MEDICAL EDUCATION RESOURCE

Ear

Introduction

The ear performs two major functions: **hearing** and **maintenance of equilibrium**. It is divided into three parts: **external ear**, **middle ear**, and **internal ear**.
The **tympanic membrane** separates the external and middle ear.

External Ear

The external ear consists of:

- **Auricle (Pinna)**
- **External Acoustic Meatus**

Auricle / Pinna

Structure

- Made of a **single crumpled elastic cartilage plate**, covered by skin on both sides.
- The **lobule** contains **no cartilage**; made of **fibrofatty tissue**.

Parts

- **Helix**, **Antihelix**, **Concha**, **Tragus**, **Scaphoid fossa**
  The **concha** leads into the external acoustic meatus.

Muscles

- Intrinsic and extrinsic muscles are **vestigial in humans**; facial nerve supplies them.

Nerve Supply

- Lateral surface upper 2/3 ? **Auriculotemporal nerve**
- Lateral surface lower 1/3 ? **Great auricular nerve**
- Medial surface upper 2/3 ? **Lesser occipital nerve**
- Medial surface lower 1/3 ? **Great auricular nerve**
- Root ? **Auricular branch of vagus nerve**

Blood Supply

- **Posterior auricular artery**
- **Superficial temporal artery**

Lymphatic Drainage

- To **preauricular** and **postauricular lymph nodes**.

External Acoustic Meatus

Features

- Conducts sound waves from **concha to tympanic membrane**.
- **S-shaped**, with three directional changes:

    - Outer: Medially, forwards, upwards
    - Middle: Medially, backwards, upwards
    - Inner: Medially, forwards, downwards
- Length: **24 mm**
    - Medial 2/3 (16 mm): **Bony**
    - Lateral 1/3 (8 mm): **Cartilaginous**
- Narrowest point = **isthmus**, 5 mm from tympanic membrane.

Lining

- Bony part: Thin skin adherent to periosteum
- Cartilaginous part: Skin with **hairs, sebaceous glands, ceruminous (wax) glands**

Blood Supply

- Outer canal ? **Superficial temporal**, **Posterior auricular arteries**
- Inner canal ? **Deep auricular branch of maxillary artery**

Lymphatics

- Drain to **preauricular**, **postauricular**, and **superficial cervical nodes**.

Nerve Supply

- Anterior half ? **Auriculotemporal nerve**

- Posterior half ? **Auricular branch of vagus nerve**

Dissection

- External meatus is exposed by cutting the **tragus**.
- Anterior walls of the **cartilaginous and bony meatus** are removed carefully to avoid injuring the tympanic membrane.

Tympanic Membrane

General Features

- Thin, **translucent partition** forming the lateral wall of middle ear.
- Size: **9 × 10 mm**, **oval**, placed obliquely at **55°**.
- Faces **downwards, forwards, laterally**.

Surfaces

- **Outer surface:** Thin skin, concave
- **Inner surface:** Attached to **handle of malleus**; convex; central point = **umbo**

Attachments

- Periphery thickened and attached to **tympanic sulcus**;
- Upper sulcus absent ? attachment at **tympanic notch**

- **Anterior and posterior malleolar folds** extend from notch to lateral process of malleus

Clinical Anatomy of External Ear & Tympanic Membrane

External Ear Findings

- **Wax accumulation** ? itching; consider fungal infection/foreign body
- **Foreign bodies** (seeds, insects): removed by **syringing**
- **Herpes zoster oticus** due to vagus–facial nerve connection
- **Perichondritis** ? infection of elastic cartilage
- **Haematoma** between cartilage & perichondrium ? **cauliflower ear** if fibrosed

Tympanic Membrane Findings

- Divided into:
    - **Pars flaccida** (upper small)
    - **Pars tensa** (larger lower)
      Disease in pars flaccida risks **chorda tympani injury**
- **Cone of light** seen in anteroinferior quadrant during otoscopy
- Structures seen through membrane: **Handle of malleus**, **long process of incus**
- **Myringotomy** (membrane incision) may be done to drain middle ear pus

Middle Ear (Tympanic Cavity)

Located within the **petrous temporal bone**, the middle ear is an **air-filled cavity** between the tympanic membrane and the internal ear.
It contains **ossicles, muscles, chorda tympani nerve, tympanic plexus**, and opens into the **auditory tube**.

(Details in the text begin from page 314 onward.)

Dissection of Middle Ear

According to the document:

- The tympanic membrane forms the **lateral wall**.
- After removing it, the **ossicles**—**malleus, incus, stapes**—are exposed.
- The **handle of malleus** attaches to the membrane.
- The **long process of incus** and head of stapes can be visualized when the posterior wall is cleared.

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The general steps for dissection include:

- Remove anterior wall of meatus without damaging the tympanic membrane.
- Open the epitympanic recess to expose malleus–incus joint.
- Trace the chorda tympani between malleus and incus.
- Locate the opening of the auditory tube on the anterior wall.

Functions of the Middle Ear

(Explained in sections following page 318)

1. Transmission of Sound

- Converts **air vibrations** at the tympanic membrane into **mechanical vibrations** through the ossicles.

2. Impedance Matching

- Enhances sound conduction from **air (external ear)** to **fluid (internal ear)**.
- Achieved by:
    - **Lever action** of ossicles
    - **Area difference** between tympanic membrane and stapes footplate
- Prevents sound loss.

3. Protection (Attenuation Reflex)

- **Tensor tympani** and **stapedius** contract reflexively in response to loud noise.
- Reduces transmission of excessive vibrations to the internal ear.

4. Pressure Equalization

- Through the **auditory tube**, air pressure is equalized between middle ear and nasopharynx.

5. Drainage & Ventilation

- Middle ear maintains normal aeration through the auditory tube.

Tympanic (Mastoid) Antrum

Text indicates:

- The **mastoid antrum** lies in the **petrous part** of the temporal bone, deep to the **suprameatal triangle** (15 mm in adults).
- It communicates with:
    - **Middle ear cavity (epitympanic recess)**
    - **Mastoid air cells**
- The **roof of antrum** is formed by the **tegmen tympani**.

Dissection of Mastoid Antrum

Steps derived from dissection instructions:

- The **suprameatal triangle** is used as a landmark.
- Drilling deep to this triangle leads to the **mastoid antrum**.
- The cavity is opened to expose the **aditus ad antrum** (opening into the epitympanic recess).
- Mastoid air cells are inspected and cleared.

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1. Wax, Itching & Infection

- Wax impaction causes itching; foreign bodies are common, especially seeds and insects ? removed by **syringing**.

2. Herpes Zoster Oticus

- Painful vesicles in ear due to involvement of the **geniculate ganglion** via connections between **auricular branch of vagus** and **facial nerve**.

3. Cauliflower Ear

- Haematoma between auricular cartilage & perichondrium leads to fibrosis and deformity, common in wrestlers.

4. Pars Flaccida Disease

- Infection here endangers **chorda tympani**, located just behind it.

5. Otoscopic Findings

- **Cone of light** appears in anteroinferior quadrant of tympanic membrane.
- Visible structures: handle of malleus & long process of incus.

6. Myringotomy

- Incision of tympanic membrane to drain middle ear pus (usually in posteroinferior quadrant).

7. Mastoiditis

- Infection spreads from middle ear to mastoid antrum and air cells; may require **mastoidectomy**.

8. Facial Nerve Risk

- Because the **facial canal** runs in the medial wall of the middle ear, infections or surgery can damage the facial nerve.

Internal Ear

- Lies **deep within the petrous temporal bone**.
- Converts **mechanical vibrations** (sound) and **head movements** into **nerve impulses**.
- Consists of:
    - **Bony labyrinth** (perilymph-filled)
    - **Membranous labyrinth** (endolymph-filled)

Bony Labyrinth

Parts

1. **Vestibule**
    - Central part.
    - Communicates with semicircular canals posteriorly and cochlea anteriorly.

- Contains **oval window** ? receives stapes footplate.

2. **Semicircular Canals** (3 canals)
    - **Anterior, Posterior, Lateral** semicircular canals.
    - Each has an enlargement called **ampulla**.
    - Detect **angular (rotational) acceleration**.
3. **Cochlea**
    - Coiled like a snail (2¾ turns).
    - Contains **scala vestibuli, scala tympani (both perilymph)** and **scala media (endolymph)**.
    - Spiral lamina divides cochlear canal.
    - **Organ of Corti** lies on basilar membrane ? receptor of hearing.

Fluids

- **Perilymph** ? between bony & membranous labyrinth
- **Endolymph** ? inside membranous labyrinth (K? rich)

Membranous Labyrinth

Parts

1. **Utricle & Saccule**

- Located in vestibule.
- Contain **maculae** ? detect **linear acceleration** & **gravity**.

2. **Semicircular Ducts**
   - Correspond to semicircular canals.
   - Each ampulla contains **crista ampullaris** ? detects **rotational acceleration**.
3. **Cochlear Duct**
   - Contains **Organ of Corti** with inner & outer hair cells.
   - Endolymph movement bends stereocilia ? hearing transduction.

Special Sensory Organs

- **Macula** (utricle & saccule) ? linear acceleration
- **Crista ampullaris** (semicircular canal ampulla) ? rotation
- **Organ of Corti** (cochlea) ? sound

Vestibulocochlear Nerve (VIII Nerve)

Divisions

1. **Cochlear nerve** ? hearing
2. **Vestibular nerve** ? balance

Course

- Arises from hair cells ? joins to form VIII nerve ? passes through **internal acoustic meatus** ? enters brainstem at **pontomedullary junction**.

Nuclei

- **Cochlear nuclei** (ventral & dorsal)
- **Vestibular nuclei** (superior, inferior, medial, lateral)

Clinical

- Injury causes:
  - **Sensorineural hearing loss**
  - **Vertigo**, **nystagmus**
  - Imbalance, nausea

Clinical Anatomy

1. Meniere's Disease

- Increased **endolymph (endolymphatic hydrops)**.
- Features: **vertigo**, **tinnitus**, **hearing loss**, **fullness in ear**.

2. Labyrinthitis

- Inflammation due to infection—causes severe vertigo and sensorineural loss.

3. Acoustic Neuroma (Vestibular Schwannoma)

- Tumour of **vestibular nerve** in internal acoustic meatus.
- Causes **progressive unilateral SNHL**, tinnitus, imbalance.

4. Ototoxicity

- Drugs like aminoglycosides damage hair cells ? irreversible SNHL.

5. Motion Sickness

- Conflict between vestibular and visual inputs ? nausea, sweating, dizziness.

Development of Internal Ear

Origin

- Develops from **otic placode** ? forms **otic vesicle (otocyst)**.

Derivatives

1. **Dorsal part** ? **Utricle**, **Semicircular ducts**
2. **Ventral part** ? **Saccule**, **Cochlear duct**

Membranous Labyrinth

- Derived from **otocyst**.

Bony Labyrinth

- Formed by surrounding mesenchyme ? ossifies.

Vestibulocochlear Nerve

- Developed from **neural crest + otic placode neuroblasts**.

Molecular Regulation

Key Signaling Pathways

- **FGF**, **Wnt**, **Shh (Sonic Hedgehog)** regulate otic vesicle patterning.
- **Notch signaling** determines hair cell vs supporting cell fate.
- **Atoh1** gene essential for **hair cell differentiation**.
- **Pax2**, **Pax8** guide cochlear development.

Clinical relevance

- Mutations in hair-cell genes cause **congenital deafness**.

Reasons for Earache (Otalgia)

The document highlights multiple reasons:

1. Wax impaction

- Dry, hardened wax presses against the tympanic membrane.

2. Furunculosis of external canal

- Infection of hair follicles ? severe localized pain.

3. Otitis externa

- Pain on pulling pinna; swollen canal.

4. Myringitis

- Inflammation of tympanic membrane.

5. Acute Otitis Media

- Middle ear infection ? **throbbing pain**, fever, hearing loss.

6. Referred pain

Because the ear shares nerves with many structures:

- **Vagus nerve** ? throat, larynx disease causes earache
- **Glossopharyngeal nerve** ? tonsillitis, pharyngitis
- **Auriculotemporal nerve** ? TMJ pain
- **Trigeminal nerve (V3)** ? dental pain
- **Cervical nerves (C2–C3)** ? mastoid and neck pathology

7. Mastoiditis

- Pain behind the ear; tenderness over mastoid.

8. Eustachian Tube Block

- During colds, sinusitis ? pressure pain in the ear.

Mnemonics (Expanded)

1. Bones of Middle Ear — “MISs”

M ? Malleus
I ? Incus
S ? Stapes

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2. Middle Ear Arch Derivatives — “1 MI, 2 S”

- **1st arch:** *Malleus, Incus*
- **2nd arch:** *Stapes*
  (Useful for development-related MCQs)

3. Nerve Supply of Tympanic Membrane — “VAgo”

- **V** ? Auriculotemporal nerve (outer surface)
- **A** ? Auricular branch of vagus (outer surface)
- **go** ? Glossopharyngeal (inner surface)
  (Combines all three nerves involved)

4. Labyrinth Fluids — “Peri = Outside, Endo = Inside”

- **Perilymph** ? between bony and membranous labyrinth
- **Endolymph** ? inside membranous labyrinth

5. Balance Organs — “Macula = Motion less, Crista = Circular”

- **Macula (utricle & saccule):** linear acceleration
- **Crista (semicircular canals):** rotational acceleration

Facts to Remember (Expanded)

1. Tympanic Membrane is Triplanar in Origin

- Develops from **ectoderm, mesoderm, and endoderm**.

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2. Nerve Supply of Tympanic Membrane

- **Outer surface:** V (auriculotemporal) + X (auricular branch)

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- **Inner surface:** Glossopharyngeal nerve

3. Ear Syringing Can Affect the Heart

- Syringing stimulates **auricular branch of vagus** ? may **slow heart rate**.

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4. Endolymph Requires Melanocytes

- Endolymph is produced by **stria vascularis**; this process needs **melanocytes**.
- Disorders like **albinism** may cause **deafness**.

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5. Acoustic Neuroma Affects Both VII and VIII Nerves

- Tumour of Schwann cells of the vestibulocochlear nerve.
- When it expands in the internal acoustic meatus ? compresses **VII**, causing:
  - Facial paralysis
  - Hearing loss
  - Tinnitus

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6. Earache Has Multiple Sources

- Ear pain can originate from the **ear**, **throat**, **nose**, **teeth**, **TMJ**, or **cervical nerves**.
- Detailed causes shown in the flowchart.

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7. Otosclerosis Causes Conductive Deafness

- Fusion of stapes footplate at the oval window ? fixed ossicle chain.
- Treated by stapedectomy + prosthesis.

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8. Mastoiditis May Spread to Brain

- Infection from mastoid air cells may extend to:
  - **Temporal lobe**

- **Cerebellum**
- **Sigmoid sinus**

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9. Facial Nerve Is at Risk in Mastoid Surgery

- Because it runs in the medial wall of the middle ear, near the mastoid antrum.

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10. Semicircular Canals Lie at Right Angles

- Each canal is positioned **90°** to the others.
- Lateral canals of both sides lie in the same plane.

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11. Cochlear Turns

- The cochlea makes **2¾ turns** around the **modiolus**.

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12. Stapes Footplate Occupies the Oval Window

- Oval window = **fenestra vestibuli** ? opens into vestibule.

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13. Receptors of the Inner Ear

- **Organ of Corti:** hearing

- **Maculae:** linear acceleration
- **Cristae:** angular acceleration

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14. Developmental Facts

- External acoustic meatus ? 1st ectodermal cleft
- Auricle ? six mesenchymal hillocks from 1st & 2nd arches
- Middle ear + auditory tube ? tubotympanic recess
- Malleus & incus ? 1st arch
- Stapes ? 2nd arch

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15. Molecular Signals

- **WNT**, **BMP** ? formation of otic placode
- **Retinoic acid** ? AP differentiation of otic vesicle
- **SHH, WNT** ? semicircular canals + cochlear duct
- **PAX2, Noggin defects** ? congenital deafness

Clinicoanatomical Problem

A clinicoanatomical case is described where a **young boy has deformity of the auricle/pinna** , but no treatment is given and he functions normally in school and games.

Questions Asked

- What are the uses of the auricle?
- What is its nerve supply?

Answer (based entirely on the document)

Uses of the Auricle

The pinna has **minimal medical importance**, but several practical and cosmetic uses:

- **Lobule** is used for wearing earrings of various shapes and sizes.
- Supports **spectacles/glasses** – its shape naturally accommodates them.
- A small piece of auricular skin can be used to test for **lepra bacilli**.
- **Hairy pinna** can be a marker associated with the Y-chromosome.
- Culturally, the pinna was traditionally **pulled as punishment** for disobedience.

Nerve Supply of the Auricle

- **Medial surface (upper 2/3):** Lesser occipital nerve
- **Medial surface (lower 1/3):** Great auricular nerve
- **Lateral surface (upper 2/3):** Auriculotemporal nerve
- **Lateral surface (lower 1/3):** Great auricular nerve

Noise Pollution

The text includes a short poetic advisory highlighting the dangers of continuous loud sound exposure.

Key Messages from the Document

- Noise pollution causes **mind–body suffering**.
- One should **plug ears**, lower volume, and seek policing against excessive noise.
- Gentle, soft speech induces calmness; **loud prolonged noise damages auditory pathways**.
- Prolonged exposure may eventually cause **auditory crippling**.
- One may even consider changing jobs if noise exposure is unavoidable, but **hearing must be protected at all costs**.
- Excessive phone use at high volume may cause **significant hearing loss**.

Additional Line from Earlier Page

Indoor noise (music albums, TV advertisements) can also damage:

- **Cochlear nerves**
- **Temporal lobes**
- Can cause **irritation, hypertension, obesity**

1. Pain in ear during swallowing

Case

A patient complains of ear pain whenever he swallows or yawns. Otoscopy is normal.

Explanation

- Pain is **referred** from the **pharynx** or **auditory tube** because both are supplied by the **glossopharyngeal nerve (IX)**.
- The glossopharyngeal nerve also supplies the **inner surface of the tympanic membrane**, so inflammation in the throat may present as **otalgia**.

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2. Severe ear pain when pulling the auricle

Case

Pulling the patient’s pinna or pressing the tragus causes severe pain.

Explanation

- Indicates **otitis externa** (infection of the external acoustic meatus).
- The skin of the cartilaginous canal is tightly adherent and contains hair follicles and ceruminous glands ? very painful when inflamed.

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3. Dry cough and nausea during ear cleaning

Case

During syringing of the ear for wax removal, the patient suddenly develops **dry cough and mild bradycardia**.

Explanation

- Stimulation of the **auricular branch of vagus nerve** supplying outer surface of tympanic membrane produces:
    - **Cough reflex**
    - **Vagal bradycardia**

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4. Sudden facial paralysis following ear infection

Case

A child with chronic otitis media develops **facial asymmetry**.

Explanation

- Infection in middle ear can spread to the **facial canal**, which lies in the **medial wall** of the tympanic cavity.
- Inflammation compresses the **facial nerve**, causing **lower motor neuron facial palsy**.

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5. A child with high-grade fever and pain behind the ear

Case

Tenderness over the mastoid region, with protruding auricle.

Explanation

- Suggests **mastoiditis** due to spread of infection from middle ear to mastoid air cells.
- Mastoid antrum lies **12–13 mm deep** to the suprameatal triangle.

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6. Conductive deafness in a woman in her twenties

Case

Gradual hearing loss with normal tympanic membrane.

Explanation

- Suggestive of **otosclerosis**—fixation of stapes at the oval window.
- Stapes is a derivative of the **2nd pharyngeal arch**; its immobility prevents sound conduction.

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7. Loss of taste in anterior 2/3 following chronic ear discharge

Case

A patient with recurrent middle ear infections complains of metallic taste and taste loss.

Explanation

- Disease in **pars flaccida** endangers the **chorda tympani nerve**, which carries **taste from anterior 2/3 of tongue**.

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8. Vertigo when turning head suddenly

Case

A patient experiences spinning sensation when changing head position.

Explanation

- Involvement of **semicircular canals** or **crista ampullaris**—responsible for detecting **rotational acceleration**.
- May represent benign positional vertigo or vestibular irritation.

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9. A child failing to respond to soft sounds after long exposure to loud music

Case

History of prolonged headphone use.

Explanation

- Chronic noise exposure damages **cochlear hair cells** ? gradual loss of perception of **soft sounds**.

- The document notes: one may become “**deaf to soft sounds** on continuous exposure to loud sounds.”

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10. Sudden severe earache in person with heavy wax impaction

Case

Patient presents with dull pain, blocked sensation, and reduced hearing.

Explanation

- Wax in cartilaginous canal presses on sensitive skin supplied by **auriculotemporal nerve** ? pain.
- May trap moisture and lead to fungal infection.

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11. Cerebellar signs after chronic ear disease

Case

A patient with long-standing otitis media develops **ataxia** and **vomiting**.

Explanation

- Infection may spread from mastoid air cells to **posterior cranial fossa**, involving **cerebellum**, causing **cerebellar abscess**.

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12. Nystagmus in internal ear disease

Case

A patient with vertigo shows rhythmic involuntary eye movements.

Explanation

- Disturbance of **vestibular nuclei** or **semicircular ducts** ? imbalance of vestibulo-ocular reflex ? **nystagmus**.

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13. Tympanic membrane appears bulging and red

Case

History of fever and ear pain.

Explanation

- **Acute otitis media** causes pus accumulation behind tympanic membrane.
- Treatment may require **myringotomy** in posteroinferior quadrant.

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14. Foreign body (insect) in ear with intense pain

Case

Extreme discomfort, buzzing sensation.

Explanation

- Cartilaginous canal contains **hair + ceruminous glands**, and has **vagal nerve supply**, making foreign body presence extremely painful.
- Removal by **syringing** is recommended.

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15. Child with congenital ear deformity (microtia)

Case

External ear is malformed.

Explanation

- External ear develops from **six tubercles of 1st and 2nd branchial arches**.
- Deformities occur when these hillocks fail to fuse properly.

Frequently Asked Questions — With Answers

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1. What type of cartilage is present in the auricle/pinna?

Answer:
The auricle is made of **elastic cartilage**, except for the **lobule**, which contains **fibrofatty tissue** and **no cartilage**.

---

2. What is the nerve supply of the tympanic membrane on both its surfaces?

Answer:

- **Outer surface:**
  - Anteroinferior part ? **Auriculotemporal nerve (V3)**
  - Posterosuperior part ? **Auricular branch of vagus (X)**, with a communicating branch from facial nerve
- **Inner surface:**
  - **Tympanic branch of glossopharyngeal nerve (IX)**

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3. Name the bony ossicles and the types of joints formed between them.

Answer:

- **Ossicles:** Malleus, Incus, Stapes
- **Joints:**
  - Malleus–Incus ? Saddle-type synovial joint
  - Incus–Stapes ? Ball-and-socket type synovial joint

---

4. Name the muscles of the middle ear with their nerve supply.

Answer:

- **Tensor tympani** ? Mandibular nerve (V3)
- **Stapedius** ? Facial nerve (VII)

---

5. Which embryonic layers form the tympanic membrane?

Answer:
The tympanic membrane develops from **all three germ layers**:

- Outer ? **Ectoderm**
- Middle ? **Mesoderm**
- Inner ? **Endoderm**

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6. How can syringing of the ear cause nausea and bradycardia?

Answer:
Stimulation of the **auricular branch of the vagus nerve** during syringing can trigger reflex **nausea, cough, vomiting, or bradycardia**.

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7. Name the walls of the middle ear.

Answer:

- **Roof:** Tegmen tympani
- **Floor:** Jugular wall
- **Anterior wall:** Carotid wall
- **Posterior wall:** Mastoid wall
- **Lateral wall:** Tympanic membrane
- **Medial wall:** Labyrinthine wall

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8. Which structures form the posterior wall of the middle ear?

Answer:

- **Aditus ad antrum**
- **Pyramidal eminence**
- **Fossa incudis**

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9. Which structures form the medial wall of the middle ear?

Answer:

- **Promontory** (produced by cochlea)
- **Oval window**
- **Round window**
- **Prominence of facial canal**

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10. Which two tubes lie in the anterior wall of the middle ear?

Answer:

- **Auditory (pharyngotympanic) tube**
- **Canal for tensor tympani muscle**

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11. How many semicircular canals (bony and membranous) are there in the internal ear?

Answer:

- **Bony semicircular canals:** 3

- **Membranous semicircular ducts:** 3

  Total: 6 structures

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12. How many cristae are present in the three membranous semicircular canals?

Answer:

Each duct has **one ampulla**, each containing **one crista** ? **3 cristae**.

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13. What is the receptor in the saccule and utricle?

Answer:

Macula is the sensory receptor in both utricle and saccule.

---

14. Which is the end organ for hearing?

Answer:

The **Organ of Corti** on the basilar membrane is the receptor organ for hearing.

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15. How do the auditory tube and middle ear cavity develop?

Answer:

They develop from the **tubotympanic recess**, derived from the endoderm of the **1st pharyngeal pouch**.

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16. Which embryonic layer gives rise to the membranous labyrinth?

Answer:

The membranous labyrinth develops from an **ectodermal otic vesicle**.

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17. Enumerate the reasons for earache.

Answer:

A detailed **flowchart** lists causes, including:

- Wax impaction
- Otitis externa
- Otitis media
- Myringitis
- Pharyngitis (referred pain via IX nerve)
- Dental causes
- TMJ problems
- Cervical spine issues

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18. How is the suprameatal triangle marked and what is its importance?

Answer:

- Located **posterior to the external acoustic meatus**.
- Important surface landmark for **mastoid antrum**, located ~15 mm deep in adults.

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19. Enumerate the complications of otitis media.

Answer:

- Mastoiditis
- Facial nerve palsy
- Labyrinthitis

- Meningitis
- Brain abscess (temporal lobe/cerebellum)
- Sigmoid sinus thrombosis
  (Complications inferred from multiple clinical anatomy sections showing spread of infection.)

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20. What are the parts of the tympanic membrane?

Answer:

- **Pars tensa** (lower tense part)
- **Pars flaccida** (upper small slack part)

Frequently Asked Questions — Ear (Clean, Exam-Ready)

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1. What type of cartilage forms the auricle (pinna)?

The auricle is made of **elastic cartilage**, except the **lobule**, which contains **fibrofatty tissue only**.

---

2. What is the nerve supply of the tympanic membrane?

- **Outer surface:** Auriculotemporal nerve (V3) + Auricular branch of vagus (X).
- **Inner surface:** Glossopharyngeal nerve (IX).

---

3. Name the auditory ossicles and the joints between them.

- Ossicles: **Malleus, Incus, Stapes**.
- Joints:
  - **Malleus–Incus:** Saddle synovial joint.
  - **Incus–Stapes:** Ball-and-socket synovial joint.

---

4. Name the muscles of the middle ear and their nerve supply.

- **Tensor tympani:** Mandibular nerve (V3).
- **Stapedius:** Facial nerve (VII).

---

5. From which germ layers does the tympanic membrane develop?

It develops from **ectoderm, mesoderm, and endoderm** (all three germ layers).

---

6. Why does ear syringing sometimes cause nausea or bradycardia?

Stimulation of the **auricular branch of the vagus nerve** can trigger a vagal reflex.

---

7. What are the walls of the middle ear?

- Roof – Tegmen tympani
- Floor – Jugular wall
- Lateral – Tympanic membrane
- Medial – Labyrinthine wall

- Anterior – Carotid wall
- Posterior – Mastoid wall

---

8. What structures form the posterior wall of the middle ear?

Aditus to mastoid antrum, pyramidal eminence, fossa incudis.

---

9. What structures form the medial wall of the middle ear?

Promontory, oval window, round window, prominence of facial canal.

---

10. Which two canals/tubes open in the anterior wall of the middle ear?

The **auditory tube** and the **canal for tensor tympani**.

---

11. How many semicircular canals and ducts exist in the internal ear?

- **3 bony semicircular canals**
- **3 membranous semicircular ducts**

---

12. How many cristae are present in semicircular ducts?

Three (one in each ampulla).

---

13. What is the sensory receptor in utricle and saccule?

The **macula**.

---

14. What is the sensory organ for hearing?

The **Organ of Corti**.

---

15. How do the auditory tube and tympanic cavity develop?

Both develop from the **1st pharyngeal pouch**, forming the **tubotympanic recess**.

---

16. From which embryonic layer is the membranous labyrinth derived?

From the **ectodermal otic vesicle**.

---

17. What are the common causes of earache (otalgia)?

Wax, otitis externa, otitis media, myringitis, throat infections (referred via IX), dental pain, TMJ issues, cervical nerve irritation.

---

18. What is the suprameatal triangle and why is it important?

A bony landmark behind the external acoustic meatus; it overlies the **mastoid antrum**, located about **15 mm deep**.

---

19. What are the complications of otitis media?

Mastoiditis, facial nerve palsy, labyrinthitis, meningitis, brain abscess, sigmoid sinus thrombosis.

---

20. What are the parts of the tympanic membrane?

- **Pars tensa**
- **Pars flaccida**

MCQs — Ear (Complete Chapter)

---

1. The auricle is made up of which type of cartilage?

a. Hyaline
b. Elastic
c. Fibrocartilage
d. Costal cartilage

Answer: b. Elastic

---

2. The lobule of the ear contains:

a. Elastic cartilage
b. Hyaline cartilage
c. Fibrous tissue only
d. Bone

Answer: c. Fibrous tissue only

---

3. The external auditory canal is narrowest at the:

a. Outer cartilaginous part
b. Isthmus
c. Tympanic membrane
d. Junction of bony and cartilaginous canal

Answer: b. Isthmus

---

4. The outer surface of the tympanic membrane is supplied by which nerve?

a. Glossopharyngeal
b. Facial
c. Auriculotemporal
d. Vagus

Answer: c. Auriculotemporal

---

5. The inner surface of the tympanic membrane is supplied by:

a. Facial nerve
b. Glossopharyngeal nerve
c. Vagus nerve
d. Trigeminal nerve

Answer: b. Glossopharyngeal nerve

---

6. Stapedius muscle is supplied by:

a. Trigeminal nerve
b. Facial nerve
c. Glossopharyngeal nerve
d. Vagus nerve

Answer: b. Facial nerve

---

7. Tensor tympani muscle is supplied by:

a. Facial nerve
b. Vagus nerve
c. Mandibular nerve (V3)
d. Glossopharyngeal nerve

Answer: c. Mandibular nerve (V3)

---

8. The auditory tube connects the middle ear with the:

a. Oropharynx
b. Nasopharynx
c. Laryngopharynx
d. Oral cavity

Answer: b. Nasopharynx

---

9. Which ossicle articulates with the oval window?

a. Malleus
b. Incus
c. Stapes
d. All three

Answer: c. Stapes

---

10. Organ of Corti is located in the:

a. Scala vestibuli
b. Scala tympani
c. Scala media
d. Vestibule

Answer: c. Scala media

---

11. Crista ampullaris is concerned with:

a. Hearing
b. Linear acceleration
c. Angular acceleration
d. Pressure changes

Answer: c. Angular acceleration

---

12. Macula of utricle detects:

a. Rotational movement
b. Horizontal linear acceleration
c. Vertical linear acceleration only
d. No movement

Answer: b. Horizontal linear acceleration

---

13. Macula of saccule detects:

a. Rotational acceleration
b. Horizontal acceleration
c. Vertical acceleration
d. Sound waves

Answer: c. Vertical acceleration

---

14. The sensory epithelium of the cochlea is called:

a. Crista
b. Macula
c. Organ of Corti
d. Spiral ganglion

Answer: c. Organ of Corti

---

15. The development of the membranous labyrinth comes from:

a. Endoderm
b. Mesoderm
c. Neural crest
d. Ectodermal otic vesicle

Answer: d. Ectodermal otic vesicle

---

16. The middle ear cavity develops from:

a. 1st pharyngeal cleft
b. 1st pharyngeal pouch
c. 2nd pharyngeal pouch
d. Otic placode

Answer: b. 1st pharyngeal pouch

---

17. Otosclerosis affects which part of the ear?

a. Round window
b. Oval window
c. Tympanic membrane
d. Utricle

Answer: b. Oval window

---

18. Which nerve can be damaged during infections of the middle ear?

a. Trochlear
b. Facial
c. Optic
d. Hypoglossal

Answer: b. Facial

---

19. Loss of taste in anterior 2/3 of tongue in otitis media is due to injury of:

a. Glossopharyngeal nerve
b. Greater petrosal nerve
c. Chorda tympani
d. Tympanic plexus

Answer: c. Chorda tympani

---

20. Sudden vertigo with nystagmus indicates involvement of:

a. Cochlear duct
b. Vestibular apparatus
c. Tympanic membrane
d. Tensor tympani

Answer: b. Vestibular apparatus

---

21. Which window opens into the scala tympani?

a. Oval window
b. Round window
c. Aqueduct of cochlea
d. Reissner’s membrane

Answer: b. Round window

---

22. Deviation of the uvula has no relation to ear pathology except in:

a. Tonsillitis
b. Otitis externa
c. Middle ear effusion
d. Glossopharyngeal neuralgia

Answer: d. Glossopharyngeal neuralgia

---

23. A child with pain on tragus pressure likely has:

a. Otitis media
b. Otitis externa
c. Otosclerosis
d. Labyrinthitis

Answer: b. Otitis externa

---

24. The cone of light is seen in which part of the tympanic membrane?

a. Posterior superior
b. Anterior inferior
c. Posterior inferior
d. Anterior superior

Answer: b. Anterior inferior

---

25. Which canal is oriented horizontally?

a. Superior semicircular canal
b. Posterior semicircular canal
c. Lateral semicircular canal
d. Cochlear canal

Answer: c. Lateral semicircular canal

Viva Voce — Ear (Full Chapter)

---

1. What type of cartilage forms the auricle?

Elastic cartilage.

---

2. What is unique about the lobule?

It has **no cartilage**—only fibrofatty tissue.

---

3. What is the nerve supply of the auricle?

- **Lateral surface:** Auriculotemporal nerve + Great auricular nerve
- **Medial surface:** Great auricular nerve + Lesser occipital nerve
- **Concha:** Auricular branch of vagus

---

4. What is the narrowest part of the external auditory canal?

The **isthmus**, about 5 mm lateral to the tympanic membrane.

---

5. Why does pulling the auricle cause pain in otitis externa?

The **skin of the cartilaginous canal** is tightly adherent and richly innervated.

---

6. What is the normal appearance of the tympanic membrane?

Pearly grey, translucent, with a visible **cone of light** in the anteroinferior quadrant.

---

7. What are the parts of the tympanic membrane?

- **Pars tensa**
- **Pars flaccida**

---

8. What attaches to the inner surface of the tympanic membrane?

The **handle of the malleus**.

---

9. What is the nerve supply of the tympanic membrane?

- Outer surface ? Auriculotemporal nerve + Auricular branch of vagus
- Inner surface ? Glossopharyngeal nerve

---

10. What are the ossicles of the middle ear?

Malleus, Incus, Stapes.

---

11. What is the smallest bone in the human body?

The **stapes**.

---

12. Which ossicle articulates with the oval window?

The **stapes** footplate.

---

13. What are the muscles of the middle ear?

- **Tensor tympani** (V3)
- **Stapedius** (VII)

---

14. What is the function of the stapedius muscle?

Prevents excessive movement of stapes and protects the inner ear from loud sounds.

---

15. What happens in facial nerve palsy involving the stapedius?

Loss of stapedius function ? **hyperacusis** (sounds appear louder).

---

16. What is the function of the auditory tube?

Equalises air pressure between the **middle ear & nasopharynx**.

---

17. Why are children more prone to otitis media?

Their auditory tube is **short, wide and more horizontal**.

---

18. What are the walls of the middle ear?

Roof (tegmen), floor (jugular wall), anterior, posterior, lateral (membrane), medial (labyrinthine).

---

19. What structures form the medial wall of the middle ear?

Promontory, oval window, round window, facial canal prominence.

---

20. What lies in the posterior wall of the middle ear?

Aditus to mastoid antrum, pyramidal eminence, fossa incudis.

---

21. Where is the mastoid antrum located?

About **15 mm deep** to the suprameatal triangle.

---

22. What is mastoiditis?

Infection spreading from the middle ear to **mastoid air cells**.

---

23. Why can middle ear infection cause facial palsy?

The **facial canal** forms part of the medial wall of the middle ear.

---

24. What is the organ of hearing?

The **Organ of Corti**.

---

25. What fluid fills the membranous labyrinth?

Endolymph.

---

26. What fluid fills the bony labyrinth?

Perilymph.

---

27. What do semicircular ducts detect?

Rotational (angular) acceleration.

---

28. What do the utricle and saccule detect?

Linear acceleration and **gravity**.

---

29. What are the sensory receptors in utricle and saccule?

Maculae.

---

30. What is found in the ampulla of semicircular canals?

Crista ampullaris.

---

31. What is the modiolus?

The central bony core of the **cochlea**.

---

32. What nerve carries hearing?

The **cochlear division** of the vestibulocochlear nerve (VIII).

---

33. What nerve carries balance?

The **vestibular division** of VIII nerve.

---

34. What happens in Meniere’s disease?

Excess **endolymph** ? vertigo, tinnitus, hearing loss.

---

35. What is otosclerosis?

Stapes fixation at the **oval window**, causing **conductive deafness**.

---

36. What is presbycusis?

Age-related **sensorineural hearing loss**.

---

37. Which part of external ear is used to test for lepra bacilli?

The skin of the **auricle**.

---

38. Why does referred ear pain occur in tonsillitis?

Shared nerve supply by the **glossopharyngeal nerve**.

---

39. Why does referred ear pain occur in dental infections?

Shared nerve supply via **auriculotemporal nerve**.

---

40. Why does syringing the ear induce cough?

Stimulation of the **auricular branch of vagus**.