ANATOMY

ANATOMY

HEAD

HEAD

AREAS
- Scalp
- Pterygopalatine Fossa
- Infratemporal Fossa
- Cranial Fossae

BONES
- Skull
- Bony Orbit
- Sphenoid Bone
- Ethmoid Bone
- Temporal Bone
- Mandible
- Nasal Skeleton
- Cranial Foramina

MUSCLES
- The Tongue
- Facial Expression
- Extraocular
- Mastication

NERVES
- Sympathetic Innervation
- Parasympathetic Innervation
- Ophthalmic Nerve
- Mandibular Nerve
- Maxillary Nerve

ORGANS
- The Ear
- The Eye
- Nose and Sinuses
- Salivary Glands
- Oral Cavity

JOINTS
- TMJ

VESSELS
- Arterial Supply
- Venous Drainage
- Lymphatics

OTHER
- Lacrimal Gland
- Eyelids
- Teeth
- Palate

Organs of the Head

The External Ear

The External Ear

Contents

The External Ear

- The ear can be divided into three parts; external, middle and inner. This article will focus on the anatomy of the **external ear** – its structure, neurovasculature, and its clinical correlations.
- The external ear can be divided functionally and structurally into **two parts**; the auricle (or pinna), and the external acoustic meatus – which ends at the tympanic membrane.

EAR

Division

EAR

- EXTERNAL EAR
- MIDDLE EAR
- INNER EAR

The External Ear

Auricle

- The **auricle** is a paired structure found on either side of the head. It functions to capture and direct sound waves towards the external acoustic meatus.
- It is a mostly cartilaginous structure, with the **lobule** being the only part not supported by cartilage. The cartilaginous part of the auricle forms an outer curvature, known as the **helix**. A second innermost curvature runs in parallel with the helix – the antihelix. The antihelix divides into two cura; the inferoanterior crus, and the superoposterior crus.
- In the middle of the auricle is a hollow depression, called the **concha**. It continues into the skull as the external acoustic meatus. The concha acts to direct sound into the external acoustic meatus. Immediately anterior to the beginning of the external acoustic meatus is an elevation of cartilaginous tissue – the tragus. Opposite the tragus is the antitragus.

The external Ear

Auricle

External Ear

Clinical Relevance: Auricular Haematoma

- An **auricular haematoma** refers to a collection of blood between the cartilage of the ear and the overlying perichondrium. It is usually occurs as a result of trauma, commonly seen in contact sports (e.g. rugby).

- The accumulation of blood can disrupt the blood supply to the cartilage, and requires prompt drainage. Untreated cases can result in avascular necrosis of the cartilage, resulting in a '**cauliflower ear**' deformity.

External Ear

Auricular Hematoma

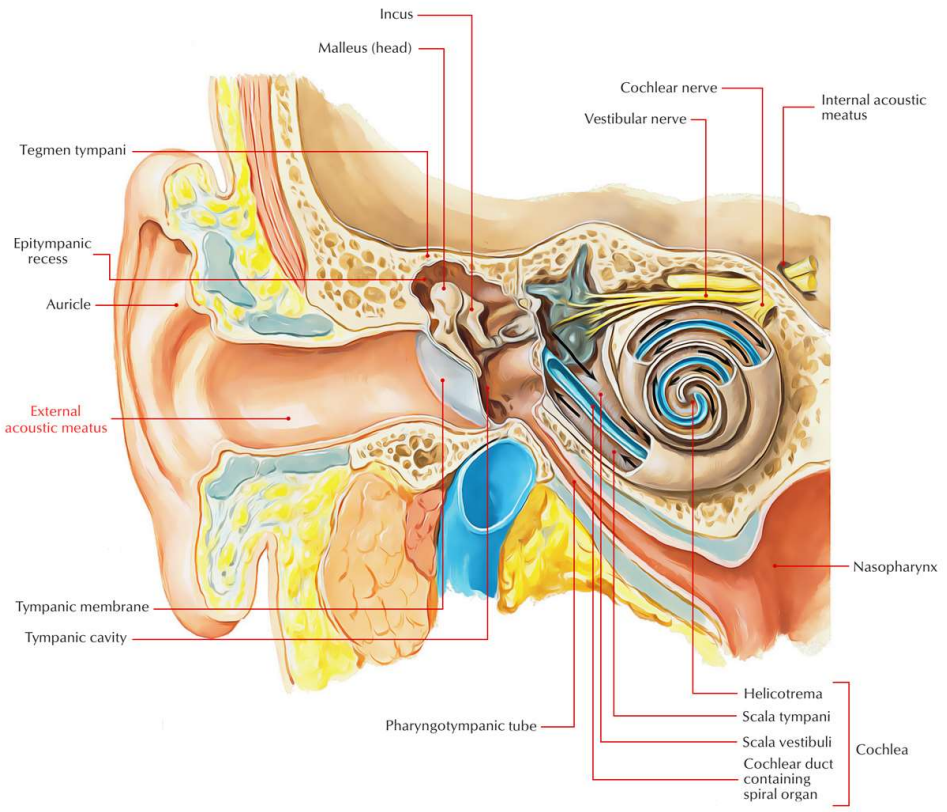
External Ear

External Acoustic Meatus

- The **external acoustic meatus** is a sigmoid shaped tube that extends from the deep part of the concha to the tympanic membrane. The walls of the external 1/3 are formed by cartilage, whereas the inner 2/3 are formed by the temporal bone.
- The external acoustic meatus does not have a straight path, and instead travels in an S-shaped curve as follows:
- Initially it travels in a **Superoanterior** direction.
- In then turns slightly to move **Superoposteriorly**.
- It ends by running in an **Inferoanterior** direction.

External Ear

External Acoustic Meatus



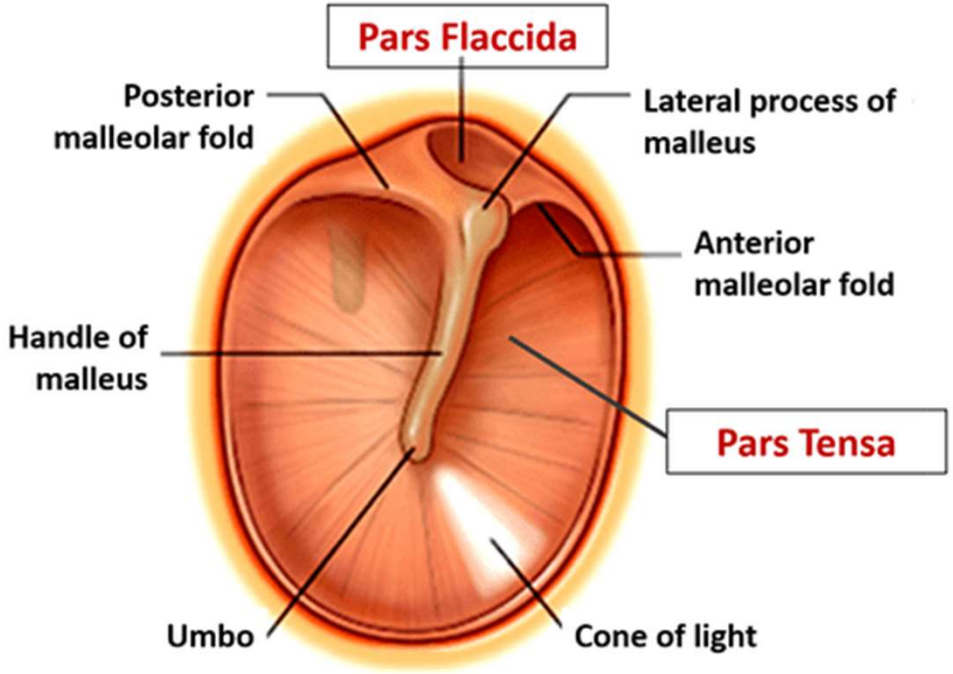
External Ear

Tympanic Membrane

- The **tympanic membrane** lies at the distal end of the external acoustic meatus. It is a connective tissue structure, covered with skin on the outside and a mucous membrane on the inside. The membrane is connected to the surrounding temporal bone by a fibrocartilaginous ring.
- The translucency of the tympanic membrane allows the structures within the middle ear to be observed during otoscopy. On the inner surface of the membrane, the handle of malleus attaches to the tympanic membrane, at a point called the **umbo** of tympanic membrane.
- The **handle of malleus** continues superiorly, and at its highest point, a small projection called the lateral process of the malleus can be seen. The parts of the tympanic membrane moving away from the lateral process are called the anterior and posterior malleolar folds.

External Ear

Tympanic Membrane



External Ear

Clinical Relevance

Perforation of the Tympanic Membrane

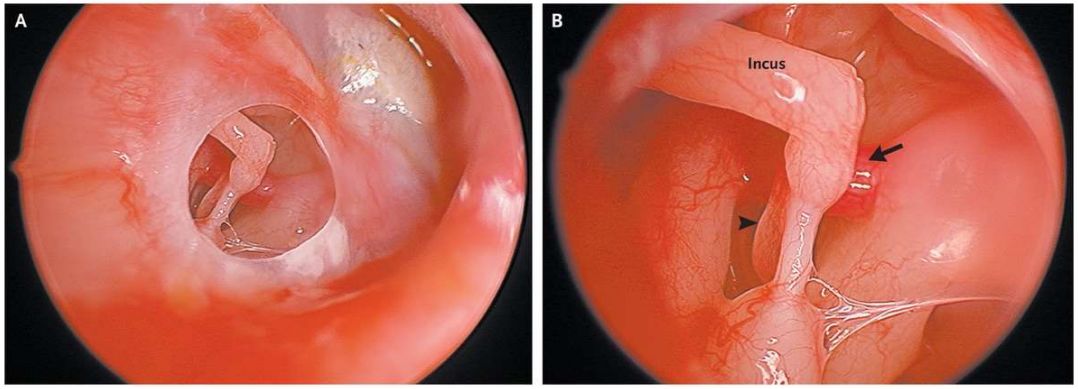
- The tympanic membrane is a relatively thin connective tissue structure, and is susceptible to **perforation** (usually by trauma or infection).
- An infection of the middle ear (**otitis media**) causes pus and fluid to build up behind the tympanic membrane. This causes an increase in pressure within the middle ear, and eventually the eardrum can rupture.
- In some cases the tympanic membrane heals itself, but in larger perforations surgical grafting may be required.

External Ear

Tympanic Membrane

External Ear

Tympanic Membrane



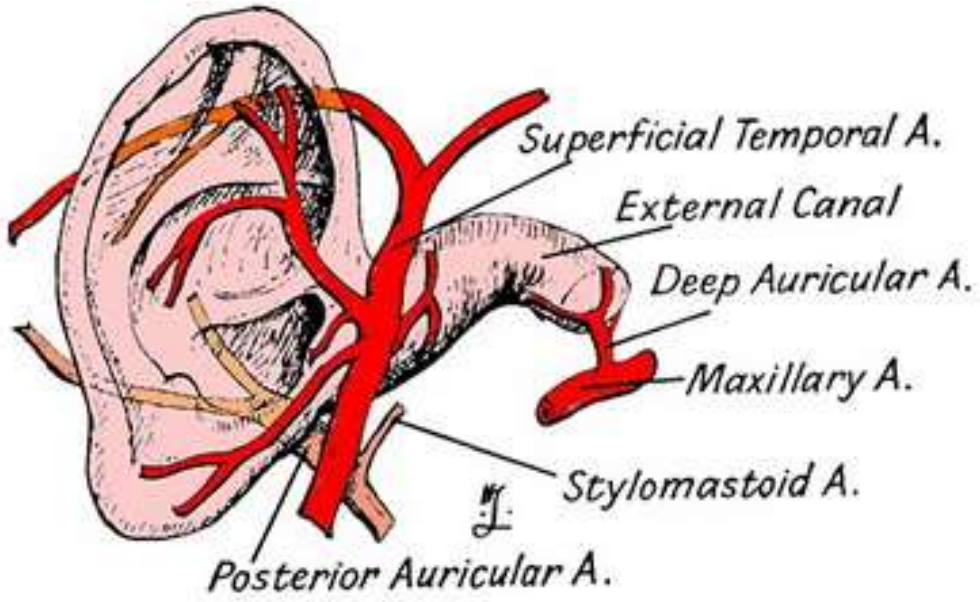
External Ear

Vasculature

The external ear is supplied by branches of the **external carotid artery**:

- **Posterior auricular artery**
- **Superficial temporal artery**
- **Occipital artery**
- **Maxillary artery** (deep auricular branch) – supplies the deep aspect of the external acoustic meatus and tympanic membrane only.
- Venous drainage is via veins following the arteries listed above.

Vasculature



External Ear

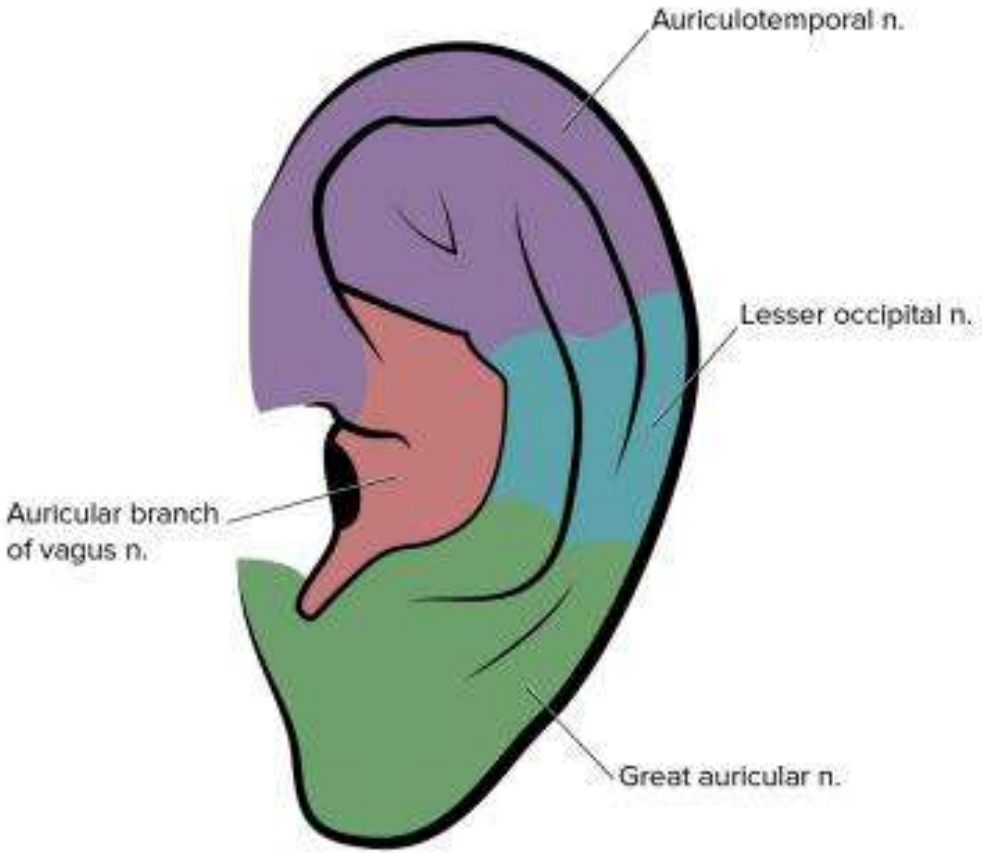
Innervation

The sensory innervation to the skin of the auricle comes from numerous nerves:

- **Greater auricular Nerve** (branch of the cervical plexus) – innervates the skin of the auricle
- **Lesser occipital nerve** (branch of the cervical plexus) – innervates the skin of the auricle
- **Auriculotemporal nerve** (branch of the mandibular nerve) – innervates the skin of the auricle and external auditory meatus.
- **Branches of the facial and vagus nerves** – innervates the deeper aspect of the auricle and external auditory meatus
- Some individuals can complain of an **involuntary cough** when cleaning their ears – this is due to stimulation of the auricular branch of the vagus nerve (the vagus nerve is also responsible for the cough reflex).

External Ear

Innervation

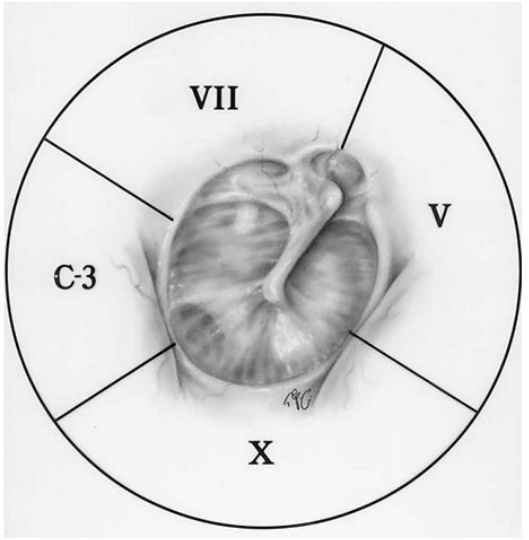


External Ear

Innervation

Nerve supply of external auditory canal

Great auricular nerve



Auriculo temporal nerve

Arnold nerve

External Ear

Lymphatics

- The **lymphatic drainage** of the external ear is to the Superficial Parotid, Mastoid, Upper Deep Cervical and Superficial Cervical Nodes.

EAR

THE MIDDLE EAR

The Middle Ear

Contents

Middle Ear

- The ear can be split into three parts; external, middle and inner.
- The **middle ear** lies within the temporal bone, and extends from the tympanic membrane to the lateral wall of the inner ear. The main function of the middle ear is to transmit vibrations from the tympanic membrane to the inner ear via the auditory ossicles.
- This article will focus on the anatomy of the **middle ear** – its structure, neurovasculature, and its clinical correlations.

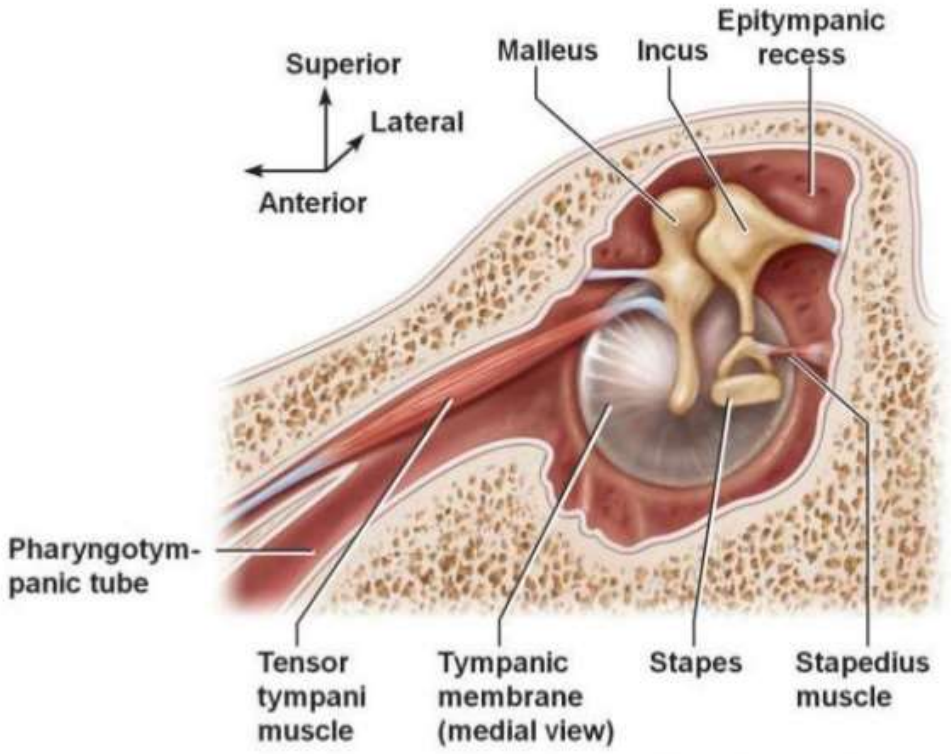
Middle Ear

Parts of the Middle Ear

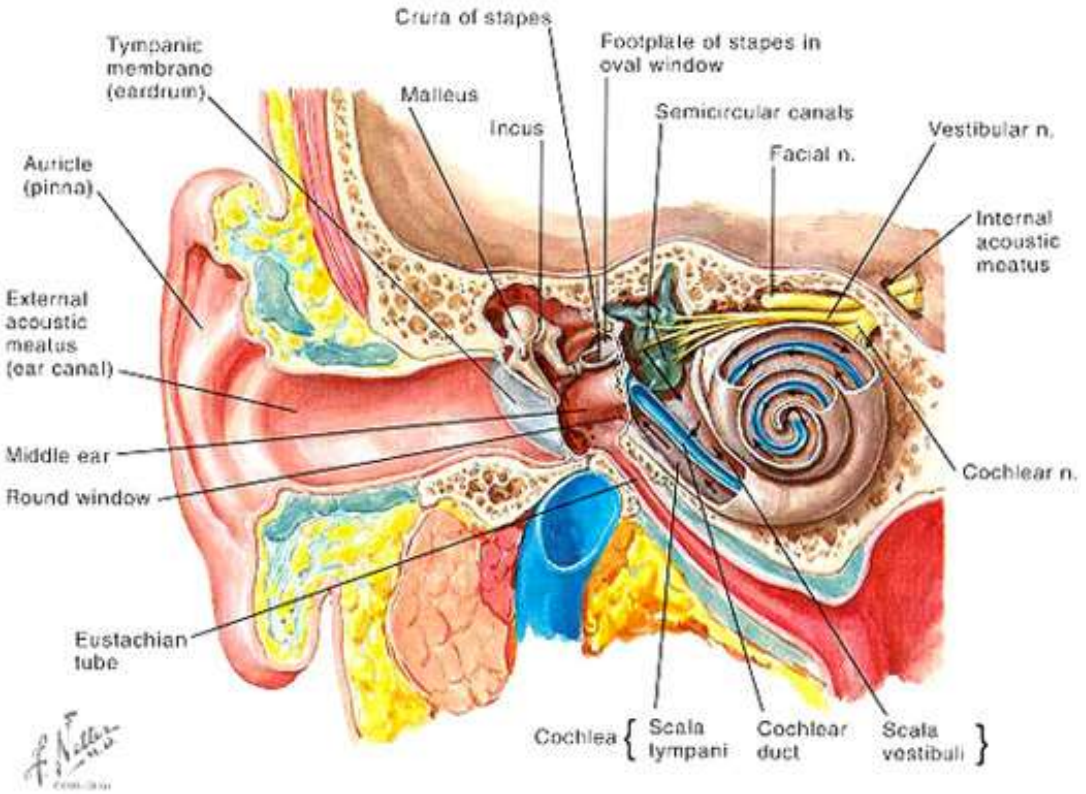
The middle ear can be divided into two parts:

- **Tympanic Cavity** – located medially to the tympanic membrane. It contains three small bones known as the auditory ossicles: the Malleus, Incus and Stapes. They transmit sound vibrations through the middle ear.
- **Epitympanic recess** – a space superior to the tympanic cavity, which lies next to the mastoid air cells. The malleus and incus partially extend upwards into the epitympanic recess.

Epitympanic Recess



Part of Middle ear



Middle Ear

Borders

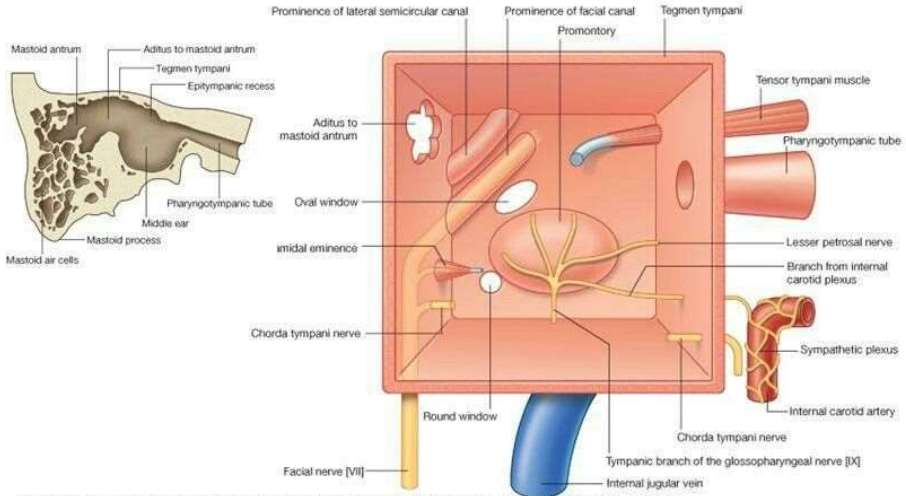
The middle ear can be visualised as a rectangular box, with a roof and floor, medial and lateral walls and anterior and posterior walls.

- **Roof** – formed by a thin bone from the petrous part of the temporal bone. It separates the middle ear from the middle cranial fossa.
- **Floor** – known as the jugular wall, it consists of a thin layer of bone, which separates the middle ear from the internal jugular vein
- **Lateral wall** – made up of the tympanic membrane and the lateral wall of the epitympanic recess.
- **Medial wall** – formed by the lateral wall of the internal ear. It contains a prominent bulge, produced by the facial nerve as it travels nearby.
- **Anterior wall** – a thin bony plate with two openings; for the auditory tube and the tensor tympani muscle. It separates the middle ear from the internal carotid artery.
- **Posterior wall** (mastoid wall) – it consists of a bony partition between the tympanic cavity and the mastoid air cells.
    - Superiorly, there is a hole in this partition, allowing the two areas to communicate. This hole is known as the aditus to the mastoid antrum.

Middle Ear

Boundaries

Boundaries of Middle Ear



Roof: tegmen tympani; separates tympanic cavity from MCF.
Floor: Thin bone separates tympanic cavity from superior bulb of IJV.
Anterior wall: Thin bone; separates tympanic cavity from ICA and at its upper part are openings into two canals (auditory tube & canal for tensor tympani).
Posterior wall: Aditus to the mastoid antrum superiorly & Pyramid inferiorly (for stapedius)
Lateral wall: tympanic membrane inferiorly & Lateral wall of attic superiorly.
Medial wall: Lateral wall of the inner ear.

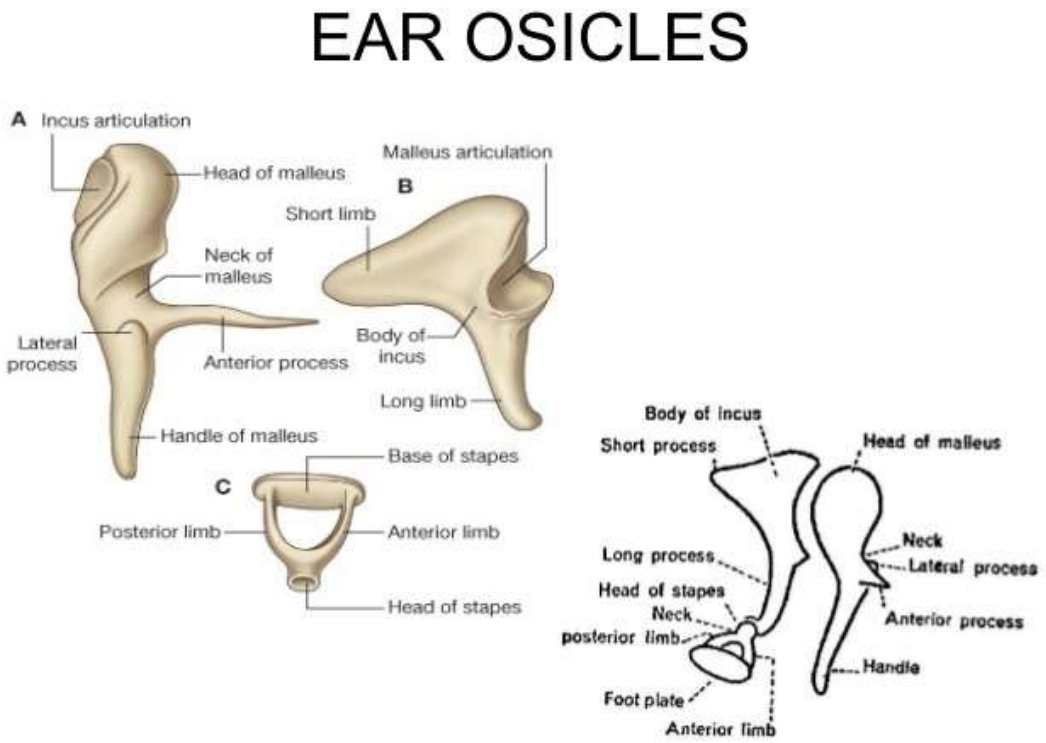
Middle Ear

Bones

- The bones of the middle ear are the **auditory ossicles** – the malleus, incus and stapes. They are connected in a chain-like manner, linking the tympanic membrane to the oval window of the internal ear.
- Sound vibrations cause a movement in the tympanic membrane which then creates movement, or **oscillation**, in the auditory ossicles. This movement helps to transmit the sound waves from the tympanic membrane of external ear to the oval window of the internal ear.
- The **malleus** is the largest and most lateral of the ear bones, attaching to the tympanic membrane, via the handle of malleus. The head of the malleus lies in the epitympanic recess, where it articulates with the next auditory ossicle, the incus.
- The next bone – the **incus** – consists of a body and two limbs. The body articulates with the malleus, the short limb attaches to the posterior wall of the middle, and the long limb joins the last of the ossicles; the stapes.
- The **stapes** is the smallest bone in the human body. It joins the incus to the oval window of the inner ear. It is stirrup-shaped, with a head, two limbs, and a base. The head articulates with the incus, and the base joins the oval window.

Middle Ear

Ear Osicles



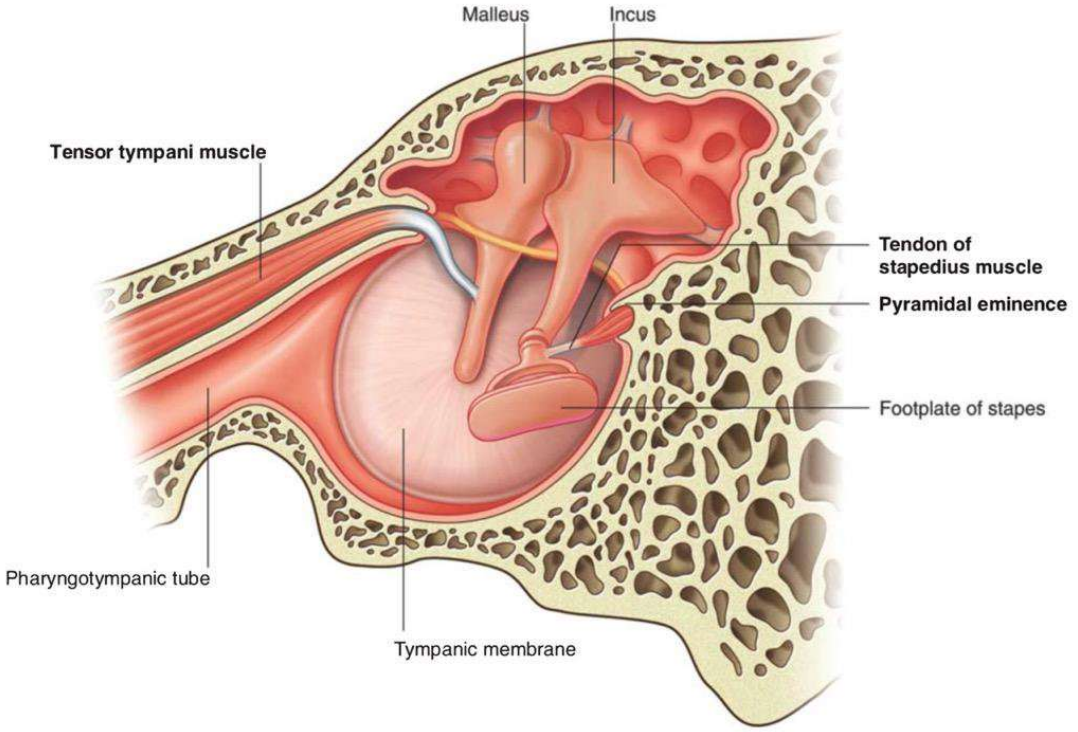
Middle Ear

Mastoid Air Cells

- The **mastoid air cells** are located posterior to epitympanic recess. They are a collection of air-filled spaces in the mastoid process of the temporal bone. The air cells are contained within a cavity called the mastoid antrum. The mastoid antrum communicates with the middle ear via the aditus to mastoid antrum.
- The mastoid air cells act as a '**buffer system**' of air – releasing air into the tympanic cavity when the pressure is too low.

Middle Ear

Mastoid air Cells



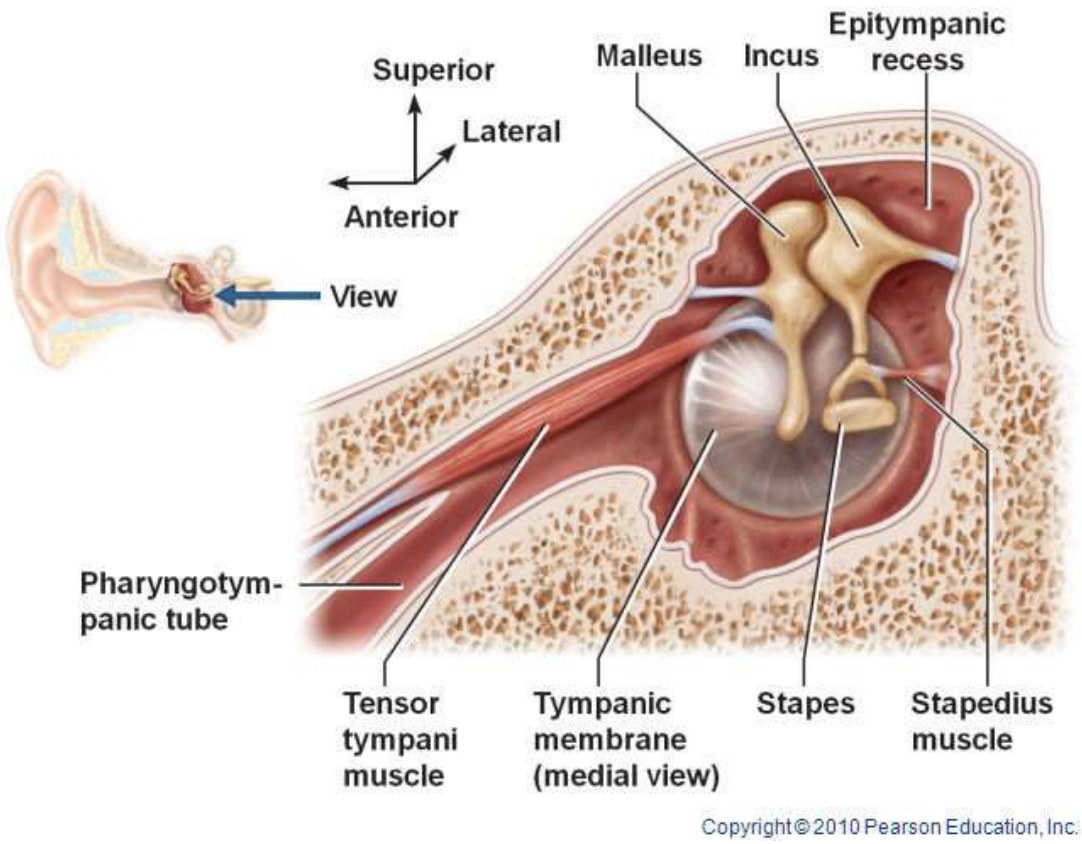
Middle Ear

Muscles

- There are two muscles which serve a **protective** function in the middle ear; the Tensor Tympani and Stapedius. They contract in **response** to loud noise, inhibiting the vibrations of the malleus, incus and stapes, and reducing the transmission of sound to the inner ear. This action is known as the **acoustic reflex**.
- The **tensor tympani** originates from the auditory tube and attaches to the handle of malleus, pulling it medially when contracting. It is innervated by the tensor tympani nerve, a branch of the **mandibular** nerve.
  The **stapedius** muscle attaches to the stapes, and is innervated by the **facial** nerve.

Middle Ear

Muscle of Middle Ear



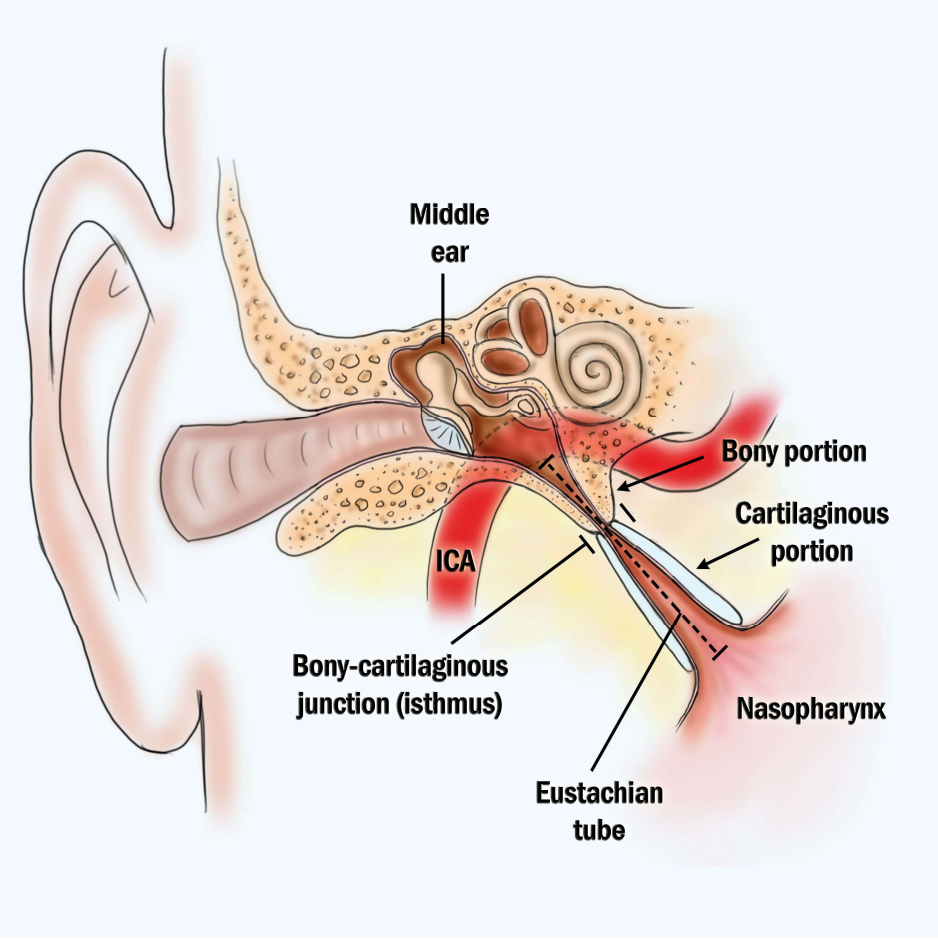
Middle Ear

Auditory Tube

- The auditory tube (eustachian tube) is a **cartilaginous** and **bony** tube that connects the middle ear to the **nasopharynx**. It acts to **equalise** the pressure of the middle ear to that of the external auditory meatus.
- It extends from the anterior wall of the middle ear, in an anterior, medioinferior direction, opening onto the **lateral** wall of the nasopharynx. In joining the two structures, it is a pathway by which an upper respiratory infection can spread into the middle ear.
- The tube is shorter and straighter in children, therefore middle ear infections tend to be more common in children than adults

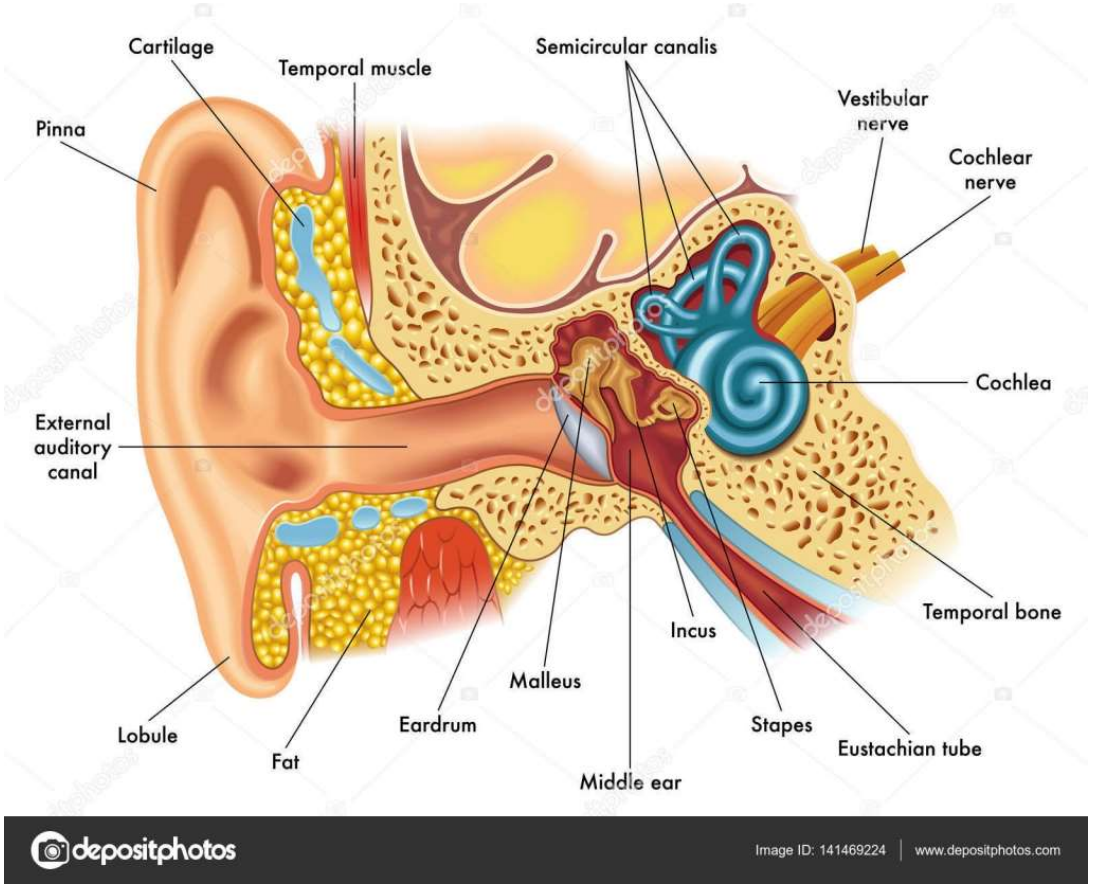
Middle Ear

Auditory Tube



Middle Ear

Auditory Tube



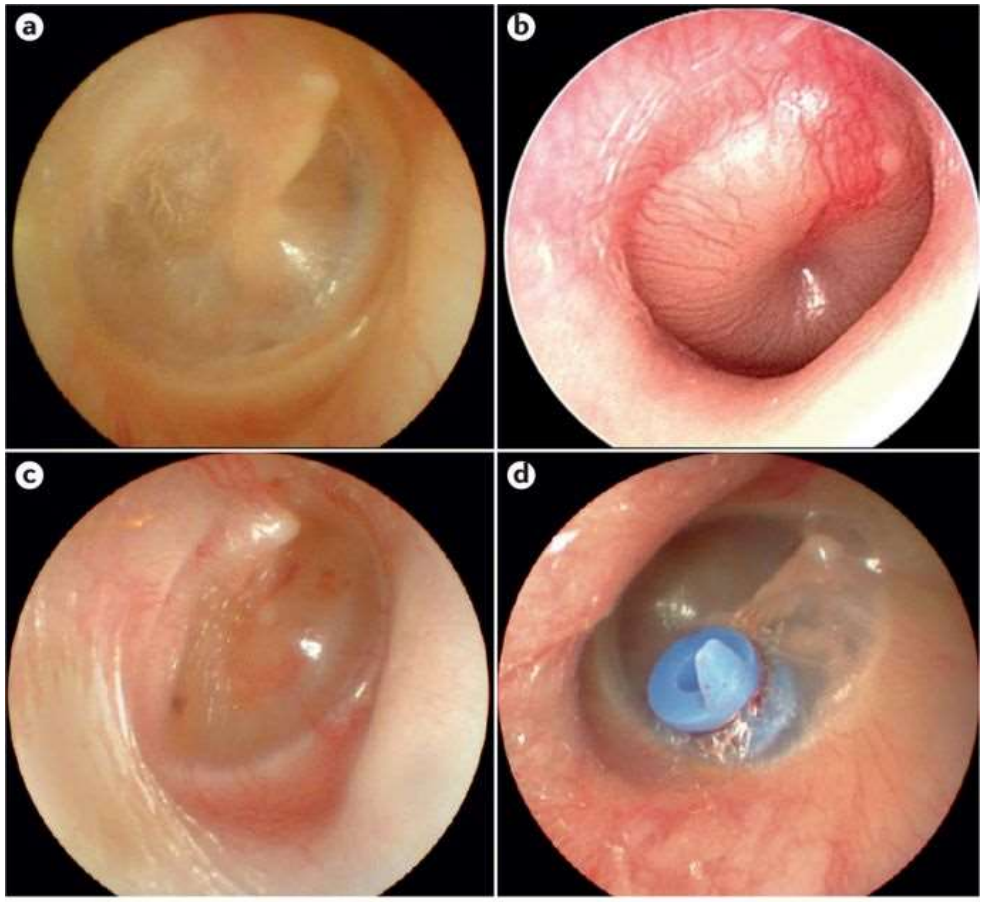
Middle Ear

Clinical Relevance: Otitis Media with Effusion

- Otitis media with effusion is commonly known as **glue ear**. It arises from persistent **dysfunction** of the auditory tube. If the auditory tube is unable to equalise middle ear pressure (due to blockage, inflammation, genetic mutation), a **negative pressure** develops inside the middle ear
- This negative pressure draws out a **transudate** from the mucosa of the middle ear, creating an environment suitable for pathogens to replicate and cause infection.
- Upon inspection of a patient with otitis media with effusion, the eardrum will appear **inverted**, with fluid visible inside the ear.

Middle Ear

Otitis Media



Nature Reviews | Disease Primers

Middle Ear

Clinical Relevance: Mastoiditis

- Middle ear infections (otitis media) can spread to the mastoid air cells. Due to their porous nature, they are a suitable site for pathogenic **replication**.
- The mastoid process itself can get infected, and this can spread to the **middle cranial fossa**, and into the brain, causing **meningitis**.
- If mastoiditis is suspected, the pus must be drained from the air cells. When doing so, care must be taken not to damage the nearby **facial** nerve.

HEAD

The Inner Ear

The Inner Ear

Contents

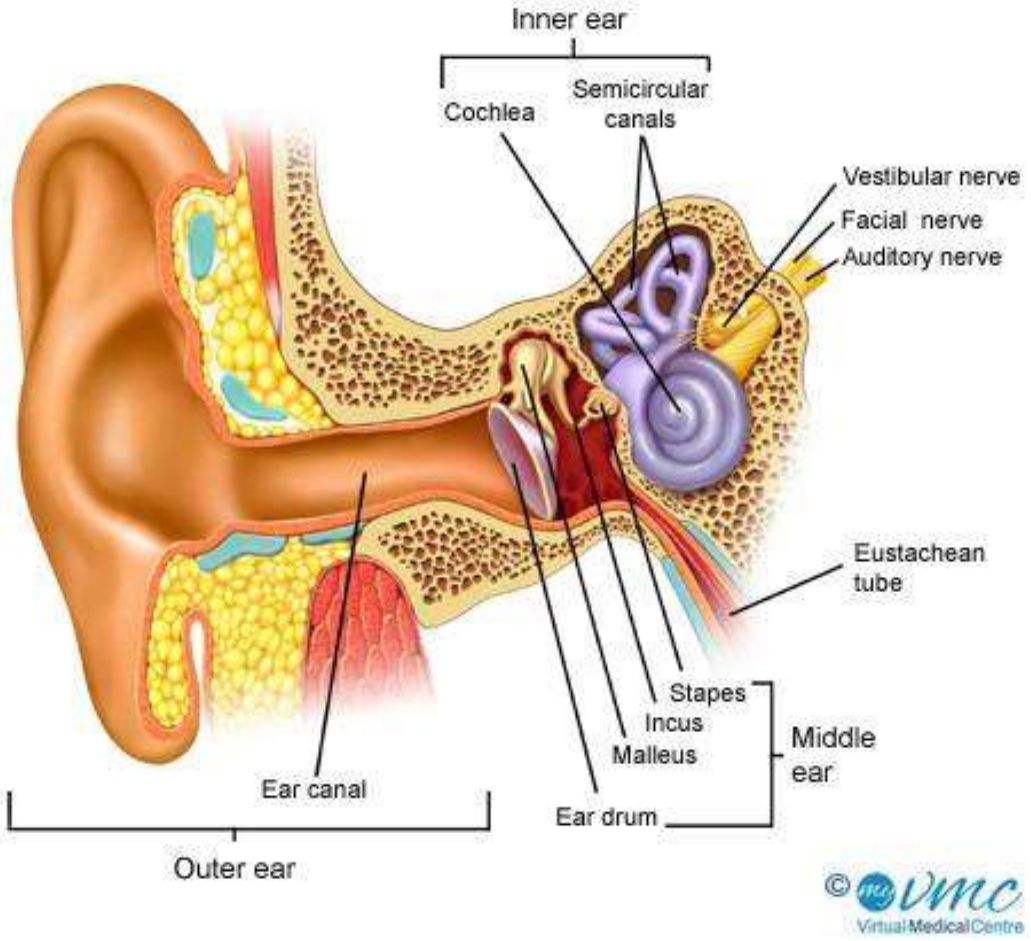
The Inner Ear

The ear can be divided into three parts: the outer ear, middle ear and inner ear.

- The inner ear is the innermost part of the ear, and houses the vestibulocochlear organs. It has two main functions:
- To convert **mechanical** signals from the middle ear into **electrical** signals, which can transfer information to the auditory pathway in the brain.
- To maintain balance by **detecting position** and **motion**.

The Inner Ear

Inner Ear



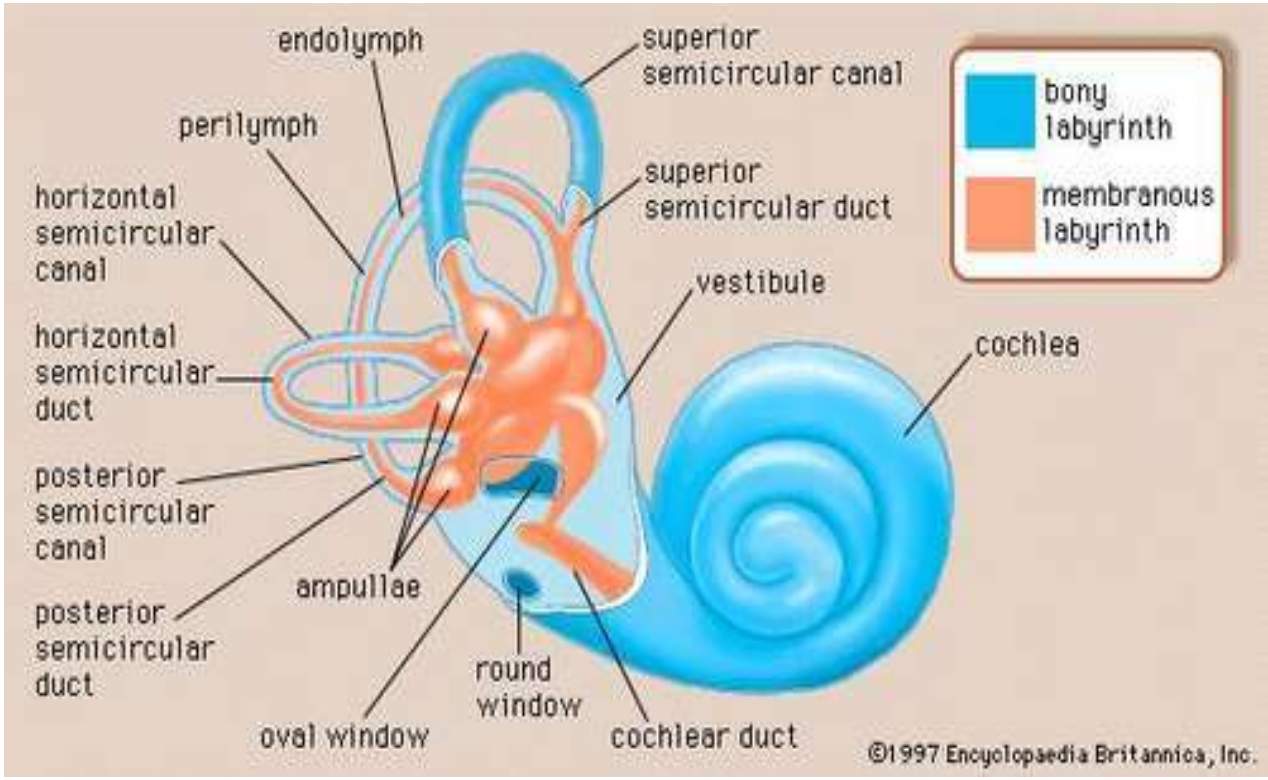
The Inner Ear

Anatomical Position and Structure

- The inner ear is located within the **petrous** part of the temporal bone. It lies between the middle ear and the internal acoustic meatus, which lie laterally and medially respectively. The inner ear has two main components – the bony labyrinth and membranous labyrinth.
- **Bony labyrinth** – consists of a series of bony cavities within the petrous part of the temporal bone. It is composed of the cochlea, vestibule and three semi-circular canals. All these structures are lined internally with periosteum and contain a fluid called perilymph.
- **Membranous labyrinth** – lies within the bony labyrinth. It consists of the cochlear duct, semi-circular ducts, utricle and the saccule. The membranous labyrinth is filled with fluid called Endolymph.
- The inner ear has two openings into the middle ear, both covered by membranes. The **oval window** lies between the middle ear and the vestibule, whilst the **round window** separates the middle ear from the scala tympani (part of the cochlear duct).

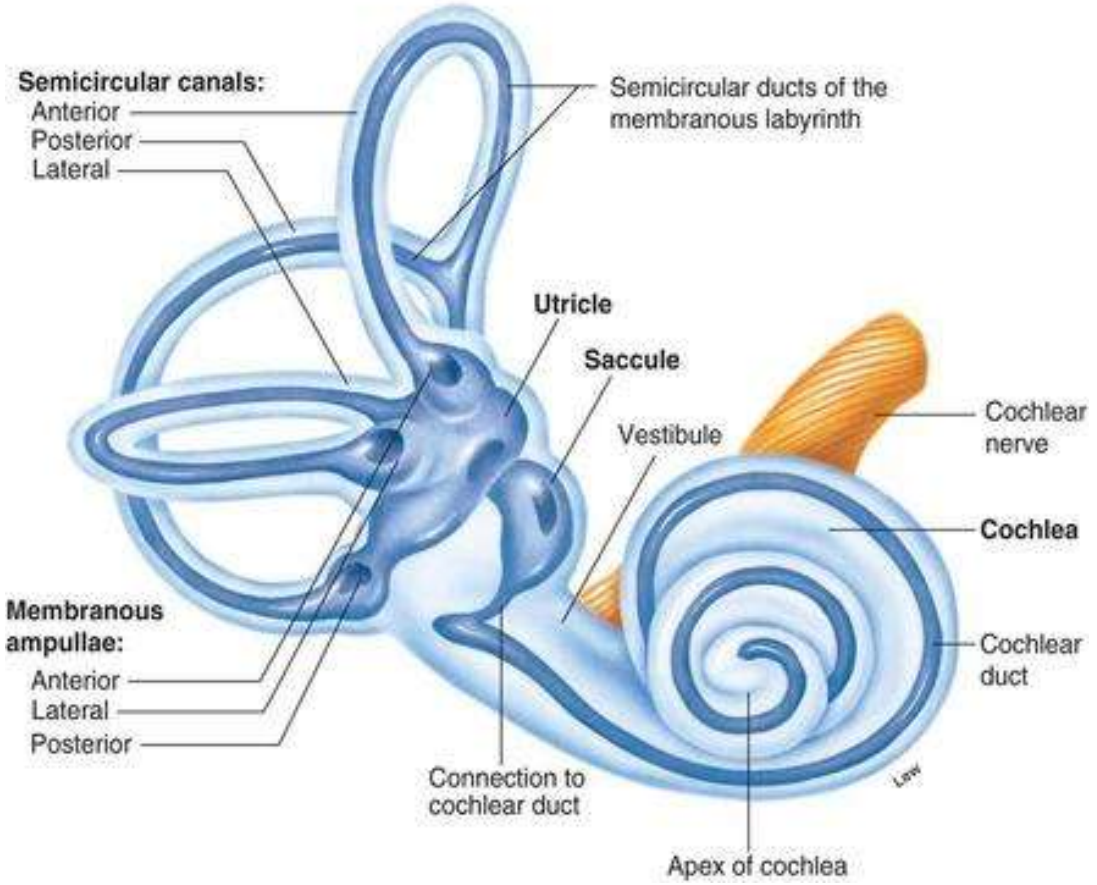
Inner Ear

Bony Labyrinth



Inner Ear

Membranous Labyrinth



The Inner Ear

Bony Labyrinth

- The bony labyrinth is a series of bony cavities within the petrous part of the Temporal bone. It consists of three parts – the cochlea, vestibule and the three semi-circular canals.

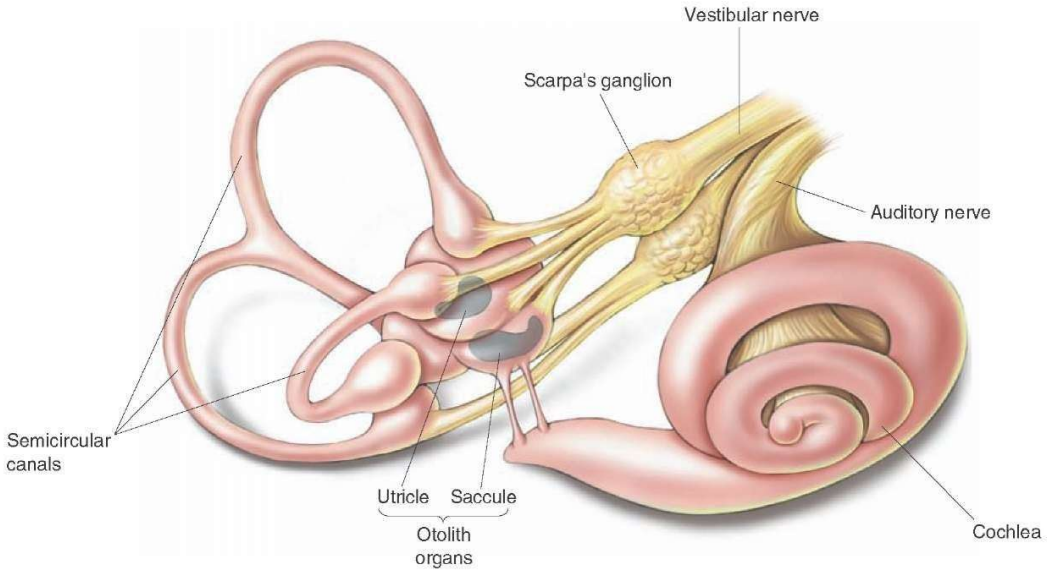
The Inner Ear

Vestibule

- The vestibule is the central part of the bony labyrinth. It is separated from the middle ear by the **oval window**, and communicates anteriorly with the cochlea and posterioly with the semi-circular canals. Two parts of the membranous labyrinth; the **saccule** and **utricle**, are located within the vestibule.

Inner Ear

Vestibule



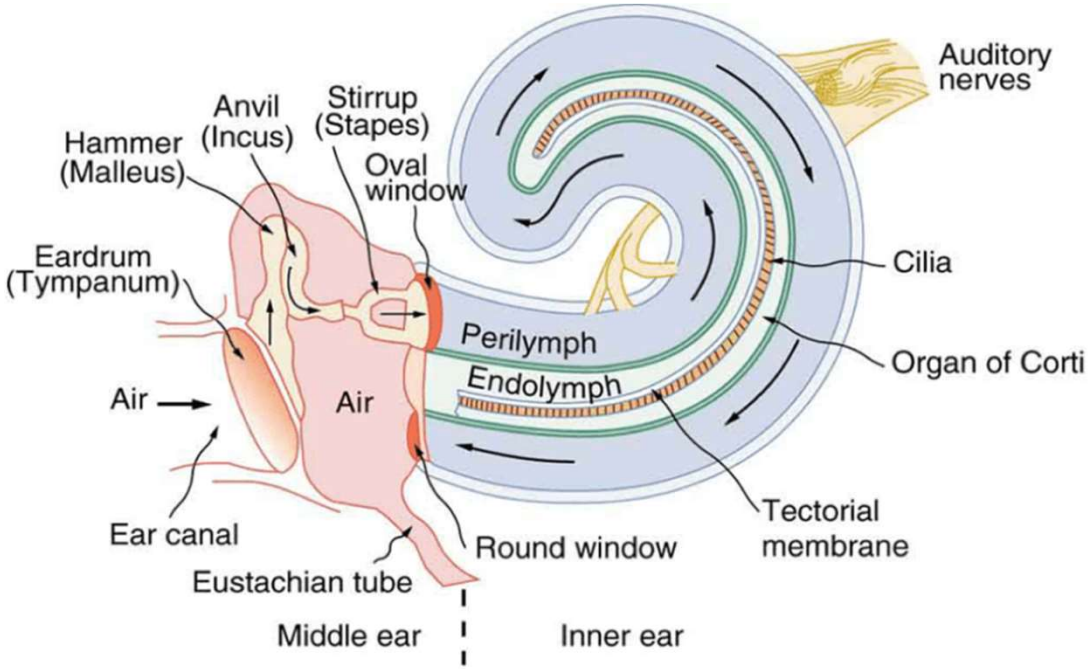
The Inner Ear

Cochlea

- The cochlea houses the cochlea duct of the membranous labyrinth – the auditory part of the inner ear. It twists upon itself around a central portion of bone called the **modiolus,** producing a cone shape which points in an **anterolateral** direction. Branches from the cochlear portion of the **vestibulocochlear** (VIII) nerve are found at the base of the modiolus.
- Extending outwards from the modiolus is a ledge of bone known as **spiral lamina,** which attaches to the cochlear duct, holding it in position. The presence of the cochlear duct creates two perilymph-filled chambers above and below:
- **Scala vestibuli**: Located superiorly to the cochlear duct. As its name suggests, it is continuous with the vestibule.
- **Scala tympani**: Located inferiorly to the cochlear duct. It terminates at the round window.

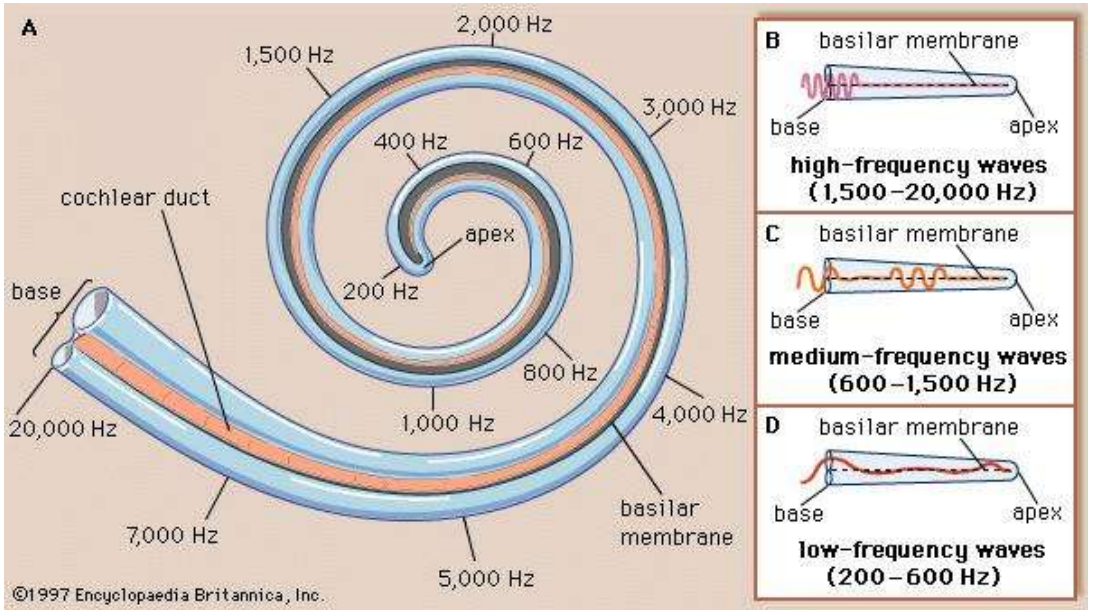
Inner Ear

Cochlea



Inner Ear

Cochlea



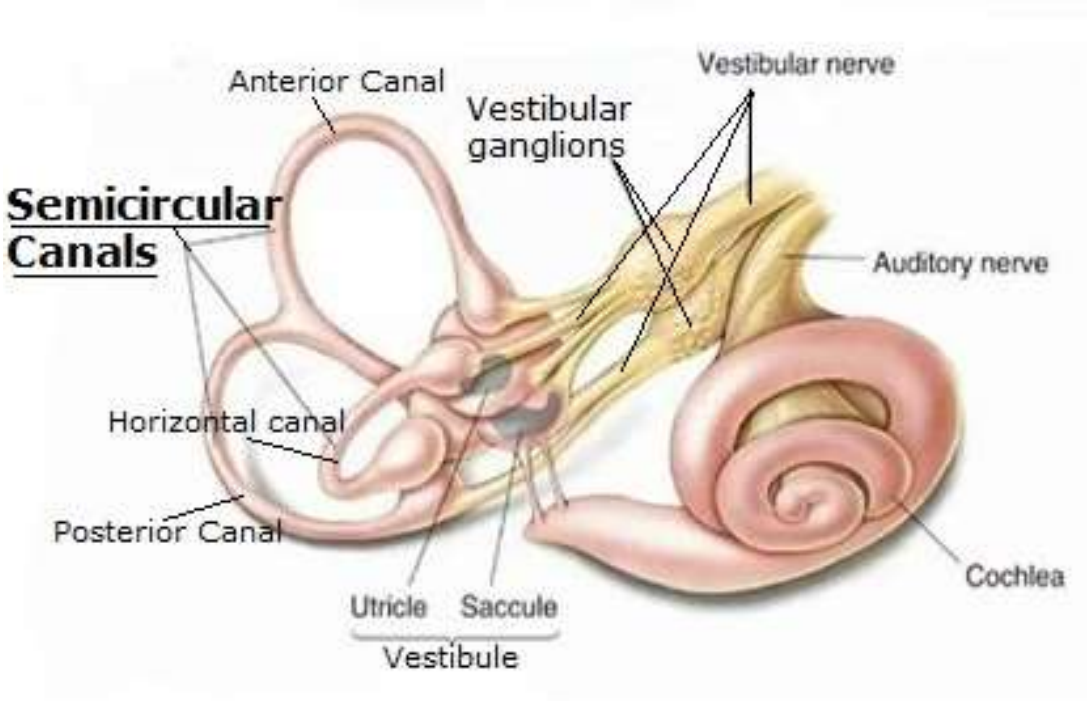
The Inner Ear

Semi-circular Canals

- There are three semi-circular canals; anterior, lateral and posterior. They contain the **semi-circular ducts**, which are responsible for balance (along with the utricle and saccule).
- The canals are situated superoposterior to the vestibule, at right angles to each other. They have a swelling at one end, known as the **ampulla**.

Inner Ear

Semi-circular Canal



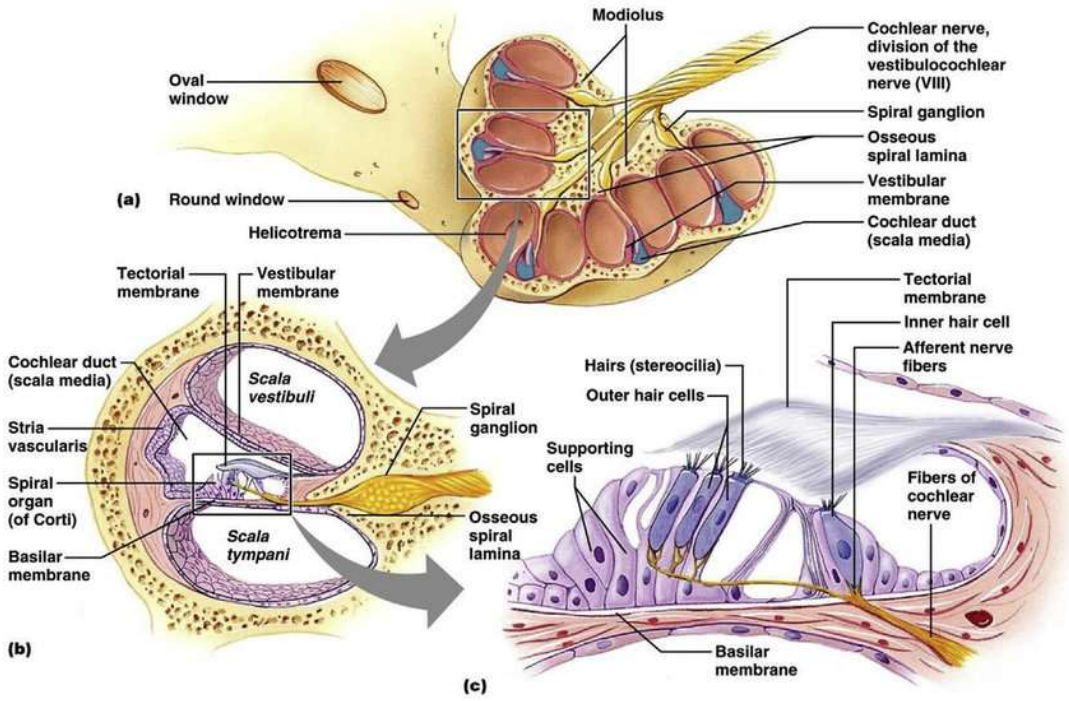
The Inner Ear

Membranous Labyrinth

- The membranous labyrinth is a continuous system of ducts filled with **endolymph.** It lies within the bony labyrinth, surrounded by perilymph. It is composed of the cochlear duct, three semi-circular ducts, saccule and the utricle.
- The cochlear duct is situated within the cochlea and is the organ of hearing. The semi-circular ducts, saccule and utricle are the organs of balance (also known as the **vestibular apparatus**).

Inner Ear

Cochlea



The Inner Ear

Cochlear Duct

The cochlear duct is located within the bony scaffolding of the cochlea. It is held in place by the spiral lamina. The presence of the duct creates two canals above and below it – the **Scala Vestibuli** and **Scala Tympani** respectively. The cochlear duct can be described as having a triangular shape:

- **Lateral wall** – Formed by thickened periosteum, known as the spiral ligament.
- **Roof** – Formed by a membrane which separates the cochlear duct from the Scala vestibuli, known as the Reissner's membrane.
- **Floor** – Formed by a membrane which separates the cochlear duct from the Scala tympani, known as the basilar membrane.
- The basilar membrane houses the epithelial cells of hearing – the **Organ of Corti.** A more detailed description of the Organ of Corti is beyond the scope of this article.

The Inner Ear

Saccule and Utricle

- The saccule and utricle are two **membranous sacs** located in the vestibule. They are organs of balance which detect movement or acceleration of the head in the vertical and horizontal planes, respectively.
- The **utricle** is the larger of the two, receiving the three semi-circular ducts. The **saccule** is globular in shape and receives the cochlear duct.
- Endolymph drains from the saccule and utricle into the **endolymphatic duct**. The duct travels through the **vestibular aqueduct** to the posterior aspect of the petrous part of the temporal bone. Here, the duct expands to a sac where endolymph can be secreted and absorbed.

Semi-circular Ducts

- The semi-circular ducts are located within the semi-circular canals, and share their orientation. Upon movement of the head, the flow of **endolymph** within the ducts changes speed and/or direction. Sensory receptors in the ampullae of the semi-circular canals detect this change, and send signals to the brain, allowing for the processing of balance.

The Inner Ear

Vasculature

The bony labyrinth and membranous labyrinth have different arterial supplies. The bony labyrinth receives its blood supply from three arteries, which also supply the surrounding temporal bone:

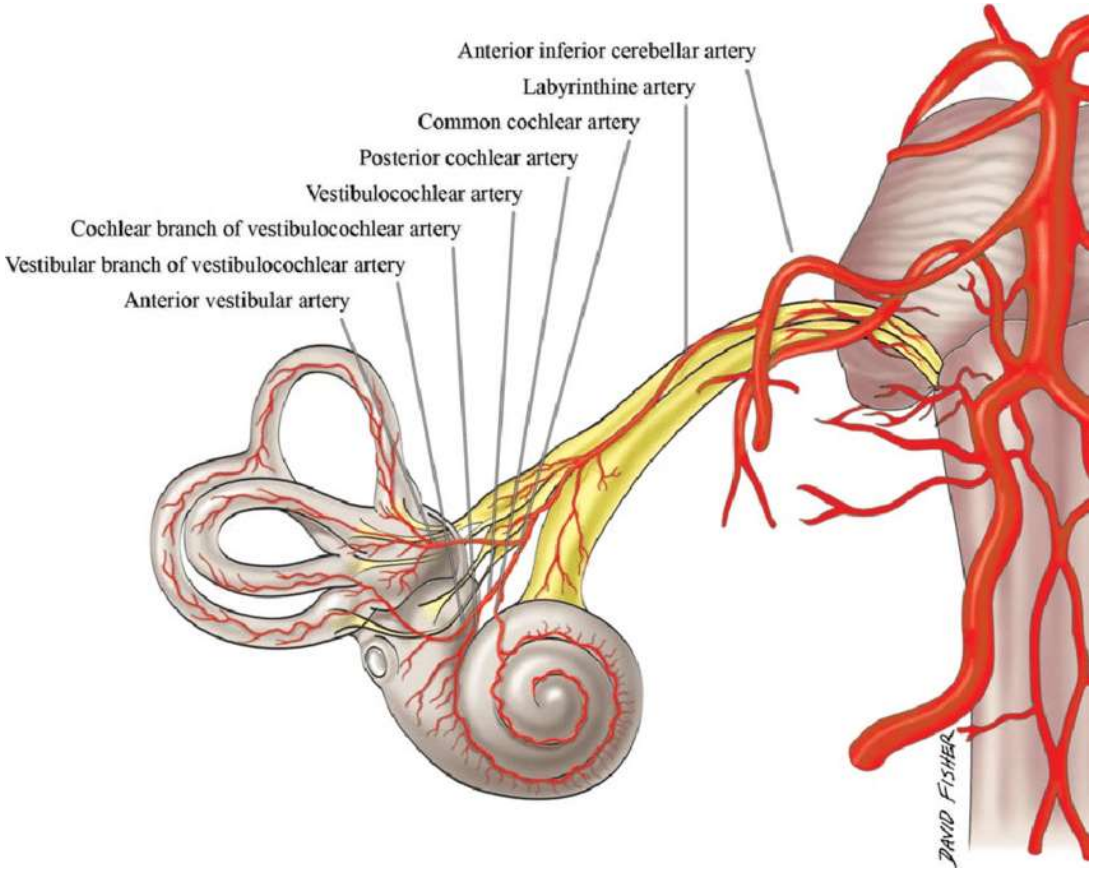
- **Anterior tympanic branch** (from maxillary artery).
- **Petrosal branch** (from middle meningeal artery).
- **Stylomastoid branch** (from posterior auricular artery).

The membranous labyrinth is supplied by the **labyrinthine artery**, a branch of the Inferior Cerebellar Artery (or, occasionally, the basilar artery). It divides into three branches:

- **Cochlear branch** – supplies the cochlear duct.
- **Vestibular branches (x2)** – supply the vestibular apparatus.
- Venous drainage of the inner ear is through the **labyrinthine vein**, which empties into the sigmoid sinus or inferior petrosal sinus.

Inner Ear

Vasculature



The Inner Ear

Innervation

- The inner ear is innervated by the vestibulocochlear nerve (CN VIII). It enters the inner ear via the internal acoustic meatus, where it divides into the **vestibular nerve** (responsible for balance) and the **cochlear nerve** (responsible for hearing):
- **Vestibular nerve** – enlarges to form the vestibular ganglion, which then splits into superior and inferior parts to supply the utricle, saccule and three semi-circular ducts.
- **Cochlear nerve** – enters at the base of the modiolus and its branches pass through the lamina to supply the receptors of the Organ of Corti.
- The facial nerve, CN VII, also passes through the inner ear, but does not innervate any of the structures present.

The Inner Ear

Clinical Relevance: Meniere's Disease

- Meniere's disease is a disorder of the inner ear, characterised by episodes of Vertigo, Low-pitched tinnitus and Hearing loss.
- The symptoms are thought to be caused by an excess accumulation of **endolymph** within the membranous labyrinth, causing progressive distension of the ducts. The resulting pressure fluctuations damage the thin membranes of the ear that detect balance and sound.

HEAD

Organs Of The Head

THE EAR

THE EYE

NOSE AND SINUSES

SALIVARY GLANDS

ORAL CAVITY

The EYE

Contents

The Bony Orbit

Extra Occular Muscle

Eye Ball

Eye Lid Lacrimal Gland

The Bony Orbit

Contents

The Bony Orbit

- The bony orbits (or eye sockets) are bilateral and symmetrical **cavities** in the head. They enclose the eyeball and its associated structures.
- In this article, we shall look at the borders, contents and clinical correlations of the bony orbit.

Bony Orbit

Borders and Anatomical Relations

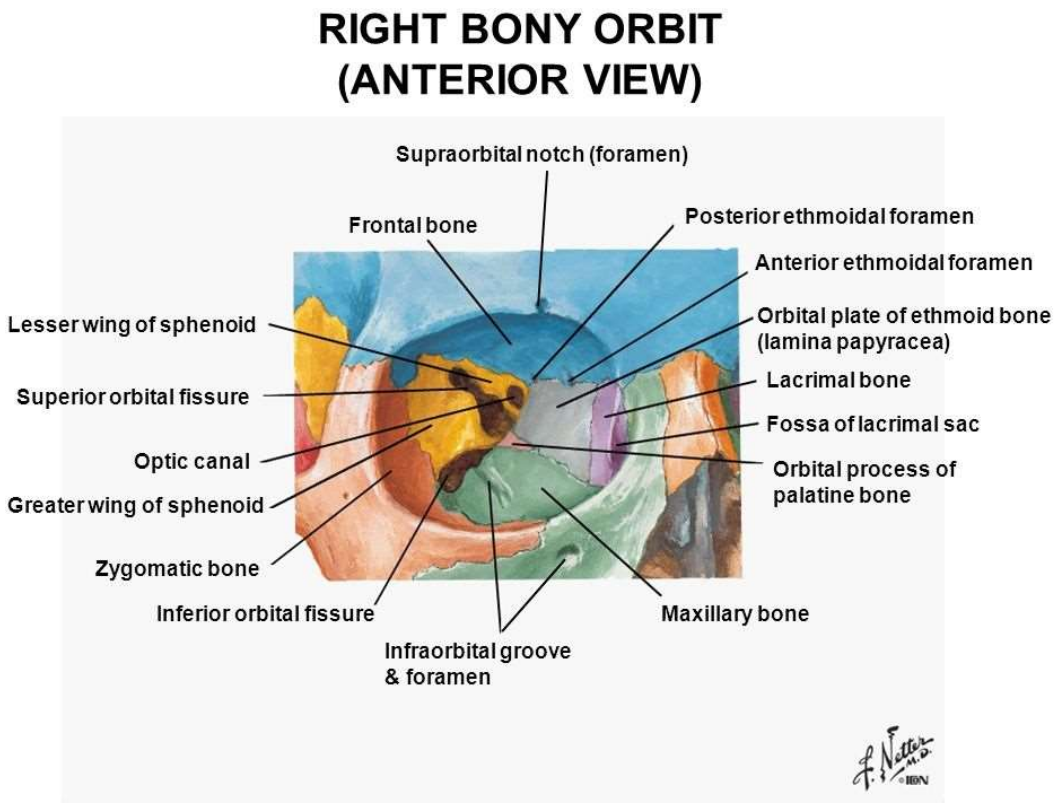
The orbit can be thought of as a **pyramidal** structure, with the apex pointing posteriorly and the base situated anteriorly. The boundaries of the orbit are formed by seven bones.

The borders and anatomical relations of the bony orbit are as follows:

- **Roof** (superior wall) – Formed by the frontal bone and the lesser wing of the sphenoid. The frontal bone separates the orbit from the anterior cranial fossa.
- **Floor** (inferior wall) – Formed by the maxilla, palatine and zygomatic bones. The maxilla separates the orbit from the underlying maxillary sinus.
- **Medial wall** – Formed by the ethmoid, maxilla, lacrimal and sphenoid bones. The ethmoidbone separates the orbit from the ethmoid sinus.
- **Lateral wall** – Formed by the zygomatic bone and greater wing of the sphenoid.
- **Apex** – Located at the opening to the optic canal, the optic foramen.
- **Base** – Opens out into the face, and is bounded by the eyelids. It is also known as the orbital rim.

Bony Orbit

Walls

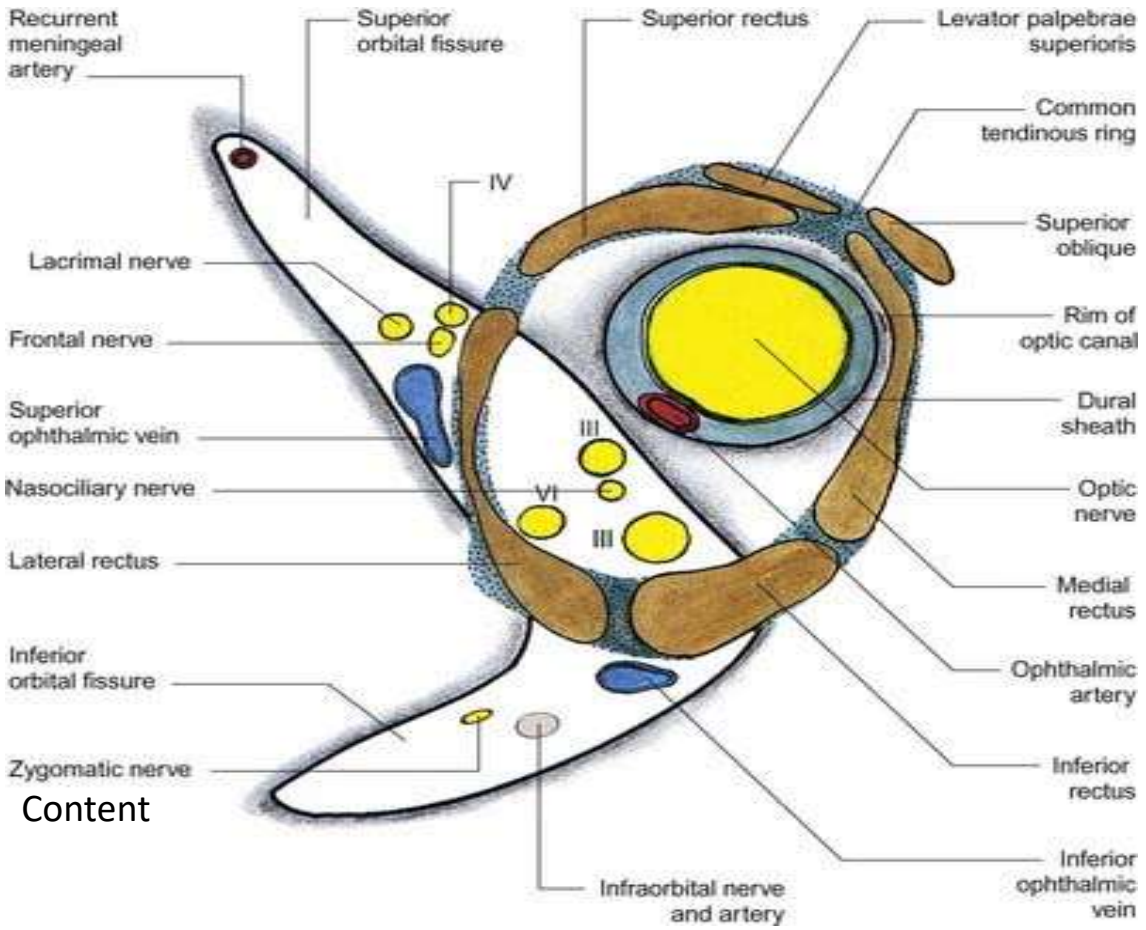


Bony Orbit

Contents

- **Extra-ocular muscles** – These muscles are separate from the eye. They are responsible for the movement of the eyeball and superior eyelid.
- **Eyelids** – These cover the orbits anteriorly.
- **Nerves**: Several cranial nerves supply the eye and its structures; optic, oculomotor, trochlear, trigeminal and abducens nerves.
- **Blood vessels**: The eye receives blood primarily from the ophthalmic artery. Venous drainage is via the superior and inferior ophthalmic veins.
- Any space within the orbit that is not occupied is filled with **orbital fat**. This tissue cushions the eye, and stabilises the extraocular muscles.

Bony Orbit


Recurrent meningeal artery
Superior orbital fissure
Superior rectus
Levator palpebrae superioris
Common tendinous ring
IV
Lacrimal nerve
Superior oblique
Rim of optic canal
Frontal nerve
Dural sheath
Superior ophthalmic vein
III
Nasociliary nerve
VI
Optic nerve
III
Lateral rectus
Medial rectus
Inferior orbital fissure
Ophthalmic artery
Zygomatic nerve
Inferior rectus
Content
Inferior ophthalmic vein
Infraorbital nerve and artery

Bony Orbit

Pathway to bony orbit

- **Optic canal** – transmits the optic nerve and ophthalmic artery.
- **Superior orbital fissure –** transmits the lacrimal, frontal, trochlear (CN IV), oculomotor (CN III), nasociliary and abducens (CN VI) nerves. It also carries the superior ophthalmic vein.
- **Inferior orbital fissure** – transmits the zygomatic branch of the maxillary nerve, the inferior ophthalmic vein, and sympathetic nerves.
- There are other minor openings into the orbital cavity. The **nasolacrimal canal**, which drains tears from the eye to the nasal cavity, is located on the medial wall of the orbit. Other small openings include the **supraorbital foramen** and **infraorbital canal** – they carry small neurovascular structures

Bony Orbit

Q. Name the structures passing through the foramina and fissures of orbit.

Superior Orbital fissure

Lateral part

3. Recurrent br. Of ophthalmic artery
4. Lacrimal N
5. Frontal N
6. Trochlear N
7. Superior ophthalmic vein

Middle part

8. Abducent N
9. Superior division of oculomotor N
10. Nasociliary nerve
11. Inferior division of oculomotor nerve

Medial part

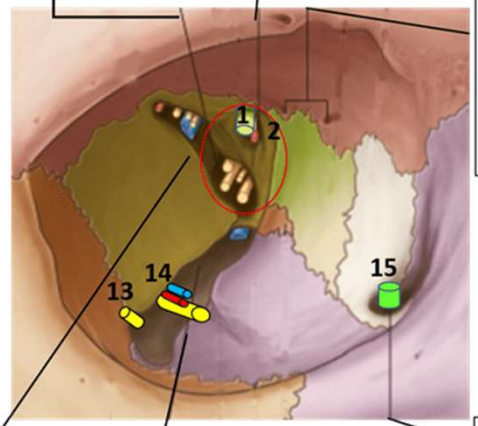
12. Inferior ophthalmic vein

Optic canal

1. Optic nerve with meninges
2. Ophthalmic artery

Anterior and posterior ethmoidal foramina

Anterior and posterior ethmoidal vessels and nerves

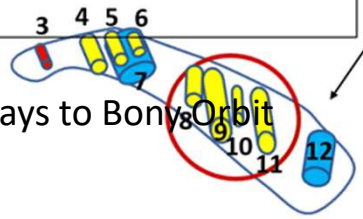


Inferior orbital fissure

13. Infraorbital nerve & vessels
14. Zygomatic nerve

Nasolacrimal canal

15. Nasolacrimal duct



Pathways to Bony Orbit

Bony Orbit

Clinical Relevance: Fractures of the Bony Orbit

- **Orbital rim fracture** – This is a fracture of the bones forming the outer rim of the bony orbit. It usually occurs at the sutures joining the three bones of the orbital rim – the maxilla, zygomatic and frontal.
- **'Blowout' fracture** – This refers to partial herniation of the orbital contents through one of its walls. This usually occurs via blunt force trauma to the eye. The medial and inferior walls are the weakest, with the contents herniating into the ethmoid and maxillary sinuses respectively.
- Any fracture of the orbit will result in intraorbital pressure, raising the pressure in the orbit, causing **exophthalmos** (protrusion of the eye). There may also be involvement of surrounding structures, – e.g haemorrhage into one of the neighbouring sinuses

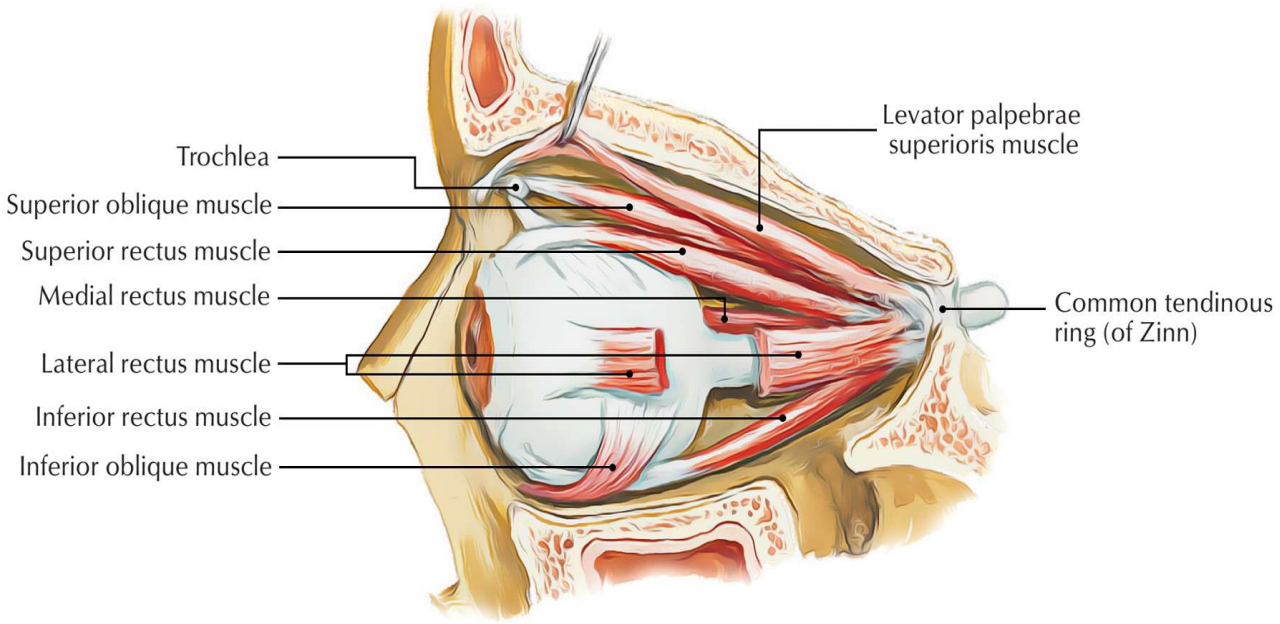
EYE

Extra Ocular Muscle

Extra Ocular Muscle

Contents

Bony Orbit



Extra Ocular Muscles

Extra Ocular Muscle

- The **extraocular muscles** are located within the orbit, but are extrinsic and separate from the eyeball itself. They act to control the movements of the **eyeball** and the **superior eyelid**.
- There are seven extraocular muscles – the levator palpebrae superioris, superior rectus, inferior rectus, medial rectus, lateral rectus, inferior oblique and superior oblique. Functionally, they can be divided into two groups:
- **Responsible for eye movement** – Recti and oblique muscles.
- **Responsible for superior eyelid movement** – Levator palpebrae superioris.

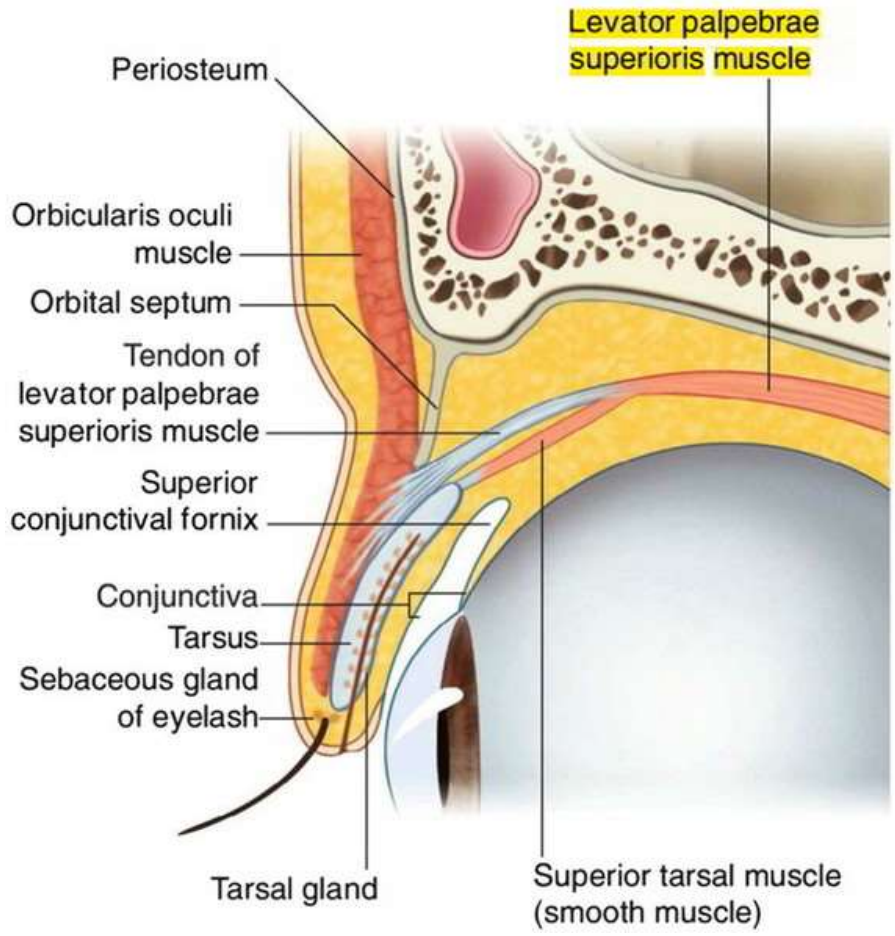
Extra Ocular Muscles

Levator Palpebrae Superioris

- The levator palpebrae superioris (LPS) is the only muscle involved in raising the superior eyelid. A small portion of this muscle contains a collection of smooth muscle fibres – known as the superior tarsal muscle. In contrast to the LPS, the superior tarsal muscle is innervated by the sympathetic nervous system.
- **Attachments:** Originates from the lesser wing of the sphenoid bone, immediately above the optic foramen. It attaches to the superior tarsal plate of the upper eyelid (a thick plate of connective tissue).
- **Actions:** Elevates the upper eyelid.
- **Innervation:** The levator palpebrae superioris is innervated by the oculomotor nerve (CN III). The superior tarsal muscle (located within the LPS) is innervated by the sympathetic nervous system.

Extra Ocular Muscle

LPS



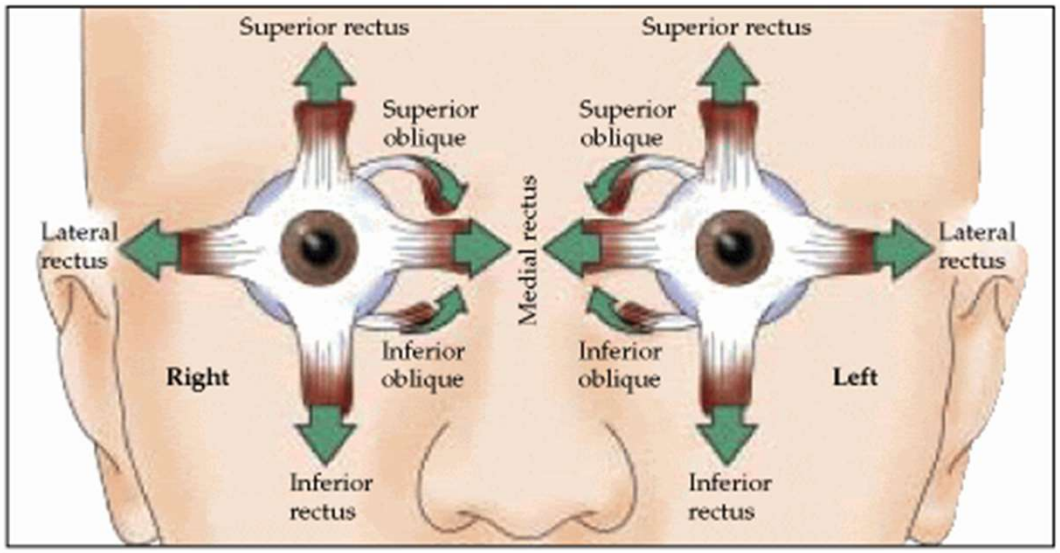
Extra Ocular Muscle

Muscles of Eye Movement

- There are six muscles involved in the control of the eyeball itself. They can be divided into two groups; the four recti muscles, and the two oblique muscles.
- **Recti Muscles**
- There are four recti muscles; superior rectus, inferior rectus, medial rectus and lateral rectus.
- These muscles characteristically originate from the **common tendinous ring**. This is a ring of fibrous tissue, which surrounds the optic canal at the back of the orbit. From their origin, the muscles pass anteriorly to attach to the sclera of the eyeball.
- The name recti is derived from the **latin** for 'straight' – this represents the fact that the recti muscles have a direct path from origin to attachment. This is in contrast with the oblique eye muscles, which have an angular approach to the eyeball.

Extra ocular Muscle

Movements of the Eye



Extra Ocular Muscle

Superior Rectus

- **Attachments**: Originates from the superior part of the common tendinous ring, and attaches to the superior and anterior aspect of the sclera.
- **Actions**: Main movement is elevation. Also contributes to adduction and medial rotation of the eyeball.
- **Innervation**: Oculomotor nerve (CN III).

Inferior Rectus

- **Attachments**: Originates from the inferior part of the common tendinous ring, and attaches to the inferior and anterior aspect of the sclera.
- **Actions**: Main movement is depression. Also contributes to adduction and lateral rotation of the eyeball.
- **Innervation**: Oculomotor nerve (CN III).

Extra Ocular Muscle

Medial Rectus

- **Attachments**: Originates from the medial part of the common tendinous ring, and attaches to the anteromedial aspect of the sclera.
- **Actions**: Adducts the eyeball.
- **Innervation**: Oculomotor nerve (CN III).

Lateral Rectus

- **Attachments**: Originates from the lateral part of the common tendinous ring, and attaches to the anterolateral aspect of the sclera.
- **Actions**: Abducts the eyeball.
- **Innervation**: Abducens nerve (CN VI).

Extra Ocular Muscle

Oblique Muscles

- There are two oblique muscles – the superior and inferior obliques. Unlike the recti group of muscles, they do not originate from the common tendinous ring.
- From their origin, the oblique muscles take an **angular** approach to the eyeball (in contrast to the straight approach of the recti muscles). They attach to the posterior surface of the sclera.

Superior Oblique

- **Attachments**: Originates from the body of the sphenoid bone. Its tendon passes through a trochlear, and then attaches to the sclera of the eye, posterior to the superior rectus.
- **Actions**: Depresses, abducts and medially rotates the eyeball.
- **Innervation**: Trochlear nerve (CN IV).

Extra Ocular Muscle

Inferior Oblique

- **Attachments**: Originates from the anterior aspect of the orbital floor. Attaches to the sclera of the eye, posterior to the lateral rectus
- **Actions**: Elevates, abducts and laterally rotates the eyeball.
- **Innervation**: Oculomotor nerve (CN III).

Extra Ocular Muscle

Clinical Relevance: Cranial Nerve Palsies

- The extraocular muscles are innervated by three cranial nerves. Damage to one of the cranial nerves will cause paralysis of its respective muscles. This will alter the resting gaze of the affected eye. Thus, a lesion of each cranial nerve has its own characteristic appearance:
- **Oculomotor nerve (CN III)** – A lesion of the oculomotor nerve affects most of the extraocular muscles. The affected eye is displaced laterally by the lateral rectus and inferiorly by the superior oblique. The eye adopts a position known as 'down and out'.
- **Trochlear nerve (CN IV)** – A lesion of CN IV will paralyse the superior oblique muscle. There is no obvious affect of the resting orientation of the eyeball. However, the patient will complain of diplopia (double vision), and may develop a head tilt away from the site of the lesion.
- **Abducens nerve (CN VI)** – A lesion of CN VI will paralyse the lateral rectus muscle. The affected eye will adducted by the resting tone of the medial rectus.
- *(A good tool to remember the innervation of the extraocular muscles is $LR_6 – SO_4 – R_3$)*

EYE

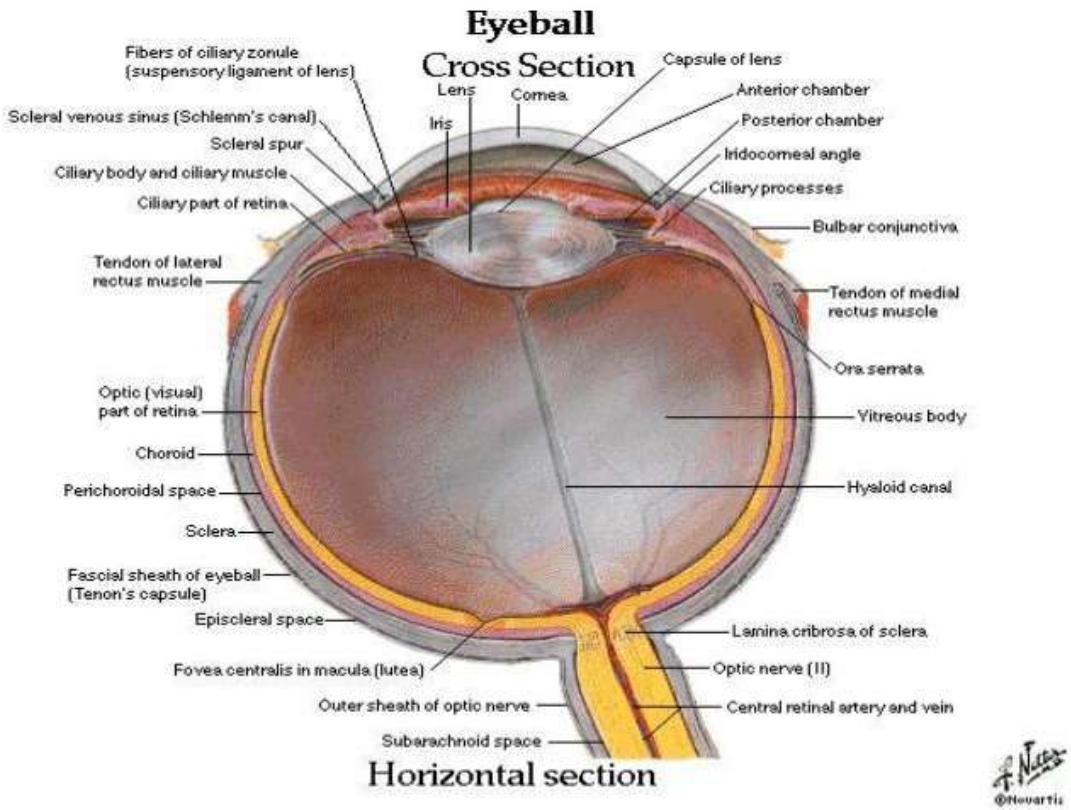
The Eye Ball

The Eye Ball

Contents

Eye Ball

Anatomical Structure



The Eye Ball

- The **eyeball** is a bilateral and spherical organ, which houses the structures responsible for vision. It lies in a bony cavity within the facial skeleton – known as the bony orbit.
- Anatomically, the eyeball can be divided into three parts – the **fibrous**, **vascular** and **inner** layers. In this article, we shall consider the anatomy of the eyeball in detail, and its clinical correlations.

The Eye Ball

Structure

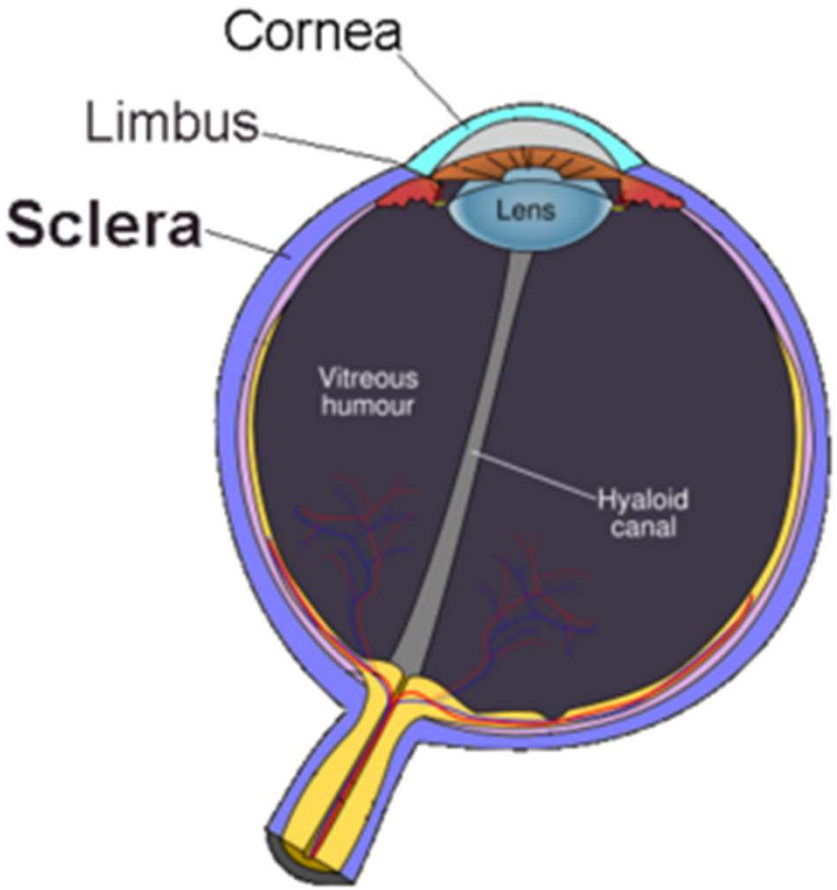
The eyeball can be divided into the fibrous, vascular and inner layers. These layers have different structures and functions. We shall now look at these layers in further detail.

Fibrous Layer

- The fibrous layer of the eye is the outermost layer. It consists of the **Sclera** and **Cornea**, which are continuous with each other. Their main functions are to provide shape to the eye and support the deeper structures.
- The **sclera** comprises the majority of the fibrous layer (approximately 85%). It provides attachment to the extraocular muscles – these muscles are responsible for the movement of the eye. It is visible as the white part of the eye.
- The **cornea** is transparent and positioned centrally at the front of the eye. Light entering the eye is refracted by the cornea.

Eye Ball

Fibrous Layer



The Eye Ball

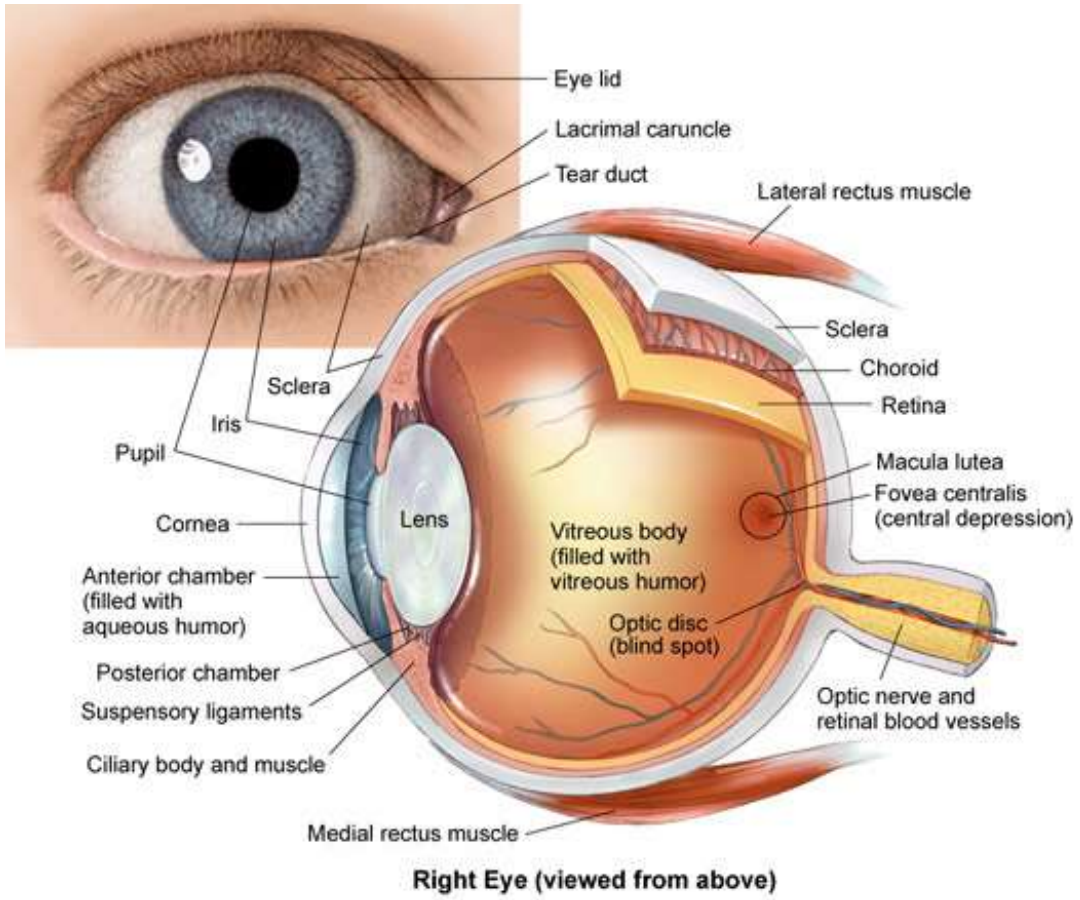
Vascular Layer

The vascular layer of the eye lies underneath the fibrous layer. It consists of The Choroid, Ciliary body and Iris:

- **Choroid** – layer of connective tissue and blood vessels. It provides nourishment to the outer layers of the retina.
- **Ciliary body** – comprised of two parts – the ciliary muscle and ciliary processes. The ciliary muscle consists of a collection of smooth muscles fibres. These are attached to the lens of the eye by the ciliary processes. The ciliary body controls the shape of the lens, and contributes to the formation of aqueous humor
- **Iris** – circular structure, with an aperture in the centre (the pupil). The diameter of the pupil is altered by smooth muscle fibres within the iris, which are innervated by the autonomic nervous system. It is situated between the lens and the cornea.

The Eye Ball

Vascular Layer



The Eye Ball

Inner Layer

The inner layer of the eye consists of the **retina**, the light detecting part of the eye. The retina itself is composed of two cellular layers:

- **Neural layer** – the innermost layer of the retina. It consists of photoreceptors; the light detecting cells of the retina. It is located posteriorly and laterally in the eye.
- **Pigmented layer** – the outer layer of the retina. It is attached to the choroid layer and acts to support the neural layer. It continues around the whole inner surface of the eye.
- Anteriorly, the pigmented layer continues but the neural layer does not – this is part is known as the **non-visual retina**. Posteriorly and laterally, both layers of the retina are present. This is the **optic** part of the retina.
- The optic part of the retina can be viewed during ophthalmoscopy. The centre of the retina is marked by an area known as the **macula**. It is yellowish in colour, and highly pigmented. The macula contains a depression called the fovea, which has a high concentration of light detecting cells. It is the area responsible for high acuity vision. The area that the optic nerve enters the retina is known as the optic disc – it contains no light detecting cells.

The Eye Ball

Other Structures in the Eyeball

Within the eyeball, there are structures that are not located in the three layers. These are the lens and the chambers of the eye.

Lens

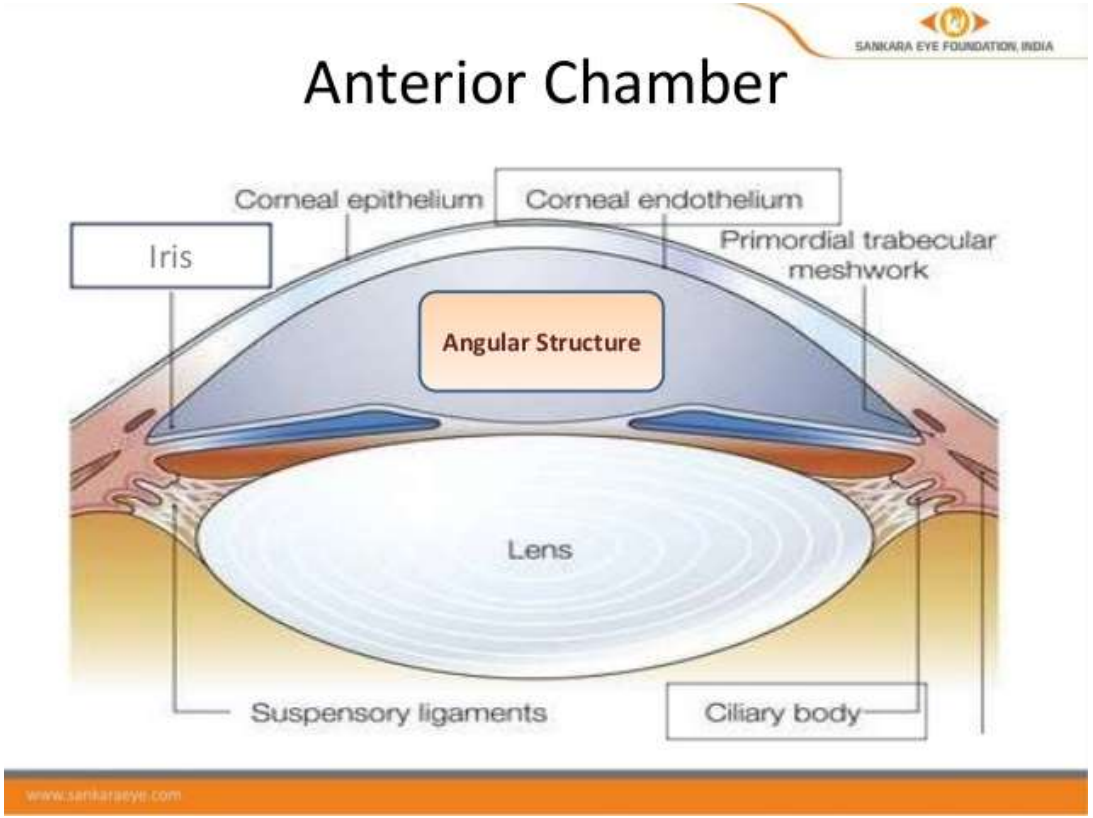
- The lens of the eye is located anteriorly, between the vitreous humor and the pupil. The shape of the lens is altered by the **ciliary body**, altering its refractive power. In old age, the lens can become opaque – a condition known as a cataract.

Anterior and Posterior Chambers

- There are two fluid filled areas in the eye – known as the **anterior** and **posterior chambers**. The anterior chamber is located between the cornea and the iris, and the posterior chamber between the iris and ciliary processes.
- The chambers are filled with **Aqueous Humor** – a clear plasma-like fluid that nourishes and protects the eye. The aqueous humor is produced constantly, and drains via the trabecular meshwork, an area of tissue at the base of the cornea, near the anterior chamber.
- If the drainage of aqueous humor is obstructed, a condition known as **Glaucoma** can result.

The Eye Ball

Anterior And Posterior Chamber



The Eye Ball

Vasculature

- The eyeball receives arterial blood primarily via the **ophthalmic artery**. This is a branch of the internal carotid artery, arising immediately distal to the cavernous sinus. The ophthalmic artery gives rise to many branches, which supply different components of the eye. The central artery of the retina is the most important branch – supplying the internal surface of the retina. Occlusion of this artery will quickly result in blindness.
- Venous drainage of the eyeball is carried out by the **superior** and **inferior ophthalmic veins**. These drain into the cavernous sinus, a dural venous sinus in close proximity to the eye.

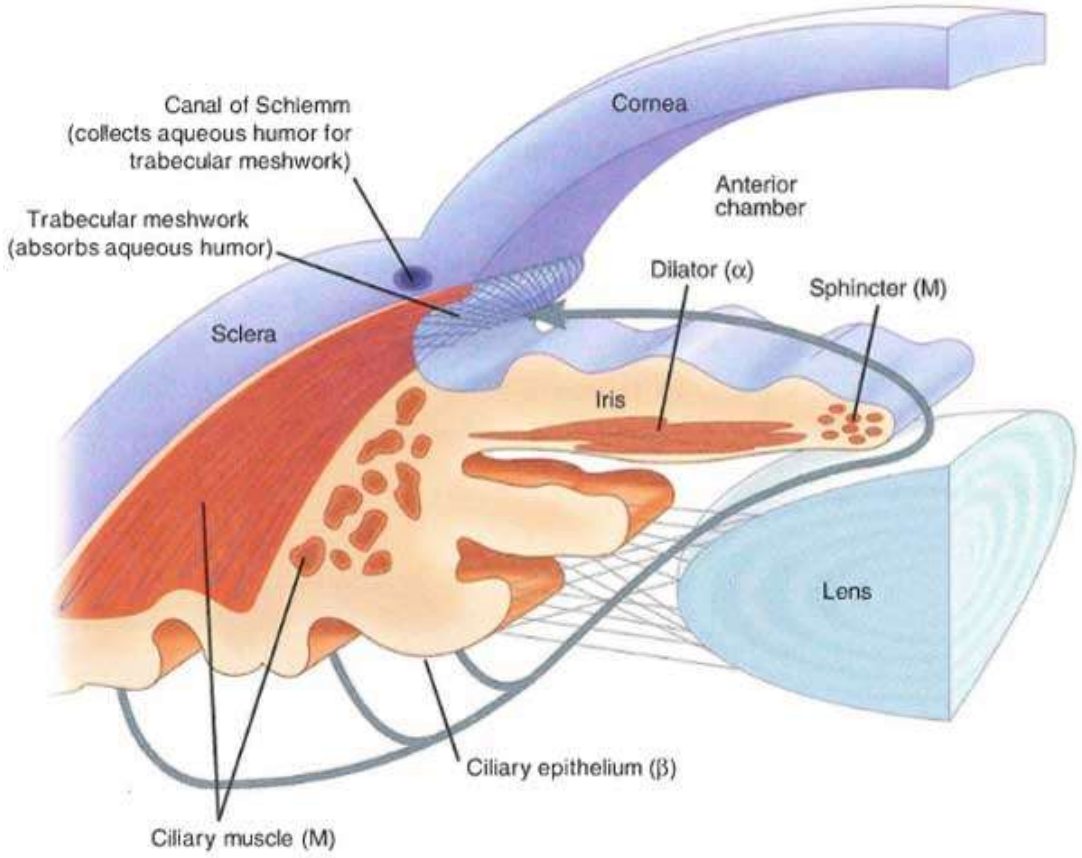
The Eye Ball

Clinical Relevance: Glaucoma

- **Glaucoma** refers to a group of eye diseases that result in damage to the optic nerve. There are two main clinical classifications of glaucoma:
- **Open angle** – where the outflow of aqueous humor through the trabecular meshwork is reduced. It causes a gradual reduction of the peripheral vision, until the end stages of the disease.
- **Closed angle** – where the iris is forced against the trabecular meshwork, preventing any drainage of aqueous humor. It is an ophthalmic emergency, which can rapidly lead to blindness.

The Eye Ball

Glaucoma



The Eye Ball

Clinical Relevance: Papilloedema

Papilloedema refers to swelling of the optic disc that occurs secondary to raised intracranial pressure. The optic disc is the area of the retina where the optic nerve enters and can be visualised using an ophthalmoscope.

Common causes include:

- Intracerebral mass lesions
- Cerebral haemorrhage
- Meningitis
- Hydrocephalus
- In papilloedema, the high pressure within the cranium resists venous return from the eye. This causes fluid to extravasate from blood vessels and collect in the retina, producing a swollen optic disc.

The Eye Ball

Papilledema

Early Papilledema

- Disc elevation.
- Venous distention and tortuosity.
- Obscuration of the normal disc margin and overlying retinal vessels.
- Absence of spontaneous venous pulsations

EYE

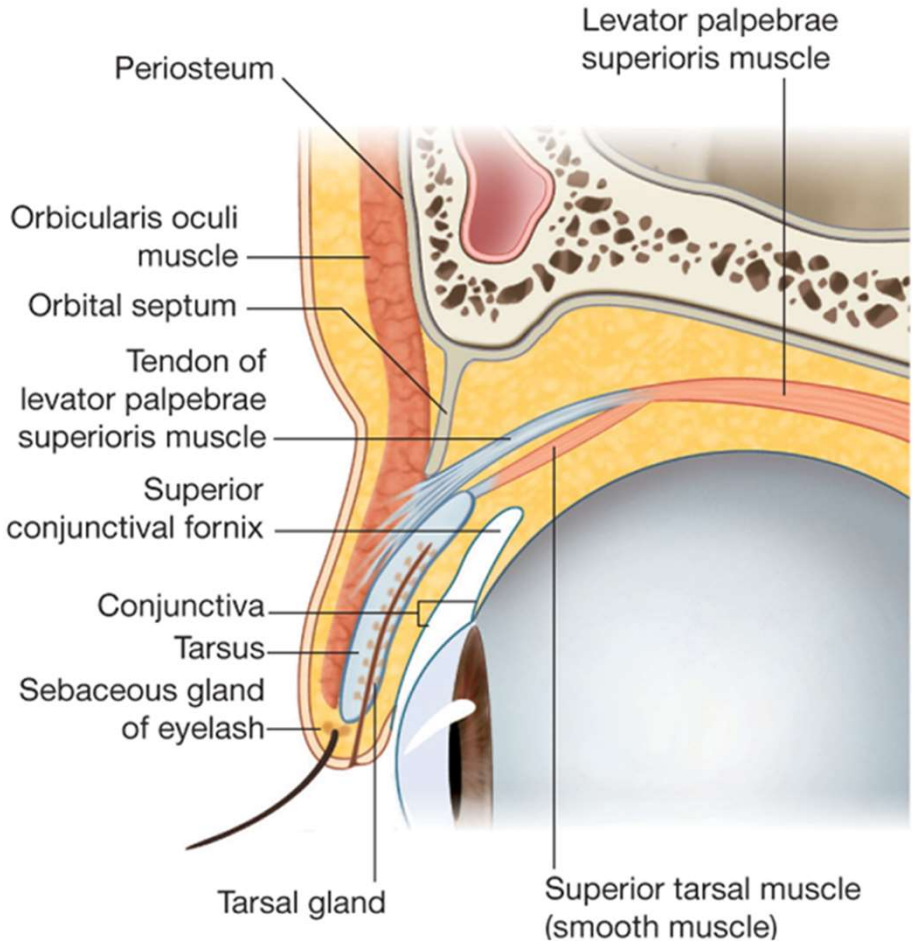
The EYE LID

EYE LID

Contents

Eye Lid

Layers



The Eye Lid

- The **eyelids** are thin, mobile folds that cover the eyeball anteriorly. They offer protection from excessive light or injury, and maintain lubrication by distributing tears over the surface of the eyeball.
- The eyelids are split into upper and lower portions, which meet at the medial and lateral canthi of the eye. The opening between the two eyelids is called the **palpebral aperture** or opening.
- In this article, we shall look at the anatomy of the **eyelids** – their layers, vasculature and innervation.

The Eye Lid

Layers of the Eyelid

The eyelid consists of five main layers (superficial to deep):

- Skin and Subcutaneous tissue
- Orbicularis oculi
- Tarsal plates
- Levator apparatus
- Conjunctiva

The Eye Lid

Skin and Subcutaneous Tissue

- The **skin** and **subcutaneous tissue** form the most superficial layer of the eyelid.
- The layer of skin is among the thinnest in the human body. In the subcutaneous layer, there is loose connective tissue but no subcutaneous fat – and subsequently, the eyelids are readily **distended** by oedema or blood.
- The eyelashes are attached here with their accompanying modified sweat glands – the **Ciliary Glands of Moll**. There are also sebaceous glands located in this layer, known as the Glands of Zeis.

The Eye Lid

Orbicularis Oculi

- The **orbicularis oculi** muscle has three distinct parts – palpebral, lacrimal and orbital.
- **Attachments** – Originates from the medial orbital margin, the medial palpebral ligament, and the lacrimal bone. It then inserts into the skin around the margin of the orbit, and the superior and inferior tarsal plates.
- **Actions:**
  - Palpebral part – gently closes the eyelids.
  - Lacrimal part – involved in the drainage of tears.
  - Orbital part – tightly closes the eyelids.
- **Innervation** – Facial nerve (CN VII, temporal and zygomatic branches)

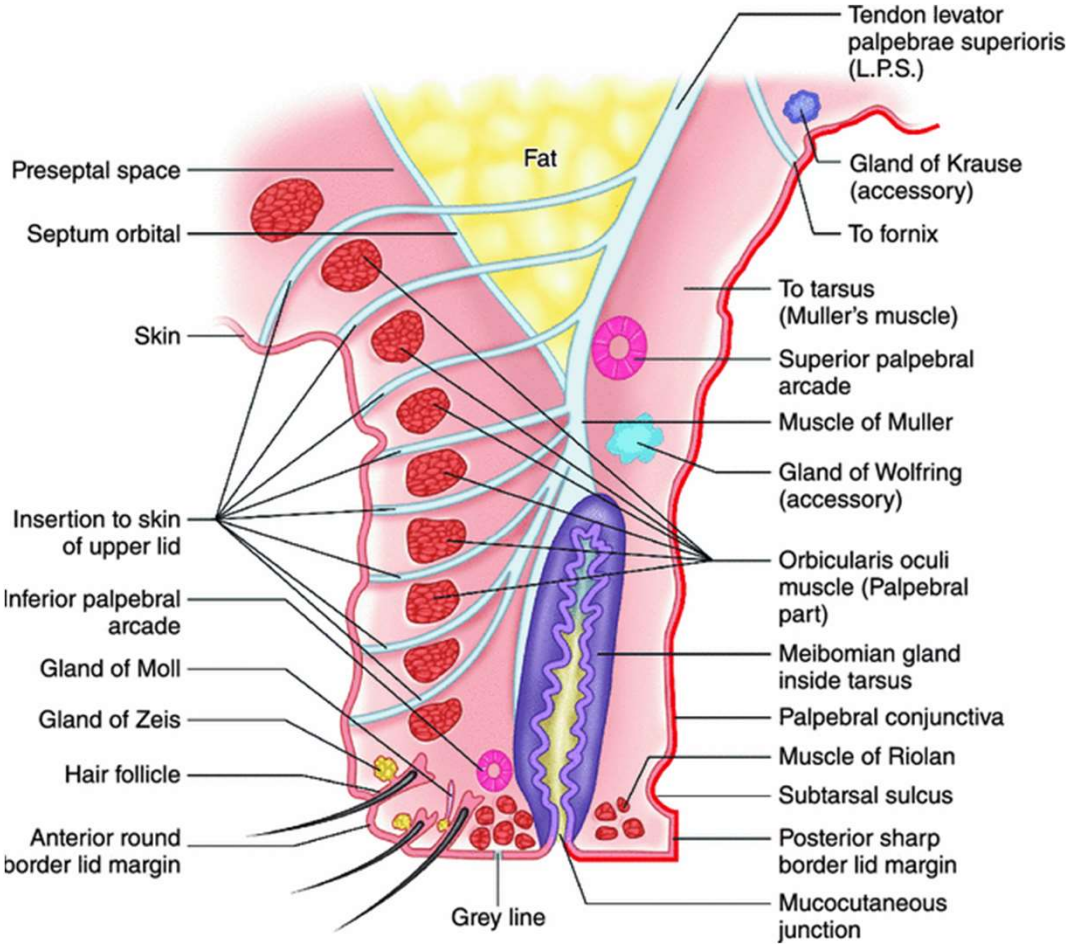
The Eye Lid

Tarsal Plates

- The **tarsal plates** are located deep to the palpebral region of the orbicularis oculi muscle. There are two plates; the superior tarsus (upper eyelid) and inferior tarsus (lower eyelid).
- They act to form the scaffolding of the eyelid, and are composed of **dense connective tissue**. The superior tarsus also acts as the attachment site of the levator palpebrae superioris.
- In the tarsal plates lie the **Meibomian glands** (also known as tarsal glands). These are a specialised type of sebaceous gland that secretes an oily substance onto the eye to slow the evaporation of the eye's tear film. The oily substance also prevents the eyelids from sticking together when closed.

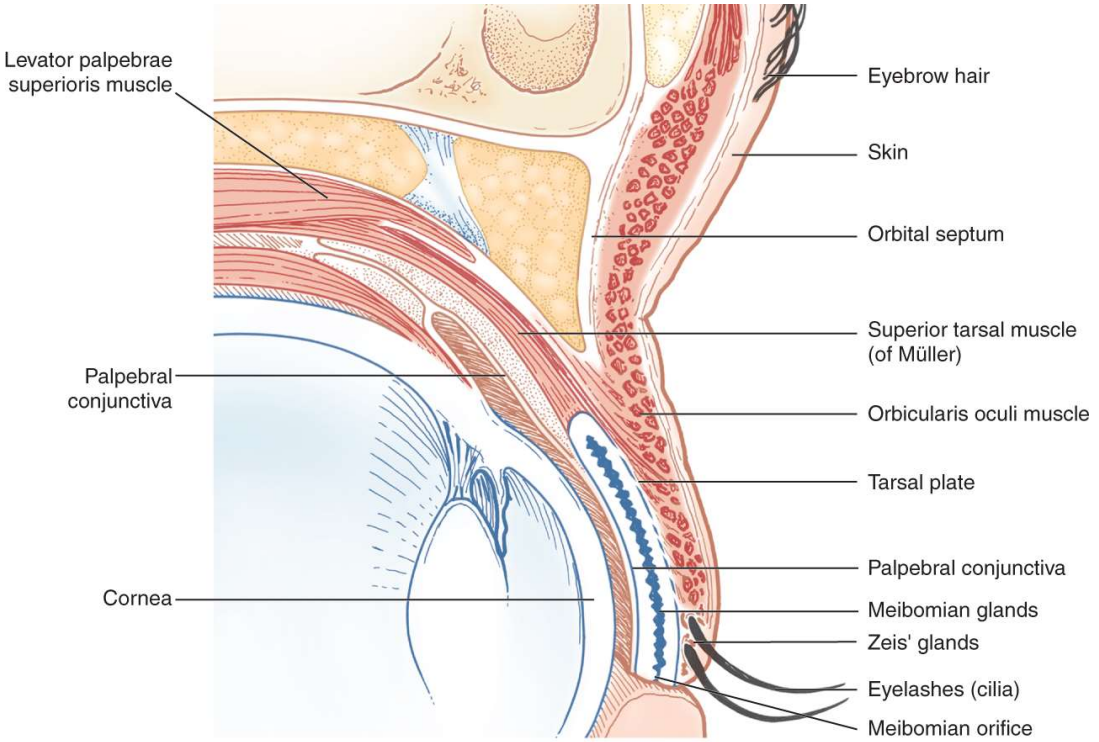
The Eye Ball

Glands Of Eye Lid



Eye Ball

Meibomian Gland



EYE

Clinical Relevance: Styes and Chalazion

- A Stye (or hordeolum) is an **infection** of a hair follicle or Meibomian glands around the eyelash. If affecting the hair follicles, they are described as **External**, and if they affect the Meibomian Glands they are classified as **internal**.
- Usually they are self-limiting, although they can sometimes be drained by removing the hair from the affected follicle.
- A chalazion is a **painless granuloma** of the Meibomian glands. It can be distinguished from a Stye by the absence of pain in a chalazion, whereas styes are normally painful.

EYE

The Eye Lid

	Levator Palpebrae Superioris	Superior Tarsal Muscle
Attachments	•Originates from the lesser wing of sphenoid, and inserts into the upper eyelid and the superior tarsal plate.	•Originates from the underside of levator palpebrae superioris and inserts into the superior tarsal plate.
Action	•Opens the eyelid.	•Assists the levator palpebrae superioris in opening the eyelid.
Innervation	•Superior branch of the oculomotor nerve (CN III).	•Sympathetic fibres from the superior cervical ganglion.

EYE

Conjunctiva

- The **Palpebral conjunctiva** forms the deepest layer of the eyelid.
- It is a thin **mucous membrane,** which is reflected onto the sclera of the eyeball (Bulbar conjunctiva).

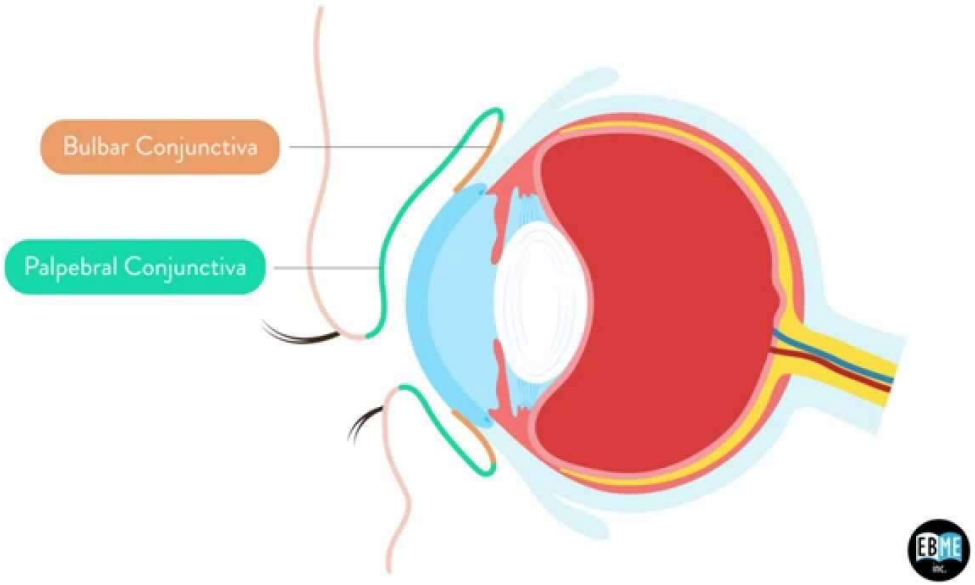
Vasculature

The eyelid has a rich arterial supply from numerous vessels:

- **Ophthalmic artery** – lacrimal, medial palpebral, supraorbital and supratrochlear arteries.
- **Facial artery** – angular branch.
- **Superficial temporal artery** – transverse facial artery branch.
- Venous drainage is provided by a rich network around the eyelid. Medially, blood drains via the medial palpebral vein into the angular and ophthalmic veins. Laterally, blood drains into the **superficial temporal vein** from the lateral palpebral vein.

The Eye

Conjunctiva



Eye Lid

Innervation

- Sensory innervation to the eyelids is supplied by branches of the trigeminal nerve:
- **Ophthalmic nerve (V1)** – Upper eyelid.
  - Supraorbital, supratrochlear, infratrochlear and lacrimal branches.
- **Maxillary nerve (V2)** – Lower eyelid.
  - Infraorbital and zygomaticofacial branches.
- As discussed above, innervation to the muscles of the eyelid is via the **facial nerve**(orbicularis oculi), oculomotor nerve (levator palpebrae superioris) and sympathetic fibres (superior tarsal muscle).

EYE

Lacrimal Gland

Lacrimal Gland

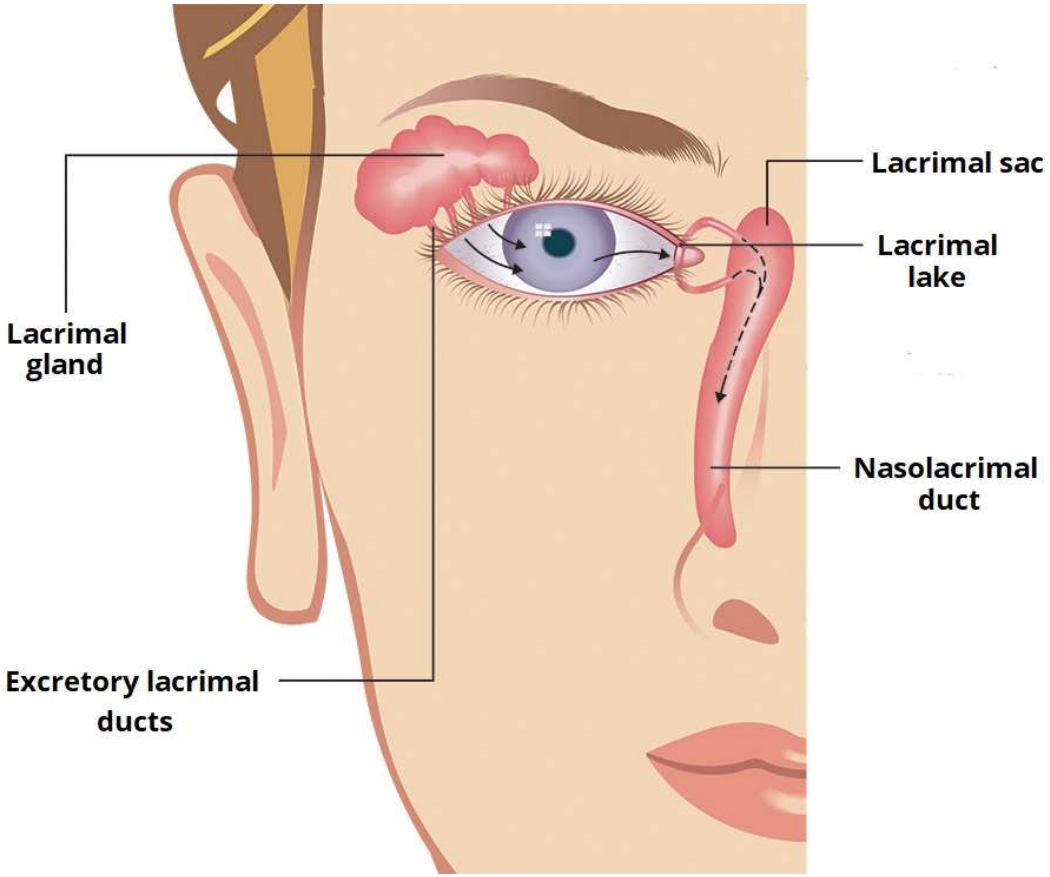
Contents

Lacrimal Gland

- The **lacrimal glands** are serous type Exocrine Glands that secrete lacrimal fluid onto the surfaces of the conjunctiva and cornea of the eye.
- **Lacrimal fluid** acts to the clean, nourish and lubricate the eyes. It forms tears when produced in excess.
- In this article, we shall look at the **anatomy of the lacrimal glands** – their location, neurovascular supply and clinical relevance.

The Eye

Lacrimal Gland



Lacrimal Gland

Anatomical Location

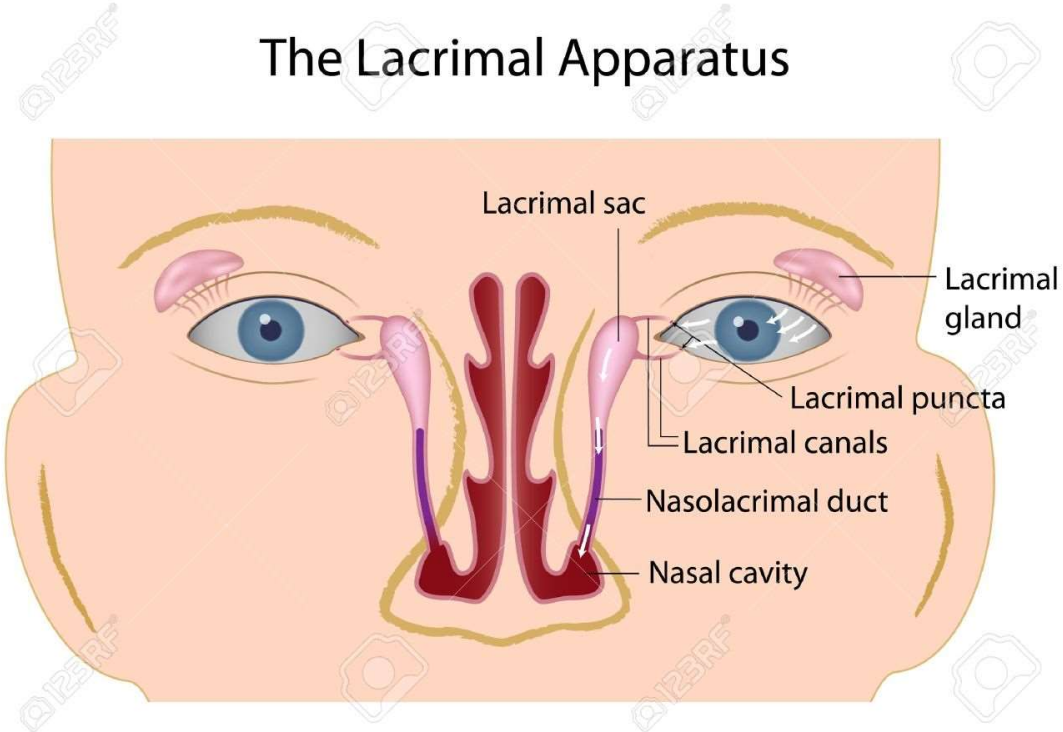
The **lacrimal gland** is located anteriorly in the superolateral aspect of the orbit, within the lacrimal fossa – a depression in the orbital plate of the frontal bone.

Its anatomical relations include:

- **Superior** – zygomatic process of frontal bone
- **Anterior** – orbital septum
- **Posterior** – orbital fat
- **Inferolateral** – lateral rectus muscle

Eye Ball

Lacrimal Gland



Lacrimal Gland

Anatomical Structure

The lacrimal gland is approximately 2cm long. It can be divided into two main parts:

- **Orbital** – larger and sits on the lateral margin of the Levator Palpabrae Superioris muscle.
- **Palprebral** – smaller and is located along the inner surface of the eyelid.
- The lacrimal gland is a compound **Tubuloacinar** gland, comprised of lobules – which are formed by multiple acini. The acini contain serous cells and produce a watery serous secretion (lacrimal fluid).
- The lacrimal fluid produced by the gland is secreted into excretory ducts, which empty into the **superior conjunctival fornix**. The fluid is then 'spread' over the cornea by the process of blinking.

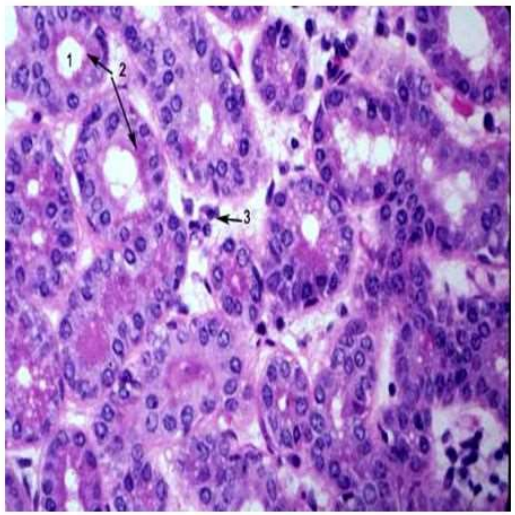
Eye

Lacrimal Gland

Anatomy

Lacrimal gland

- The lacrimal gland is tubuloacinar gland derived from surface ectoderm with ducts lined by a **low columnar or cuboidal epithelium** (often bilayered).
- The secretory cells in the acini have a predominance of dense granules, suggesting that most are of a serous nature
- However, some cells are mucus producing



Lacrimal Gland

Lacrimal Apparatus

- The **lacrimal apparatus** is the system responsible for the drainage of lacrimal fluid from the orbit.
- After secretion, lacrimal fluid circulates across the eye, and accumulates in the **lacrimal lake**– located in the medial canthus of the eye. From here, it drains into the lacrimal sac via a series of canals.
- The lacrimal sac is the dilated end of the **nasolacrimal duct**, and is located in a groove formed by the lacrimal bone and frontal process of the maxilla. Lacrimal fluid drains down the nasolacrimal duct and empties into the inferior meatus of the nasal cavity.

Lacrimal Gland

Vasculature

- The main arterial supply to the lacrimal gland is from the **lacrimal artery**, which is derived from the ophthalmic artery – a branch of the internal carotid.
- Venous drainage is via the **superior ophthalmic vein**, and ultimately empties into the cavernous sinus.
- Lymphatic drainage is to the **superficial parotid lymph nodes**. They empty into the superior deep cervical nodes.

Lacrimal Gland

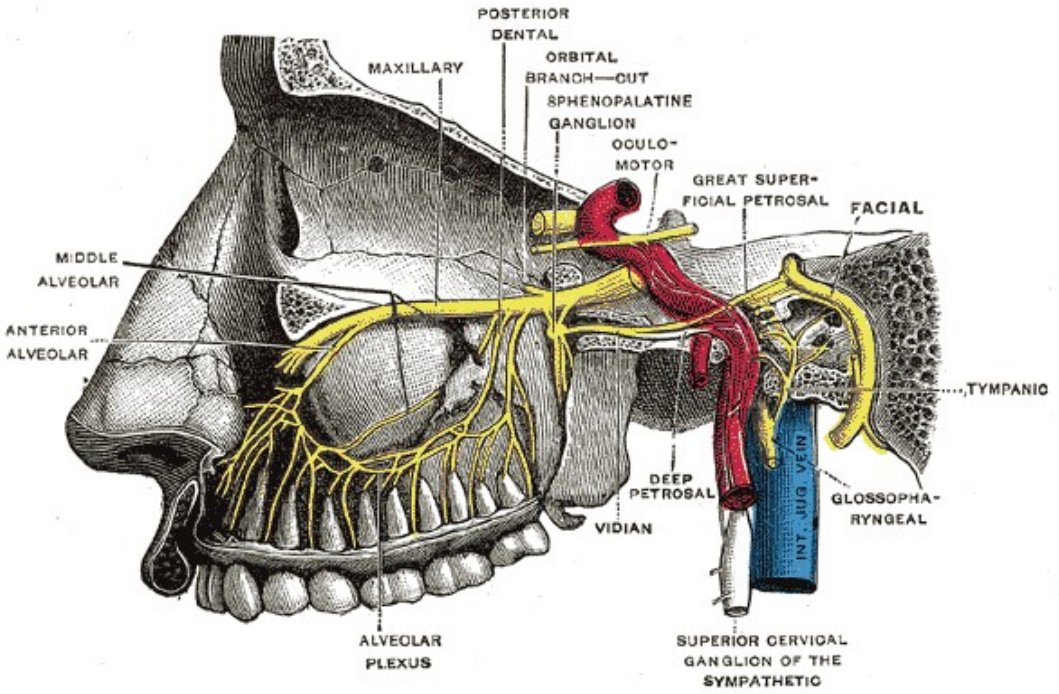
Innervation

- The sensory innervation to the lacrimal gland is via the **lacrimal nerve**. This is a branch of the ophthalmic nerve (in turn derived from the trigeminal nerve).
- The lacrimal gland also receives autonomic nerve fibres:
- **Parasympathetic:**
  - Preganglionic fibres are carried in the greater petrosal nerve (branch of the facial nerve) and then the nerve of pterygoid canal, before synapsing at the pterygopalatine ganglion.
  - Postganglionic fibres travel with the maxillary nerve, and finally the zygomatic nerve.
  - Stimulates fluid secretion from the lacrimal gland

Eye Ball

Lacrimal Gland

Innervation



Lacrimal Gland

Clinical Relevance: Dacryoadenitis

Dacryoadenitis refers to inflammation of the lacrimal glands.

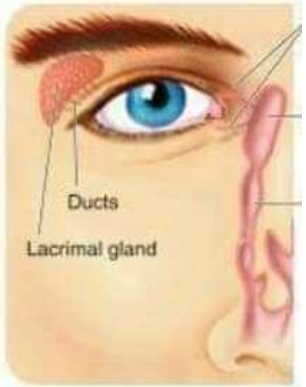
- It can present acutely or chronically:
- **Acute dacryoadenitis** – typically due to a viral and bacterial infection such as mumps, Epstein-Barr virus, staphylococcus and gonococcus.
- **Chronic dacryoadenitis** – usually due to a non-infectious inflammatory condition such as sarcoidosis or thyroid eye disease associated with Grave's disease.
- Clinical features include swelling, pain and **excess tear production**. The swelling can lead to visual impairment, secondary to pressure on the eye.
- If the cause is viral, simple rest and warm compresses can be helpful. For other causes, treating the underlying cause is necessary and effective.

Lacrimal Gland

Dacryocystitis

Dacryocystitis

→ Infection of the nasolacrimal system



Clinical

- Unilateral, painful
- Erythema, swelling, warmth
- Tenderness of lacrimal sac
- Possibly purulent discharge
- Epiphora (overflow of tears)

Complications

- Preseptal or orbital cellulitis
- Meningitis

ANATOMY

HEAD

HEAD

ORGANS

- **THE EAR**
- **THE EYE**
- **NOSE AND SINUSES**
- **SALIVARY GLANDS**
- **ORAL CAVITY**

The External Nose

Contents

External Nose

The external nose is a visible component of the face, projecting over and allowing entrance into the nasal cavity. This article will discuss the anatomy of the external nose – its skeletal structure, muscles, blood supply and innervation.

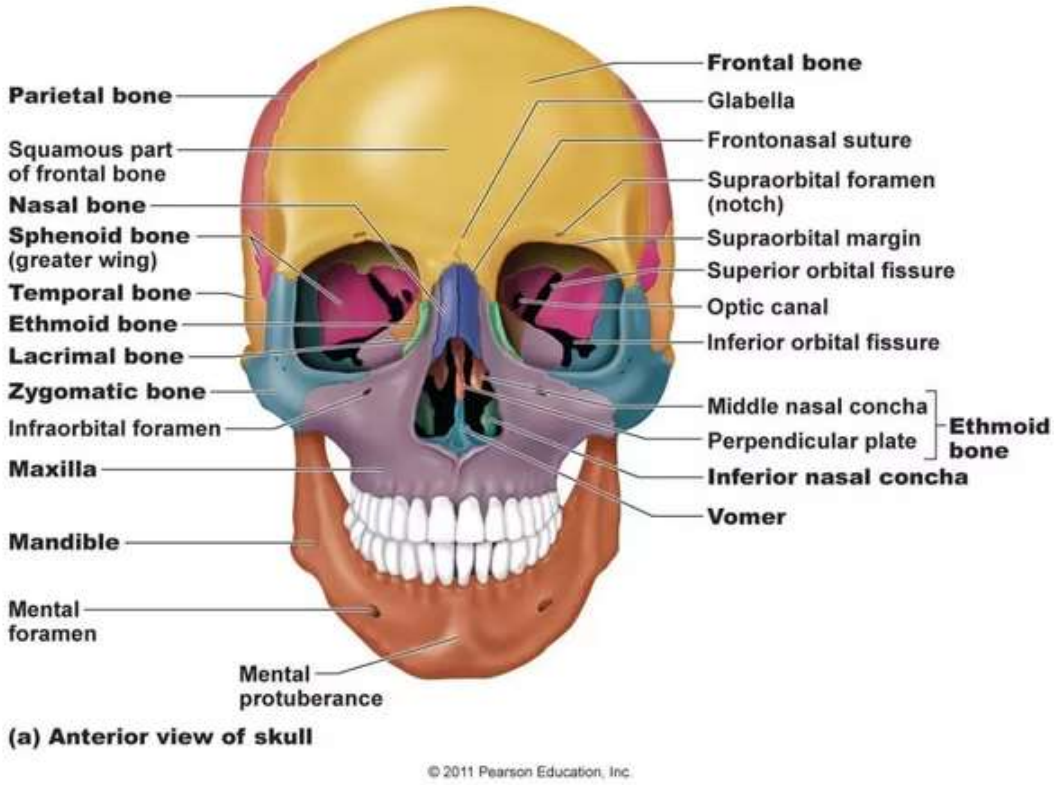
External Nose

Surface Appearance

- The external nose is said to have a pyramidal shape. The **nasal root** is located superiorly, and is continuous with the forehead. The apex of the nose ends inferiorly in a rounded 'tip'. Spanning between the root and apex is the **dorsum** of the nose.
- Located immediately inferiorly to the apex are the **nares**; piriform openings into the vestibule of the nasal cavity. The nares are bounded medially by the **Nasal Septum**, and laterally by the **Ala Nasi** (the lateral cartilaginous wings of the nose).

External Nose

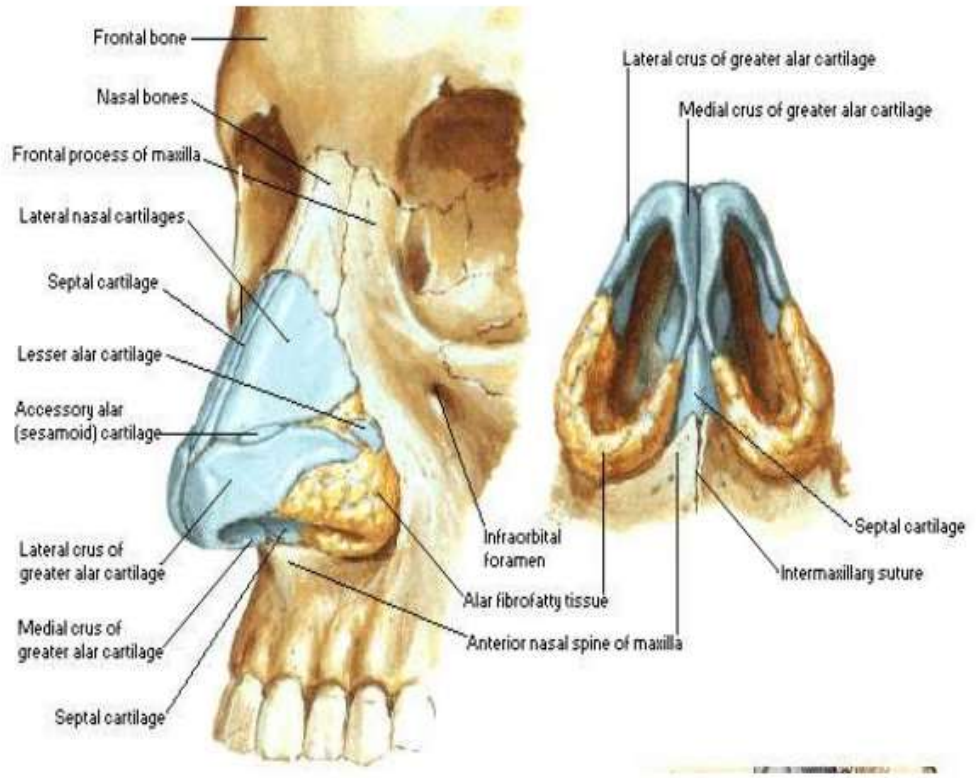
Bony Skeleton



(a) Anterior view of skull

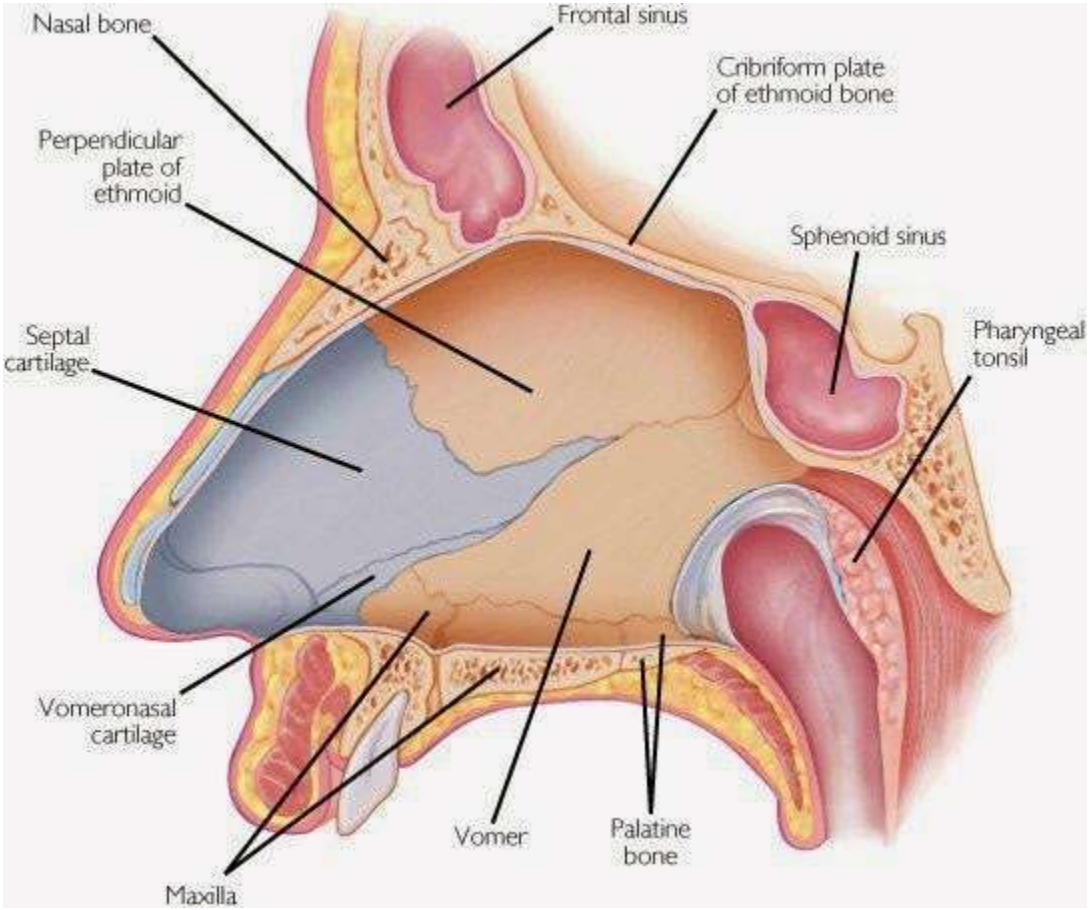
External Nose

Nasal Cartilages



External Nose

Nasal Septum



External Nose

Skeletal Structure

The skeleton of the external nose is made of both bony and cartilaginous components:

- **Bony component** – located superiorly, and is comprised of contributions from the nasal bones, maxillae and frontal bone.
- **Cartilaginous component** – located inferiorly, and is comprised of the two lateral cartilages, two alar cartilages and one septal cartilage. There are also some smaller alar cartilages present.
- Whilst the skin over the bony part of the nose is thin, that overlying the cartilaginous part is thicker with many sebaceous glands. This skin extends into the vestibule of the nose via the nares. Here there are hairs which function to filter air as it enters the respiratory system.

External Nose

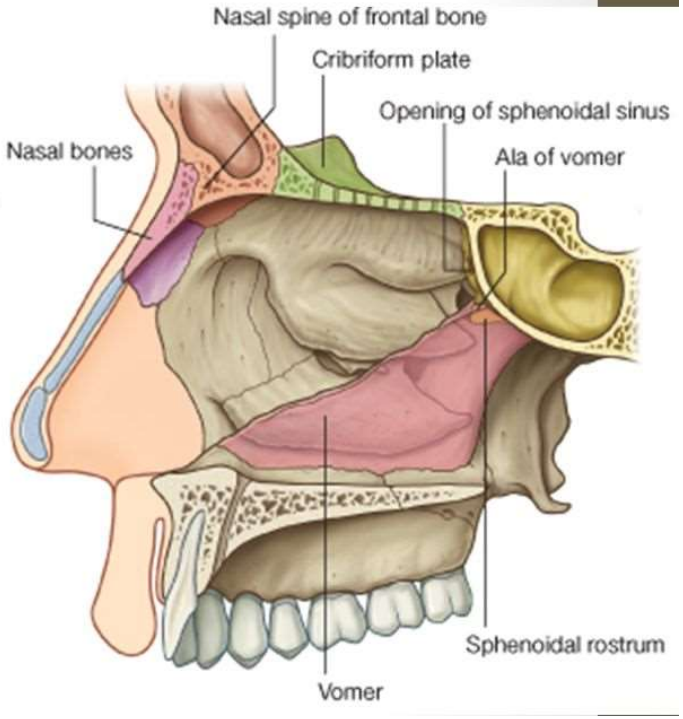
Lateral Wall

Roof

- narrow

Formed by :

1. cribriform plate of the ethmoid bone
2. nasal and frontal bones, and posteriorly sphenoid Bone.



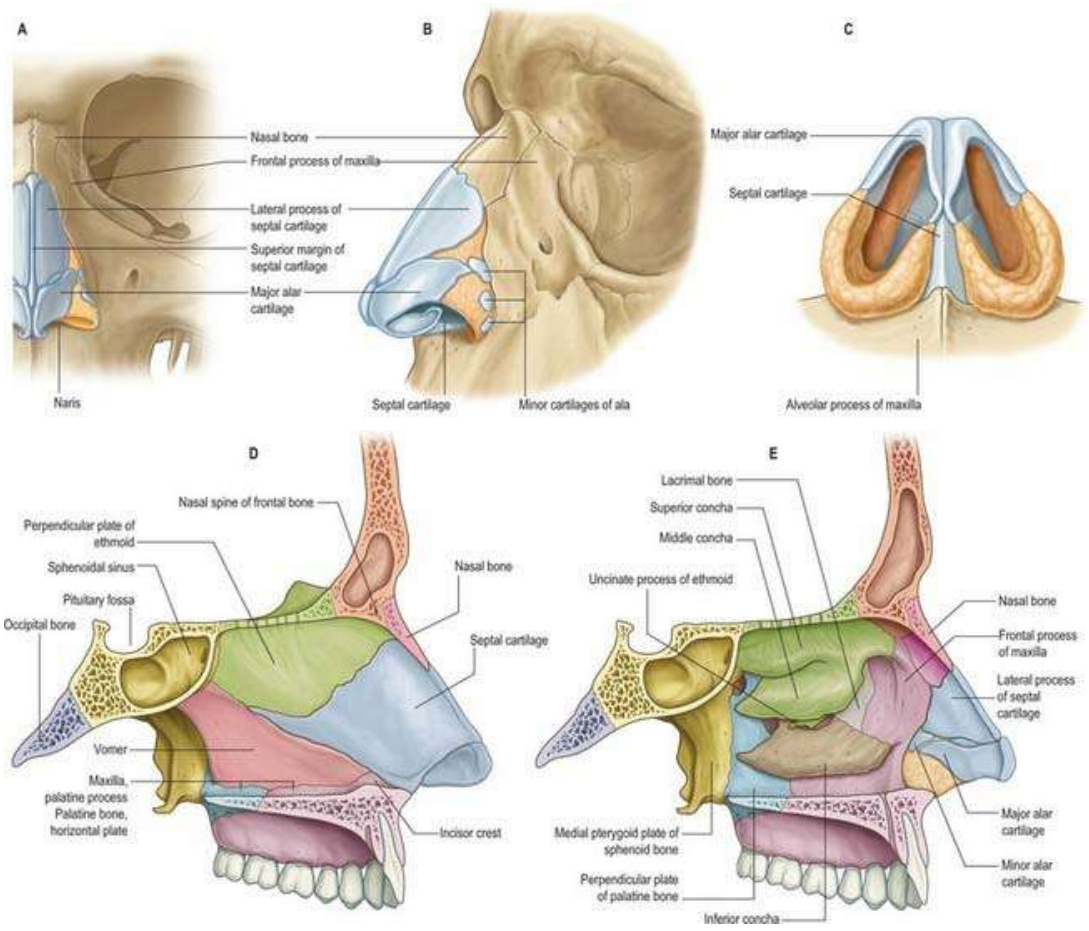
External Nose

Clinical Relevance – Saddle Nose Deformity

- The saddle nose deformity occurs primarily as a result of nasal trauma; whereby septal support to the nose is lost, and subsequently the middle part of the nose appears sunken. This is either a result of direct damage to the septal bone or cartilage, or a consequence of **nasal septal haematoma**.
- As cartilage has no blood supply of its own, it relies on oxygen and nutrients diffusing from blood vessels in the surrounding perichondrium. A haematoma between these two structures can result in destruction of the septum, and therefore deformity of the nose.

External Nose

Anatomy



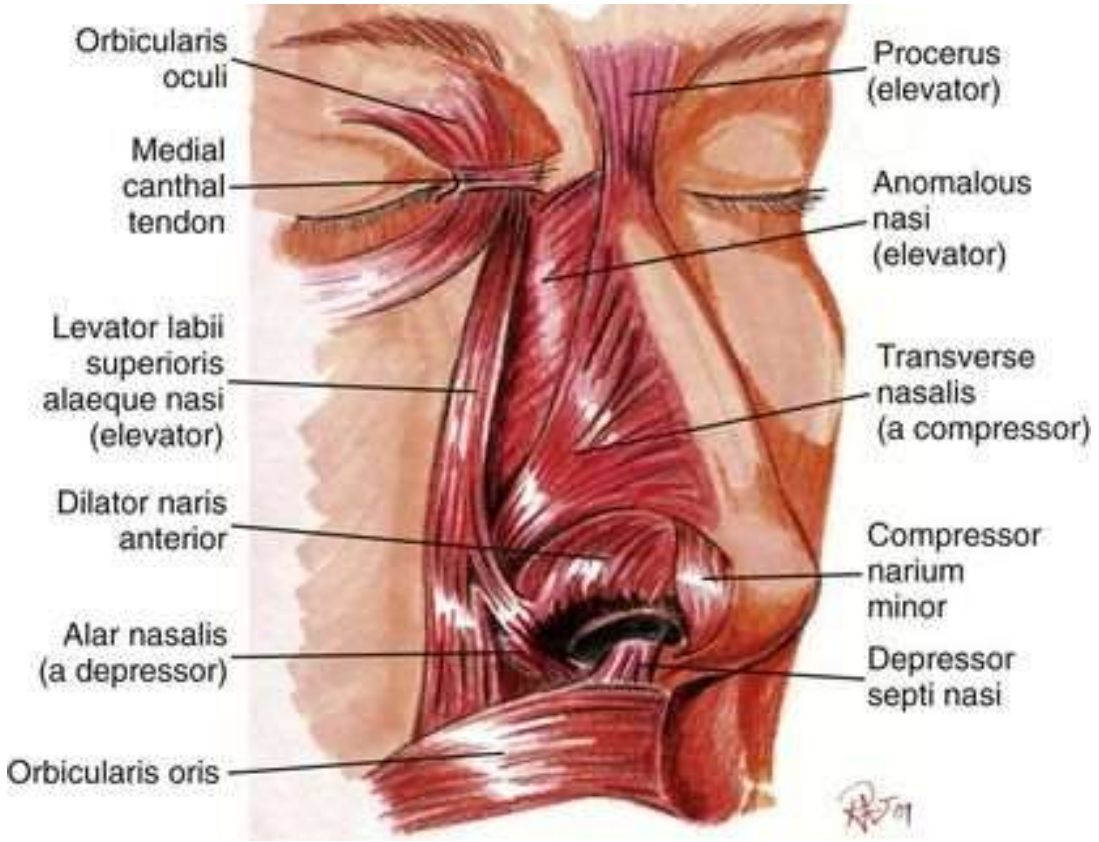
External Nose

Muscles

- A number of small muscles insert into the external nose, contributing to facial expression. All these muscles are innervated by branches of the **facial nerve (CN VII).**
- The **procerus** muscle originates in the fascia overlying the nasal bone and lateral nasal cartilage, inserting into the inferior forehead. Contraction can depress the medial eyebrows, and wrinkles the skin of the superior dorsum.
- The transverse portion of the **Nasalis** muscle assists the procerus muscle in this action. Meanwhile the alar part of nasalis arises from the maxilla, inserting into the major alar cartilage. This allows the muscle to dilate the nares, “flaring” them. This action is assisted by the **Depressor septi nasi.**

External Nose

Muscles Of the Nose



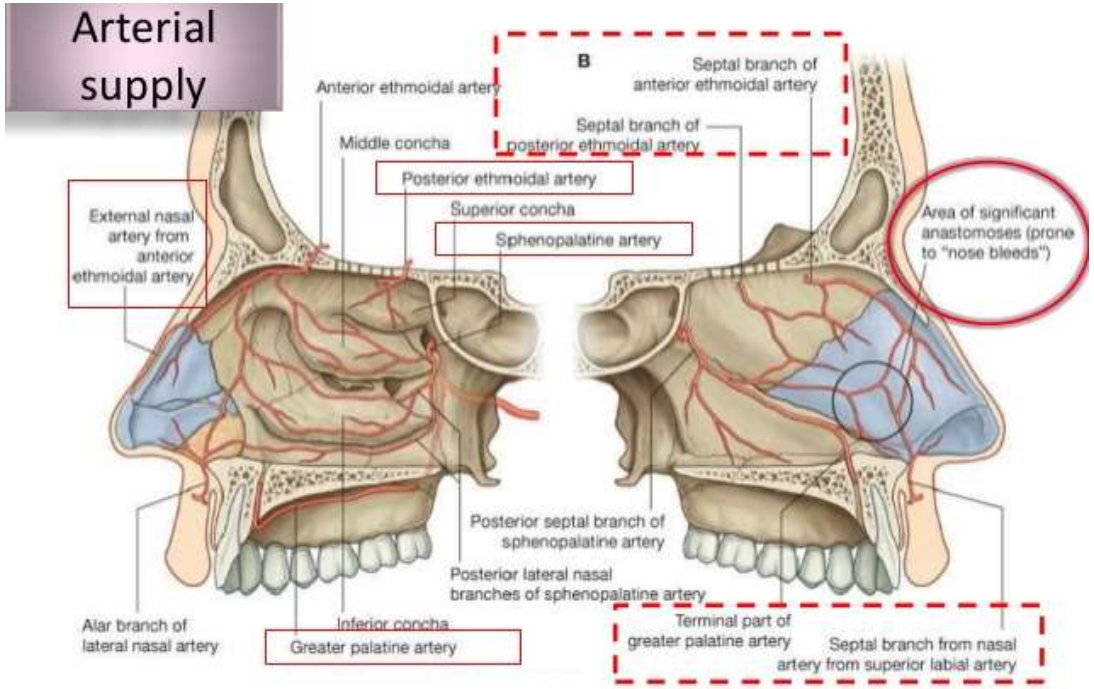
External Nose

Vessels and Lymphatics

- The skin of the external nose receives arterial supply from branches of the maxillary and ophthalmic arteries. The septum and alar cartilages receive additional supply from the **angular** artery and **lateral nasal** artery. These are both branches of the **facial artery** (derived from the external carotid artery).
- Venous drainage is into the **facial vein**, and then in turn into the internal jugular vein.
- Lymphatic drainage from the external nose is via superficial lymphatic vessels accompanying the facial vein. These vessels, like all lymphatic vessels of the head and neck, ultimately drain into the **deep cervical lymph nodes**.

External Nose

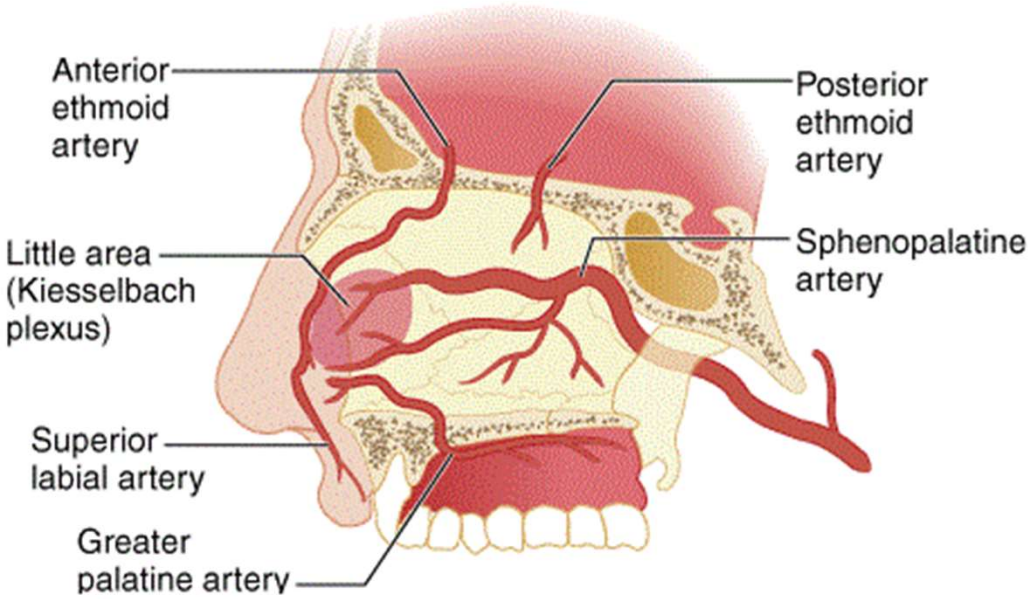
Blood Supply



Plane of dissection to mobilise soft tissue should be closer to bone or cartilage to avoid injury to muscles and superficial vessels

External Nose

Blood Supply



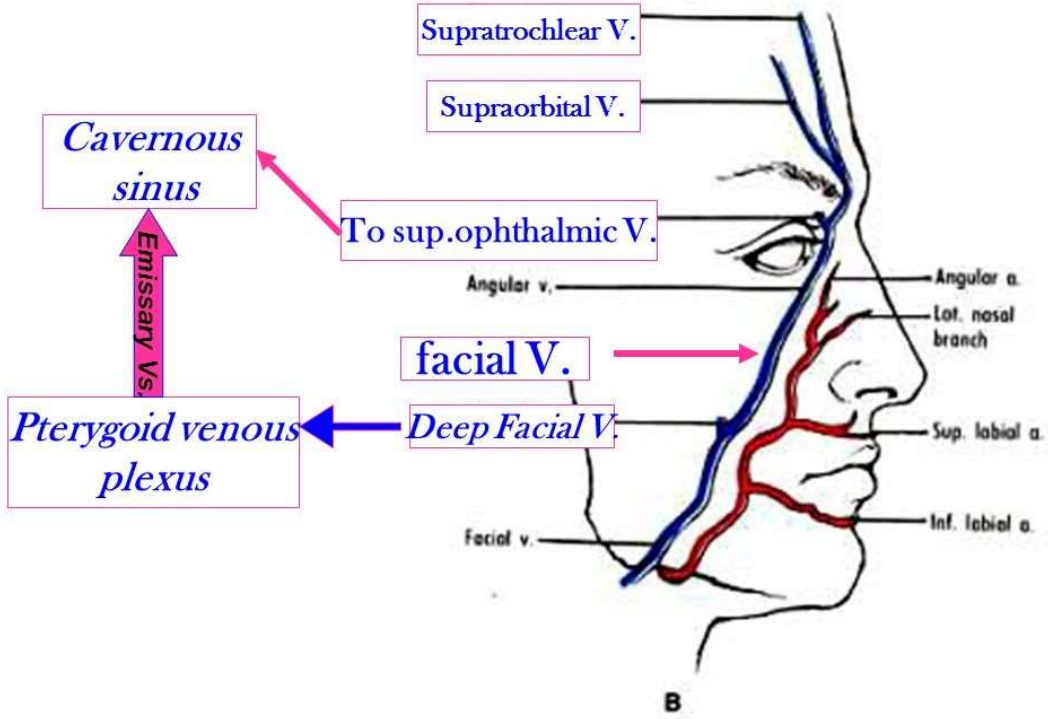
External Nose

Clinical Relevance: Danger Triangle of the Face

- The venous drainage of the nose and surrounding area is unique as a result of communication between the **facial vein** and **cavernous sinus**, via the **ophthalmic vein**.
- As the cavernous sinus lies within the cranial cavity, this enables infections from the nasal area to spread to the brain. This retrograde spread of infection can therefore cause cavernous sinus thrombosis, meningitis or brain abscess.

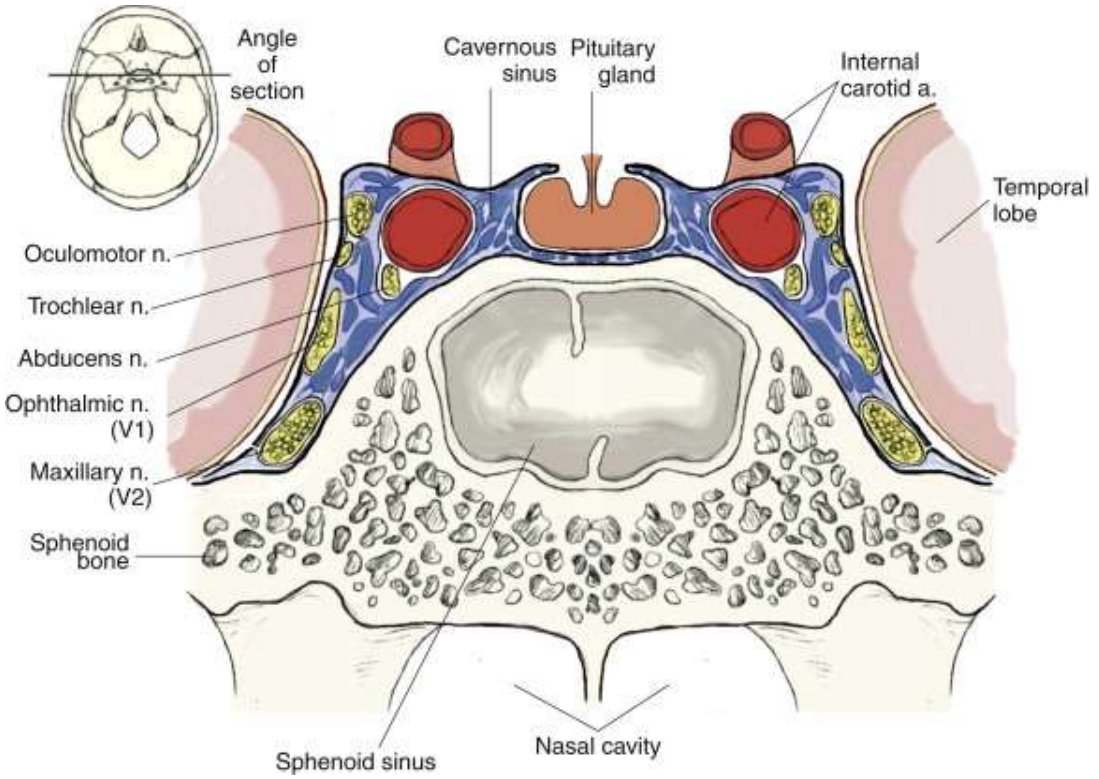
External Nose

Dangerous Area of the Face



External Nose

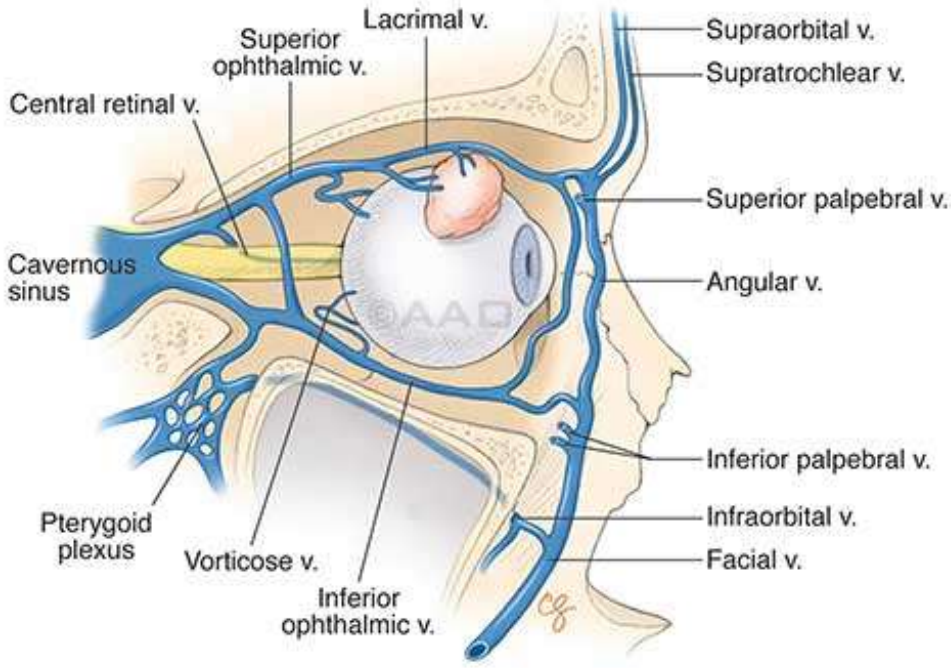
Cavernous sinus



External Nose

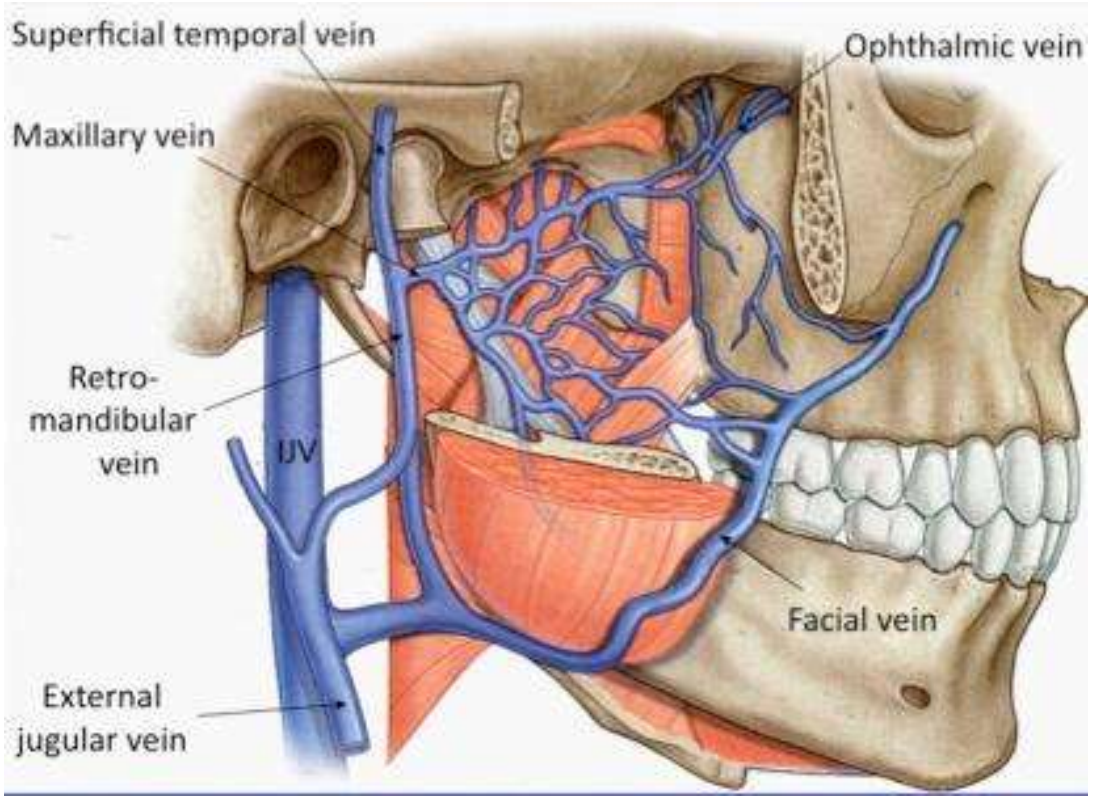
Cavernous Sinus

1



External Nose

Dangerous Area Of the Face



External Nose

Innervation

- Sensory innervation of the external nose is derived from the **trigeminal nerve (CN V).** The **external nasal nerve**, a branch of the ophthalmic nerve (CN V_1), supplies the skin of the dorsum of nose, nasal alae and nasal vestibule. The lateral aspects of the nose are supplied by the **infrorbital nerve**, a branch of the maxillary nerve (CN v_2).
- Motor innervation to the nasal muscles of facial expression is via the **facial nerve (CN VII).**

HEAD

Organs of the Head

Head

Organs of the Head

Salivary Gland

- Parotid Gland
- Submandibular
- Sublingual

Parotid Gland

Contents

Parotid Gland

- The parotid gland is a bilateral **salivary gland** located in the face. It produces **Serous Saliva**, a watery solution rich in enzymes. This is then secreted into the oral cavity, where it lubricates and aids in the breakdown of food.
- In this article, we shall look at the location, vasculature and innervation of the parotid gland. We shall also consider any clinical correlations.

Parotid Gland

Anatomical Position

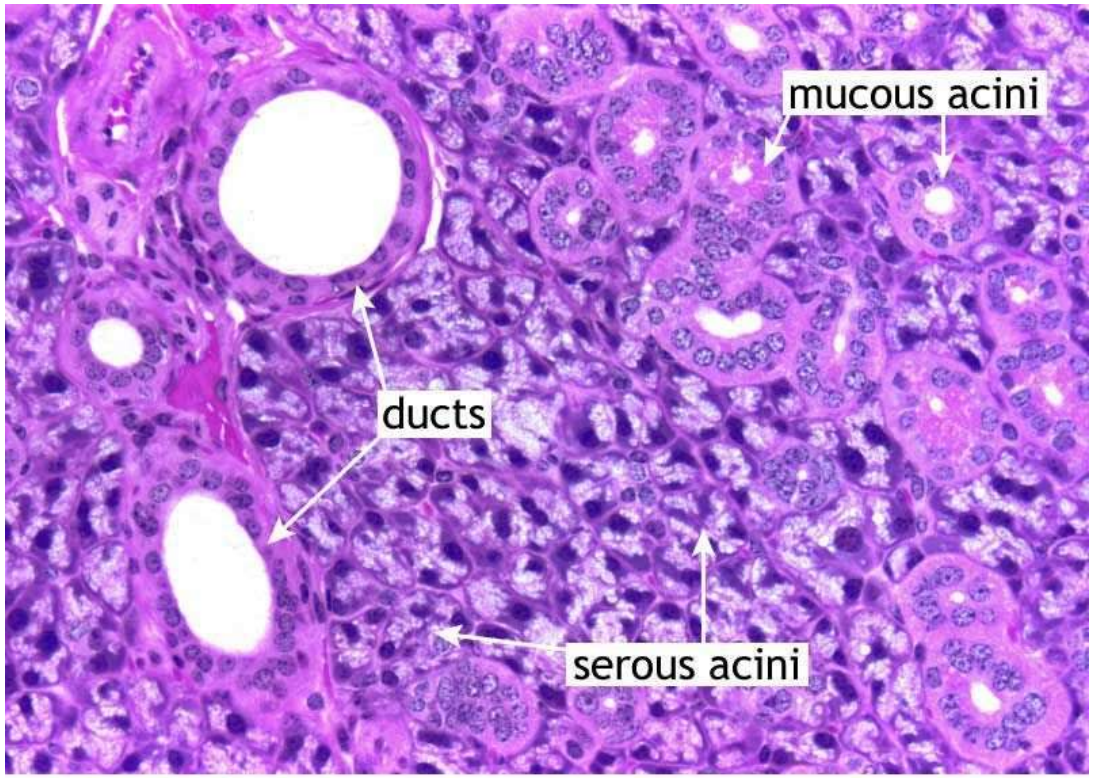
- The parotid gland is a bilateral structure, which displays a lobular and irregular morphology. Anatomically, it can be divided into **deep** and **superficial lobes**, which are separated by the facial nerve.

It lies within a deep hollow, known as the **parotid region**. The parotid region is bounded as follows:

- **Superiorly** – Zygomatic arch.
- **Inferiorly** – Inferior border of the mandible.
- **Anteriorly** – Masseter muscle.
- **Posteriorly** – External ear and Sternocleidomastoid.
- The secretions of the parotid gland are transported to the oral cavity by the **Stensen Duct.** It arises from the anterior surface of the gland, traversing the **masseter** muscle. The duct then pierces the Buccinator, moving medially. It opens out into the oral cavity near the **second upper molar**.

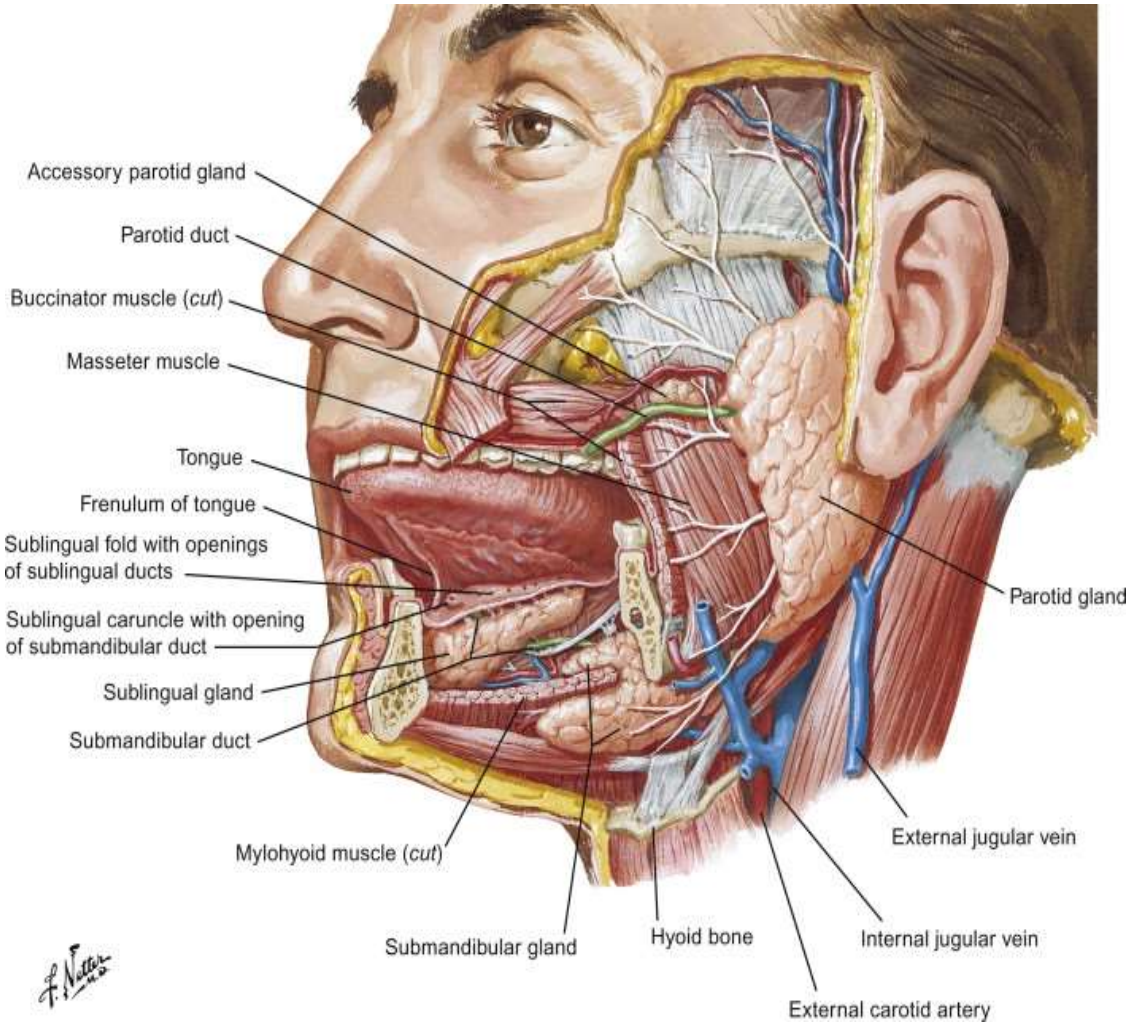
Parotid Gland

Histology



Parotid Gland

Anatomical Position



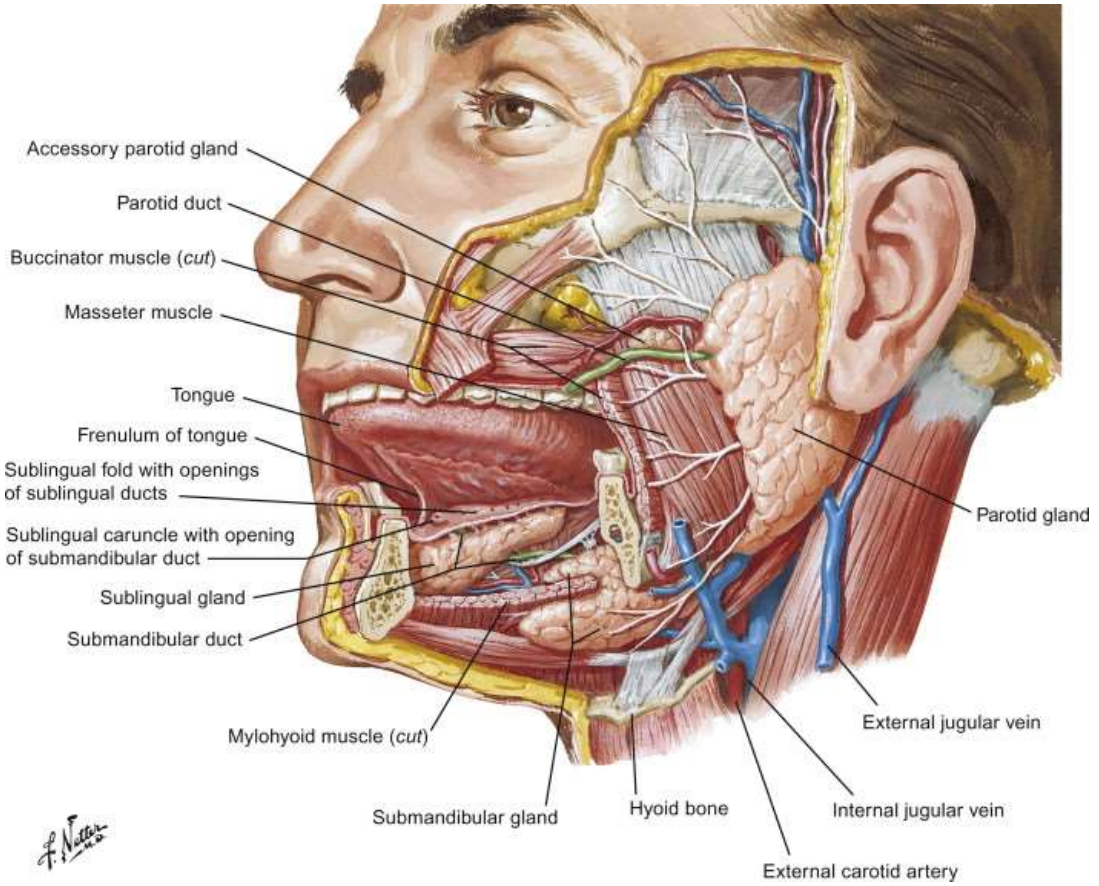
Parotid Gland

Anatomical Relationships

- The anatomical relationships of the parotid gland are of great clinical importance – particularly during parotid gland surgery.
- Several important neurovascular structures pass through the gland:
- The facial nerve (cranial nerve VII), gives rise to five terminal branches within the parotid gland. These branches innervate the muscles of facial expression.
- The **External Carotid artery** (ECA) ascends through the parotid gland. Within the gland, the ECA gives rise to the posterior auricular artery. The ECA then divides into its two terminal branches – the Maxillary artery and Superficial temporal artery.
- The **retromandibular vein** is formed within the parotid gland by the convergence of the superficial temporal and maxillary veins. It is one of the major structures responsible for venous drainage of the face.

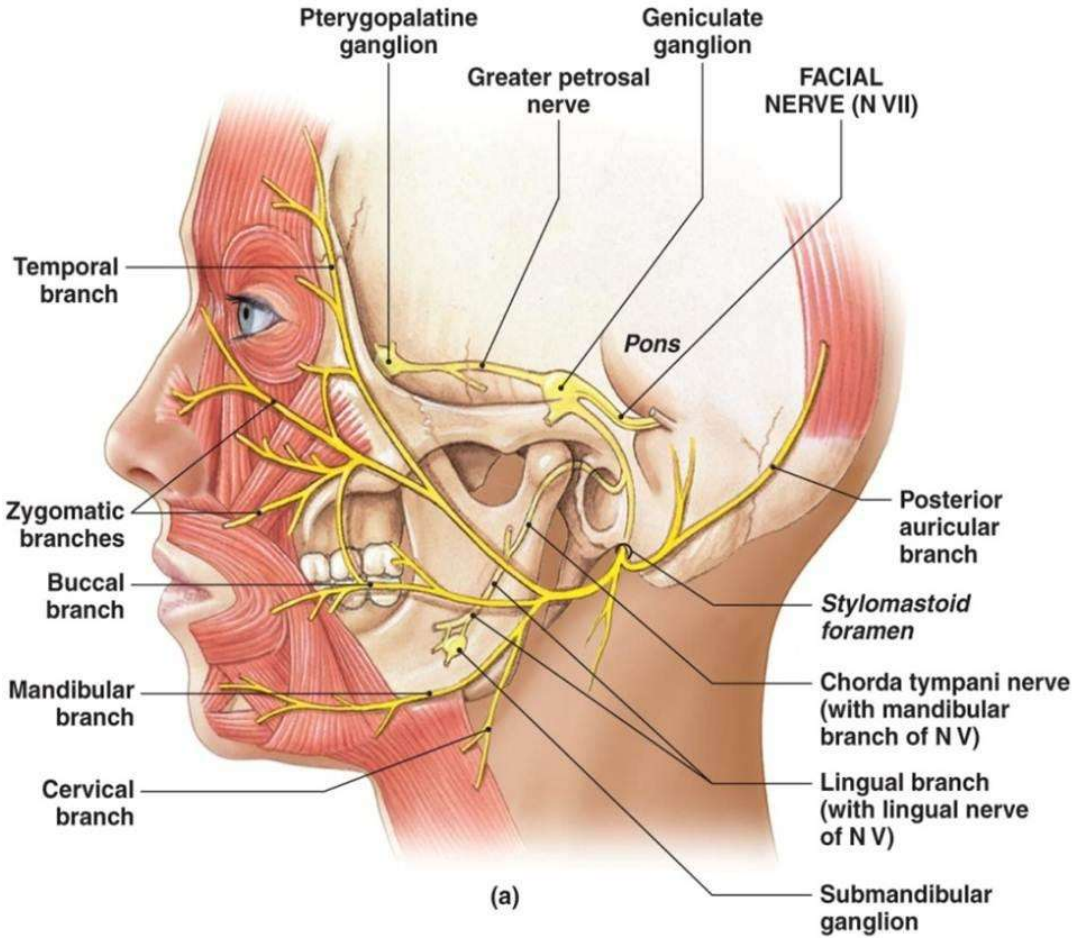
Parotid Gland

Anatomical Relation



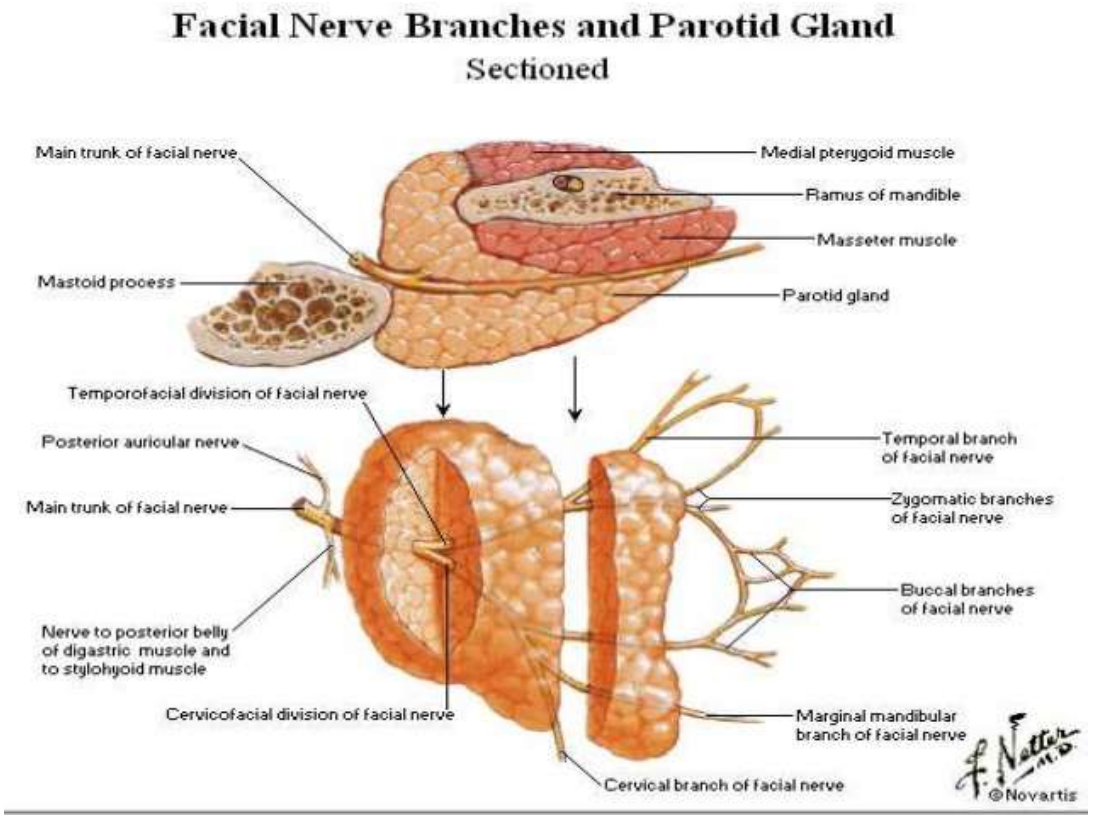
Parotid Gland

Relations



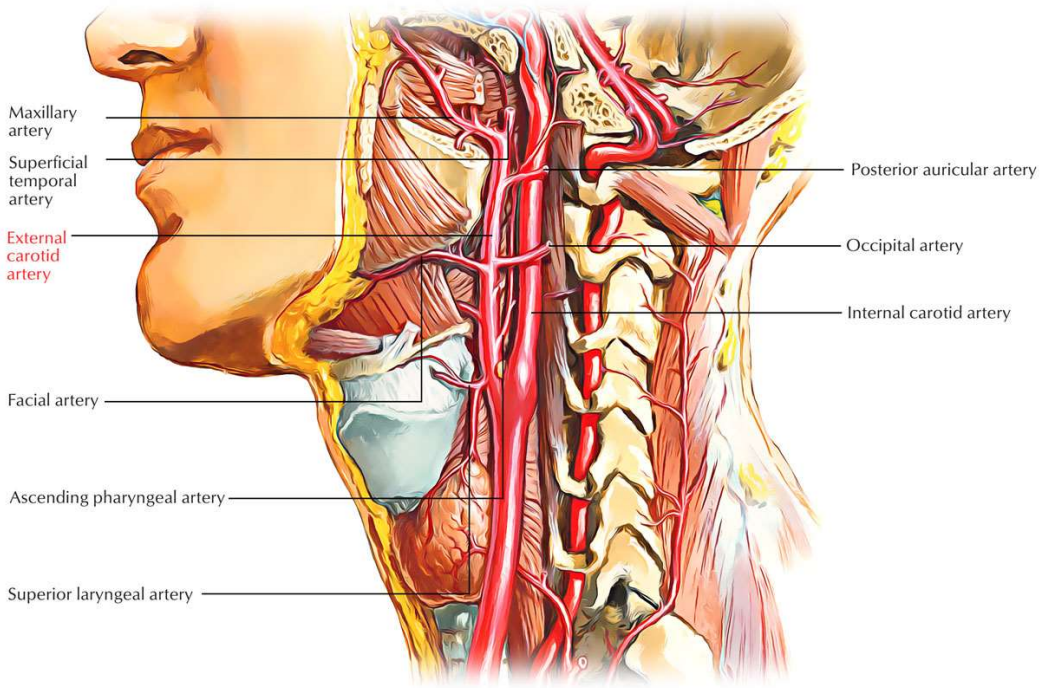
Parotid Gland

Relation



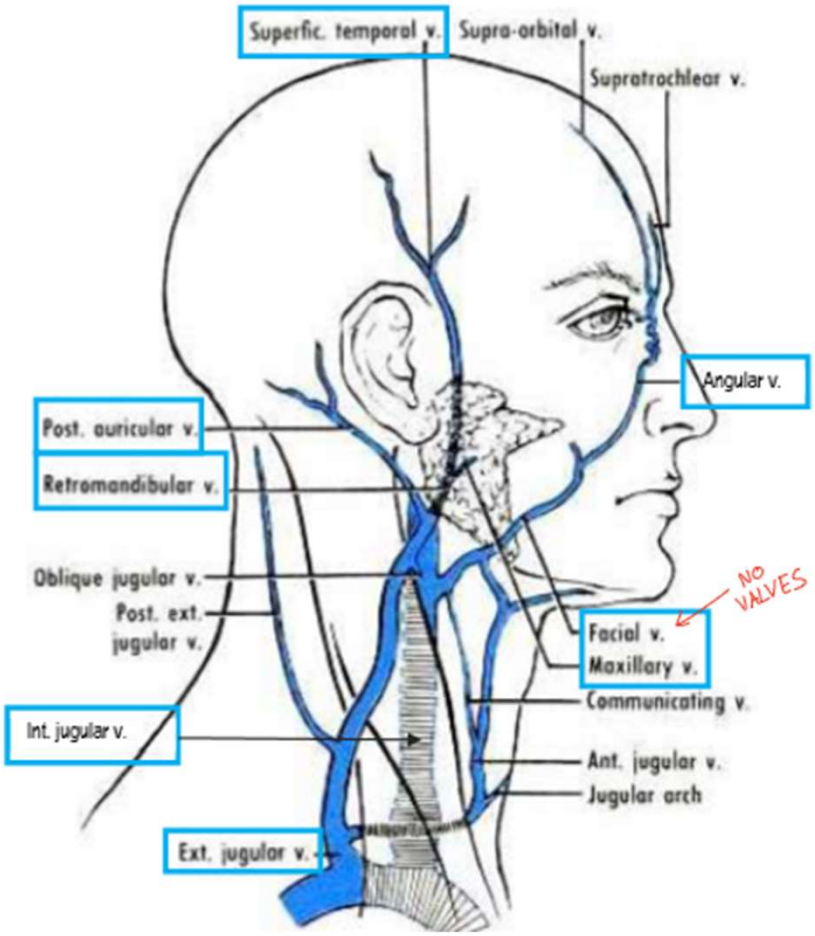
Parotid Gland

Relations



Parotid Gland

Relations



Parotid Gland

Vasculature

- Blood is supplied by the **Posterior Auricular** and **Superficial Temporal Arteries**. They are both branches of the External carotid artery, which arise within the parotid gland itself.
- Venous drainage is achieved via the **Retromandibular vein**. It is formed by unification of the Superficial Temporal and Maxillary Veins.

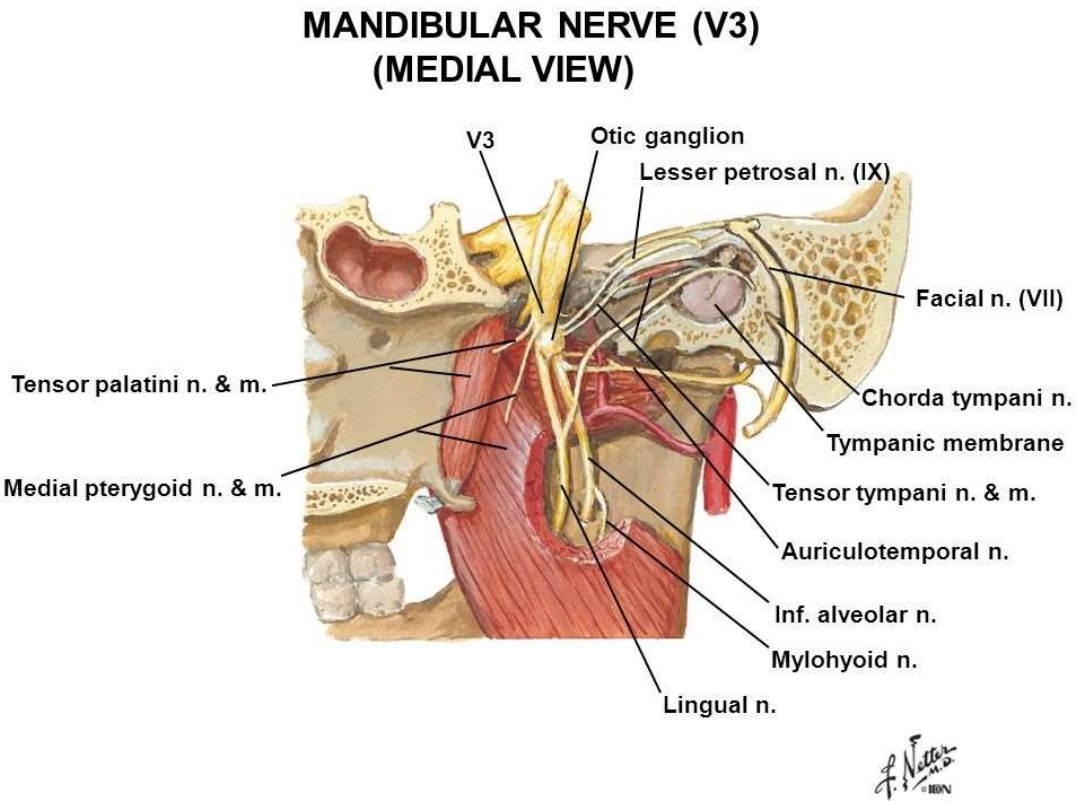
Parotid Gland

Innervation

- The parotid gland receives **sensory** and **Autonomic** innervation. The autonomic innervation controls the rate of saliva production.
- Sensory innervation is supplied by the **Auriculotemporal nerve** (gland) and the **Great auricular nerve** (fascia).
- The parasympathetic innervation to the parotid gland has a complex path. It begins with the **Glossopharyngeal nerve** (cranial nerve IX). This nerve synapses with the **Otic ganglion** (a collection of neuronal cell bodies). The **Auriculotemporal nerve** then carries parasympathetic fibres from the otic ganglion to the parotid gland. Parasympathetic stimulation causes an increase in saliva production.
- Sympathetic innervation originates from the **superior cervical ganglion**, part of the paravertebral chain. Fibres from this ganglion travel along the external carotid artery to reach the parotid gland. Increased activity of the sympathetic nervous system inhibits saliva secretion, via vasoconstriction.

Parotid Gland

Innervation



Parotid Gland

Clinical Relevance: Disorders of the Parotid Gland

Parotid Gland Tumours

- The parotid gland is the most common site of a salivary gland tumour. These tumours are usually benign, such as an **Adenolymphoma**. In contrast, tumours of the submandibular and sublingual glands are less common, but more likely to be **Malignant**.
- Treatment usually involves surgical excision of the tumour and parotid gland, known as a **parotidectomy**. During this procedure, it is critical to identify and preserve the facial nerve and its branches.
- Damage to facial nerve or its branches will cause **paralysis** of the facial muscles. The affected muscles will lose tone, and the area will 'sag'. The inferior eyelid can be particularly affected, falling away from the eyeball (known as **ectropion**).

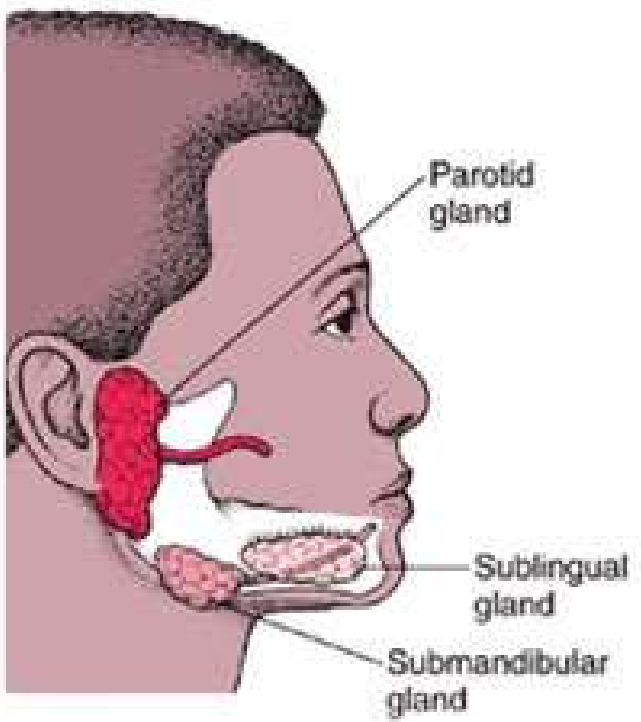
Parotid Gland

Parotitis

- Parotitis refers to **inflammation** of the parotid gland, usually as a result of an infection. The parotid gland is enclosed in a tough **fibrous capsule**. This limits swelling of the gland, producing pain.
- The pain produced can be referred to the external ear. This is because the **auriculotemporal nerve** provides sensory innervation to the parotid gland and the external ear.

Parotid Gland

Parotitis



The Sublingual Gland

Contents

The Sublingual Gland

- The sublingual glands are the smallest of the three paired salivary glands and the most deeply situated. Both glands contribute to only 3-5% of overall salivary volume, producing mixed secretions which are predominately mucous in nature. These secretions are important in lubricating food, keeping the oral mucosa moist and initial digestion.
- In this article, the location, vasculature and innervation of the sublingual glands will be discussed, and the relevant clinical correlations will be identified.

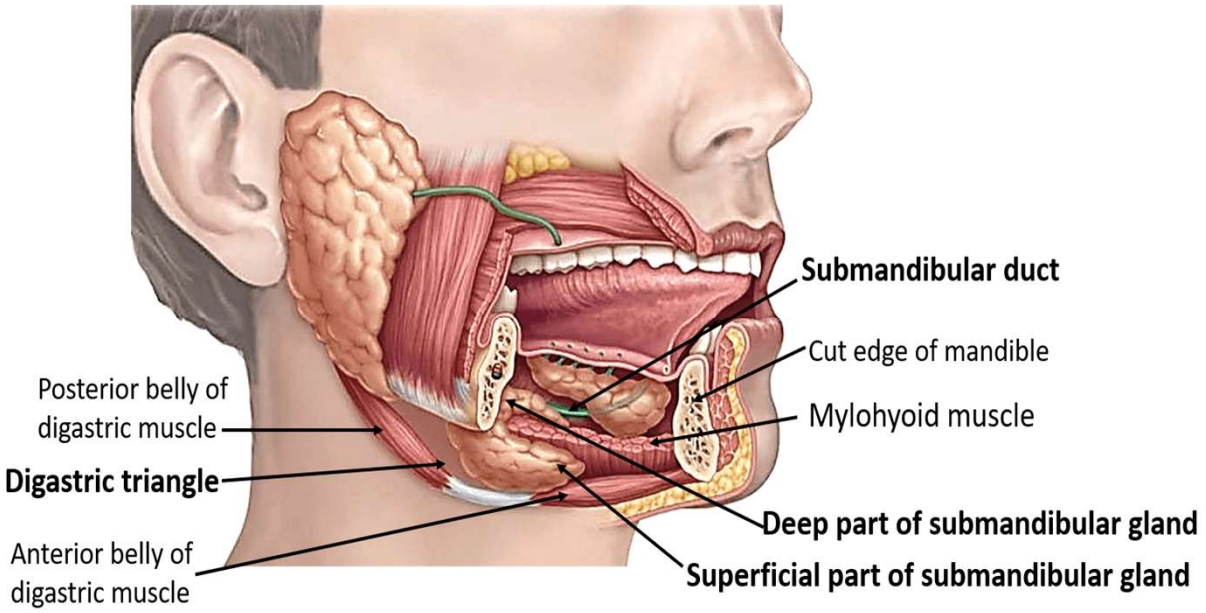
Sublingual Gland

Anatomical Position

- The sublingual glands are **almond-shaped** (ovoid) and lie on the floor of the oral cavity proper. They are situated under the tongue, bordered laterally by the mandible and medially by genioglossus muscle. The glands form a shallow groove on the medial surface of the mandible known as the **sublingual fossa**.
- Medially, the submandibular duct and its lingual nerve relation pass immediately next to the sublingual glands between genioglossus.
- Both sublingual glands unite anteriorly and form a single mass through a horseshoe configuration around the **lingual frenulum**. The superior aspect of this U-shape forms an elevated, elongate crest of mucous membrane called the **sublingual fold** (plica sublingualis). Each sublingual fold extends from a posterolateral position and traverses anteriorly to join the **sublingual papillae** at the midline bilateral to the lingual frenulum.

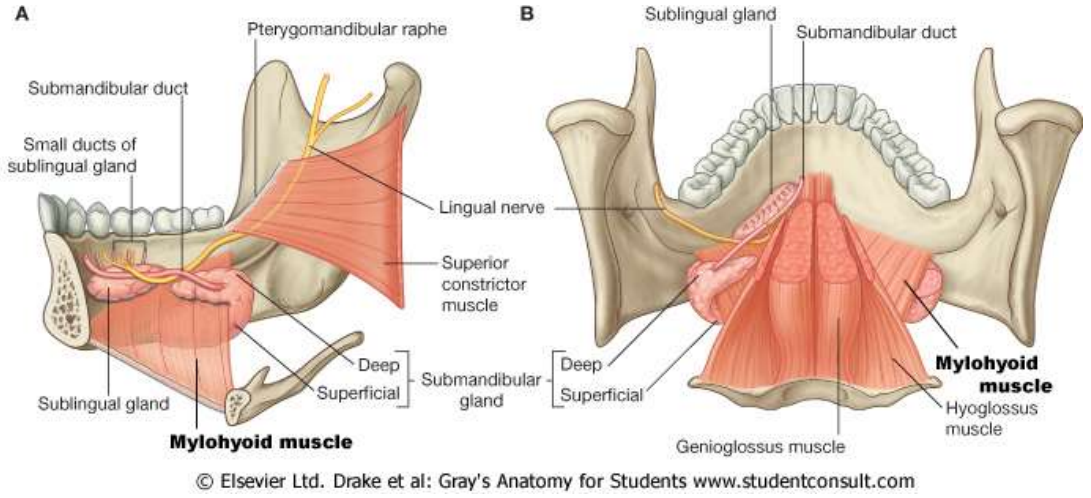
Sublingual Gland

Anatomical Position



Sublingual Gland

Anatomical Position

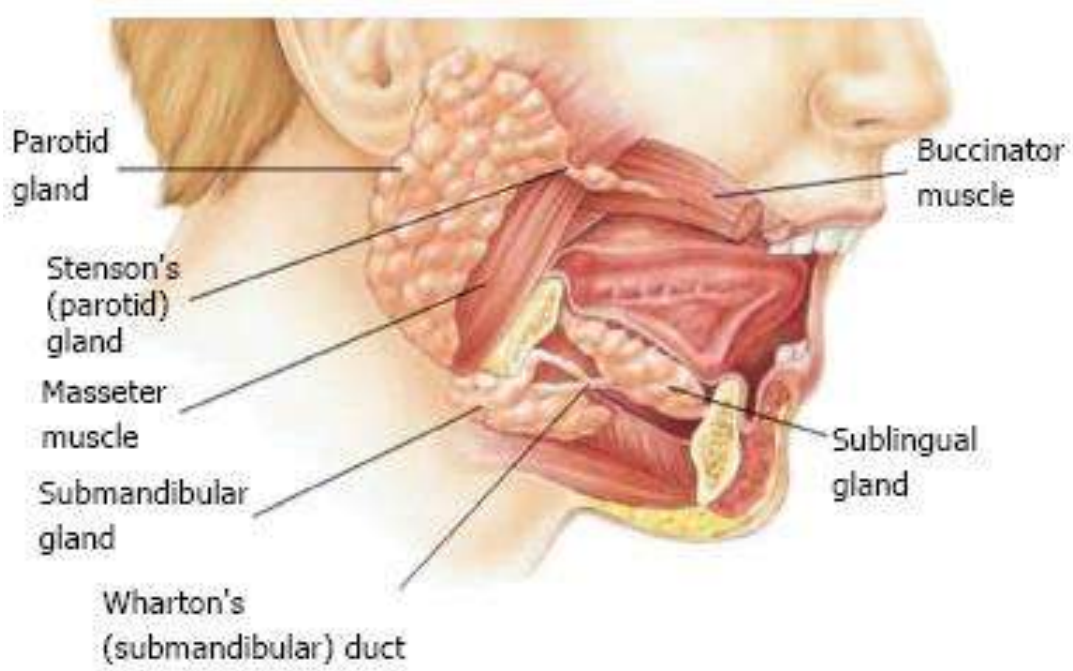


Sublingual Gland

Secretions drain into the oral cavity by **minor sublingual ducts** (of Rivinus), of which there are 8-20 excretory ducts per gland, each opening out onto the sublingual folds. Through anatomical variance, a major sublingual duct (of Bartholin) can be present in some people. This large accessory duct arises from the inferior aspect of the sublingual gland and then adheres to the passing submandibular duct on its medial side. Drainage then follows the submandibular duct out through the **sublingual papillae**.

Submandibular Gland

Sublingual Duct



Sublingual Gland

Vasculature

- Blood supply is via the **Sublingual** and **Submental arteries** which arise from the Lingual and Facial Arteries respectively; both of the External carotid artery.
- Venous drainage is through the **Sublingual** and **Submental veins** which drain into the lingual and facial veins respectively; both then draining into the Internal jugular vein.

Sublingual Gland

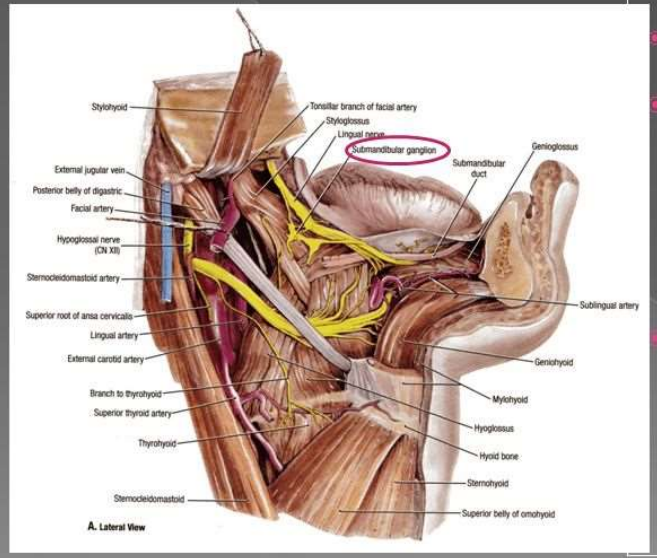
Innervation

- The sublingual glands receive autonomic innervation through parasympathetic and sympathetic fibres, which directly and indirectly regulate salivary secretions respectively. Their innervation is the same as that of the submandibular glands.

Sublingual Gland

Submandibular Ganglion

SUBMANDIBULAR GANGLION



- Small parasympathetic ganglion
- **Location**:
- on the lateral surface of the hyoglossus muscle.
- Suspended from the lingual nerve by several branches;
- **Preganglionic parasympathetic fibers** reach the ganglion from the superior salivary nucleus of the facial nerve via the chorda tympani & lingual nerves.
- The pre-ganglionic fibers synapse within the ganglion, and the post-ganglionic fibers pass to the submandibular & sublingual salivary glands.

Submandibular Gland

Submandibular Ganglion

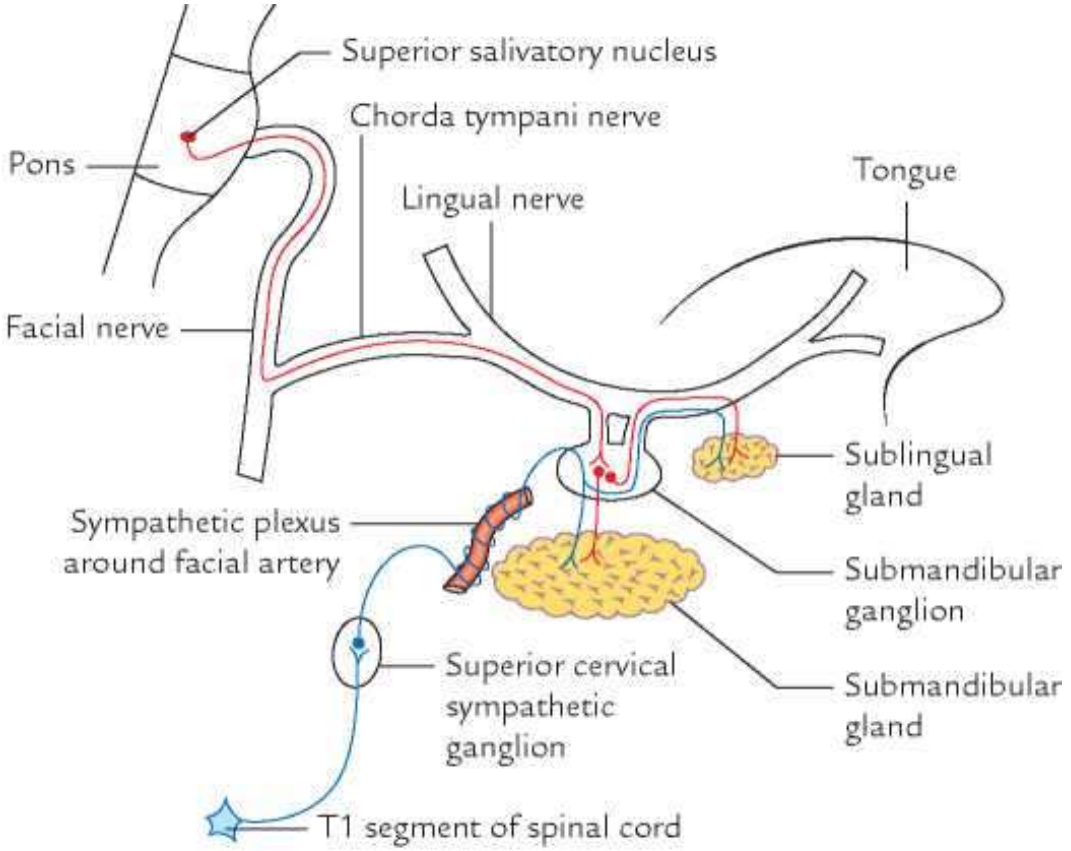
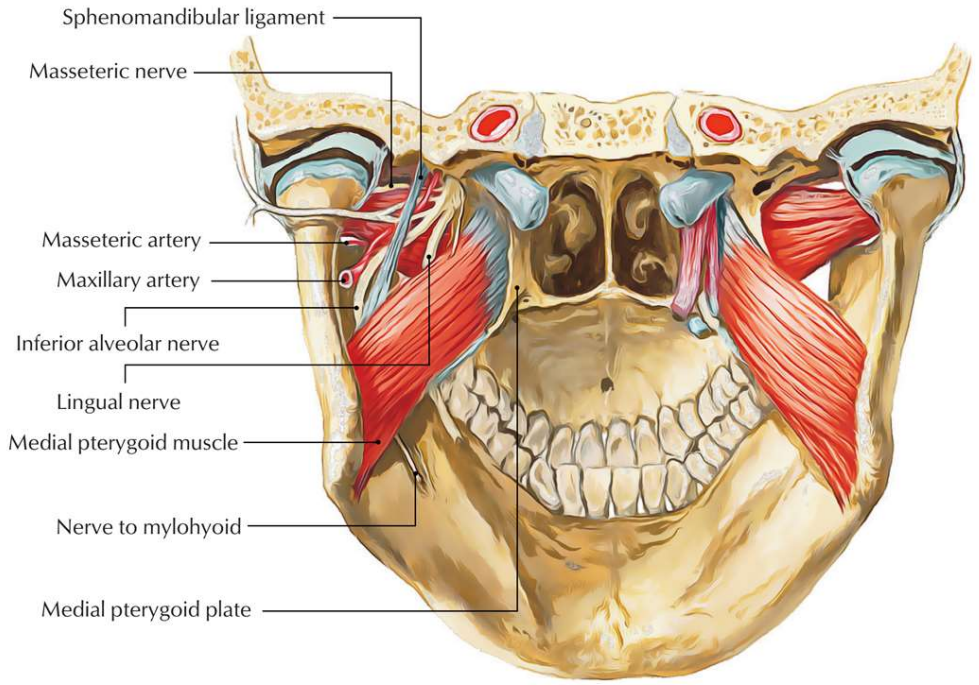


Fig. 9.21 Submandibular ganglion and its connections.

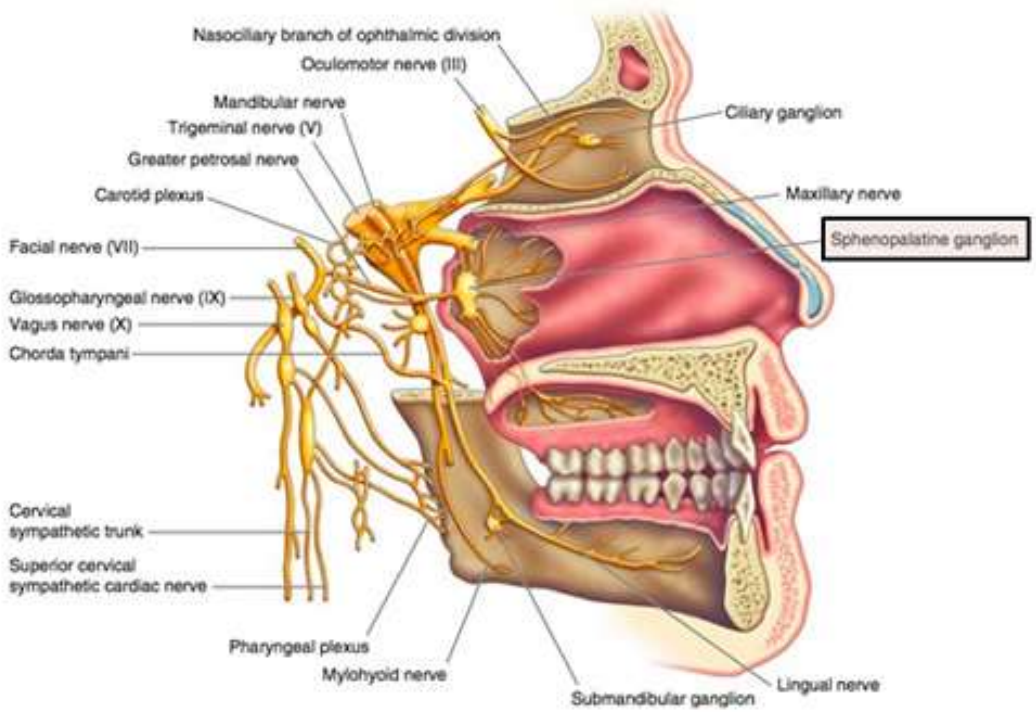
Sublingual Gland

Submandibular Ganglion



Sublingual Gland

Submandibular Ganglion



Sublingual Gland

Innervation

- Parasympathetic innervation originates from the **superior salivatory nucleus** through pre-synaptic fibres via the chorda tympani branch of the facial nerve (CNVII). The chorda tympani then unifies with the lingual branch of the mandibular nerve (CNViii) before synapsing at the **submandibular ganglion** and suspending it by two nerve filaments.
- Post-ganglionic innervation consists of **secretomotor** fibres which directly induce the gland to produce secretions, and vasodilator fibres which accompany arteries to increase blood supply to the gland. Increased parasympathetic drive promotes saliva secretion.

Sublingual Gland

Sympathetic

- Sympathetic innervation originates from the **Superior Cervical Ganglion**, where post-synaptic vasoconstrictive fibres travel as a plexus on the internal and external carotid arteries, facial artery and finally the sublingual and submental arteries to enter each gland.
- Increased sympathetic drive reduces glandular blood flow through vasoconstriction and decreases the volume of salivary secretions, resulting in a more mucus saliva.

Sublingual Gland

Clinical Relevance: Ranula

- A ranula is a type of **Mucocele** (Mucous Cyst) that occurs in the floor of the mouth inferior to the tongue. It is the most common disorder associated with the sublingual glands due to their higher **Mucin** content in secretions compared to other salivary glands.
- Ranulas can be caused by trau**m**a to the delicate sublingual gland ducts causing them to rupture, with mucin then collecting within the connective tissues to form a cyst.
- Ranulas may be small and asymptomatic and can therefore be left alone. Alternatively, they may cause pain and grow large enough to fill the mouth causing **dysphagia**; an indication for sublingual gland excision. Spilt mucin from the gland or ducts may collect inferiorly beneath mylohyoid and present as a swelling in the neck (a cervical ranula). Rarely, this collection can course posteriorly into the parapharyngeal space.

Sublingual Gland

Ranula

Submandibular Gland

Contents

Submandibular Gland

- The submandibular glands are bilateral salivary glands located in the face. Their mixed serous and mucous secretions are important for the lubrication of food during mastication to enable effective swallowing and aid digestion.
- In this article, the location, vasculature and innervation of the submandibular glands will be discussed, and the relevant clinical correlations will be investigated.
-

Submandibular Gland

Anatomical Positron

The submandibular gland is located within the anterior part of the **submandibular triangle**. The boundaries of this triangle are:

- **Superiorly:** Inferior body of the mandible.
- **Anteriorly**: Anterior belly of the digastric muscle.
- **Posteriorly**: Posterior belly of the digastric muscle

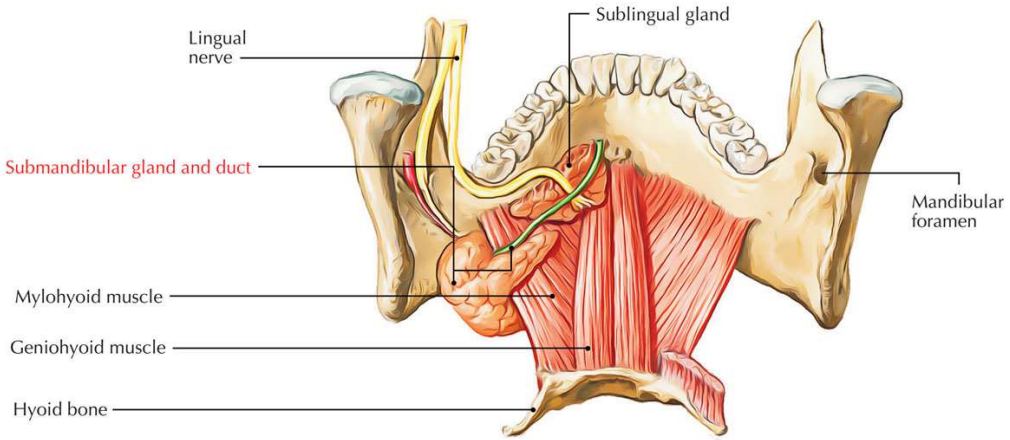
Submandibular Gland

Anatomical Structure

- Structurally, the submandibular glands are a pair of elongate, flattened hooks which have two sets of arms; superficial and deep. The positioning of these arms is in relation to the **mylohyoid** muscle, which the gland hooks around.
- **Superficial arm** – comprises the greater portion of the gland and lies partially inferior to the posterior half of the mandible, within an impression on its medial aspect (the submandibular fossa). It is situated outside the boundaries of the oral cavity.
- **Deep arm** – hooks around the posterior margin of mylohyoid through a triangular aperture to enter the oral cavity proper. It lies on the lateral surface of the **hyoglossus**, lateral to the root of the tongue.
- Secretions from the submandibular glands travel into the oral cavity via the **submandibular duct** (Wharton's duct). This is approximately 5cm in length and emerges anteromedially from the deep arm of the gland between the mylohyoid, hypoglossus and genioglossus muscles. The duct ascends on its course to open as 1-3 orifices on a small **sublingual papilla**(caruncle) at the base of the lingual frenulum bilaterally.

Submandibular Gland

Anatomical Structure



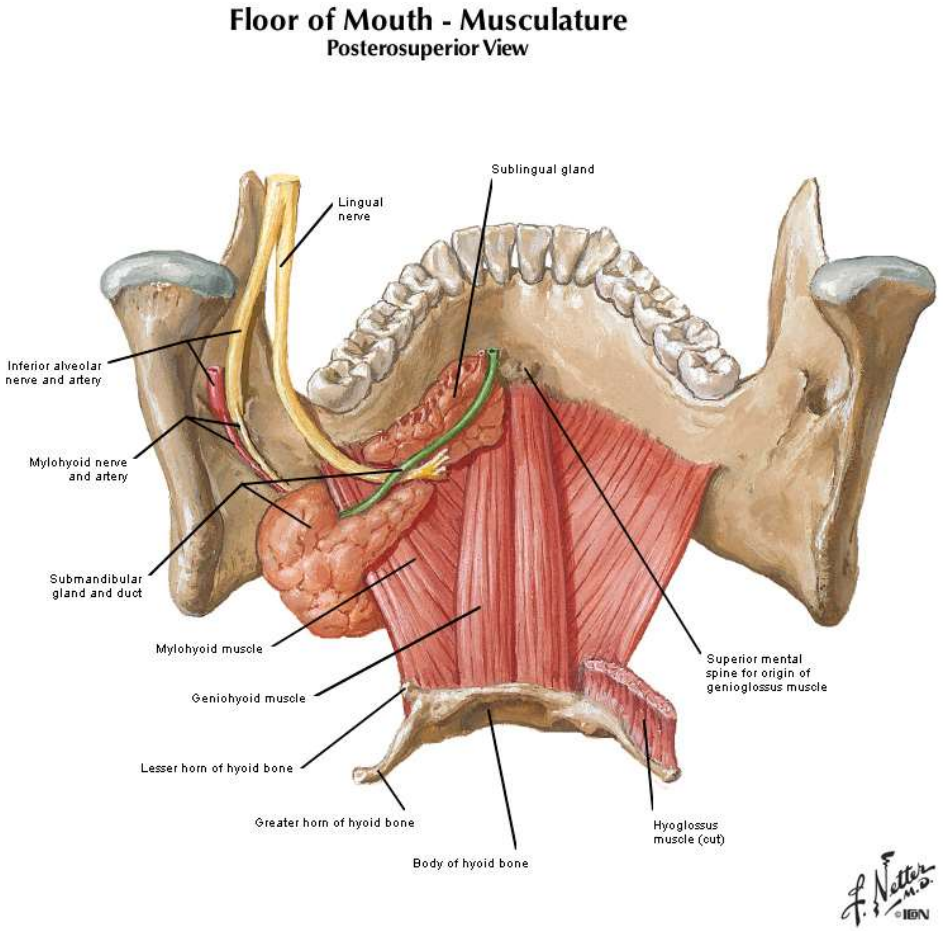
Submandibular Gland

Relationship with Nerves

- Both the submandibular gland and duct share an intimate anatomical relationship with three principal nerves; the **lingual nerve**, **Hypoglossal nerve** and **facial nerve (marginal mandibular branch)**. The courses of these nerves are briefly outlined:
- **Lingual nerve:** Beginning lateral to the submandibular duct, this nerve courses anteromedially by looping beneath the duct and then terminating as several medial branches. The terminal branches ascend on the external and superior surface of Hypoglossus to provide general somatic afferent innervation to the mucus membrane of the anterior two-thirds of the tongue.
- **Hypoglossal nerve:** Lies deep to the submandibular gland and runs superficial to hyoglossus and deep to digastric muscle.
- **Facial nerve (marginal mandibular branch):** Exits the anterior-inferior portion of the parotid gland at the angle of the jaw and traverses the margin of the mandible in the plane between platysma and the investing layer of deep cervical fascia curving down inferior to the submandibular gland.

Submandibular Gland

Relations



Submandibular Gland

Clinical relevance

Submandibular Gland Excision

- **Lingual nerve:** Immediate post-operative ipsilateral parathesia and loss of taste from the anterior two-thirds of the tongue, which is rarely permanent.
- **Hypoglossal nerve:** Ipsilateral paresis or paralysis of the intrinsic muscles of the tongue leading to dysarthria and deviation of tongue to side of the lesion. This nerve is rarely injured in this procedure to an extent to produce noticeable disability.
- **Facial nerve (marginal mandibular branch):** Ipsilateral paresis or paralysis of the muscles supplying the lower lip and chin, including depressor labii inferioris, which characteristically presents as drooping of the lower lip. This is usually temporary, lasting for 6-12 weeks.

Submandibular Gland

Vasculature

- Blood supply is via the **submental arteries** which arise from the facial artery; a branch of the external carotid artery.
- Venous drainage is through the **submental veins** which drain into the facial vein and then the internal jugular vein.

Submandibular Gland

Innervation

- The submandibular glands receive autonomic innervation through parasympathetic and sympathetic fibres, which directly and indirectly regulate salivary secretions respectively.

Parasympathetic

- Parasympathetic innervation originates from the **superior salivatory nucleus** through pre-synaptic fibres, which travel via the chorda tympani branch of the facial nerve (CNVII). The chorda tympani then unifies with the **lingual branch** of the mandibular nerve (CN Viii) before synapsing at the submandibular ganglion and suspending it by two nerve filaments.
- Post-ganglionic innervation consists of **secretomotor fibres** which directly induce the gland to produce secretions, and vasodilator fibres which accompany arteries to increase blood supply to the gland. Increased parasympathetic drive promotes saliva secretion.

Submandibular Gland

Sympathetic

- Sympathetic innervation originates from the **superior Cervical Ganglion**, where post-synaptic vasoconstrictive fibres travel as a **plexus** on the internal and external carotid arteries, facial artery and finally the submental arteries to enter each gland. Increased sympathetic drive reduces glandular blood flow through vasoconstriction and decreases the volume of salivary secretions, resulting in a more mucus and enzyme-rich saliva.

Submandibular Gland

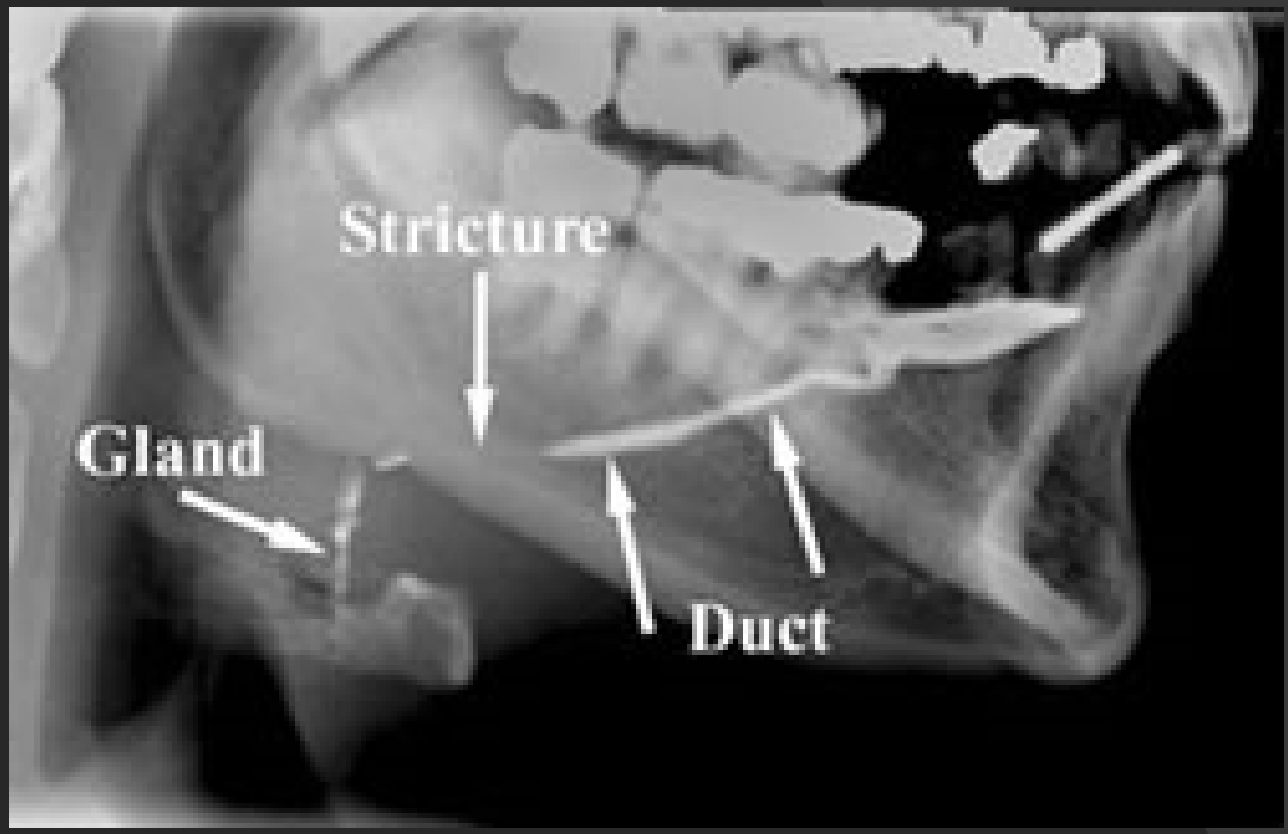
Clinical Relevance: Salivary Duct Calculi

A calculus or sialolith is a **calcified deposit** which can block the lumen of a duct. The submandibular duct is the most susceptible to calculi out of all the salivary ducts; accounting for approximately 80% of cases. This is thought to be due to the

- Torturous length of the duct (5cm)
- Ascending secretory pathway
- Nature of salivary secretion
- The submandibular glands and the patency of the ducts can be examined by direct injection of a contrast medium. This is known as a **sialogram**, which is a special type of radiograph. A calculus may present radiographically as a stricture or complete occlusion of the duct.

Submandibular Gland

Sialography



Oral Cavity

Contents

Oral Cavity

The oral cavity, better known as the mouth, is the start of the alimentary canal. It has three major functions:

- **Digestion** – receives food, preparing it for digestion in the stomach and small intestine.
- **Communication** – modifies the sound produced in the larynx to create a range of sounds.
- **Breathing** – acts as an air inlet in addition to the nasal cavity.
- In this article, we shall look at the anatomy of the oral cavity – its divisions, contents, and any clinical correlations.

Oral Cavity

Divisions of the Oral Cavity

- The oral cavity spans between the **oral fissure** (anteriorly – the opening between the lips), and the **oropharyngeal isthmus** (posteriorly – the opening of the oropharynx).
- It is divided into two parts by the **upper** and **lower dental arches** (formed by the teeth and their bony scaffolding). The two divisions of the oral cavity are the vestibule, and the mouth cavity proper.

Oral Cavity

Vestibule

The horseshoe-shaped vestibule is situated anteriorly. It is the space between the lips/cheeks, and the gums/teeth.

The vestibule communicates with the mouth proper via the space behind the third molar tooth, and with the exterior through the **oral fissure**. The diameter of the oral fissure is controlled by the muscles of facial expression – principally the **orbicularis oris**.

Opposite the upper second molar tooth, the duct of the parotid gland opens out into the vestibule, secreting salivatory juices.

Oral Cavity

Mouth Proper

The mouth proper lies posteriorly to the vestibule. It is bordered by a roof, a floor, and the cheeks. The tongue fills a large proportion of the cavity of the mouth proper.

The Roof

- The roof of the mouth proper consists of the hard and soft palates.
- The **hard palate** is found anteriorly. It is a bony plate that separates the nasal cavity from the oral cavity. It is covered superiorly by respiratory mucosa (ciliated pseudostratified columnar epithelium) and inferiorly by oral mucosa (stratified squamous epithelium).
- The **soft palate** is a posterior continuation of the hard palate. In contrast to the hard palate, it is a muscular structure. It acts as a valve that can lower to close the oropharyngeal isthmus, and elevate to separate the nasopharynx from the oropharynx.

Oral Cavity

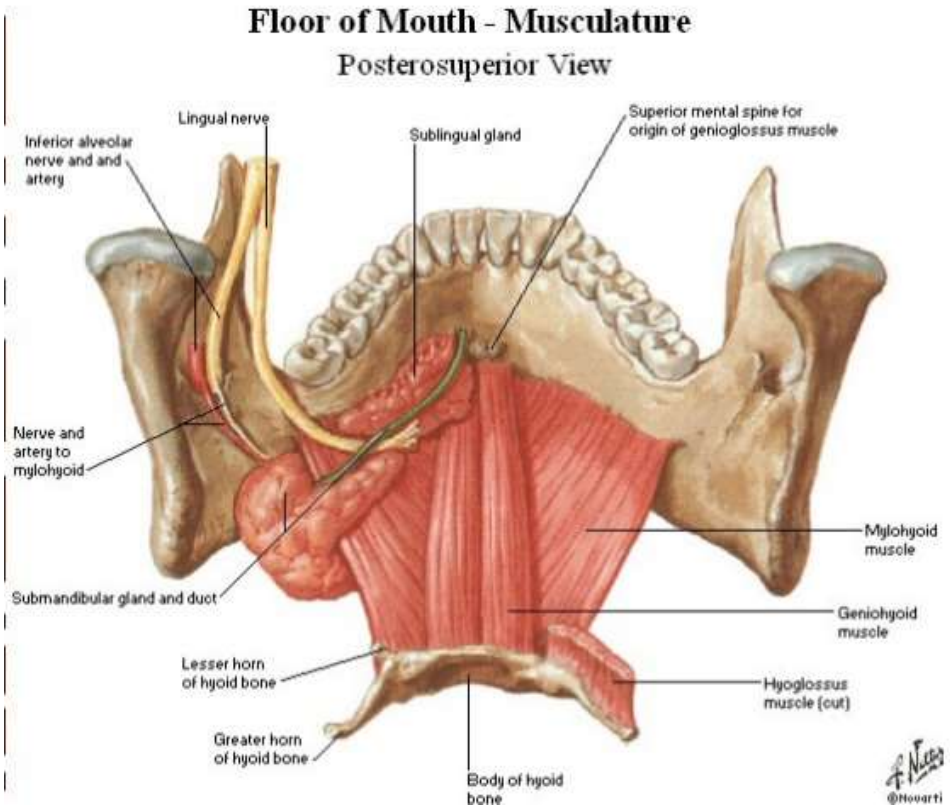
The Floor

The floor of the oral cavity consists of several structures:

- **Muscular diaphragm** – comprised of the bilateral mylohyoid muscles. It provides structural support to the floor of the mouth, and pulls the larynx forward during swallowing.
- **Geniohyoid muscles** – pull the larynx forward during swallowing.
- **Tongue** – connected to the floor by the frenulum of the tongue, a fold of oral mucosa.
- **Salivary glands and ducts**.

Oral Cavity

Floor



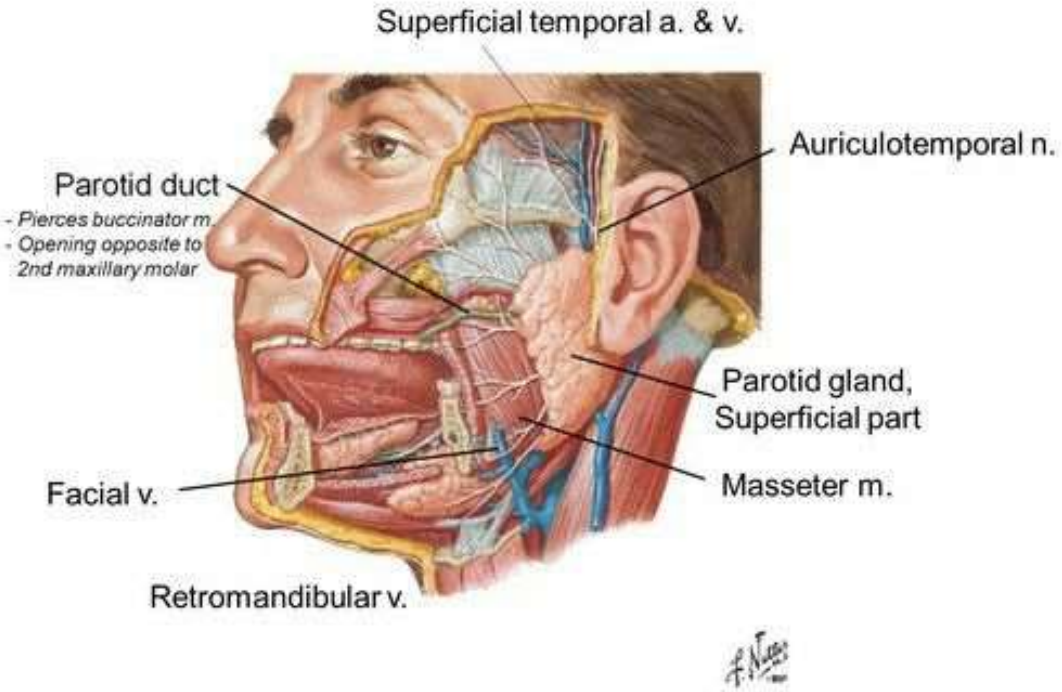
Oral Cavity

The Cheeks

- The cheeks are formed by the **buccinator** muscle, which is lined internally by the oral mucous membrane.
- The buccinator muscle contracts to keep food between the teeth when chewing, and is innervated by the **buccal branch** of the facial nerve (CN VII).

Oral Cavity

Cheeks



Oral Cavity

Innervation

- Sensory innervation of the oral cavity is supplied by the branches of the **trigeminal nerve** (CN V).
- The hard palate is innervated by the **greater palatine** and **nasopalatine nerves**, both of which are branches of the maxillary nerve (CN V2). The soft palate is innervated by **lesser palatine** nerve, another branch of the maxillary nerve.
- The floor of the oral cavity receives sensory innervation from the **lingual nerve** – a branch of the mandibular (V3) division of the trigeminal nerve. The tongue is also innervated by special sensory fibres for taste from the **chorda tympani**, a branch of the facial nerve (CN VII).
- The cheeks are innervated by the **buccal nerve**. It is also a branch of the mandibular division of the trigeminal nerve.

Oral Cavity

Clinical relevance: The Gag Reflex

- The gag reflex is protective against foreign bodies touching the posterior aspects of the oral cavity, which are most innervated by the **Glossopharyngeal Nerve** (CN IX).
- When stimulated, a reflex arc leads to contraction of the pharyngeal musculature and the elevation of the soft palate. The efferent nerve in this case is the vagus nerve (CN X).