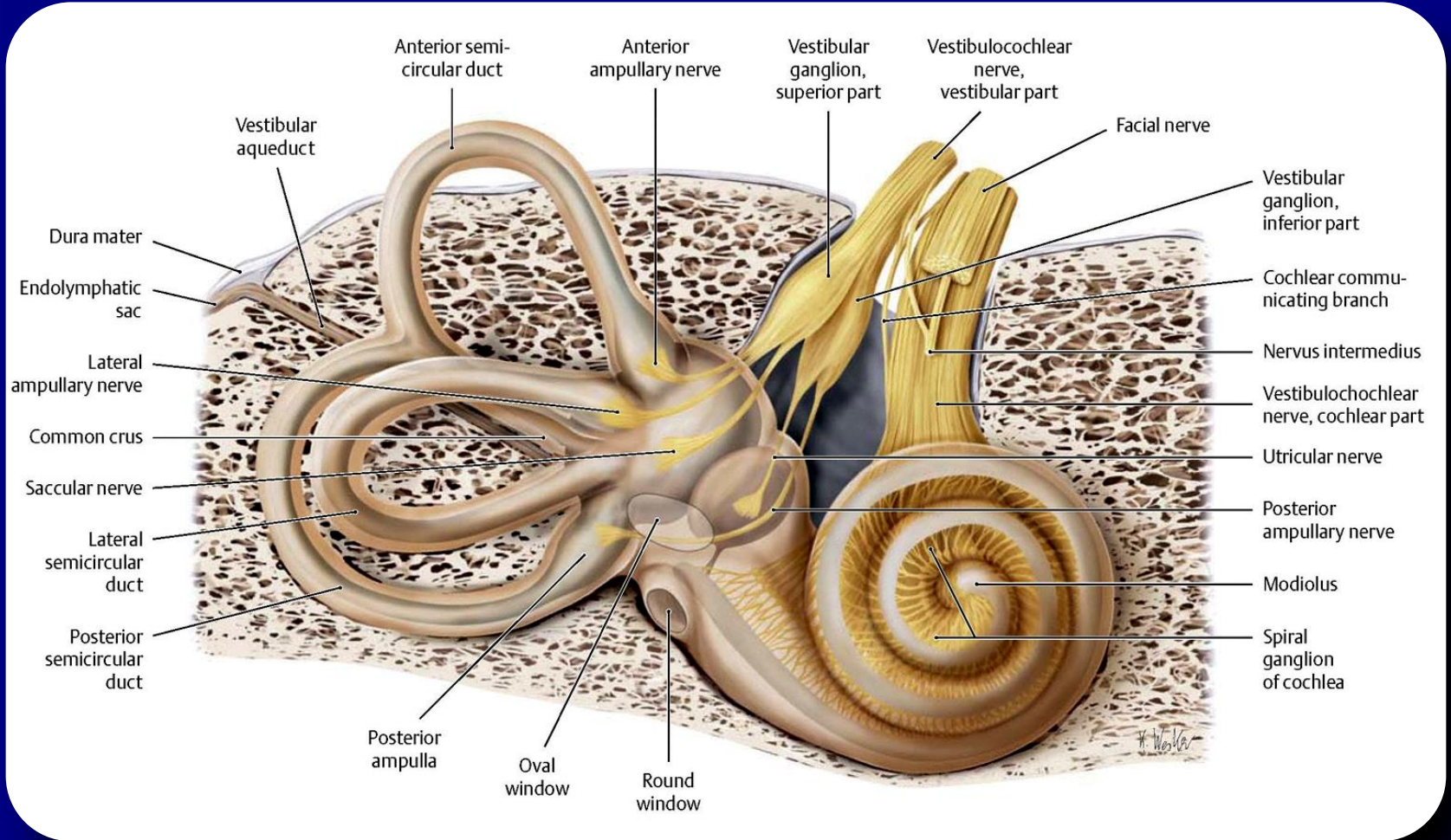
# Internal (inner) ear consists of:





Schematic diagram  
of the inner ear





Clinically important levels of the tympanic cavity



**Hyperacusis** – is a debilitating hearing disorder characterized by an increased sensitivity to certain frequency and volume ranges of sound (a collapsed tolerance to usual environmental sound). A person with severe hyperacusis has difficulty tolerating everyday sounds, some of which may seem unpleasantly or painfully loud to that person but not to others.

- Cochlear Hyperacusis – damage to the sound sensing organ (cochlea) that results in the brain having sound sensitivities around certain pitches;
- Vestibular Hyperacusis – a form of Hyperacusis that also affects a person's Vestibular (balance) system resulting in nausea, dizziness and the sensation of falling, in addition to sound hypersensitivity and/or Tinnitus and hearing loss.

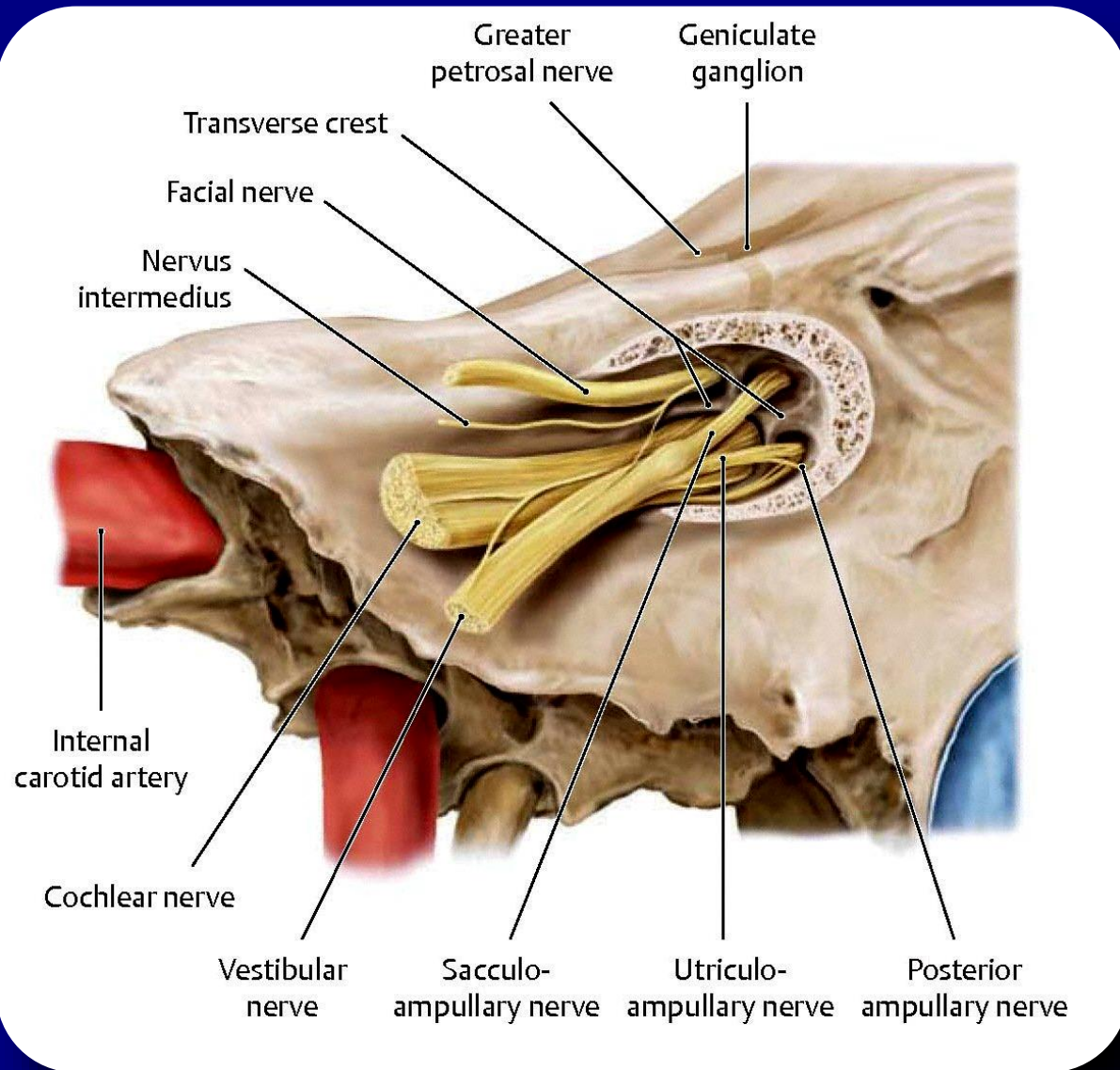
## Causes include, but are not limited to:

- Adverse drug reaction
- Anxiety
- Autism spectrum
- Bell's palsy
- Chronic ear infections
- Chronic fatigue syndrome
- Ciprofloxacin antibiotic (quinolone family)
- Depression
- Developmental coordination disorder
- Ear irrigation
- Electroconvulsive Therapy
- Facial nerve dysfunction (to stapedius)
- Fibromyalgia
- Head injury
- Lyme disease
- MAO inhibitor discontinuation syndrome
- Migraine
- Ménière's disease
- Multiple Sclerosis
- Noise-induced hearing loss
- Posttraumatic stress disorder
- Sensory Processing Disorder
- Severe head trauma
- Superior canal dehiscence syndrome (SCDS)
- Surgery
- Systemic lupus erythematosus (SLE)
- Tay–Sachs disease
- Temporomandibular joint disorder
- Tension myositis syndrome
- Tinnitus
- Williams syndrome

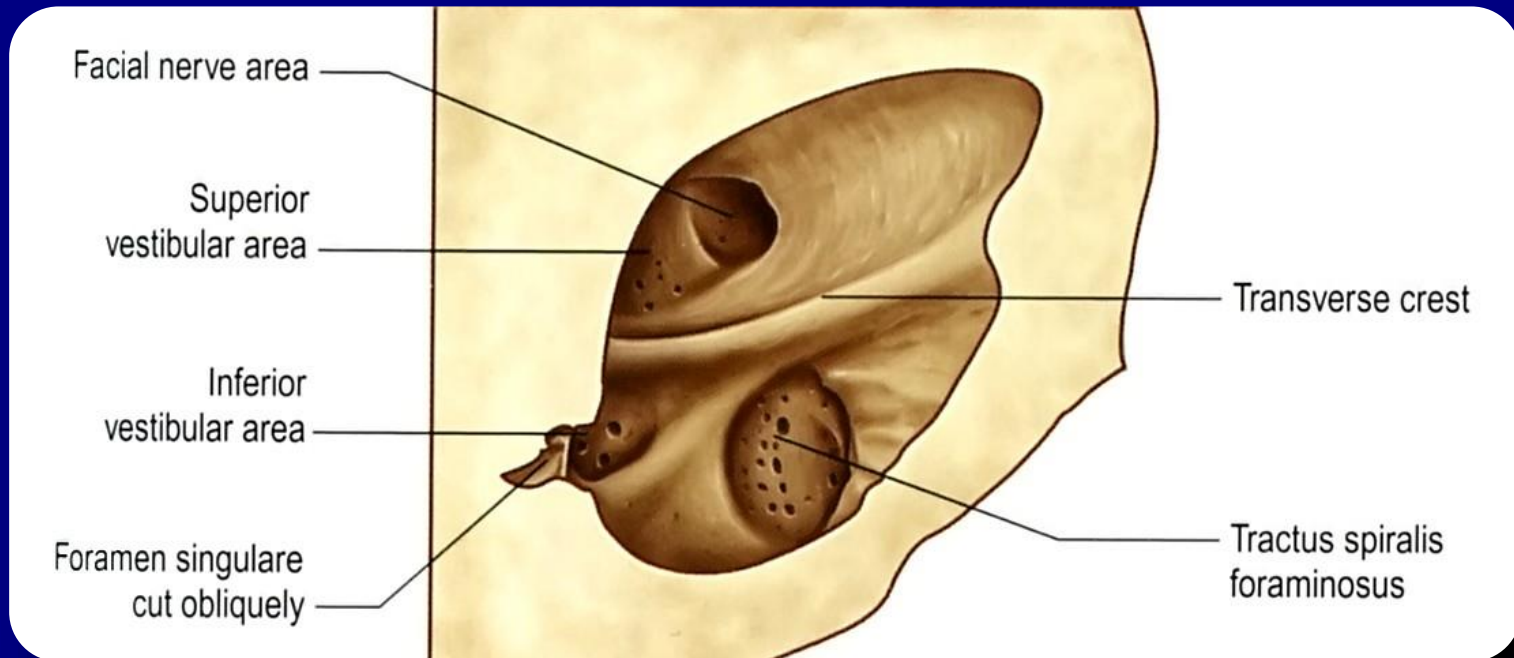


Symptoms are ear pain, annoyance, and general intolerance to many sounds that most people are unaffected by.

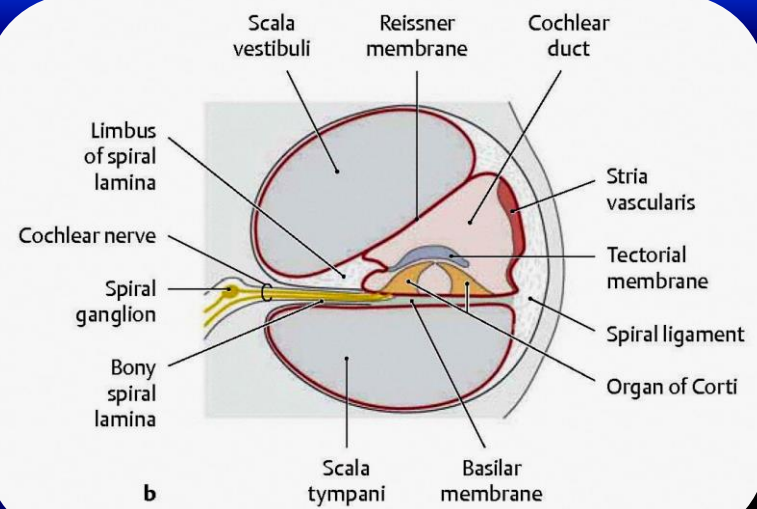
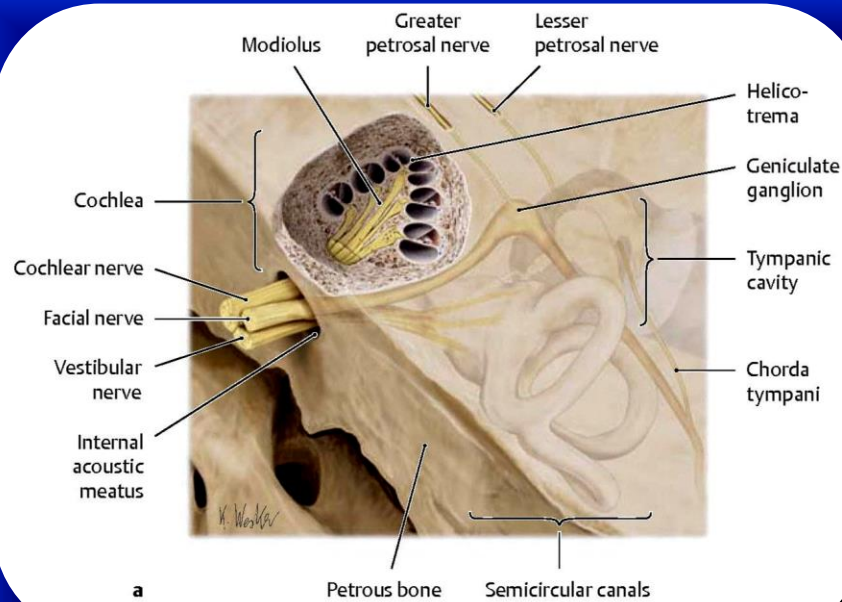
Hyperacusis can result in anxiety, stress and phonophobia.



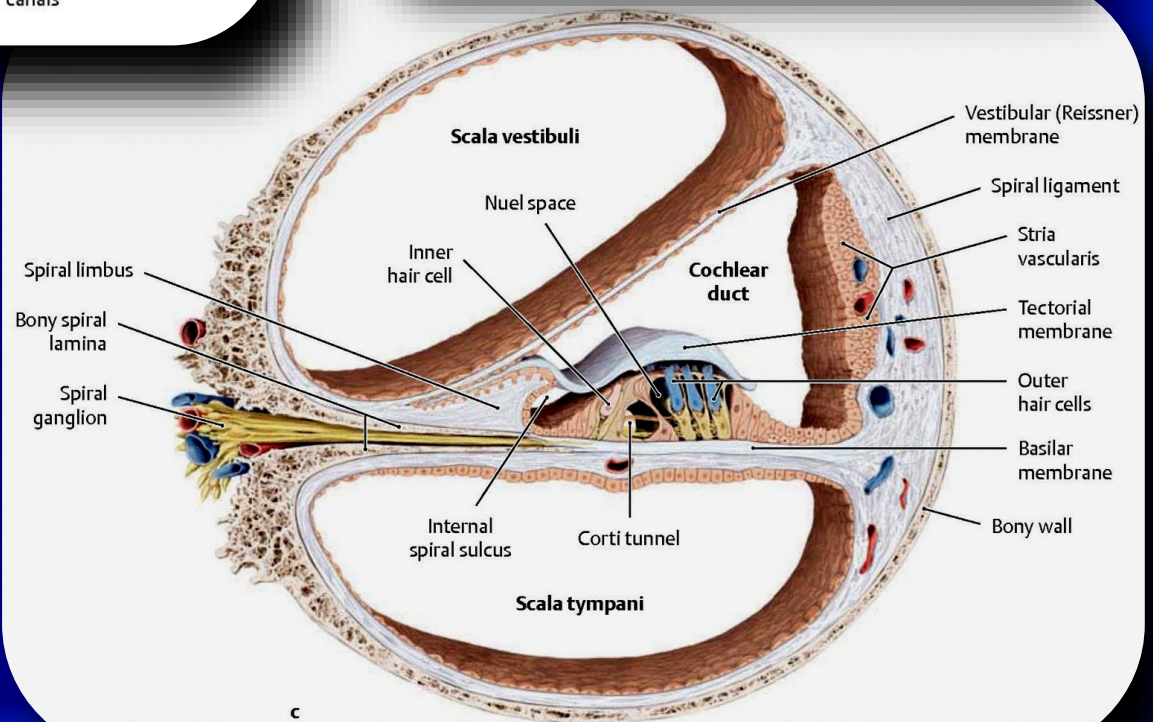
Passage of cranial nerves through the right internal acoustic meatus



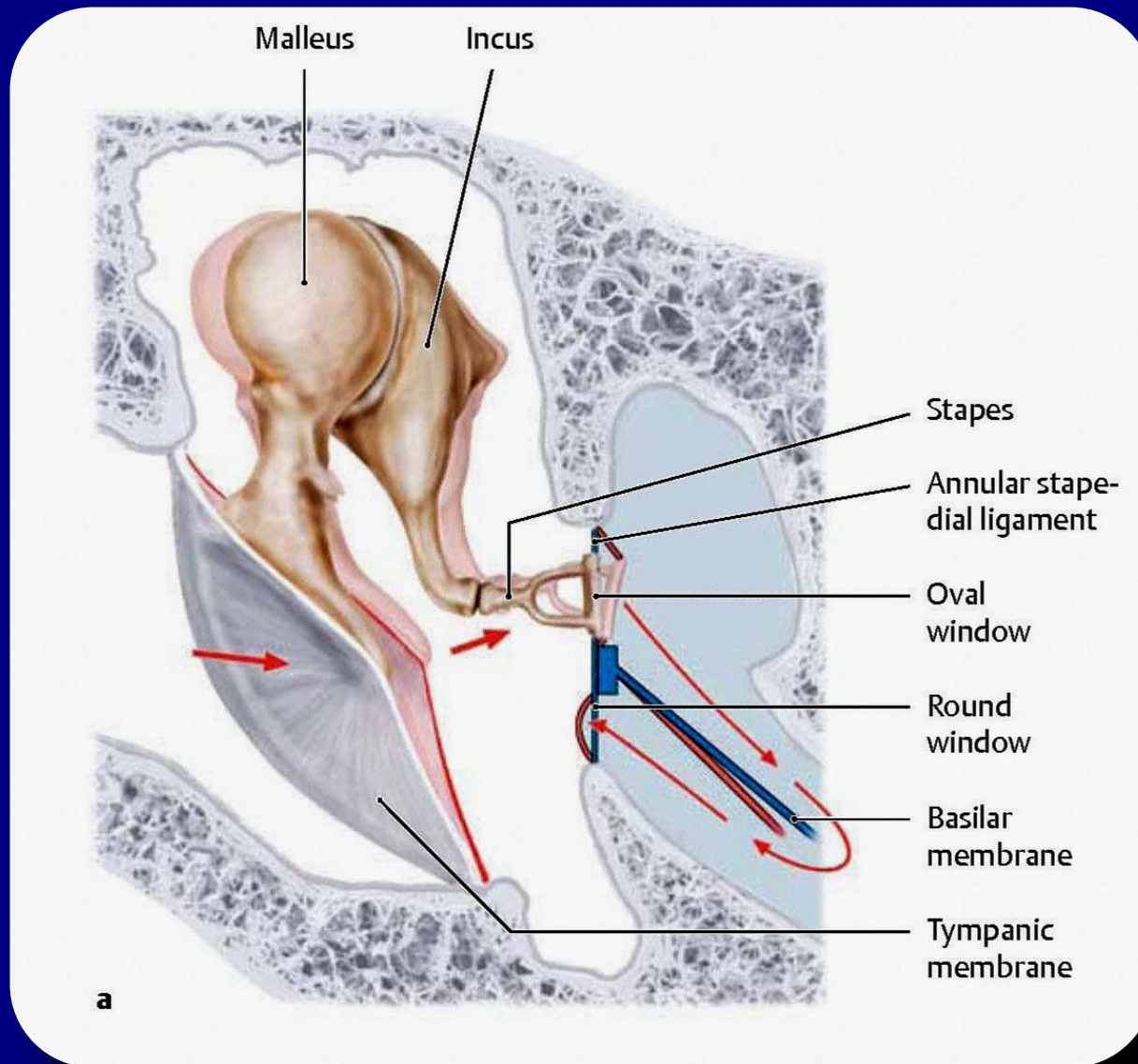
The fundus of the left internal acoustic meatus, exposed by a section through the petrous part of the left temporal bone nearly parallel to the line of its superior border.



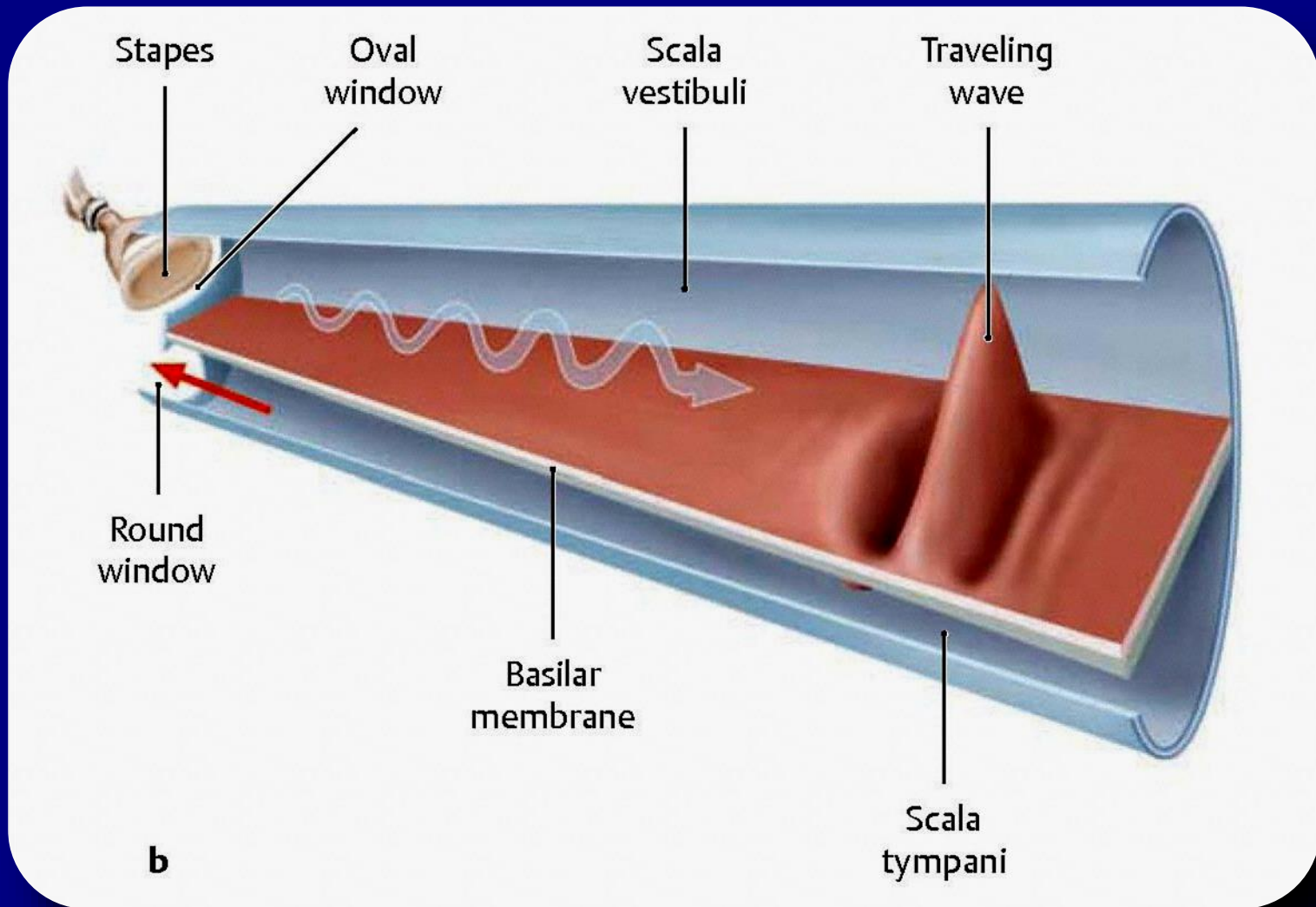
## Location and structure of the cochlea







Sound conduction during hearing



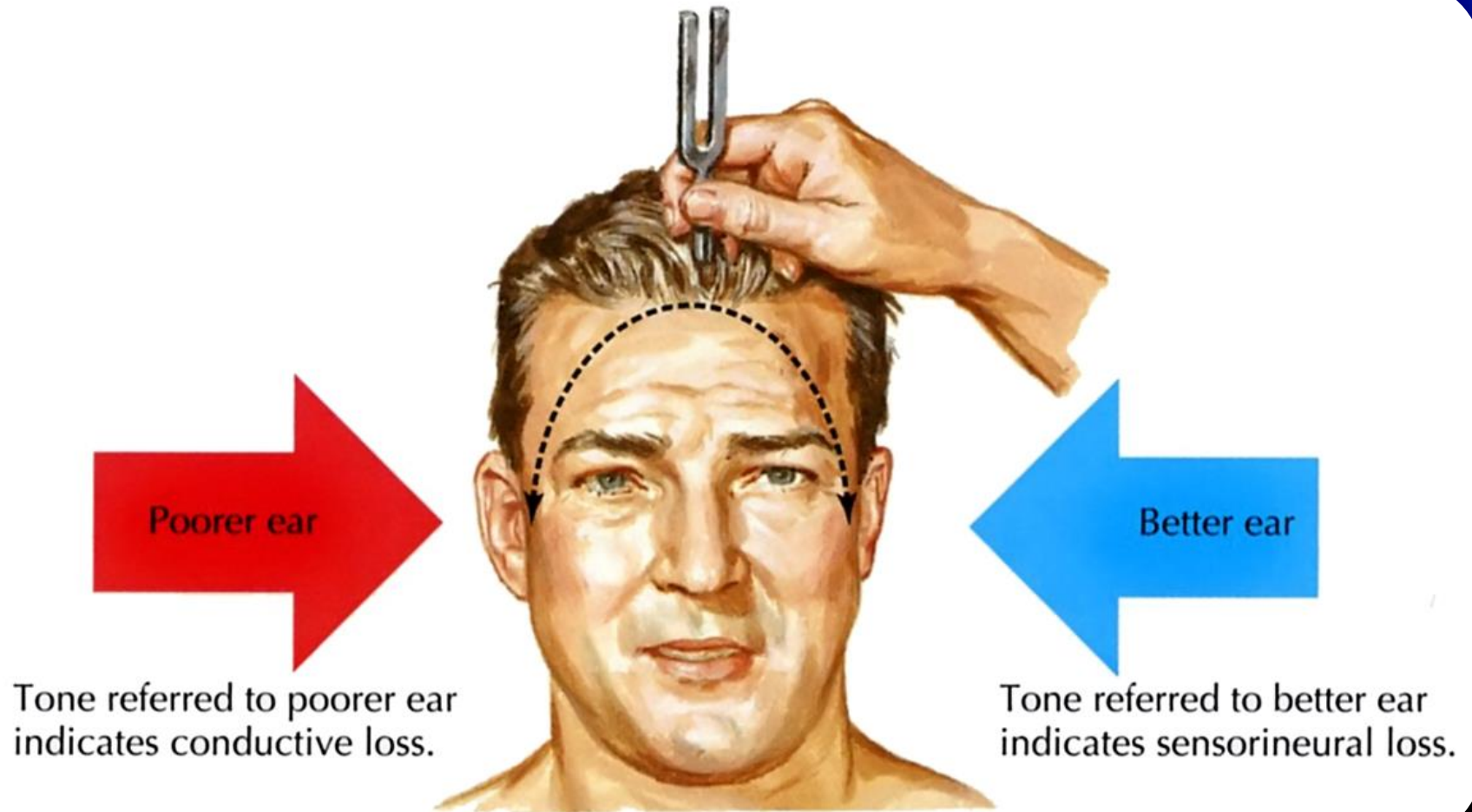
Sound conduction during hearing

## Weber and Rinne Tests

**Sensorineural** hearing loss suggests a disorder of the internal ear or the cochlear division of CN VIII.

**Conductive** hearing loss suggests a disorder of the external or middle ear (eardrum, ear ossicles, or both).

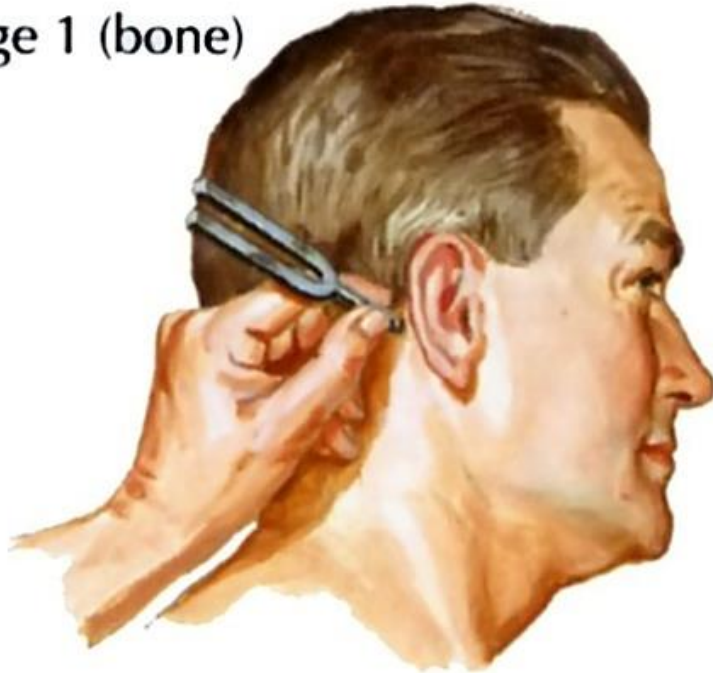
The Weber and Rinne tests offer an easy way to differentiate between sensorineural and conductive hearing loss.



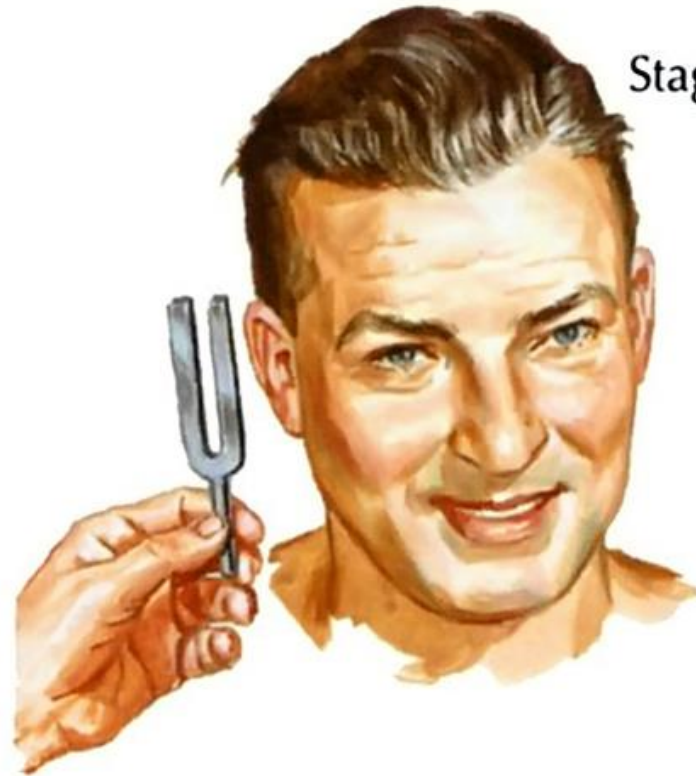
Weber test



Stage 1 (bone)



Stage 2 (air)



Normal: air conduction > bone

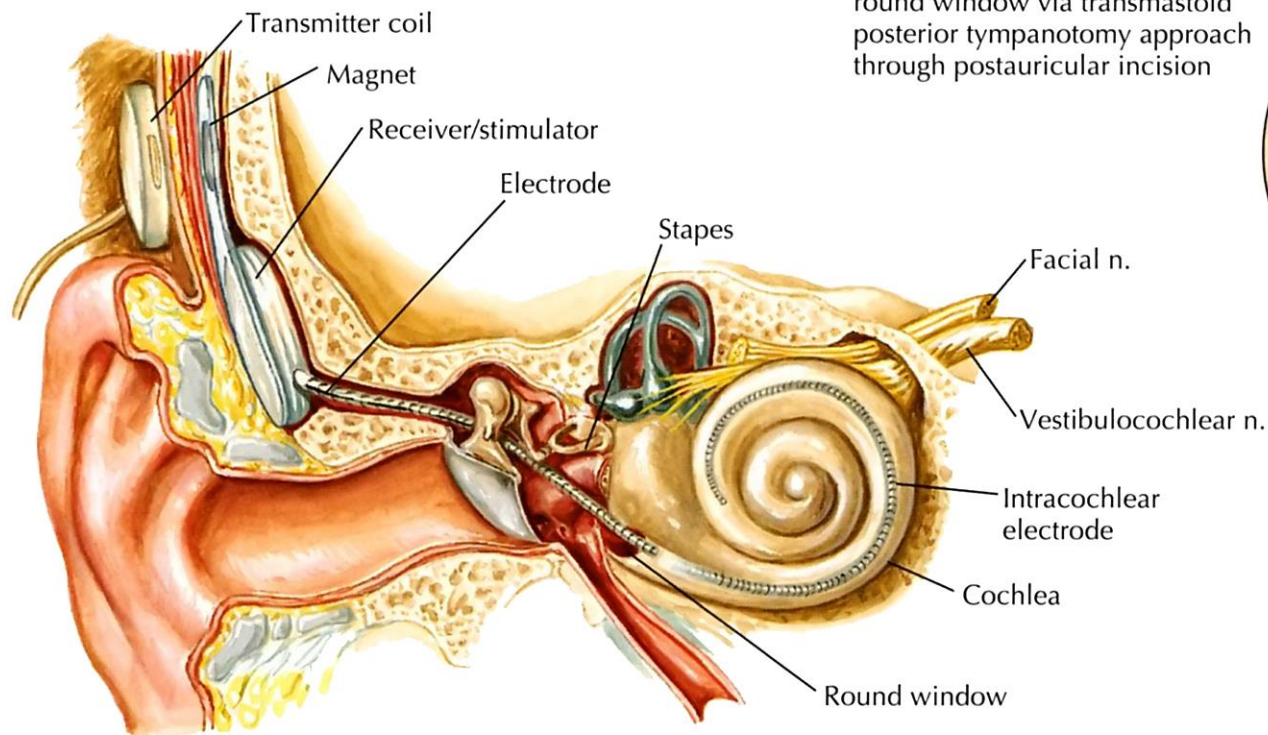
In ear with decreased hearing, if bone > air, evidence of conduction loss

In ear with decreased hearing, if air > bone, evidence of sensorineural loss

| <b><i>Test</i></b> | <b><i>Site</i></b>               | <b><i>Findings</i></b>   |
|--------------------|----------------------------------|--|
| <b>Weber</b>       | Fork placed on forehead          | Sound heard in middle if normal hearing or equal deafness exists; lateralization to one side indicates a conductive loss on that side or a sensorineural loss on the opposite side |
| <b>Rinne</b>       | Tines of fork held beside ear    | Reveals air conduction hearing loss  |
|                    | Handle placed on mastoid process | Reveals bone conduction hearing loss   |

## Cochlear Implant

Two million Americans have profound bilateral deafness. A cochlear implant consists of a speech processor and implanted electrodes. An external microphone detects sound, which is converted by the processor into electrical signals transmitted to the cochlear implant and vestibulocochlear nerve.



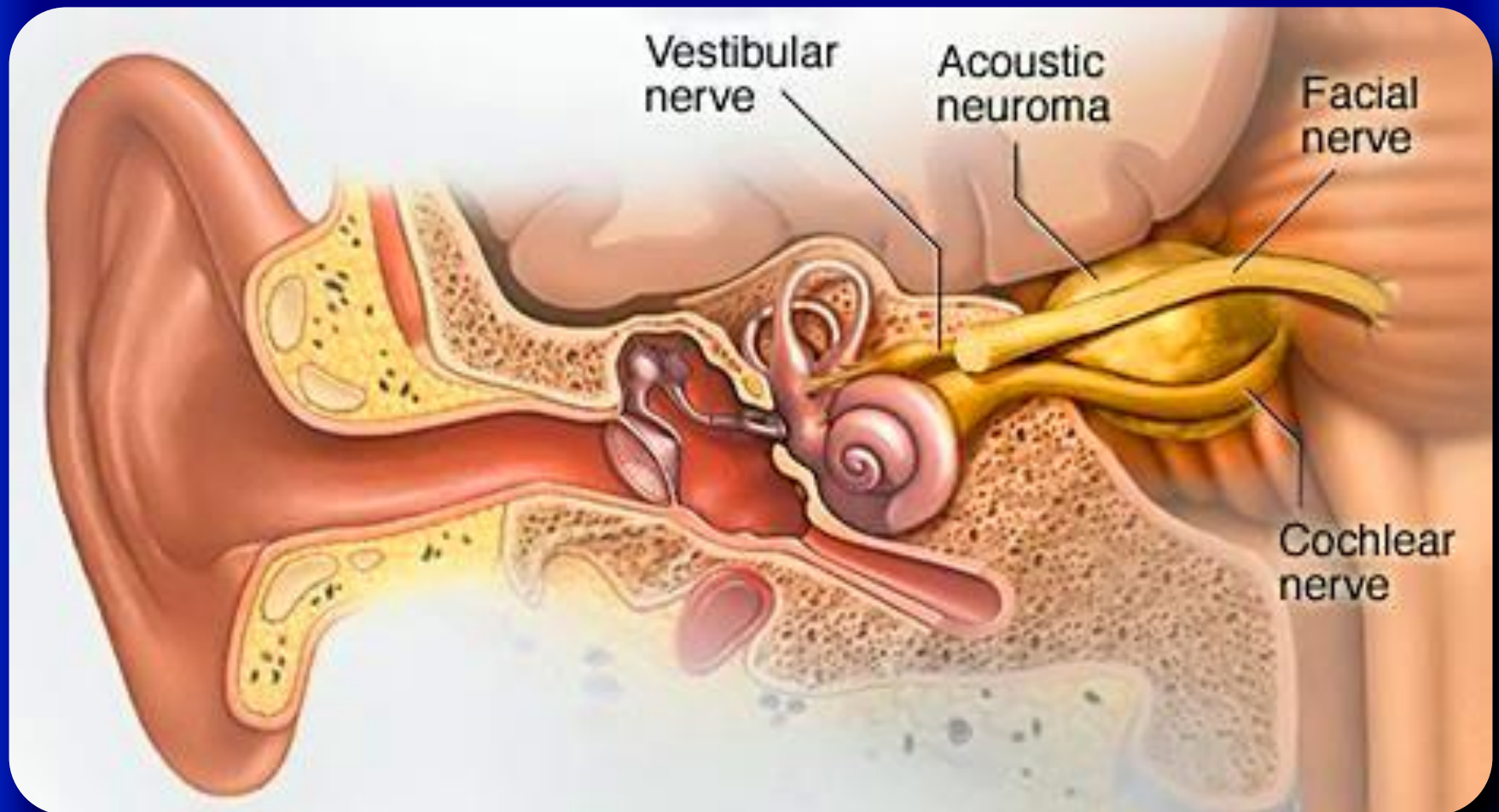
**Placement of prosthesis**

**Electrode placed in cochlea** near round window via transmastoid posterior tympanotomy approach through postauricular incision

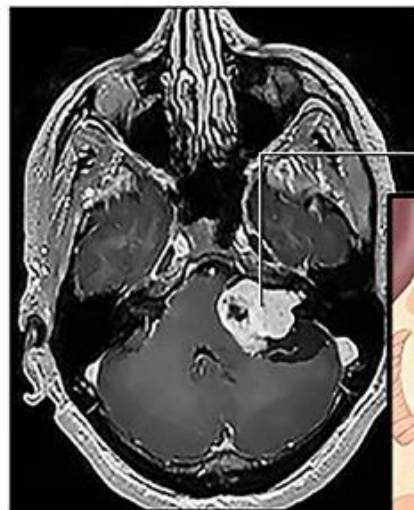
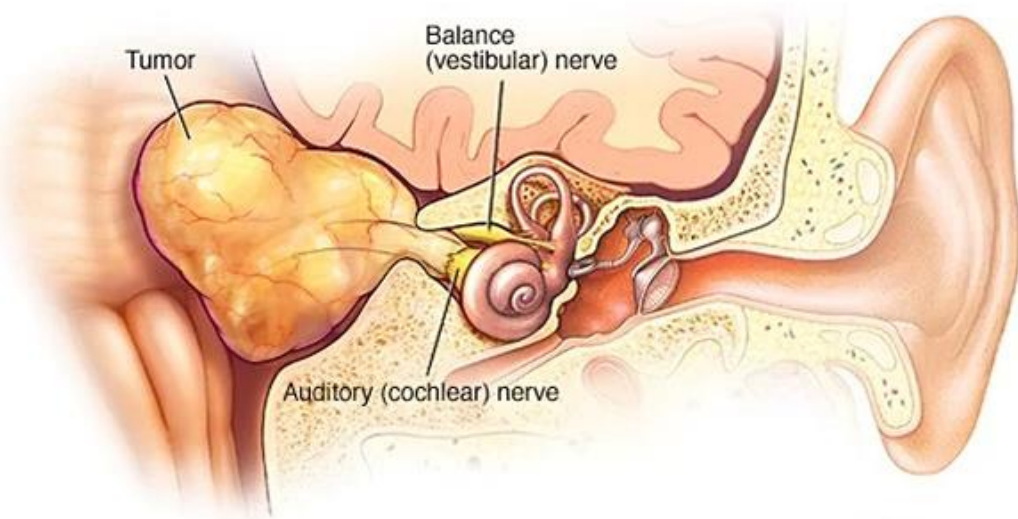


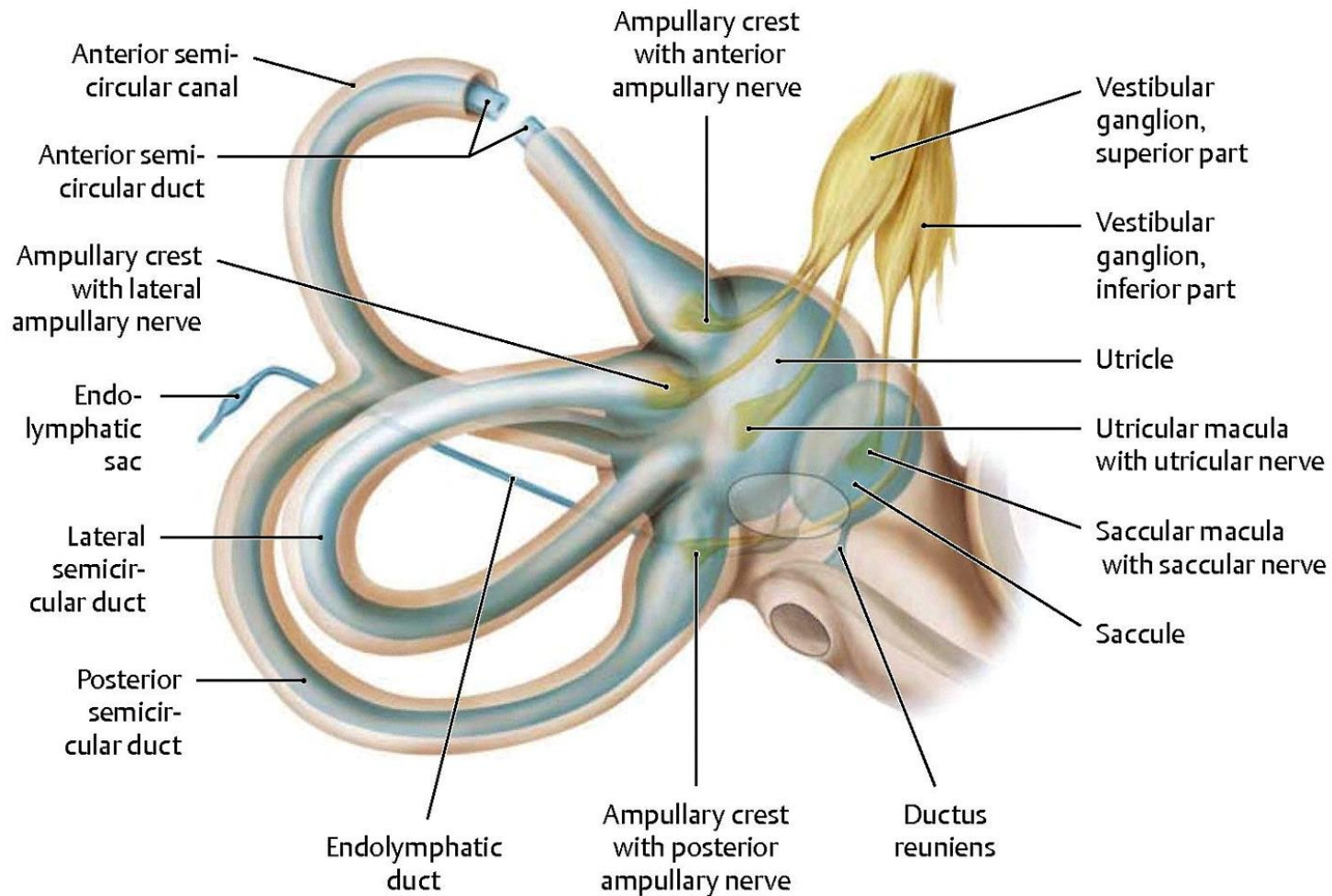
**External device in position**



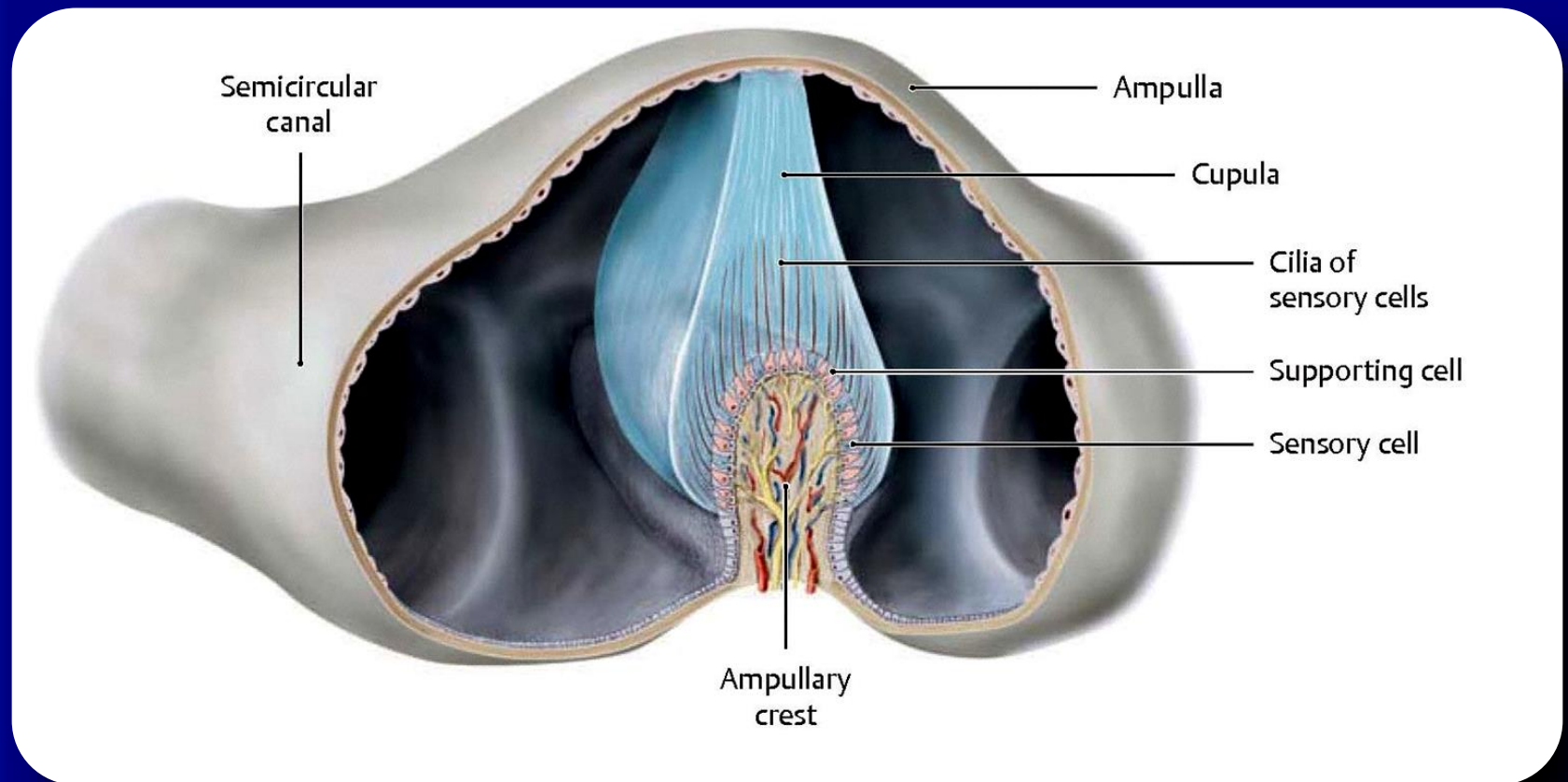






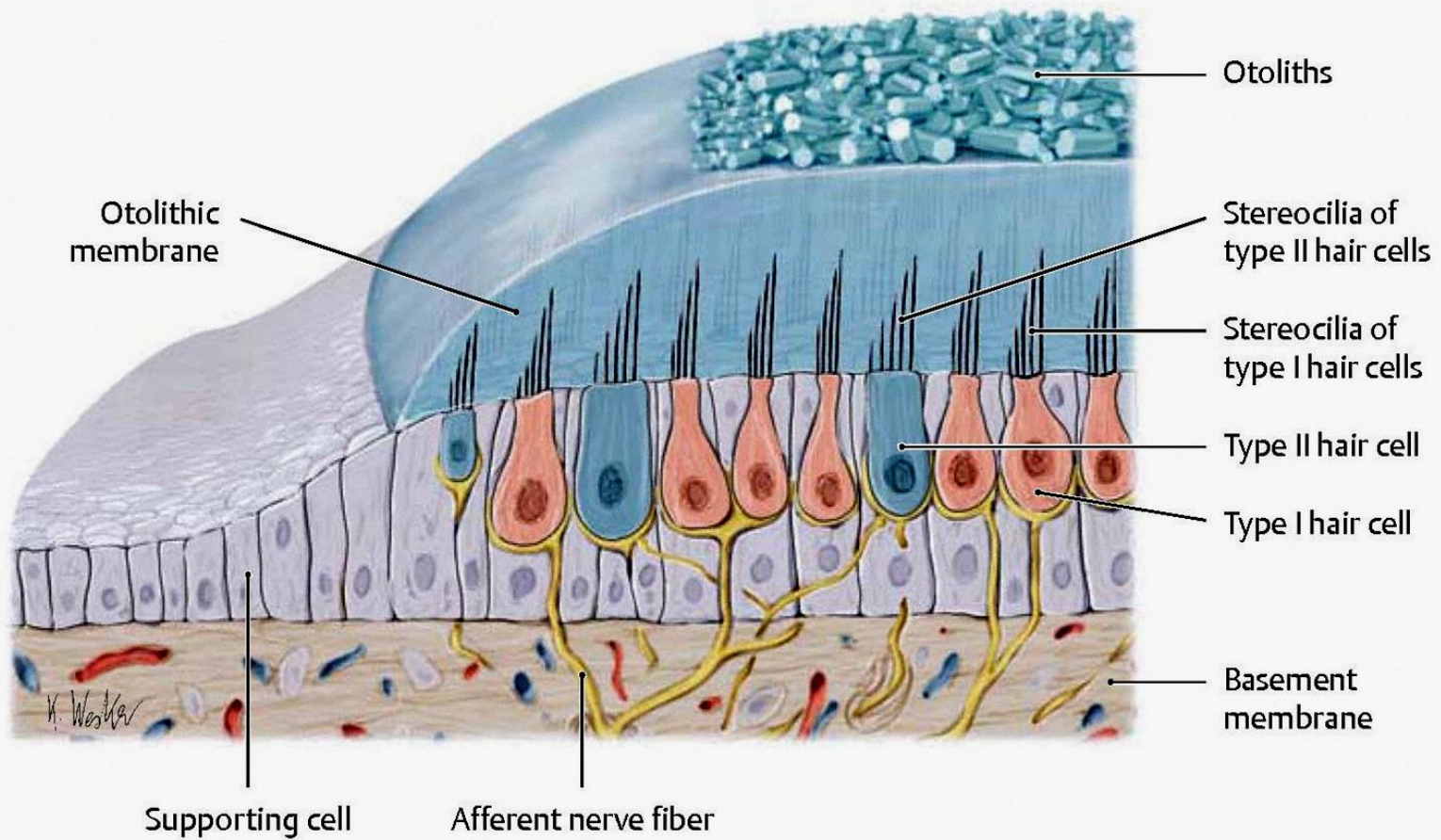


Structure of the vestibular apparatus



Structure of the ampulla and ampullary crest





Structure of the utricle and saccular maculae

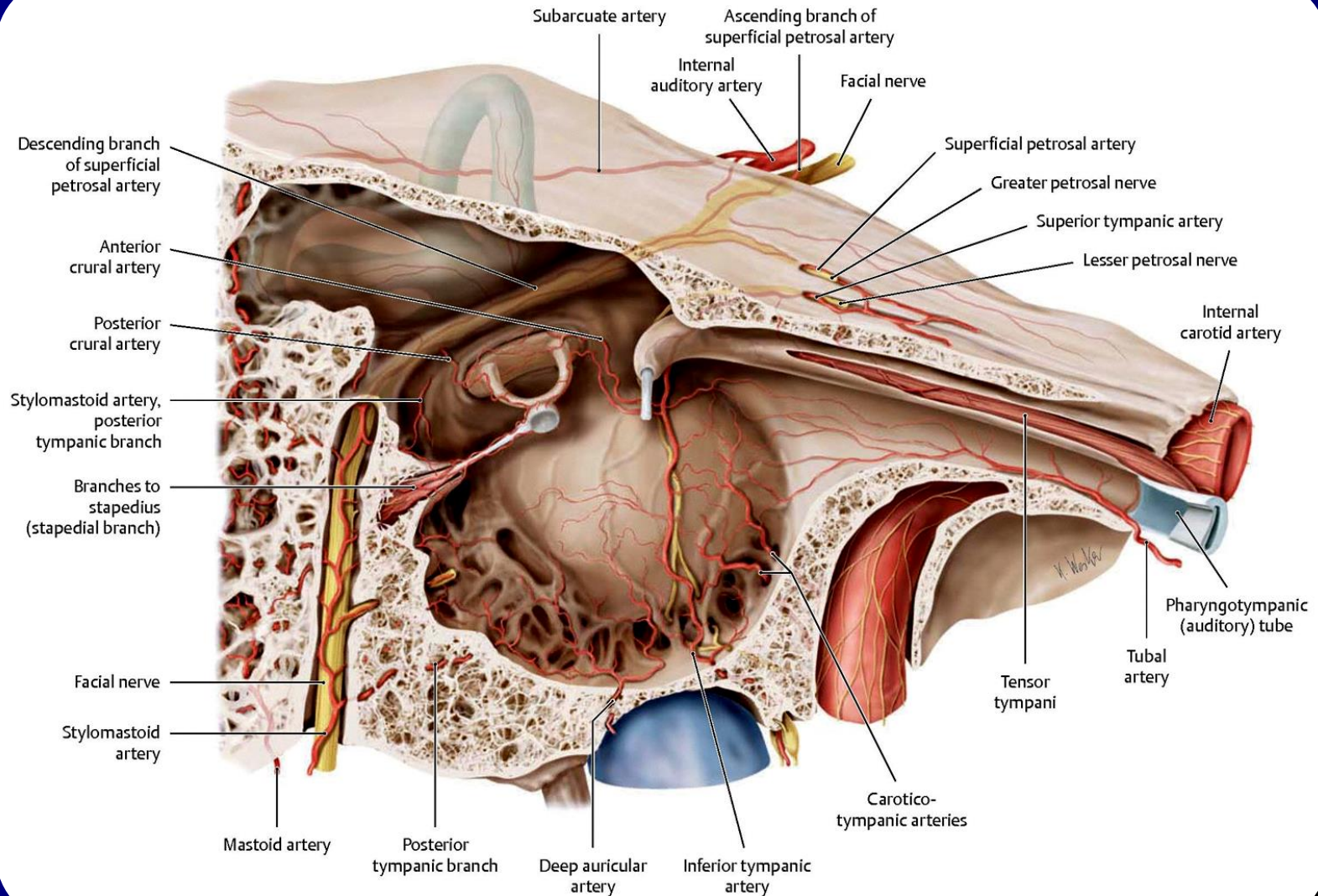


**Meniere's disease** – is a disorder of the inner ear that is characterized by episodes of feeling like the world is spinning (vertigo), ringing in the ears (tinnitus), hearing loss, and a fullness in the ear. Typically only one ear is affected, at least initially; however, over time both ears may become involved. Episodes generally last from 20 minutes to a few hours. The time between episodes varies. The hearing loss and ringing in the ears may become constant over time.

The cause of Ménière's disease is unclear but likely involves both genetic and environmental factors.

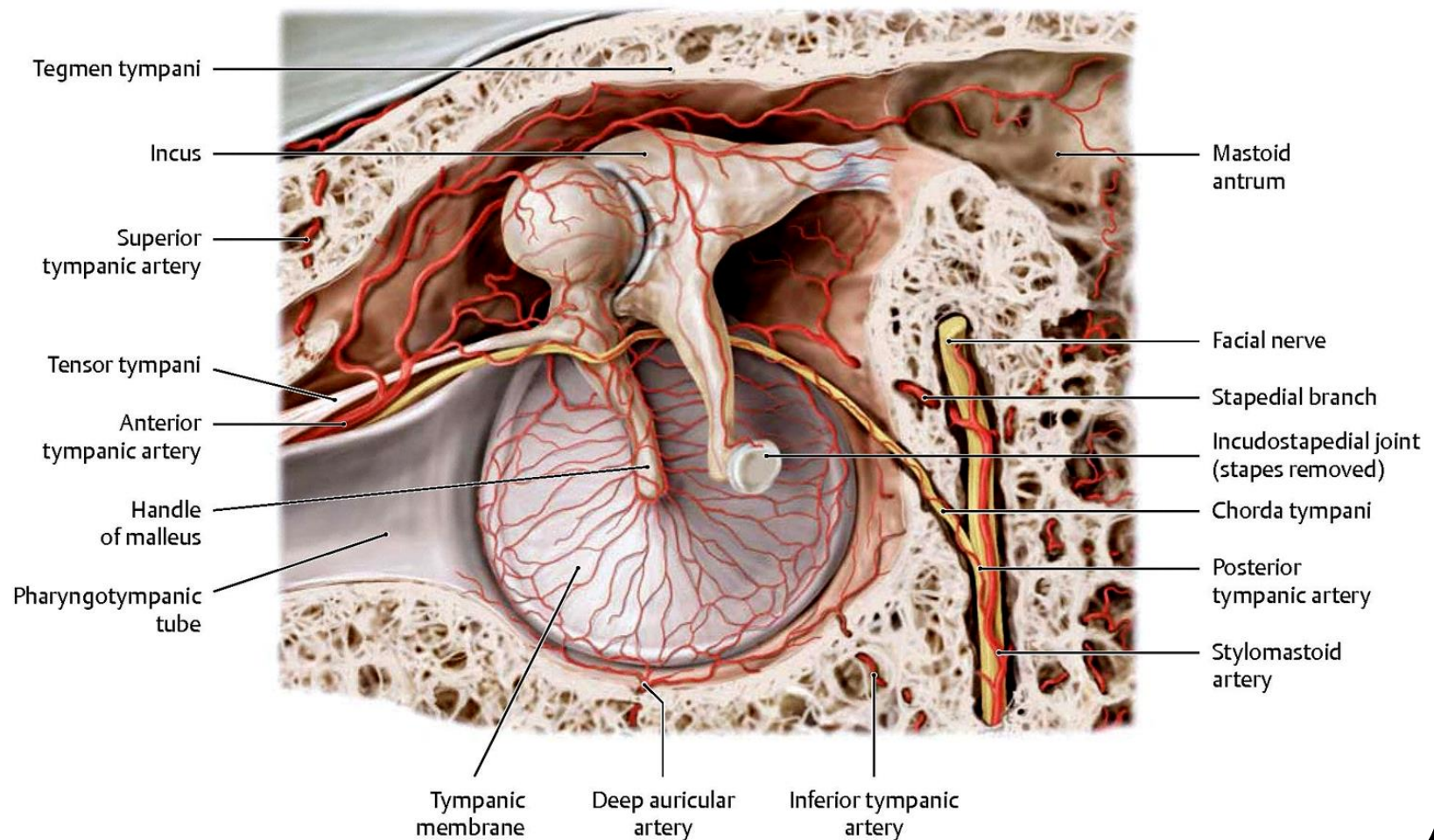
In 1972, the academy defined criteria for diagnosing Ménière's disease as:

- Fluctuating, progressive, sensorineural deafness.
- Episodic, characteristic definitive spells of vertigo lasting 20 minutes to 24 hours with no unconsciousness, vestibular nystagmus always present.
- Tinnitus (ringing in the ears, from mild to severe) Often the tinnitus is accompanied by ear pain and a feeling of fullness in the affected ear. Usually the tinnitus is more severe before a spell of vertigo and lessens after the vertigo attack.
- Attacks are characterized by periods of remission and exacerbation.



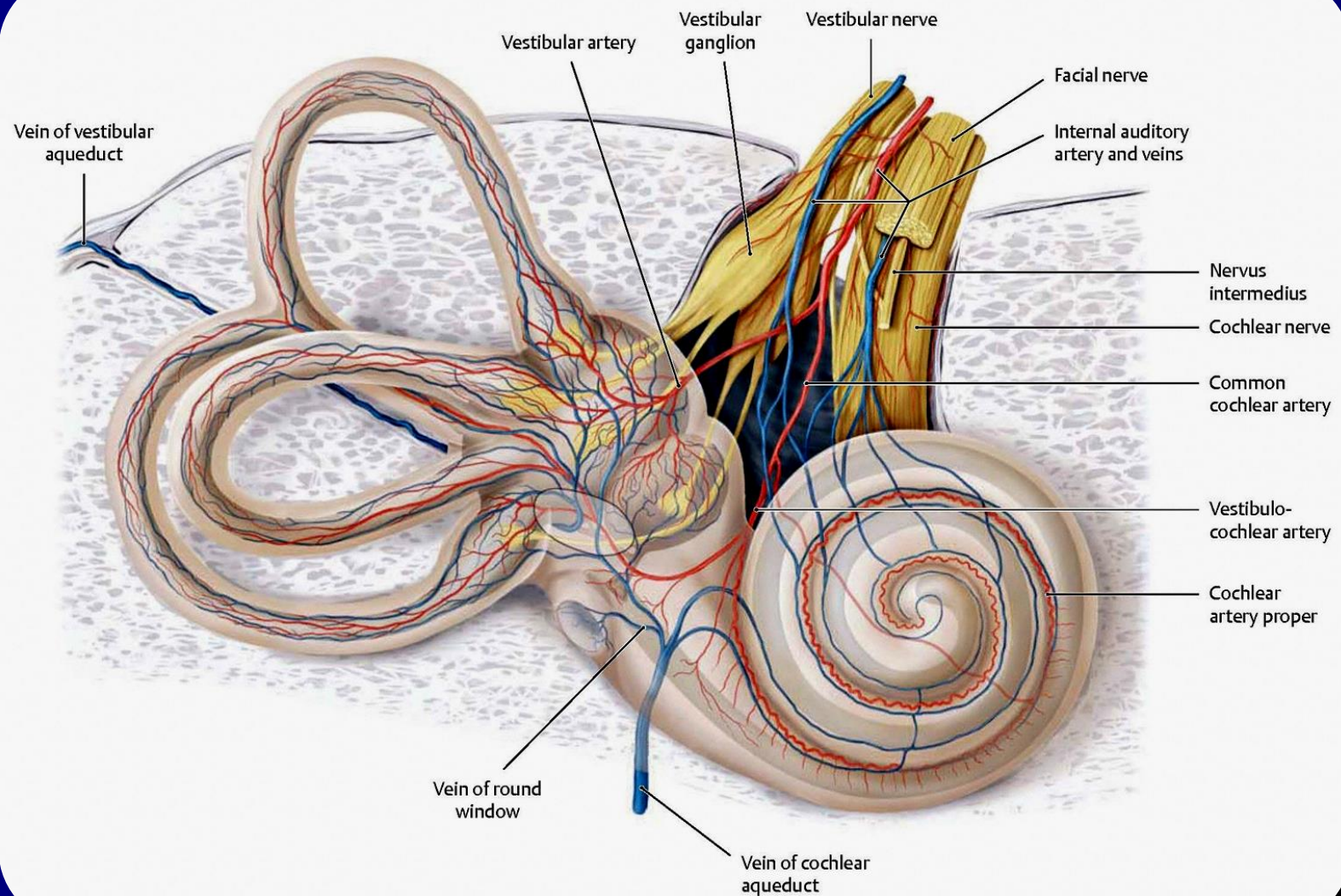
Arteries of the tympanic cavity and mastoid air cells





Vascular supply of the ossicular chain and tympanic membrane





Blood supply of the labyrinth

*Thank you very much*



*Fot. J. Urbaniak*

**Laryngologist**