ENT

1 ANATOMY OF EAR

Anatomy of Ear

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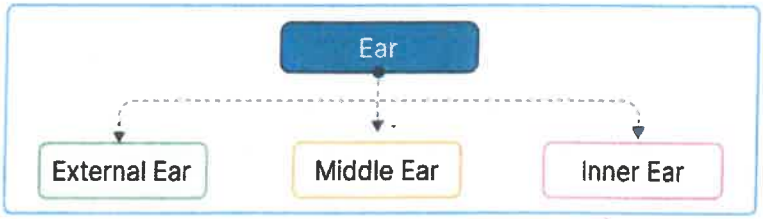
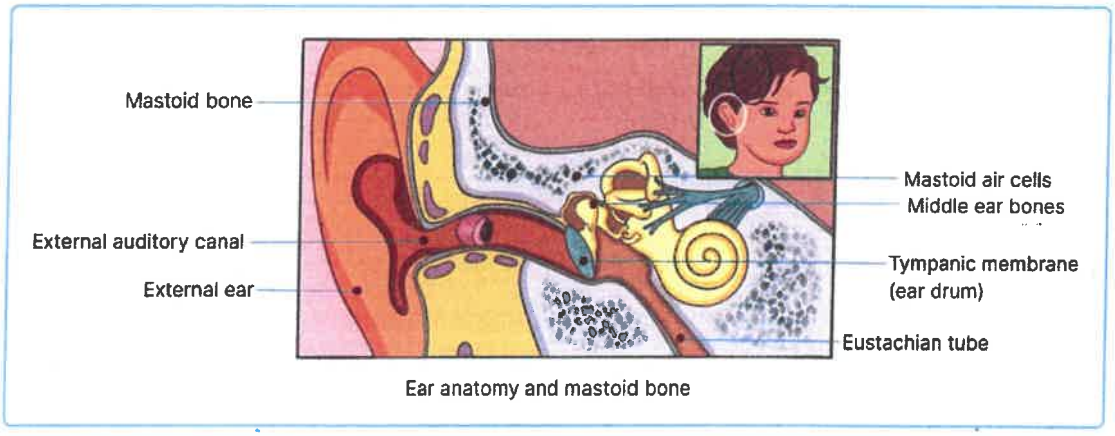


External Ear



Ear anatomy and mastoid bone

3 parts of the external ear

PYQ: NEET PG 2020

PYQ: FMGE 2021

1. Pinna
2. External auditory canal
3. Tympanic membrane

Pinna

- The pinna is made up of elastic cartilage.
- **Areas devoid of cartilage are:**
  - Incisura terminalis: The space between the tragus and the helix
  - Ear lobule

Important Information

- Incisura terminalis is the site of incision in an endaural surgery.
- This incision is known as a Lempert endaural incision.

External Auditory Canal

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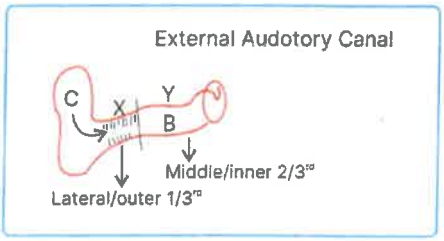
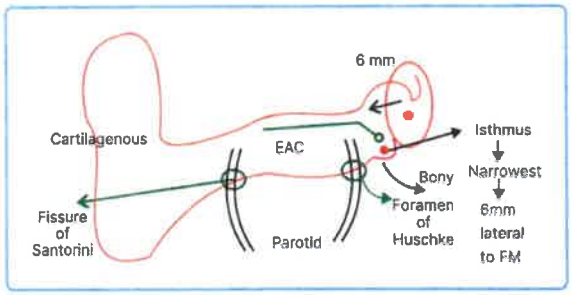
- It is the continuation of the pinna.
- The length of the external auditory canal is 24mm.
- **Two parts of EAC:**
  1. Cartilaginous part
  2. Bony part



Cartilaginous part	Bony part
It is the lateral or outer part.	It is the medial or inner part.
It accounts for 1/3rd length of EAC i.e., 8mm.	It accounts for 2/3rd length of EAC i.e., 16mm

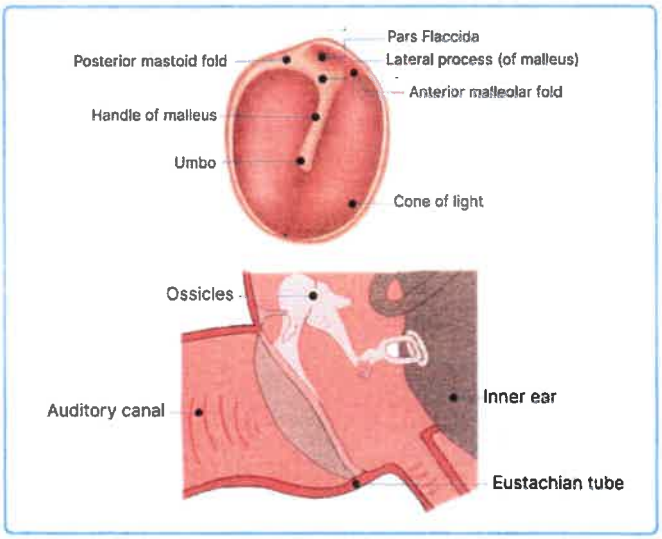
Hair follicles, sebaceous glands and ceruminous are present	Hair follicles, sebaceous glands and ceruminous are absent
Otitis externa or folliculitis (staphylococcus infection) are seen	Not seen

- **Shape**: The canal is S-shaped
- **For tympanic membrane examination**:
  - In adults, pinna is pulled upwards, backwards and outwards.
  - In children, pinna is pulled downwards and backwards. (because the bony part of EAC is not fully developed)
- The parotid gland is present below the EAC.
- **2 Communications between EAC and parotid gland are:**
  - Fissure of Santorini: It is present between the cartilaginous part of EAC and the parotid gland.
  - Foramen of Huschke: It is present between the bony part of EAC and the parotid gland.
    - → These communications are responsible for infection from the parotid gland to EAC and vice versa.
    - → These two communications usually disappear by the age of 5-7 years.



Tympanic Membrane

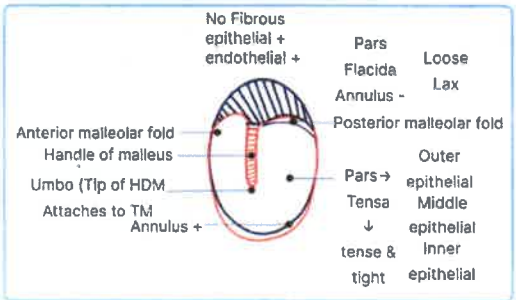
- Partition between the external ear and middle ear
- It is obliquely placed to the EAC at the angle of 45°
- Oval in shape
- 10mm tall
- 9mm wide
- TSA = 10 × 9 = 90mm²
- 0.1mm thick
- The vibrating area of TM is the peripheral portion (Because, in the center, the handle of the malleus rests on TM medially, which prevents vibrations)
- Effective vibrating area = ½ TSA
  - Effective vibrating area = ½ 90 mm² = 45mm²



Parts of Tympanic Membrane

- Two parts:
  - Pars Tensa: It is tense and tight in nature
  - Pars Flaccida

	Pars Tensa	Pars Flaccida
	It is tense and tight in nature	It is loose and lax in nature.
Annulus	Present	Absent
No. of layers	3 (outer epithelial layer, the middle fibrous layer, and the inner endothelial layer)	2 (outer epithelial layer and the inner endothelial layer)
Umbo and cone of light	Umbo in center and cone of light in anteroinferior part	

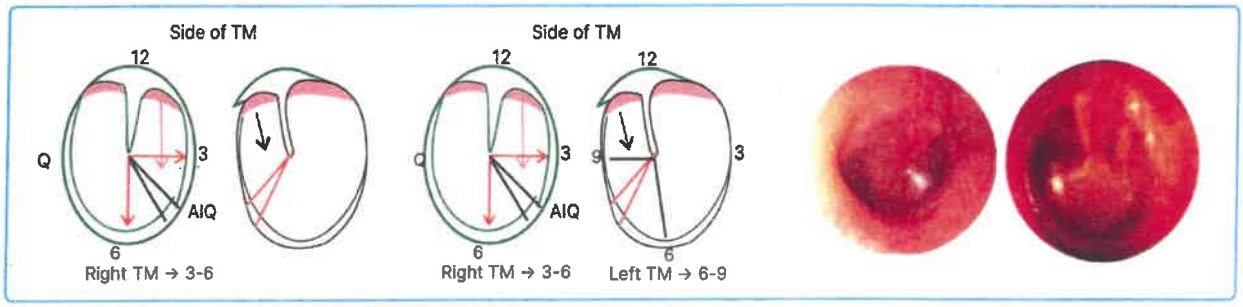


- The point at which the tip of the handle of the malleus attaches to the tympanic membrane is known as the umbo.

- 2 malleolar folds: The shorter fold is Anterior and the longer fold is posterior.
- Two imaginary lines one passes through the umbo horizontally, and the other passes through the handle of the malleus vertically.
  - Divides the pars tensa into 4 quadrants:
    - → Anterosuperior quadrant
    - → Anteroinferior quadrant
    - → Posterosuperior quadrant and
    - → Posteroinferior quadrant.
- **Cone of light**: It is present in the anteroinferior quadrant of the pars tensa.

Side of the tympanic membrane

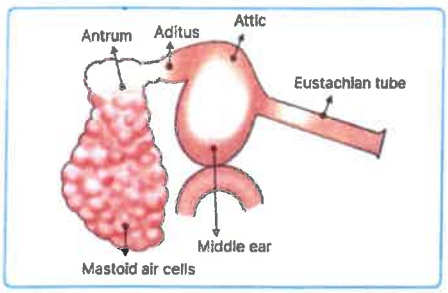
Right tympanic membrane	A cone of light is present in the 3 o'clock to 6 o'clock position
Left tympanic membrane	A cone of light is present in the 6 o'clock to 9 o'clock position



Middle Ear Cleft

PYQ: NEET PG 2022 00:17:53

- **Function:** Ventilation of the middle ear
- **Components:**
  - Eustachian tube (anterior): Connects the middle ear and the nasopharynx.
  - Middle ear proper
  - Attic
  - Aditus (communication between the attic and the Antrum)
  - Mastoid air cells (posterior)
- **Ventilatory pathway of the middle ear/ Middle ear cleft:**
  - On inhalation, the air reaches the nose → nasopharynx → eustachian tube → middle ear proper → Attic → Aditus → Antrum → Rest of the mastoid air cells.



Important Information

- The largest mastoid air cell is the antrum

Anatomy of the Middle Ear Proper

- It is hourglass in shape.
- Anteroposterior dimension of:
  - Attic: 4mm
  - Mesotympanum: 2mm
  - Hypotympanum: 6mm

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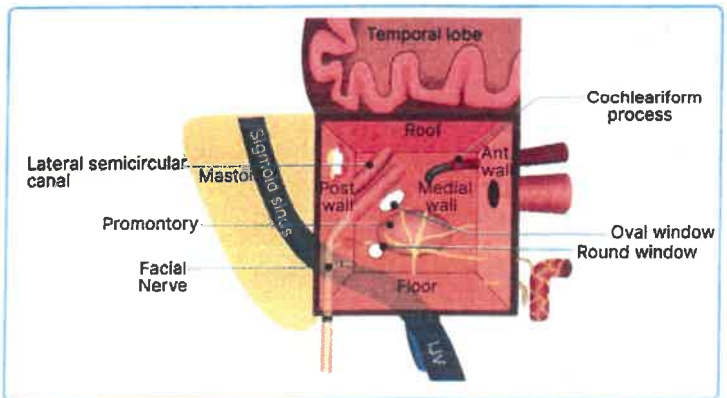


6 Walls

Roof	Tegmen tympani (separates the middle ear from the middle cranial fossa)
Floor	Internal jugular vein: thin bone separating jugular bulb
Anterior wall	1. Communicated with ET 2. Bone separating Internal carotid artery. 3. Communicates with a canal for tensor tympani
Posterior wall	Pyramid, aditus, and antrum
Lateral wall	Tympanic membrane and outer attic wall called scutum
Medial wall	1. Impression of lateral semicircular canal 2. Promontory: Impression of the basal turn of the cochlea 3. Oval window 4. Round window 5. Facial nerve passing between semicircular canal and promontory. 6. Processus cochlearformis

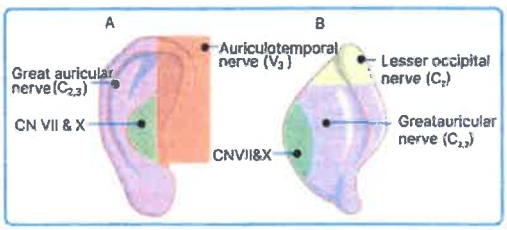
- The promontory has a tympanic plexus (made of glossopharyngeal nerve and sympathetic plexus around the carotid)

PYQ One Liners

External ear	Middle ear	Inner ear
• Cartilage-Elastic • Area devoid of cartilage: lobule and incisura terminalis • Length of ET tube: 24mm • Bony part: ⅔rd • Cartilaginous part: ⅓rd • Fissure of Santorini: Cartilaginous part • Foramen of Huschke: Bony part	• Roof: Tegmen tympani • Floor: IJV • Post: Pyramid/ Additus • Ant: ET/TT/ICA • Lateral: Tympanic Membrane • Medial: Promontory, Lateral SCC, Oval window, round window, Facial nerve, and Processus cochlearformis • CP	• Sensory neuro epithelium in the vestibule: Maculae • Sensory neuro epithelium in SCC: Cristae • Sensory neuro epithelium in Cochlea: Organ of Corti

Nerve Supply

- **Nerve supply of Pinna:**
  1. Lesser occipital nerve
  2. Auriculotemporal nerve
  3. Greater auricular nerve
  4. 7th and 10th cranial nerves (Facial and vagus nerve)
- **Mnemonic**: LAG 7 & 10
- The greater surface area of the pinna is supplied by the greater auricular nerve.



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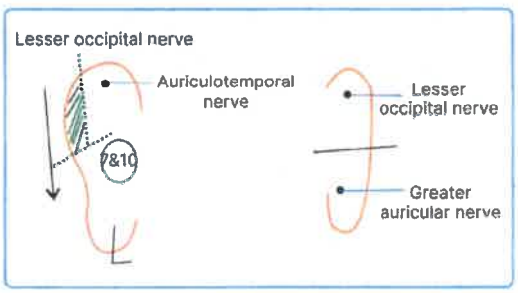


Area	Nerve supply	
Lateral surface	Lower half	Greater auricular nerve
	Upper half anterior 2/3rd	Auriculotemporal nerve
	Upper half posterior 1/3rd	Lesser occipital nerve
	Concha	7th and 10th nerve

Nerve supply of EAC

- Nerve supply of ME: Glossopharyngeal nerve
- Nerve supply of IE: Vestibulocochlear nerve
- Cochlea: Cochlear nerve
- Semicircular canals: Vestibular nerve

Area	Nerve supply
Anterior wall and roof	Auriculotemporal nerve
Posterior wall and floor	Arnold's nerve (Auricular branch of Vagus nerve)

Nerve Supply Summary

External ear	Middle ear	Inner ear
• L - Lesser occipital nerve • A - Auriculo temporal nerve • G - Greater auricular nerve • 7 - Sensory supply • 10 - Arnolds nerve	9th nerve	**8th nerve:** Vestibulo cochlear nerve • Cochlea: Cochlear nerve • SCC and vestibule - Vestibular nerve

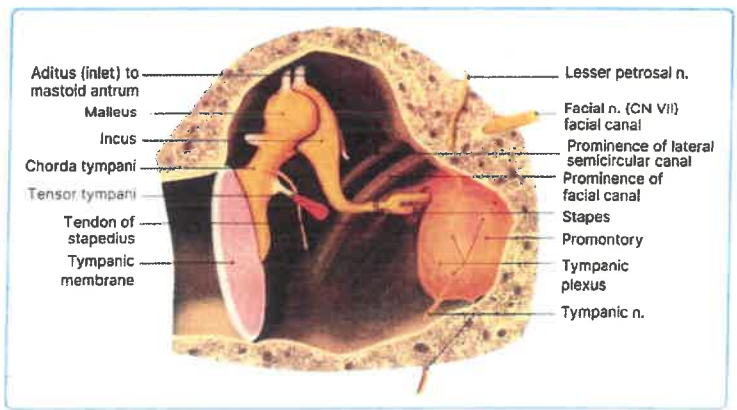
Perforated tympanic membrane

Point to know

- Subtotal perforation: Perforation including all quadrants except annulus.
- Structures visible:
  - Handle of malleus
  - The long process of the incus
  - Head of stapes
  - Stapedial crura
  - Footplate
  - Stapedius muscle
  - Promontory
  - The oval window above and the round window below (posteroinferior quadrant)
  - ET is in antero-inferior quadrant.
  - Ossicles are present in the posterior superior quadrant.

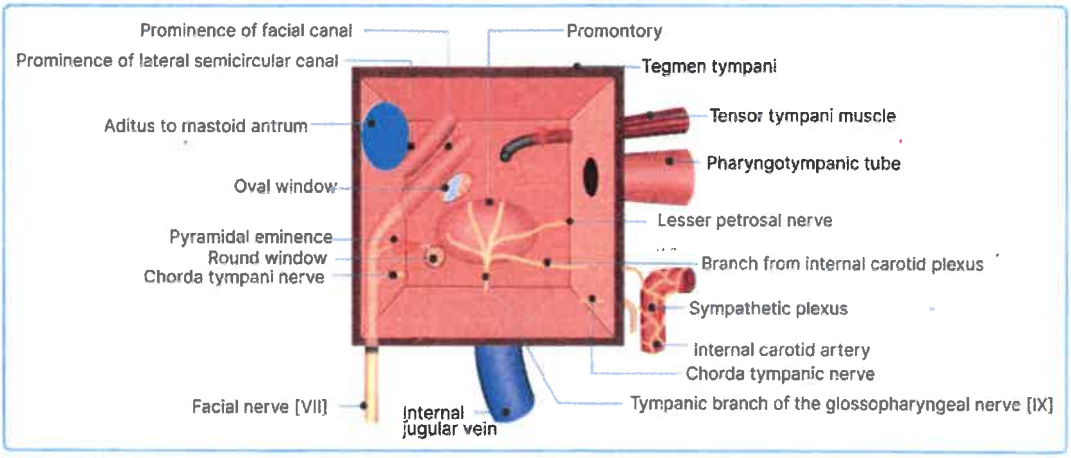
Intratympanic muscles and tympanic plexus

Intratympanic muscles



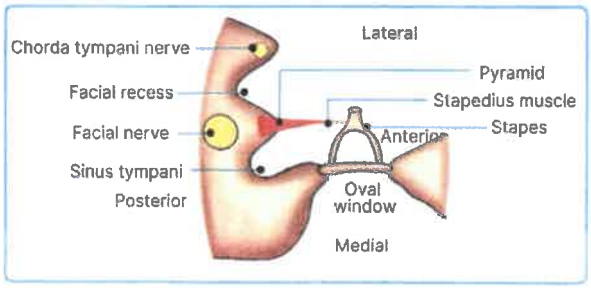
- Tensor tympani- formed from the first embryological arch and supplied by the mandibular branch of the trigeminal nerve. It is attached to the malleus neck
- Stapedius- formed from the second embryological arch and supplied by the facial nerve. It is attached to the stapes neck
- Function- dampens loud sound and protects the inner ear.

Facial Nerve Landmarks in the Middle Ear 00:44:00



	Facial nerve	Landmark
Comes from the inner ear and makes its first turn.	1st genu / geniculate ganglion	Cochleariform process
Continues horizontally in the medial wall of the middle ear and takes a vertical turn to continue in the posterior wall finally exiting through the stylomastoid foramen	2nd genu	Pyramid
In the medial wall of the middle ear	Horizontal segment	It lies above the oval window and below the lateral semicircular canal

Facial recess and sinus tympani relations with facial nerve and pyramidal eminence



Recess	Boundaries	Importance
Facial recess/ supra pyramidal recess	• Laterally- Vertical segment of the facial nerve • Medially- Chorda tympani • Superiorly- Fossa incudis (space below the incus).	• Approach to reach the middle ear through the posterior route or mastoid route in posterior tympanostomy. • Posterior tympanotomy done in cochlear implant surgery.

Sinus tympani/ infra pyramidal recess: It is a hidden space that is difficult to visualize.		• It is the most common site for residual cholesteatoma

Anatomy of Inner Ear

PYQ: NEET PG 2020, 2022

PYQ: FMGE 2023

- Also called a labyrinth.
- Made of:
  - **Bony labyrinth:** Outer covering.
  - **Membranous labyrinth:** Content within bony labyrinth.

Parts of Inner Ear

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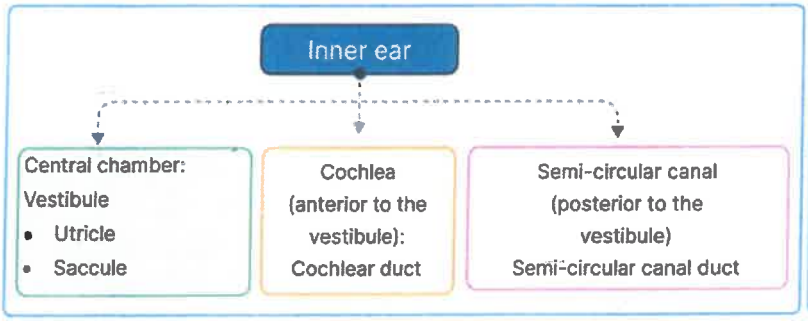
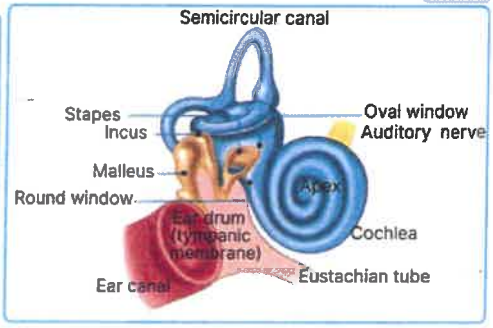
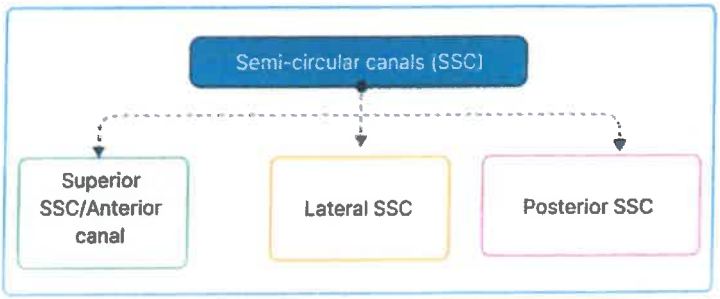


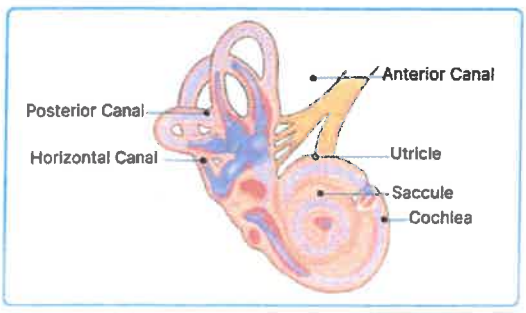


Vestibule

- The vestibule contains two recesses: Spherical and Elliptical recess.
- The Spherical recess contains the saccule.
- The Elliptical recess contains the utricle.
- The Spherical and Elliptical recess belong to the bony labyrinth.
- The utricle and saccule are part of the membranous labyrinth.
- Maculae: Neurosensory epithelium present in saccule & utricle are responsible for hearing & balance.
- Saccule is connected to cochlear ducts anteriorly.
- Utricle is connected to SCC

Semi-Circular Canals (SSC)



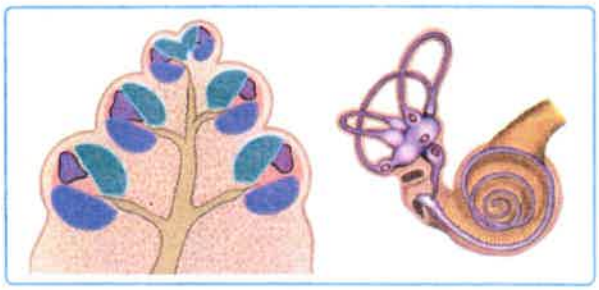


- Each of the semi-circular canals have semi-circular ducts.
- Each canal will have a dilated end & a non-dilated end.
- Each canal has 2 openings thus utricle should receive 6 openings of SSC.
- However, utricle receives only 5 openings because:
  - The non-ampulated end of the superior canal fuses with the non-ampulated end of the posterior canal and forms a common opening known as the crus commune.
  - 3 ampulated ends & 2 non-dilated ends.

- **Crista ampularis:**
  - Neurosensory epithelium in the ampullated end of SSC.
  - Function: Responsible only for angular or rotatory motion.

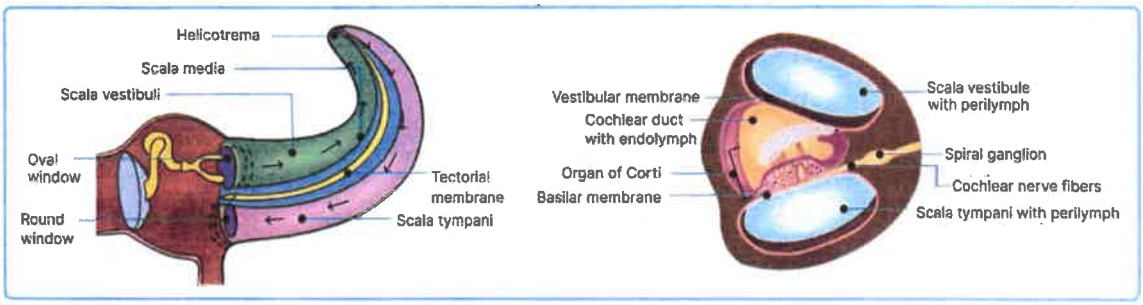
Cochlear Duct 00:53:27

A spiral-shaped structure that resembles a snail



- It rotates around the central axis known as the modiolus.
- Number of turns taken by cochlea around it is $2^{1/2}$ & $2^{1/4}$
- The cochlear chamber is cochlear duct/scala media.
- Over it is the bony covering.
- The compartment above the cochlear duct is scala vestibuli.
- The compartment below the cochlear duct is the scala tympani.

Cross-Section of Cochlea



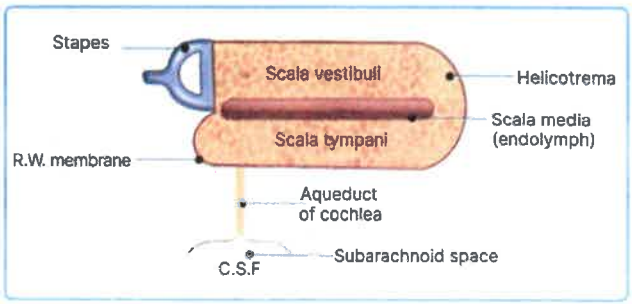
At the Basal Part	At the Apex
• Scala vestibuli on one end is covered with an oval window, which is further covered by a footplate of stapes. • Scala tympani is covered by a round window.	• Scala vestibuli is communicating with the scala tympani is known as helicotrema.

Vestibular/reissners membrane	Separates scala vestibuli & scala media
Basilar membrane	Separates scala media from scala tympani
Organ of Corti	• Neurosensory epithelium responsible for hearing • Present on the basilar membrane in scala media
Aqueduct of cochlea:	• Communication between scala tympani & subarachnoid space.

Perilymph and Endolymph

Perilymph

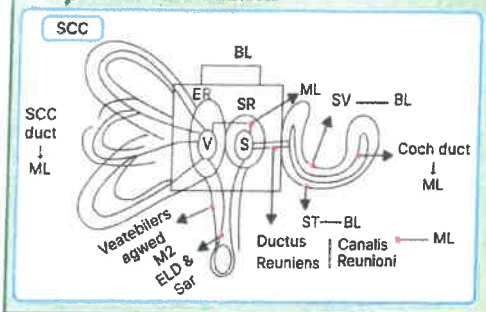
- Present in the scala vestibuli and scala tympani.
- It is the ultra filtrate of CSF.
- It communicates with CSF through the aqueduct of cochlea.
- Rich in Sodium.



Endolymph

- Present in the scala media.
- Produced and reabsorbed by the stria vascularis.
- It is rich in potassium.

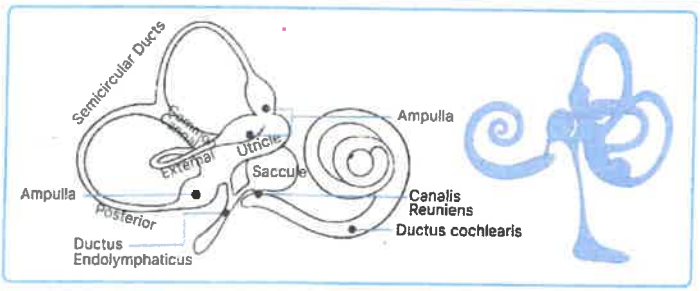
Important Information



- Parts included in the bony labyrinth:
  - SCC
  - Elliptical and spherical recess
  - Scala vestibuli and tympani.
- Cochlear duct connected to saccule via Ductus reuniens /cannalis reuniens
- Saccular and utricular ducts combine to form endolymphatic ducts leading to endolymphatic sac
- Vestibular aqueduct: Bony covering around the endolymphatic duct

Parts included in the membranous labyrinth

- Scc ducts
- Utricle and Saccule
- Ductus reuniens
- The endolymphatic duct and sac belong to the membranous labyrinth.



Landmark for endolymphatic sac

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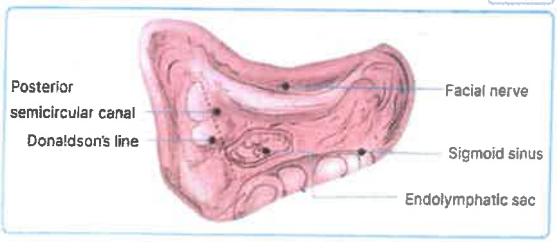
- Donaldson's line: It is an imaginary line passing from the lateral semicircular canal and bisecting the posterior semicircular canal.
- The Donaldson's line represents the endolymphatic duct.
- The endolymphatic sac is present inferiorly to the Donaldson's line.



Embryology

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Mesoderm of 5 Arches

- 1st and 2nd arch forms 6 tubercles known as hillocks of his.
- 1st hillock gives rise to tragus.
- Other hillocks fuse together to form pinna.

Development of Middle Ear and Tympanic Membrane

- Pouch of 1st and 2nd arch fuse to form tubotympanic recess. which is responsible for the formation of the eustachian tube and middle ear.
- The tympanic membrane is formed from all three layers (ectoderm, endoderm, and mesoderm).

Ear part	Embryonic layer	Arch PYQ: FMGE 2021
Pinna	Mesoderm	1 and 2 arch
External auditory canal	Ectoderm	1st cleft
Tympanic membrane	All three layers	1st cleft and 2nd pouch along with mesoderm
Middle ear cleft	Endoderm	1st and 2nd forms tubo tympanic recess
Malleus and incus	Mesoderm	1st arch
Suprastructure of stapes	Mesoderm	2nd arch
Footplate of stapes	Mesoderm	Otic capsule
Mastoid	Mesoderm	Squamous and petrous parts of the temporal bone