

وسهلا



أهلا

يُمنع أخذ السلايدات بدون  
إذن المحرر واي اجراء  
يخالف ذلك يقع تحت طائلة  
المسؤولية القانونية  
جميع المعلومات للاستخدام  
التعليمي فقط

الأستاذ الدكتور يوسف حسين

كلية الطب - جامعة مؤتة - الأردن

دكتورة من جامعة كولونيا المانيا

Prof. Dr. Youssef Hussein Anatomy - YouTube

الواتس (أي استفسار)  
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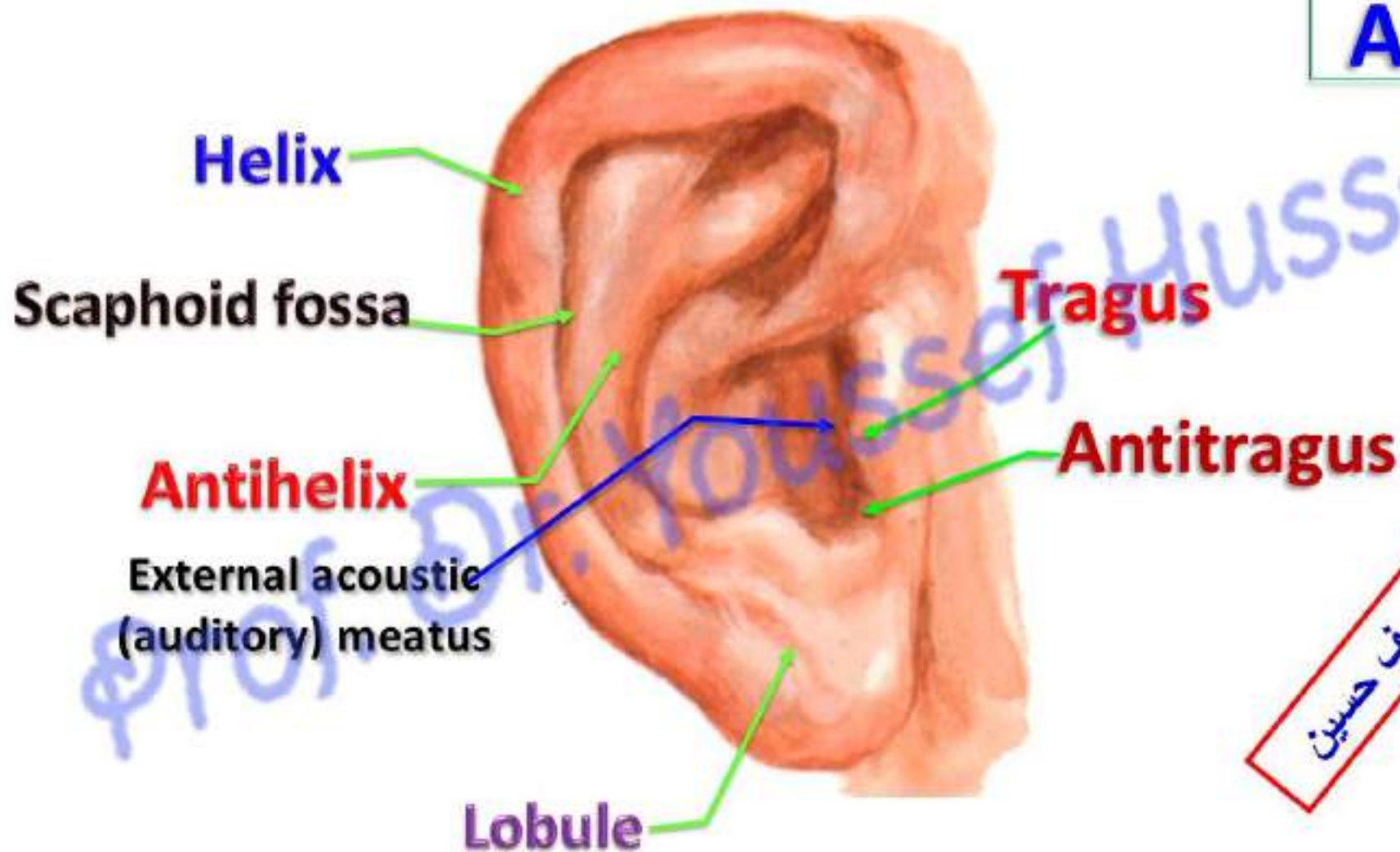
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# External Ear

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# Auricle



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- **External auditory meatus**

- **Length:** about one inch

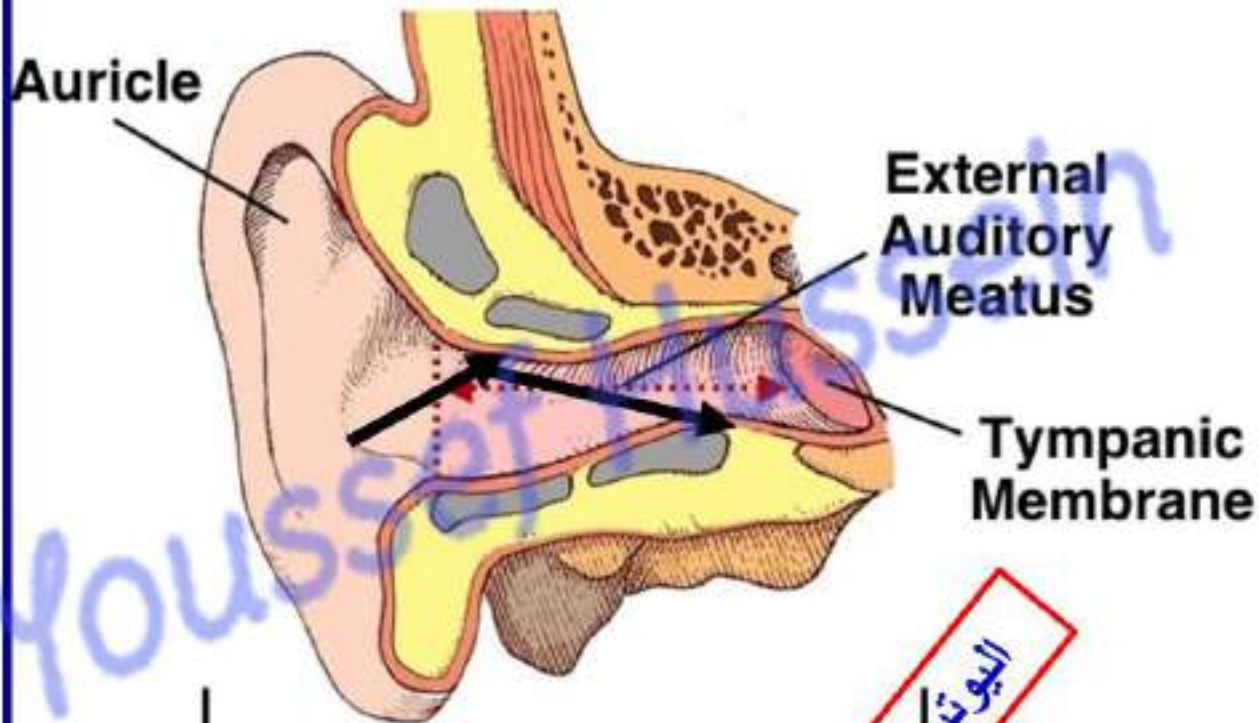
- **Parts:**

- a) **Outer 1/3 cartilaginous**, directed **upward, forward and medially**.

- b) **Inner 2/3 bony in temporal bone**, directed **downward, forward and medially**.

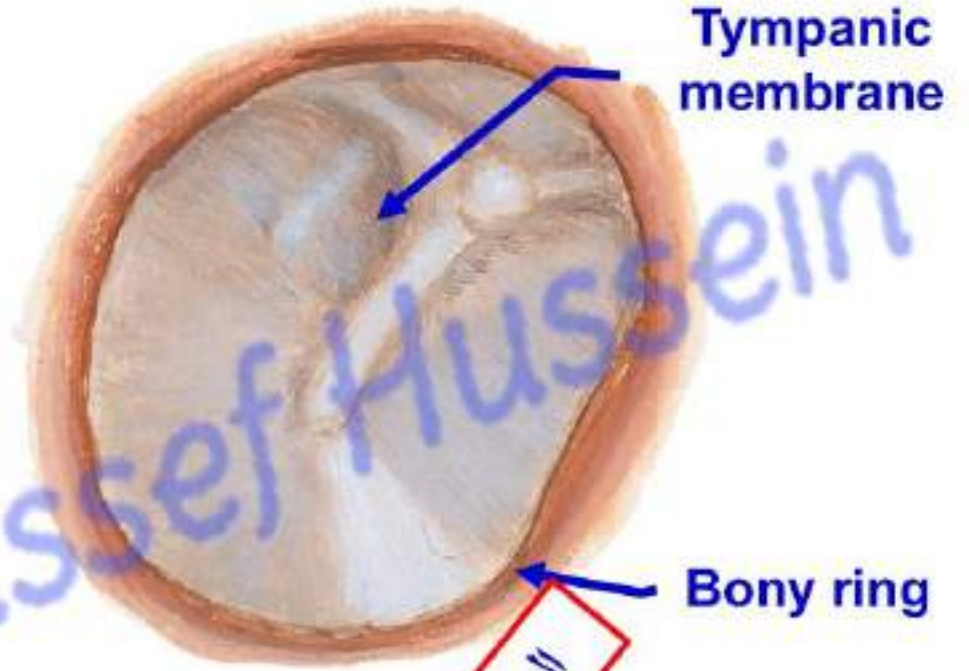
- **Nerve supply;**

Auriculotemporal nerve and auricular branch of vagus.



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- **Ear drum (tympanic membrane)**
- **Position:** it lies obliquely **between middle and external ear** and forms an acute angle (**55 degree**), **So** the **anterior wall and floor** of the canal is **longer** than posterior wall and roof.
- **Structure:** semitransparent membrane surrounded by bony ring, it is formed of:
  1. Outer layer of skin.
  2. Middle layer of fibrous tissue.
  3. Inner layer of mucous membrane.



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- **Ear drum (tympanic membrane)**

**\*\* Surfaces;**

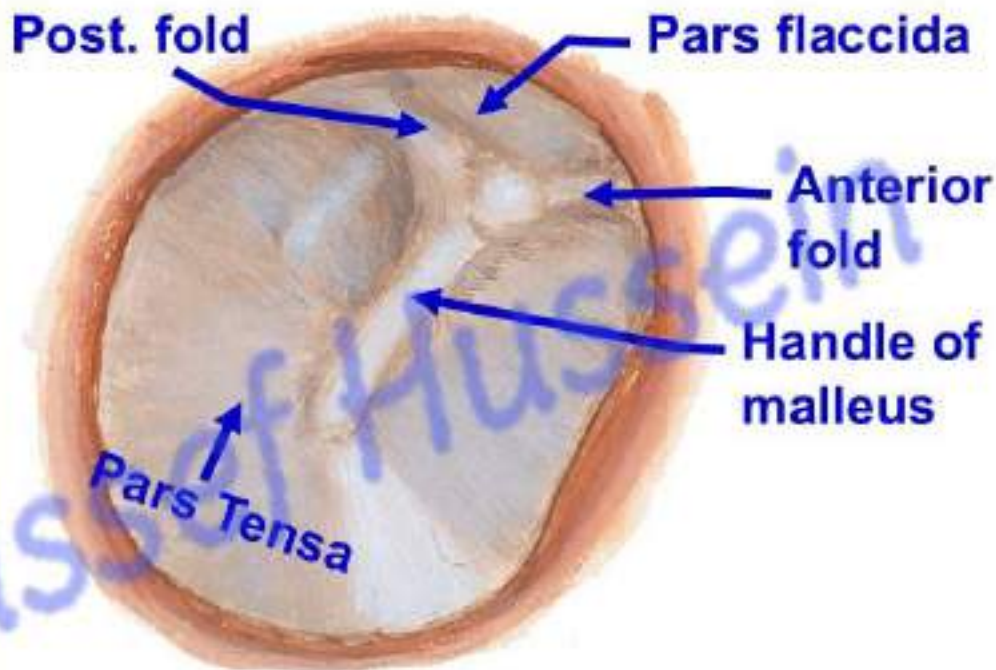
1. **Outer surface, slightly concave.** The most depressed part called **umbo**.
2. **Inner surface, convex,** gives attachment to handle of malleus.

**\*\* Parts:**

1) **Pars tensa:** the major part that contains fibrous layer.

2) **Pars flaccida** (Shrapnel's membrane): upper most part does not contain fibrous layer.

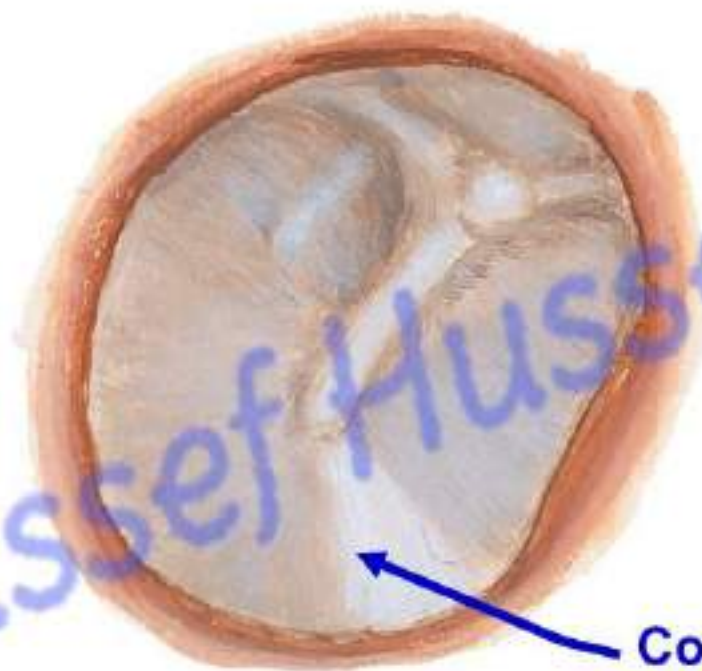
- The pars flaccida and pars tensa are separated from each other by 2 folds called **anterior and posterior malleolar folds**.



- **Tympanic membrane perforation (Pars flaccida)** is caused by **Otitis media (middle ear infection)** Or trauma, Rapid change in pressure

- It heals within a few weeks without treatment, Sometimes needs surgical repair

• **Cone of light**, Shining light on tympanic membrane causes a cone-shaped reflection of light in **anterior inferior quadrant** during examination of tympanic membrane with an Otoscope.



Cone of light



**Otoscopic  
examination**

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# Middle Ear

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Middle ear lies inside petrous part of temporal bone

Inner ear

Auditory tube

Nasopharynx

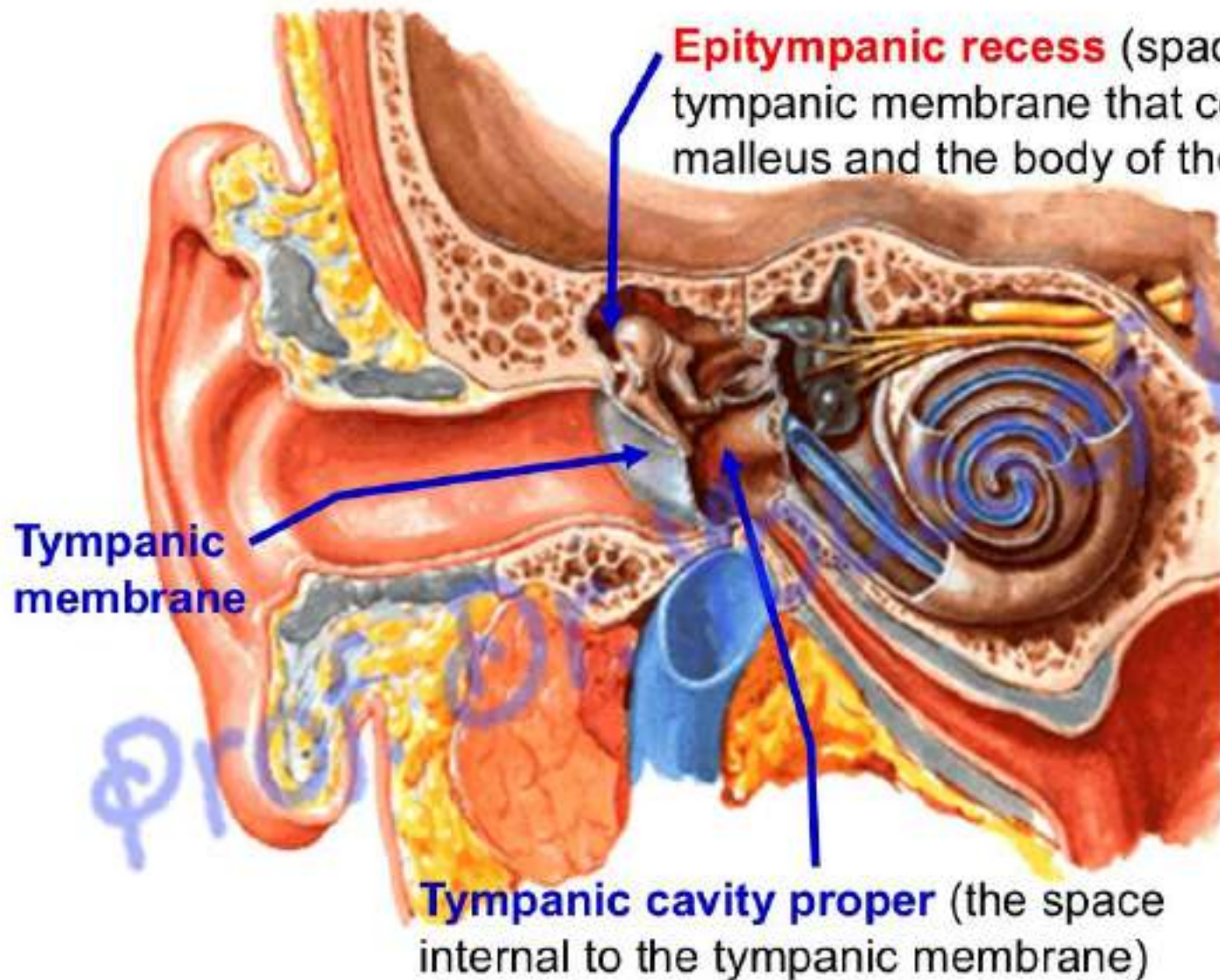
External acoustic meatus

Tympanic membrane

▪ **Communications;**

- **Anteriorly**, with the **nasopharynx** through the auditory tube.
- **Posteriorly** With the **mastoid air cells** through the **mastoid antrum**.

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**Parts of  
tympanic  
cavity**

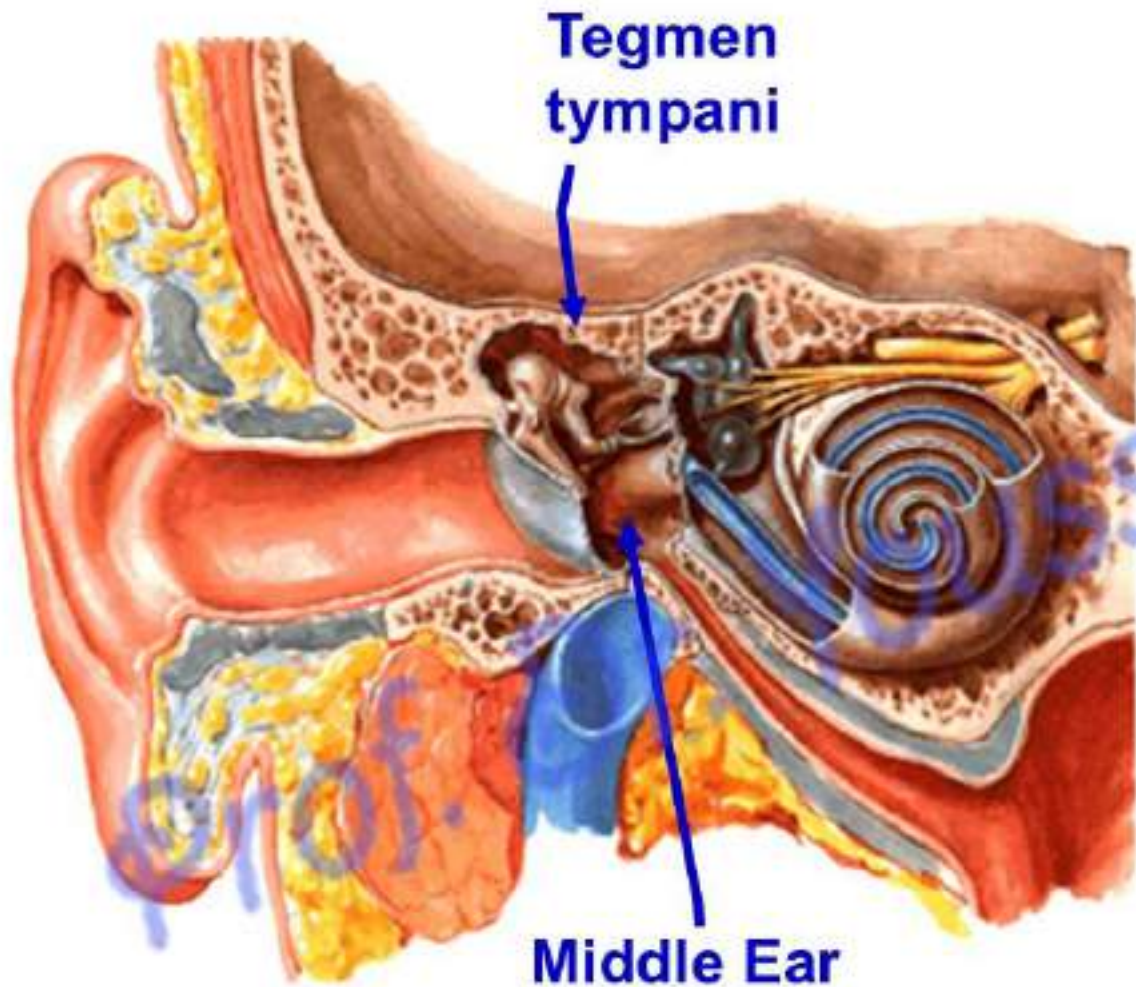
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# Boundaries of Middle Ear

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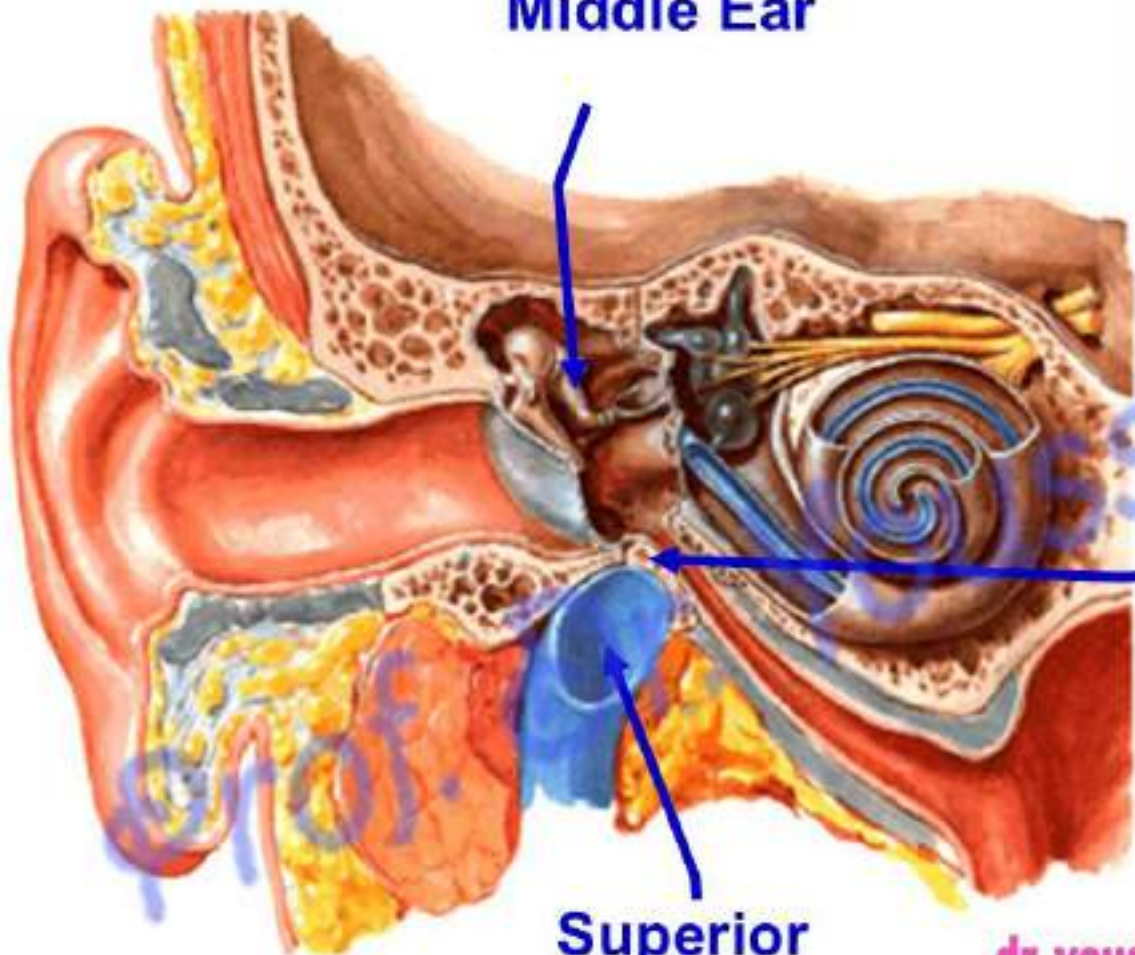
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- **Roof** (tegmental wall)  
- It is formed by a thin plate of the **petrous part of the temporal bone** (called **tegmen tympani**) which separates it from the **middle cranial fossa**.

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**Middle Ear**



**Floor (jugular wall)**

- It is formed by a **thin plate of bone** which separates it from superior bulb of internal jugular vein.
- It is **pierced by tympanic branch of glossopharyngeal nerve.**

**Thin plate of bone**

**Superior bulb of IJV**

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**Fenestra vestibuli**

It is closed by the **base of the stapes**

**Oval window**

**Horizontal part of Facial canal**

**Medial wall**  
separates middle ear cavity from inner ear

**Facial nerve**

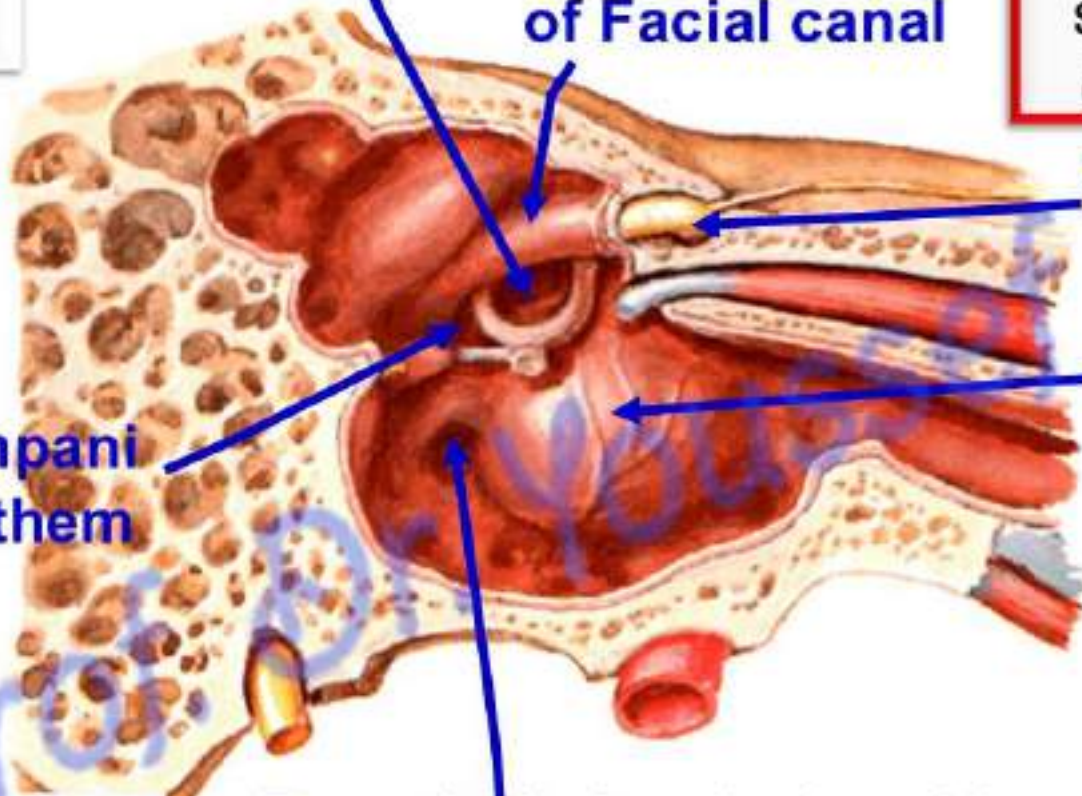
**Promontory** by the **first turn of the cochlea** of the inner ear

**Sinus tympani** between them

**Fenestra cochleae**

- **Round window** is closed by **secondary tympanic membrane**.

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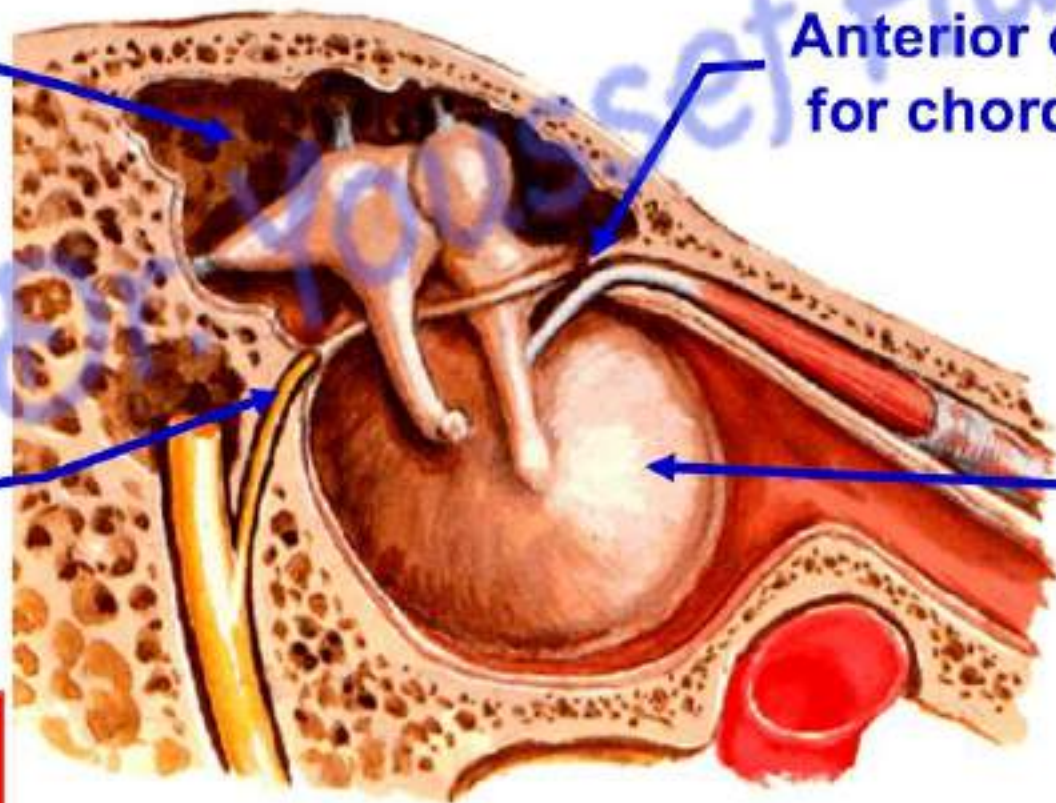


Epitympanic recess

Anterior canaliculus for chorda tympani

Posterior canaliculus for chorda tympani

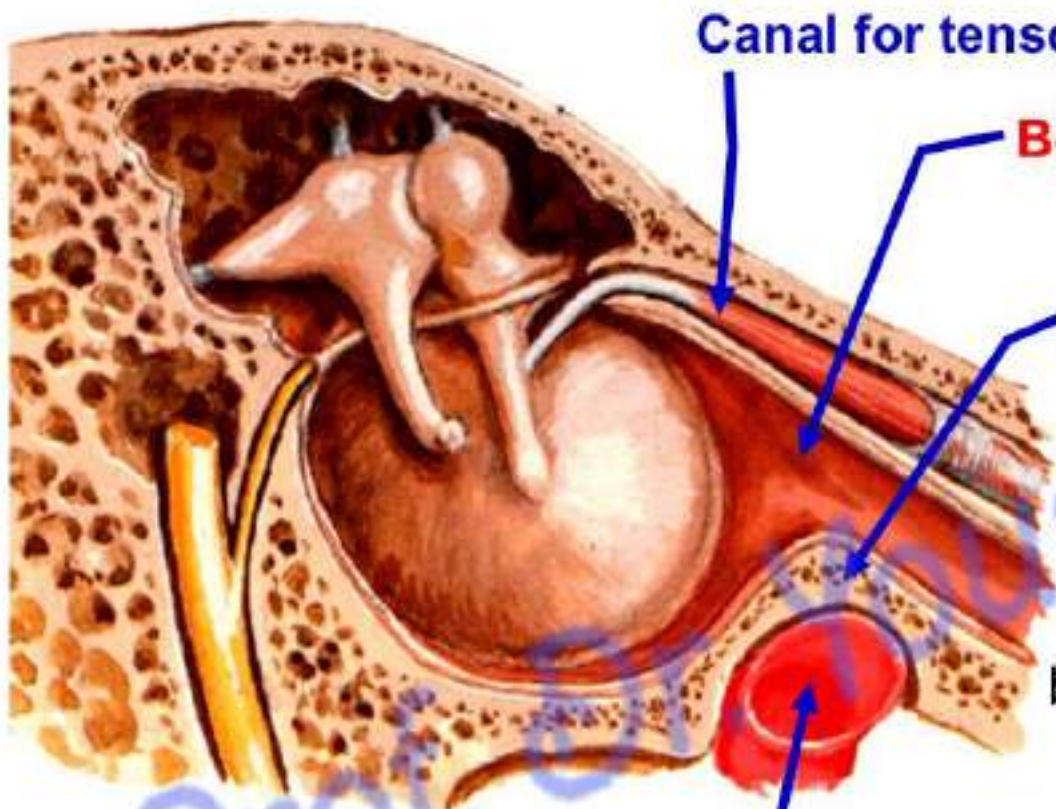
Tympanic membrane



**Lateral wall**  
separates middle ear cavity from external ear

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Canal for tensor tympani M

**Bony part of Auditory (Eustachian) tube**

Thin plate of bone which separates cavity from ICA within carotid canal.

It is pierced by:

- a) **Caroticotympanic artery** (branch of internal carotid artery).
- b) **Caroticotympanic nerve** (sympathetic plexus around internal carotid artery).

**Anterior wall (Carotid)**

**Internal carotid artery**

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**Opening to mastoid antrum**

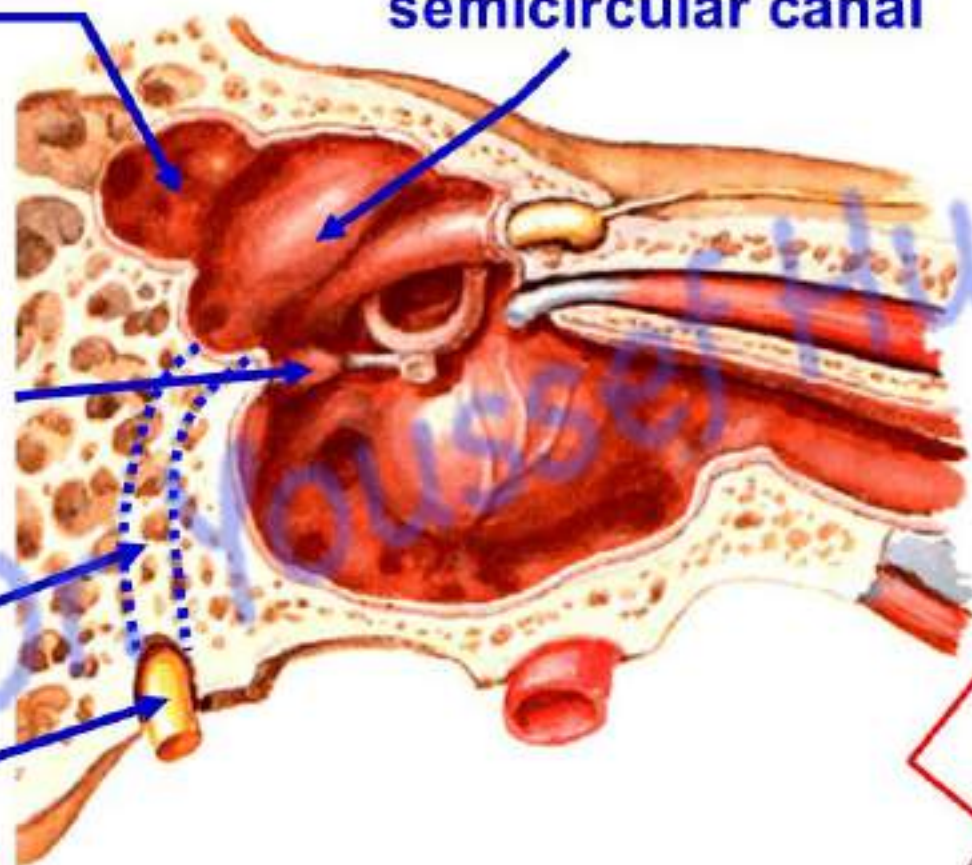
communicates with the epitympanic recess

**Pyramid containing stapedius muscle**

**Vertical part of facial canal**

**Facial nerve**

**Elevation of lateral semicircular canal**



**Posterior wall (Mastoid)**

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# Contents of Middle Ear

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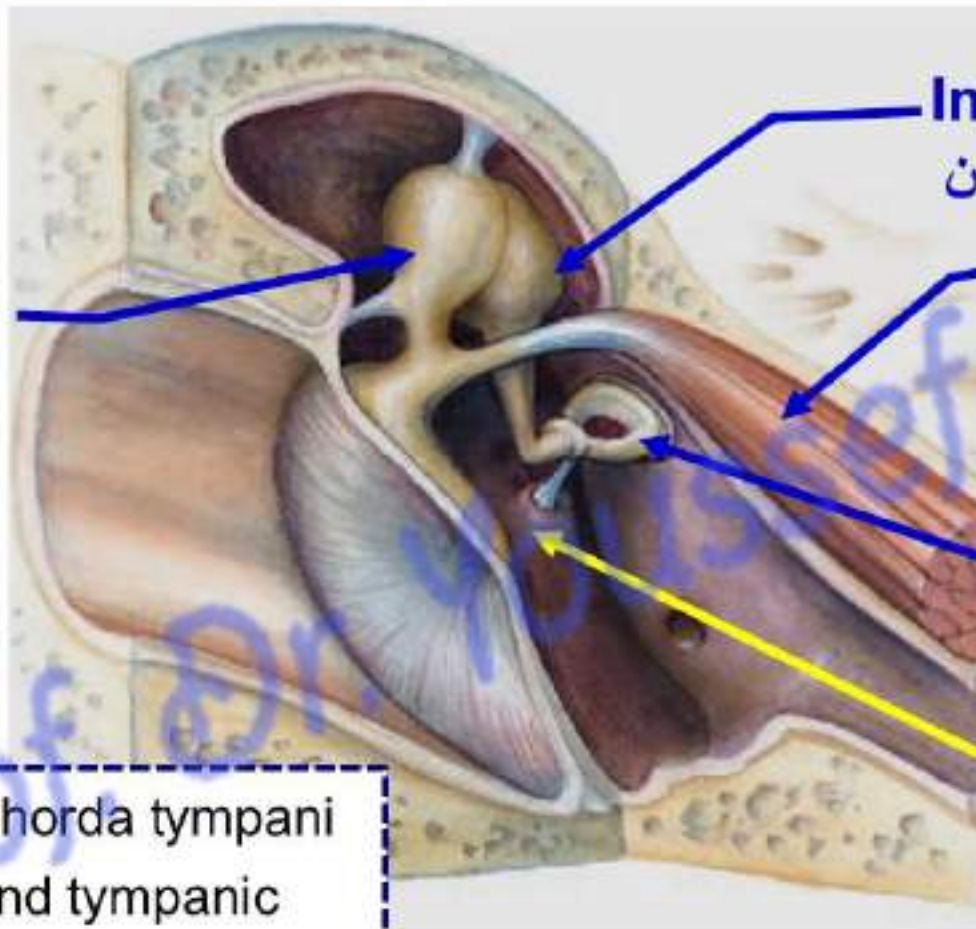
Malleus  
المطرقة

Incus  
السندان

Tensor tympani M

Stapes  
الركاب

Pyramid  
contains  
Stapedius M



- **2 nerves** : chorda tympani of facial N and tympanic plexus on the promontory
- **Air**

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• **Malleus:** المطرقة

- It is hammer-shaped. It is the largest one.
- It is formed of

**a- Head** articulates with the body of the **incus**.

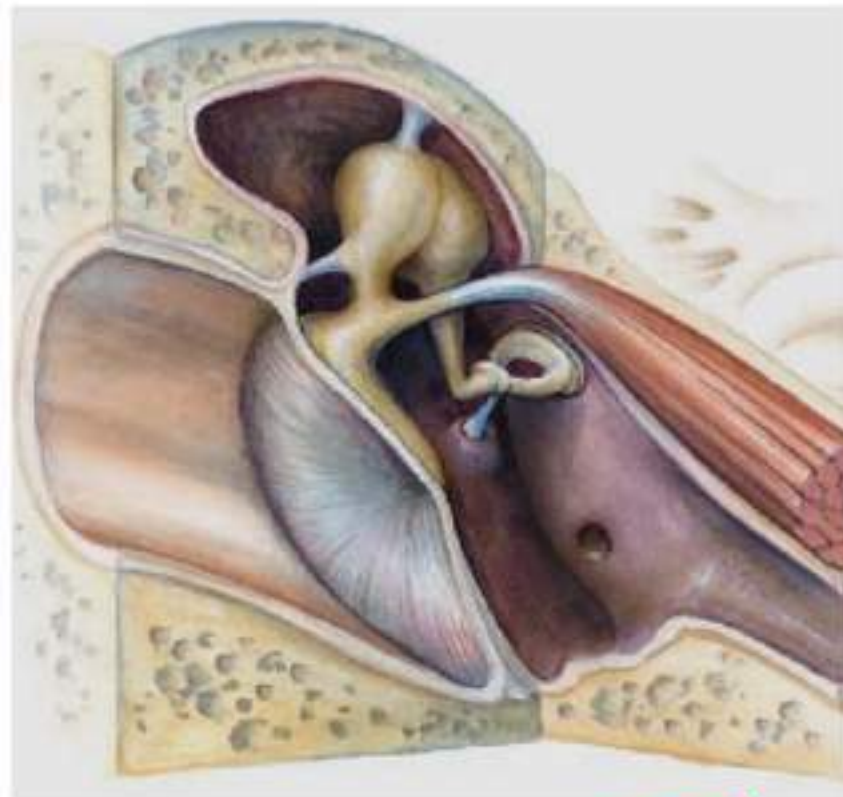
**b- Neck** is the narrow constriction just below the head.

**c- Handle** is attached to inner surface of **tympanic membrane**.

\* The handle receives the **insertion** of the **tensor tympani** muscle.

**d- Anterior process** connected to the petrotympanic fissure by a ligament.

**e- Lateral process** attached to the tympanic membrane.



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▪ **Incus: (intermediate ossicle):** السندان

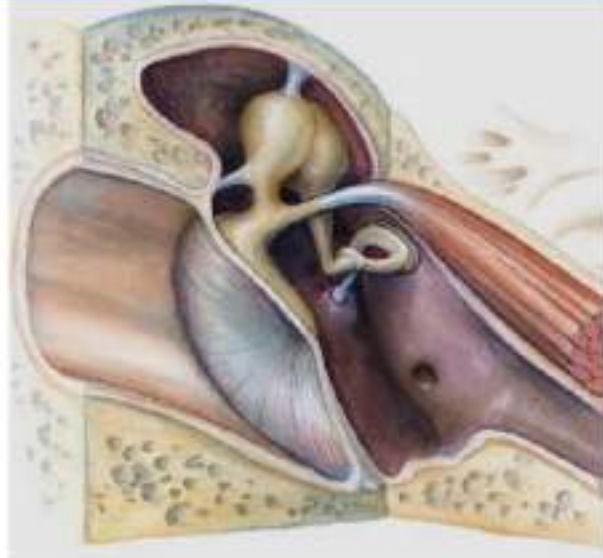
- It is anvil-like

\* It is formed of

\* **Body** articulates with the head of the malleus.

\* **Long process** articulates with the head of the stapes.

\* **Short process** conical in shape.



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• **Stapes: (the medial ossicle):** الركاب

- It is stirrup- like.

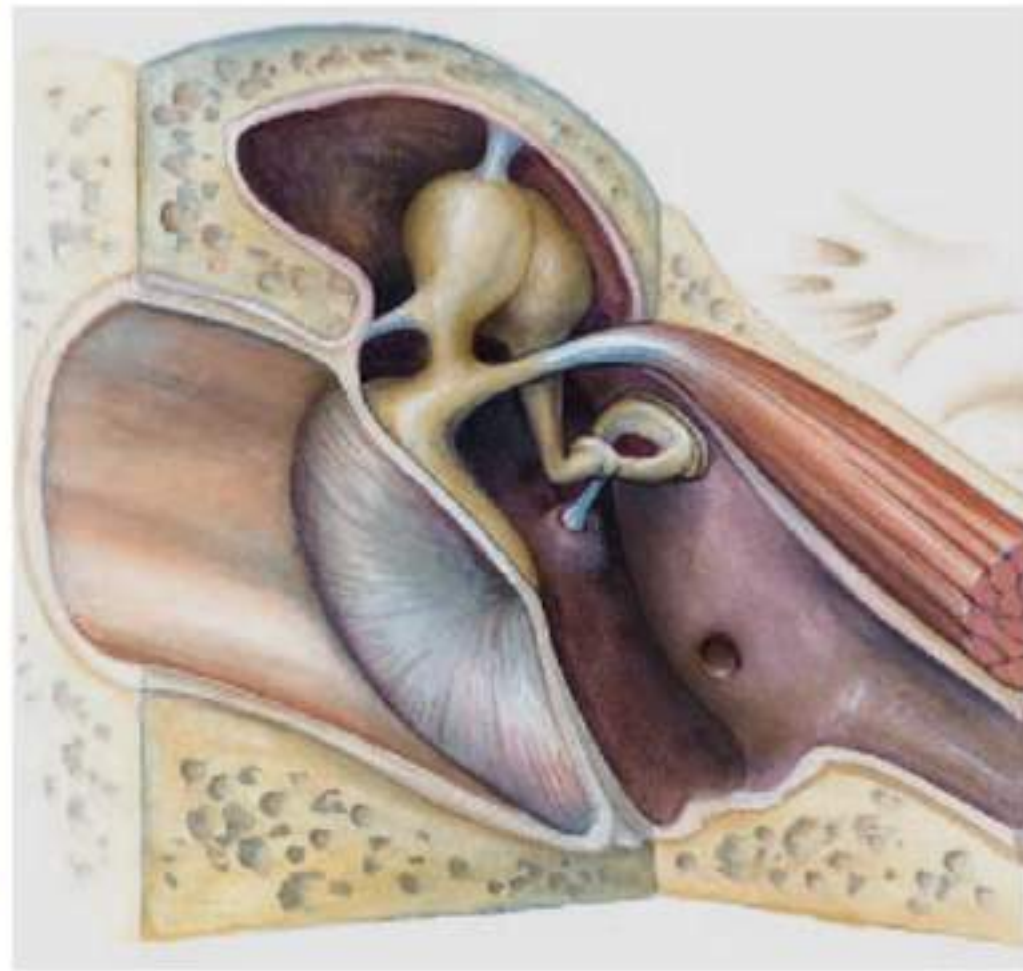
- It is formed of.

\* **Head** articulates with the long process of the incus.

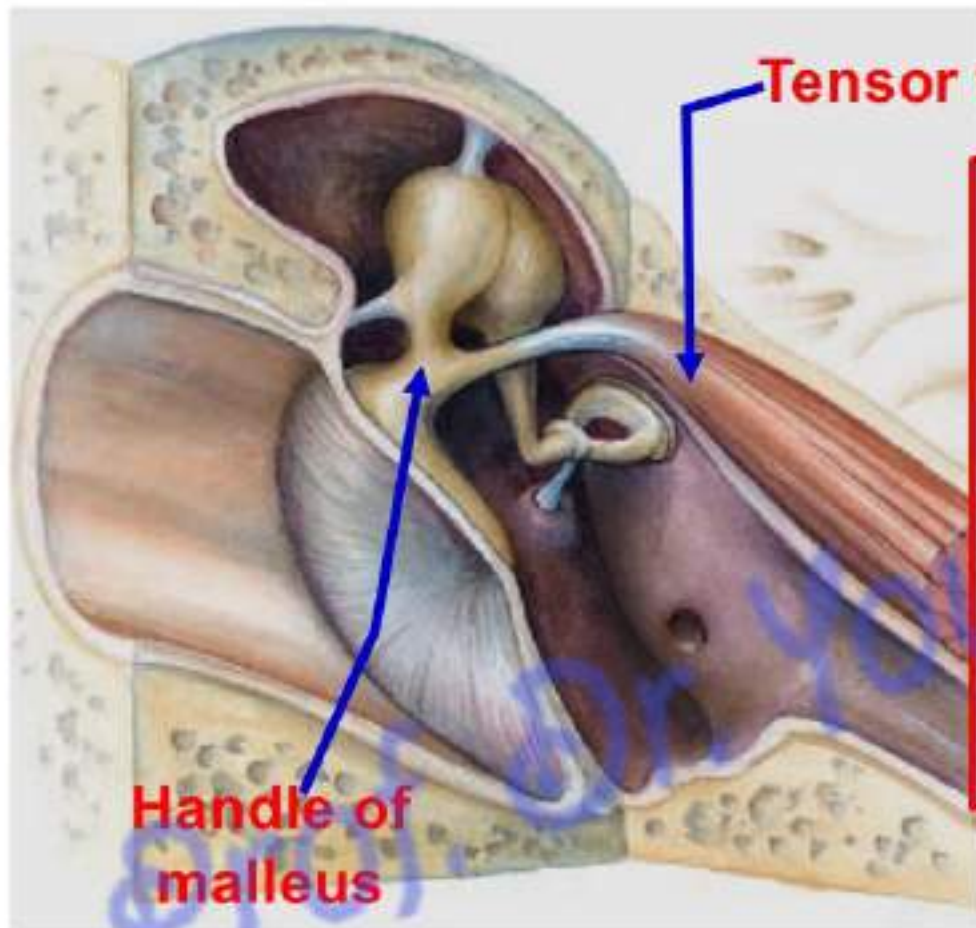
\* **Neck** is a narrow part below head, revised insertion of stapedius muscle.

\* **Two limbs (posterior and anterior)** extend from the neck to the base.

\* **Base (foot plate)** closed the **Fenestra vestibule** of the inner ear.



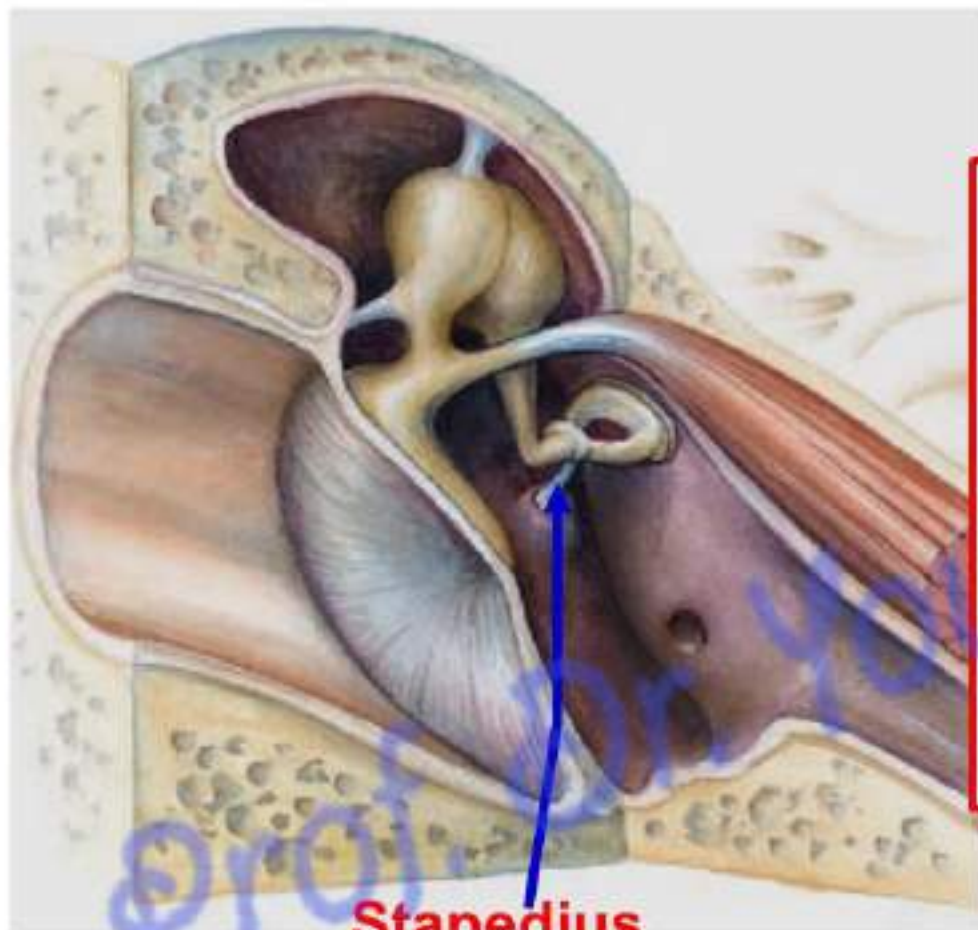
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## Tensor tympani M

- \* **Origin:** from cartilaginous part of the auditory tube.
- \* **Insertion:** into the handle of malleus.
- **Nerve supply:** nerve to the medial pterygoid muscle (from trunk of mandibular nerve)
- **Action:** pulls and tens the tympanic membrane

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**Stapedius**

- \* **Origin:** from the inner walls of the pyramid.
- \* **Insertion:** into the posterior aspect of neck of stapes.
- **Nerve supply:** branch from the facial nerve within the facial canal.
- **Action:** pulls the stapes, damping down (protective effect against high pitched sound vibration).

- **Arterial supply of the middle ear**

- 1- **Anterior tympanic artery**: from the first part of maxillary artery.
- 2- **Superior tympanic artery**: from the middle meningeal artery from the first part of maxillary artery.
- 3- **Posterior tympanic artery**, branch of the stylomastoid artery (from posterior auricular artery) ECA.
- 4- **Inferior tympanic artery**: from the ascending pharyngeal artery ECA.
- 5- **Caroticotympanic artery**: from the internal carotid artery

\* **Lymphatic drainage of the middle ear** Into the preauricular and upper deep cervical lymph nodes.

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- **Applied anatomy;**

- **Hyperacusis**, In **facial paralysis**, Sound waves are transmitted without any protective control because of paralysis of the **stapedius**.
- **Otitis media** is a condition of **middle ear infection** that may be spread from the nasopharynx through the auditory tube, causing rupture of tympanic membrane.
- **Fracture of middle cranial fossa** causes bleeding from the ear and discharge C.S.F. اليوثيوب د. يوسف حسين
- **Otosclerosis** is a condition of **abnormal bone formation** around the stapes and the oval window, limiting the movement of the stapes and thus resulting in **deafness**.
- **Auditory stimuli** are faster than visual stimuli because the sensory process for light is more neurologically complex (**NORMAL**).

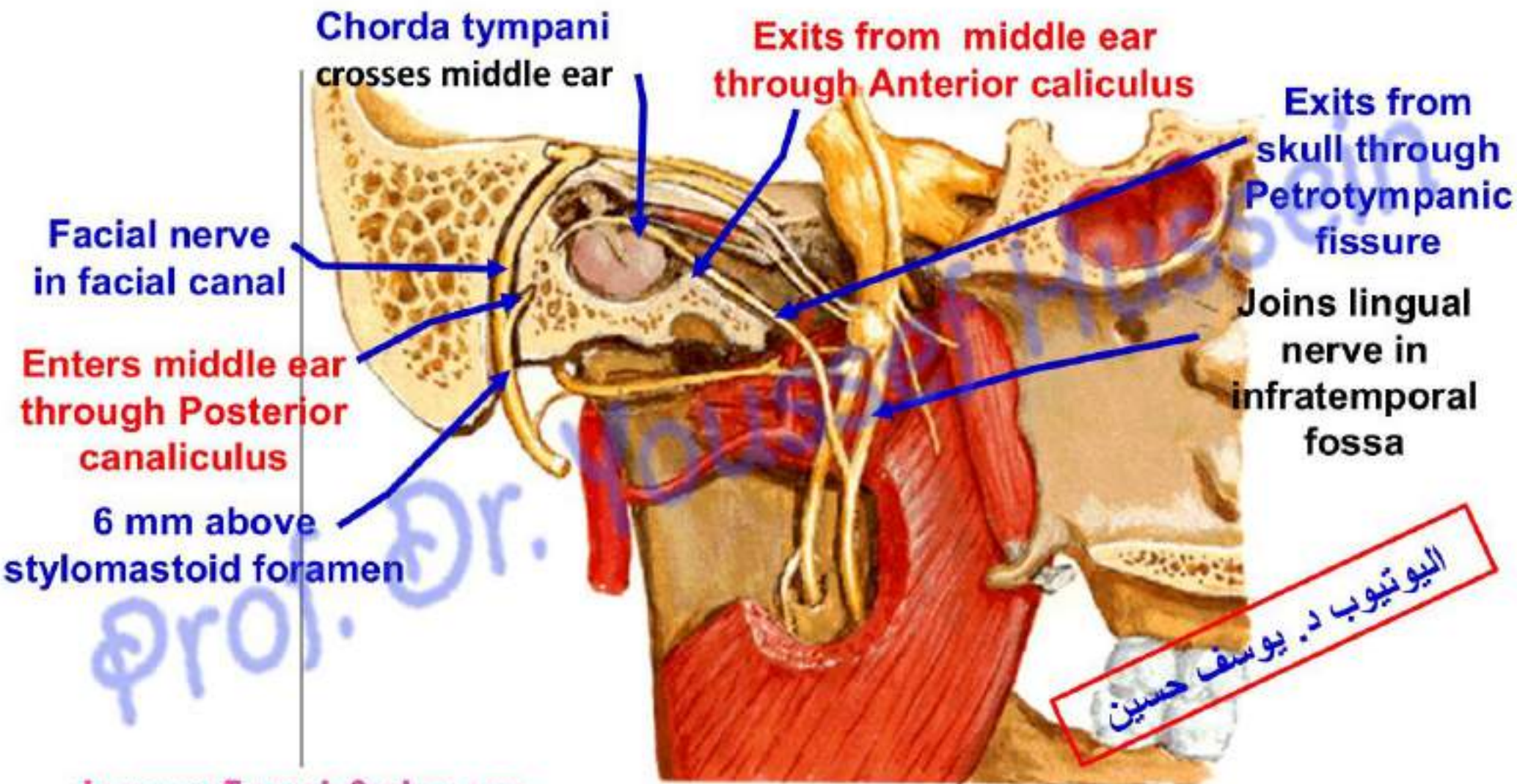
## EUSTACHEAN TUBE or Auditory tube

- It extends downward, forward and medially from the middle ear cavity to nasopharynx
- Its lateral 1/3 is bony part while the medial 2/3 is cartilaginous.
- It **equalizes pressure** of the air on both sides of the tympanic membrane.
- It forms angle 45° with the sagittal plane (Adult) while in infant, it is shorter and more horizontal, **So Otitis media** is more common in children.

### • Mastoid Antrum

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- This is an ear sinus in the petrous part of the temporal bone
- It connects with the epitympanic recess of the middle ear by the aditus.
- It acts as a buffer system of air (Releasing air into middle when pressure is too low).
- **Its Lateral wall** is formed by the **suprameatal triangle** of the temporal bone.
- **Its medial wall** related to the posterior semicircular canal.
- **Its roof** formed by the tegmen tympani which separates it from the middle cranial fossa.
- **Posteriorly**, it is related to the sigmoid sinus.



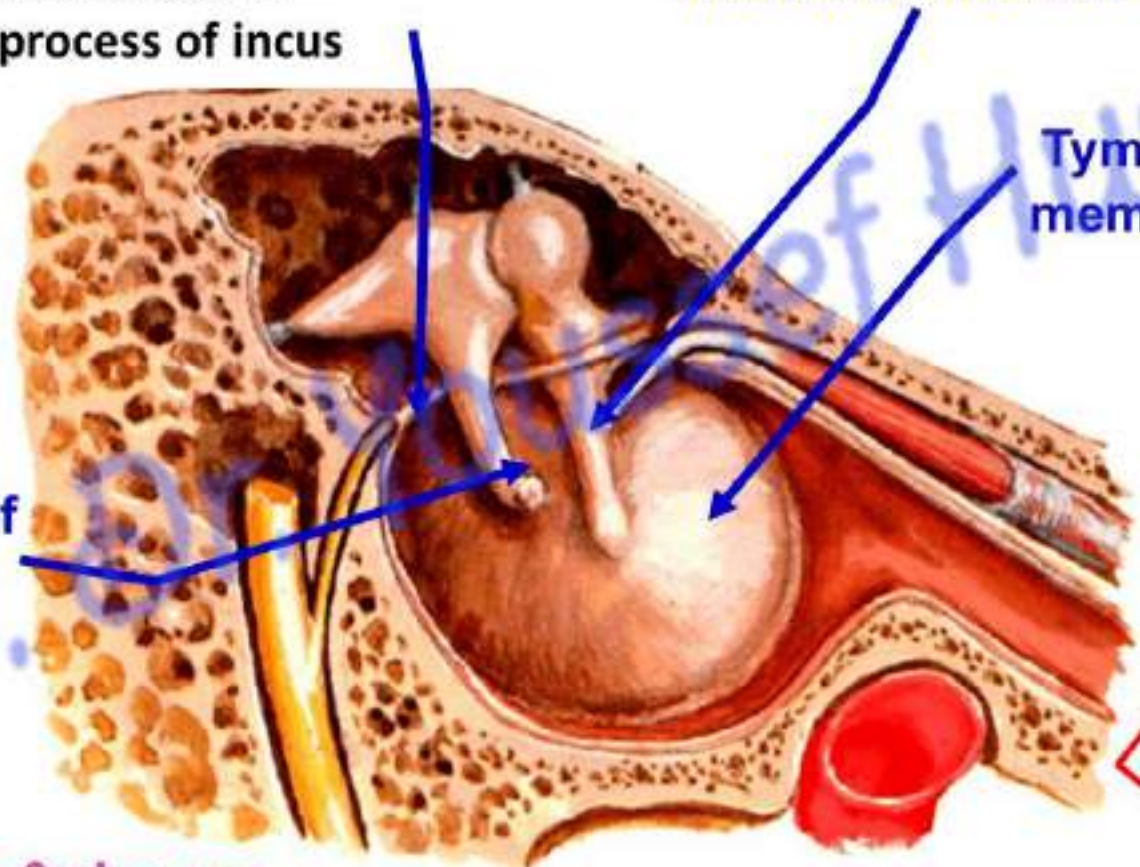
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**Chorda tympani** crosses tympanic cavity , related to tympanic membrane, between handle of malleus and long process of incus

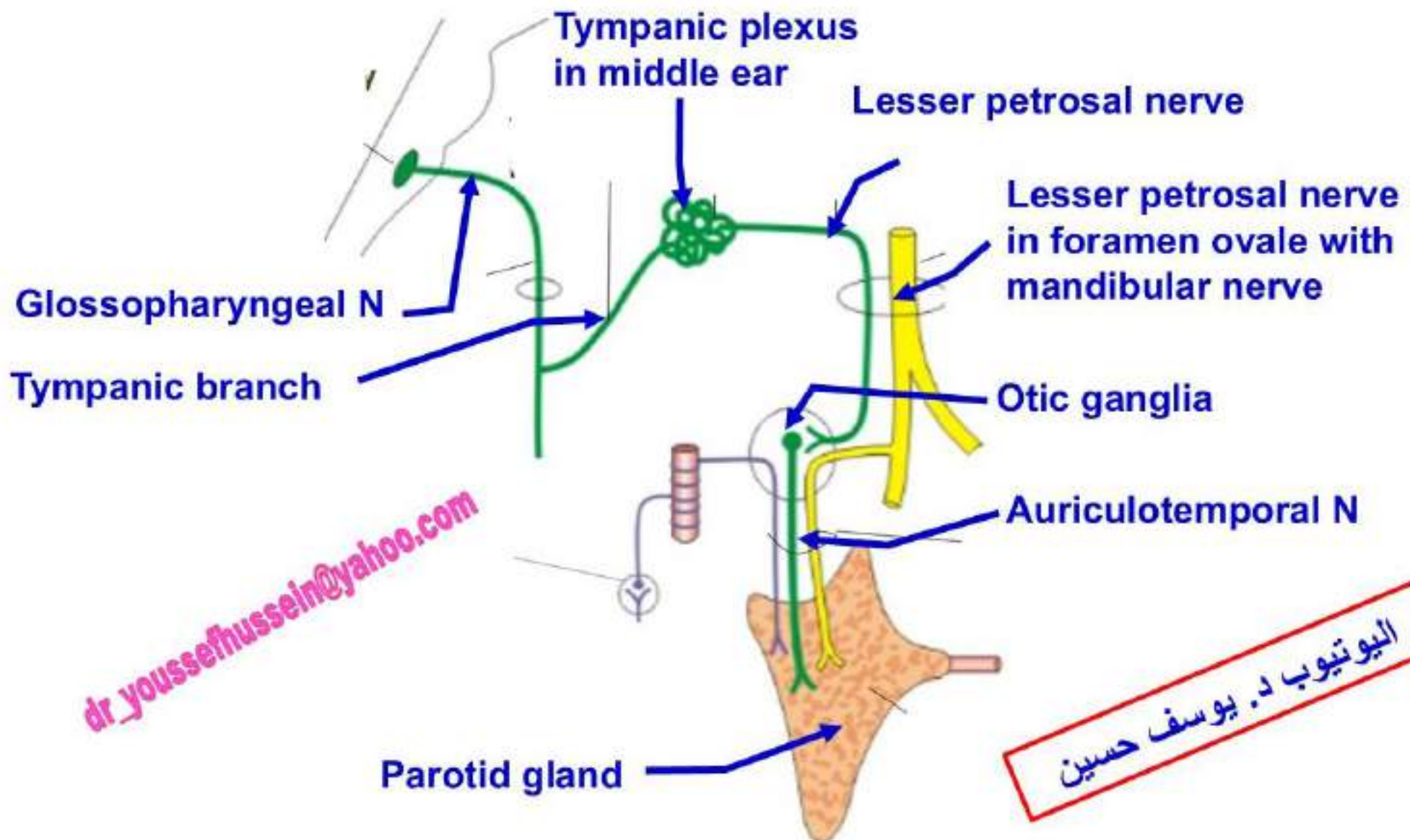
Handle of malleus

Tympanic membrane

Long process of incus



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# Inner Ear

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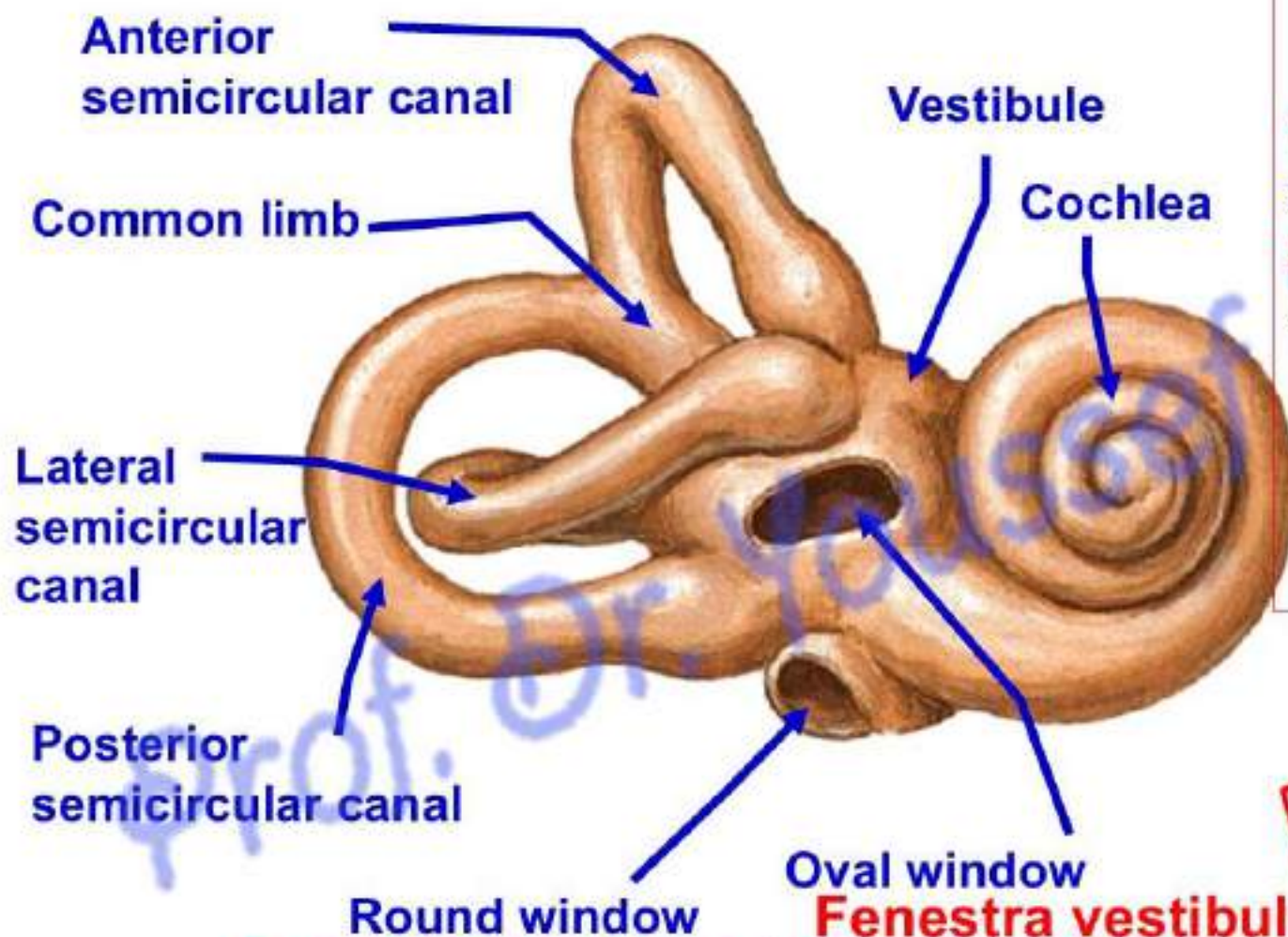
- it consists of 2 parts:
  - (1) **Bony labyrinth**: bony cavities inside the petrous part of temporal bone.
  - (2) **Membranous labyrinth**: interconnected sacs and ducts inside the bony labyrinth.

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# Bony Labyrinth

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- 3 arched Semicircular canals

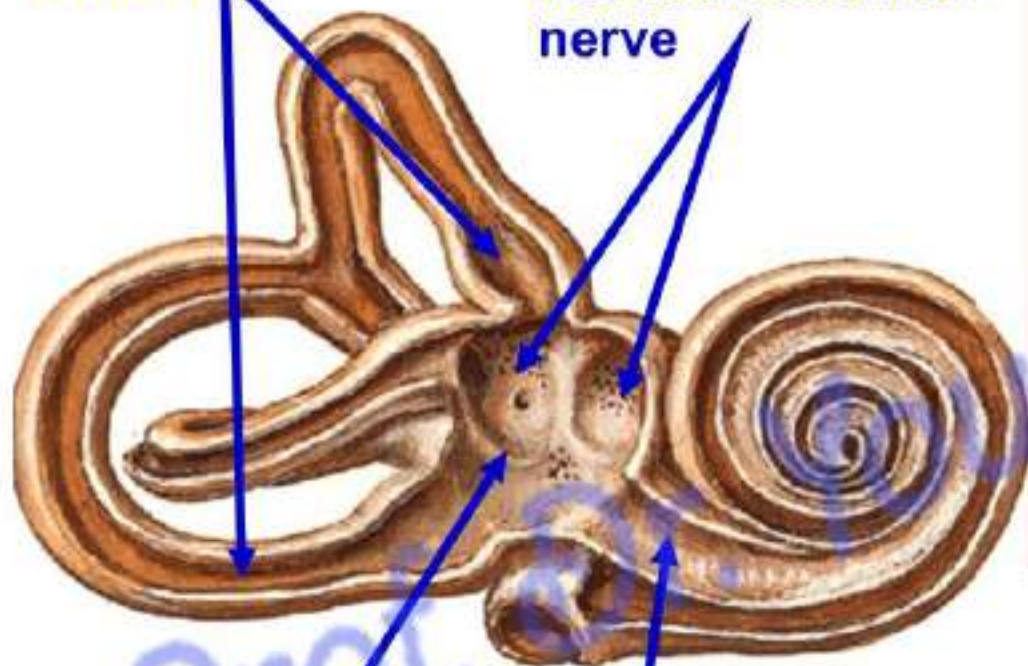
- 1) **Anterior** in vertical plane.
  - 2) **Posterior** in vertical plane.
  - 3) **Lateral** in horizontal plane.
- These 3 canals open in the posterior aspect of the **vestibule** by 5 orifices (common limb from anterior and posterior canals).

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Round window **Fenestra vestibule**  
Oval window **Fenestra cochleae** [dr\\_youssefhusseini@yahoo.com](mailto:dr_youssefhusseini@yahoo.com)

Semicircular  
canals

Perforation of  
vestibulocochlear  
nerve



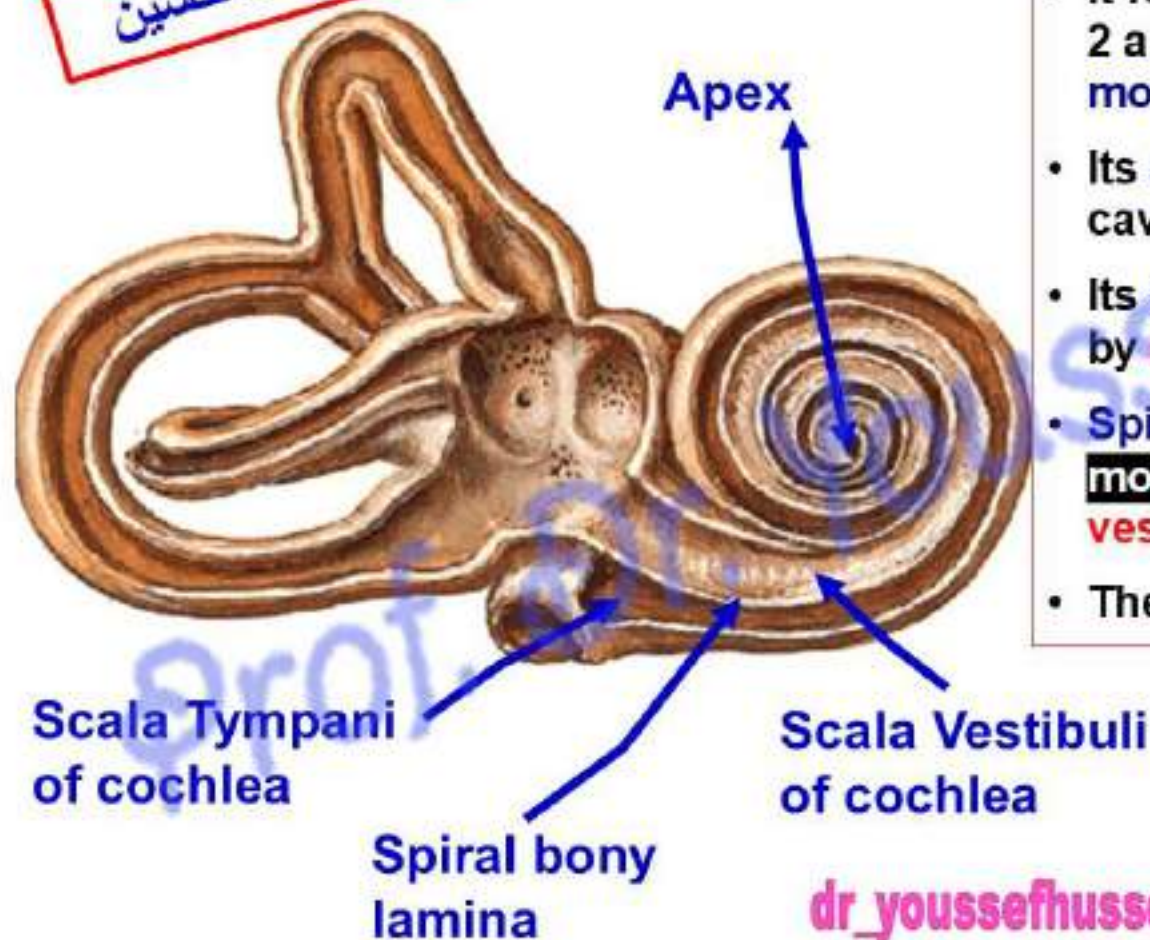
Vestibule

Scala Vestibuli of  
cochlea

- **Vestibule:** central part of bony labyrinth.
  - Its **posterior wall** receives the 5 openings of the 3 semicircular canals.
  - Its **anterior wall** shows the opening of the scala vestibuli of the cochlea.
  - Its **lateral wall** is related to the middle ear and shows **fenestra vestibuli** (oval window) which is closed by the foot of stapes.
  - Its **medial wall** forms the bottom of the internal auditory meatus and is perforated by the 8<sup>th</sup> cranial nerve.



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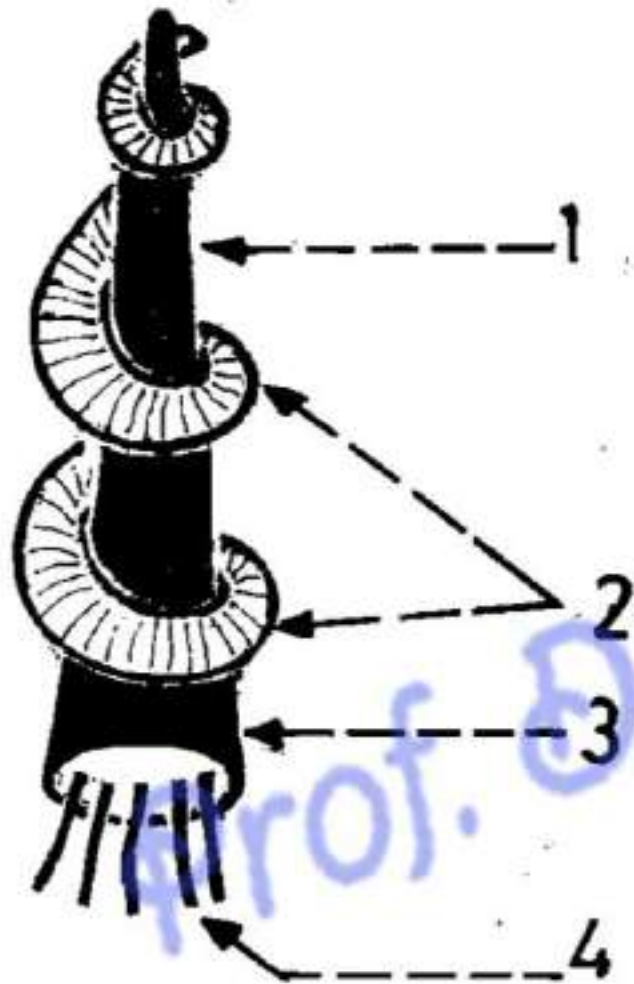


## • Cochlea القوقعة

- Anterior part of bony labyrinth
- It resembles shell of a common snail forming 2 and 1/2 turns around its axis called modiolus.
- Its apex is directed laterally towards tympanic cavity.
- Its base is directed medially and is perforated by cochlear nerve.
- Spiral bony lamina projects from the **modiolus** dividing cochlear canal into **Scala vestibuli** above and **Scala tympani** below.
- The cochlear canal lodges cochlear duct.

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## • Modiolus

- It is the central pillar العمود المركزي of the **cochlea**
- It is conical in shape and its base directed to the bottom of the internal auditory (acoustic) meatus

### 1- Modiolus

2- **Spiral bony lamina** project from modulus dividing cochlear canal into **Scala vestibuli** above and **Scala tympani** below

3- **Base of modiolus** is perforated by of cochlear nerve

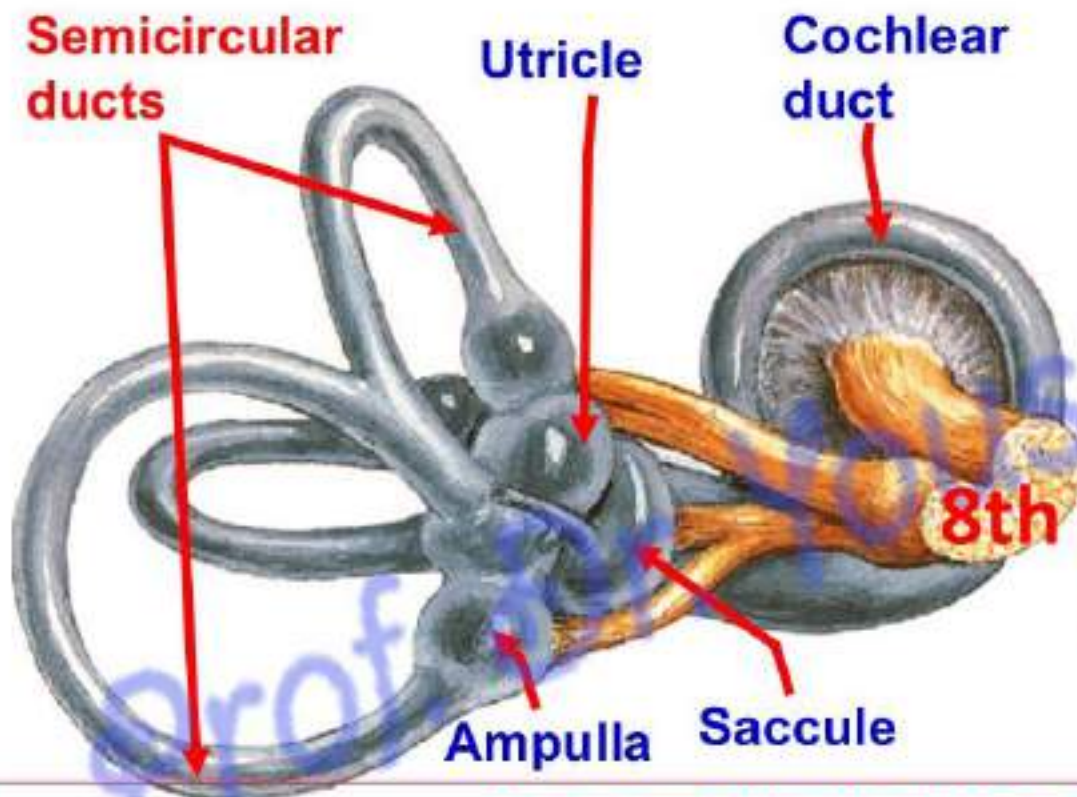
4- Cochlear nerve

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# Membranous Labyrinth

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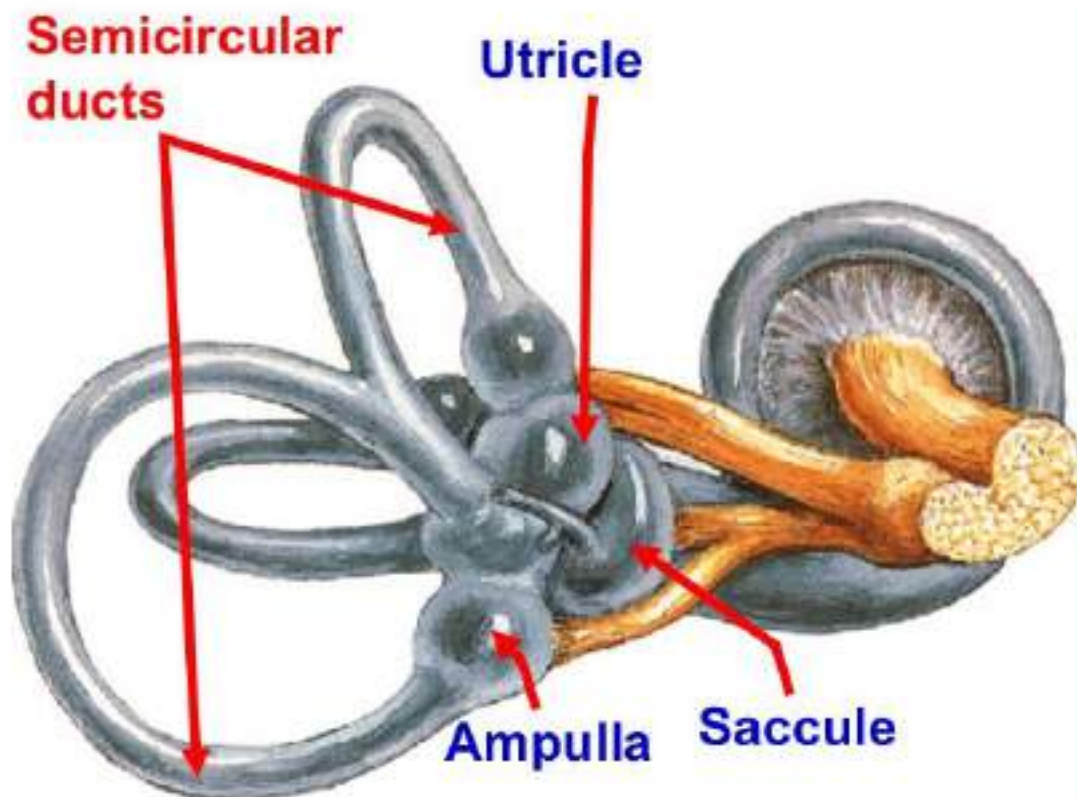


## ❖ MEMBRANOUS LABYRINTH

- \* It consists of number of membranous cavities inside the bony labyrinth.
- These cavities are filled with fluid called **endolymph**.
- They are separated from the bony labyrinth by fluid called **perilymph** that **communicate with subarachnoid space** through **aqueduct of cochlea**

## ❖ 3 semicircular ducts

- They lie within the corresponding semicircular canals.
- Each duct has a dilatation **at one of its ends** called **ampulla**
- They open in the utricle.



- **The utricle and saccule** small sacs are situated within the vestibule of the bony labyrinth and connected together
- They are filled by **endolymph** and **surrounded by perilymph** in the **vestibule**.
- **Utricle** is larger than saccule, receives 3 semicircular ducts
- **Saccule**, close to base of cochlea.
- **The utricle detects horizontal movements (e.g., driving),**
- **while the saccule detects vertical movements (e.g., elevators).**

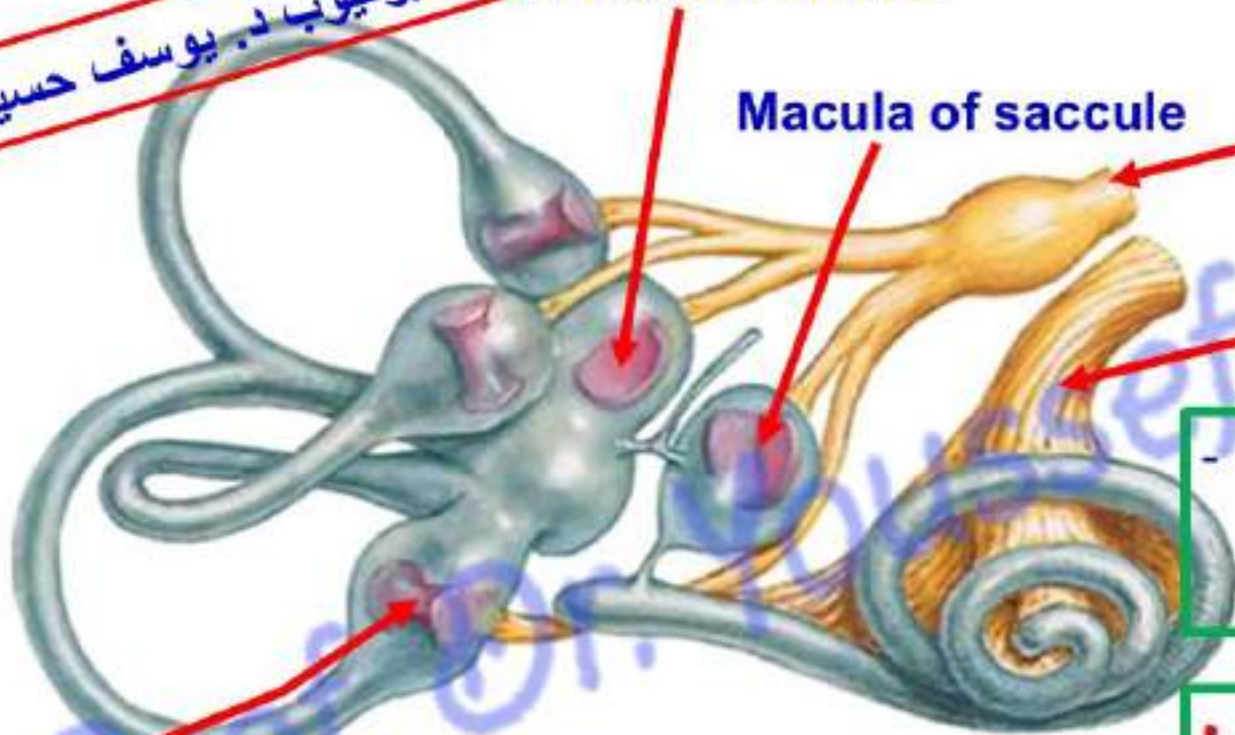
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Macula of utricle

Macula of saccule

Vestibular nerve

Cochlear nerve



- The macula and crista receive the fibres of the vestibular nerve.

**Crista:** is the sensory organ located within the ampulla of each semicircular duct, **detects angular acceleration and rotational movement.**

- **Lateral wall of the utricle** is thickened to form a **macula.**
- **Anterior wall of the saccule** is thickened to form a **macula.**

# Cochlear duct

Scala vestibuli  
containing perilymph

Vestibular membrane

Cochlear duct  
containing endolymph

Organ of Corti

Basilar membrane

Bony cochlea

Hair cells

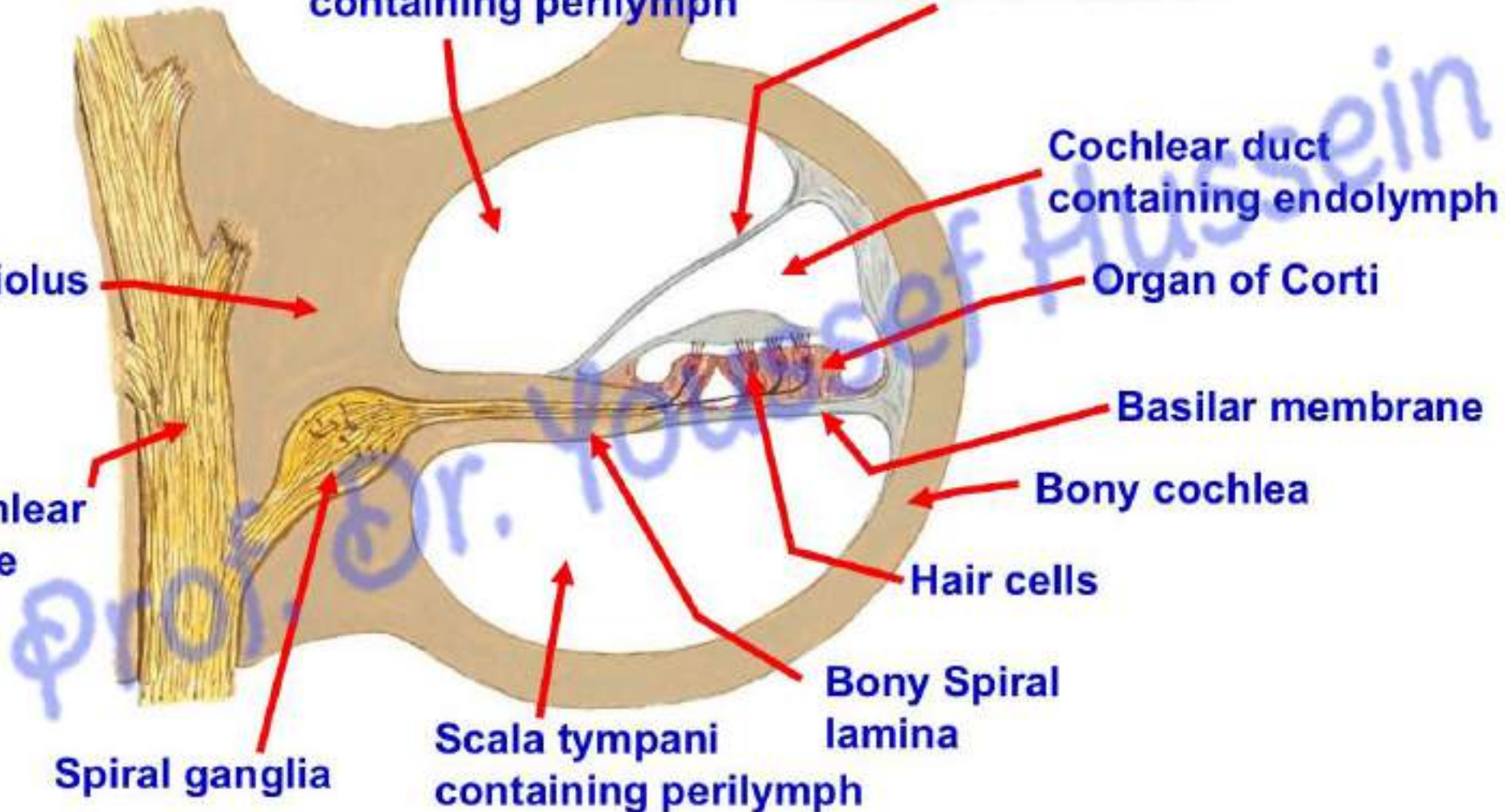
Bony spiral  
lamina

Scala tympani  
containing perilymph

Modiolus

Cochlear  
nerve

Spiral ganglia



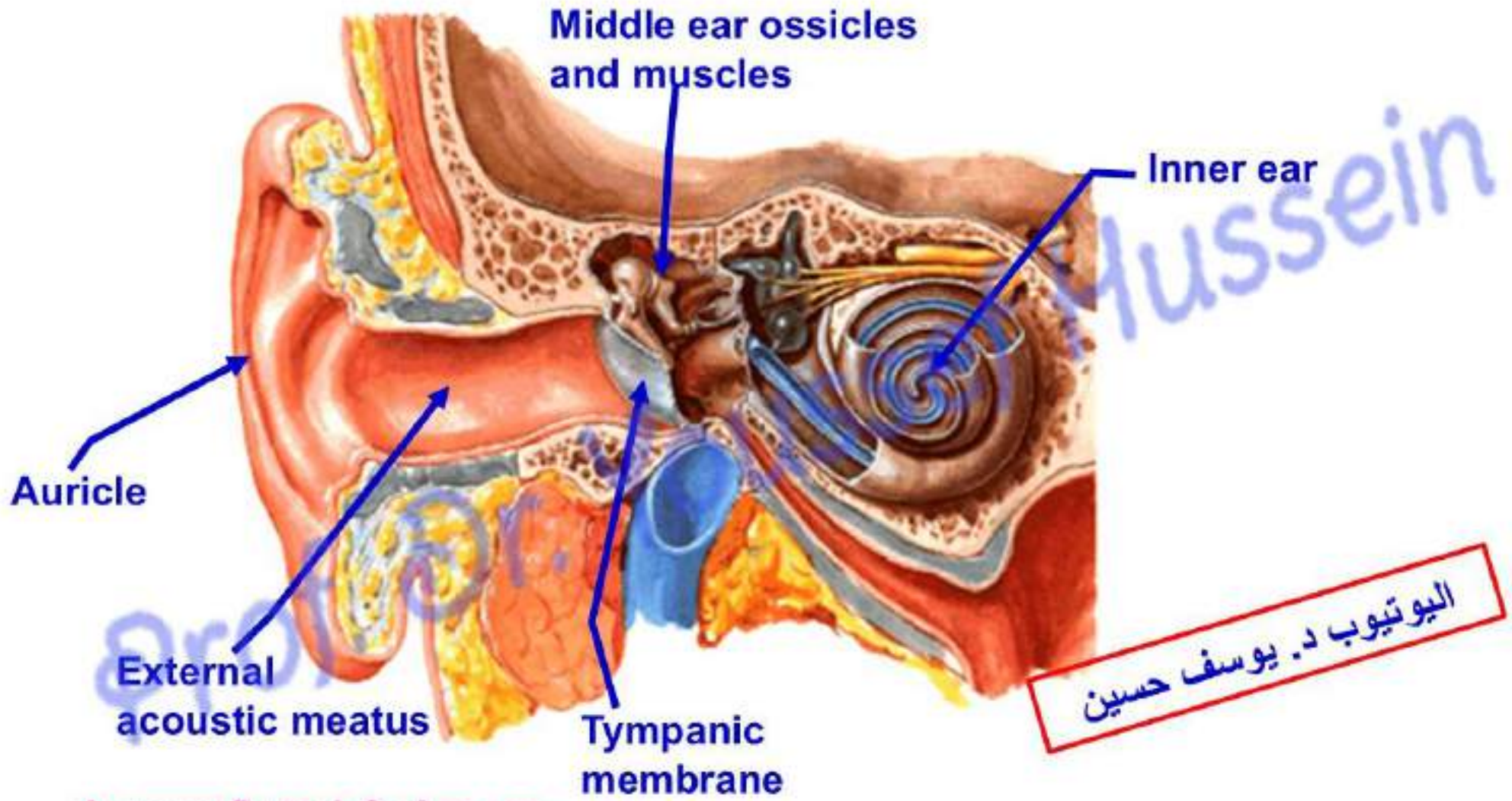
▪ **Cochlear duct** (inside the cochlear canal)

- It contains endolymph and **organ of Corti**.
- It extends between **scala vestibuli** above and **scala tympani** below.
- It is separated from the scala vestibuli (above) by the **vestibular membrane**.
- It is separated from the scala tympani (below) by the **basilar membrane**.
- **The spiral ganglion** contains bipolar neurons in the cochlea whose peripheral processes receive auditory signals from the **hair cells within the organ of Corti** on the basilar membrane. Their central processes (axons) form **cochlear nerve**

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# Auditory Pathway

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Auricle

External  
acoustic meatus

Middle ear ossicles  
and muscles

Tympanic  
membrane

Inner ear

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# Receptors

Scala vestibuli  
containing perilymph

Vestibular membrane

Organ of Corti

Hair cells

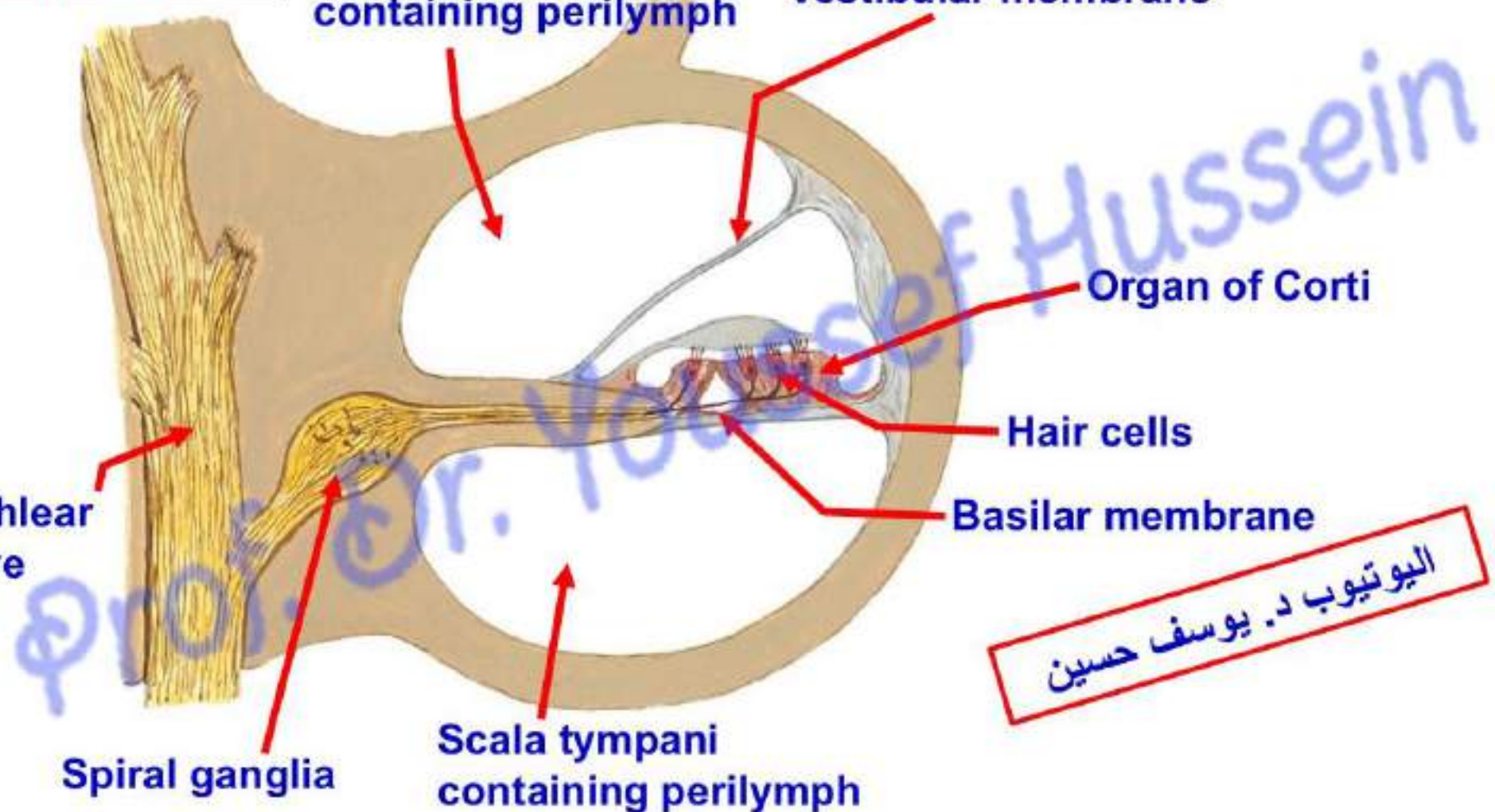
Basilar membrane

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Scala tympani  
containing perilymph

Spiral ganglia

Cochlear  
nerve



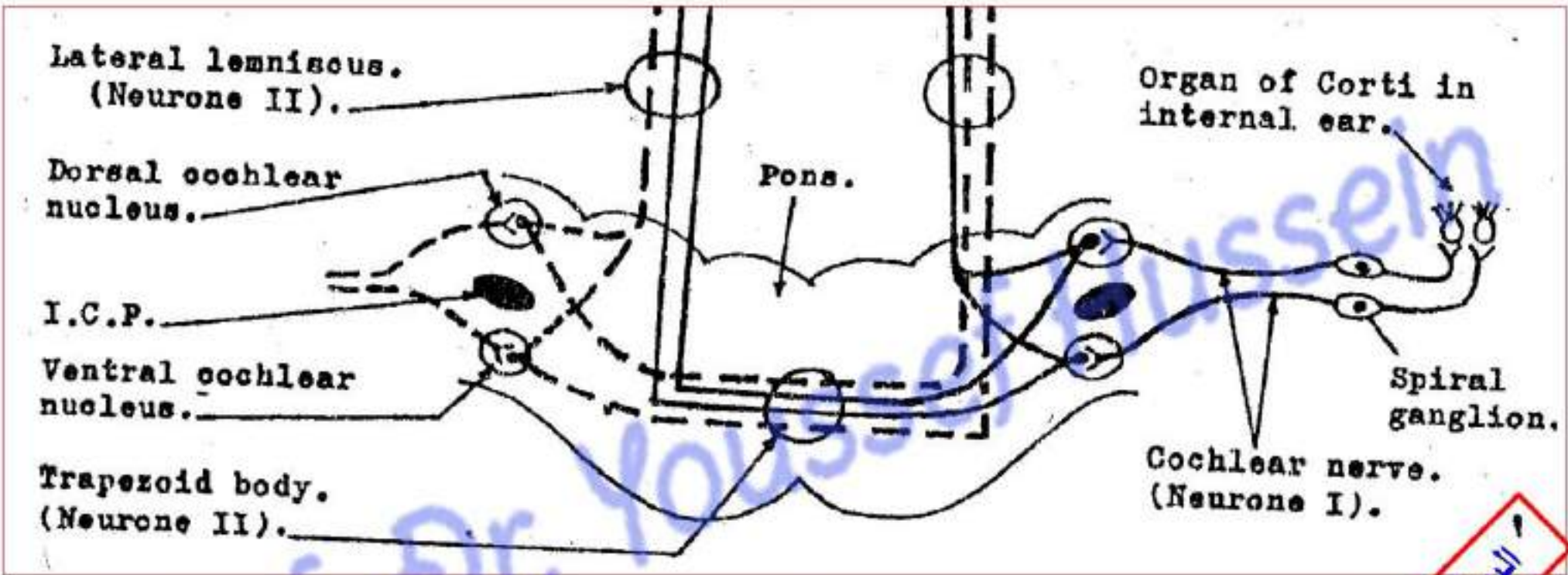
## AUDITORY (Hearing) PATHWAY

### \*\* Receptors

- Sound waves → External acoustic meatus ---- vibration of the tympanic membrane → sound waves and send vibrations to the auditory ossicles (malleus – incus and stapes) → send sound vibrations to cochlea → vibration of perilymph of scala tympani → vibration of basilar membrane → Hair cells within organ of Corti located on the basilar membrane transform the **sound vibration** into **electrical signals** to spiral ganglia (First neuron) to the **cochlear nerve** which ends in **ventral and dorsal cochlear nuclei** in pons.

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**2- Second neuron: ventral and dorsal cochlear nuclei.**

- **Most of the axons of these cells cross to the opposite side** → decussate with their fellows of the opposite side to form **trapezoid body** → ascend as a **lateral lemniscus** with **some fibres from the same side** → **medial geniculate body** of the thalamus that filters information before it reaches the cortex.

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**Auditory area**

**Auditory pathway**

**MGB**

**Inferior colliculus**

**Midbrain**

**Lateral lemniscus**

**3- Third order neuron (Medial geniculate body, MGB):**

- Their axons form **auditory radiation** passes through **sublentiform** of **internal capsule** to **auditory area** of cerebral cortex (area 41 & 42).

\* **On the midbrain** some of the fibers pass to the **inferior colliculus** (center of auditory reflex, sound localization and tonal discrimination)

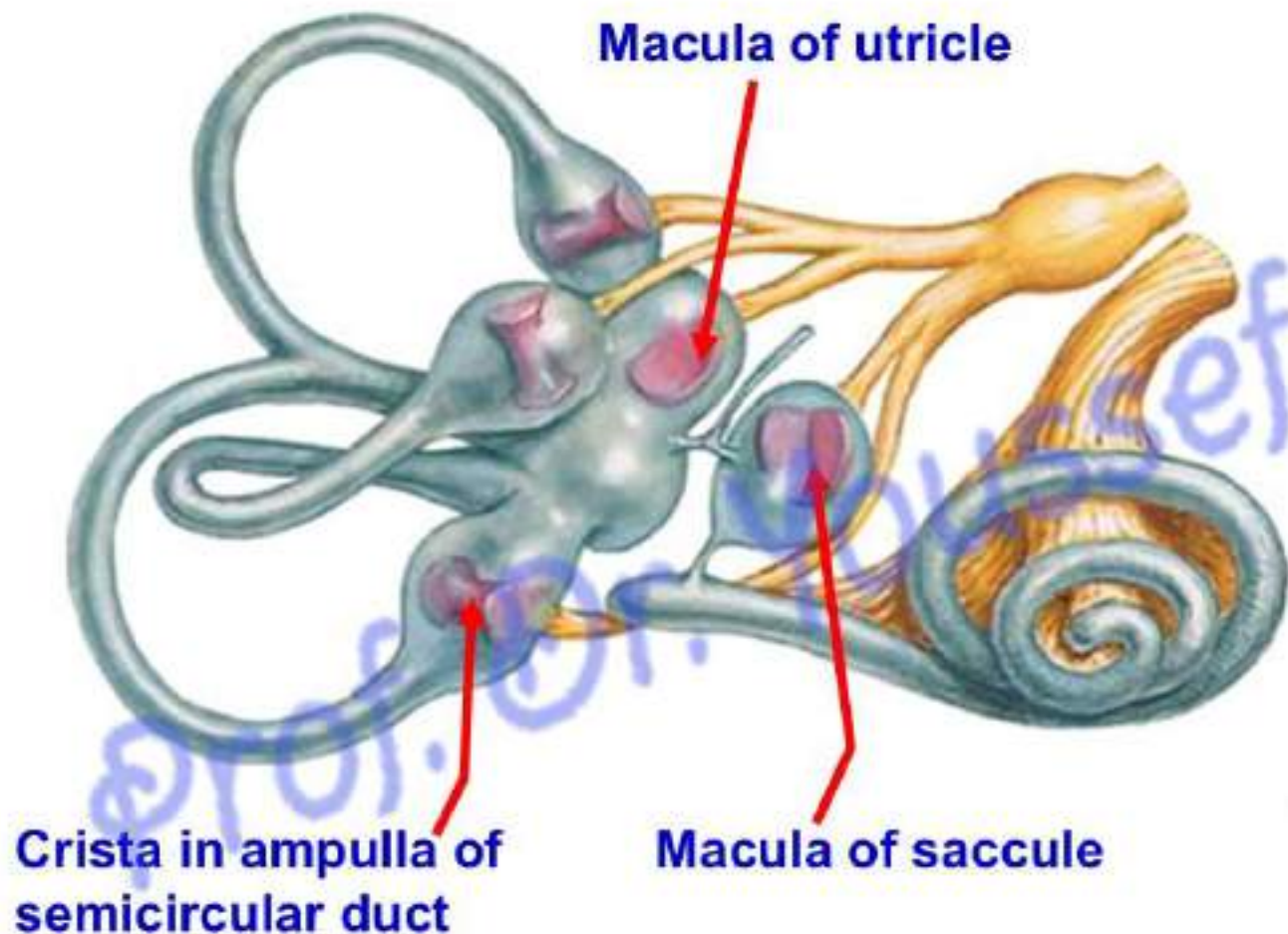
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# Vestibular Pathway

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## Vestibular receptors

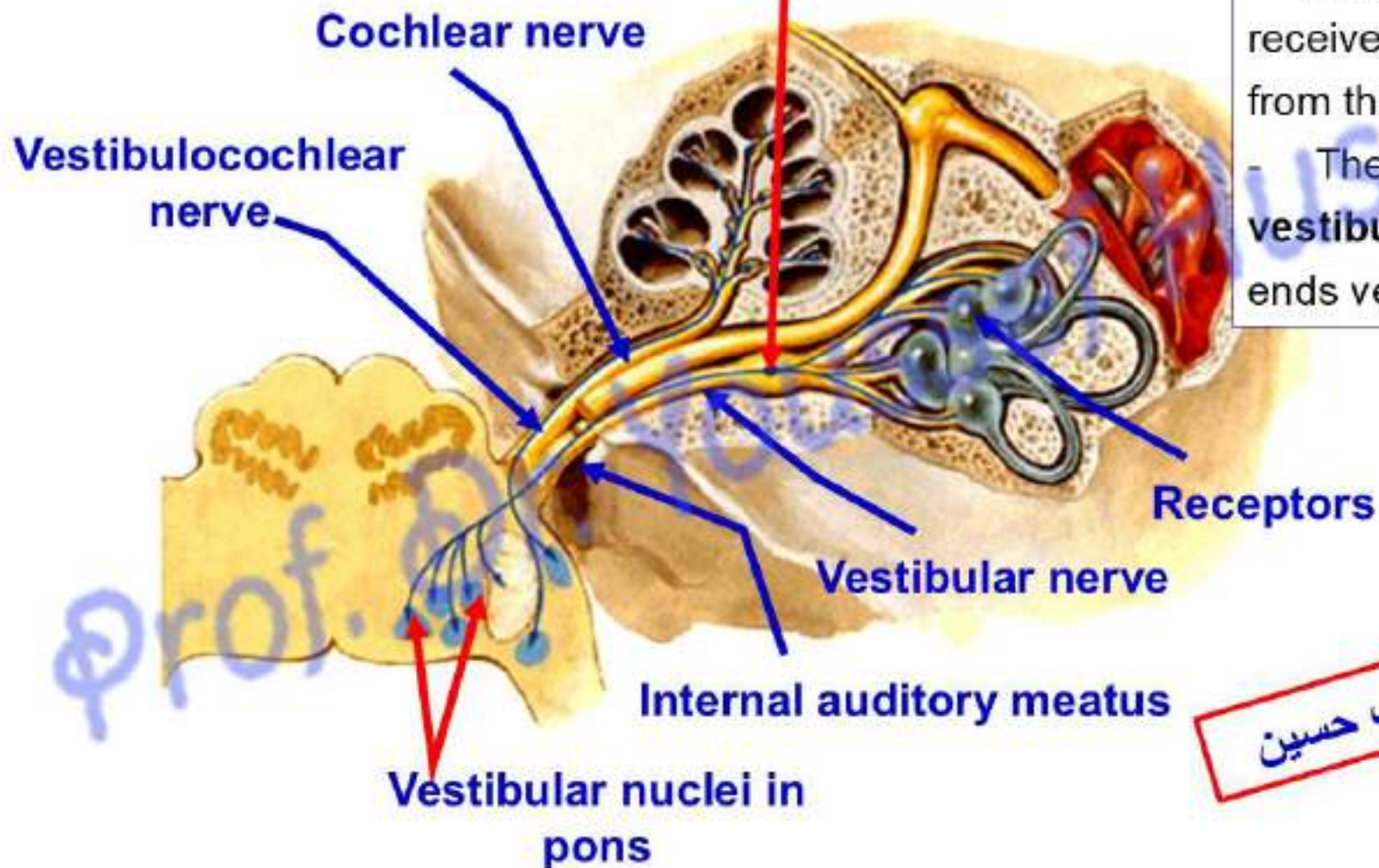


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## Vestibular nerve

## Scarpa's ganglia



## 1- Scarpa's ganglion.

- Peripheral processes receive the sensation from the receptors.
- Their axons form vestibular nerve which ends vestibular nuclei.

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## ❖ **The four vestibular nuclei.**

- These nuclei are located on the floor of the fourth ventricle, in the pons and medulla.
- **From the vestibular nuclei**, fibers travel to
  1. **Vestibulo-spinal:** Motor nuclei of anterior horn cells of spinal cord, to maintain posture and stabilize the head
  2. **Vestibulo-ocular:** Motor nuclei of the 3rd, 4th & 6th cranial nerves for gaze stability.
  3. **Vestibulo-cerebellar:** Cerebellum controls the equilibrium of the body
  4. **Vestibulo-cortical:** Thalamus and temporal lobe near auditory area **above and below lateral sulcus (Sylvian fissure) and insula** (at the bottom of the deep lateral sulcus) for conscious awareness.

[https://www.youtube.com/channel/UCVSNqbibj9UWYaJdd\\_cn0PQ](https://www.youtube.com/channel/UCVSNqbibj9UWYaJdd_cn0PQ)

يُمنع أخذ السلايدات بدون  
إذن المحرر واي اجراء  
يخالف ذلك يقع تحت  
طائلة المسؤولية القانونية

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Questions

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