

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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Clinical Anatomy of Middle Ear & Mastoid Region

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 (Ootalgia)

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**.

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.

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**.
-

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.
-

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.
-

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.
-

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**.
-

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**.
-

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

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)**
-

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**
-

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**.

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
-

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

Answer:

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

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

Answer:

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

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

Answer:

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

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

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

Answer:

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

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.

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**.

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

Answer:

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

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
-

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.
-

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.)
-

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)

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**.