Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

Gross Anatomy
Head & Neck
Lec. : 1
Date: Tues. 4th. , Oct. 2022

Head & Neck

Basic Anatomy

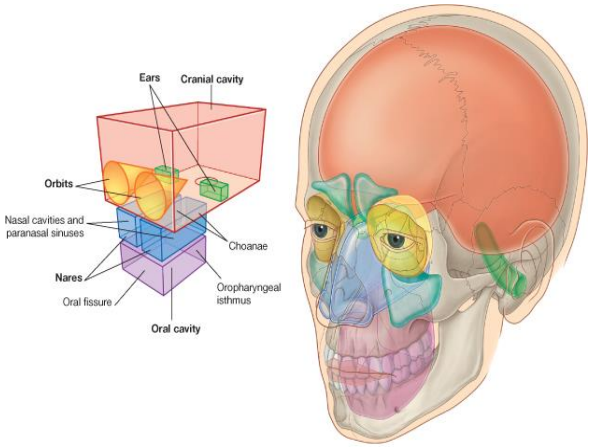
The Head

The head in human anatomy is the upper portionالجزء of the body, consistingتحتوي of the skull with it`s coveringsأغلفتها and contentsمحتوياتها , including the lower jaw, it is attachedتتصل to the spinal column via the first cervical vertebra, "the occipital bone joinsترتبط with the atlas near the foramen magnumالثقب الكبير , "a large holeفتحة foramen at the base of the skull". The atlas joins with the occipital condyleاللقمة above and the axis below, the spinal cordالحبل الشوكي passes throughتمر the foramen magnum. The head is connectedترتبط with the trunk by the muscles, blood vessels, and nerves that constituteتشكل the neck.

The skull consists of two major parts: the neurocranium (calvaria) and the viscerocranium (facial skeleton). The neurocranium is the part envelopingتغلف the brain and is formed outتتكون من of two parts; the skull base that supportsتدعم أو تسند the brain and the vault (skullcap) that sits on top of the base, covering the brain. The viscerocranium supportsتسند mainly بصورة رئيسية the facial muscles and a varietyمختلف of anatomical structures.

The head is composedمتكون من of a seriesسلسلة of compartments التراكيب , which are formed by bone and soft tissues, they are:

* the cranial cavity.
* two ears.
* two orbits.
* two nasal cavities.
* the oral cavity.



The cranial cavity is the largest compartmentقسم and contains the brain and associatedالمتعلقة membranes أغشية (meningesالسحايا).

The *Face* is the anterior aspectالجانب of the head and contains a uniqueفذ group of muscles that move the skin relativeالقريب to underlyingالتحتاني bone and control the anterior openings of the orbits and oral cavity.

The *Scal*p فروة الرأس covers the superior, posterior, and lateral regions of the head.

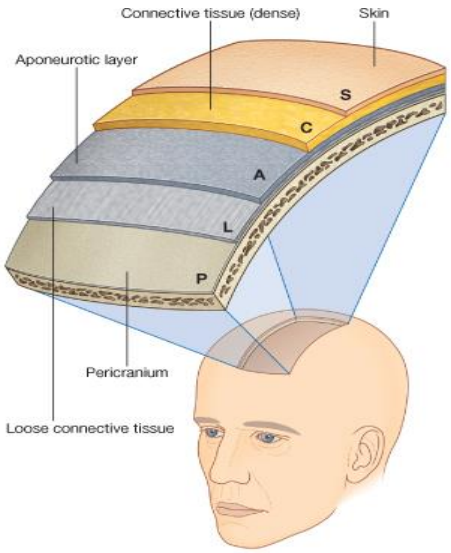
The Scalp

The **scalp** refersتشير الى to the layers of skin and subcutaneousتحت الجلد tissue that cover the bones of the skull.

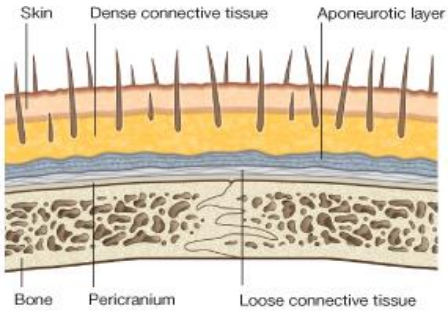
Layers of the scalp

The scalp consists of five layers, the first three layers are tightlyبقوة boundمرتبطة togetherببعض , and move as a unitوتتحرك كقطعة واحدة .

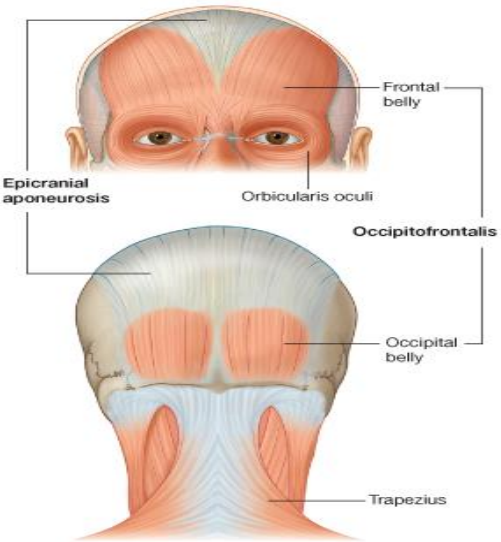
The term مصطلح *'**SCALP**' can be a useful way to remember*تذكر *the layers of the scalp: **S**kin, **C**onnective Tissue " Dense" , **A**poneurosis*صفاق *" Epicranial ", **L**oose*فضفاض *Areolar*هالي *Connective Tissue and **P**eriosteum.*



- ***Skin*** ; contains numerous hair follicles بصيلات and sebaceous glands غدد زهمية (thus it is a common site for sebaceous cysts.
- ***Connective tissue*** *" Dense"* ; connects the skin to the epicranial aponeurosis, it is richly vascularised تزويد وعائي and innervated تجهيز عصبي , the blood vessels within the layer are highly adherent ملتصقة to the connective tissue, so they are unable to constrict تتقلص fully تامة if lacerated تمزقها and so the scalp can be a site of profuse شديد bleeding.
- ***Aponeurosis*** *" Epicranial "*; a thin, tendon-like structure that connects the occipitalis and frontalis muscles.
- ***Loose areolar connective tissue***; a thin connective tissue layer that separates تفصل the periosteum of the skull from the epicranial aponeurosis, it contains numerous العديد blood vessels, including تتضمن emissary veins اوردة نافذة which connect the veins of the scalp to the diploic veins الأوردة التي تتموضع في الطبقة الوسطى من عظام الجمجمة and intracranial داخل الجمجمة venous sinuses تجاويف دموية .



- ***Periosteum****;* the outer layer of the skull bones. It becomes continuous متواصلة with the endosteum at the suture lines خطوط الدروز .



Clinical notes

Scalp infections

The ‘danger area of the scalp’ is the area of loose connective tissue, because pus القيح and blood spread تنتشر easily بسهولة within خلالها it, and can pass تمر into the cranial cavity along the emissary veins, so infection can spread from the scalp to the meninges, which could lead to meningitis التهاب السحايا .

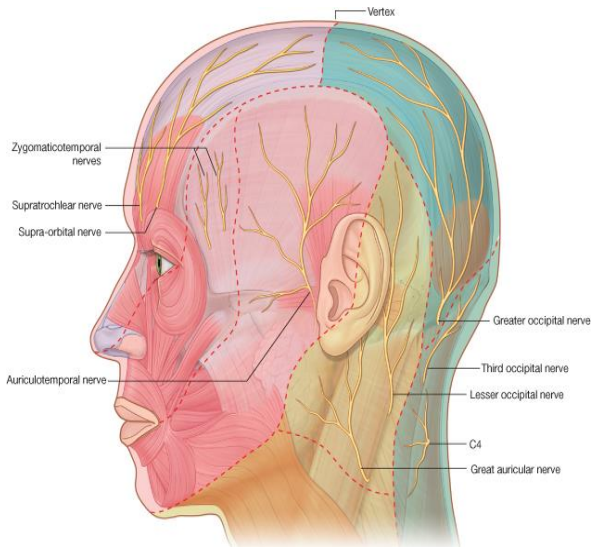
Innervation

Sensory حسي innervation تجهيز of the scalp is from two major sources مصادر , cranial nerves or cervical nerves,

depending اعتمادا على on whether اذا فيما it is anterior or posterior to the ears and the vertex of the head.

Anterior to the ears and the vertex

Anterior branches of the trigeminal nerve [V] supply the scalp, supra-to the ears and the vertex of the head, these branches are the supratrochlear, orbital, zygomaticotemporal, and auriculotemporal nerves.



- the supratrochlear nerve exits تخرج من the orbit محجر العين , passes through the frontalis belly الجبهي الجزء of occipitofontalis muscle, continues superior نحو الأعلى across عبر the front the forehead جبهة , supplying it near the midline.
- the supra-orbital nerve exits the orbit through the supra-orbital notch or foramen, passes through the frontalis belly of occipitofrontalis muscle, continues superiorly across the scalp supplying the scalp as far بعيدا back الى الخلف as the vertex of the head.
- the zygomaticotemporal nerve exits the skull through a foramen in the zygomatic bone and supplying the scalp over a small anterior area of the temple. الزاوية العليا الأمامية من جانب الجمجمة
- the auriculotemporal nerve exits from the skull, deep to the parotid gland الغدة النكفية , passes just anterior to the ear, continues superiorly until nearly reaching the vertex of the head, supplying the scalp over the temporal الصدغي region and the area anterior to the ear up to near the vertex.

Posterior to the ears and the vertex

Posterior to the ears and vertex, sensory innervation of the scalp is by cervical nerves, specific خاصة branches from the spinal cord levels مستويات C2 and C3 , they are;

- the great auricular nerve is a branch of the cervical plexus ظفيرة عنقية , arises تظهر from the anterior rami of the C2 and C3 spinal nerves, ascends تجه نحو الأعلى on the surface of the sternocleidomastoid muscle, and innervates تزود بالأعصاب a small area of the scalp just posterior to the ear.
- the lesser occipital nerve is also a branch of the cervical plexus, arises from the anterior ramus of the C2 spinal nerve, ascends on the posterior border حد او حافة of the sternocleidomastoid muscle, and supplies تجهز an area of the scalp posterior and superior to the ear.
- the greater occipital nerve is a branch of the posterior ramus of the C2 spinal nerve, ascends superficial to the suboccipital triangle مثلث , and then spreads out to supply a large part of the posterior scalp as far superiorly as the vertex.
- the third occipital nerve is a branch of the posterior ramus of the C3 spinal nerve, and supplies a small area of the lower part of the scalp.

Vessels

Arteries

Arteries supplying the scalp are branches of either the external carotid سباتي artery or the ophthalmic artery, which is a branch of the internal carotid artery.

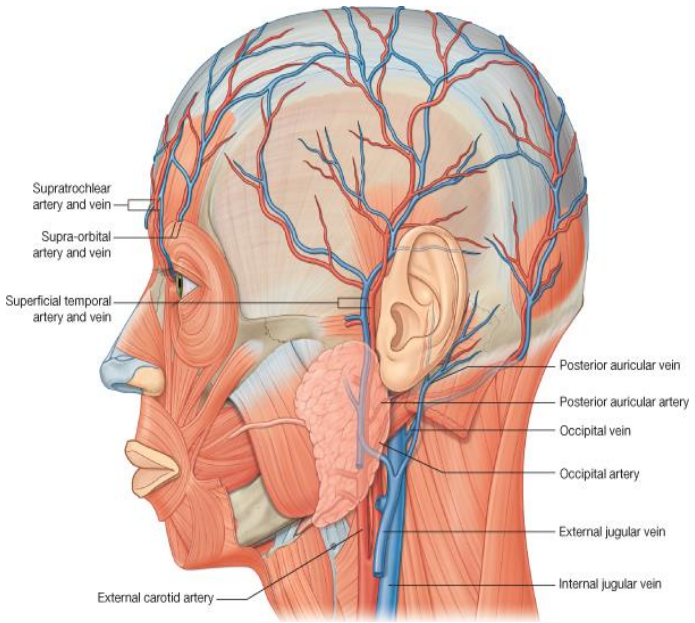
Branches from the Ophthalmic artery

The supratrochlear and supra-orbital arteries supply the anterior and superior aspectsجهة of the scalp, they branch from the ophthalmic artery whileبينما it is in the orbit, continue through the orbit, and exit onto the forehead in associationبالأرتباط مع with the supratrochlear and supra-orbital nerves. Like the nerves, the arteries ascend across the forehead to supply the scalp as far posteriorly as the vertex of the head.

Branches from the External carotid artery

Three branches of the external carotid artery supply the largest part of the scalp; the superficial temporal, the posterior auricular, and the occipital arteries supplying the lateral and posterior aspects of the scalp.

- ✓ the smallest branch (the posterior auricular artery) is one of the posterior branches of the external carotid artery, and supply an area of the scalp posterior to the ear.
- ✓ the occipital artery, is also one of the posterior branches of the external carotid artery, which ascends in a posterior direction to supply a large part of the posterior aspect of the scalp.
- ✓ the third arterial branch supplying the scalp is the superficial temporal artery, a terminalالنهائي branch of the external carotid artery that passes superiorly, just anterior to the ear, divides into anterior and posterior branches, and supplies almostتقريبا the entireكل lateral aspect of the scalp.



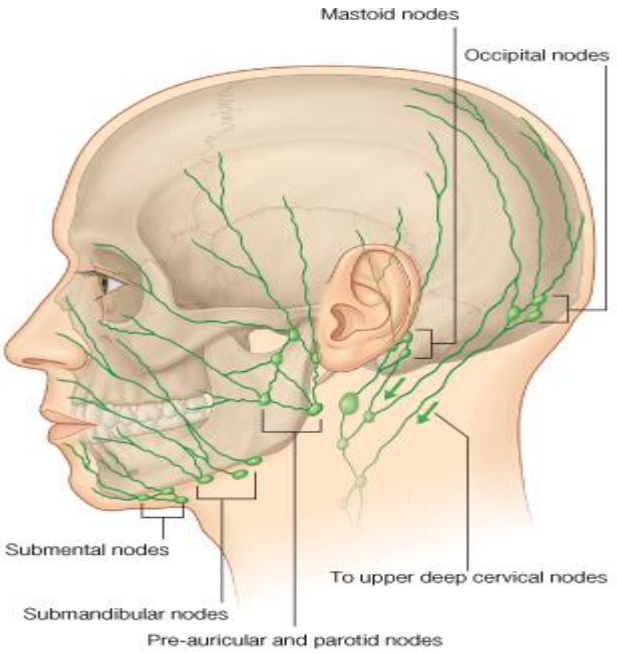
Veins

Veins drainingتبزل the scalp followتتبع a patternنظام similarمشابه to the arteries;

- ❖ the supratrochlear and supra-orbital veins drain the anterior part of the scalp from the superciliary arches to the vertex of the head, pass inferior to the superciliary arches, communicateتتواصل with the ophthalmic veins

in the orbit, and continue inferiorly to participate تساهم in the formation تكوين of the angular زاوي vein, which is the upper tributary رافد to the facial vein.

- the superficial temporal vein drains the entire lateral area of the scalp before passing inferiorly to join in the formation of the retromandibular vein.
- the posterior auricular vein drains the area of the scalp posterior to the ear and eventually empties تفرغ into a tributary of the retromandibular خلف الفك الأسفل vein.
- the occipital vein drains the posterior aspect of the scalp from the external occipital protuberance نتوء مرتفع and superior nuchal قفوي lines to the vertex of the head; deeper, it passes through the musculature in the posterior neck to join in the formation of the plexus of veins in the sub - occipital triangle.



Lymphatic drainage

Lymphatic drainage of the scalp generally عموما follows the pattern of arterial distribution توزيع ; the lymphatics in the occipital region initially مبدئيا drain to occipital nodes near the attachment of the trapezius muscle at the base of the skull , the occipital nodes drain into upper deep cervical nodes, there is also some direct drainage to upper deep cervical nodes from this part of the scalp.

Lymphatics from the upper part of the scalp drain in two directions;

* posterior to the vertex of the head they drain to mastoid nodes (retro-auricular/posterior auricular nodes) posterior to the ear near the mastoid process of the temporal bone and efferent صادرة vessels from these nodes drain into upper deep cervical nodes;
* anterior to the vertex of the head they drain to pre-auricular and parotid nodes anterior to the ear on the surface of the parotid gland. Finally, there may be some lymphatic drainage from the forehead to the submandibular nodes through efferent vessels that follow the facial artery.

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Lec. : 2
Date: Sun. 9th. Oct, 2022

The Head

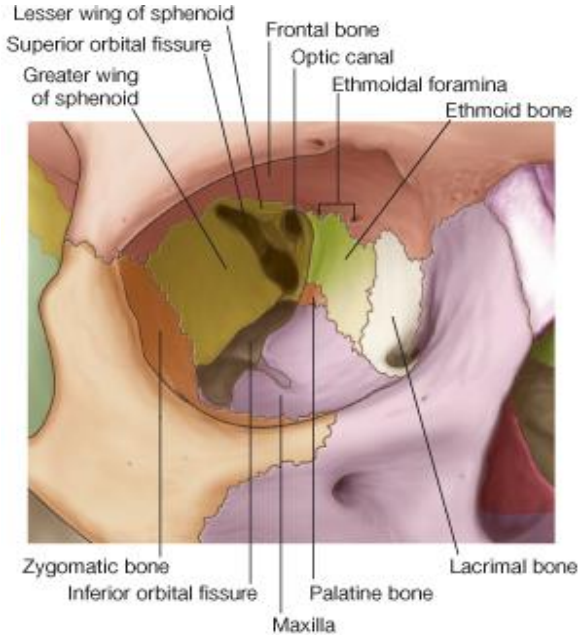
The Orbit

Description

The orbit is a pyramidal cavity with it`s base in front and it`s apex behind, the orbital margin is formed:

- Above by the frontal bone.
- Laterally: by the processes of the frontal and zygomatic bones.
- Inferiorly: by the zygomatic bone and the maxilla.
- Medially: by the processes of the maxilla and the frontal bone.

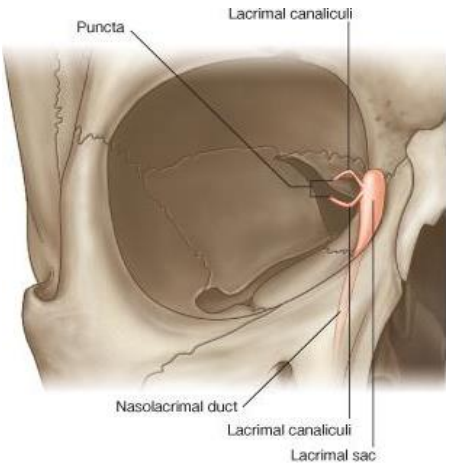
It houses the eyeball and it`s associated muscles, nerves, blood vessels and fat, and guarded by two thin movable folds ; the eyelids.



Openings in to the orbital cavity

The openings into the orbital cavity are:

- ***Orbital opening****:* lies anteriorly, about one-sixth of the eye is exposed; the remainder is protected by the walls of the orbit.
- ***Supraorbital notch*** *(foramen):* the supraorbital notch is situated on the superior orbital margin, it transmits the supraorbital nerve and blood vessels.
- ***Infraorbital groove and canal****:* situated on the floor of the orbit in the orbital plate of the maxilla, they transmit the infraorbital nerve (a continuation of the maxillary nerve) and blood vessels.

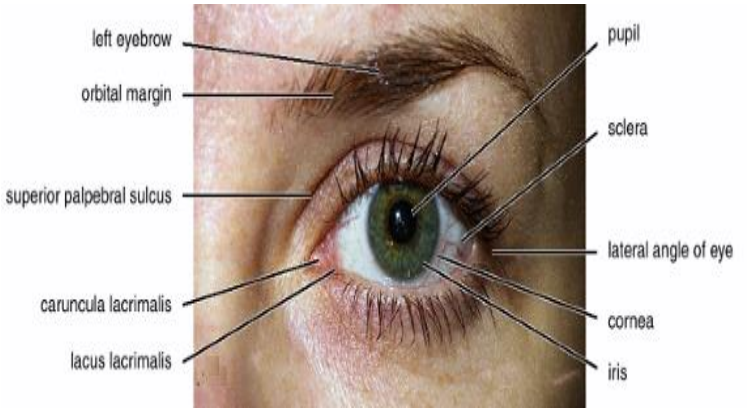


- ***Nasolacrimal canal****:* located anteriorly on the medial wall; it communicates with the inferior meatus of the nose, it transmits the nasolacrimal duct.
- ***Inferior orbital fissure****:* located posteriorly between the maxilla and the greater wing of the sphenoid, it communicates with the pterygopalatine fossa, it transmits the maxillary nerve and it`s zygomatic branch, the inferior ophthalmic vein, and sympathetic nerves.
- ***Superior orbital fissure****:* located posteriorly between the greater and lesser wings of the sphenoid, it communicates with the middle cranial fossa, it transmits the lacrimal nerve, the frontal nerve, the trochlear nerve, the oculomotor nerve (upper and lower divisions), the abducent nerve, the nasociliary nerve, and the superior ophthalmic vein.
- ***Optic canal****:* located posteriorly in the lesser wing of the sphenoid, it communicates with the middle cranial fossa, it transmits the optic nerve and the ophthalmic artery.

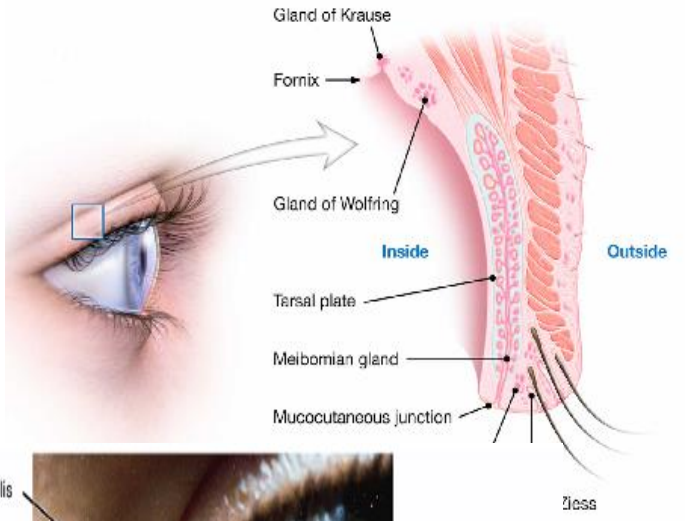
Eyelids

The eyelids protect the eye from injury and excessive light by their closure ,the upper eyelid is larger and more mobile than the lower one, they meet each other at the medial and lateral angles. the palpebral fissure is the elliptical opening between the eyelids and is the entrance into the conjunctival sac.

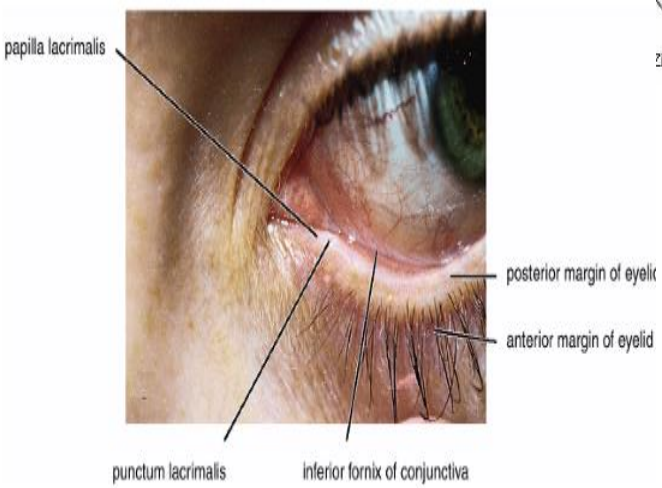
The superficial surface of the eyelids is covered by skin, and the deep surface is lined by a mucous membrane, called conjunctiva. The eyelashes are short, curved hairs on the free edges of the eyelids , they are arranged in double or triple rows at the mucocutaneous junction, sebaceous glands (glands of Zeis) open directly into the eyelash follicles.



The ciliary glands (glands of Moll) are modified sweat glands that open separately between adjacent lashes. The tarsal glands "Meibomian glands" are long, modified sebaceous glands that pour their oily secretion onto the margin of the lid; their openings lie behind the eyelashes, this oily material prevents the overflow of tears and helps make the closed eyelids airtight.



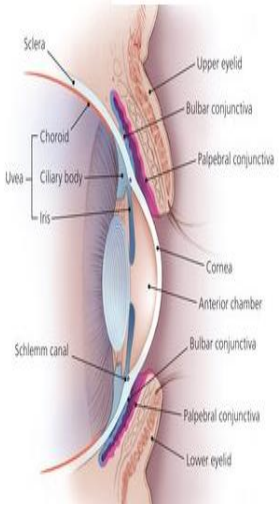
Papilla lacrimalis is a a small elevation near the medial angle of the eye, on it`s summit is a small hole, the punctum lacrimale, which leads into the canaliculus lacrimalis, the papilla lacrimalis projects into the lacus, and the punctum and canaliculus carry tears down into the nose.

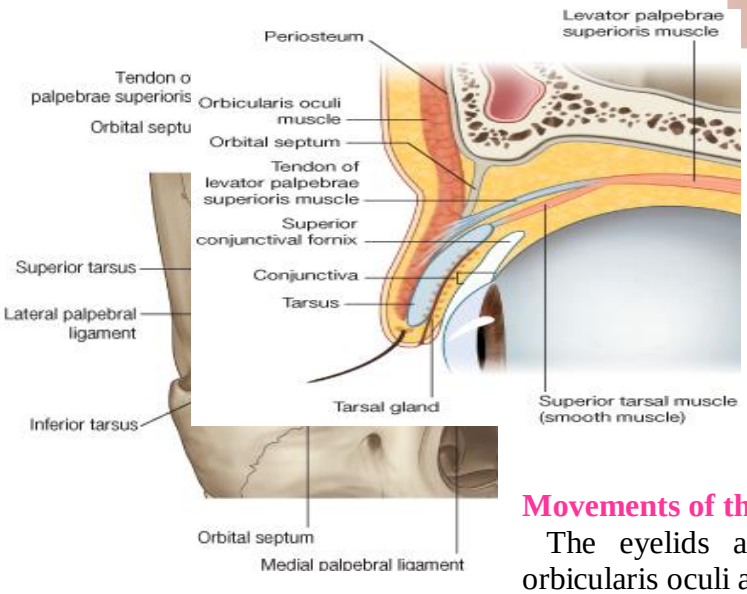


The conjunctiva is a thin mucous membrane that lines the eyelids and is reflected at the superior and inferior fornices onto the anterior surface of the eyeball , the conjunctiva thus forms a potential space, the conjunctival sac, which is open at the palpebral fissure. Beneath the eyelid is a groove, the subtarsal sulcus, which runs close to and parallel with the margin of the lid , the sulcus tends to trap small foreign particles introduced into the conjunctival sac and is thus clinically important.

The framework of the eyelids is formed by a fibrous sheet, the *orbital septum* , this is attached to the periosteum at the orbital margins, the orbital septum is thickened at the margins of the lids to form the *superior and inferior tarsal plates*. The lateral ends of the plates are attached by a band, the *lateral*

palpebral ligament, to a bony tubercle just within the orbital margin. The medial ends of the plates are attached by a band, the *medial palpebral ligament*, to the crest of the lacrimal bone.



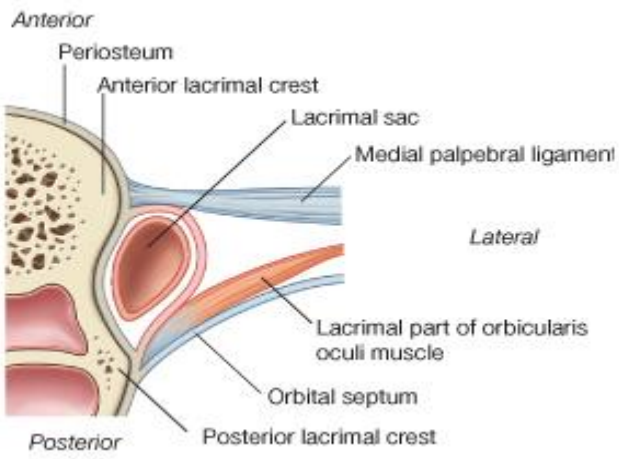


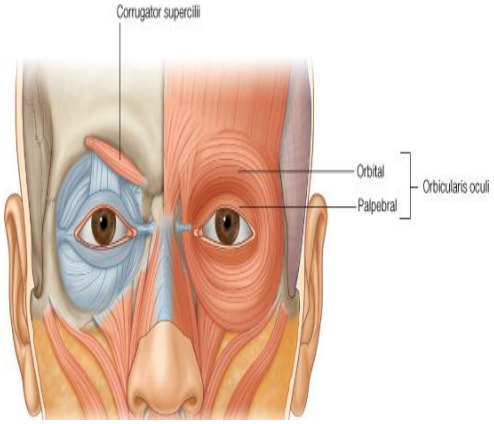
Movements of the eyelids

The eyelids are closed by the contraction of the orbicularis oculi and the relaxation of the levator palpebrae superioris muscles, when looking upward, the eye is opened by the levator palpebrae superioris العضلة المدارية العينية which contracts raising the upper lid with the eyeball, but on looking downward, both lids move, the upper lid continues to cover the upper part of the cornea, and the lower lid is pulled downward slightly by the conjunctiva, which is attached to the sclera and the lower lid.

Muscle	Origin	Insertion	Innervation	Function
Orbicularis oculi -Palpebral part -Orbital part	Medial palpebral lig.	Lateral palpebral raphe	Facial nerve [VII]	Closes the eyelids gently بلطف
	Medial palpebral lig. and adjoining bone	Loops return to origin	Facial nerve [VII]	Closes the eyelids forcefully بقوة
Levator palpebrae superioris	Back of orbital cavity	Anterior surface and upper margin of superior tarsal plate	Striated muscle oculomotor nerve, smooth muscle sympathetic	Anterior surface and upper margin of superior tarsal plate

An additional small lacrimalدمعي part of this muscle lies deep, medial in position, and attaches to bone posterior to the lacrimal sac of the lacrimal apparatus in the orbit.

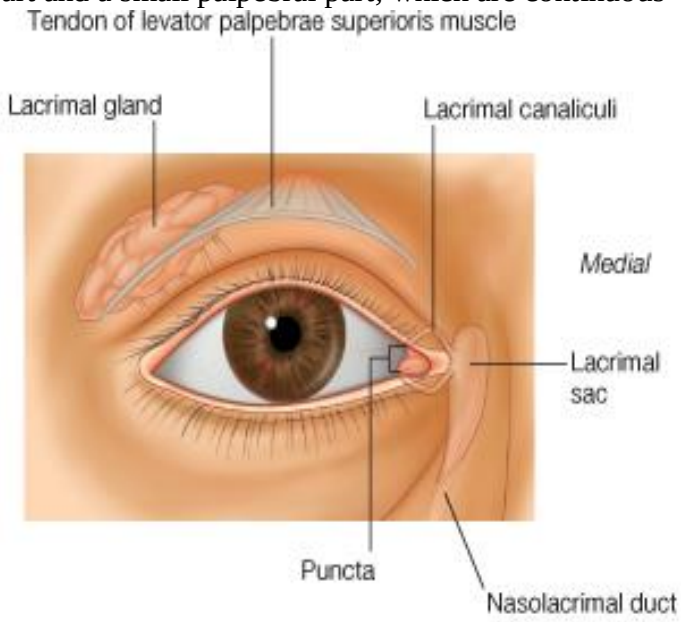




Lacrimal apparatus

Lacrimal gland

The lacrimal gland consists of a large orbital part and a small palpebral part, which are continuous with each other around the lateral edge of the aponeurosis of the levator palpebrae superioris, it is situated above the eyeball in the anterior and upper part of the orbit posterior to the orbital septum, the gland opens into the lateral part of the superior fornix of the conjunctiva by 12 ducts.



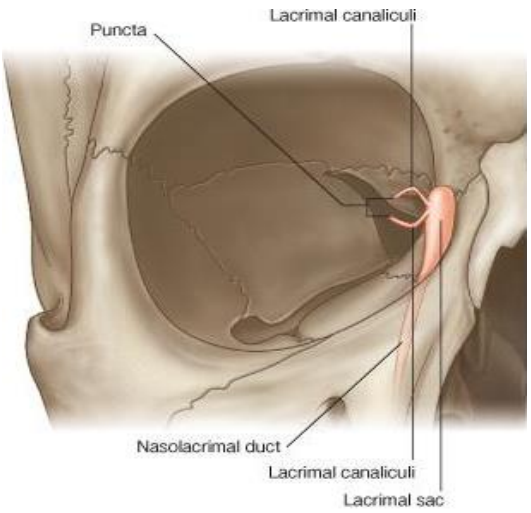
The parasympathetic secretomotor nerve supply is derived from the lacrimal nucleus of the facial nerve, the preganglionic fibers reach the pterygopalatine ganglion (sphenopalatine ganglion) via the nervus intermedius and it`s great petrosal branch and via the nerve of the pterygoid canal. The postganglionic fibers leave the ganglion and join the maxillary nerve, they then pass into it`s zygomatic branch and the zygomaticotemporal nerve, reaching the lacrimal gland within the lacrimal nerve.

Lacrimal ducts

The tears circulate across the cornea and accumulate in the lacus lacrimalis, entering the canaliculi lacrimales through the puncta lacrimalis, the canaliculi lacrimales pass medially and open into the

lacrimal sac , which lies in the lacrimal groove behind the medial palpebral ligament and is the upper blind end of the nasolacrimal duct.

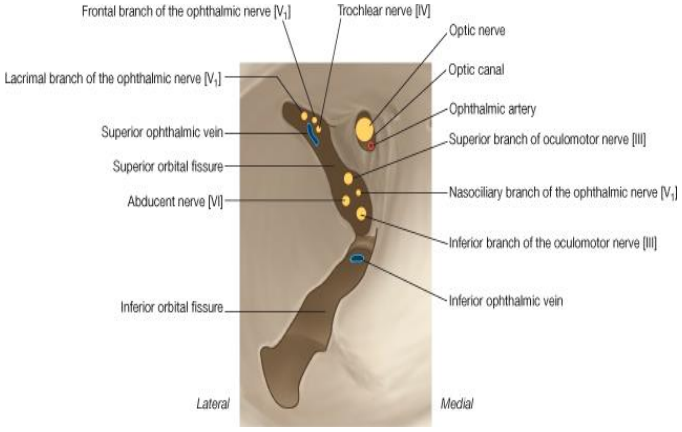
The nasolacrimal duct is about 0.5 in. (1.3 cm) long and emerges from the lower end of the lacrimal sac, the duct descends downward, backward, and laterally in a bony canal and opens into the inferior meatus of the nose, the opening is guarded by a fold of mucous membrane known as the lacrimal fold, which prevents air from being forced up the duct into the lacrimal sac on blowing the nose.



Nerves of the orbit

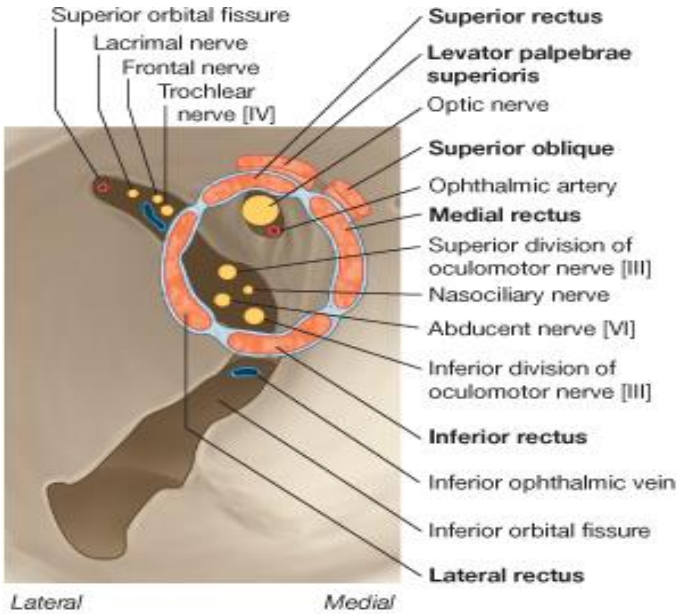
Optic nerve

Enters the orbit from the middle cranial fossa by passing through the optic canal, accompanied by the ophthalmic artery, which lies on it`s lower lateral side, it is surrounded by sheaths of pia mater, arachnoid mater, and dura mater, it runs forward and laterally within the cone of the recti muscles and pierces the sclera at a point medial to the posterior pole of the eyeball where; the meninges fuse with the sclera so that the subarachnoid space with it`s contained cerebrospinal fluid extends forward from the middle cranial fossa, around the optic nerve, and through the optic canal, as far as the eyeball.



Lacrimal nerve

Arises from the ophthalmic division of the trigeminal nerve, enters the orbit through the upper part of the superior orbital fissure and passes forward along the upper border of the lateral rectus muscle, it is joined by a branch of the zygomaticotemporal nerve, which later leaves it to enter the lacrimal gland (parasympathetic secretomotor fibers), it ends by supplying the skin of the lateral part of the upper lid.



Frontal nerve

It arises from the ophthalmic division of the trigeminal nerve, it enters the orbit through the upper part of the superior orbital fissure and passes forward on the upper surface of the levator palpebrae superioris beneath the roof of the orbit ,it divides into the supratrochlear and supraorbital nerves that wind around the upper margin of the orbital cavity to supply the skin of the forehead; the supraorbital nerve also supplies the mucous membrane of the frontal air sinus.

Trochlear nerve

Enters the orbit through the upper part of the superior orbital fissure, runs forward to supply the superior oblique muscle.

Oculomotor nerve

The superior ramus of the oculomotor nerve enters the orbit through the lower part of the superior orbital fissure, it supplies the superior rectus muscle, then pierces it, and supplies the levator palpebrae superioris muscle.

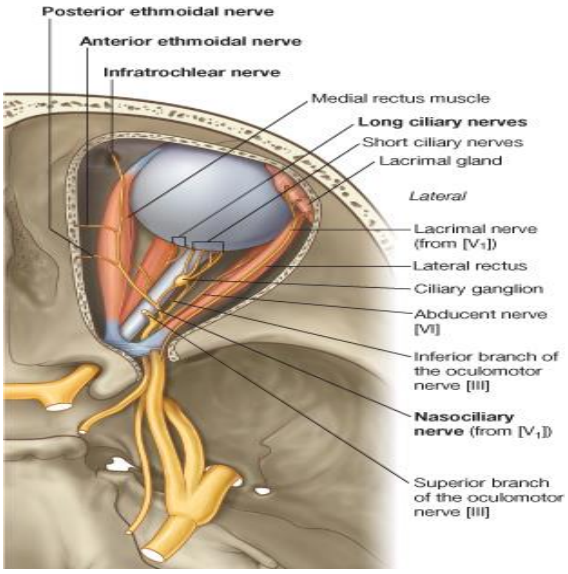
The inferior ramus of the oculomotor nerve enters the orbit in a similar manner and supplies the inferior rectus, the medial rectus, and the inferior oblique muscles. The nerve to the inferior oblique gives off a branch that passes to the ciliary ganglion and carries parasympathetic fibers to the sphincter pupillae and the ciliary muscle.

Abducent nerve

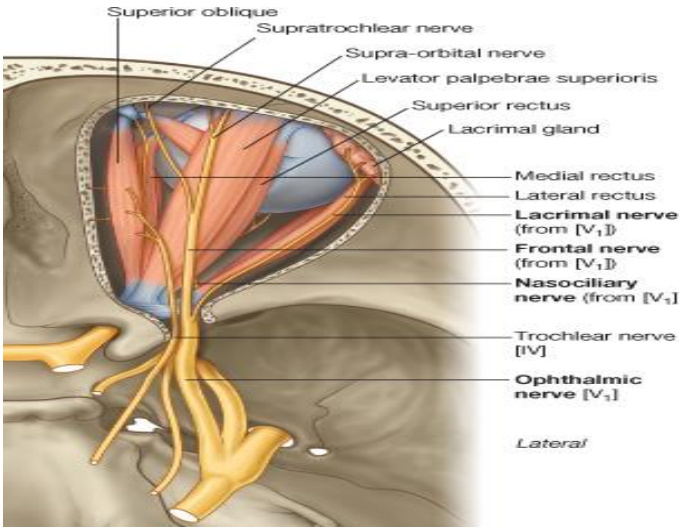
It enters the orbit through the lower part of the superior orbital fissure and supplies the lateral rectus muscle.

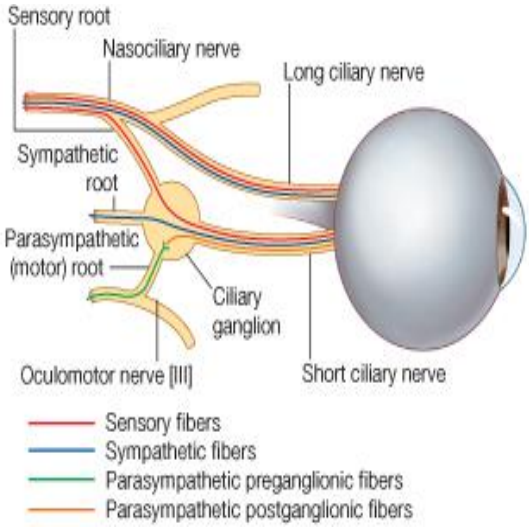
Nasociliary nerve

The nasociliary nerve arises from the ophthalmic division of the trigeminal nerve and ends by dividing into the anterior ethmoidal and infratrochlear nerves, branches of the nerve are:



- *communicating branch to the ciliary ganglion* is a sensory nerve, sensory fibers from the eyeball pass to the ciliary ganglion via the short ciliary nerves, pass through the ganglion without interruption, and then join the nasociliary nerve by means of the communicating branch.
- *long ciliary nerves*, two or three in number, arise from the nasociliary nerve as it crosses the optic nerve , they contain sympathetic fibers for the dilator pupillae muscle.
- *posterior ethmoidal nerve* supplies the ethmoidal and sphenoidal air sinuses.
- *infratrochlear nerve* passes forward below the pulley of the superior oblique muscle and supplies the skin of the medial part of the upper eyelid and the adjacent part of the nose.





- *anterior ethmoidal nerve* appears on the face as the external nasal branch at the lower border of the nasal bone, and supplies the skin of the nose down as far as the tip.

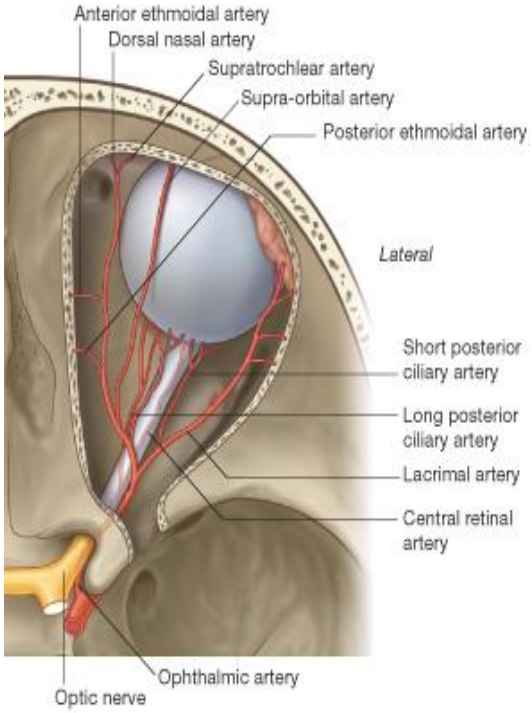
Blood Vessels and Lymph Vessels of the Orbit

Ophthalmic Artery

The ophthalmic artery is a branch of the internal carotid artery; the vessel emerges through the cavernous sinus, it enters the orbit through the optic canal with the optic nerve, runs forward and crosses the optic nerve to reach the medial wall of the orbit, giving off numerous branches, which accompany the nerves in the orbital cavity.

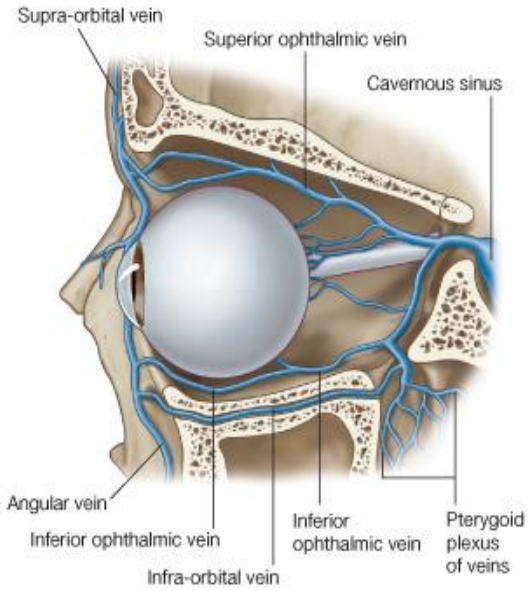
Branches of the ophthalmic artery

- *The central artery* of the retina is a small branch that pierces the meningeal sheaths of the optic nerve to gain entrance to the nerve. It runs in the substance of the optic nerve and enters the eyeball at the center of the optic disc, where it divides into branches, which are end arteries.
- *Muscular branches.*
- *The ciliary arteries* can be divided into anterior and posterior groups, the former group enters the eyeball near the corneoscleral junction; the latter group enters near the optic nerve.
- *The lacrimal artery* to the lacrimal gland.
- *The supratrochlear and supraorbital arteries* are distributed to the skin of the forehead



Ophthalmic veins

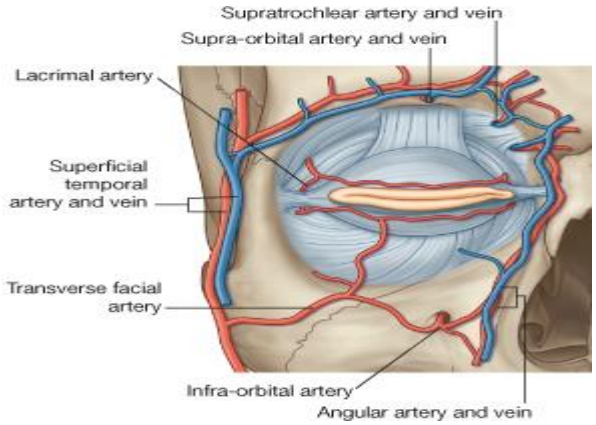
The *superior ophthalmic vein* communicates in front with the facial vein, the *inferior ophthalmic vein* communicates through the inferior orbital fissure with the pterygoid venous plexus, both veins pass backward through the superior orbital fissure and drain into the cavernous sinus.



Lymph Vessels

No lymph vessels or nodes are present in the orbital cavity.

The eye



Movements of the eyeball

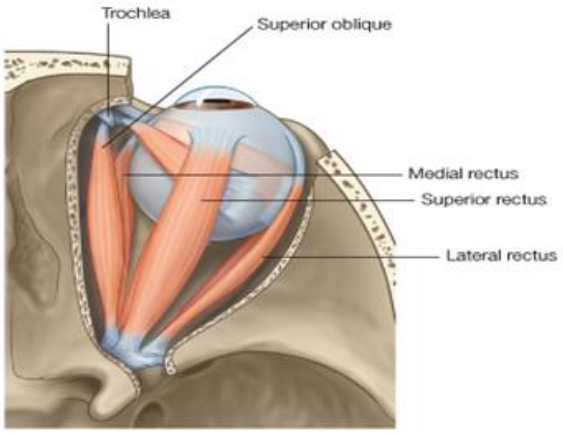
Extrinsic muscles producing movements of eye

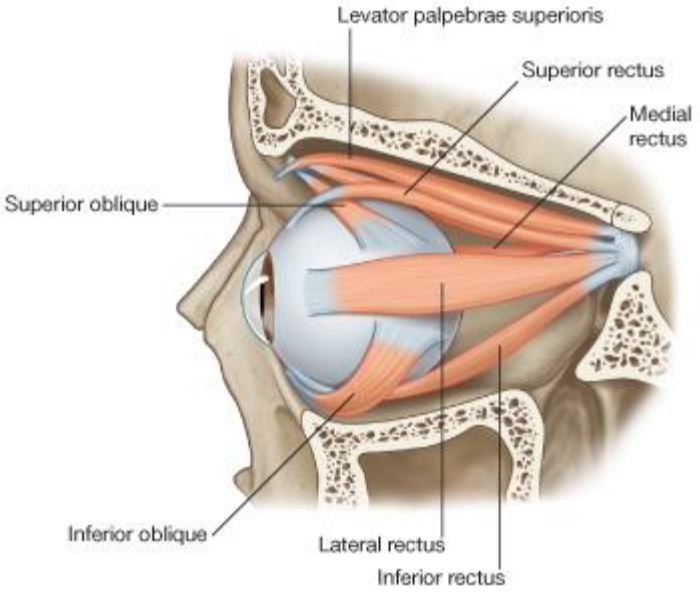
There are six voluntary muscles that run from posterior wall of the orbital cavity to the eyeball, these are the superior rectus, the inferior rectus, the medial rectus, the lateral rectus, and the superior and inferior oblique muscles.

Intrinsic muscles

The involuntary intrinsic muscles are the *ciliary muscle*, the constrictor and the dilator pupillae of the iris take no part in the movement of the eyeball.

Muscle	Origin	Insertion	Innervation	Function
Levator palpebrae superioris	Lesser wing of sphenoid anterior to optic canal	Anterior surface of tarsal plate; a few fibers to skin and superior conjunctival fornix	Oculomotor nerve [III]- superior branch	Elevation of upper eyelid
Superior rectus	Superior part of common tendinous ring	Anterior half of eyeball superiorly	Oculomotor nerve [III]- superior branch	Elevation, adduction, medial rotation of eyeball
Inferior rectus	Inferior part of common tendinous ring	Anterior half of eyeball inferiorly	Oculomotor nerve [III]- inferior branch	Depression, adduction, lateral rotation of eyeball
Medial rectus	Medial part of common tendinous ring	Anterior half of eyeball medially	Oculomotor nerve [III]- inferior branch	Adduction of eyeball
Lateral rectus	Lateral part of common tendinous ring	Anterior half of eyeball laterally	Abducent nerve [VI]	Abduction of eyeball
Superior oblique	Body of sphenoid, superior and medial to optic canal	Outer posterior quadrant of eyeball	Trochlear nerve [IV]	Depression, abduction, medial rotation of eyeball
Inferior oblique	Medial floor of orbit posterior to rim; maxilla lateral to nasolacrimal groove	Outer posterior quadrant of eyeball	Oculomotor nerve [III]- inferior branch	Elevation, abduction, lateral rotation of eyeball





Structure of the eye

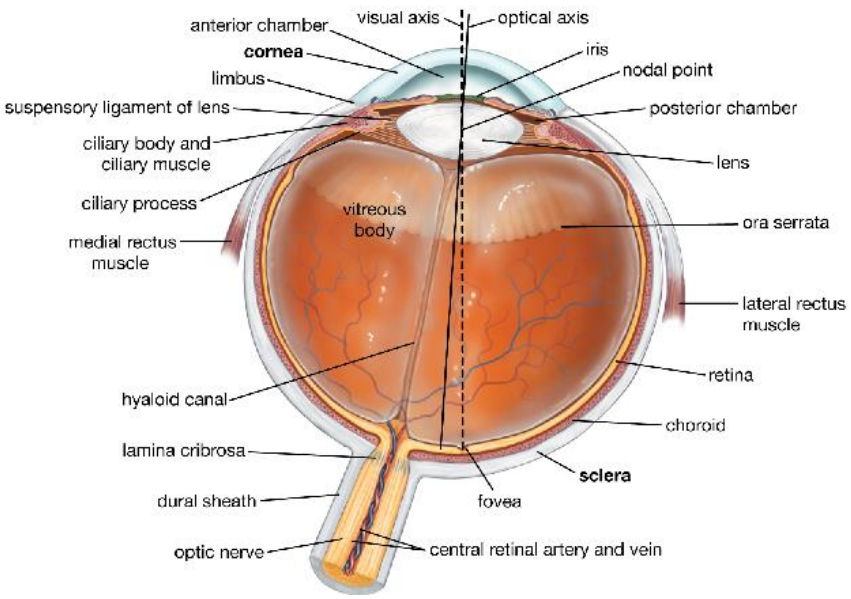
The eyeball is embedded in orbital fat but is separated from it by the facial sheath of the eyeball,
it`s wall consists of three coats, which, from out inward, are the fibrous coat, the vascular pigmented coat, and the nervous coat.

Fibrous coat

The fibrous coat is made up of a posterior opaque part, the sclera, and an anterior transparent part, the cornea, the *sclera* is directly continuous in front with the cornea at the corneoscleral junction, or limbus. The transparent cornea is largely responsible for the refraction of the light entering the eye, the cornea is avascular and devoid of lymphatic drainage, it is nourished by diffusion from the aqueous humor and from the capillaries at it`s edge.

Vascular pigmented coat

The vascular pigmented coat consists, from behind forward, of the choroid, the ciliary body, and the iris.

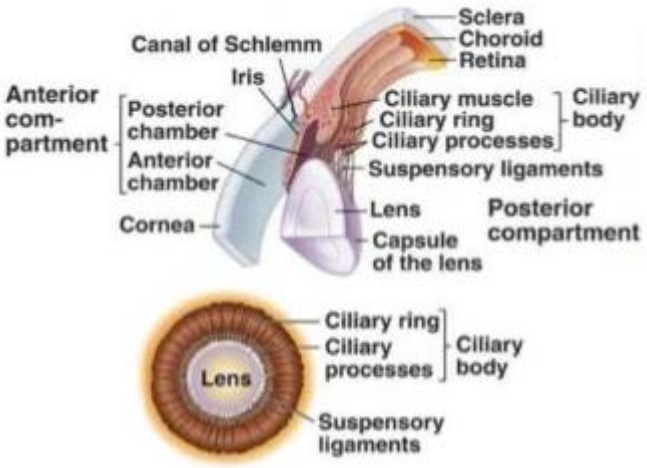


Choroid is composed of an outer pigmented layer and an inner, highly vascular layer. *Ciliary body* is composed of the ciliary ring, the ciliary processes, and the ciliary muscle, contraction of the ciliary muscle, especially the meridianal fibers, pulls the ciliary body forward relieving the tension in the suspensory ligament, and the elastic lens becomes more convex.

Iris is a thin, contractile, pigmented diaphragm with a central aperture, the *pupil* is

suspended in the aqueous humor between the cornea and the lens.

The muscle fibers of the iris are involuntary and consist of circular and radiating fibers, the circular fibers form the *sphincter pupillae* while the radial fibers form the *dilator pupillae* and consist of a thin sheet of radial fibers that lie close to the posterior surface.

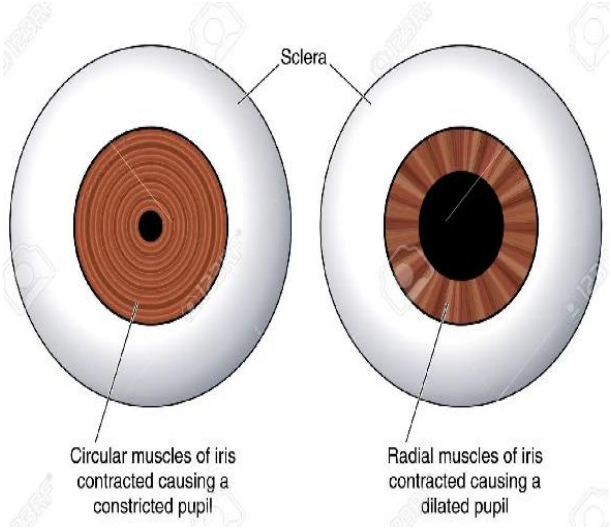


The sphincter pupillae constricts the pupil in the presence of bright light and during accommodation while the dilator pupillae dilates the pupil in the presence of light of low intensity or in the presence of excessive sympathetic activity such as occurs in fright.

Nervous Coat

The retina

It consists of an outer pigmented layer and an inner nervous layer, it`s outer surface is in contact with the choroid, and it`s inner surface is in contact with the vitreous body, the posterior three fourths of the retina is the receptor organ.



Clinical Notes

Eye Trauma

Blowout fractures of the orbital floor involving the maxillary sinus commonly occur as a result of blunt force to the face. If the force is applied to the eye, the orbital fat explodes inferiorly into the maxillary sinus, fracturing the orbital floor. Not only can blowout fractures cause displacement of the eyeball, with resulting symptoms of double vision (diplopia), but also the fracture can injure the infraorbital nerve, producing loss of sensation of the skin of the cheek and the gum on that side. Entrapment of the inferior rectus muscle in the fracture may limit upward gaze.

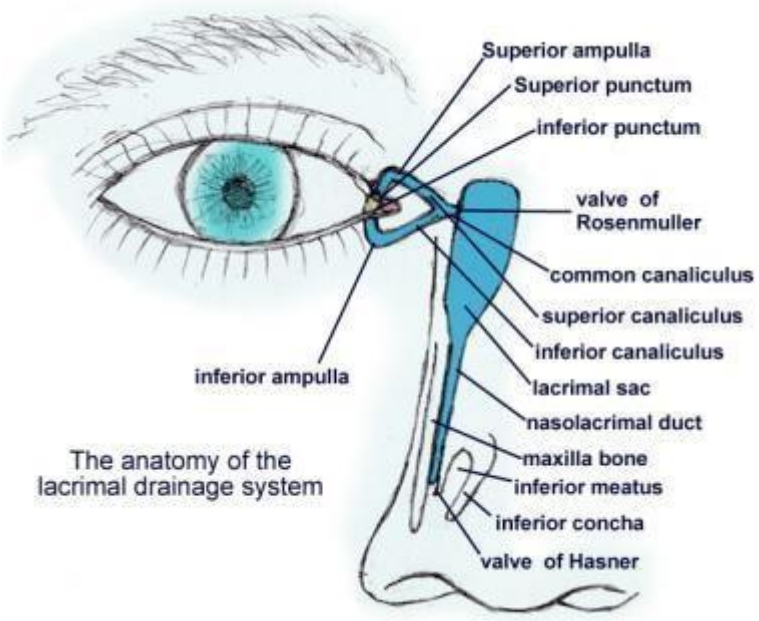
Pupillary Reflexes

The reactions of the pupils to light and accommodation depend on the integrity of nervous pathways.

Direct light reflex, the normal pupil reflexly contracts when a light is shone into the patient's eye.

Consensual light reflex is tested by shining the light in one eye and noting the contraction of the pupil in the opposite eye, this reflex is possible because the afferent pathway just described travels to the parasympathetic nuclei of both oculomotor nerves.

Accommodation reflex is the contraction of the pupil that occurs when a person suddenly focuses on a near object after having focused on a distant object.



The anatomy of the lacrimal drainage system

Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

Gross Anatomy
Head & Neck
Lec. : 3
Date: Sun. 16th. Oct, 2022

The Head

The respiratory system in the head and neck

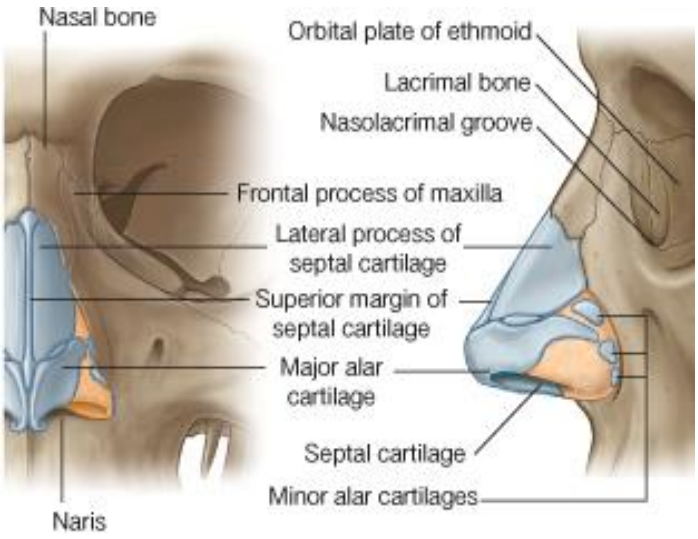
The nose

The nose consists of the external nose and the nasal cavity, both of which are divided by a septum into right and left halves.

External nose

The external nose has two elliptical orifices called the nostrils, which are separated from each other by the nasal septum, the lateral margin, the ala nasi, is rounded and mobile.

The framework of the external nose is made up above by the nasal bones, the frontal processes of the maxillae, and the nasal part of the frontal bone, Below; the framework is formed of plates of hyaline cartilage.



Blood supply of the external nose

The skin of the external nose is supplied by branches of the ophthalmic and the maxillary arteries. The skin of the ala and the lower part of the septum are supplied by branches from the facial artery, blood drained from the external nose to the facial vein via the angular and the lateral nasal veins.

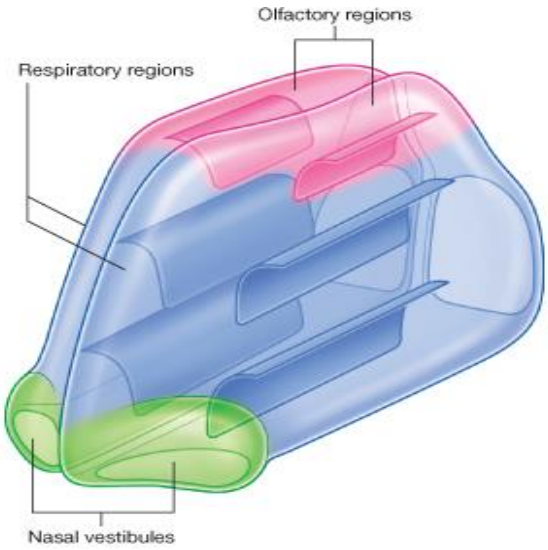
Nerve supply of the external nose

The infratrochlear and external nasal branches of the ophthalmic nerve and the infraorbital branch of the maxillary nerve.

Nasal cavity

The nasal cavity extends from the nostrils in front to the posterior nasal apertures or choanae behind, where the nose opens into the nasopharynx.

The nasal cavity is divided into right and left halves by the nasal septum. which is made up of the septal cartilage, the vertical plate of the ethmoid, and the vomer.



Regions of the nasal cavity

Each nasal cavity consists of three general regions; the nasal vestibule, the respiratory region, and the olfactory region.

- the nasal vestibule is a small dilated space just internal to the naris that is lined by skin and contains hair follicles.
- the respiratory region is the largest part of the nasal cavity, has a rich neurovascular supply, and is lined by respiratory epithelium composed mainly of ciliated and mucous cells.
- the olfactory region is a small area lying at the apex of each nasal cavity, it is lined by olfactory epithelium, and contains the olfactory receptors.

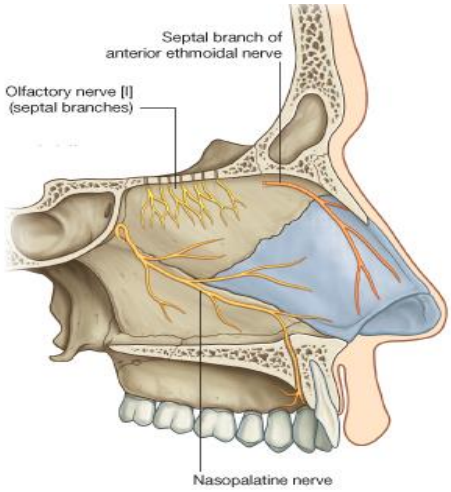
The nasal cavities are separated from:

- each other by a midline nasal septum.
- the oral cavity below by the hard palate.
- the cranial cavity above by parts of the frontal, ethmoid, and sphenoid bones.
- lying lateral to the nasal cavities on either sides are the orbits.

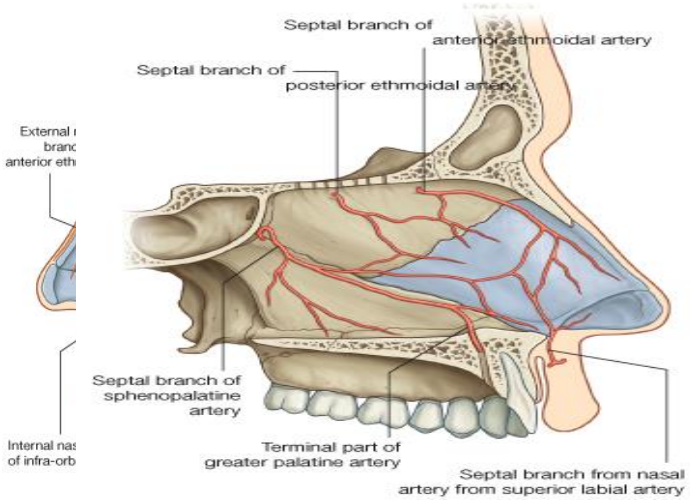
Innervation of the nasal cavities

Innervation of the nasal cavities is by three cranial nerves.

- Olfaction is carried by the olfactory nerve [I] , fibers of the nerve from the olfactory mucous membrane ascend through the cribriform plate of the ethmoid bone to the olfactory bulbs in the middle cranial fossa.
- General sensation is carried by the trigeminal nerve [V], the anterior region by the ophthalmic nerve [V_1], and the posterior region by the maxillary nerve [V_2].
- all glands are innervated by parasympathetic fibers in the facial nerve [VII] (greater petrosal nerve), which joins branches of the maxillary nerve [V_2] in the pterygopalatine fossa.



- Sympathetic fibers are ultimately derived from the T1 spinal cord level, synapsing mainly in the superior cervical sympathetic ganglion and postganglionic fibers reach the nasal cavities along blood vessels, or by joining branches of the maxillary nerve [V_2] in the pterygopalatine fossa.



branches of the internal carotid artery "ophthalmic" are the anterior and posterior ethmoidal arteries.

- the anterior part of the nasal septum "Kiesselbach area" is the site of an anastomotic arterial plexus involving all the arteries supplying the septum.

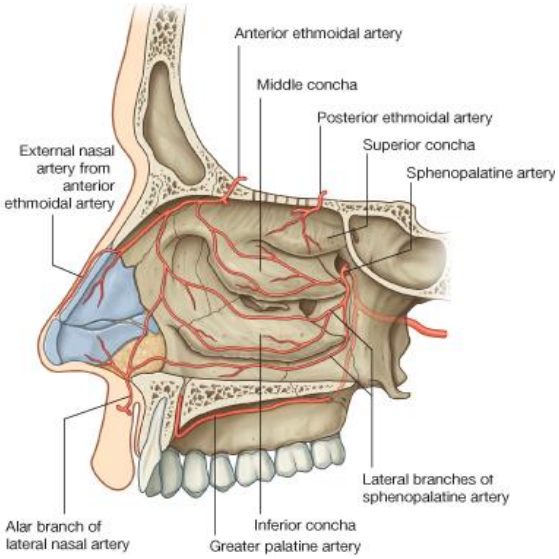
Veins draining the nasal cavities generally follow the arteries:

- veins that pass with branches that ultimately originate from the maxillary artery drain into the pterygoid plexus of veins in the infratemporal fossa.

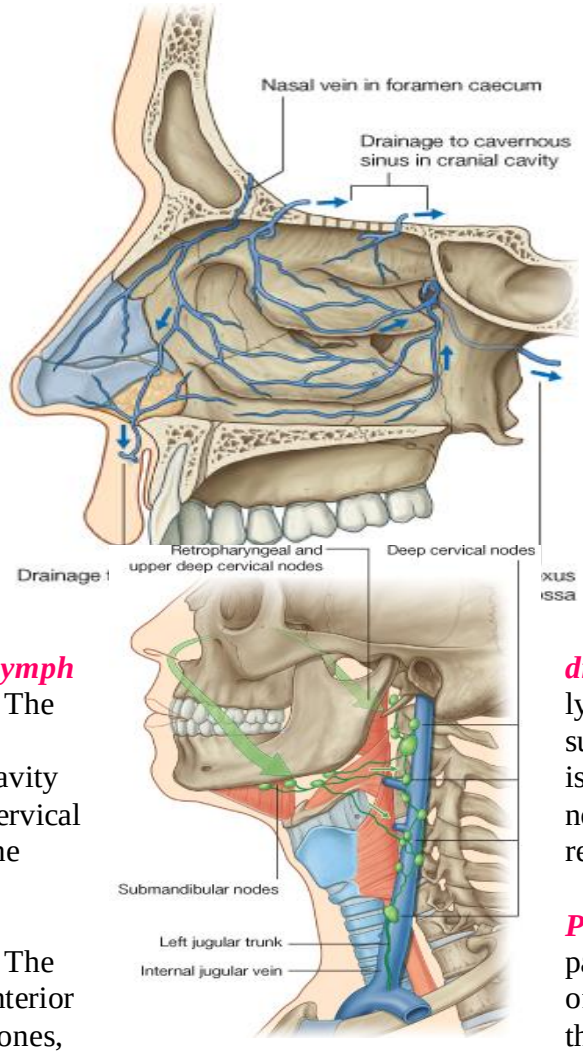
Blood supply

Blood supply to the nasal cavities is by arteries that supply the nasal cavity include vessels that originate from both the internal and external carotid arteries;

- vessels that originate from branches of the external carotid artery "maxillary" include the sphenopalatine, greater palatine, superior labial, and lateral nasal arteries.
- vessels that originate from



- veins from anterior regions of the nasal cavities join the facial vein.



In some individuals, an additional nasal vein passes superiorly through a midline aperture "foramen caecum" in the frontal bone anterior to the crista galli, and joins with the anterior end of the superior sagittal sinus, because this nasal vein connects an intracranial venous sinus with extracranial veins, it is classified as an emissary vein.

Emissary veins in general are routes by which infections can track from peripheral regions into the cranial cavity.

Veins that accompany the anterior and posterior ethmoidal arteries are tributaries of the superior ophthalmic vein, which is one of the largest emissary veins and drains into the cavernous sinus on either side of the hypophysial fossa.

Lymph drainage of the nasal cavity

The lymph vessels draining the vestibule end in the submandibular nodes, the remainder of the nasal cavity is drained by vessels that pass to the upper deep cervical nodes. Some of this lymph passes first through the retropharyngeal nodes.

Paranasal sinuses

The paranasal sinuses are cavities found in the interior of the maxilla, frontal, sphenoid, and ethmoid bones, they are lined with mucoperiosteum and filled with air; they communicate with the nasal cavity through relatively small apertures.

The maxillary and sphenoid sinuses are present in a rudimentary form at birth; they enlarge appreciably after the eighth year and become fully formed in adolescence.

Drainage of mucous and function of paranasal sinuses

The mucus produced by the mucous membrane is moved into the nose by ciliary action of the columnar cells, drainage of the mucus is also achieved by the siphon action created during the blowing of the nose.

The function of the sinuses is to act as resonators to the voice; they also reduce the weight of the skull, when the apertures of the sinuses are blocked or they become filled with fluid, the quality of the voice is markedly changed.

Maxillary Sinus

The maxillary sinus is pyramidal in shape and located within the body of the maxilla behind the skin of the cheek, it`s roof is formed by the floor of the orbit, and the floor is related to the roots of the premolars and molar teeth, the maxillary sinus opens into the middle meatus of the nose through the hiatus semilunaris.

The maxillary sinuses are innervated by infra-orbital and alveolar branches of the maxillary nerve [V_2], and receive their blood through branches from the infra-orbital and superior alveolar branches of the maxillary arteries.

Frontal sinuses

The two frontal sinuses are contained within the frontal bone, they are separated from each other by a bony septum, each sinus is roughly triangular, extending upward above the medial end of the eyebrow and backward into the medial part of the roof of the orbit, each frontal sinus opens into the middle meatus of the nose through the infundibulum.

The frontal sinuses are innervated by branches of the supra-orbital nerve from the ophthalmic nerve [V_1]. Their blood supply is from branches of the anterior ethmoidal arteries.

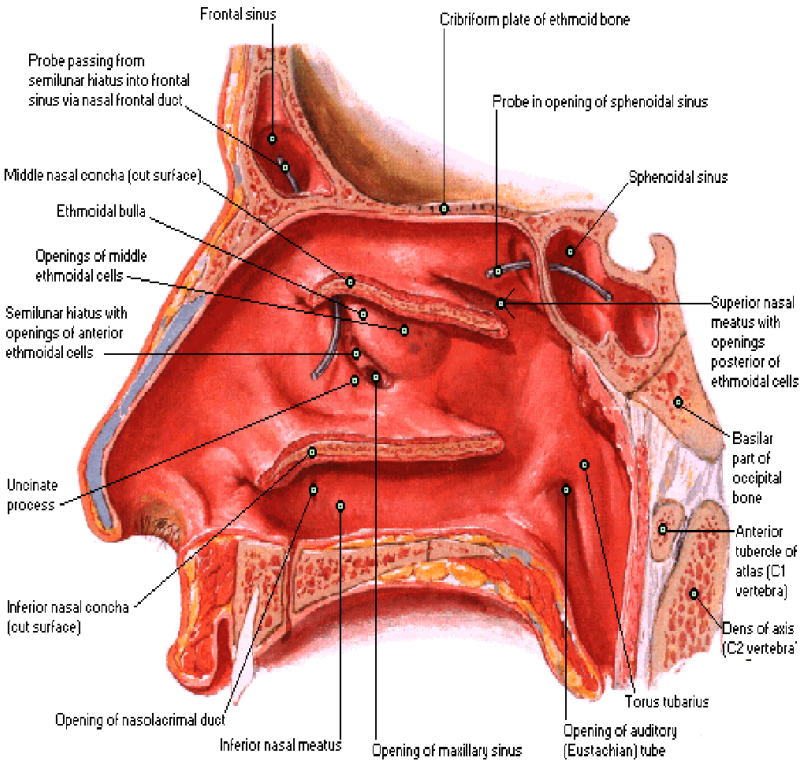
Sphenoidal sinuses

The two sphenoidal sinuses lie within the body of the sphenoid bone, each sinus opens into the Sphenoethmoidal recess above the superior concha.

Innervation of the sphenoidal sinuses is provided by:

- the posterior ethmoidal branch of the ophthalmic nerve [V_1];
- the maxillary nerve [V_2] via orbital branches from the pterygopalatine ganglion.

The sphenoidal sinuses are supplied by branches of the pharyngeal arteries from the maxillary arteries.



Ethmoid Sinuses

The ethmoidal sinuses are anterior, middle, and posterior and they are contained within the ethmoid bone, between the nose and the orbit, they are separated from the latter by a thin plate of bone so that infection can readily spread from the sinuses into the orbit.

The anterior sinuses open into the infundibulum; the middle sinuses open into the middle meatus, on or above the bulla ethmoidalis; and the posterior sinuses open into the superior meatus.The ethmoidal cells are innervated by:

- the anterior and posterior ethmoidal branches of the nasociliary nerve from the ophthalmic nerve [V_1];
- the maxillary nerve [V_2] via orbital branches from the pterygopalatine ganglion.

The ethmoidal cells receive their blood supply through branches of the anterior and posterior ethmoidal arteries.

Table 1: Paranasal sinuses and their site of drainage in to the nose

Sinus	Site of Drainage
Maxillary sinus	Middle meatus through hiatus semilunaris
Frontal sinuses	Middle meatus via infundibulum
Sphenoidal sinuses	Sphenoethmoidal recess
Ethmoidal sinuses	
Anterior group	Infundibulum and into middle meatus
Middle group	Middle meatus on or above bulla ethmoidalis
Posterior group	Superior meatus

Clinical notes

Examination of the nasal cavity

Examination of the nasal cavity may be carried out by inserting a speculum through the external nares or by means of a mirror in the pharynx, in the latter case, the choanae and the posterior border of the septum can be visualized.

Foreign bodies

Foreign bodies in the nose are common in children, presence of the nasal septum and the existence of the folded, shelflike conchae make impaction and retention of balloons, peas, and small toys relatively easy, it should be remembered that the nasal septum is rarely situated in the midline, a severely deviated septum may interfere with drainage of the nose and the paranasal sinuses.

Trauma to the nose

Fractures involving the nasal bones are common, blows directed from the front may cause one or both nasal bones to be displaced downward and inward, lateral fractures also occur in which one nasal bone is driven inward and the other outward; the nasal septum is usually involved.

Infection of the nasal cavity

Infection of the nasal cavity can spread in a variety of directions, paranasal sinuses are especially prone to infection, organisms may spread via the nasal part of the pharynx and the auditory tube to the middle ear, it is possible for organisms to ascend to the meninges of the anterior cranial fossa, along the sheaths of the olfactory nerves through the cribriform plate, and produce meningitis.

Nose bleeding

Epistaxis, or bleeding from the nose, is a frequent condition, the most common cause is nose picking, the bleeding may be arterial or venous, and most episodes occur on the anteroinferior portion of the septum.

Sinusitis and the examination of the paranasal sinuses

Infection of the paranasal sinuses is a common complication of nasal infections . Frontal, ethmoidal, and maxillary sinuses can be palpated clinically for areas of tenderness,

- the frontal sinus can be examined by pressing the finger upward beneath the medial end of the superior orbital margin where the floor of the frontal sinus is closest to the surface.
- the ethmoidal sinuses can be palpated by pressing the finger medially against the medial wall of the orbit,

- the maxillary sinus can be examined for tenderness by pressing the finger against the anterior wall of the maxilla below the inferior orbital margin; pressure over the infraorbital nerve may reveal increased sensitivity, , maxillary sinusitis may be contributed to extension from an apical dental abscess.

Directing the beam of a flashlight either through the roof of the mouth or through the cheek in a darkened room will often enable a physician to determine whether the maxillary sinus is full of inflammatory fluid rather than air, this method of transillumination is simple and effective.

Radiologic examination of the sinuses is also most helpful in making a diagnosis, one should always compare the clinical findings of each sinus on the two sides of the body.

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Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

Gross Anatomy
Head & Neck
Lec. : 4
Date: Sun. 23rd. Oct. 2022

The head

The face

Is the anterior part of the head extending from the hairline in adolescent above down to the chin and the base of the mandible, and as far back as the ears on either side, the forehead can be considered as a common area for both the scalp and face. The face is covered with skin and soft tissues overlying the bony framework "norma frontalis".

Skin

- highly vascularized so that when injured bleeds profusely but heals so rapid.
- possess large number of sweat glands that assist in regulating the body temperature, and sebaceous glands; sebum keeps the skin moist and oily but also cause acne in adults.
- presence of large number of muscles in the face that insert in skin make it more flexible and elastic.

Fascia

Superficial fascia: all the facial muscles insert in this layer, in addition to the vessels and nerves, fat also present in this layer but in different amounts, it is absent in the eyelids but highly concentrated in the cheeks forming the buccal pads that assist in sucking.

Deep fascia: confined in the parotid region forming parotid fascia and over the buccinators forming the buccopharyngeal fascia. Wrinkle`s lines develop in the face as a result of :

- loss of youth strength and flexibility of the muscles.
- repeated folding of the skin run perpendicularly to the long axis of underlying muscles, scars run along the wrinkles lines are less obvious.

Facial muscles

The muscles of the face are embedded in the superficial fascia, most of them arise from the bones of the skull to be inserted into the skin, a secondary function of the facial muscles is to modify the expression of the face.

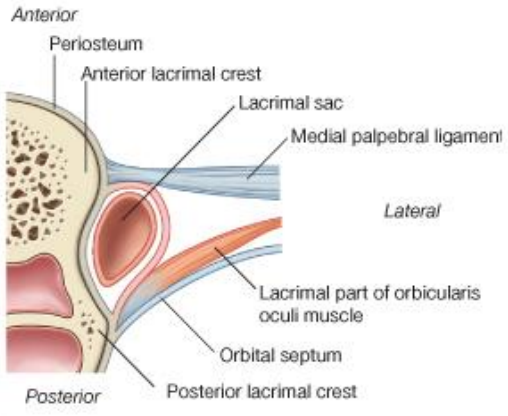
Functionally; the orifices of the face, namely, the orbit, mouth and nose are guarded by the palpebral , oral fissures and nostrils, it is the function of the facial muscles to serve as sphincters or dilators of these structures, each opening has a single sphincter and variable number of dilators, the sphincters are normally circular in shape while the dilators are radial.

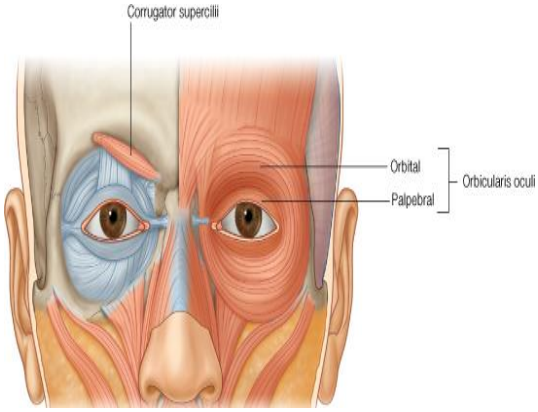
- all the muscles of the face are developed from the mesoderm of the second pharyngeal arch.
- are supplied by the facial nerve except the levator palpebrae superioris, which is supplied by oculomotor nerve.
- arranged in groups around the orifices: eye, nose, mouth and ear.
- taking origin from the bones and fascia and inserted to the skin acting as facial expression as a non – verbal communications.

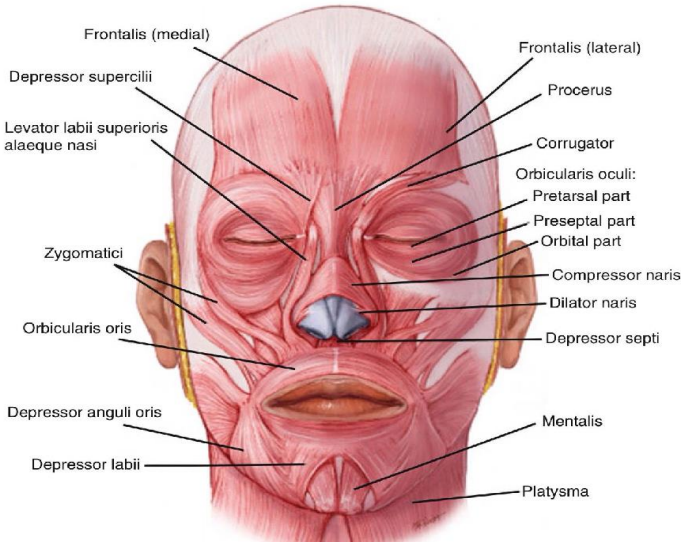
Orbital group

Muscles associated with the orbit are; orbicularis oculi , corrugator supercilii and levator palpebrae superioris, which is supplied by sympathetic fibers and oculomotor nerve.

Orbicularis oculi is a sphincter while the levator palpebrae superioris and the frontal belly of occipitofrontalis muscles act as dilators.







Nasal group

Muscles associated with the nose are; procerus, depressor septi nasi **,** compressor naris and dilator naris. Compressor naris is a sphincter while the dilator naris, depressor septi nasi and the medial slip of the levator labiisuperioris alaeque nasi act as dilators.

Oral group

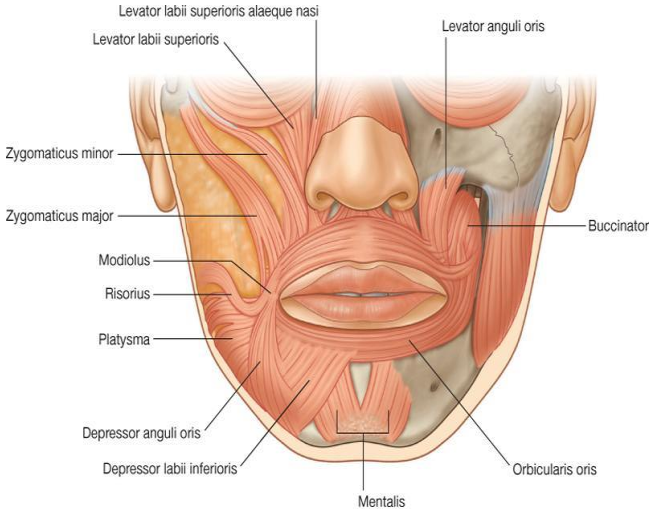
The oral group consists of a sphincter muscle for the lip and a number of dilators.

Orbicularis oris;

a sphincter muscle of the lips surrounds the oral orifice,

it`s fibers arise from

- midline between the maxilla and mandible
- many of the fibers are derived from the buccinators muscle.
- others derived from the deep surface of the skin and pass to the mucous membrane of the lips.



nerve supply from both the buccal and mandibular branches of facial nerve.

action of the muscle is to compress the lips together.

The dilator muscles are divided in to two groups

Lower group of oral muscles; Depressor anguli oris, Depressor labii inferioris and Mentalis.

Upper group of oral muscles; Risorius , Zygomaticus major, Zygomaticus minor, Levator labii superioris, Levator labii superioris alaeque nasi and Levator anguli oris.

Orbicularis oris is a sphincter muscle while the remaining muscles except the mentalis "which doesn`t convoy with the orbicularis oris" are dilators.

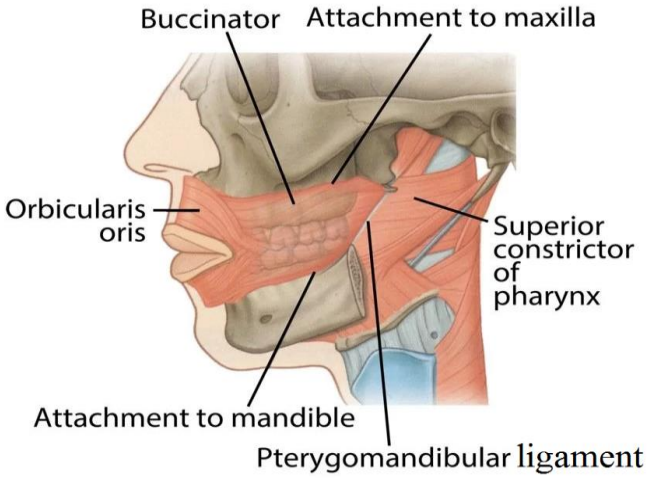
Muscle of the cheek

Buccinator

origin: from the outer surface of the alveolar margins of the maxilla and mandible opposite the molar teeth and from the pterygomandibular ligament.

insertion: the muscle fibers pass forward, forming the muscle layer of the cheek, pierced by the parotid duct.

At the angle of the mouth the central fibers decussate, those from below entering the upper lip and those from above entering the lower lip; the highest and lowest fibers continue into the upper and lower lips, respectively, without intersecting, buccinator muscle thus blends and forms part of the orbicularis oris muscle.



nerve supply: buccal branch of the facial nerve.

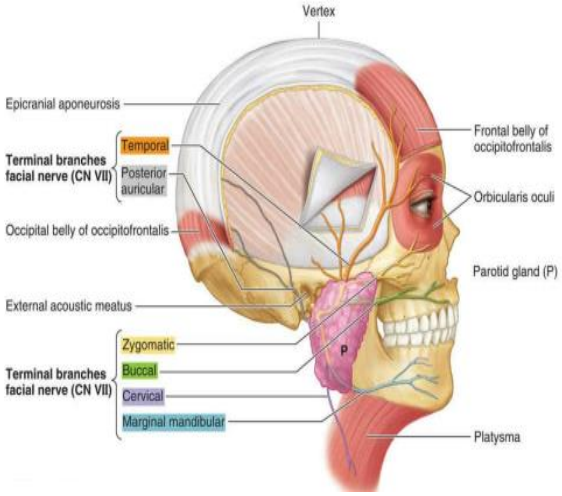
action: compresses the cheeks and lips against the teeth.

Innervation

Motor innervation of the face carried out by the facial nerve [VII], the nerve exits the posterior cranial fossa through the internal acoustic meatus , passing through the temporal bone, giving off several branches, and emerges from the base of the skull through the stylomastoid foramen.

The nerve continues forward entering the deep surface of the parotid gland where it gives five terminal groups of branches: the temporal, zygomatic, buccal, marginal mandibular, and cervical , these branches emerge from the parotid gland, they can be imagined by placing the wrist over the parotid region and spreading the fingers on the face.

Although there are variations in the pattern of distribution of the five terminal groups of branches, the basic pattern is as follows:



✓ temporal branches exit from the superior border of the parotid gland to supply muscles in the area of the temple, forehead, and supra-orbital area.

✓ zygomatic branches emerge from the anterosuperior border of the parotid gland to supply muscles in the infra-orbital area, the lateral nasal area, and the upper lip.

✓ buccal branches emerge from the anterior border of the parotid gland to supply muscles in the cheek, the upper lip, and the corner of the mouth.

✓ marginal mandibular branches emerge from the anteroinferior border of the parotid gland to supply muscles of the lower lip and chin.

✓ cervical branches emerge from the inferior border of the parotid gland to supply the platysma.

Muscle	Origin	Insertion	Nerve Supply	Action
Muscle of Scalp				
Occipitofrontalis				
Occipital belly	Highest nuchal line of occipital bone	Epicranial aponeurosis	Facial nerve	Moves scalp on skull and raises eyebrows
Frontal belly	Skin and superficial fascia of eyebrows			
Muscles of Facial Expression				
Orbicularis oculi				
Palpebral part	Medial palpebral ligament	Lateral palpebral raphe	Facial nerve	Closes eyelids and dilates lacrimal sac
Orbital part	Medial palpebral ligament and adjoining bone	Loops return to origin	Facial nerve	Throws skin around orbit into folds to protect eyeball
Corrugator supercilii	Superciliary arch	Skin of eyebrow	Facial nerve	Vertical wrinkles of forehead, as in frowning
Compressor nasi	Frontal process of maxilla	Aponeurosis of bridge of nose	Facial nerve	Compresses mobile nasal cartilages
Dilator naris	Maxilla	Ala of nose	Facial nerve	Widens nasal aperture
Procerus	Nasal bone	Skin between eyebrows	Facial nerve	Wrinkles skin of nose
Orbicularis oris	Maxilla, mandible, and skin	Encircles oral orifice	Facial nerve	Compresses lips together
Dilator Muscles of Lips				
Levator labii superioris alaeque nasi	Arise from bones and fascia around oral aperture and insert into substance of lips		Facial nerve	Separate lips
Levator labii superioris				
Zygomaticus minor				
Zygomaticus major				
Levator anguli oris				
Risorius				
Depressor anguli oris				
Depressor labii inferioris				
Mentalis				
Buccinator	Outer surface of alveolar margins of maxilla and mandible and pterygomandibular ligament		Facial nerve	Compresses cheeks and lips against teeth

Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

Gross Anatomy
Head & Neck
Lec. : 5
Date: Sun. 30th. Oct. 2022

The head

The face

Sensory innervation of the face

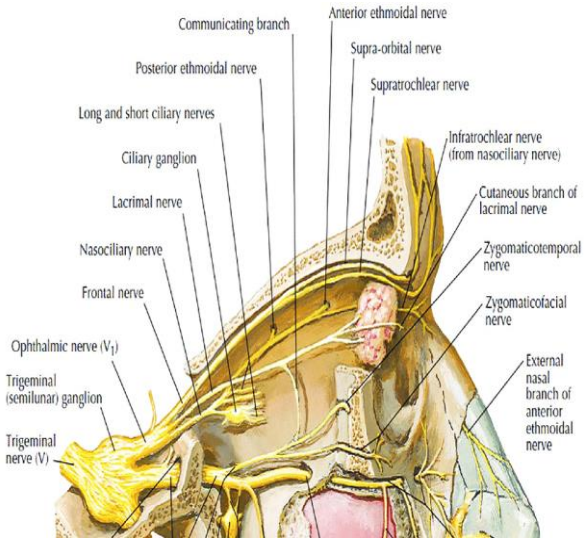
The skin of the face is innervated by branches of the three divisions of the trigeminal nerve, except for a small area over the angle of the mandible and the parotid gland, which is innervated by the great auricular nerve (C2 and 3), the overlap of the three divisions of the trigeminal nerve is slight compared with the marked overlap of dermatomes of the trunk and limbs.

These nerves not only innervate the skin of the face, but also send proprioceptive fibers to the underlying muscles of facial expression, in addition to sensory innervation to the mouth, teeth, nasal cavities, and paranasal air sinuses.

Ophthalmic nerve (CN V1)

It`s the superior division of the trigeminal nerve and the smallest one of them , it is purely sensory, it innervates the skin of the forehead, upper eyelid, conjunctiva, and the side of the nose downward including the tip, five branches of the nerve pass to the skin:

- *lacrimal nerve* innervates the skin and conjunctiva of the lateral part of the upper eyelid.
- *supraorbital nerve* winds around the upper margin of the orbit at the supraorbital notch, dividing into branches that innervate the skin and conjunctiva on the central part of the upper eyelid; it also innervates the skin of the forehead.
- *supratrochlear nerve* winds around the upper margin of the orbit medial to the supraorbital nerve, dividing into branches that innervate the skin and conjunctiva on the medial part of the upper eyelid and the skin over the lower part of the forehead, close to the median plane.

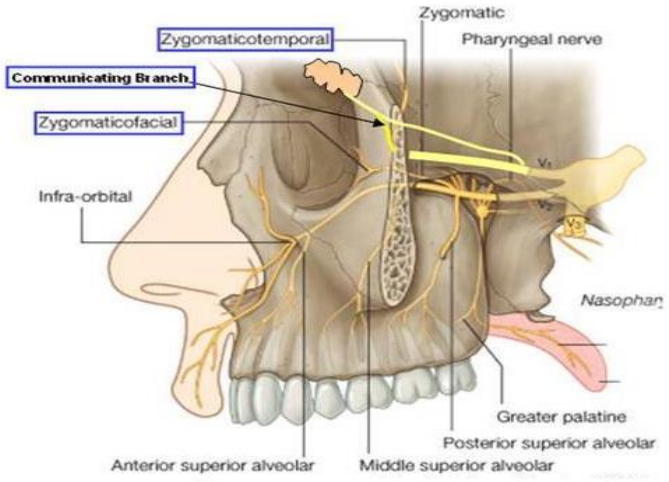


- *infratrochlear nerve* leaves the orbit below the pulley of the superior oblique muscle, innervating the skin and conjunctiva on the medial part of the upper eyelid and the adjoining part of the side of the nose.
- *external nasal nerve* leaves the nose by emerging between the nasal bone and the upper nasal cartilage, it innervates the skin on the side of the nose down as far as the tip.

Maxillary nerve (CN V2)

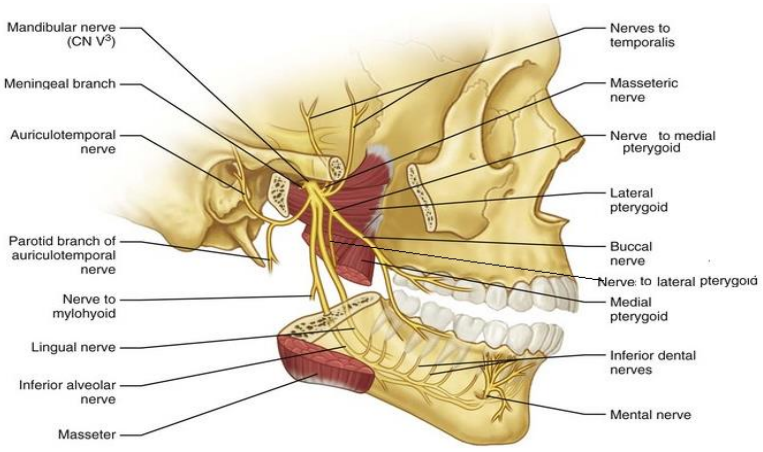
It is the intermediate division of the trigeminal nerve, it is sensory also innervating the skin on the posterior part of the side of the nose, the lower eyelid, the cheek, the upper lip, and the lateral side of the orbital opening, three branches of the nerve innervate the skin of the face.

- *infraorbital nerve* is a direct continuation of the nerve, it enters the orbit and appears on the face through the infraorbital foramen, immediately divides into numerous small branches, which radiate out from the foramen and innervate the skin of the lower eyelid and cheek, the side of the nose, and the upper lip.
- *zygomaticofacial nerve* passes onto the face through a small foramen on the lateral side of the zygomatic bone, innervating the skin over the prominence of the cheek.
- *zygomaticotemporal nerve* emerges in the temporal fossa through a small foramen on the posterior surface of the zygomatic bone to innervate the skin over the temple.



Mandibular nerve (CN V3)

The mandibular nerve is the largest of the three divisions of the trigeminal nerve , unlike the ophthalmic and maxillary divisions, which are purely sensory, the mandibular nerve is a mixed one "both sensory and motor", the sensory root emerges from the trigeminal ganglion and leave the skull through the foramen ovale entering the infratemporal fossa, the motor root leaves the skull through the same foramen to join the sensory root forming the main stem of the nerve, giving rise to a small meningeal branch and the nerve to medial pterygoid, then divides into a small anterior and large posterior trunks.



The mandibular nerve innervates the skin of the lower lip, the lower part of the face, the temporal region, and part of the auricle, then it passes upward to the side of the scalp, three branches of the nerve pass to the skin.

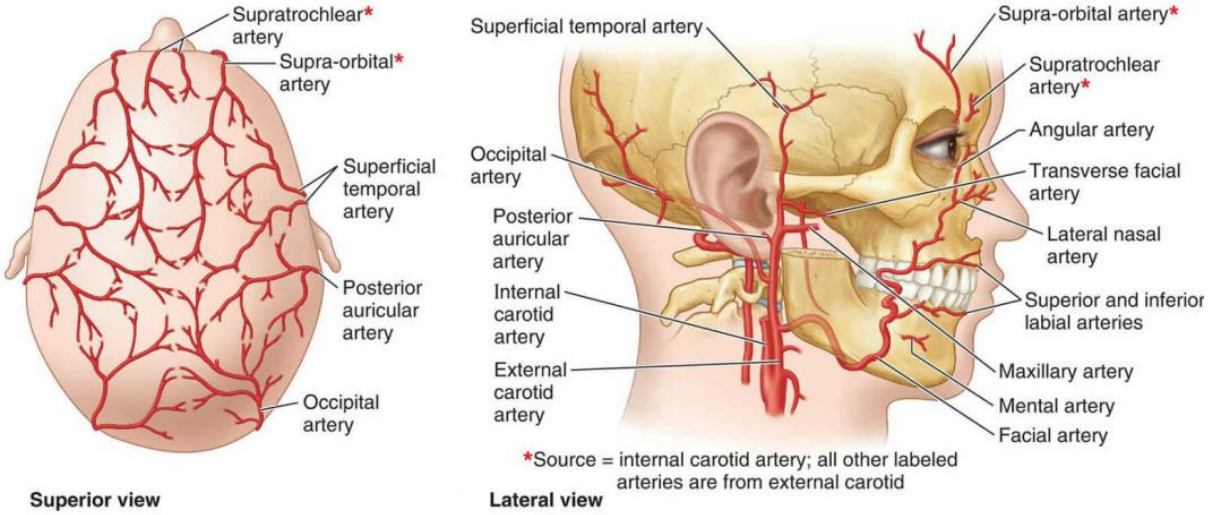
- *mental nerve* emerges from the mental foramen of the mandible and innervates the skin of the lower lip and chin.
- *buccal nerve* emerges from beneath the anterior border of the masseter muscle and innervates the skin over a small area of the cheek.
- *auriculotemporal nerve* ascends from the upper border of the parotid gland between the superficial temporal vessels and the auricle, to innervate the skin of the auricle, external auditory meatus, the outer surface of the tympanic membrane, and the skin of the scalp above the auricle.

Blood supply of the face

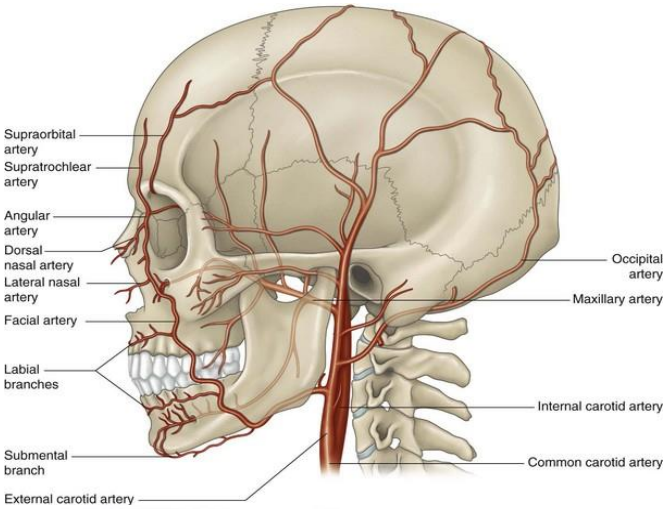
The face is highly vascularized, being supplied mainly by the facial and transverse facial artery in addition to numerous small vessels that accompany the ophthalmic , maxillary and superficial temporal nerves.

Facial artery

Facial artery arises from the external carotid artery in the carotid triangle at the level of the

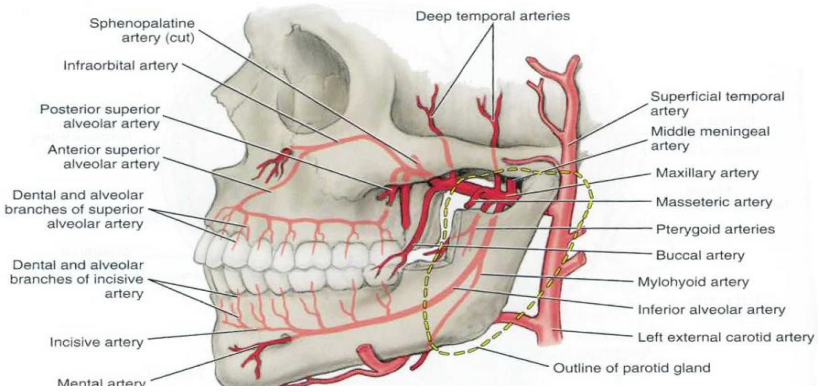


greater cornu of the hyoid bone, reaching the submandibular triangle winding around the base of the mandible, piercing the deep cervical fascia, at the anteroinferior angle of the masseter muscle where it`s pulse can be easily palapated, called "anaesthetist's artery", and enter the face,



The artery runs upward forward for 1.25 cm lateral to the angle of the mouth covered by the platysma and the risorius muscles, it then ascends deep to the zygomaticus muscles and the levator labii superioris muscle " it runs between the superficial and deep muscles of the face" , and ascends along the side of the nose up to the medial angle of the eye terminating by supplying the lacrimal sac and anastomosing with the dorsal nasal branch of the ophthalmic artery.

The course of the artery is very tortuous, this tortuosity protects it`s walls from being stretched during the movements of the lips, mandible and the cheeks, branches of the facial artery are:



● *submental artery* arises from the facial artery at the lower border of the body of the mandible, it supplies the skin of the chin and lower lip.

- *inferior labial artery* arises near the angle of the mouth, it runs medially in the lower lip and anastomoses with its fellow of the opposite side.
- *superior labial artery* arises near the angle of the mouth, it runs medially in the upper lip and gives branches to the septum and ala of the nose.
- *lateral nasal artery* arises from the facial artery alongside the nose, it supplies the skin on the side and dorsum of the nose.

Transverse facial artery

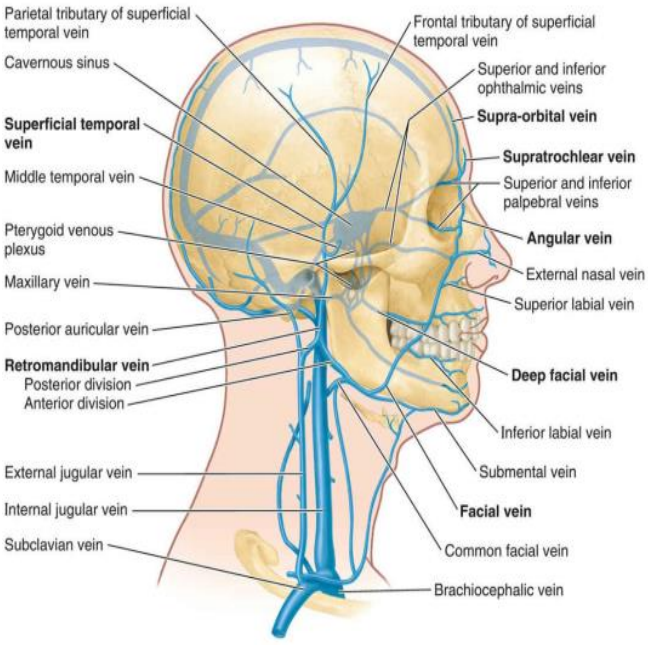
Is a branch of the superficial temporal artery, arises within the parotid gland, and runs forward across the cheek just above the parotid duct. Superficial temporal artery is the smaller terminal branch of the external carotid artery begin in the parotid gland and ascends anterior to the auricle to supply the scalp.

Branches from ophthalmic artery

Supraorbital and supratrochlear arteries, branches of the ophthalmic artery, supply the skin of the forehead.

Venous drainage

Veins of the face accompany the arteries and drain into the common facial and retromandibular veins, they communicate with the cavernous sinus. The veins on each side form a 'W-shaped' arrangement, each corner of the figure prolonged upward to the scalp and downward into the neck



Facial vein

It`s the major vein draining the face, it`s point of origin is near the medial corner of the orbit as the supra-trochlear and supra-orbital veins come together to form the angular vein, this vein becomes the facial vein as it passes inferiorly just posterior to the facial artery. The facial vein descends across the face with the facial artery until it reaches the inferior border of the mandible where they part company and the facial vein crosses the anteroinferior angle of the masseter, piercing the deep fascia, to crosse the submandibular gland, and joins the anterior division of the retromandibular vein below the angle of the mandible to form the common facial vein, the vein drains into the internal jugular vein.

Tributaries

The facial vein receives tributaries that correspond to the branches of the facial artery, it is joined to the

- pterygoid venous plexus by the deep facial vein which passes backwards over the buccinator.
- cavernous sinus by the superior ophthalmic vein that communicates with the supraorbital vein.

- in the area of the cheek it communicates with veins passing into the infra-orbital foramen.

Throughout it`s course the facial vein receives tributaries from veins draining the eyelids, external nose, lips, cheek, and chin that accompany the various branches of the facial artery.

Transverse facial vein

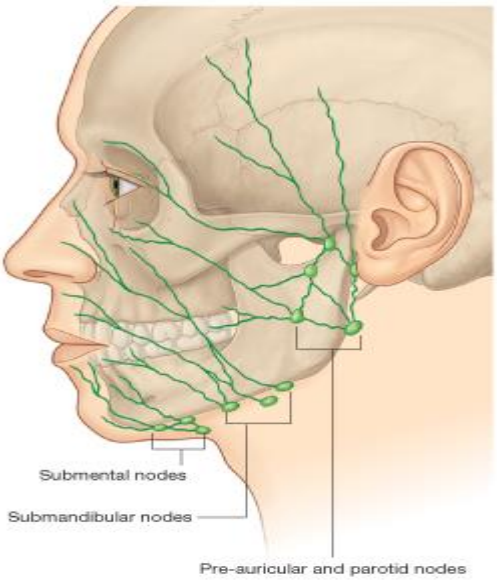
The transverse facial vein is a small vein that accompanies the transverse facial artery in it`s journey across the face, it empties into the superficial temporal vein within the substance of the parotid gland.

All these venous channels have interconnections with the intracranial cavernous sinus through emissary veins that connect extracranial with intracranial veins. There are no valves in the facial vein or any other venous channels in the head, so blood can move in any direction.

Because of the interconnections between the veins, infections of the face, primarily above the mouth (i.e. the 'danger area') should be handled with great care to prevent the dissemination of infectious materials in an intracranial direction.

Lymphatic drainage

Lymphatic drainage from the face primarily moves towards three groups of lymph nodes;



- ✓ *submental nodes* inferior and posterior to the chin, which drain lymphatic from the central part of the lower lip and the chin bilaterally "lower territory"..
- ✓ *submandibular nodes* superficial to the submandibular gland and inferior to the body of the mandible, which drain the lymphatics from the including a strip over the median part of the forehead, external nose, upper lip, lateral part of the lower lip, medial halves of the eyelids, medial part of the cheek, and the greater part of lower jaw that follow the course of the facial artery "middle territory".
- ✓ *pre-auricular and parotid* nodes anterior to the ear, which drain lymphatics from most part of the forehead, lateral halves of eyelids, conjunctiva, lateral part of the cheek and parotid area, drains into the preauricular parotid nodes "upper territory".

Common facial expressions

1. Surprise: Frontalis
2. Dislike: Corrugator supercilii and procerus
3. Anger: Dilator naris and depressor septi
4. Smiling and laughing: Zygomaticus major
5. Grinning: Risorius
6. Sadness: Levator labii superioris and levator anguli oris
7. Grief: Depressor anguli oris
8. Closing the mouth: Orbicularis oris
9. Whistling/kissing: Buccinator, and orbicularis oris
10. Doubt: Mentalis
11. Horror, terror and fright: Platysma

No.	Expression	Change in skin of face	Muscle responsible
1.	Surprise	Transverse wrinkles at forehead Transverse wrinkles at the bridge of the nose.	Frontalis and Procerus
2.	Frowning	Vertical wrinkles at forehead	Corrugator supercilii
3.	Anger	Dilatation of ant. Nasal aperture. Depression of lower part of nasal septum "columella"	Dilator naris and Depressor septi
4.	Smiling and laughing	Angle of mouth drawn upward and laterally.	Zygomaticus major
5.	Sadness	Angle of mouth drawn downward and laterally.	Depressor anguli oris
6.	Sorrow and grief	Accentuation of nasolabial furrow with elevation and eversion of upper lip.	Levator labii superioris, Levator anguli oris and Zygomaticus minor
7.	Grinning	Retraction of angle of mouth.	Risorius
8.	Disdain/ doubt	Puckering of skin over chin with protrusion of lower lip.	Mentalis
9.	Whistling	Pressing the cheek against the gum with pursing the mouth in a small opening.	Buccinator

Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

Gross Anatomy
Head & Neck
Lec. : 6
Date: Sun. 6th. Nov. 2022

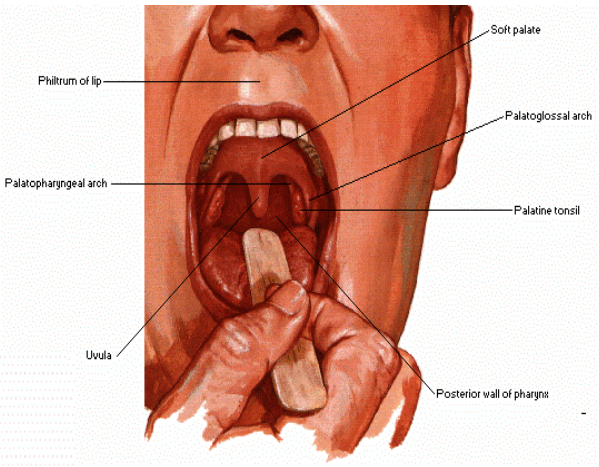
The Head

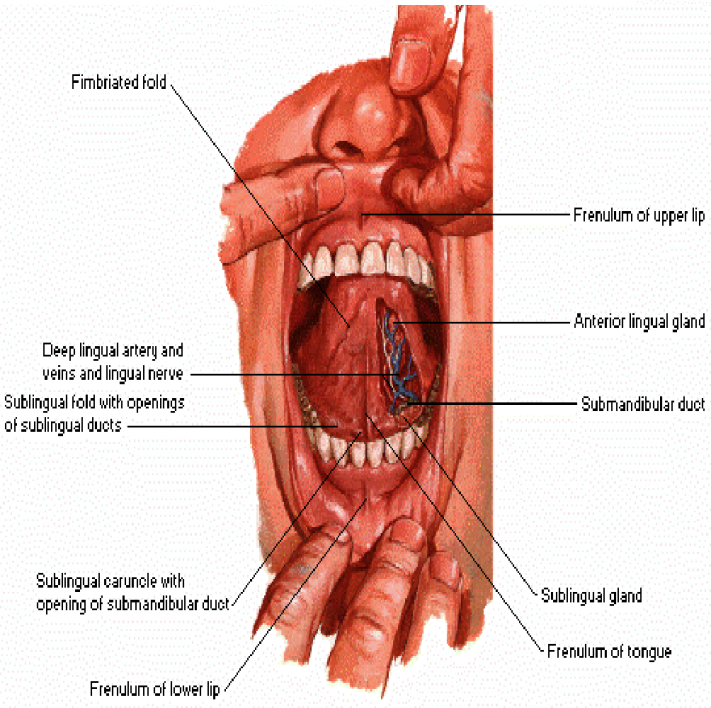
Oral cavity

The lips

The lips are two fleshy folds that surround the oral orifice, they are covered on the outside by skin and are lined on the inside by mucous membrane, the substance of the lips is made up by the orbicularis oris muscle and the muscles that radiate from the lips into the face.

Also included are the labial blood vessels and nerves, connective tissue, and many small salivary glands. The philtrum is the shallow vertical groove seen in the midline on the outer surface of the upper lip.





The mouth

The mouth extends from the lips to the pharynx " nasopharynx" , the oropharyngeal isthmus, is formed on each side by the palatoglossal fold.

The mouth is divided into the vestibule and the mouth cavity proper.

Vestibule

The vestibule lies between the lips and the cheeks externally and the gums and the teeth internally, a slitlike space communicates with the exterior through the oral fissure between the lips.

When the jaws are closed, it communicates with the mouth proper behind the third molar tooth on each side, the vestibule is limited above and below by the reflection of the mucous membrane from the lips and cheeks to the gums.

The vestibule as a whole is lined with mucous membrane which form median folds " superior and inferior" labial frenula connect the inner surface of the lips to the gums.

The lateral wall of the vestibule is formed by the cheek, which is made up by the buccinator muscle and is lined with mucous membrane, the tone of the buccinator muscle and that of the muscles of the lips keeps the walls of the vestibule in contact with one another, the duct of the parotid salivary gland opens on a small papilla into the vestibule opposite the upper second molar tooth.

Mouth cavity proper

The mouth proper has a roof and a floor, the roof of the mouth is formed by the hard palate in front and the soft palate behind, while the floor is formed largely by the anterior two thirds of the tongue and by the reflection of the mucous membrane from the sides of the tongue to the gum of the mandible, a fold of mucous membrane called the frenulum of the tongue connects the undersurface of the tongue in the midline to the floor of the mouth.

The duct of the submandibular gland opens onto the floor of the mouth on the summit of a small papilla on either side of the frenulum of the tongue, the sublingual gland projects up into the mouth, producing a low fold of mucous membrane, the sublingual fold, numerous ducts of the gland open on the summit of the fold.

Cheeks (L. buccae*)*

The cheeks have essentially the same structure as the lips with which they are continuous in front at the nasolabial sulcus " furrow" which extends from the side of the nose to the angle of the mouth, they form a large part of the side of the face and the movable walls of the oral cavity.

Layers of the cheek in order are:

- skin
- superficial fascia with it`s contents" facial muscles, nerves , vessels, molar mucous glands and a part of the course of the parotid gland.
- buccinators muscle enveloped with the buccopharyngeal fascia and pierced with parotid duct.
- submucosa containing a number of buccal mucous gland.
- mucosa

Superficial to the buccinators are encapsulated collections of fat, these *buccal fat-pads* are proportionately much larger in infants, presumably to reinforce the cheeks and keep them from collapsing during sucking.

Lymphatic from the cheek drain mainly to the pre-auricular and sub-mandibular lymph nodes, some lymphatic drain to the buccal and mandibular lymph nodes.

Gums (Gingivae)

The gums are composed of dense fibrous tissue covered with stratified squamous epithelium cover the alveolar processes of the maxilla and the mandible" upper and lower jaws surrounding the necks of the teeth, the gum is formed of two parts:

- the free part that surrounds the neck of each tooth like a collar.
- the attached part that is connected with the alveolar processes of the maxilla and mandible firmly. The fibrous tissue of the gums is continues with the periosteum of the alveolar processes " periodontal membrane".

Mucous membrane of the mouth

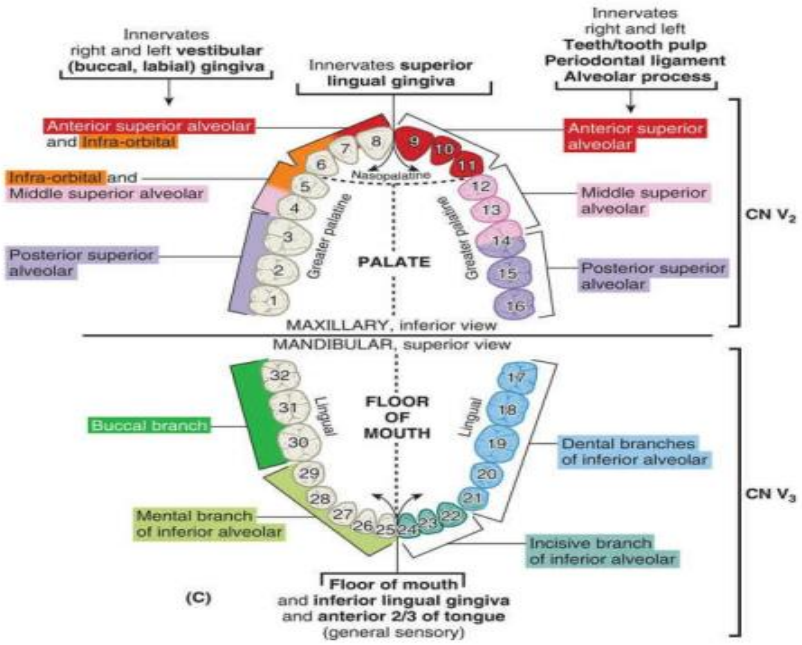
In the vestibule the mucous membrane is tethered to the buccinator muscle by elastic fibers in the submucosa that prevent redundant folds of mucous membrane from being bitten between the teeth when the jaws are closed, the mucous membrane of the gingiva, or gum, is strongly attached to the alveolar periosteum.

Nerve supply of the gums

The gum has two aspects " labial and lingual" and each of them has it`s own innervations:

Upper gum:

labial aspect: posterior, middle and anterior superior alveolar nerves [V2].
lingual aspect: palatine and nasopalatine nerves (from pterygopalatine ganglion).

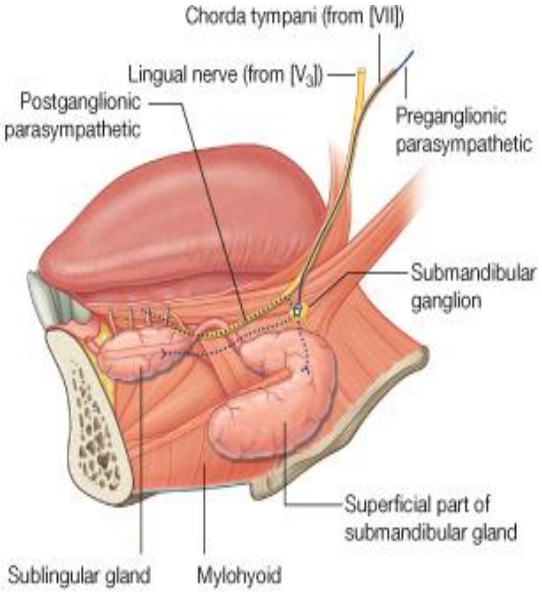


Lower gum:
labial aspect: buccal branch of mandibular and incisive branch of mental nerve [V3].

lingual aspect: lingual nerve [V3].

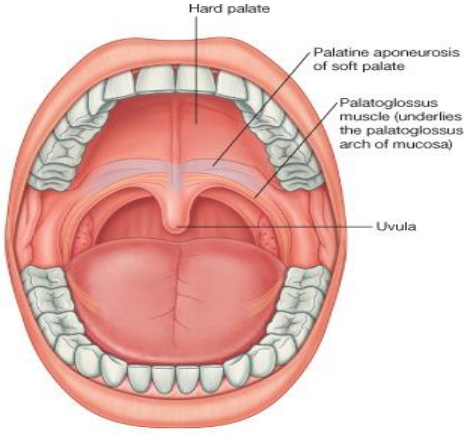
Lymphatics of the gums

Lymphatics from the upper gums pass to the submandibular nodes, those of the anterior part of the lower gums drains into the submental nodes, whereas the posterior part drains into the submandibular nodes.



Sensory innervation of the mouth

- Roof: greater palatine, lesser palatine and nasopalatine nerves branches of the maxillary division of the trigeminal nerve, [CV2].
- Floor: lingual nerve (common sensation), a branch of the mandibular division of the trigeminal nerve[CV3], taste fibers travel in the chorda tympani nerve, a branch of the facial nerve.
- Cheek: buccal nerve, a branch of the mandibular division of the trigeminal nerve (the buccinator muscle is innervated by the buccal branch of the facial nerve).



The palate

The palate forms the roof of the mouth and the floor of the nasal cavity, it is divided into two parts: the hard palate in front and the soft one behind.

Hard palate

The hard palate is formed by the palatine processes of the maxillae and the horizontal plates of the palatine bones, it is continuous behind with the soft palate.

Soft palate

The soft palate is a mobile fold attached to the posterior border of the hard palate, it`s free posterior border presents in the midline a conical projection called the uvula.

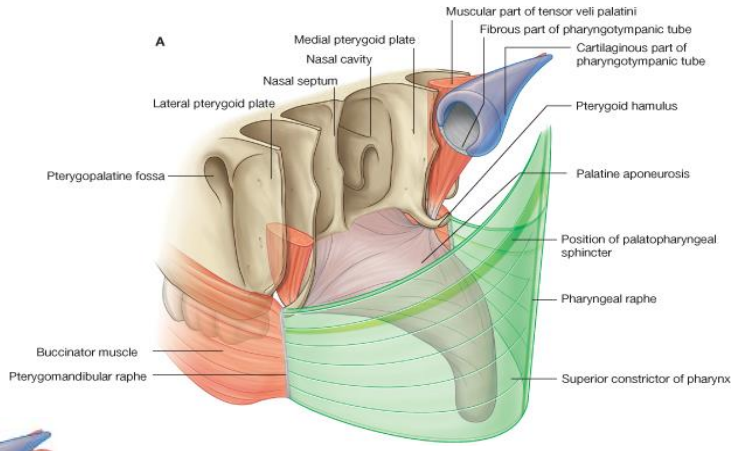
The soft palate is continuous at the sides with the lateral wall of the pharynx, the soft palate is composed of mucous membrane, palatine aponeurosis, and muscles.

Mucous membrane

Mucous membrane covers the upper and lower surfaces of the soft palate.

Palatine aponeurosis

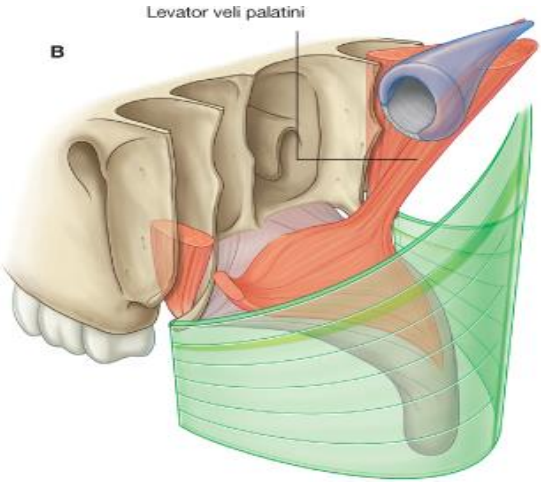
The palatine aponeurosis is a fibrous sheet attached to the posterior border of the hard palate, it is the expanded tendon of the tensor veli palatini muscle.



Muscles of the soft palate

The muscles of the soft palate are the tensor veli palatini, the levator veli palatini, the palatoglossus, the palatopharyngeus, and the musculus uvulae.

The muscle fibers of the tensor veli palatini converge as they descend from their origin to form a narrow tendon, which turns medially around the pterygoid hamulus.



The tendon, together with the tendon of the opposite side, expands to form the palatine aponeurosis, when the muscles of the two sides contract, the soft palate is tightened so that the soft palate may be moved upward or downward as a tense sheet.

Nerve supply of the palate

The greater and lesser palatine nerves from the maxillary division of the trigeminal nerve enter the palate through the greater and lesser palatine foramina.

The nasopalatine nerve, also a branch of the maxillary nerve, enters the front of the hard palate through the incisive foramen, glossopharyngeal nerve also supplies the soft palate.

Table 1 Muscles of the soft palate

Muscle	Origin	Insertion	Nerve Supply	Action
Tensor veli palatini	**Spine of sphenoid, auditory tube**	**With muscle of other side, forms palatine aponeurosis**	**Nerve to medial pterygoid from**	**Tenses soft palate**

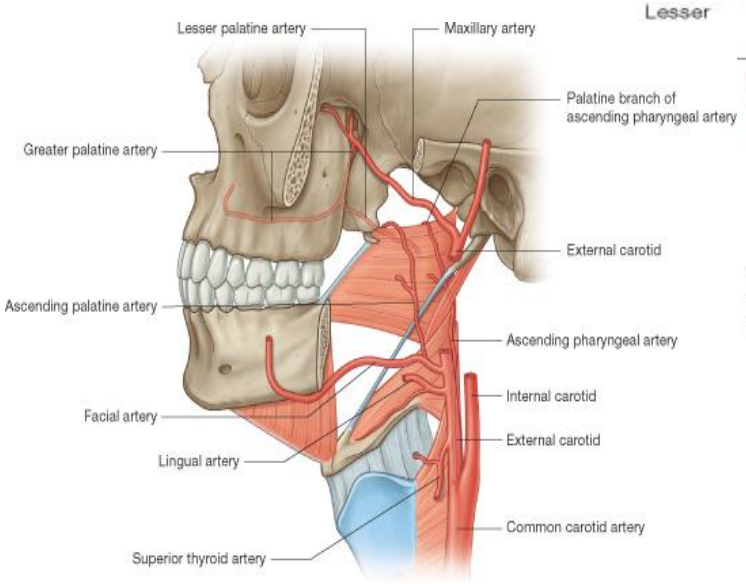
			mandibular nerve	
Levator veli palatini	**Petrous part of temporal bone, auditory tube**	**Palatine aponeurosis**	**Pharyngeal plexus**	**Raises soft palate**
Palatoglossus	**Palatine aponeurosis**	**Side of tongue**	**Pharyngeal plexus**	**Pulls root of tongue upward and backward, narrows oropharyngeal isthmus**
Palatopharyngeus	**Palatine aponeurosis**	**Posterior border of thyroid cartilage**	**Pharyngeal plexus**	**Elevates wall of pharynx, pulls palatopharyngeal folds medially**
Musculus uvulae	**Posterior border of hard palate**	**Mucous membrane of uvula**	**Pharyngeal plexus**	**Elevates uvula**

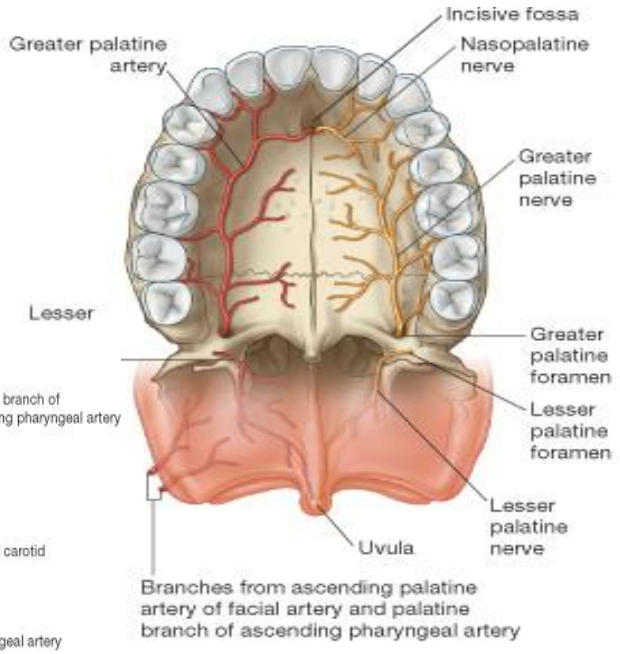
Blood supply of the palate

The greater palatine branch of the maxillary artery, the ascending palatine branch of the facial artery, and the ascending pharyngeal artery.

Lymph drainage of the palate

Deep cervical lymph nodes





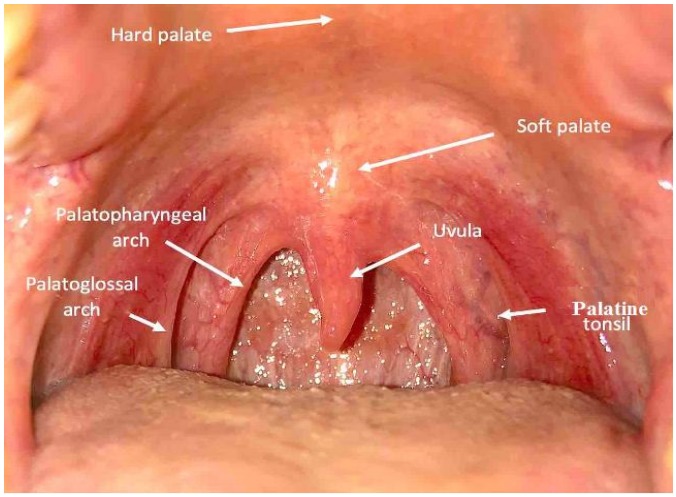
Palatoglossal arch

The palatoglossal arch is a fold of mucous membrane containing the palatoglossus muscle, which extends from the soft palate to the side of the tongue, the palatoglossal arch marks where the mouth becomes the pharynx.

Palatopharyngeal arch

The palatopharyngeal arch is a fold of mucous membrane behind the palatoglossal arch that runs downward and laterally to join the pharyngeal wall.

The muscle contained within the fold is the palatopharyngeus muscle, palatine tonsils*, which are masses of lymphoid tissue, are located between the palatoglossal and palatopharyngeal arches.



Movements of the soft palate

Raising of the soft palate causes closing of the pharyngeal isthmus "the channel communicates the nasal and oral parts of the pharynx", this movement occurs during the production of explosive consonants in speech and during swallowing.

Bilateral contraction of the levator veli palatini muscles raises the soft palate at the same time, the upper fibers of the superior constrictor muscle contract and pull the posterior pharyngeal wall forward. The palatopharyngeus muscles on both sides also contract so that the palatopharyngeal arches are pulled medially, like side curtains.

*The pharyngeal tonsils are located near the opening of the nasal cavity into the pharynx, when these tonsils become enlarged they may interfere with breathing and are called adenoidsاللحيمات
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Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

Gross Anatomy
Head & Neck
Lec. : 7
Date: Sun. 13th. Nov, 2022

The Head

Oral cavity

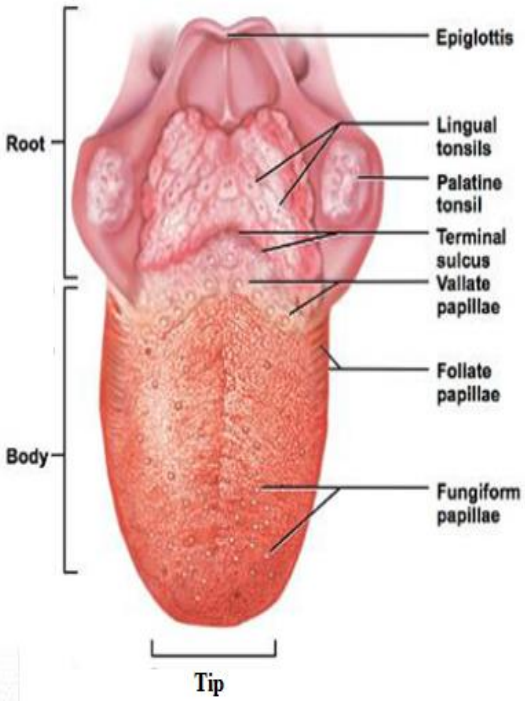
The tongue

The tongue is a mass of striated muscle covered with mucous membrane.

Parts of the tongue

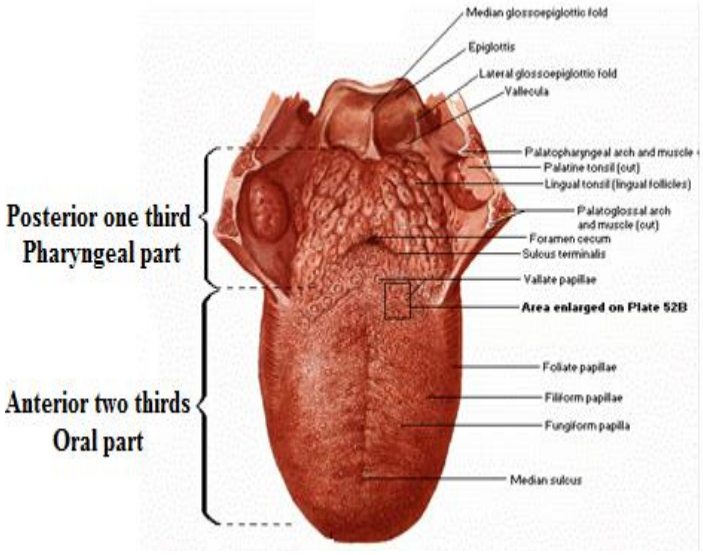
The tongue is formed of 3 parts: tip , body and root, the tip forms the anterior free end of the tongue being lying behind the upper incisor teeth. The upper surface of the body is curved while it`s inferior surface accommodates the floor of the oral cavity.

The root of the tongue attached above with the styloid process and the soft palate, and below with the hyoid bone and the mandible, the attachments of the tongue with structures above and below prevents man from swallowing it.



Mucous membrane of the tongue

The mucous membrane of the upper surface of the tongue is divided into anterior and posterior parts by a V-shaped sulcus, the sulcus terminalis, the apex of the sulcus projects backward and is marked by a small pit, the foramen cecum, the sulcus serves to divide the tongue into the anterior two thirds, or oral part, and a posterior one third , it also marks the site of the upper end of the thyroglossal duct. The tongue is divided into right and left halves by a median fibrous septum.

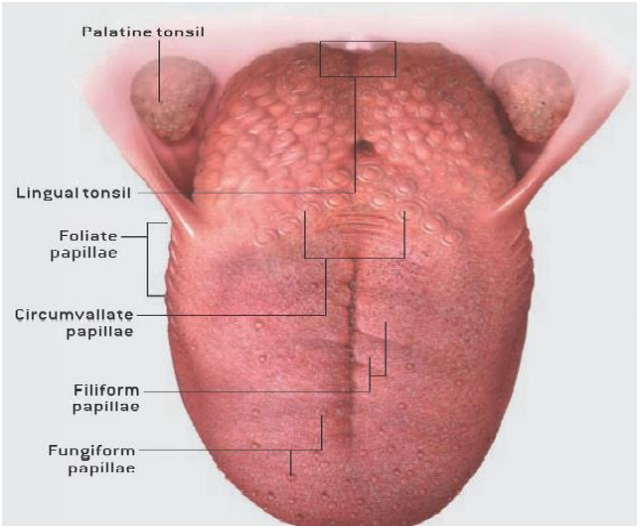


Four types of lingual papillae are present on the upper surface of the tongue: the filiform, the fungiform, the circumvallate and the vallate papillae.

The mucous membrane covering the posterior third of the tongue is devoid of papillae but has an irregular surface, caused by the presence of underlying lymph nodules, the lingual tonsil.

The mucous membrane on the inferior surface of the tongue is reflected from the tongue to the floor of the mouth, in the midline anteriorly, the undersurface of the tongue is connected to the floor of the mouth by a fold of mucous membrane, the frenulum of the tongue, on the lateral

side of the frenulum, the deep lingual vein can be seen through the mucous membrane. Lateral to the lingual vein, the mucous membrane forms a fringed fold called the plica fimbriata.



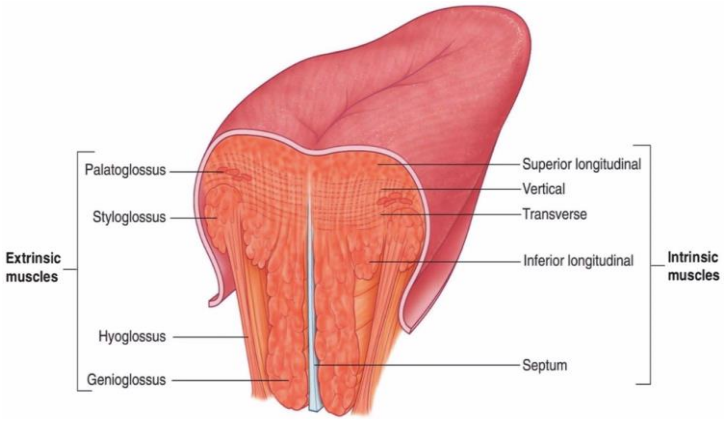
- ✓ *Filiform:* numerous slender projections that lack taste buds giving the tongue a rough feel.
- ✓ *Fungiform:* larger mushroom-shaped papillae (may appear as red caps) scattered on the dorsum of the tongue's surface; possess taste buds, they are smaller than the vallate papillae but larger than the filiform papillae.
- ✓ *Vallate or circumvallate papillae:* larger papillae lying in a row just anterior to the sulcus terminalis and possess taste buds.
- ✓ *Foliate:* lie along the sides of the tongue and are rudimentary in man; possess taste buds.

Muscles of the tongue

The muscles of the tongue are divided into two types: intrinsic and extrinsic.

Intrinsic muscles

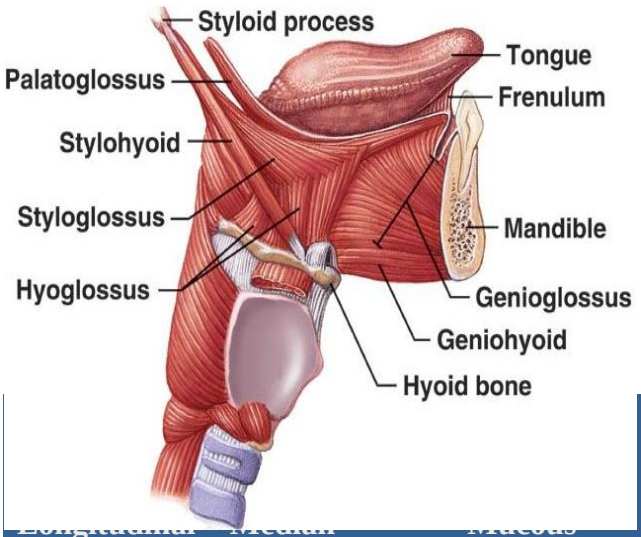
These muscles are confined to the tongue and are not attached to bone; they consist of longitudinal, transverse, and vertical fibers.



- *Nerve supply:* Hypoglossal nerve.
- *Action:* Alter the shape of the tongue.

Extrinsic muscles

Each one of these muscles connects the tongue with one of the neighboring structures; they are the



genioglossus "mandible", the hyoglossus "hyoid bone", the styloglossus " styloid process", and the palatoglossus to the " soft palate".

Nerve supply: Hypoglossal nerve except the palatoglossus which is innervated by the pharyngeal nerve plexus.

			Nerve Supply	Action
Transverse Vertical	septum and submucosa	membrane	Hypoglossal nerve	Alters shape of tongue
Extrinsic Muscles				
Genioglossus	Superior genial spine of mandible	Blends with other muscles of tongue	Hypoglossal nerve	Protrudes apex of tongue through mouth
Hyoglossus	Body and greater cornu of hyoid bone	Blends with other muscles of tongue	Hypoglossal nerve	Depresses tongue
Styloglossus	Styloid process of temporal bone	Blends with other muscles of tongue	Hypoglossal nerve	Draws tongue upward and backward
Palatoglossus	Palatine aponeurosis	Side of tongue	Pharyngeal plexus	Pulls roots of tongue upward and backward, narrows oropharyngeal isthmus

Movements of the tongue

Muscles of the tongue act in gathering, some of them do more than one movement, a part of a single muscle may act independently and produces different and may be antagonist actions. However the extrinsic muscles change the position of the tongue while the intrinsic ones change it`s shape.

- *Protrusion:* Genioglossus muscles on both sides acting together.
- *Retraction:* Styloglossus and hyoglossus muscles on both sides acting together
- *Depression:* Hyoglossus muscles on both sides acting together
- *Retraction and elevation of the posterior third:* Styloglossus and palatoglossus muscles on both sides acting together
- *Shape changes:* Intrinsic muscles.

To summarize the action of the intrinsic muscles;

- *Superior longitudinal muscle* shortens the tongue making it`s dorsum concave.
- *Inferior longitudinal muscle* shortens the tongue making it`s dorsum concave.

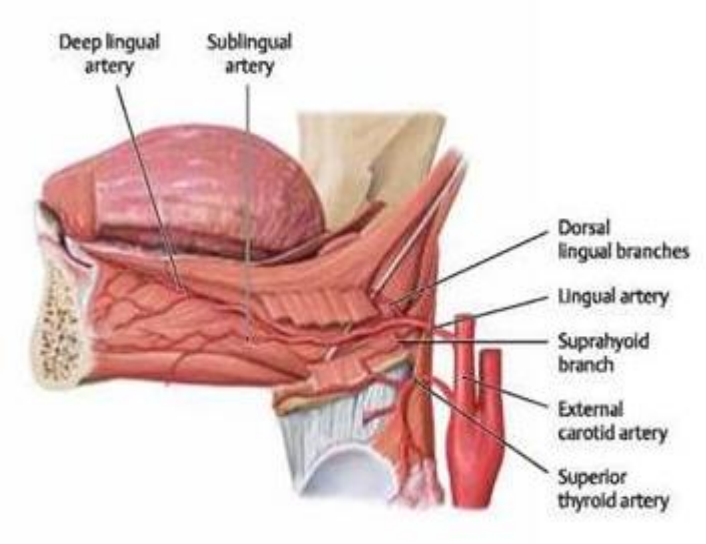
- *Transverse muscle* make the tongue elongate and narrow.
- *Vertical muscle* make the tongue broad and flattened.

Extrinsic muscles change the position of the tongue.

- *Genioglossus muscle* protrudes the tongue.
- *Hyoglossus muscle* depresses the tongue.
- *Styloglossus muscle* retracts the tongue.
- *Palatoglossus muscle* elevates the tongue.

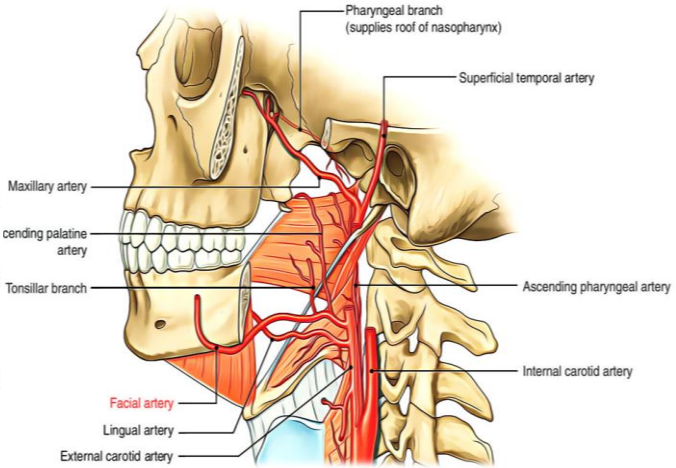
Blood supply

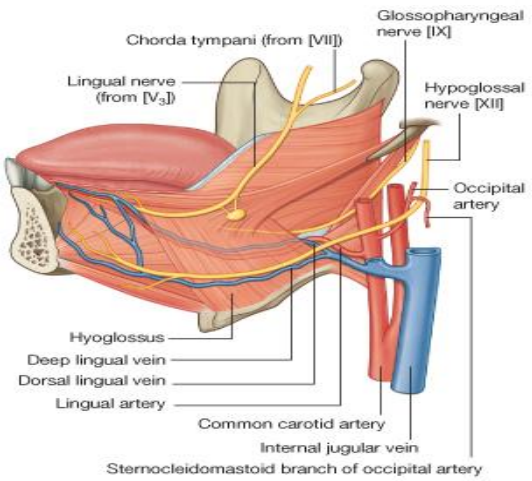
The lingual artery, the tonsillar branch of the facial artery, and the ascending pharyngeal artery supply the tongue. The veins drain into the internal jugular vein.



Lymph drainage

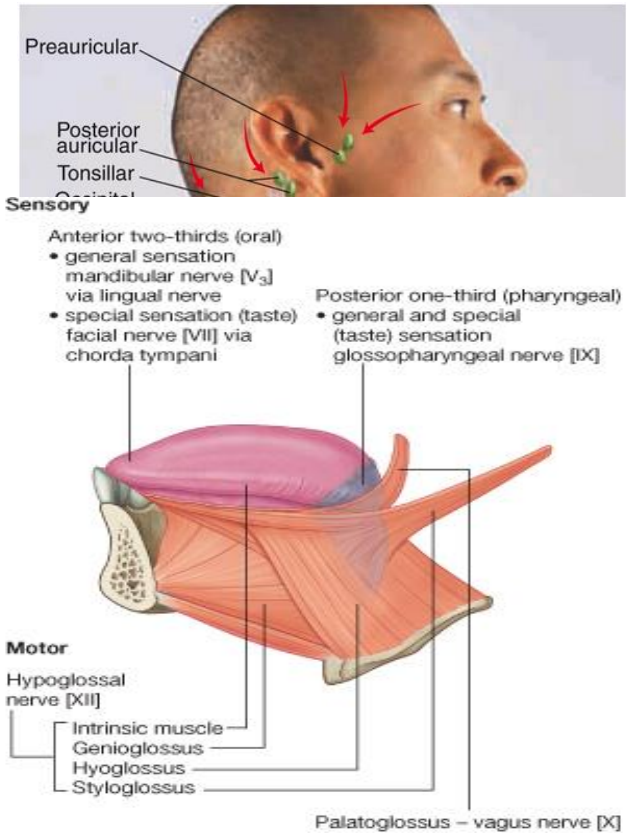
- Tip: Submental lymph nodes.
- Sides of the anterior two thirds: Submandibular and deep cervical lymph nodes.
- Posterior third: Deep cervical lymph nodes

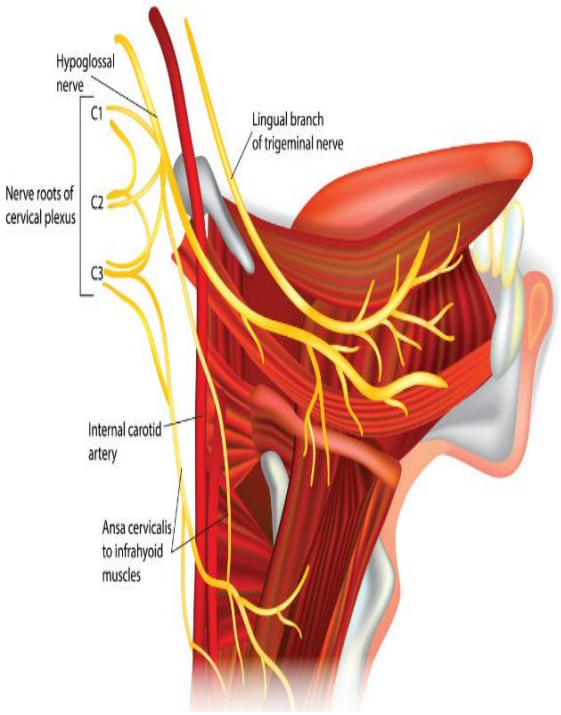




Sensory innervation

- Anterior two thirds: Lingual nerve branch of mandibular division of trigeminal nerve (general sensation) and chorda tympani branch of the facial nerve (taste).
- Posterior third: Glossopharyngeal nerve (general sensation).
- Epiglottic region: internal branch of the superior laryngeal nerve, for general sensation and taste on the base of the tongue.





Clinical notes

Laceration of the tongue

A wound of the tongue is often caused by the patient's teeth following a blow on the chin when the tongue is partly protruded from the mouth, it can also occur when a patient accidentally bites the tongue while eating, during recovery from an anesthetic, or during an epileptic attack.

Bleeding is halted by grasping the tongue between the finger and thumb posterior to the laceration, thus occluding the branches of the lingual artery.

Angioedema of the uvula (Quincke's Uvula)

The uvula has a core of voluntary muscle, the musculus uvulae, that is attached to the posterior border of the hard palate, surrounding the muscle is the loose connective tissue of the submucosa that is responsible for the great swelling of this structure secondary to angioedema.

Cleft palate

Cleft palate is commonly associated with cleft upper lip, all degrees of cleft palate occur and are caused by failure of the palatal processes of the maxilla to fuse with each other in the midline; in severe cases, these processes also fail to fuse with the primary palate (premaxilla).

The first degree of severity is cleft uvula, and the second degree is ununited palatal processes, the third degree is ununited palatal processes and a cleft on one side of the primary palate, this type is usually associated with unilateral cleft lip.

The fourth degree of severity, which is rare, consists of ununited palatal processes and a cleft on both sides of the primary palate, this type is usually associated with bilateral cleft lip.

A rare form may occur in which a bilateral cleft lip and failure of the primary palate to fuse with the palatal processes of the maxilla on each side are present.

A baby born with a severe cleft palate presents a difficult feeding problem, since he or she is unable to suck efficiently, such a baby often receives in the mouth some milk, which then is regurgitated through the nose or aspirated into the lungs, leading to respiratory infection.

For this reason, careful artificial feeding is required until the baby is strong enough to undergo surgery. Plastic surgery is recommended usually between 1 and 2 years of age, before improper speech habits have been acquired.

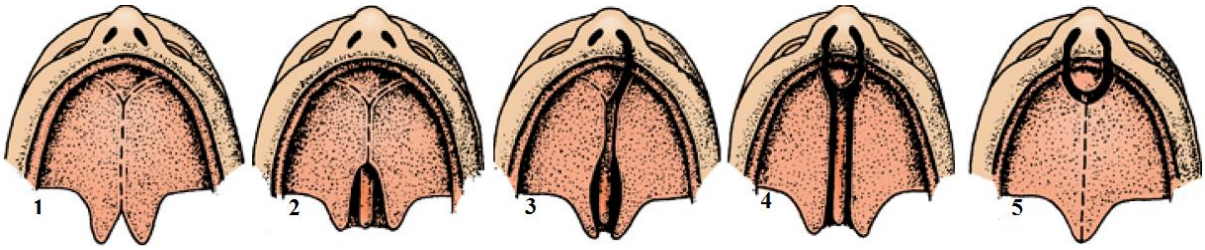


Fig. 1; Different forms of cleft palate: cleft uvula (1), cleft soft and hard palate (2), total unilateral cleft palate and cleft lip (3), total bilateral cleft palate and cleft lip (4), and bilateral cleft lip and jaw (5).

Fig. 2; Cleft hard and soft palate.

Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

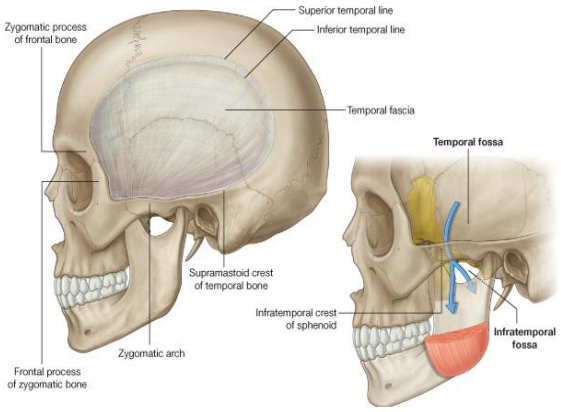
Gross Anatomy
Head & Neck
Lec. : 8
Date: Sun. 20th. Nov. 2022

The Face

Temporal and infratemporal fossae

Is a narrow fan-shaped space covers the lateral surface of the skull, it is bounded:

- superiorly, by the superior and inferior temporal lines that arch across the skull from the zygomatic process of the frontal bone to the supramastoid crest of the temporal bone.
- laterally, by the temporal fascia, which is a tough fan-shaped aponeurosis overlying the temporalis muscle and attached by it`s upper margin to the superior temporal line and by it`s inferior margin to the zygomatic arch.
- in front, by the posterior surface of both of the frontal process of the zygomatic bone and the zygomatic process of the frontal bone, which separate the temporal fossa behind from the orbit in front.
- inferiorly, by the zygomatic arch laterally and the infratemporal crest of the greater wing of the sphenoid medially, between these two structures, the floor of the temporal fossa communicates medially with the infratemporal fossa and laterally with the region containing the masseter muscle.

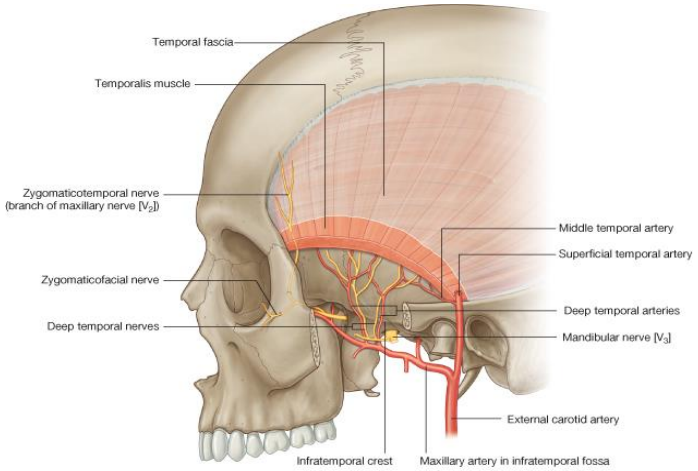


Contents

The major structure in the temporal fossa is the temporalis muscle, *" highlighted with muscles of mastication"* the zygomaticotemporal branch of the maxillary nerve [V_2] ,the deep temporal nerve and vessels and the middle temporal vessels.

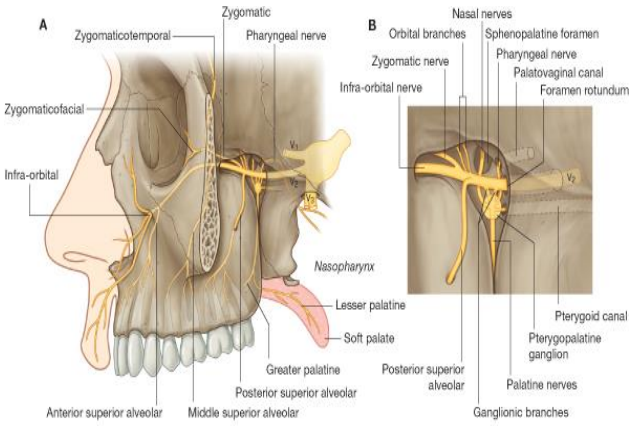
Deep temporal nerves

Usually two in number, originate from the anterior trunk of the mandibular nerve [V_3] in the infratemporal fossa, they pass superiorly and around the infratemporal crest of the greater wing of the sphenoid to enter the temporal fossa deep to the temporalis muscle, supplying it.



Zygomaticotemporal nerve

Is a branch of the zygomatic nerve, which in turn a branch of the maxillary nerve [V_2], originating in the pterygopalatine fossa,



the nerve enters the temporal fossa through one or more small foramina on the temporal fossa surface of the zygomatic bone.

Branches of the zygomaticotemporal nerve pass superiorly between the bone and the temporalis muscle to penetrate the temporal fascia and supply the skin of the temple.

Deep temporal arteries

Normally two in number, these vessels originate from the maxillary artery in the infratemporal fossa and travel with the deep temporal nerves around the infratemporal crest of the greater wing of the sphenoid to supply the temporalis muscle, they anastomose with branches of the middle temporal artery.

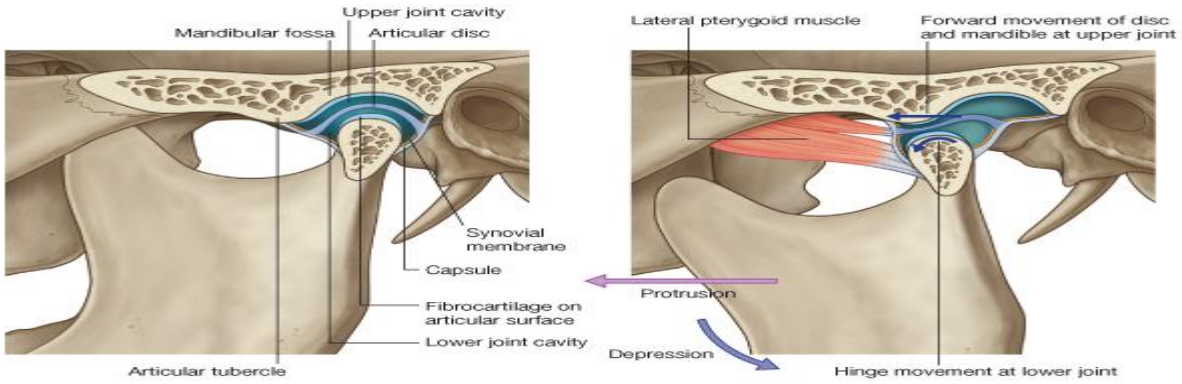
Middle temporal artery

Originates from the superficial temporal artery just superior to the root of the zygomatic arch between this structure and the external ear, it penetrates the temporalis fascia and travels superiorly on the deep surface of the temporalis muscle, It supplies temporalis muscle and anastomoses with branches of the deep temporal arteries.

Temporomandibular joint (TMG)

Articulation

Occurs between the articular tubercle and the anterior portion of the mandibular fossa of the temporal bone above and the head (condyloid process) of the mandible below, the articular surfaces are covered with fibrocartilage , the joint is a synovial one, it`s type is hinge.



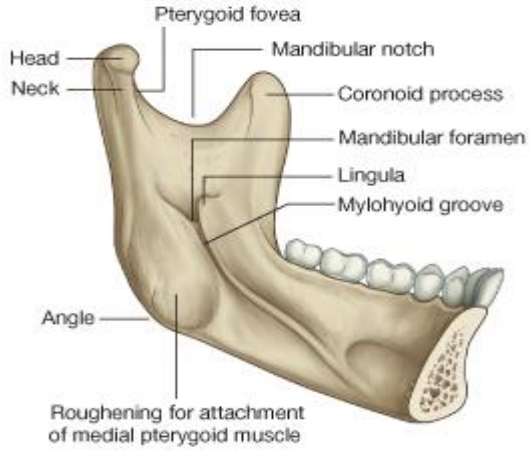
Capsule

Surrounds the joint and is attached above to the articular tubercle and the margins of the mandibular fossa and below to the neck of the mandible.

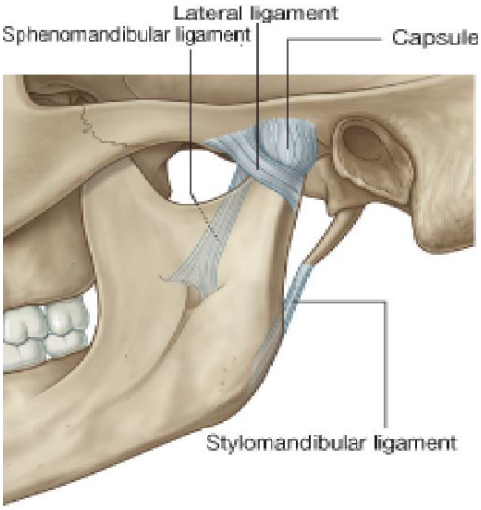
Ligaments

Lateral temporomandibular ligament strengthens the lateral aspect of the capsule, it`s fibers run downward backward from the tubercle on the root of the zygoma to the lateral surface of the neck of the mandible, it limits the movement of the mandible in a posterior direction and thus protects the external auditory meatus.

Sphenomandibular ligament lies on the medial side of the joint, it is a thin band that is attached above to the spine of the sphenoid bone and below to the lingula of the mandibular foramen.



Stylomandibular ligament lies behind and medial to the joint and some distance from it, it`s a band of thickened deep cervical fascia that extends from the apex of the styloid process to the angle of the mandible.



The articular disc divides the joint into upper and lower cavities, it is an oval plate of fibrocartilage that is attached: [1]circumferentially to the capsule, [2] in front to the tendon of the lateral pterygoid muscle and [3] by fibrous bands to the head of the mandible.

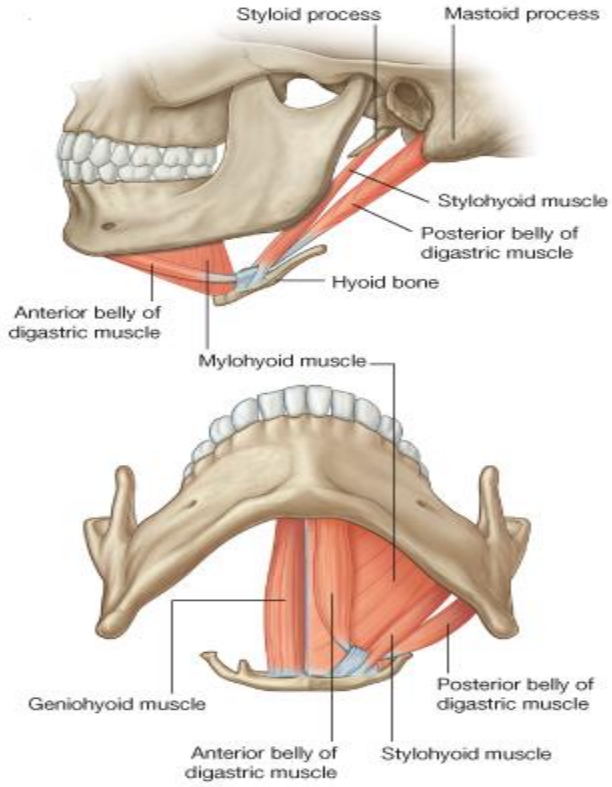
These bands ensure that the disc moves forward and backward with the head of the mandible during protraction and retraction of the mandible. The upper surface of the disc is concavoconvex from before

backward to fit the shape of the articular tubercle and the mandibular fossa, while the lower surface is concave to fit the head of the mandible.

Synovial membrane lines the capsule in the upper and lower cavities of the joint.

Nerve supply

Except for the *geniohyoid muscle*, which is innervated by the C1 spinal nerve, all muscles that move the temporomandibular joint are innervated by the auriculotemporal and masseteric branches of the mandibular nerve, [V_3] which originate in the infratemporal fossa.



Movements

The mandible can be depressed or elevated, protruded or retracted, rotation can also occur, as in chewing.

In the position of rest, the teeth of the upper and lower jaws are slightly apart, but when the jaws closed, the teeth come into contact.

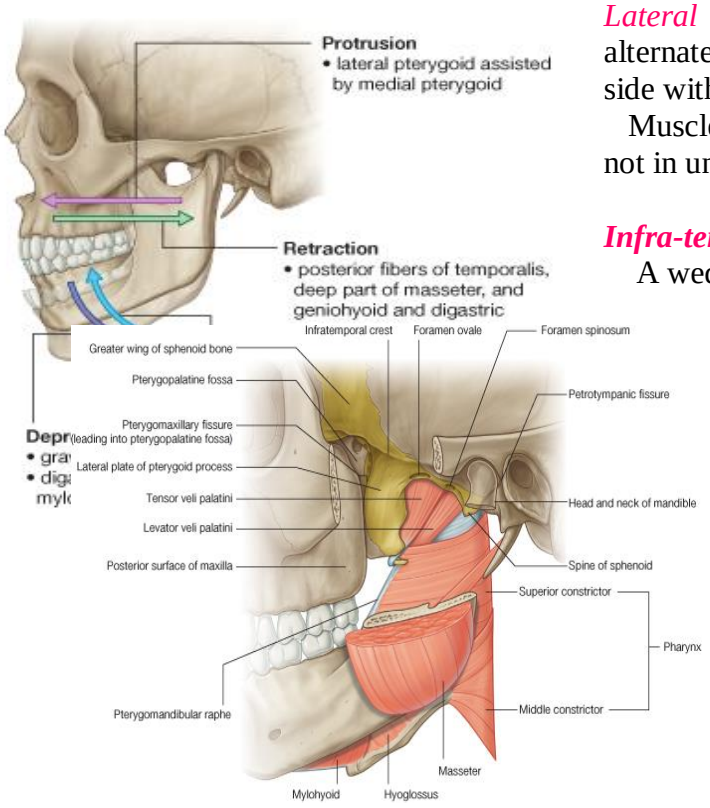
Depression of the mandible is brought about by contraction of the:

- digastrics,
- geniohyoids,
- mylohyoids and
- lateral pterygoids , the later plays an important role by pulling the mandible forward.

Elevation of the mandible is brought about by contraction of the temporalis, the masseter, and the medial pterygoids.

Protrusion of the mandible, brought about by contraction of the lateral pterygoid muscles of both sides, assisted by both medial pterygoids.

Retraction of the mandible is brought about by contraction of the posterior fibers of the temporalis.



Lateral chewing movements are accomplished by alternately protruding and retracting the mandible on each side with a certain amount of rotation occurs.

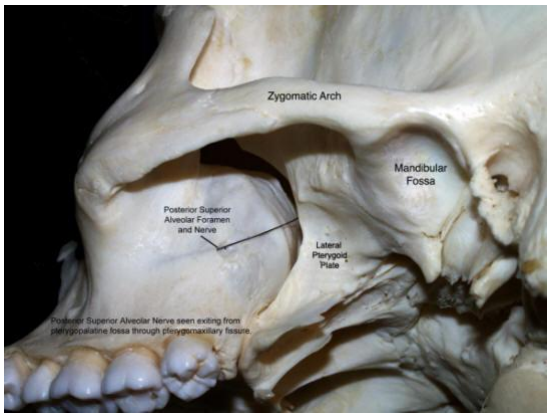
Muscles responsible on both sides work alternately and not in unison.

Infra-temporal fossa

A wedge-shaped fossa lies inferior to the temporal fossa between the ramus of the mandible laterally and the wall of the pharynx medially, it has a roof, a lateral and medial walls, and opens to the neck posteroinferiorly.

- the roof is formed by the inferior surfaces of the greater wing of the sphenoid and the temporal bones, contains the foramen spinosum, foramen ovale, and the petrotympanic fissure.
- the lateral wall is the medial surface of the ramus of the mandible, which contains the opening to the mandibular canal.
- the medial wall is formed anteriorly by the lateral plate of the pterygoid process and more posteriorly by the pharynx and by two muscles of the soft palate (tensor and levator veli palatini muscles).

- the anterior wall is formed by part of the posterior surface of the maxilla, contains the alveolar foramen.



Contents

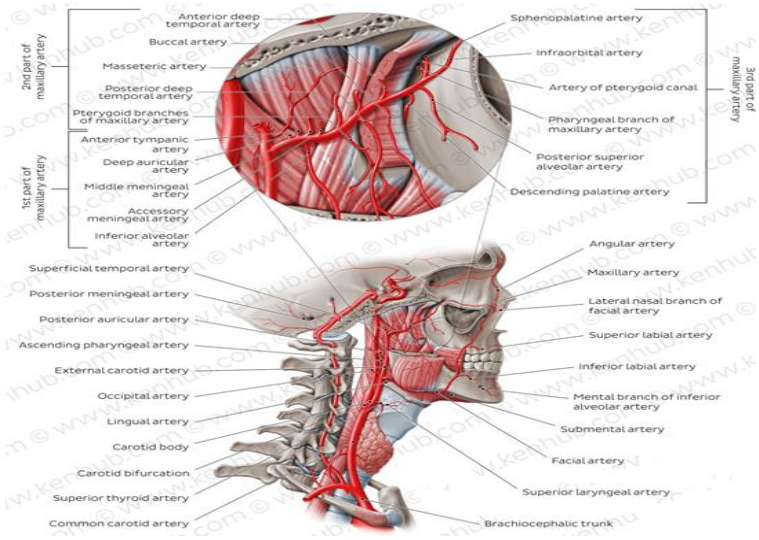
Major contents of the fossa include the:

- sphenomandibular ligament, "*highlighted before*".
- medial and lateral pterygoid muscles, *"highlighted with muscles of mastication"*.
- maxillary artery.
- mandibular division [V_3] of trigeminal nerve.
- branches of the facial [VII] and the glossopharyngeal [IX] nerves.
- the pterygoid plexus of veins.

Maxillary artery

The maxillary artery originates within the substance of the parotid gland and passes forward, between the neck of mandible and sphenomandibular ligament ascending obliquely through the infratemporal fossa to enter the pterygopalatine fossa by passing through the pterygomaxillary fissure.

It is the largest branch of the external carotid artery in the neck and is a major source of blood supply for the nasal cavity, the lateral wall and roof of the oral cavity, all teeth, and the dura mater in the cranial cavity.



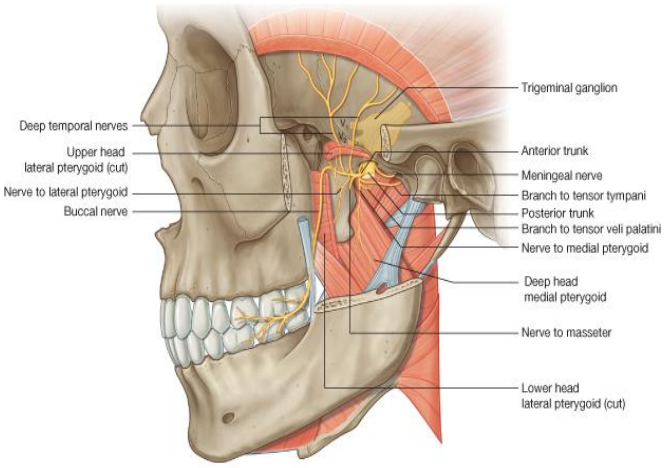
Parts and branches

Parts of the artery and the branches of each part are as follows:

- *the first part of the maxillary artery* (the part between the neck of mandible and the sphenomandibular ligament) gives origin to two major branches (the middle meningeal and inferior alveolar arteries.
- *the second part of the maxillary artery* "the part related to the lateral pterygoid muscle" gives origin to deep temporal, masseteric, buccal, and pterygoid branches, which course with branches of the mandibular nerve [V_3].
- *the third part of the maxillary artery* lies in the pterygopalatine fossa, highlighted forward.

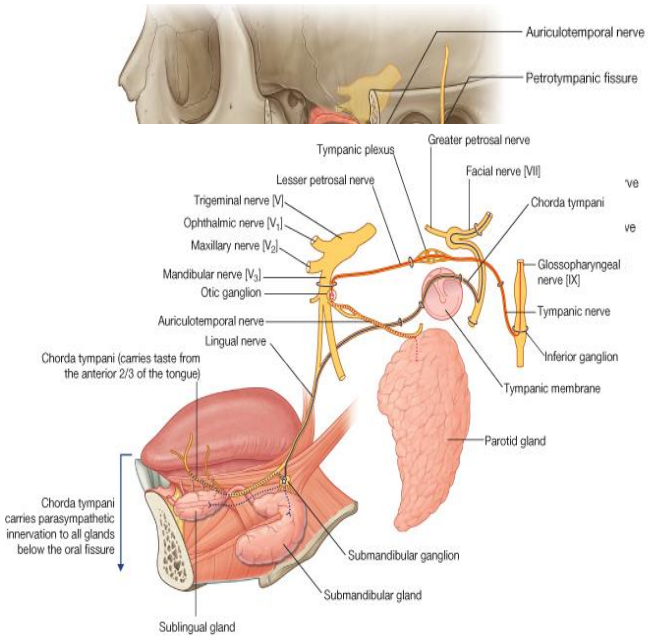
Mandibular nerve [V_3]

Is the largest of the three divisions of the trigeminal nerve [V], unlike the ophthalmic [V_1] and maxillary [V_2] nerves, which are purely sensory, the mandibular nerve [V_3] is both sensory and motor, soon after the sensory and motor roots join: the mandibular nerve [V_3] gives rise to a small meningeal branch and to the nerve to medial pterygoid and then divides into anterior and posterior trunks:



- branches from the anterior trunk are the buccal, masseteric, and deep temporal nerves, and the nerve to lateral pterygoid, all of which, except the buccal nerve (which is sensory) are motor nerves.

- branches from the posterior trunk are the auriculotemporal, lingual, and inferior alveolar nerves, all of which, except a small nerve (nerve to mylohyoid which is motor) that branches from the inferior alveolar nerve, are sensory nerves.



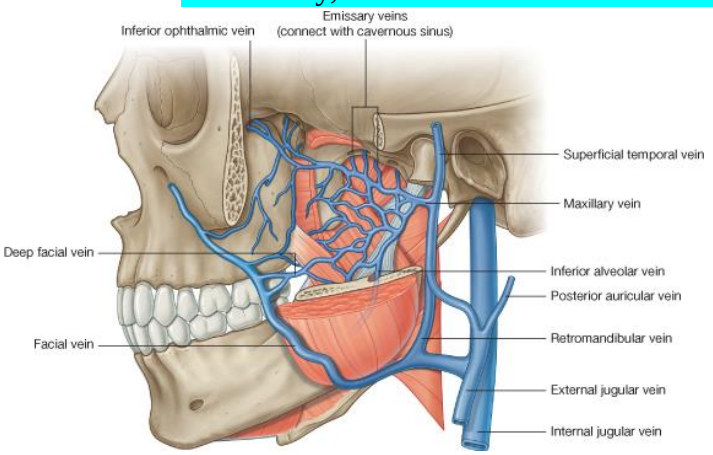
Branches of the facial nerve [VII] and the glossopharyngeal nerve [IX].

Branches of two cranial nerves join branches of the mandibular nerve [V_3] in the infratemporal fossa ,these are the chorda tympani branch of the facial nerve [VII] and the lesser petrosal nerve, a branch of the tympanic plexus in the middle ear, which had it`s origin from a branch of the glossopharyngeal nerve[IX].

Pterygoid plexus

A network of veins between the medial and lateral pterygoid muscles, and between the lateral pterygoid and temporalis muscles.

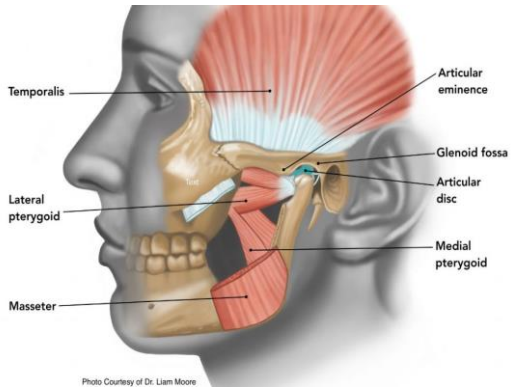
Veins that drain regions supplied by arteries branching from the maxillary artery in the Infratemporal fossa and pterygopalatine fossa connect with the pterygoid plexus. The tributaries include those that drain the nasal cavity, roof and lateral wall of the oral cavity, all teeth, muscles of the Infratemporal fossa, paranasal sinuses, and nasopharynx, in addition, the inferior ophthalmic vein from the orbit drains through the inferior orbital fissure into the pterygoid plexus. The plexus connects:



- posteriorly, via a short maxillary vein, with the retromandibular vein in the neck.
- anteriorly, via a deep facial vein, with the facial vein on the face.

Muscles of mastication

There are four muscles of mastication: temporalis, masseter, lateral pterygoid and medial pterygoid.



Temporalis muscle

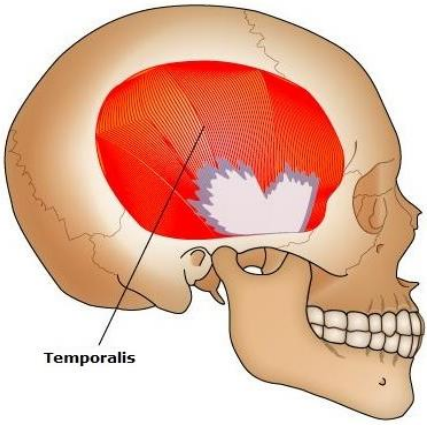
Temporalis muscle is a large fan-shaped muscle fills much of the temporal fossa.

Origin: the bony surfaces of the fossa medially, the inferior temporal line superiorly; and the temporal fascia laterally.

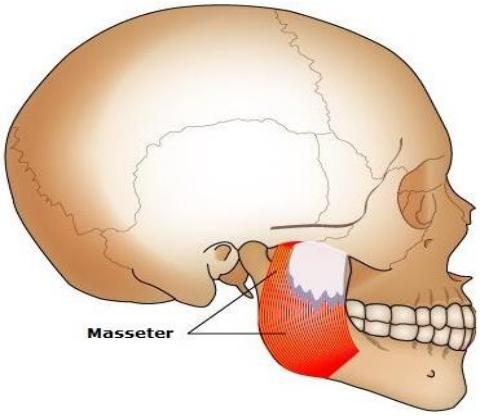
Insertion: the more anterior fibers oriented vertically while the more posterior ones oriented horizontally, collectively, the fibers converge inferiorly to form a tendon, which passes between the zygomatic arch and the infratemporal crest of the greater wing of the sphenoid to insert on the anterior surface of the coronoid process and along the related margin of the ramus of the mandible, almost to the last molar tooth.

Action:

- it`s a powerful elevator of the mandible, because this movement involves posterior translocation of the head of the mandible from the articular tubercle of the temporal bone back into the mandibular fossa.
- temporalis also retracts the mandible or pulls it posteriorly.
- in addition, temporalis participates in side-to-side movements of the mandible.



Innervation: the muscle is innervated by the deep temporal nerves.
Blood supply: of the muscle is by the deep and middle temporal artery.



Masseter muscle

Is a powerful muscle of mastication that elevates the mandible, it overlies the lateral surface of the ramus of the mandible, it has a quadrangular shape and is anchored above to the zygomatic arch and below to most of the lateral surface of the ramus of mandible.

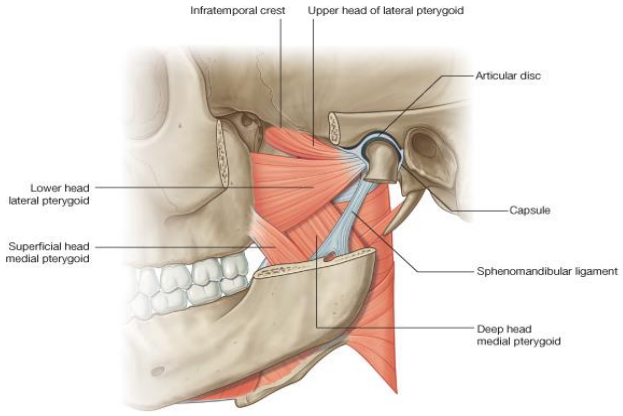
Origin:

- the more superficial part of the muscle originates from the maxillary process of the zygomatic bone and the anterior two thirds of the zygomatic process of the maxilla.
- the deep part of the muscle originates from the medial aspect of the zygomatic arch and the posterior part of its inferior margin.

Insertion: the superficial part inserts into the angle of mandible and related posterior part of the lateral surface of the ramus of mandible, while the deep part inserts into the central and upper part of the ramus of mandible as high as the coronoid process.

Innervation: the muscle is innervated by the masseteric nerve from the mandibular nerve [V_3].

Blood supply: masseteric branch of the maxillary artery supplies the muscle. The masseteric nerve and artery originate in the infratemporal fossa and pass laterally over the margin of the mandibular notch to enter the deep surface of the masseter muscle.



Lateral pterygoid muscle

Is a thick triangular muscle with two heads: the upper and lower.

Origin:

the upper head originates from the roof of the infratemporal fossa (inferior surface of the greater wing of the sphenoid and the infratemporal crest) lateral to the foramen ovale and foramen spinosum.

the lower head is larger than the upper head and originates from the lateral surface of the lateral plate of the pterygoid process, and the inferior part insinuates itself between the cranial attachments of the two heads of the medial pterygoid.

Insertion: fibers from both heads of the lateral pterygoid muscle converge to insert into the pterygoid fovea of the neck of mandible and the capsule of the temporomandibular joint in the region where the capsule is attached internally to the articular disc.

Action: fibers of the muscle are oriented almost horizontally, so when contracts it pulls the articular disc and head of the mandible forward onto the articular tubercle and is therefore the major protruder of the lower jaw.

Innervation: nerve to lateral pterygoid from the mandibular nerve [V_3] innervates the muscle.

Medial pterygoid muscle

The muscle is quadrangular in shape and has deep and superficial heads:

Origin:

- *the deep head* is attached above to the medial surface of the lateral plate of the pterygoid process and the associated surface of the pyramidal process of the palatine bone, and descends obliquely downwards, medial to the sphenomandibular ligament.
- *the superficial head* originates from the tuberosity of the maxilla and adjacent pyramidal process of the palatine bone and joins with the deep head to insert on the mandible.

Insertion:

- *the deep head* inserted to the roughened medial surface of the ramus of mandible near the angle of mandible.
- *the superficial head* joins with the deep head to insert on the mandible

Action: the muscle mainly elevates the mandible, because it passes obliquely backwards to insert into the mandible, it also assists the lateral pterygoid muscle in protruding the lower jaw.
Innervation: nerve to medial pterygoid from the mandibular nerve [V_3].

When the lateral and medial pterygoids contract on one sideonly, the 'chin' moves to the opposite side, when opposite movements at the two temporomandibular joints are coordinated, a 'chewing' movement results.

Muscle	**Origin**	**Insertion**	**Innervation**	**Action**
Temporalis	Bone of temporal fossa and temporal fascia	Coronoid process of mandible and anterior margin of ramus of mandible almost to last molar tooth	Deep temporal nerves from the anterior trunk of the mandibular nerve [V_3]	Elevation and retraction of mandible
Masseter	Zygomatic arch and maxillary process of the zygomatic bone	Lateral surface of ramus of Mandible	Masseteric nerve from the anterior trunk of the mandibular nerve [V_3]	Elevation of mandible
Lateral pterygoid muscle	Lateral pterygoid plate and greater wing of sphenoid	Neck of the mandible	Nerve to lateral pterygoid directly from the anterior trunk of the mandibular nerve [V_3] or from the buccal branch	Pulls the neck of the mandible forward
Medial pterygoid muscle	Lateral pterygoid plate and maxillary tuberosity	Medial surface of angle of ramus	Nerve to medial pterygoid from the mandibular nerve [V_3]	Elevates the mandible

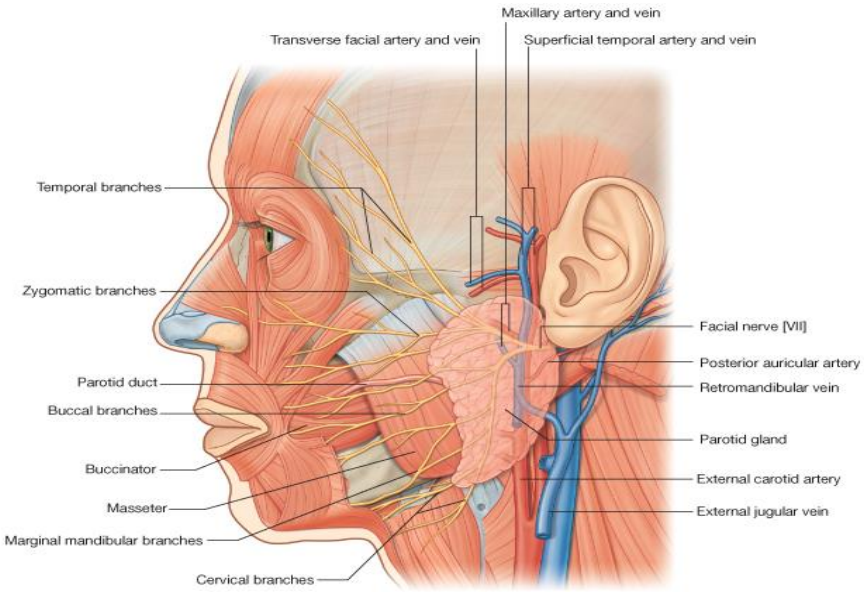
Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

Gross Anatomy
Head & Neck
Lec. : 9
Date: Sun. 27th. Nov. 2022

Parotid region

Parotid gland ; general description

Parotid gland is the largest of the three main salivary glands* in the head, it is situated in the pre -auricular area (flattened region anterior to the tragus of the ear) on each side of the face, each gland is irregular, consisting of a superficial and a deep lobes, the gland itself is yellowish and is covered with a pink connective tissue, it measures about 5.8 centimeters long and 3.4 centimeters across and average weighs 14.28 grams. The glands produce about 10% of the saliva that's in the mouth, during eating, the glands contribute even more saliva ; approximately 25%.



Although the parotid gland is described as being irregular, it`s general outline is that of an inverted pyramid, the base is the most superior part of the gland, while the blunted apex points inferiorly, it also has anteromedial, posteromedial, and superficial surfaces, the gland on each side is entirely outside the boundaries of the oral cavity in a shallow triangular-shaped trench lies:

- anterior to and below the lower half of the ear.
- posterior and deep to the ramus of the mandible.
- between the lower border of the mandible and up to the zygomatic arch.
- posteriorly it covers the anterior part of the sternocleidomastoid muscle , anteriorly to halfway across the masseter muscle.

Parotid " *Stensen* " duct leaves the anterior edge of the parotid gland crossing the face in a transverse direction, the duct is about 2 inches. "5 cm" long and passes forward across the masseter about a fingerbreadth below the zygomatic arch, it then pierces the buccinator muscle to enter the mouth opposite the upper second molar tooth.

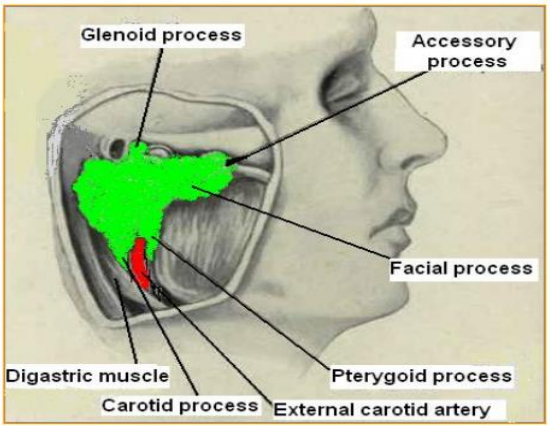
Lobes of the gland

The parotid gland is usually divided into a superficial and a deep lobes by the posterior border of the mandible or the facial nerve that threads through it.

Processes of the gland

The gland is an irregular lobulated mass, sends 'processes' in various directions, these include:

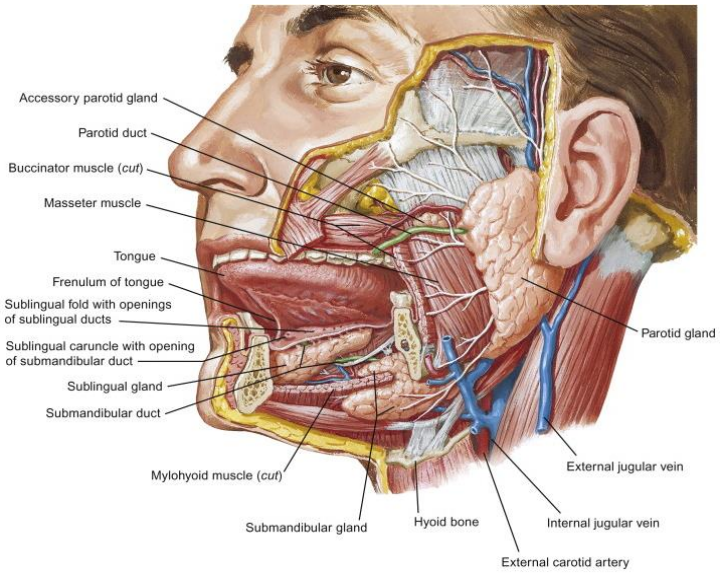
1. *glenoid process* extends upward behind the temporomandibular joint, in front of external auditory meatus.
2. *facial process* extends anteriorly onto the masseter muscle
3. *accessory process* (part), small part of facial process lying along the parotid duct, may be defined as an accessory parotid gland.
4. *pterygoid process* extends forward from the deeper part, lies between the medial pterygoid muscle & the ramus of mandible
5. *carotid process* lies posterior to the external carotid artery.



Important relationships

Several major structures enter and pass through or just deep to the parotid gland, these include :

- the facial nerve [VII].
- the external carotid artery and it`s branches.
- the retro - mandibular vein and it`s tributaries.



Facial nerve

The facial nerve [VII] exits the skull through the stylomastoid foramen and passes into the deep substance of the parotid gland, where it usually divides into upper and lower trunks which pass through the substance of the parotid gland, where there may be further branching and anastomosing of the nerves.

The intimate relationships between the facial nerve [VII] and the parotid gland means that surgical removal of the parotid gland is a difficult dissection if all branches of the facial nerve [VII] are to be spared.

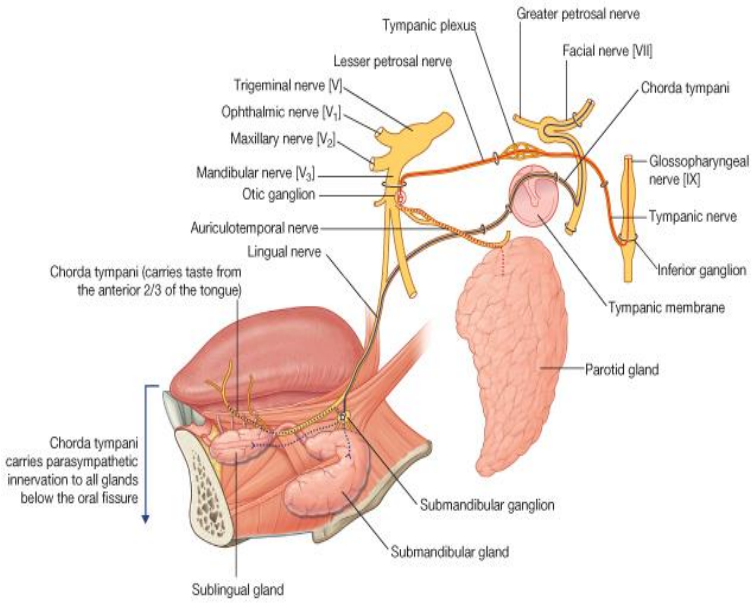
External carotid artery and it`s branches

The external carotid artery passes deep to the inferior border of the parotid gland , as it continues in a superior direction, it gives off the posterior auricular artery before dividing into it`s two terminal branches (maxillary and superficial temporal arteries) near the lower border of the ear:

- the maxillary artery passes horizontally deep to the mandible.
- the superficial temporal artery continues in a superior direction and emerges from the upper border of the gland after giving off the transverse facial artery.

Retro - mandibular vein and it`s tributaries

Retro mandibular vein is formed in the substance of the parotid gland when the superficial temporal and maxillary veins join together, and passes inferiorly in the substance of the parotid gland, it usually divides into anterior and posterior branches just below the inferior border of the gland.



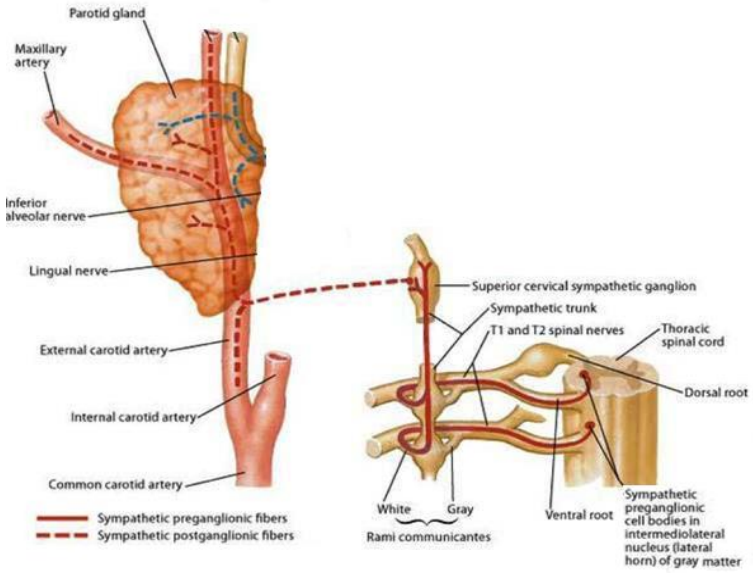
Arterial supply

The parotid gland receives it`s arterial supply from posterior auricular and superficial temporal arteries. Venous drainage is achieved via the retro-mandibular vein.

Innervation

The gland receives sensory and autonomic innervations. *Sensory innervation* of the gland is provided by the auriculotemporal nerve, which is a branch of the mandibular nerve [V_3].

Autonomic innervation controls the rate of saliva production; *Parasympathetic fibers* to the gland begins with the glossopharyngeal nerve (cranial nerve IX), this nerve synapses with the otic ganglion** "a collection of neuronal cell bodies" , the parasympathetic fibres from the ganglion to the gland pass through the auriculotemporal nerve , stimulation of the parasympathetic nervous system causes an increase in saliva production.



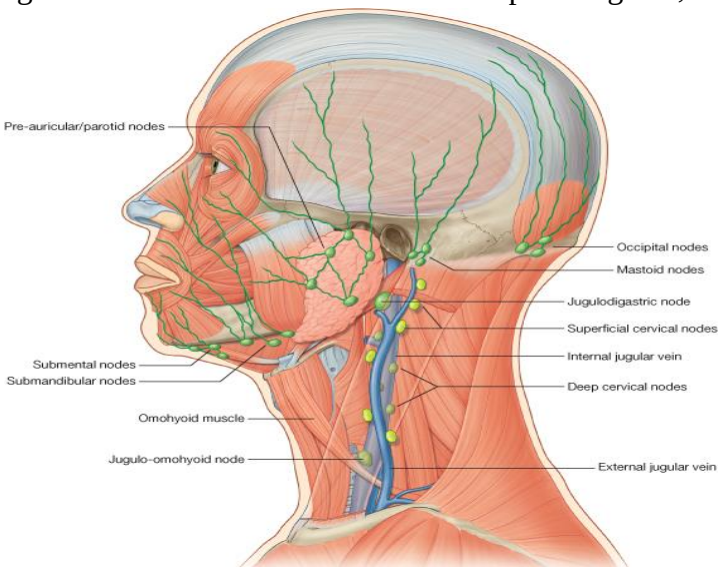
Sympathetic innervation originates from the superior cervical ganglion, fibres from this ganglion travel along the external carotid artery to reach the parotid gland, increased activity of the sympathetic nervous system inhibits saliva secretion, via vasoconstriction.

Remember the secretomotor pathway of the parotid gland with the mnemonic, which stands for;

- Inferior salivatory nucleus
- Tympanic branch of 9th nerve
- Lesser petrosal nerve
- Otic ganglion
- Auriculotemporal nerve

Lymph drainage of the gland

There are numerous lymph nodes distributed throughout and around the substance of the parotid gland, this is an exception to the normal as all other salivary glands (both major and minor) do not have lymph nodes within the glandular tissue itself and have far fewer nodes surrounding them, the lymph nodes of the parotid gland are distributed throughout the superficial and deep lobes of the gland.



Lymphatic vessels from the parotid gland drain mainly to the pre - auricular or parotid lymph nodes which ultimately drain to the deep cervical chain.

The parotid gland contains 3 to 32 "average 20" intraglandular lymph nodes that are interconnected by a plexus of lymph vessels that drain the skin from the side of the head above the parotid gland, the orbital region, the nose, upper lip, external auditory meatus, eustachean tube and tympanic membrane.

Clinical relevance: disorders of the parotid gland

Parotid duct injury

The parotid duct, which is a comparatively superficial structure on the face, may be damaged in injuries to the face or may be inadvertently cut during surgical operations on the face. Parotid *" Stensen "* duct leaves the anterior edge of the parotid gland crossing the face in a transverse direction, the duct is about 2 inches. "5 cm" long and passes forward across the masseter about a fingerbreadth below the zygomatic arch, it then pierces the buccinator muscle to enter the mouth opposite the upper second molar tooth.

most parotid gland conditions cause similar symptoms, including:

- swelling of the face and jaw.
- pain (sometimes discomfort is worse after eating).
- fever.

Sialolithiasis

Is the medical term for calcified stones (calculi) that can develop and block the parotid gland duct, the case results in painful swelling that worsens when eating.

Parotid gland tumors

The parotid gland is the most common site of a salivary gland tumors, these tumors are usually benign, such as an *adenolymphoma* , in contrast, tumors of the submandibular and sublingual glands are less common, but more likely to be malignant.

The facial nerve lies in the interval between the two lobes of the gland " the superficial and deep". a benign parotid neoplasm is rarely, if ever occurred; causes facial palsy, damage to facial nerve or it`s 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 *"ptosis"*.

Malignant tumor of the parotid is usually highly invasive and quickly involves the facial nerve, causing unilateral facial paralysis.

Treatment usually involves surgical excision of the tumor and parotid gland, known as a *parotidectomy*, during this procedure, it is critical to identify and preserve the facial nerve and it`s branches.

Parotid gland infections

The parotid gland may become acutely inflamed as a result of retrograde bacterial infection from the mouth via the parotid duct, the gland may also become infected via the bloodstream, as in mumps, in both

cases the gland is swollen and painful because it`s facial capsule which is derived from the investing layer of the deep cervical fascia is strong and limits the swelling of the gland.

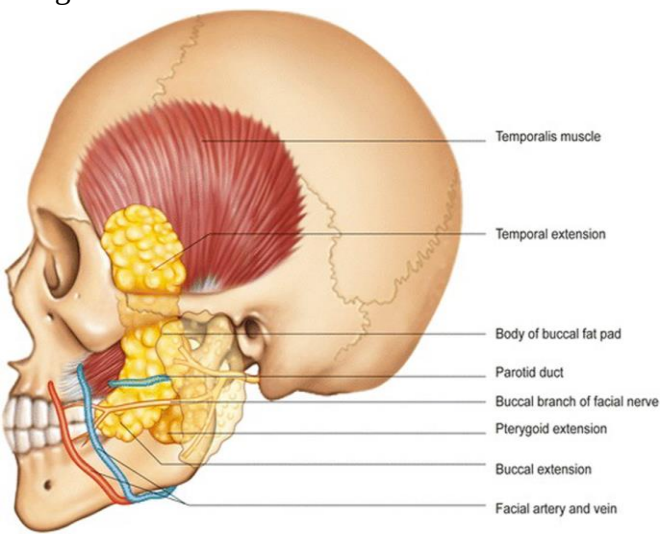
The swollen glenoid process, which extends medially behind the temporomandibular joint, is responsible for the pain experienced in acute parotitis when eating.

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. *Sialadenitis* refers to parotid gland infection caused by blockages, bacteria or viruses; culprits include staph infections and the mumps virus.

Frey's syndrome

Frey's syndrome is an interesting complication that sometimes develops after penetrating wounds of the parotid gland, when the patient eats, drops of sweating appear on the skin covering the parotid, this condition is caused by damage to the auriculotemporal and great auricular nerves.

During the process of healing, the parasympathetic secretomotor fibers in the auriculotemporal nerve grow out and join the distal end of the great auricular nerve, eventually, these fibers reach the sweat glands in the facial skin, by this means, a stimulus intended for saliva production produces sweat secretion instead.



Buccal fat pad

Also called "Bichat's fat pad", is one of several encapsulated fat masses in the cheek, it is a deep fat pad located on either side of the face between the buccinator muscle and several more superficial muscles ; including the masseter, the zygomaticus major, and minor muscels.

The inferior portion of the pad is contained within the buccal space, it should not be confused with the malar fat pad, which is directly below the skin of the cheek or jowl fat pads, it is implicated in the formation of hollow cheeks and the nasolabial fold, but not in the formation of jowls.

Nomenclature and structure

The buccal fat pad is composed of several parts, although exactly how many parts seems to be a point of disagreement, but it was described as being divided into three lobes, the *anterior, intermediate, and posterior*, according to

- the structure of the lobar envelopes.
- the formation of ligaments.
- the source of the nutritional vessels.

The anterior lobe of the buccal fat surrounds the parotid duct, it is a triangular mass with one vertex at the buccinators, one at the levator labii superioris alaeque nasi, and one at the orbicularis oris.

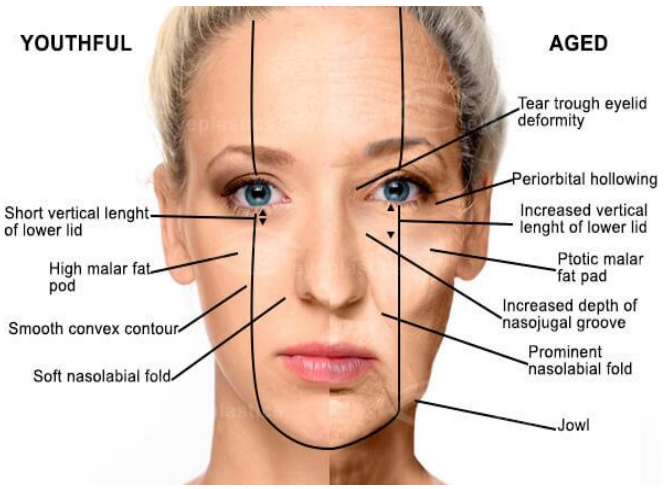
The intermediate lobe lies between the anterior and posterior lobes over the maxilla, it seems to lose a significant amount of volume between childhood and adulthood.

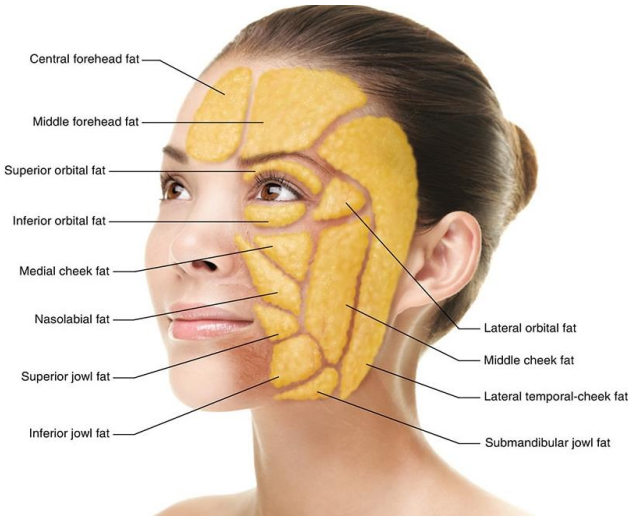
The posterior lobe runs from the infraorbital fissure and temporal muscle to the upper rim of the mandible and back to the mandibular ramus.

There are four extensions from the body of the buccal fat pad:

-
- the pterygomandibular,
- the temporal,
- the buccal,
- *the pterygoid.*

The nomenclature of these extensions derives from their location and proximal muscles.





Function

Some people describe the buccal fat pad's primary function in relation to chewing and suckling, especially in infants, this theory derives some support from the loss of volume to the intermediate lobe, which would be most directly involved in chewing and sucking, from infancy to adulthood.

Another proposed function is as gliding pads that facilitate the action of the muscles of mastication. The buccal fat pad may also function as a cushion to protect sensitive facial muscles from injury due to muscle action or exterior force.

Uses

The pad is commonly used in facial recontouring, several authors discuss the importance of the buccal fat pad in attaining good results from a facelift.

Buccal flaps (not always including the buccal fat pad) are used in reconstruction of the periorbital area after injury, they are also used to repair congenital defects of the oral cavity or for repair of congenital cleft palate.

Removal of the buccal fat pad is also sometimes used to reduce cheek prominence, although this procedure may carry with it a significant risk of damage to the buccal branch of the facial nerve.

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*Salivary glands secreting saliva, which has protective, digestive, and lubricating properties, are a subtype of *exocrine glands*, which are glandular structures that involve a duct system to release their products onto an epithelial surface, this differs from *endocrine glands* (like the adrenal and thyroid glands) that release their products directly into the bloodstream.

**Is a small parasympathetic ganglion located immediately below the foramen ovale in the infratemporal fossa and on the medial surface of the mandibular nerve, functionally it is associated with the glossopharyngeal nerve and innervates the parotid gland for salivation, it is one of four parasympathetic ganglia of the head and neck. The others are the ciliary ganglion, the submandibular ganglion and the pterygopalatine ganglion.

Salivary glands are a subtype of exocrine glands, which are glandular structures that involve a duct system to release their products onto an epithelial surface, this differs from endocrine glands (like the adrenal and thyroid glands) that release their products directly into the bloodstream.

There are two sets of salivary glands within the oral cavity responsible for these secretions: the major and minor salivary glands, the major salivary glands are all paired and consist of the parotid, submandibular, and sublingual glands, they are encapsulated and have their own ducts through which saliva is secreted into the buccal cavity.

The minor salivary glands are numerous (ranging between 600 to 1000 glands), are mostly unnamed, and are widely distributed throughout the oral cavity; those that are named include the labial, buccal, molar, palatine, and lingual glands. unlike the major salivary glands, the minor glands are not encapsulated and they either share duct systems with adjacent salivary glands or have their own.

As an exocrine gland, the parotid gland is composed of a lobular system of branching ducts that are separated by connective tissue septa, like it`s fellow major salivary glands; parotid gland is also surrounded by a dense connective tissue capsule, it also has a pseudocapsule arising from the deep investing layer of the cervical fascia, it produces watery, serous saliva as opposed to seromucous secretions like the other two major salivary glands, or mucous secretions like the minor glands.

The parotid gland is rich in serous cells, which are pyramidal cells with circular nuclei, these cells are polarized and rich in rough endoplasmic reticulum and secretory granules towards the apex of the cells, the cells are tightly adhered to each other at the respective tight junctions and are arranged in grape-like clusters known as serous acini (singular, “acinus”), they are also rich in alpha-amylase, which promotes hydrolysis of carbohydrates and protein abundant in proline.

Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

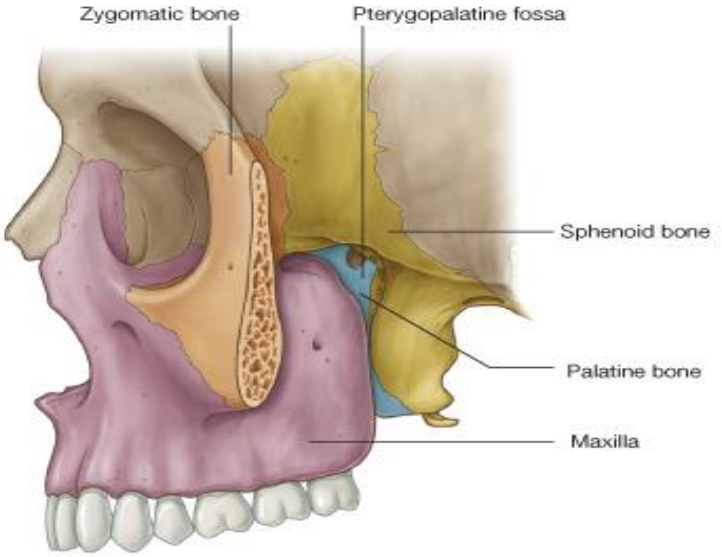
Gross Anatomy
Head & Neck
Lec. : 10
Date: Sun. 4th. Dec. 2022

The Head

Pterygopalatine fossa

Definition

It is an inverted pyramidal 'tear-drop' shaped space between bones on the lateral side of the skull immediately posterior to the maxilla, it lies inferior to the apex of the orbit and medial to the infratemporal fossa.



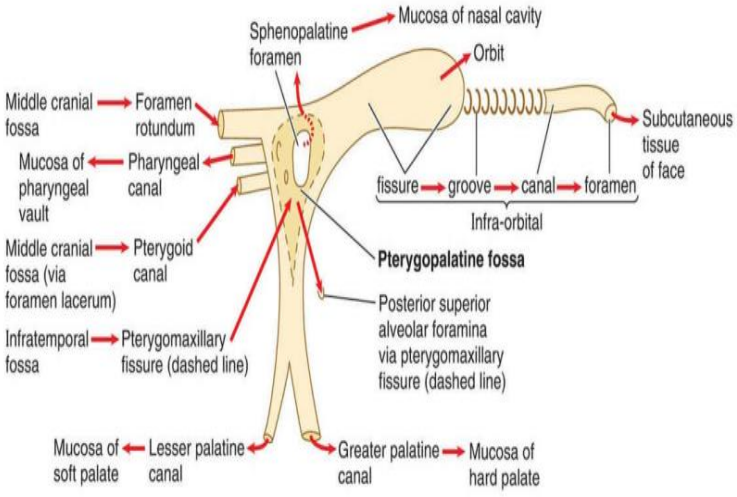
Skeletal framework

The walls of the pterygopalatine fossa are formed by parts of the palatine, maxilla, and sphenoid bones:

- ✓ the anterior wall is formed by the rounded posterior surface of the maxilla.
- ✓ the posterior wall and is formed by the pterygoid process of the sphenoid bone.
- ✓ the medial wall and the floor are formed by the fragile perpendicular plate "lateral surface" of the palatine bone.
- ✓ the incomplete roof of the pterygopalatine fossa is formed by the medial continuation of the infratemporal surface of the greater wing of the sphenoid.

Gateways

Seven foramina and fissures provide apertures through which structures enter and leave the pterygopalatine fossa:



- foramen rotundum and pterygoid (vidian) canal *communicate* with the middle cranial fossa and open onto the posterior wall.
- a small palatovaginal canal opens onto the posterior wall and *leads to* the nasopharynx.
- the palatine canal *leads to* the roof of the oral cavity (hard palate) and opens inferiorly.

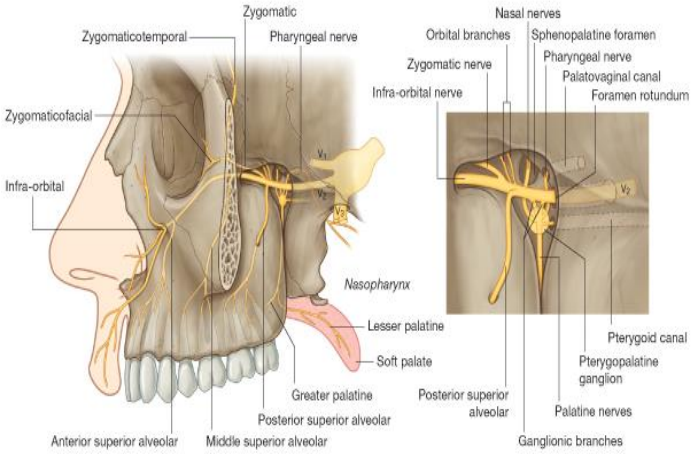
- sphenopalatine foramen *opens onto* the lateral wall of the nasal cavity and is in the medial wall.
- the lateral aspect of the pterygopalatine fossa *is continuous with* the infratemporal fossa via a large gap (the pterygomaxillary fissure) between the posterior surface of the maxilla and pterygoid process of the sphenoid bone.
- the superior aspect of the anterior wall of the fossa *opens into* the floor of the orbit via the inferior orbital fissure.

Contents

- maxillary nerve [V_2] with associated pterygopalatine ganglion, branches arising from the ganglion within the fossa are considered to be branches of the maxillary nerve.
- nerve of the pterygoid canal.
- terminal "pterygopalatine or third" part of the maxillary artery and the initial parts of it`s branches.
- veins "tributaries of the pterygoid venous plexus".
- lymphatic and a fatty matrix occupy all the remaining space.

Maxillary nerve

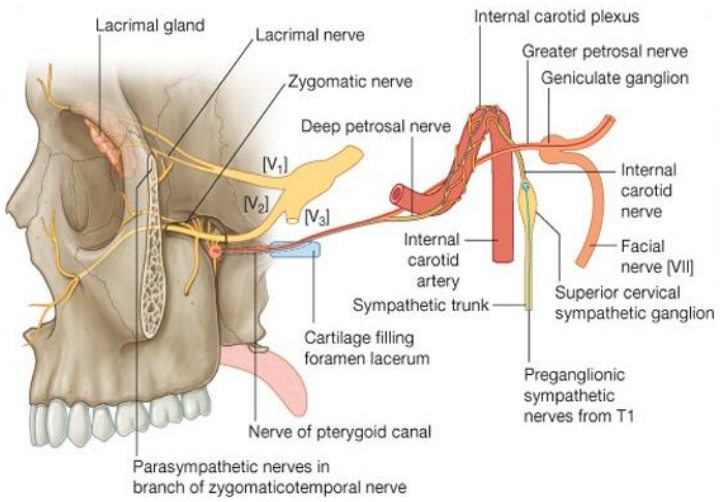
The maxillary nerve [V_2] is purely sensory, it originates from the trigeminal ganglion in the cranial cavity, exits the middle cranial fossa, and enters the pterygopalatine fossa through the foramen rotundum , passing anteriorly through the fossa and exits as the infra-orbital nerve through the inferior orbital fissure**.**



While passing through the pterygopalatine fossa, the maxillary nerve [V_2] gives rise to the zygomatic nerve, the posterior superior alveolar nerve, and two ganglionic branches. The two ganglionic branches originate from it`s inferior surface and pass through the pterygopalatine ganglion.

Branches:

1- zygomatic nerve**.**



2- posterior superior alveolar nerve.

3- two ganglionic branches.

Nerve of the pterygoid canal

The nerve of the pterygoid canal is formed in the middle cranial fossa by the union of:

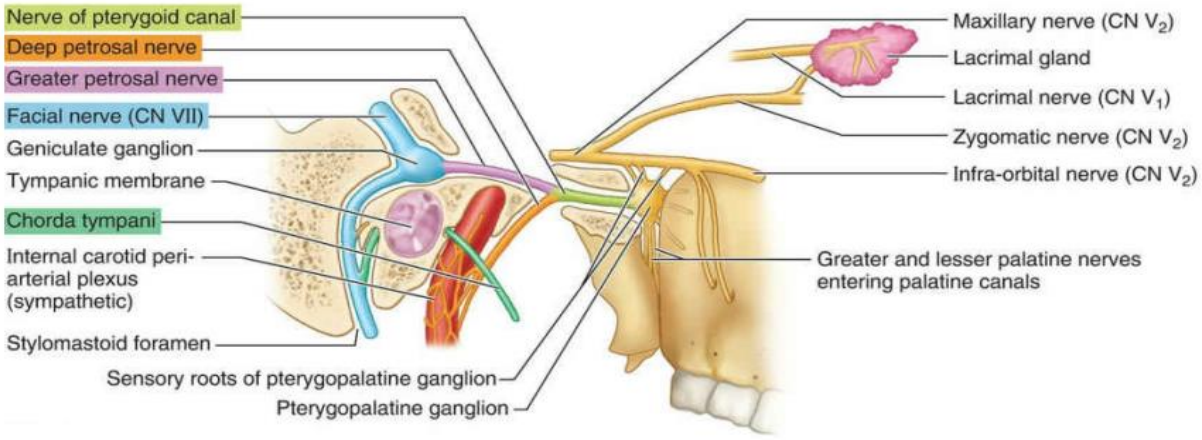
- greater petrosal nerve; a branch of the facial nerve [VII], presynaptic parasympathetic fibers
- deep petrosal nerve ; a branch of the internal carotid plexus, postsynaptic sympathetic fibers.

The nerve of the pterygoid canal passes into the pterygopalatine fossa, joins the pterygopalatine ganglion, and carries mainly preganglionic parasympathetic and postganglionic sympathetic fibers.

Pterygopalatine ganglion

The pterygopalatine ganglion is the largest parasympathetic ganglia in the head and is formed by the cell bodies of the nerve of the pterygoid canal around the branches of the maxillary nerve [V_2].

The postganglionic fibers that originate in the pterygopalatine ganglion, together with sympathetic fibers, join fibers from the ganglionic branches of the maxillary nerve [V_2] to form:



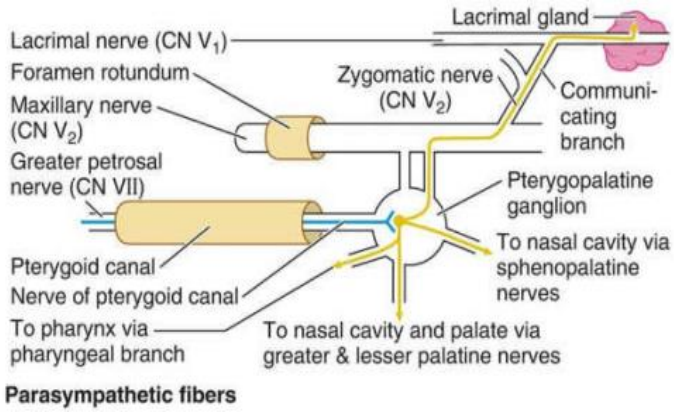
- orbital
- palatine
- nasal
- pharyngeal branches, which leave the ganglion.

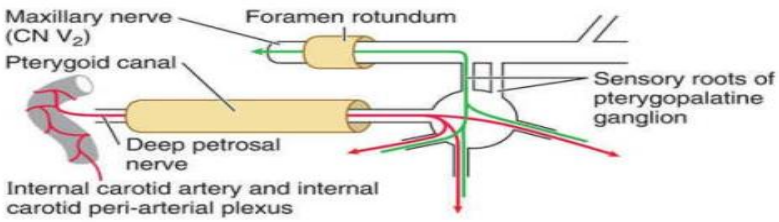
Other postganglionic parasympathetic fibers and sympathetics pass superiorly through the ganglionic branches of the maxillary nerve [V_2] to enter the main trunk of the maxillary nerve and be distributed with the zygomatic, posterior superior alveolar, and infra-orbital nerves.

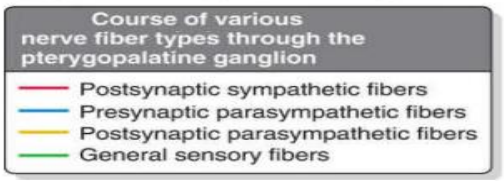
Secretomotor postsynaptic parasympathetic and vasoconstrictive postsynaptic sympathetic fibers are distributed to the lacrimal, nasal, palatine, and pharyngeal glands. Similarly, sensory fibers are distributed to the mucosa of the nasal cavity, palate, and uppermost pharynx.

The postganglionic parasympathetic and sympathetic fibers that pass into the orbit with the zygomatic nerve are important because they innervate the lacrimal gland.

The zygomatic nerve arises in the pterygopalatine fossa, it enters the orbit through the inferior orbital fissure, and divides at the back of that cavity into two branches; the zygomaticotemporal and zygomaticofacial nerves, which exit the orbit using identically named foramen. The zygomatic nerve carries sensory fibers from the skin, it also carries parasympathetic fibers (originating in the pterygopalatine ganglion) to the lacrimal nerve via a communication, these fibers will eventually provide innervation to the lacrimal gland.

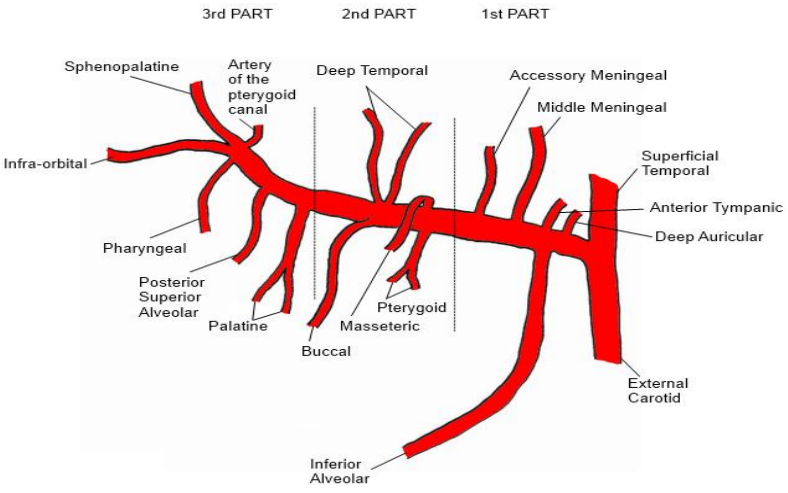






Maxillary artery

The part of the maxillary artery located anterior to the lateral pterygoid), passes medially through the pterygomaxillary fissure and enters the fossa, inside the fossa "the third part" passes anterior to the pterygopalatine ganglion and gives rise to branches that accompany all nerves entering and exiting the fossa, sharing the same names with many branches of the maxillary nerve [V_2] and the pterygopalatine ganglion.



Branches

1. posterior superior alveolar artery.
2. infra-orbital artery.
3. greater palatine artery.
4. pharyngeal artery.
5. sphenopalatine artery.
6. artery of pterygoid canal.

Collectively, these branches supply much of the nasal cavity, the roof of the oral cavity, and all upper teeth. In addition, they contribute to the blood supply of the sinuses, oropharynx, and floor of the orbit.

Veins

Veins that drain areas supplied by branches of the terminal part of the maxillary artery generally travel with these branches back into the pterygopalatine fossa.

The veins coalesce in the pterygopalatine fossa and then pass laterally through the pterygomaxillary fissure to join the pterygoid plexus of veins in the infratemporal fossa.

The infra-orbital vein, which drains the inferior aspect of the orbit, may pass directly into the infratemporal fossa through the lateral aspect of the inferior orbital fissure, so bypassing the pterygopalatine fossa.

Clinical relevance: Transantral approach to pterygopalatine fossa

Surgical access to the deeply placed pterygopalatine fossa is gained through the maxillary sinus; after elevating the upper lip, the maxillary gingiva and anterior wall of the sinus are traversed to enter the sinus.

The posterior wall is then chipped away as needed to open the anterior wall of the pterygopalatine fossa. In the case of *chronic epistaxis "nosebleed",* the third part of the maxillary artery may be ligated in the fossa to control the bleeding.

Internal foramina of the skull

Foramen	**Structures passing through foramen**
Anterior cranial fossa	
Foramen caecum	Emissary veins to nasal cavity
Olfactory foramina in cribriform plate	Olfactory nerves [I]
Optic canal	Optic nerve [II]; ophthalmic artery
Middle cranial fossa	
Superior orbital fissure	Oculomotor nerve [III]; trochlear nerve [IV]; ophthalmic division of the trigeminal nerve [V_1]; abducent nerve [VI]; ophthalmic veins
Foramen rotundum	Maxillary division of the trigeminal nerve [V_2]
Foramen ovale	Mandibular division of the trigeminal nerve [V_3]; lesser petrosal nerve
Foramen spinosum	Middle meningeal artery
Hiatus for the greater petrosal nerve	Greater petrosal nerve
Hiatus for the lesser petrosal nerve	Lesser petrosal nerve
Posterior cranial fossa	
Foramen magnum	End of brainstem/beginning of spinal cord; vertebral arteries; spinal roots of the accessory nerve; meninges
Internal acoustic meatus	Facial nerve [VII]; vestibulocochlear nerve [VIII]; labyrinthine artery
Jugular foramen	Glossopharyngeal nerve [IX]; vagus nerve [X]; accessory nerve [XI]; inferior petrosal sinus, sigmoid sinus (forming internal jugular vein)
Hypoglossal canal	Hypoglossal nerve [XII]; meningeal branch of the ascending pharyngeal artery
Condylar canal	Emissary vein

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Gross Anatomy
Head & Neck
Lec. : 11
Date: Sun. 11th. Dec. 2022

The Head

Temporomandibular joint "TMJ"

The joint is defined as a ginglymoarthrodial joint i.e. both a hinge and a gliding joint because it has a rotational movement in the sagittal plane and a translation movement on it`s own axis , this translation movement generates more movement.

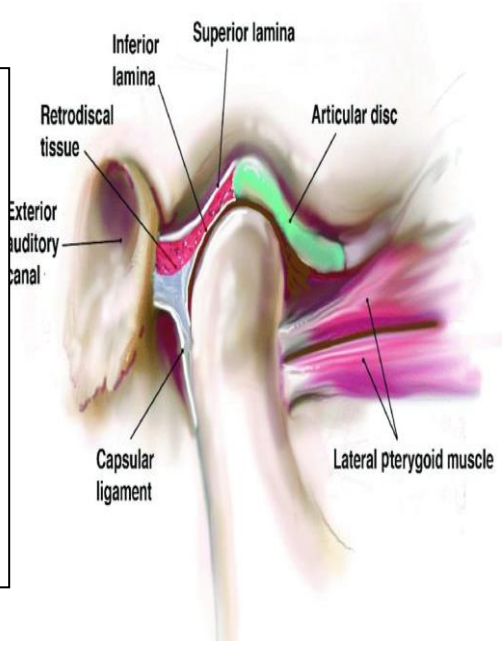
These movements are constrained by various passive factors, as well as passive tension of the ligaments and muscles, the ligaments of the joint can be divided into intrinsic and extrinsic ligaments.

Intrinsic ligaments

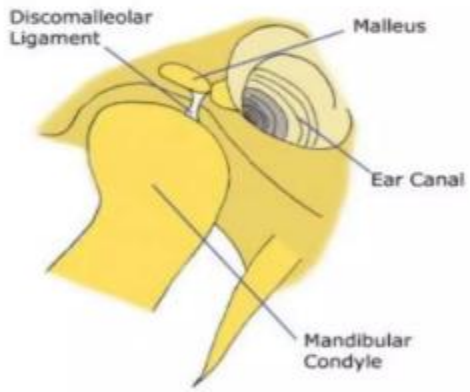
- *collateral disc ligaments*

Also known as the discal ligaments are intra-capsular, they connect the articular disc to the joint capsule and are made of two fascicles: one lateral and one medial , their primary function is to help to prevent movement of the intra-articular disc away from the condyle.

Movement of the condyle-disc complex depends on these ligaments , the disc modifies it`s position depending on the position of the condyle during movement in order to improve pressure distribution, as these ligaments are richly innervated, they also provide proprioceptive and pain information



- *oto-mandibular ligaments*



Oto-mandibular ligaments are the discomalleolar ligament (DML), which arises from the malleus (one of the ossicles of the middle ear) and runs to the medial retrodiscal tissue of the joint, and the anterior malleolar ligament (AML), which arises from the malleus and connects with the lingula of the mandible via the sphenomandibular ligament.

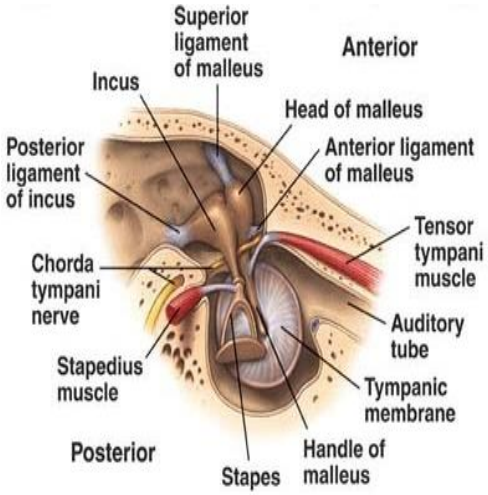
The oto-mandibular ligaments may be implicated in tinnitus associated with joint disorders, a positive correlation has been found between tinnitus and ipsilateral TMJ disorder. It has been proposed that a TMJ disorder may stretch the DML and AML, thereby affecting middle ear structure equilibrium.

Retrodiscal tissue

As mentioned before the articular disc is a fibrous extension divides the joint into two sections, each with it`s own synovial membrane, it is attached to the condyle medially and laterally by the collateral ligaments.

The anterior disc attaches to the joint capsule and the superior head of the lateral pterygoid while the posterior portion attaches to the mandibular fossa which is referred to as the *retrodiscal tissue*.

Unlike the disc itself, the retrodiscal tissue is vascular and highly innervated, as a result, the retrodiscal tissue is often a major contributor to the pain of the joint, particularly when there is inflammation or compression within the joint.



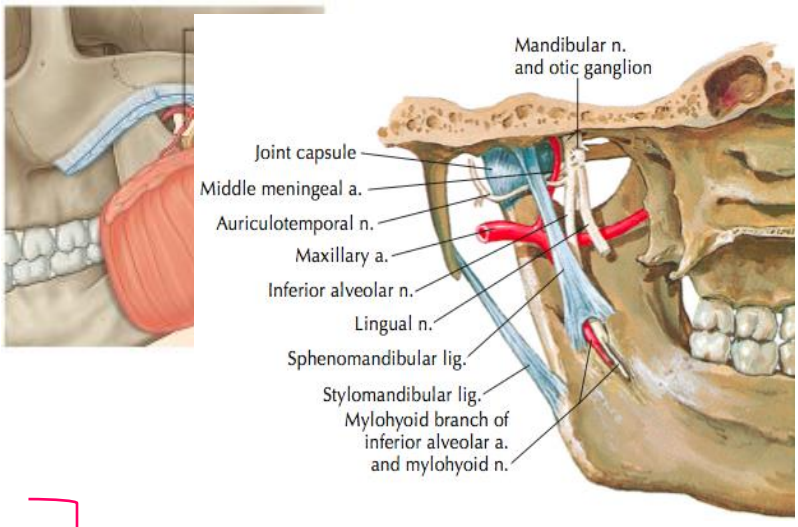
Important relations of the temporomandibular joint

Anteriorly: the mandibular notch and the masseteric nerve and artery.

Posteriorly: the tympanic plate of the external auditory meatus and the glenoid process of the parotid gland.

Laterally: the parotid gland, fascia, and skin.

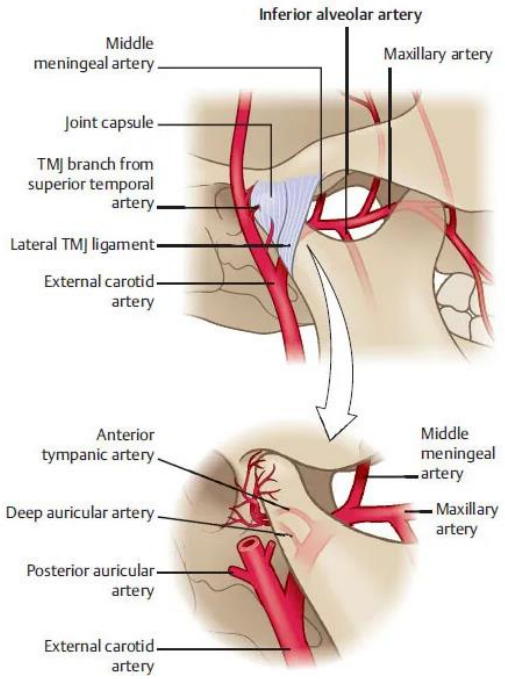
Medially: the maxillary artery and vein and the auriculotemporal nerve.



Extrinsic **ligaments**
Type
The articular disk
Capsule
Synovial membrane covered before
Ligaments
Nerve supply
Movements

Blood supply

Superficial temporal artery and "deep auricular and anterior tympanic branches" of maxillary artery run along the lateral and medial sides of the condylar neck, supplying the joint through the auricular root. The key veins are the pterygoid plexus and superficial temporal veins.



Clinical notes

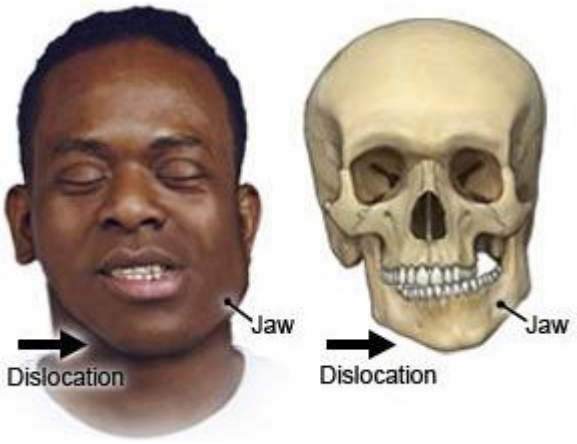
Clinical significance of the temporomandibular joint

The temporomandibular joint lies immediately in front of the external auditory meatus, the great strength of the lateral temporomandibular ligament prevents the head of the mandible from passing backward and fracturing the tympanic plate when a severe blow falls on the chin.

The articular disc of the temporomandibular joint may become partially detached from the capsule, and this results in it`s movement becoming noisy and producing an audible click during movements at the joint.

Dislocation of the temporomandibular joint

Dislocation sometimes occurs when the mandible is depressed, in this movement, the head of the mandible and the articular disc both move forward until they reach the summit of the articular tubercle, the joint becomes unstable, and a minor blow on the chin or a sudden contraction of the lateral pterygoid muscles, as in yawning, may be sufficient to pull the disc forward beyond the summit. In bilateral cases the mouth is fixed in an open position, and both heads of the mandible lie in front of the articular tubercles.



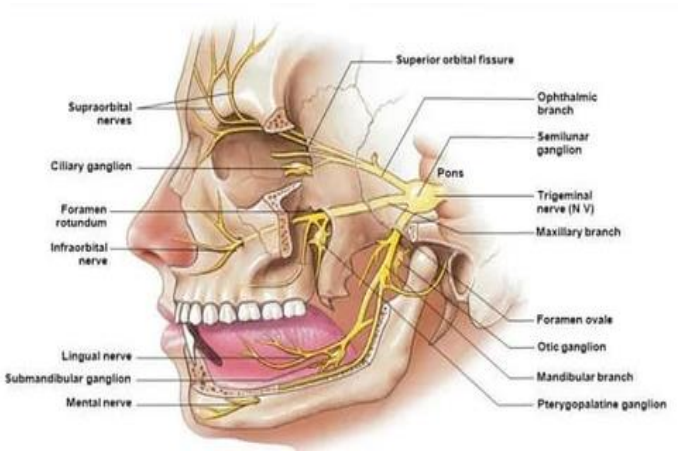
Reduction of the dislocation is easily achieved by pressing the gloved thumbs downward on the lower molar teeth and pushing the jaw backward, downward pressure overcomes the tension of the temporalis and masseter muscles, and the backward pressure overcomes the spasm of the lateral pterygoid muscles.

Otic ganglion

It is a small parasympathetic ganglion located immediately below the foramen ovale in the infratemporal fossa and on the medial surface of the mandibular nerve, it is functionally associated with the glossopharyngeal nerve and innervates the parotid gland for salivation, it is one of four parasympathetic ganglia of the head and neck. The others are the ciliary ganglion, the submandibular ganglion and the pterygopalatine ganglion.

Structure

It is a small (2–3 mm), oval shaped, flattened parasympathetic ganglion of a reddish-grey color, located immediately below the foramen ovale in the infratemporal fossa and on the medial surface of the mandibular nerve.



Relations

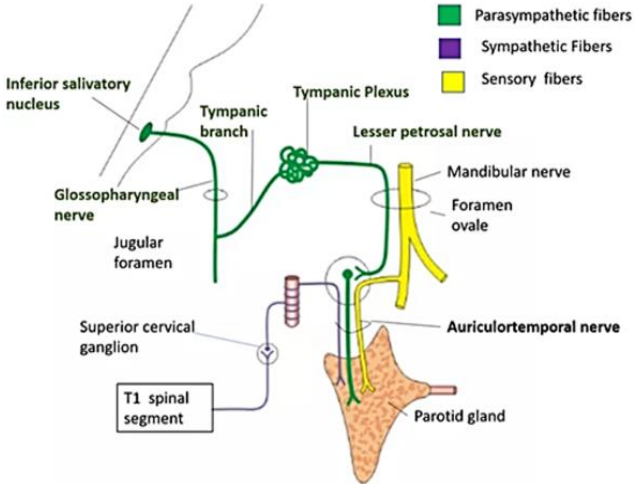
Laterally; with the trunk of the mandibular nerve at the point where the motor and sensory roots join.

Medially; with the cartilaginous part of the auditory tube, and the origin of the tensor veli palatini.

Posteriorly; with the middle meningeal artery.

It surrounds the origin of the nerve to the medial pterygoid.

Connection



The preganglionic parasympathetic fibers originate in the inferior salivatory nucleus of the glossopharyngeal nerve, they leave the glossopharyngeal nerve by it`s tympanic branch and then pass via the tympanic plexus and the lesser petrosal nerve to the otic ganglion where the fibers synapse and the postganglionic fibers pass by communicating branches to the auriculotemporal nerve, which conveys them to the parotid gland, they produce *vasodilator* and *secretomotor* effects. The otic ganglion transmits postganglionic parasympathetic secretomotor fibers to all branches of the mandibular division of the trigeminal nerve.

It`s sympathetic root is derived from the plexus on the middle meningeal artery, it contains post-ganglionic fibers arising in the superior cervical ganglion, the fibers pass through the ganglion without relay and reach the parotid gland via the auriculotemporal nerve, they are *vasomotor* in function.

The sensory root receives fibers from the glossopharyngeal nerve via the tympanic plexus and lesser superficial petrosal nerve passing through the auriculotemporal nerve and is sensory to the parotid gland.

The motor route of the otic ganglion originates from the mandibular nerve and passes through the otic ganglion without synapsing and enters the medial pterygoid nerve to innervate the medial pterygoid muscle, tensor veli palatini, and tensor tympani muscles.

The ganglion is connected to the chorda tympani nerve and also to the nerve of the pterygoid canal, these pathways provide an alternate pathway of taste from the anterior two-thirds of the tongue, these fibers do not pass through the middle ear.

Clinical significance

Frey's syndrome "covered before"

Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

Gross Anatomy
Head & Neck
Lec. : 12
Date: Sun. 18th. Dec. 2022

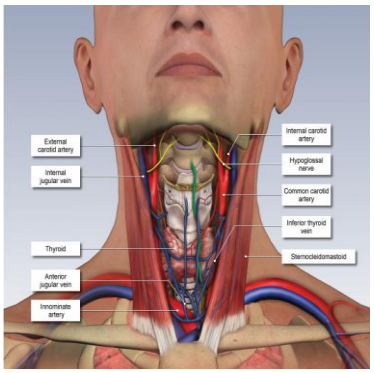
Head & Neck

Basic anatomy

Neck

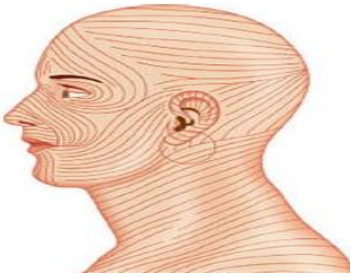
The neck is the region of the body that lies between the lower margin of the mandible above and the suprasternal notch and the upper border of the clavicle below, it is strengthened by the cervical part of the vertebral column, which is convex forward and supports the skull, behind the vertebrae is a mass of extensor muscles and in front is a smaller group of flexor muscles.

In the central region of the neck are parts of the respiratory system, namely, the larynx and the trachea, and behind are parts of the alimentary system, the pharynx and the esophagus, at the sides of these structures are the vertically running carotid arteries, internal jugular veins, the vagus nerve, and the deep cervical lymph nodes.



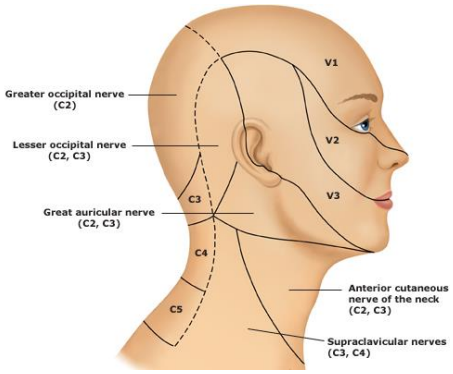
Skin of the neck

The natural lines of cleavage of the skin are constant and run almost horizontally around the neck, this is important clinically because an incision along a cleavage line will heal as a narrow scar, whereas one that crosses the lines will heal as a wide or hea ped-up scar.



Cutaneous nerves

The skin overlying the trapezius muscle on the back of the neck and on the back of the high as the vertex is supplied segmentally by posterior rami of cervical nerves 2 to 5, greater occipital nerve is a branch of the posterior ramus of the second cervical nerve, the *first cervical nerve has no cutaneous branch*.



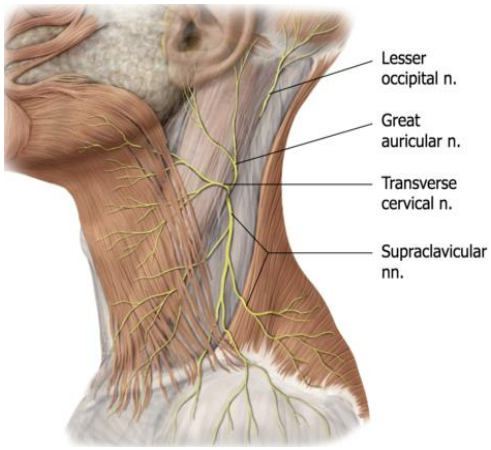
The skin of the front and sides of the neck is supplied by anterior rami of cervical nerves 2 to 4 through branches of the cervical plexus, they emerge from beneath the posterior border of the sternocleidomastoid muscle.

Lesser occipital nerve (C2) hooks around the accessory nerve and ascends along the posterior border of the sternocleidomastoid muscle to supply the skin over the lateral part of the occipital region and the medial surface of the auricle.

Great auricular nerve (C2 and 3) ascends across the sternocleidomastoid muscle and divides into branches that supply the skin over the angle of the mandible, the parotid gland, and on both surfaces of the auricle.

Transverse cutaneous nerve (C2 and 3) emerges from behind the middle of the posterior border of the sternocleidomastoid muscle, passing forward across that muscle and divides into branches that supply the skin on the anterior and lateral surfaces of the neck, from the body of the mandible to the sternum.

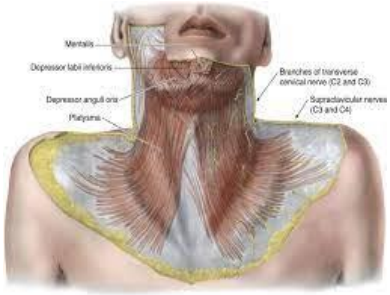
Supraclavicular nerves (C3 and 4) emerge from beneath the posterior border of the sternocleidomastoid muscle and descend across the side of the neck, they pass onto the chest wall and shoulder region, down to the level of the second rib.



- the medial supraclavicular nerve crosses the medial end of the clavicle and supplies the skin as far as the median plane.
- the intermediate supraclavicular nerve crosses the middle of the clavicle and supplies the skin of the chest wall.
- the lateral supraclavicular nerve crosses the lateral end of the clavicle and supplies the skin over the shoulder and the upper half of the deltoid muscle; this nerve also supplies the posterior aspect of the shoulder as far down as the spine of the scapula.

Superficial fascia

Superficial fascia of the neck forms a thin layer that encloses the platysma muscle, and the cutaneous nerves innervate the side and front of the neck, the superficial veins, and the superficial lymph nodes.

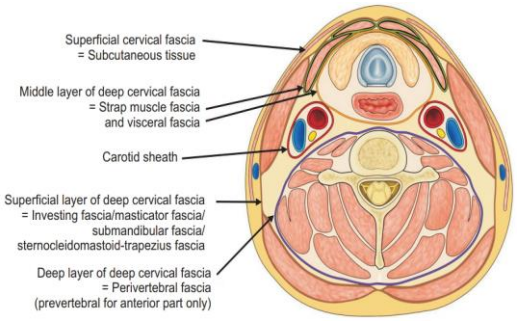


Platysma

It is a large thin but clinically important muscular sheet embedded in the superficial fascia, it arises below the clavicle in the upper part of the thorax and ascends through the neck to the mandible, at this point, the more medial fibers insert on the mandible, while the lateral fibers join with muscles around the mouth.

Deep cervical fascia

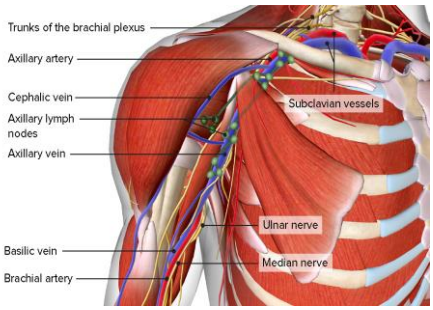
The deep cervical fascia supports the muscles, the vessels, and the viscera of the neck, in certain areas, it is condensed to form well-defined, fibrous sheets called the investing layer, the pretracheal layer, and the prevertebral layer, it is also condensed to form the carotid sheath



Investing layer is a thick layer that encircles the neck. It splits to enclose the trapezius and the sternocleidomastoid muscles.

Pretracheal layer is a thin layer that is attached above to the laryngeal cartilages , it surrounds the thyroid and the parathyroid glands, forming a sheath for them, and encloses the infrahyoid muscles.

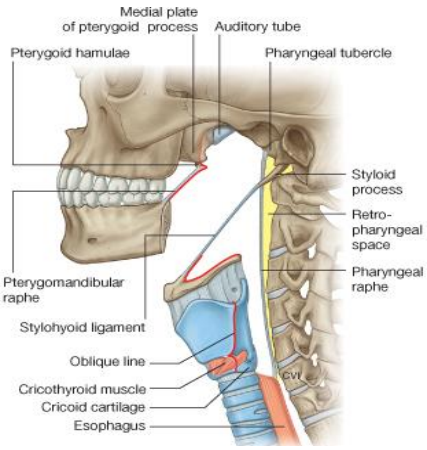
Prevertebral layer is a thick layer that passes like a septum across the neck behind the pharynx and the esophagus and in front of the prevertebral muscles and the vertebral column , it forms the facial floor of the posterior triangle, and it extends laterally over the first rib into the axilla to form the important axillary sheath.



Carotid sheath is a local condensation of the prevertebral, the pretracheal, and the investing layers of the deep fascia that surround the common and internal carotid arteries, the internal jugular vein, the vagus nerve, and the deep cervical lymph nodes.

Axillary sheath : all the anterior rami of the cervical nerves that emerge in the interval between the scalenus anterior and scalenus medius muscles lie at first deep to the prevertebral fascia. As the subclavian artery and the brachial plexus emerge in the interval between the scalenus anterior and the scalenus medius muscles, they carry with them a sheath of the fascia, which extends into the axilla and is called the axillary sheath.

Cervical ligaments



- *Stylohyoid ligament:* connects the styloid process to the lesser cornu of the hyoid bone
- *Stylomandibular ligament:* connects the styloid process to the angle of the mandible
- *Sphenomandibular ligament:* connects the spine of the sphenoid bone to the lingula of the mandible
- *Pterygomandibular ligament:* connects the hamular process of the medial pterygoid plate to the posterior end of the mylohyoid line of the mandible, it gives attachment to the superior constrictor and the buccinator muscles.

Triangles of the neck

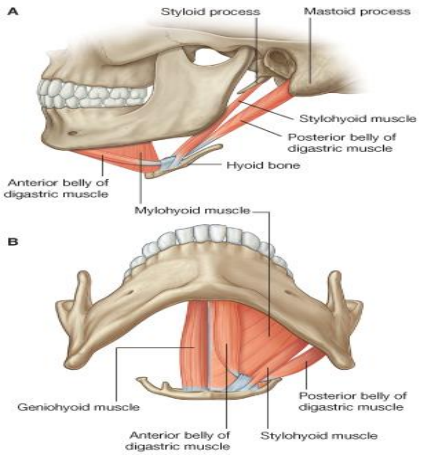
Key neck muscles

Sternocleidomastoid muscle

When the sternocleidomastoid muscle contracts, it appears as an oblique band crossing the side of the neck from the sternoclavicular joint to the mastoid process of the skull, it divides the neck into anterior and posterior triangles, the anterior border covers the carotid arteries, the internal jugular vein, and the deep cervical lymph nodes; it also overlaps the thyroid gland. The muscle is covered superficially by skin, fascia, the platysma muscle, and the external jugular vein, the deep surface of the posterior border is related to the cervical plexus of nerves, the phrenic nerve, and the upper part of the brachial plexus.

Anterior triangle of the neck

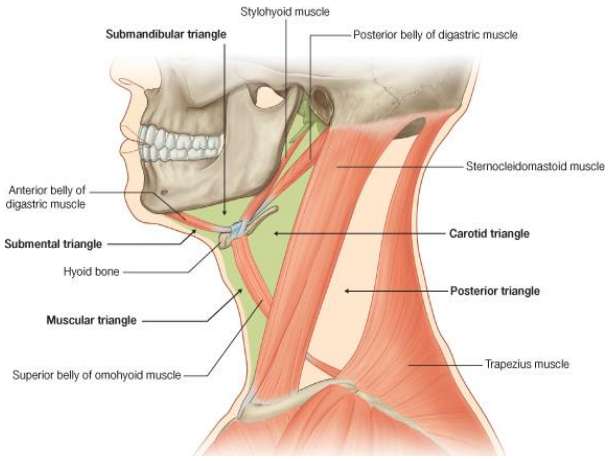
The anterior triangle of the neck is outlined by the anterior border of the sternocleidomastoid muscle laterally, the inferior border of the mandible superiorly, and the midline of the neck medially, it is further subdivided into several smaller triangles as follows:



- the submandibular triangle is outlined by the inferior border of the mandible superiorly and the anterior and posterior bellies of the digastric muscle inferiorly.
- the submental triangle is outlined by the hyoid bone inferiorly, the anterior belly of the digastric muscle laterally, and the midline.
- the muscular triangle is outlined by the hyoid bone superiorly, the superior belly of the omohyoid muscle, and the anterior border of the sternocleidomastoid muscle laterally, and the midline.
- the carotid triangle is outlined by the superior belly of the omohyoid muscle anteroinferiorly, the stylohyoid muscle and posterior belly of the digastric superiorly, and the anterior border of the sternocleidomastoid muscle posteriorly.

Each of these triangles contains numerous structures that can be identified as being

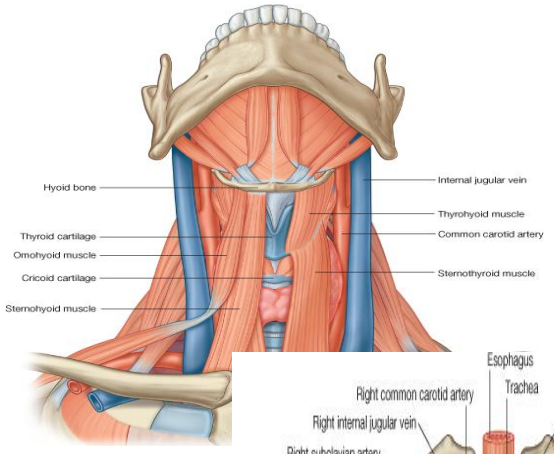
- within a specific triangle,
- passing into a specific triangle from outside the area,
- originating in one triangle and passing to another triangle, or
- passing through several triangles while passing through the region.



Muscles

The muscles in the anterior triangle of the neck can be grouped according to their location relative to the hyoid bone:

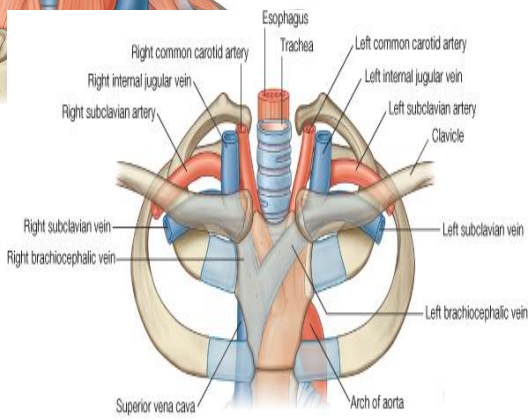
- muscles superior to the hyoid are classified as suprahyoid muscles and include the stylohyoid, digastric, mylohyoid, and geniohyoid.
- muscles inferior to the hyoid are infrahyoid muscles and include the omohyoid, sternohyoid, thyrohyoid, and sternothyroid.



Vessels

Passing through the anterior triangle of the neck are the common carotid arteries and their branches, the external and internal carotid arteries, these vessels supply all structures of the head and neck.

Associated with this arterial system are the internal jugular vein and it`s tributaries, which drain the blood from all structures of the head and neck.



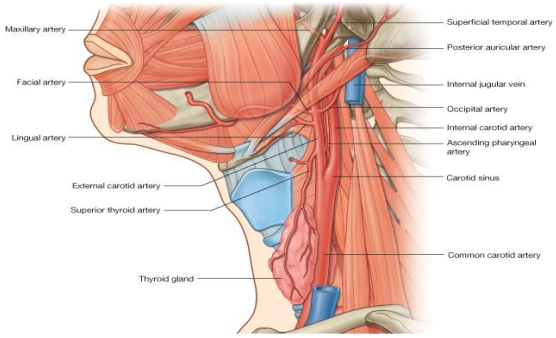
Carotid system

Common carotid arteries

Common carotid arteries are the beginning of the system:

- the right common carotid artery originates from the brachiocephalic trunk immediately posterior to the right sternoclavicular joint and is entirely in the neck throughout its course.
- the left common carotid artery begins in the thorax as a direct branch of the arch of the aorta and passes superiorly to enter the neck near the left sternoclavicular joint.

Both right and left common carotid arteries ascend through the neck, just lateral to the trachea and esophagus, within a facial compartment (the carotid sheath), they give off no branches as they pass through the neck.



Near the superior edge of the thyroid cartilage each common carotid artery divides into its two terminal branches; the external and internal carotid arteries.

The superior part of each common carotid artery and its division into external and internal carotid arteries occurs in the carotid triangle, which is a subdivision of the anterior triangle of the neck.

At the bifurcation, the common carotid artery and the beginning of the internal carotid artery are dilated, forming the *carotid sinus* and contains receptors that monitor changes in blood pressure and are innervated by a branch of the glossopharyngeal nerve [IX].

Another accumulation of receptors in the area of the bifurcation is responsible for detecting changes in blood chemistry, primarily oxygen content, it is called the carotid body and is innervated by branches from both the glossopharyngeal [IX] and vagus [X] nerves.

Internal carotid arteries

After its origin, the internal carotid artery ascends toward the base of the skull, it gives off no branches in the neck and enters the cranial cavity through the carotid canal in the petrous part of the temporal bone.

The internal carotid arteries supply the cerebral hemispheres, the eyes and the contents of the orbits, and the forehead.

External carotid arteries

The external carotid arteries begin giving off branches immediately after the bifurcation of the common carotid arteries as follows;

- the ***superior thyroid artery*** is the first branch, arises from the anterior surface near or at the bifurcation, and passes in a downward and forward direction to reach the superior pole of the thyroid gland.
- the ***ascending pharyngeal artery*** is the second and smallest branch-arises from the posterior aspect of the external carotid artery and ascends between the internal carotid artery and the pharynx.
- the ***lingual artery*** arises from the anterior surface of the external carotid artery just above the superior thyroid artery at the level of the hyoid bone, passes deep to the hypoglossal nerve [XII], and passes between the middle constrictor and hyoglossus muscles.
- the ***facial artery*** is the third anterior branch of the external carotid artery, arises just above the lingual artery, passes deep to the stylohyoid and posterior belly of the digastric muscles, continues deep between the submandibular gland and mandible, and emerges over the edge of the mandible just anterior to the masseter muscle, to enter the face.
- the ***occipital artery*** arises from the posterior surface of the external carotid artery, near the level of origin of the facial artery, passes upwards and posteriorly deep to the posterior belly of the digastric muscle, and emerges on the posterior aspect of the scalp.
- the ***posterior auricular artery*** is a small branch arising from the posterior surface of the external carotid artery, and passes upwards and posteriorly.
- the ***superficial temporal artery*** is one of the terminal branches and appears as an upwards continuation of the external carotid artery-beginning posterior to the neck of mandible, it passes anterior to the ear, crosses the zygomatic process of the temporal bone, and above this point divides into anterior and posterior branches.

- the ***maxillary artery*** is the larger of the two terminal branches of the external carotid artery- arising posterior to the neck of mandible, it passes through the parotid gland, continues medial to the neck of mandible and into the infratemporal fossa, and continues through this area into the pterygopalatine fossa.

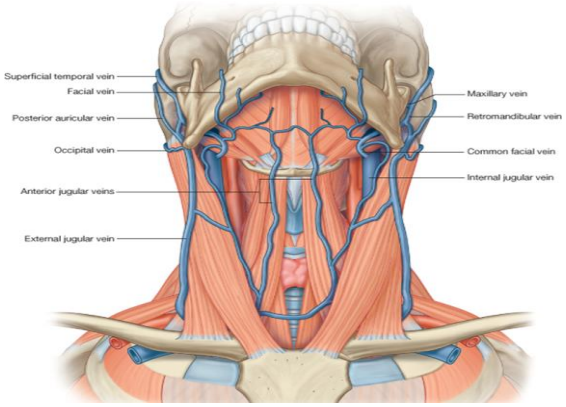
Veins

Internal jugular vein collectes blood from the skull, brain, superficial face, and parts of the neck, it begins as a dilated continuation of the sigmoid sinus, which is a dural venous sinus, this initial dilated part is referred to as the superior bulb and receives another dural venous sinus (the inferior petrosal sinus) soon after it is formed, it exits the skull through the jugular foramen.

The vein traverses the neck within the carotid sheath associated with the common carotid artery and the vagus nerve [X].

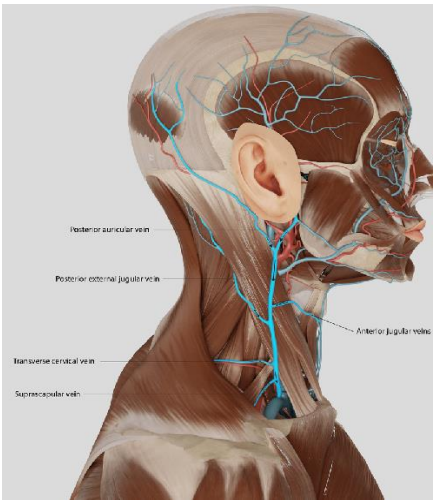
The paired internal jugular veins join with the subclavian veins posterior to the sternal end of the clavicle to form the right and left brachiocephalic veins. Tributaries to each internal jugular vein include the;

- inferior petrosal sinus
- facial
- lingual
- pharyngeal
- occipital
- superior thyroid
- middle thyroid.



External jugular vein

It begins just behind the angle of the mandible by the union of the posterior auricular vein with the posterior division of the retromandibular vein, it descends obliquely across the sternocleidomastoid muscle and, just above the clavicle in the posterior triangle, pierces the deep fascia and drains into the subclavian vein. It varies considerably in size, and it`s course extends from the angle of the mandible to the middle of the clavicle, it has the following tributaries:



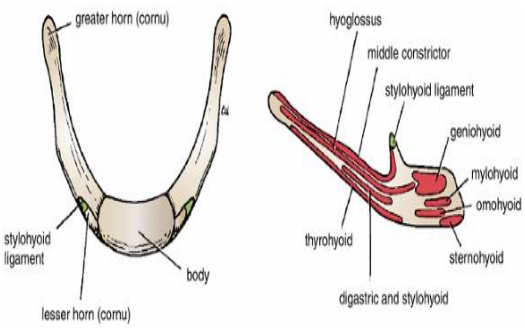
- posterior auricular vein
- posterior division of the retromandibular vein
- posterior external jugular vein, a small vein that drains the posterior part of the scalp and neck and joins the external jugular vein about halfway along it`s course.
- transverse cervical vein
- suprascapular vein
- anterior jugular vein.

Anterior Jugular Vein

Begins just below the chin, by the union of several small veins, running down the neck close to the midline, just above the suprasternal notch, the veins of the two sides are united by a transverse trunk called the jugular arch, which then turns sharply laterally and passes deep to the sternocleidomastoid muscle to drain into the external jugular vein.

Bones of the neck in the anterior triangle

Hyoid bone



The hyoid bone is a mobile single bone found in the midline of the neck below the mandible and abides the larynx, It does not articulate with any other bones, the hyoid bone is U shaped and consists of a body and two greater and two lesser cornua, it is attached to the skull by the stylohyoid ligament and to the thyroid cartilage by the thyrohyoid membrane.

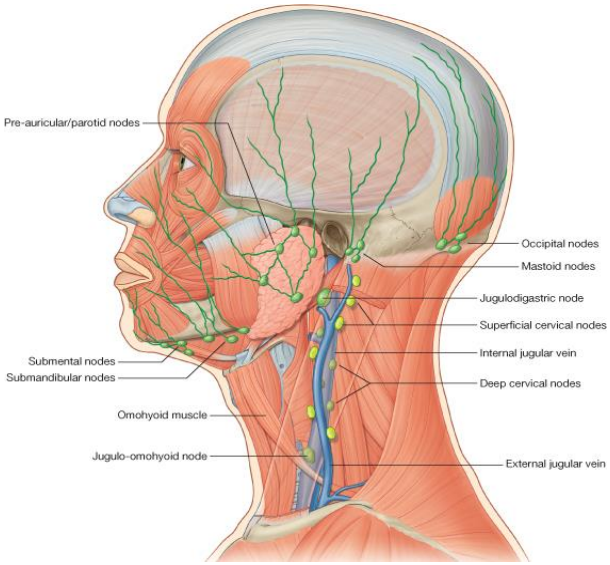
The hyoid bone forms a base for the tongue and is suspended in position by muscles that connect it to the mandible, to the styloid process of the temporal bone, the thyroid cartilage, the sternum, and the scapula.

Lymph nodes of the neck

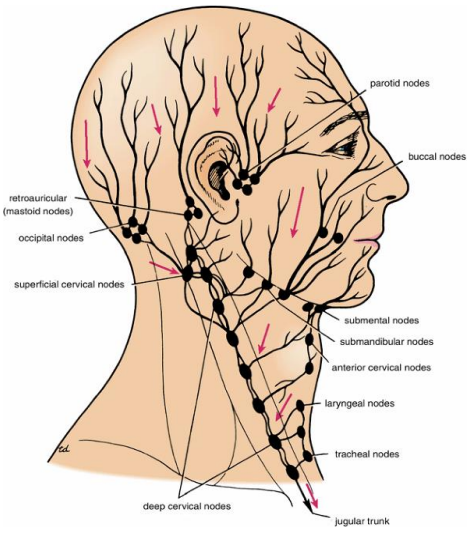
The regional nodes of the neck are arranged as superficial and deep groups:

Superficial lymph nodes

Lying along the external jugular vein superficial to the sternocleidomastoid muscle, they receive lymph vessels from the occipital and mastoid lymph nodes and drain into the deep cervical lymph nodes.

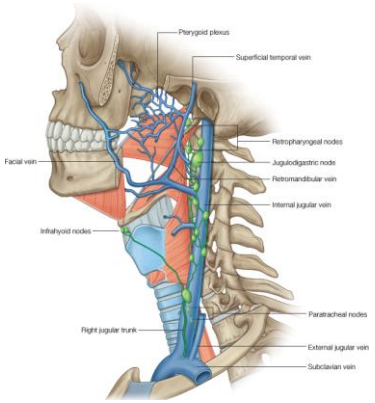


- *Submandibular nodes:* lie superficial to the submandibular salivary gland just below the lower margin of the jaw. They receive lymph from the front of the scalp; the nose; the cheek; the upper lip and the lower lip (except the central part); the frontal, maxillary, and ethmoid sinuses; the upper and lower teeth (except the lower incisors); the anterior two thirds of the tongue (except the tip); the floor of the mouth and vestibule; and the gums.
- *Submental nodes:* lie in the submental triangle just below the chin. They drain lymph from the tip of the tongue, the floor of the anterior part of the mouth, the incisor teeth, the center part of the lower lip, and the skin over the chin.
- *Anterior cervical nodes:* lie along the course of the anterior jugular veins in the front of the neck. They receive lymph from the skin and superficial tissues of the front of the neck.



- *Superficial cervical nodes:* lie along the course of the external jugular vein on the side of the neck. They drain lymph from the skin over the angle of the jaw, the skin over the lower part of the parotid gland, and the lobe of the ear.
- *Retropharyngeal nodes:* lie behind the pharynx and in front of the vertebral column. They receive lymph from the nasal pharynx, the auditory tube, and the vertebral column.
- *Laryngeal nodes:* lie in front of the larynx. They receive lymph from the larynx.

- *Tracheal (paratracheal) nodes:* lie alongside the trachea. They receive lymph from neighboring structures, including the thyroid gland.



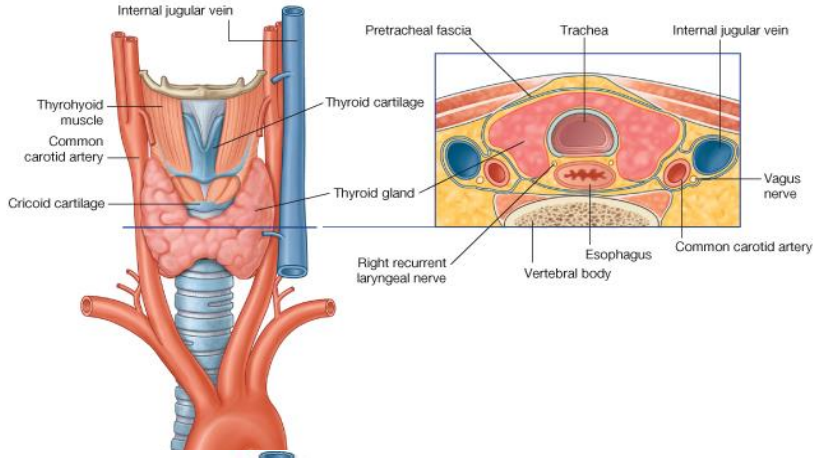
Deep cervical nodes

The deep cervical nodes form a vertical chain along the course of the internal jugular vein within the carotid sheath, they receive lymph from all the groups of regional nodes, the jugulodigastric node, which is located below and behind the angle of the jaw, is mainly concerned with drainage of the tonsil and the tongue. The jugulo-omohyoid node, which is situated close to the omohyoid muscle, is mainly associated with drainage of the tongue.

The efferent lymph vessels from the deep cervical lymph nodes join to form the jugular trunk, which drains into the thoracic duct or the right lymphatic duct.

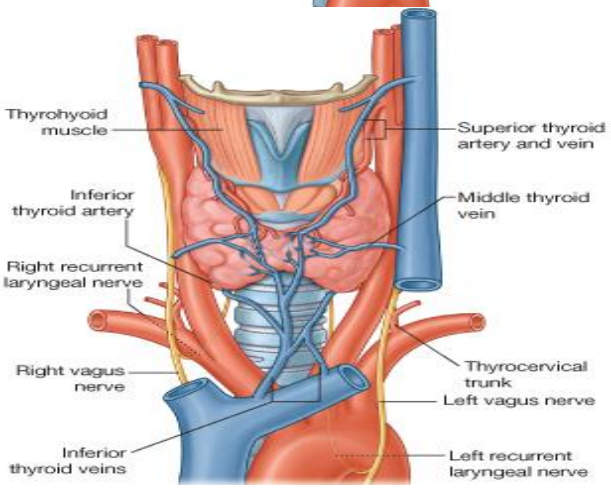
Thyroid & Parathyroid glands

The thyroid gland is anterior in the neck below and lateral to the thyroid cartilage ,it consists of two lateral lobes (which cover the anterolateral surfaces of the trachea, the cricoid cartilage, and the lower part of the thyroid cartilage) with *an isthmus* that connects the lateral lobes and crosses the anterior surfaces of the second and third tracheal cartilages.



Lying deep to the sternohyoid, sternothyroid, and omohyoid muscles, the thyroid gland is in the visceral compartment of the neck. This compartment also includes the pharynx, trachea, and esophagus and is surrounded by the pretracheal layers of fascia.

The thyroid gland arises as a median outgrowth from the floor of the pharynx near the base of the tongue. The foramen caecum of the tongue indicates the site of origin and the thyroglossal duct marks the path of migration of the thyroid gland to it`s final adult location. The thyroglossal duct usually disappears early in development, but remnants may persist as a cyst or as a connection to the foramen caecum (i.e. a fistula). Derived from the third (the inferior parathyroid glands) and fourth (the superior parathyroid glands) pharyngeal pouches, these paired structures migrate to their final adult position and are named accordingly.



Arterial supply

Two major arteries supply the thyroid gland.

Superior thyroid artery

The superior thyroid artery is the first branch of the external carotid artery, it descends to reach the superior pole of the lateral lobe of the gland where it divides into anterior and posterior glandular branches:

- the anterior glandular branch supplies along the superior border of the thyroid gland and anastomoses with it`s twin from the opposite side across the isthmus;
- the posterior glandular branch passes to the posterior side of the gland and may anastomose with the inferior thyroid artery

Inferior thyroid artery

The inferior thyroid artery is a branch of the thyrocervical trunk, which arises from the first part of the subclavian artery , it ascends to reach the inferior pole of the lateral lobe of the thyroid gland where it divides in to an:

- inferior branch, which supplies the lower part of the thyroid gland and anastomoses with the posterior branch of the superior thyroid artery;
- an ascending branch, which supplies the parathyroid glands.

Thyroid ima artery

Occasionally, a small thyroid ima artery arises from the brachiocephalic trunk or the arch of the aorta and ascends on the anterior surface of the trachea to supply the thyroid gland.

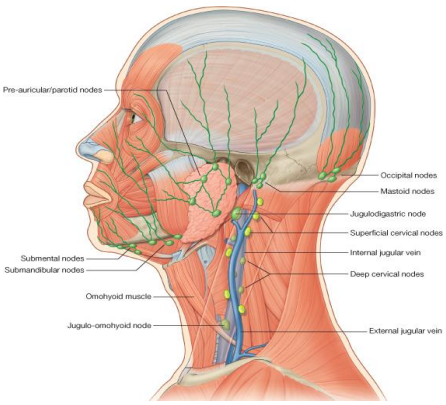
Venous and lymphatic drainage

Three veins drain the thyroid gland

- ✓ the superior thyroid vein primarily drains the area supplied by the superior thyroid artery;
- ✓ the middle and inferior thyroid veins drain the rest of the thyroid gland.

The superior and middle thyroid veins drain into the internal jugular vein and the inferior thyroid veins empty into the right and left brachiocephalic veins, respectively.

Lymphatic drainage of the thyroid gland is to nodes beside the trachea (paratracheal nodes) and to deep cervical nodes inferior to the omohyoid muscle along the internal jugular vein.



Innervation

The three cervical sympathetic ganglion provide autonomic innervation to the thyroid gland and it`s vasculature, the inferior ganglion also forms a plexus around the inferior thyroid artery, which also interacts with both the external and recurrent laryngeal nerves, which also provides parasympathetic innervation to the gland as well.

Recurrent laryngeal nerves

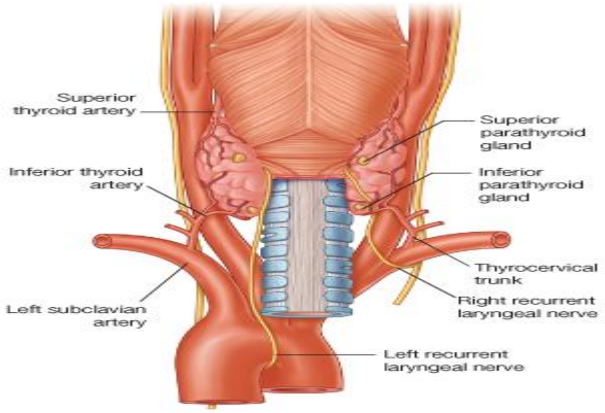
The thyroid gland is closely related to the recurrent laryngeal nerves, after branching from the vagus nerve [X] and looping around the subclavian artery on the right and the arch of the aorta on

the left, the recurrent laryngeal nerves ascend in a groove between the trachea and esophagus. They pass deep to the posteromedial surface of the lateral lobes of the thyroid and enter the larynx.

Parathyroid glands

The parathyroid glands are two pairs of small, ovoid, yellowish structures on the deep surface of the lateral lobes of the thyroid gland naming as the superior and inferior parathyroid glands. However, their position is quite variable.

The arteries supplying the parathyroid glands are the inferior thyroid arteries, and venous and lymphatic drainage follows that described for the thyroid gland.



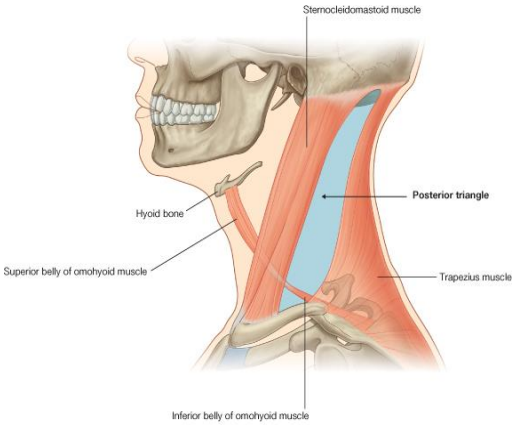
Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

Gross Anatomy
Head & Neck
Lec. : 13
Date: Sunday; 8th. Dec.

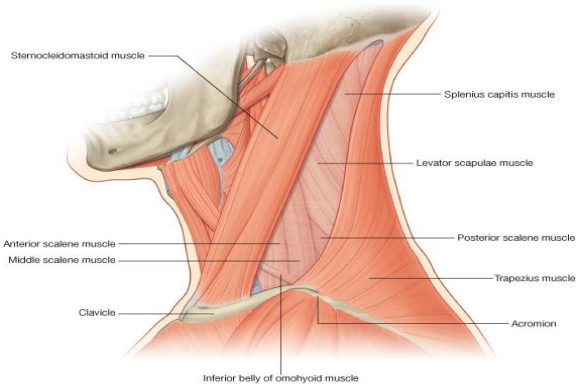
Head & Neck

The posterior triangle

The posterior triangle of the neck is on the lateral aspect of the neck in direct continuity with the upper limb, it is bordered:



- anteriorly by the posterior edge of the sternocleidomastoid muscle.
- posteriorly by the anterior edge of the trapezius muscle.
- It`s base is the middle one-third of the clavicle.
- It`s apex is the occipital bone just posterior to the mastoid process where the attachments of the trapezius and sternocleidomastoid come together.



The roof of the posterior triangle consists of an investing layer of cervical fascia that surrounds the sternocleidomastoid and trapezius muscles as it passes through the region.

The muscular floor of the posterior triangle is covered by the prevertebral layer of cervical fascia; and from superior to inferior consists of the splenius capitis, levator scapulae, and the posterior, middle, and anterior scalene muscles.

Muscles

Numerous muscles participate in forming the borders and floor of the posterior triangle of the neck.

In addition the omohyoid muscle passes across the inferior part of the posterior triangle before disappearing under the sternocleidomastoid muscle and emerging in the anterior triangle, it is enclosed in the investing layer of cervical fascia and crosses the posterior triangle from lateral to medial as it continues in a superior direction.

It originates on the superior border of the scapula, just medial to the scapular notch and eventually inserts into the inferior border of the body of the hyoid bone, it has two bellies connected by a tendon, which is anchored by a fascial sling to the clavicle:

- the superior belly is in the anterior triangle.
- *the inferior belly crosses the posterior triangle, subdividing it into a small, subclavian* triangle inferiorly and a much larger occipital triangle superiorly.*

The omohyoid is innervated by branches of the ansa cervicalis (anterior rami from C1 to C3) and it depresses the hyoid bone.

Nerves

A variety of nerves passes through or is within the posterior triangle, these include the accessory nerve [XI], branches of the cervical plexus, components forming the brachial plexus, and branches of the brachial plexus.

The subclavian triangle (or supraclavicular triangle, omoclavicular triangle, Ho's triangle), the smaller division of the posterior triangle, is bounded, above, by the inferior belly of the omohyoideus; below, by the clavicle; its base is formed by the posterior border of the sternocleidomastoideus.

Muscle	Origin	Insertion	Innervation	Function
Sternocleidomastoid				
Sternal head	Upper part of anterior surface of manubrium sterni	Lateral one-half of superior nuchal line	Accessory nerve [XI] and branches from anterior rami of C2 to C3 (C4)	Individually- tilt head to-wards shoulder on same side, rotating head to turn face to opposite side; acting together, draw head forwards
Clavicular head	Superior surface of medial one-third of clavicle	Lateral surface of mastoid process		
Splenius capitis	Lower half of ligamentum nuchae; spinous processes of vertebrae CVII to TIV	Mastoid process, skull below lateral one-third of superior nuchal line	Posterior rami middle cervical nerves	Together, draw head back-wards; individually, draw and rotate head to one side (turn face to same side)
Levator scapulae	Transverse processes of CI to C4	Upper part of medial border of scapula	C3,C4; and dorsal scapular nerve (C4, C5)	Elevates scapula
Posterior scalene	Posterior tubercles of transverse processes of vertebrae CIV to CVI	Upper surface of rib II	Anterior rami of C5 to C7	Elevation of rib II
Middle scalene	Transverse processes of vertebrae CII to CVII	Upper surface of rib I between tubercle and groove for subclavian artery	Anterior rami of C3 to C7	Elevation of rib I
Anterior scalene	Anterior tubercles of the transverse processes of vertebrae CIII to CVI	Scalene tubercle and upper surface of rib I	Anterior rami of C4 to C7	Elevation of rib I
Omohyoid	Superior border of the scapula, just medial to the scapular notch	Inferior border of the body of the hyoid bone	Superior and inferior roots of ansa cervicalis	Depresses the hyoid
Trapezius	Superior nuchal line, external occipital protuberance, ligamentum nuchae and spinous processes of vertebrae CVII to TXII	Lateral one-third of clavicle; acromion; spine of scapula	Motor-accessory nerve [XI]; proprioception-C3 and C4	Powerful elevator of the scapula, assists in rotating the scapula during abduction of humerus, middle horizontal fibers retract scapula,

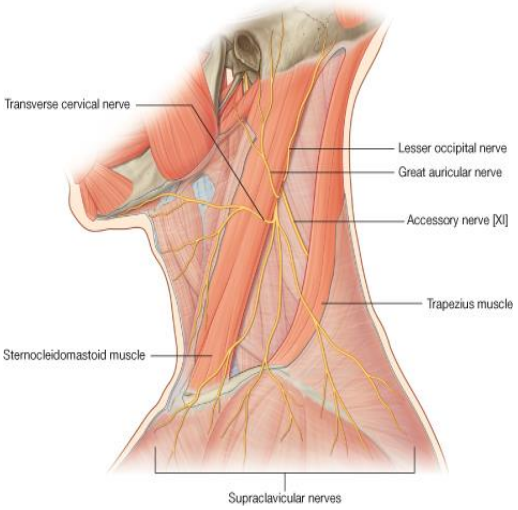
				lower fibers depress scapula.

Accessory nerve

The accessory nerve [XI] exits the cranial cavity through the jugular foramen, it descends through the neck in a posterior direction, to reach the superior border of the sternocleidomastoid muscle. passing either deep to or through and innervating it , the accessory nerve [XI] continues to descend and enters the posterior triangle.

It crosses the posterior triangle, still in an obliquely downward direction, within the investing layer of cervical fascia as this fascia crosses between the sternocleidomastoid and trapezius muscles.

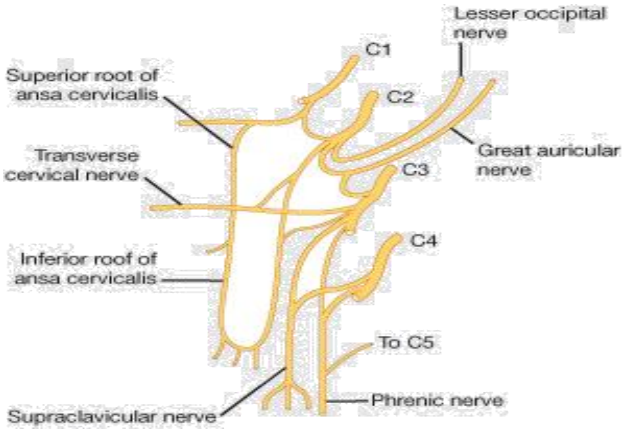
When the accessory nerve [XI] reaches the anterior border of the trapezius muscle, it continues on it`s deep surface and innervates it. The superficial location of the accessory nerve as it crosses the posterior triangle makes it susceptible to injury.



Cervical plexus

The cervical plexus is formed by the anterior rami of cervical nerves C2 to C4, and possibly a contribution from the anterior ramus of cervical nerve C1.

The cervical plexus forms in the substance of the muscles making up the floor of the posterior triangle within the prevertebral layer of cervical fascia, and consists of:



- muscular (or deep) branches.
- cutaneous (or superficial) branches, are visible in the posterior triangle emerging from beneath the posterior border of the sternocleidomastoid muscle.

Muscular branches

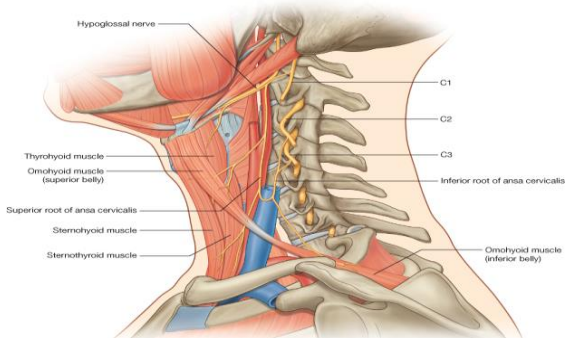
Muscular (deep) branches of the cervical plexus distribute to several groups of muscles, a major branch is the phrenic nerve, which supplies the diaphragm with both sensory and motor innervation. It arises from the anterior rami of the C3 to C5. Hooking around the upper lateral border of the anterior scalene muscle, the nerve continues inferiorly across the anterior surface of the anterior scalene within the prevertebral fascia to enter the thorax. As the nerve descends in the neck, it is 'pinned' to the anterior scalene muscle by the transverse and suprascapular arteries.

Several muscular branches of the cervical plexus supply prevertebral and lateral vertebral muscles, including the rectus capitis anterior, rectus capitis lateralis, longus colli, and longus capitis.

The cervical plexus also contributes to the formation of the superior and inferior roots of the ansa cervicalis, this loop of nerves receives contributions from the anterior rami of the cervical nerves C1 to C3 and innervates the infra hyoid muscles.

Cutaneous branches

Cutaneous (superficial) branches of the cervical plexus are visible in the posterior triangle as they pass outward from the posterior border of the sternocleidomastoid muscle.



- the lesser occip al nerve
- the great auricu r nerve
- the transverse c rvical nerve covered before
- the supraclavicular nerves

The peripheral nerves in these categories include the transverse cervical nerve "covered before" from the cervical plexus and the upper and lower roots of the ansa cervicalis.

Ansa cervicalis

The ansa cervicalis is a loop of nerve fibers from cervical nerves C1 to C3 that innervate the muscles in the anterior triangle of the neck, it begins as branches from the cervical nerve C1 join the hypoglossal nerve [XII] soon after it leaves the skull.

As the hypoglossal nerve [XII] completes it`s descent and begins to pass forward across the internal and external carotid arteries, some of the cervical nerve fibers leave it and descend between the internal jugular vein and the internal, and then common, carotid arteries. These nerve fibers are the **superior root** of the ansa cervicalis and innervate the superior belly of the omohyoid muscle, and the upper parts of the sternohyoid and sternothyroid muscles.

Completing the loop is a direct branch from the cervical plexus containing nerve fibers from the second and third cervical nerves C2 and C3, this is the **inferior root** of the ansa cervicalis, it descends either medial or lateral to the internal jugular vein before turning medially to join the superior root, at this location, the ansa cervicalis gives off branches that innervate the inferior belly of the omohyoid, and the lower parts of the sternohyoid and sternothyroid muscles.

Brachial plexus

The brachial plexus is an arrangement of nerve fibers, running from the spine, formed by the ventral rami of the lower cervical and upper thoracic nerve roots, (C5-T1), it proceeds through the neck, the axilla (armpit region) and into the arm.

- The roots: the five roots are the five anterior rami of the spinal nerves, after they have given off their segmental supply to the muscles of the neck.

- The trunks: the roots merge to form three trunks:
  - "superior" or "upper" (C5-C6)
  - "middle" (C7)
  - "inferior" or "lower" (C8-T1) , each trunk then splits in two parts forming six divisions:

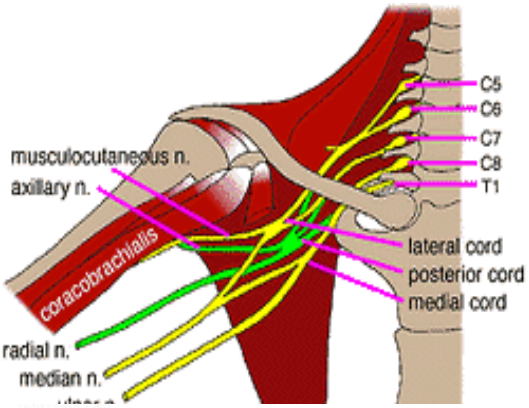
- The divisions:
  - anterior divisions of the upper, middle and lower trunks
  - posterior divisions of the upper, middle, and lower trunks.

- The cords: the six divisions will regroup to become three cords, the cords are named by their position in respect to the axillary artery.

- The *posterior cord* is formed from the three posterior divisions of the trunks (C5-T1)
- The *lateral cord* is the anterior divisions from the upper and middle trunks (C5-C7)
- The *medial cord* is simply a continuation of the anterior division of the lower trunk (C8-T1)

- **The branches**: the most branches are from the cords, the five "terminal branches" are; Musclocutaneous , Axillary, Radial , Ulnar and Median nerves, but few branches emerges directly from earlier structures , these branches can be remembered using the mnemonic LML ULNAR M4U respectively.

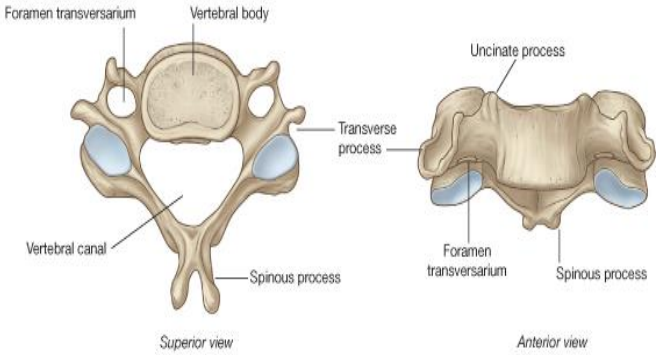
  - ✓ LML - lateral pectoral nerve , musculocutaneous nerve , lateral root of the median nerve.
  - ✓ ULNAR - upper subscapular nerve , lower subscapular nerve , nerve to latissmus dorsi (thoracodorsal nerve) , axillary nerve , radial nerve.
  - ✓ M4U - medial pectoral nerve , medial root of the median nerve , medial cutaneous nerve of the arm , medial cutaneous nerve of the forearm and ulnar nerve.



Bones of the neck

Cervical vertebrae

The seven cervical vertebrae are characterized by their small size and by the presence of a foramen in each transverse process, a typical cervical vertebra has the following features:



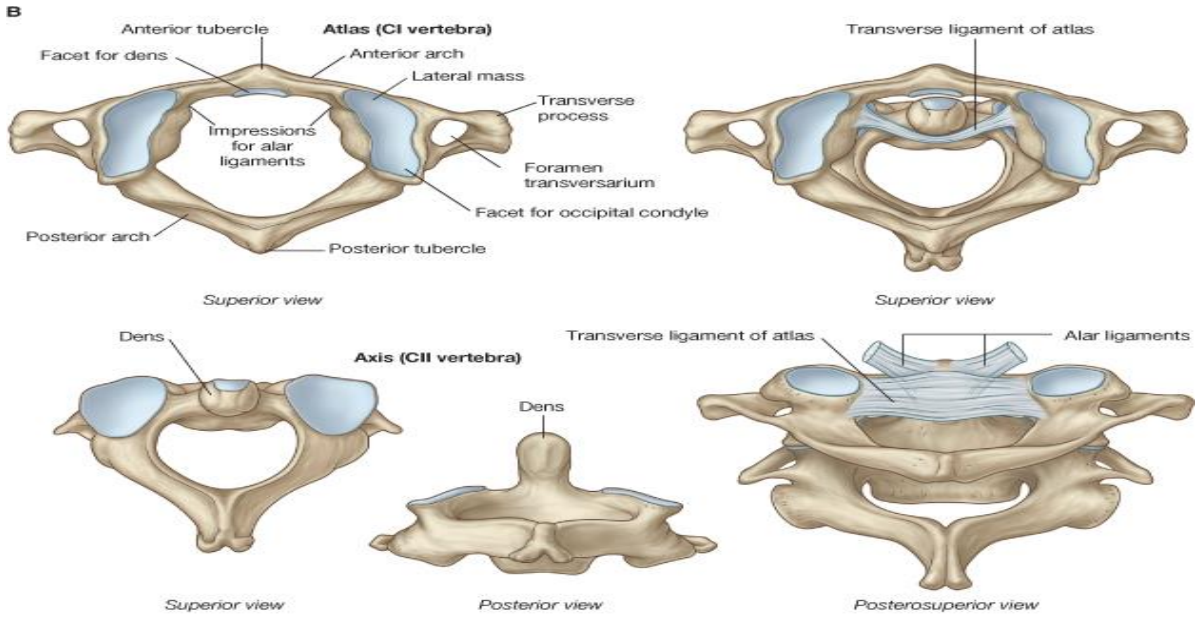
- the vertebral body is short in height and square shaped when viewed from above and has a concave superior surface and a convex inferior surface.
- each transverse process is trough-shaped and perforated by a round foramen transversarium.
- the spinous process is short and bifid.
- the vertebral foramen is triangular in shape.
- some cervical vertebrae that are unique. C1 and C2 (called the atlas and axis respectively), are specialized to allow for the movement of the head.
- C7 vertebrae have a much longer spinous process, which does not bifurcate.

Atlas and axis

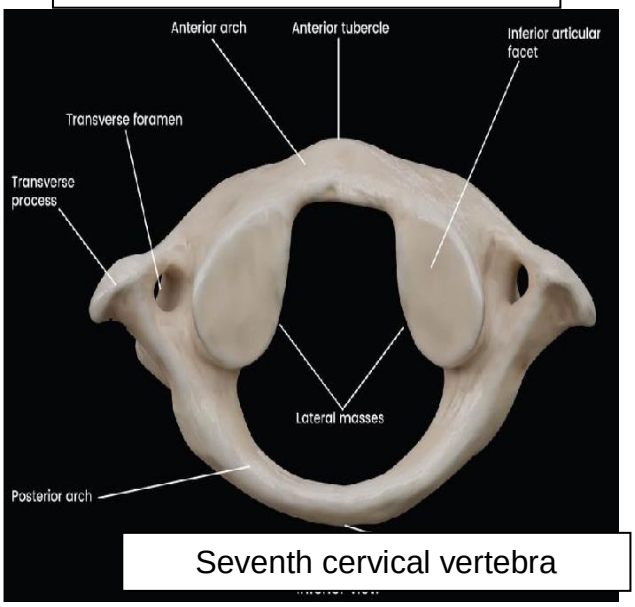
The first and second cervical vertebrae-the atlas and axis-are specialized to accommodate movement of the head, vertebra CI (the atlas) articulates with the head, it`s major distinguishing feature is that it lacks a vertebral body, when viewed from above, the atlas is ring-shaped and composed of two lateral masses interconnected by an anterior and a posterior arch, each lateral mass articulates above with an occipital condyle of the skull and below with the superior articular process of vertebra CII (the axis), the superior articular surfaces are bean shaped and concave, whereas the inferior articular surfaces are almost circular and flat.

The atlanto-occipital joint allows the head to nod up and down on the vertebral column, the posterior surface of the anterior arch has an articular facet for the dens, which projects superiorly from the vertebral body of the axis, the dens is held in position by a strong transverse ligament of atlas posterior to it, the dens acts as a pivot that allows the atlas and attached head to rotate on the axis, side to side.

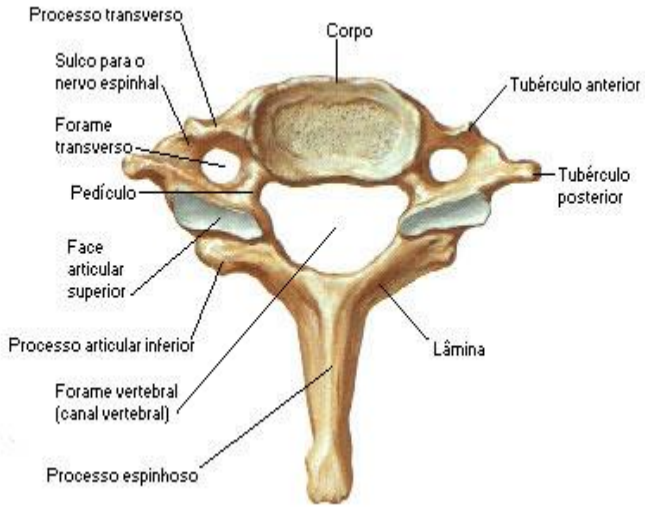
The transverse processes of the atlas are large and protrude further laterally than those of the other cervical vertebrae and act as levers for muscle action, particularly for muscles that move the head at the atlanto-axial joints, the axis is characterized by the large tooth-like dens, which extends superiorly from the vertebral body, the anterior surface of the dens has an oval facet for articulation with the anterior arch of the atlas, the two superolateral surfaces of the dens possess circular impressions that serve as attachment sites for strong alar ligaments, one on each side, which connect the dens to the medial surfaces of the occipital condyles, the alar ligaments check excessive rotation of the head and atlas relative to the axis.



Inferior view of atlas



Seventh cervical vertebra



Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

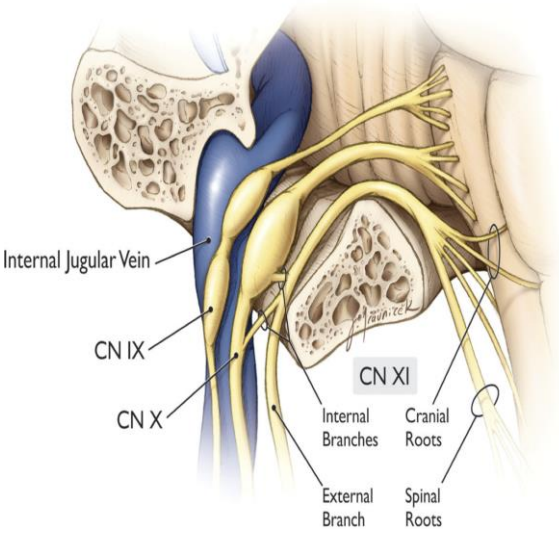
Gross Anatomy
Head & Neck
Lec. : 14
Date: Sunday; 26th. Feb.

Head & Neck

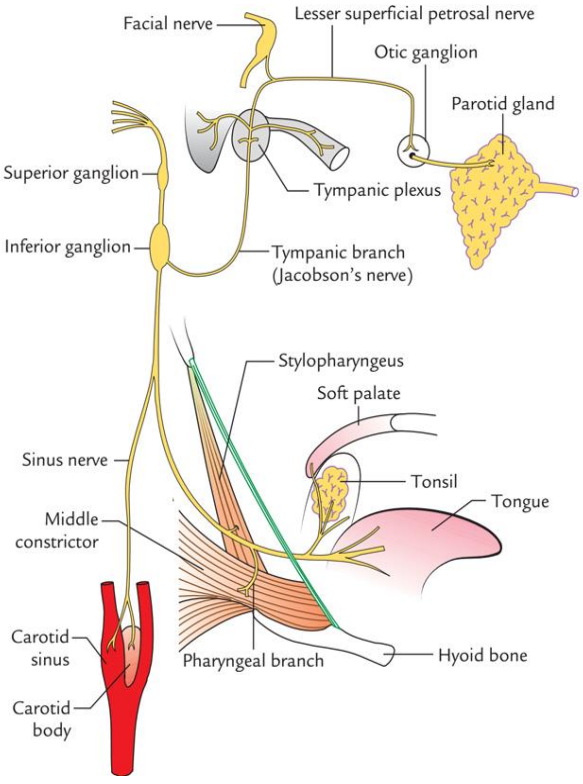
Nerves passing through the neck

Glossopharyngeal nerve

It is a mixed cranial nerve emerges from the anterior surface of the medulla oblongata passing laterally in the posterior cranial fossa and leaves the skull passing through the jugular foramen, the superior and inferior sensory ganglia are located on the nerve as it passes through the foramen, it then descends through the upper part of the neck to the back of the tongue. Important branches of the nerve are:



- *Tympanic branch* passes to the tympanic plexus in the middle ear.
- *Preganglionic parasympathetic fibers* for the parotid salivary gland leaving the plexus as the lesser petrosal nerve, and they synapse in the otic ganglion.
- *Carotid branch* contains sensory fibers from the carotid sinus (pressoreceptor mechanism for the regulation of blood pressure and the carotid body and chemoreceptor mechanism for the regulation of heart rate and respiration).



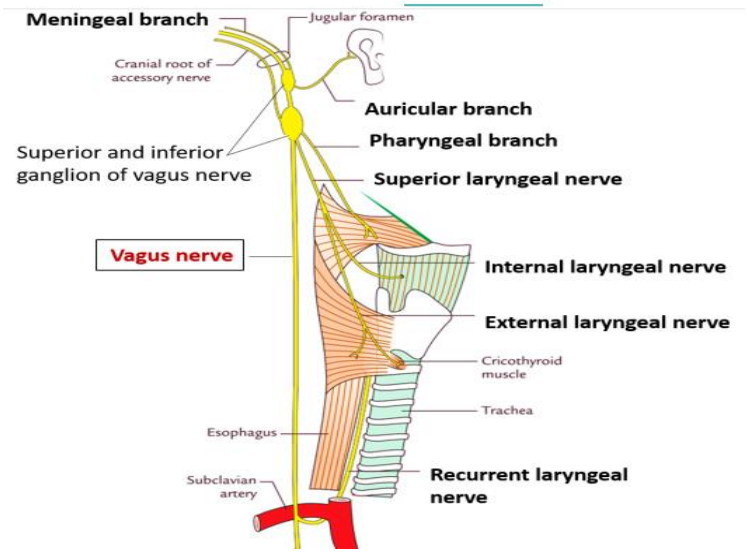
- *Nerve to the stylopharyngeus muscle*.
- *Pharyngeal branches* run to the pharyngeal plexus and also receive branches from the vagus nerve and the sympathetic trunk.
- *Lingual branch* passes to the mucous membrane of the posterior third of the tongue (including the vallate papillae).

The glossopharyngeal nerve thus assists swallowing and promotes salivation, also conducts sensation from the pharynx and the back of the tongue and carries impulses, which influence the arterial blood pressure and respiration, from the carotid sinus and carotid body.

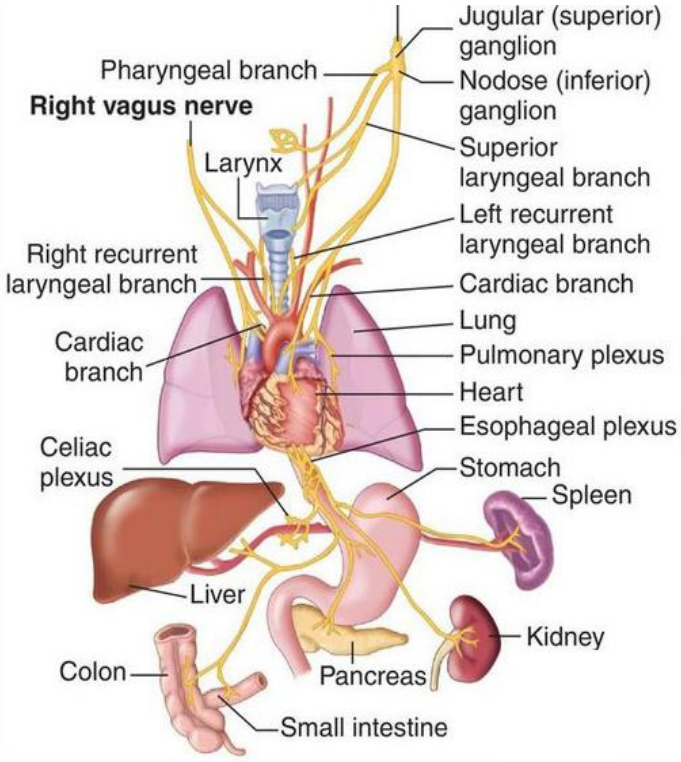
Vagus nerve

It is composed of motor and sensory fibers emerging from the anterior surface of the medulla oblongata passing laterally through the posterior cranial fossa and leaves the skull through the jugular foramen, the nerve has both superior and inferior sensory ganglia, below the inferior ganglion, the cranial root of the accessory nerve joins the vagus nerve and is distributed mainly in it`s pharyngeal and recurrent laryngeal branches.

The vagus nerve descends through the neck alongside the carotid arteries and internal jugular vein within the carotid sheath, it passes through the mediastinum of the thorax behind the root of the lung, and enters the abdomen through the esophageal opening in the diaphragm. Important branches of the nerve in the neck are:



- *Meningeal and auricular branches.*
- *Pharyngeal branch* contains nerve fibers from the cranial part of the accessory nerve, this branch joins the pharyngeal plexus and supplies all the muscles of the pharynx (except the stylopharyngeus) and of the soft palate (except the tensor veli palatini).
- *Superior laryngeal nerve* divides into the internal and the external laryngeal nerves, the internal laryngeal nerve is sensory to the mucous membrane of the piriform fossa and the larynx down as far as the vocal cords , while the external one is motor and is located close to the superior thyroid artery; it supplies the cricothyroid muscle.
- *Recurrent laryngeal nerve* (covered before)
- *Cardiac branches* (two or three) arise in the neck, descend into the thorax, and end in the cardiac plexus.



The vagus nerve thus innervates the heart and great vessels within the thorax, the larynx, trachea, bronchi, and lungs; and much of the alimentary tract from the pharynx to the splenic flexure of the colon, it also supplies glands associated with the alimentary tract, such as the liver and pancreas, the vagus nerve has the most extensive distribution of all the cranial nerves and supplies the aforementioned structures with afferent and efferent fibers.

Accessory nerve

Is a motor nerve consists of a cranial and a spinal roots (parts)

Cranial root

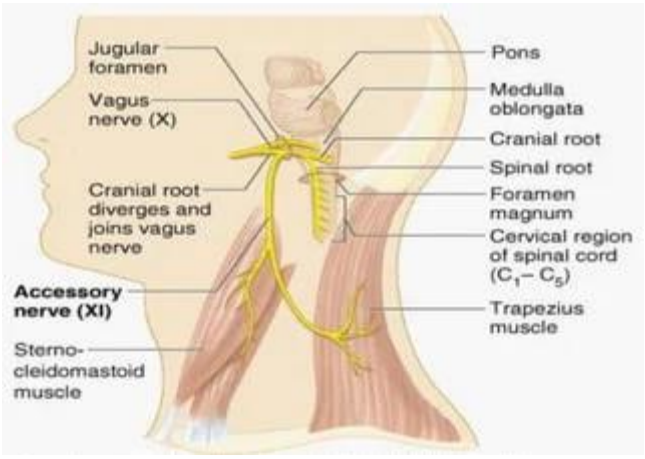
Emerges from the anterior surface of the medulla oblongata running laterally in the posterior cranial fossa and joins the spinal root.

Spinal root

Arises from nerve cells in the anterior gray column (horn) of the *upper five segments* of the cervical part of the spinal cord , ascending alongside the spinal cord and enters the skull through the foramen magnum, then turns laterally to join the cranial root.

The two roots unite and leave the skull through the jugular foramen , then separate: the cranial root joins the vagus nerves and is distributed in it`s branches to the muscles of the soft palate and

pharynx (via the pharyngeal plexus) and to the muscles of the larynx (except the cricothyroid muscle).

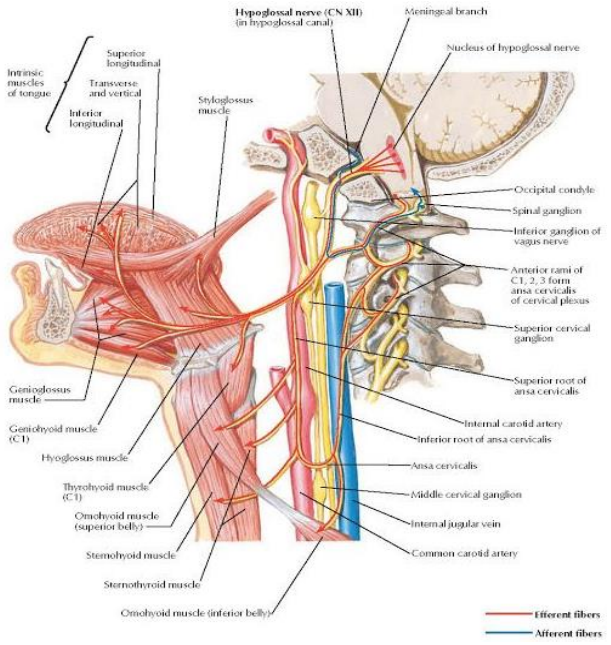


The spinal root runs downward and laterally and enters the deep surface of the sternocleidomastoid muscle, which it supplies, and then crosses the posterior triangle of the neck to supply the trapezius muscle.

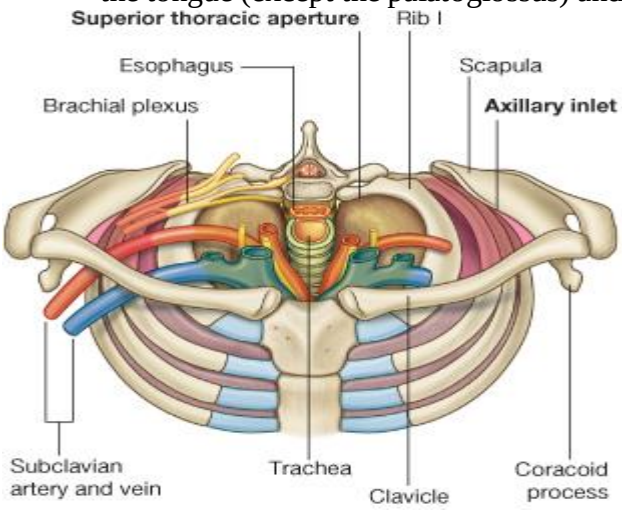
The accessory nerve thus brings about movements of the soft palate, pharynx, and larynx and controls the movements of the sternocleidomastoid and trapezius muscles, two large muscles in the neck.

Hypoglossal nerve

Is a motor nerve emerging on the anterior surface of the medulla oblongata , crosses the posterior cranial fossa, and leaves the skull through the hypoglossal canal, the nerve then passes downward and forward in the neck and crosses the internal and external carotid arteries to reach the tongue. In the upper part of it`s course, it is joined by C1 fibers from the cervical plexus, important branches of the hypoglossal nerve



- *Meningeal branch*
- *Descending branch (C1 fibers)* passes downward and joins the descending cervical nerve (C2 and 3) to form the ansa cervicalis, branches from this loop supply the omohyoid, the sternohyoid, and the sternothyroid muscles.
- *Nerve to the thyrohyoid muscle (C1).*
- *Muscular branches* to all the muscles of the tongue except the palatoglossus (pharyngeal plexus).
- *Nerve to the geniohyoid muscle (C1)*. The hypoglossal nerve thus innervates the muscles of the tongue (except the palatoglossus) and therefore controls the shape and movements of the tongue.

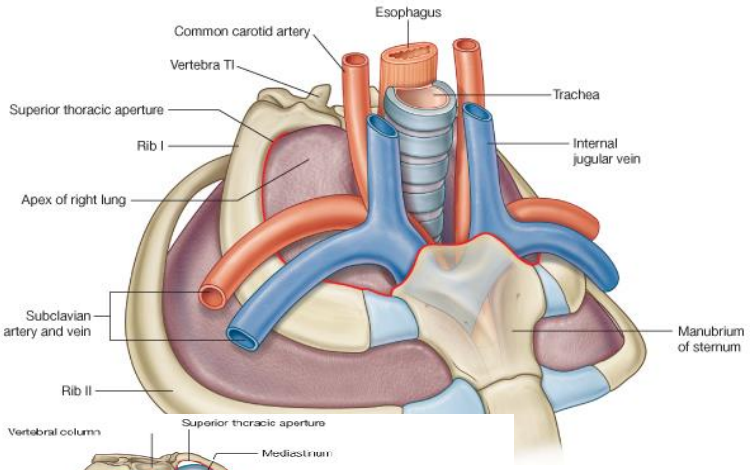


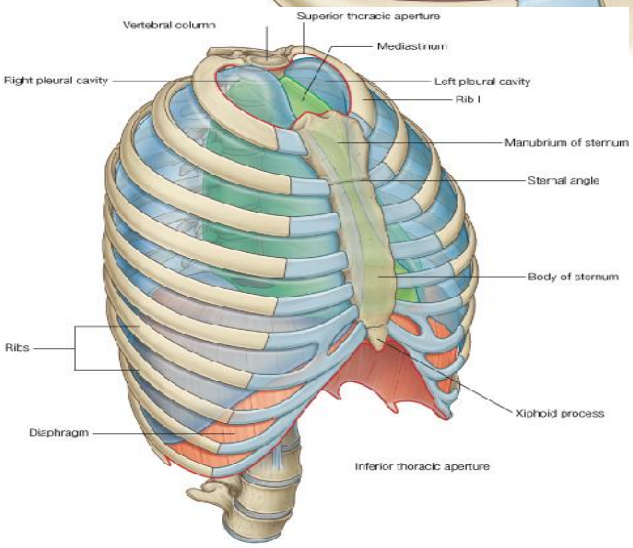
Root of the neck

The root of the neck is the area immediately superior to the superior thoracic aperture "inlet into the thorax and axillary inlets", it is bounded by:

- the top of the manubrium of sternum and superior margin of the clavicle anteriorly.
- the top of the thoracic vertebra TI and the superior margin of the scapula to the coracoid process posteriorly.

It contains structures passing between the neck, thorax, and upper limb, there is also an extension of the thoracic cavity projecting into the root of the neck, consists of an upward projection of the





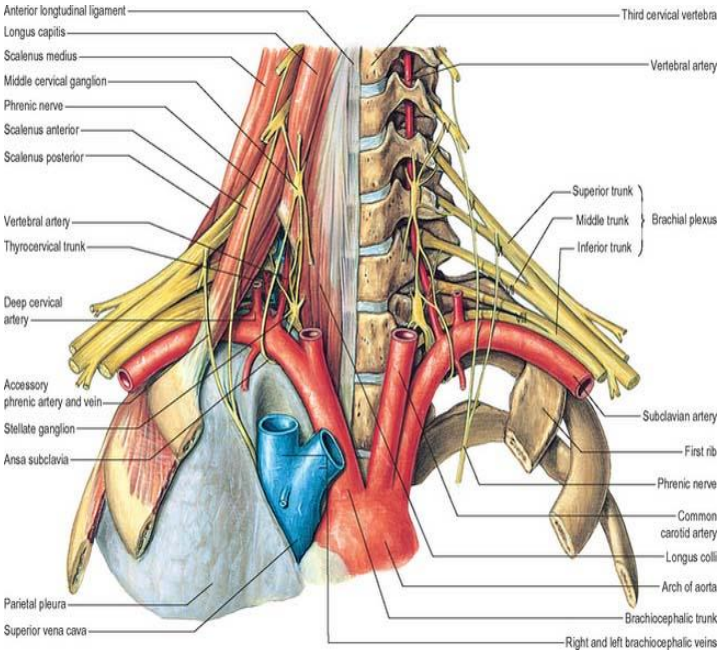
pleural cavity on both sides including the cervical part of the parietal pleura (cupula) and the apical part of the superior lobe of each lung.

Anteriorly, the pleural cavity extends above the top of the manubrium of sternum and superior border of rib I, while posteriorly, due to the downward slope of the superior thoracic aperture the pleural cavity remains below the top of the vertebra TI.

Muscles of the root of the neck

Scalenus anterior

This muscle is deeply placed and descends almost vertically from the vertebral column to the first rib. It arises from the anterior tubercles of the transverse processes of the third, fourth, fifth, and sixth cervical vertebrae, and descending, almost vertically, is inserted by a narrow, flat tendon into the scalene tubercle on the inner border of the first rib, and into the ridge on the upper surface of the second rib in front of the subclavian groove. It arises from the anterior tubercles of the transverse processes of the third, fourth, fifth, and sixth cervical vertebrae, and descending, almost vertically, is inserted by a narrow, flat tendon into the scalene tubercle on the inner border of the first rib, and into the ridge on the upper surface of the second rib in front of the subclavian groove.



- *anteriorly* related to the carotid arteries, the vagus nerve, the internal jugular vein, and the deep cervical lymph nodes, the transverse cervical, the suprascapular arteries. The prevertebral layer of deep cervical fascia bind the phrenic nerve to the muscle.
- *posteriorly* related to the pleura, the origin of the brachial plexus, and the second part of the subclavian artery , scalenus medius muscle lies behind the scalenus anterior muscle.
- *medially* related to the vertebral artery and vein and the sympathetic trunk , on the left side, the medial border is related to the thoracic duct.
- *laterally* related to the emerging branches of the cervical plexus, the roots of the brachial plexus, and the third part of the subclavian artery.

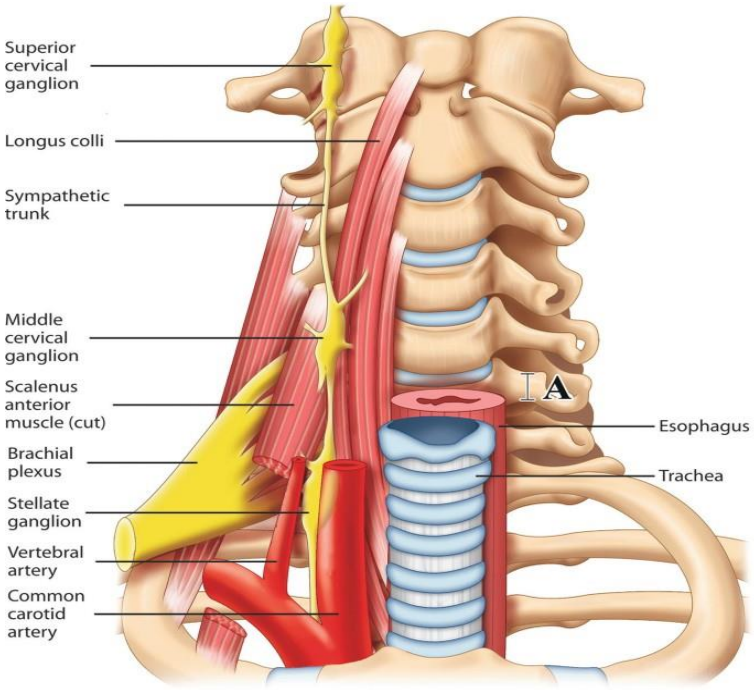
Scalenus medius lies behind the scalenus anterior and extends from the transverse process of the atlas and the transverse processes of the next five cervical vertebrae downward and laterally to be inserted into the upper surface of the first rib behind the groove for the subclavian artery, it lies behind the roots of the brachial plexus and the subclavian artery.

Autonomic nervous system in the head and neck

Sympathetic part

Cervical part of the sympathetic trunk

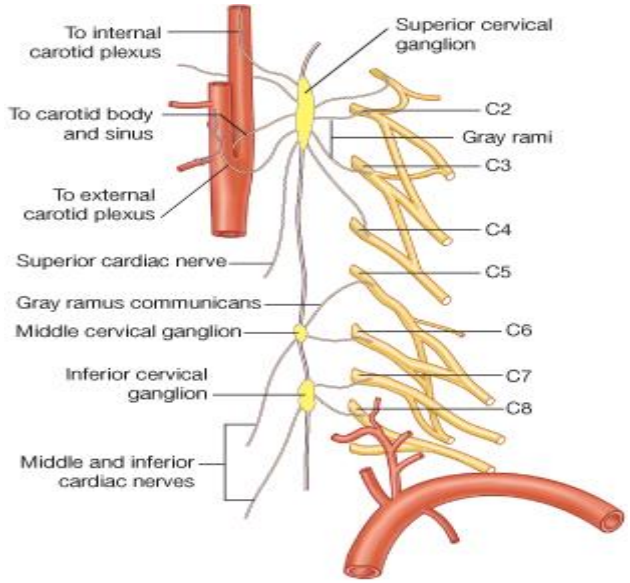
The cervical part of the sympathetic trunk extends upward to the base of the skull and below to the neck of the first rib, where it becomes continuous with the thoracic part of the sympathetic trunk, lying directly behind the internal and common carotid arteries (i.e., medial to the vagus) and is embedded in deep fascia between the carotid sheath and the prevertebral layer of deep fascia, it possesses three ganglia: the superior, middle, and inferior cervical ganglia.



Superior cervical ganglion

It lies immediately below the skull, branches are:

- *The nerve to internal carotid artery*, consisting of postganglionic fibers, accompanies the internal carotid artery into the carotid canal in the temporal bone, dividing into branches around the artery to form the internal carotid plexus.



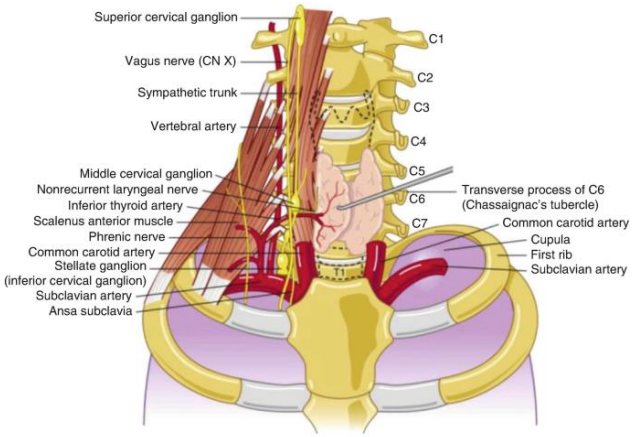
- *Gray rami communicantes* to the upper four anterior rami of the cervical nerves.
- *Arterial branches to the common and external carotid arteries*, these branches form a plexus around the arteries and are distributed along the branches of the external carotid artery.
- *Cranial nerve branches*, which join the 9th, 10th, and 12th cranial nerves.
- *Pharyngeal branches*, which unite with the pharyngeal branches of the glossopharyngeal and vagus nerves to form the pharyngeal plexus
- *Superior cardiac branch*, which descends in the neck and ends in the cardiac plexus in the thorax.

Middle cervical ganglion

Lying at the level of the cricoid cartilage, branches of this ganglion are:

- Gray rami communicantes to the anterior rami of the fifth and sixth cervical nerves.
- Thyroid branches, which pass along the inferior thyroid artery to the thyroid gland.

- The middle cardiac branch, which descends in the neck and ends in the cardiac plexus in the thorax.

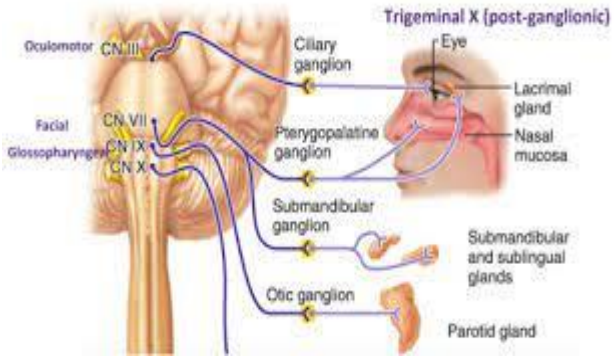


Inferior cervical ganglion

In most people; this ganglion is fused with the first thoracic ganglion to form the stellate ganglion, it lies in the interval between the transverse process of the seventh cervical vertebra and the neck of the first rib, behind the vertebral artery , branches of this ganglion are:

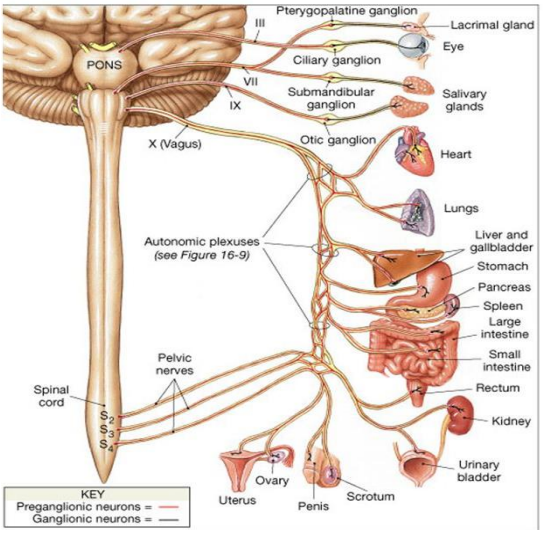
- Gray rami communicantes to the anterior rami of the seventh and eighth cervical nerves.
- Arterial branches to the subclavian and vertebral arteries.
- The inferior cardiac branch, which descends to join the cardiac plexus in the thorax.

The part of the sympathetic trunk connecting the middle cervical ganglion to the inferior or stellate ganglion is represented by two or more nerve bundles. The most anterior bundle crosses in front of the first part of the subclavian artery and then turns upward behind it, this bundle is referred to as the ansa subclavia.



Parasympathetic part

The cranial portion of the craniosacral outflow of the parasympathetic part of the autonomic nervous system is located in the nuclei of the oculomotor (3rd), facial (7th), glossopharyngeal (9th), and vagus (10th) cranial nerves.



Parasympathetic
(Craniosacral outflow)

"REST AND DIGEST"

Salivation
Lacrimation
Urination
Digestion
Defecation

3 decreases
- **Heart rate**
- **Airway diameter**
- **Pupil size (constrict)**

The parasympathetic nucleus of the oculomotor nerve is called the Edinger-Westphal nucleus; those of the facial nerve the lacrimatory and the superior salivary nuclei; that of the glossopharyngeal nerve the inferior salivary nucleus; and that of the vagus nerve the dorsal nucleus of the vagus.

The axons of these connector nerve cells are myelinated preganglionic fibers that emerge from the brain within the cranial nerves. The preganglionic fibers synapse in peripheral ganglia located close to the viscera they innervate.

The cranial parasympathetic ganglia are the ciliary, the pterygopalatine, the submandibular, and the otic, in certain locations, the ganglion cells are placed in nerve plexuses, such as the cardiac plexus, the pulmonary plexus, the myenteric plexus (Auerbach's plexus), and the mucosal plexus (Meissner's plexus), the last two plexuses are found in the gastrointestinal tract. The postganglionic fibers are nonmyelinated, and they are short in length.

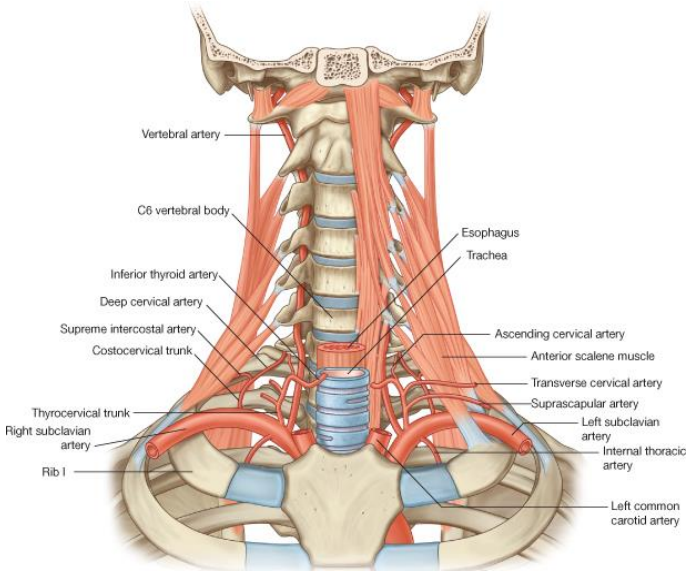
Vessels

Subclavian arteries

Right subclavian artery arises from the brachiocephalic artery, behind the right sternoclavicular joint arching upward and laterally over the pleura and between the scalenus anterior and medius muscles, at the outer border of the first rib, it becomes the axillary artery.

Left subclavian artery arises from the arch of the aorta in the thorax, ascending to the root of the neck and then arches laterally in a manner similar to that of the right subclavian artery.

The arteries on both sides arch upwards out of the thorax to enter the root of the neck, both subclavian arteries are divided into three parts by the anterior scalene muscle that passes anterior to the artery on each side and divides it into three parts.



The first part of the subclavian artery extends from the origin of the subclavian artery to the medial border of the scalenus anterior muscle, this part gives off the vertebral artery, the thyrocervical trunk, and the internal thoracic artery, branches of this part are:

Vertebral artery

The vertebral artery is the first branch of the subclavian artery as it enters the root of the neck, medial to the anterior scalene muscle; it ascends and enters the foramen in the transverse process of vertebra CVI, continuing to pass superiorly through the foramina of vertebrae CV to CI, at the superior border of vertebra CI, the artery turns medially to pass through the foramen magnum and enter the posterior cranial fossa.

Thyrocervical trunk

The second branch of the subclavian artery is the thyrocervical trunk, it arises from the first part of the subclavian artery medial to the anterior scalene muscle

The inferior thyroid artery ascends to the posterior surface of the thyroid gland, where it is closely related to the recurrent laryngeal nerve, it supplies the thyroid and the inferior parathyroid glands.

The superficial cervical artery is a small branch that crosses the brachial plexus.

The suprascapular artery runs laterally over the brachial plexus and follows the suprascapular nerve onto the back of the scapula.

Internal thoracic artery

This artery branches from the inferior edge of the subclavian artery and descends, it passes posterior to the clavicle and the large veins in the region and anterior to the pleural cavity, it enters the thoracic cavity posterior to the ribs and anterior to the transverse thoracic muscle and continues to descend giving off numerous branches, it descends vertically one fingerbreadth lateral to the sternum; in the sixth intercostal space, it divides into the superior epigastric and the musculophrenic arteries.

Second part of the subclavian artery lies behind the scalenus anterior muscle, branches of this part are:

The costocervical trunk

The final branch of the subclavian artery in the root of the neck is the costocervical trunk, it arises in a slightly different position, depending on the side:

- on the left, it arises from the first part of the subclavian artery, just medial to the anterior scalene muscle.
- on the right, it arises from the second part of the subclavian artery.

Eventually it divides into two branches; the deep cervical and the supreme intercostal arteries:

- the deep cervical artery ascends in the back of the neck and anastomoses with the descending branch of the occipital artery.
- the supreme intercostal artery descends anterior to rib I and divides to form the posterior intercostal arteries for the first two intercostal spaces.

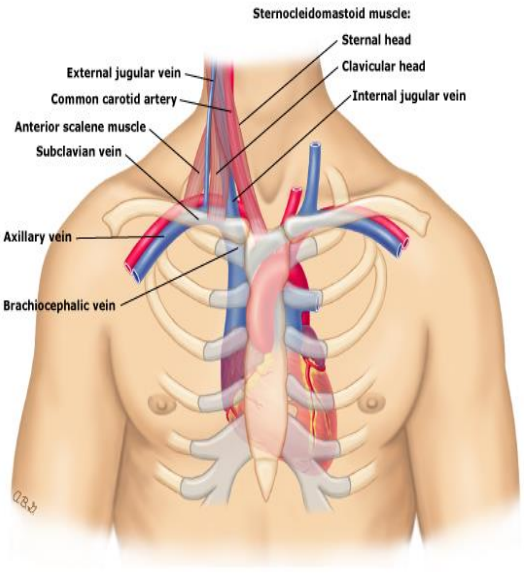
Third part of the subclavian artery extends from the lateral border of the scalenus anterior muscle across the posterior triangle of the neck to the lateral border of the first rib, where it becomes the axillary artery, here, in the root of the neck, it is closely related to the nerves of the brachial plexus. The third part of the subclavian artery usually has no branches, occasionally, however, the superficial cervical arteries, the suprascapular arteries, or both arise from this part.

Veins

Numerous veins pass through the root of the neck, small veins accompany each of the arteries described above, and large veins form major drainage channels.

The subclavian veins begin at the lateral margin of rib I as continuations of the axillary veins, passing medially on each side, just anterior to the anterior scalene muscles, each subclavian vein is joined by the internal jugular vein to form the brachiocephalic veins.

The only tributary to the subclavian veins are the external jugular veins, subclavian veins accompanying the numerous arteries in this region empty into other veins. In addition, it often receives the thoracic duct on the left side and the right lymphatic duct on the right.



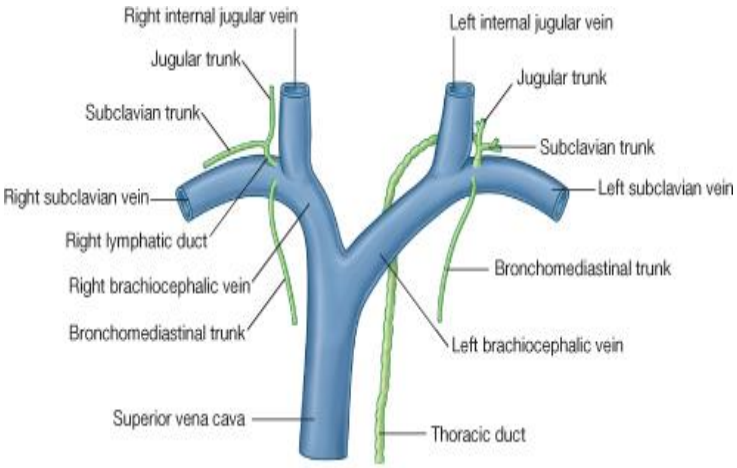
Lymphatic
Thoracic duct

The thoracic duct is a major lymphatic channel that begins in the abdomen, passes superiorly through the thorax, and ends in the venous channels in the neck, it passes through the lower thoracic cavity in the midline with:

- ✓ the thoracic aorta on the left.
- ✓ the azygos vein on the right.
- ✓ the esophagus anteriorly

At about the level of thoracic vertebra TV the thoracic duct passes to the left and continues ascending just to the left of the esophagus and enters the root of the neck and terminates in the

junction between the left internal jugular and the left subclavian veins, near it`s junction with the venous system it is joined by:



- the left jugular trunk, which drains lymph from the left side of the head and neck;
- the left subclavian trunk, which drains lymph from the left upper limb.
- occasionally, the left bronchomediastinal trunk, which drains lymph from the left half of the thoracic structures.

There is variability in how these trunks enter the veins. They may combine into a single right lymphatic duct to enter the venous system or enter as three separate trunks.

Lymphatics of the neck
Superficial & deep lymph nodes (covered before)
Lymphatic trunks and ducts

Lymphatic vessel	Area drained
Right jugular trunk	Right side of head and neck
Left jugular trunk	Left side of head and neck
Right subclavian trunk	Right upper limb, superficial regions of thoracic and upper abdominal wall
Left subclavian trunk	Left upper limb, superficial regions of thoracic and upper abdominal wall
Right bronchomediastinal trunk	Right lung and bronchi, mediastinal structures, thoracic wall
Left bronchomediastinal trunk	Left lung and bronchi, mediastinal structures, thoracic wall
Thoracic duct	Lower limbs, abdominal walls and viscera, pelvic walls and viscera, thoracic wall

All lymphatic vessels coalesce to form larger trunks or ducts, which drain into the venous system at sites in the neck where the internal jugular veins join the subclavian veins to form the brachiocephalic veins**:**

- lymph from the right side of the head and neck, the right upper limb, right side of the thorax, and right side of the upper and more superficial region of the abdominal wall is carried by lymphatic vessels that connect with veins on the right side of the neck
- lymph from all other regions of the body is carried by lymphatic vessels that drain into veins on the left side of the neck
- Lymphatic drainage from all structures and regions of the body below the diaphragm converges on collections of lymph nodes and vessels associated with the major vessels of the posterior abdominal region. Lymph from the lower limb and perineum passes upward to the collection of nodes and vessels associated with the external iliac artery and vein. It continues its upward journey to lymph nodes and vessels around the common iliac artery and vein. At this point, it is joined by lymph from

the pelvic cavity that has passed through nodes and vessels associated with the internal iliac artery and vein

- Approaching the aortic bifurcation, the collections of lymphatics associated with the two common iliac arteries and veins merge, and multiple groups of lymphatic vessels and nodes associated with the abdominal aorta and inferior vena cava pass superiorly. These collections may be subdivided into **pre-aortic nodes,** which are anterior to the abdominal aorta, and **right** and **left lateral aortic** or **lumbar nodes**, which are positioned on either side of the abdominal aorta
- As these collections of lymphatics pass through the posterior abdominal region, they continue to collect lymph from a variety of structures. The lateral aortic or lumbar lymph nodes receive lymphatics from the body wall, the kidneys, the suprarenal glands, and the testes or ovaries
- The pre-aortic nodes are organized around the three anterior branches of the abdominal aorta that supply the abdominal part of the gastrointestinal tract, as well as the spleen, pancreas, gallbladder, and liver. They are divided into celiac, superior mesenteric, and inferior mesenteric nodes, and receive lymph from the organs supplied by the similarly named arteries
- Finally, the lateral aortic or lumbar nodes form the right and left lumbar trunks, while the pre-aortic nodes form the intestinal trunk .These trunks come together and form a confluence that, at times, appears as a saccular dilation (the cisterna chyli). This confluence of lymph trunks is posterior to the right side of the abdominal aorta and anterior to the bodies of vertebrae LI and LII. It marks the beginning of the thoracic duct.

Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 2

Gross Anatomy
Head & Neck
Lec. : 15
Date: Sunday; 5th. Mar. 2023

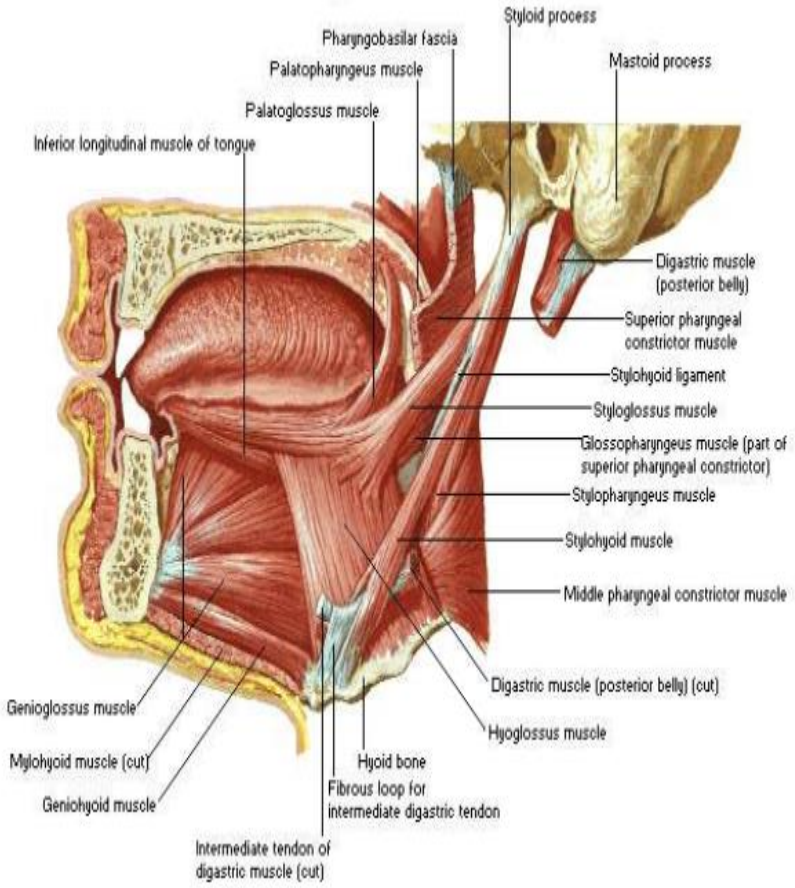
Head & Neck

Submandibular region

It`s the region lying under the body of the mandible , extending between mylohyoid lines above and hyoid bone below.

Contents

- *Muscles:* suprahyoid muscles and extrinsic muscles of the tongue.
- *Salivary glands:* submandibular and sublingual.
- *Arteries:* facial and lingual.
- *Nerves:* lingual, hypoglossal and glossopharyngeal.
- *Ganglions:* submandibular



Muscles of the submandibular region

Suprahyoid muscles

The four suprahyoid muscles are in the submental and submandibular triangles, pass in a superior direction from the hyoid bone to the mandible or the skull and raise the hyoid, as occurs during swallowing.

Stylohyoid muscle arises from the base of the styloid process and passes anteroinferiorly to attach to the lateral area of the body of the hyoid bone, during swallowing it pulls the hyoid bone posterosuperiorly, it is innervated by the facial nerve [VII].

Digastric muscle has two bellies connected by a tendon, which attaches to the body of the hyoid bone

- the *posterior belly* arises from the mastoid notch on the medial side of the mastoid process of the temporal bone.
- the *anterior belly* arises from the digastric fossa on the lower inside of the mandible.

The tendon between the two bellies, which is attached to the body of the hyoid bone, is the point of insertion of both bellies, because of this arrangement, the muscle has multiple actions depending on which bone is fixed, when the mandible is fixed the digastric muscle raises the hyoid bone and when the hyoid bone is fixed the digastric muscle opens the mouth by lowering the mandible.

Innervation of the digastric muscle is from two different cranial nerves, the posterior belly of the digastric muscle is innervated by the facial nerve [VII] whereas the anterior belly of the muscle is innervated by the trigeminal nerve [V].

Mylohyoid muscle is superior to the anterior belly of the digastric and, with it`s partner from the opposite side, forms the floor of the mouth , it originates from the mylohyoid line on the mandible and inserts into the hyoid bone and also blends with the mylohyoid muscle from the opposite side **,**it supports and elevates the floor of the mouth and elevates the hyoid bone. It is innervated by the trigeminal nerve [V]**.**

Geniohyoid is the final muscle in the suprahyoid group , it is a narrow muscle, it is superior to the medial part of each mylohyoid muscle, the muscles from each side are next to each other in the midline, it arises from the inferior mental spine of the mandible and passes backward and downward to insert on the body of the hyoid bone. It has two functions depending on which bone is fixed:

- fixation of the mandible elevates and pulls the hyoid bone forward.
- fixation of the hyoid bone pulls the mandible downward and inward. It is innervated by a branch from the anterior ramus of C1 carried along the hypoglossal nerve [XII].

Muscle	Origin	Insertion	Innervation	Function
Stylohyoid	Base of styloid process	Lateral area of body of hyoid bone	Facial nerve [VII]	Pulls hyoid bone upward in a posterosuperior direction
Digastric -Anterior belly	Digastric fossa on lower inside of mandible	Attachment of tendon between two bellies to body of hyoid bone	Mylohyoid nerve from inferior alveolar branch of mandibular nerve [V_3]	Opens mouth by lowering mandible; raises hyoid bone
-Posterior belly	Mastoid notch on medial side of mastoid process of temporal bone		Facial nerve [VII]	
Mylohyoid	Mylohyoid line on mandible	Body of hyoid bone and fibers from muscle on opposite side	Mylohyoid nerve from inferior alveolar branch of mandibular nerve [V_3]	Support and elevation of floor of mouth; elevation of hyoid
Geniohyoid	Inferior mental spine on inner surface of mandible	Anterior surface of body of hyoid bone	Branch from anterior ramus of C1 (carried along the hypoglossal nerve [XII])	Fixed mandible elevates and pulls hyoid bone forward; fixed hyoid bone pulls mandible downward and in-ward

Extrinsic muscles of the tongue

Each one of these muscles connects the tongue with one of the neighboring structures; they are the genioglossus "mandible", the hyoglossus "hyoid bone", the styloglossus " styloid process", .(covered before) and a part of superior constrictor of pharynx , (should be cover later). Key muscle is the hyoglossus.

Submandibular gland

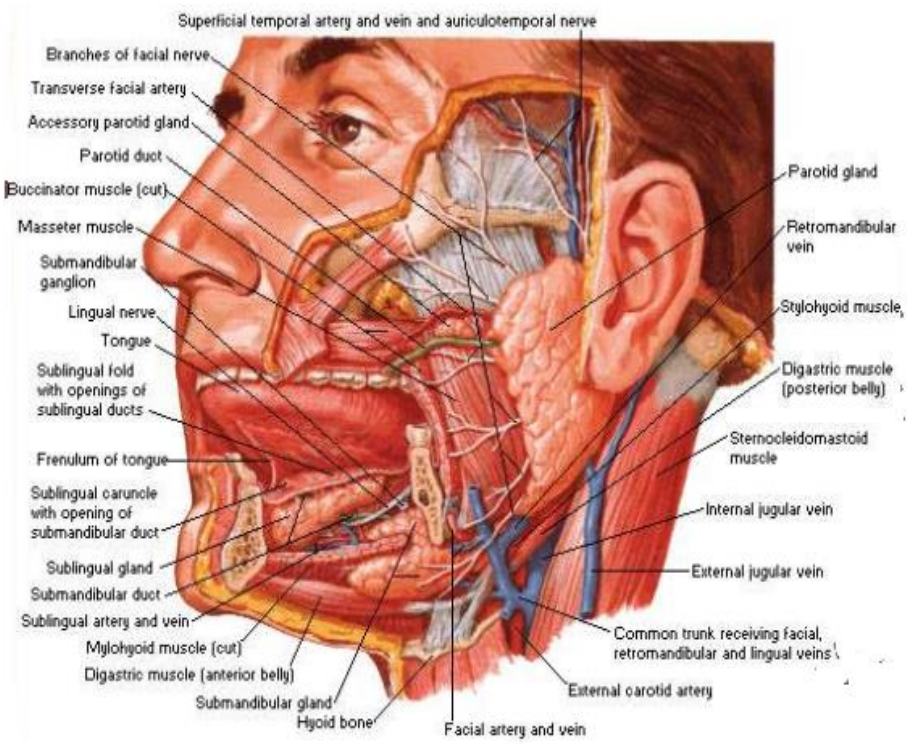
The submandibular gland is about the size of a walnut consisting of a mixture of serous and mucous acini, it lies beneath the lower border of the body of the mandible and is divided into a

large superficial and a small deep parts, the two parts are continues with each other around the posterior border of the mylohyoid muscle.

The superficial part presenting two ends; anterior and posterior and three surfaces ; inferior , lateral and medial. The anterior end extends up to the anterior belly of digastric muscle while the posterior end extends up to stylomandibular ligament which separates the submandibular gland from parotid gland, it presents a groove for the ascending limb of the facial artery.

Relations of the superficial part of the gland

- anteriorly: the anterior belly of the digastrics
- posteriorly: the stylohyoid, the posterior belly of the digastric, and the parotid gland.
- medially: the mylohyoid, the hyoglossus, and the lingual and hypoglossal nerves.
- laterally: the gland lies in contact with the submandibular fossa in the medial surface of the mandible.
- inferolaterally, it is covered by the investing layer of deep cervical fascia , the platysma muscle, and skin, it is crossed by the cervical branch of the facial nerve and facial vein, the submandibular lymph nodes also lie lateral to it.



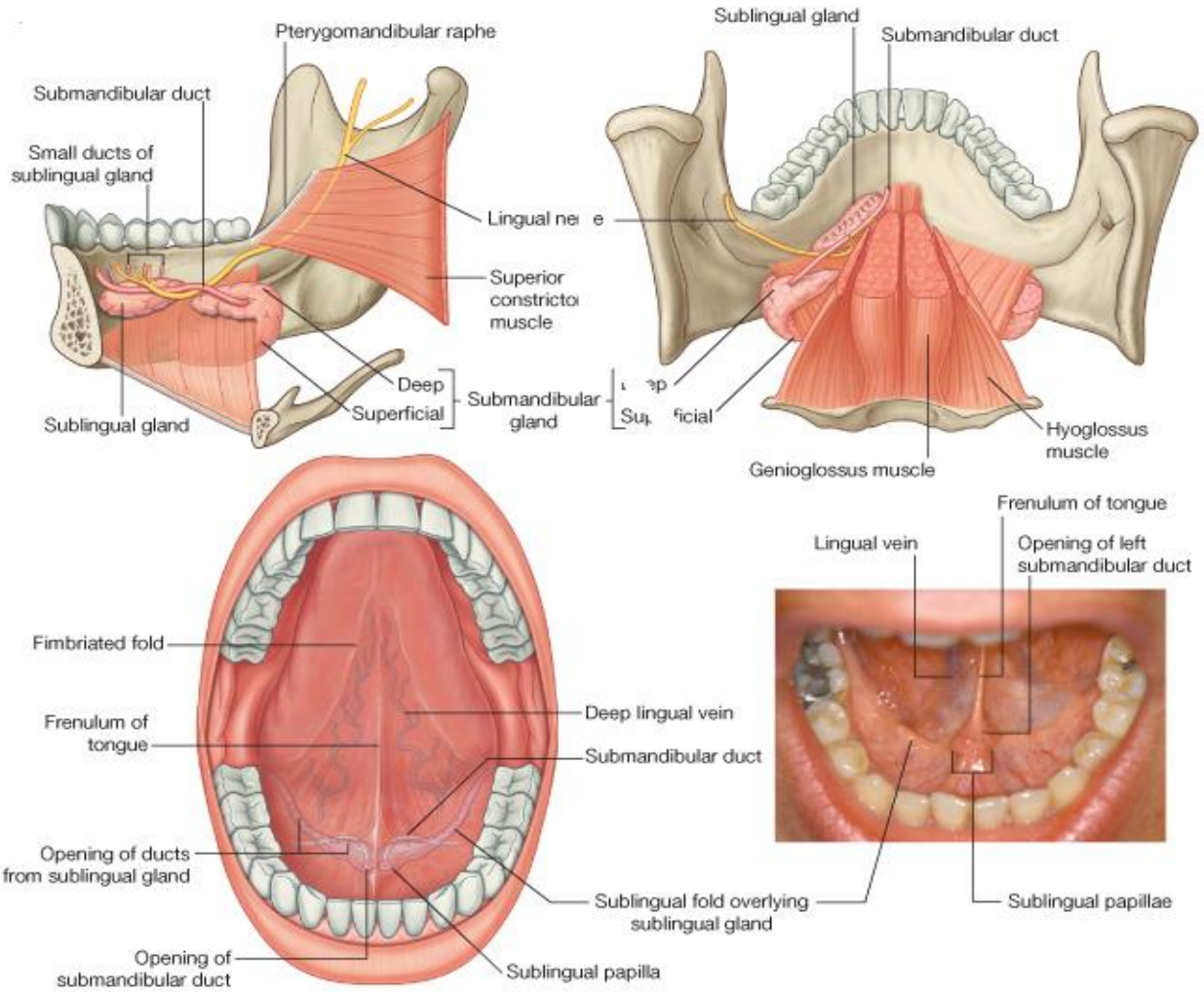
The facial artery is related to the posterior and superior aspects of the superficial part of the gland.

The deep part of the gland extends forward in the interval between the mylohyoid below and laterally and the hyoglossus and styloglossus medially. It`s posterior end is continuous with the superficial part of the gland around the posterior border of the mylohyoid muscle; it`s anterior end reaches as far as the sublingual gland.

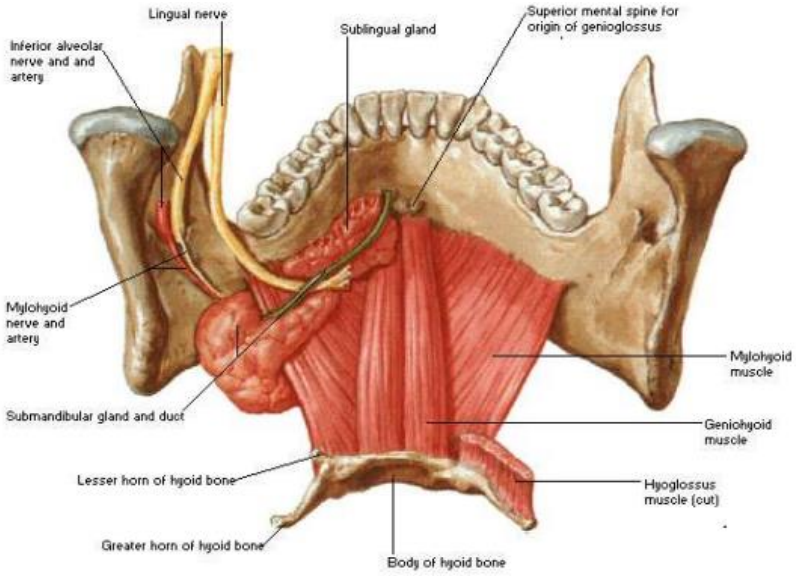
Relations of the deep part of the gland

- anteriorly: the sublingual gland.
- posteriorly: the stylohyoid, the posterior belly of the digastric, and the parotid gland.
- medially: the hyoglossus and styloglossus.
- laterally: the mylohyoid muscle and the superficial part of the gland.
- superiorly: it is related superiorly to the lingual nerve and the submandibular ganglion; it is covered by the mucous membrane of the floor of the mouth.
- inferiorly: the hypoglossal nerve

The submandibular duct (Wharton's duct) 5 cm long emerges from the anterior end of the deep part of the gland and runs forward beneath the mucous membrane of the mouth on the hyoglossus between lingual and hypoglossal nerves , it crossed by lingual nerve, near the anterior border of hyoglossus, continues forward between sublingual gland and genioglossus muscle, it opens into the



mouth on the summit of sublingual papilla, which is situated at the side of the frenulum of the tongue.



Nerve supply

Parasympathetic secretomotor supply is from the facial nerve via the chorda tympani, and the submandibular ganglion, the postganglionic fibers pass directly to the gland.

Clinical notes

Submandibular salivary gland: calculus formation

The submandibular salivary gland and it`s duct is the more common site for calculus formation for two reasons:

- secretion is more viscid.
- duct takes a tortuous and upward course (against gravity) , this condition is rare in the other salivary glands. Presence of a tense swelling below the body of the mandible, which is greatest before or during a meal and is reduced in size or absent between meals, is diagnostic of the condition.

Examination of the floor of the mouth will reveal absence of ejection of saliva from the orifice of the duct of the affected gland, frequently, the stone can be palpated in the duct, which lies below the mucous membrane of the floor of the mouth.

Skin incision for removal of calculus or tumor from submandibular gland 4 cm below the angle of mandible.

Enlargement of the submandibular lymph nodes and swelling of the submandibular salivary gland

The submandibular lymph nodes are commonly enlarged as a result of a pathologic condition of the scalp, face, maxillary sinus, or mouth cavity. One of the most common causes of painful enlargement of these nodes is acute infection of the teeth, enlargement of the submandibular lymph nodes should not be confused with pathologic swelling of the submandibular salivary gland.

Sublingual gland

It is the smallest of the three large salivary glands , it is almond shaped with 3 to 4 gm. weight, it lies in the floor of the mouth between the mucous membrane and mylohyoid muscle (sublingual fold) of the floor of the mouth, close to the frenulum of the tongue, it has both serous and mucous acini, with the latter predominating. It lodges in the sublingual fossa of the mandible.

Most of the sublingual ducts "ducts of Rivinus" (8 to 20 in number) open separately in the floor of the mouth on the summit of the sublingual fold, some ducts from the anterior part of the gland unite to form the sublingual duct "Duct of Bartholin" which opens into the submandibular duct.

Arterial supply: sublingual and submental arteries.

Lymphatic drainage: the lymphatics drain into submental and submandibular nodes.

Nerve supply

Parasympathetic secretomotor supply is from the facial nerve via the chorda tympani, and the submandibular ganglion, postganglionic fibers pass directly to the gland.

Clinical notes

Sublingual salivary gland and cyst formation

The sublingual salivary gland, which lies beneath the sublingual fold of the floor of the mouth, opens into the mouth by numerous small ducts, blockage of one of these ducts is believed to be the cause of cysts under the tongue.

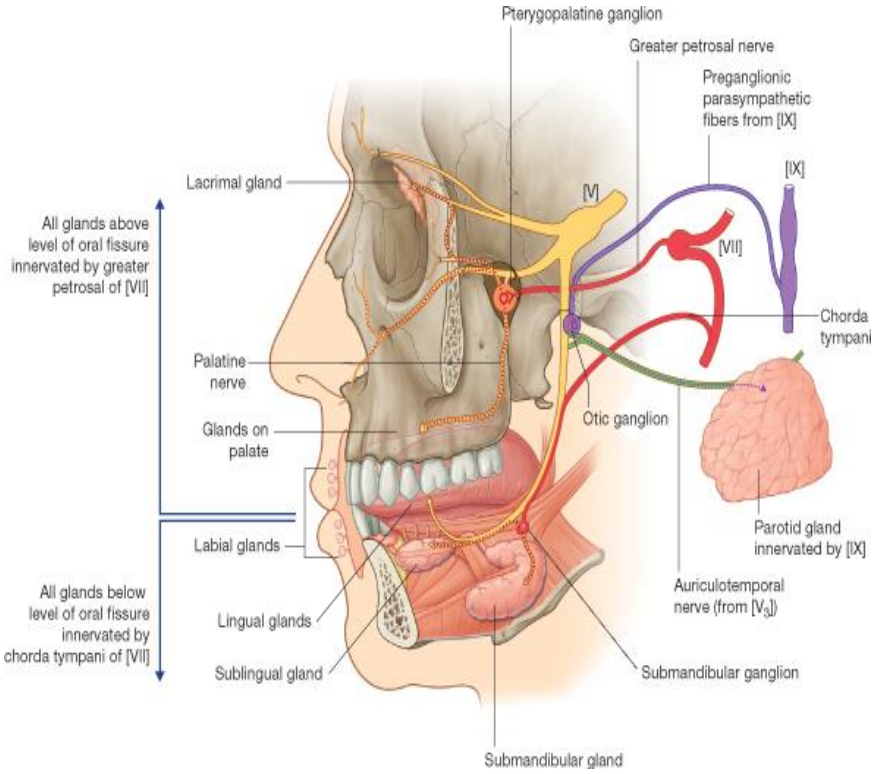
Submandibular ganglion

Lies on the outer surface of hyoglossus muscle suspending from the lingual nerve by two roots: "posterior and anterior", it has three types of fibers: parasympathetic, sympathetic and sensory. The sympathetic and sensory roots run through the submandibular ganglion, while parasympathetic root fibers are the only fibers to synapse within the submandibular ganglion.

The parasympathetic root of the submandibular ganglion is one of three roots of the submandibular ganglion. Parasympathetic fibers originate from the superior salivatory nucleus (SSN) in the pons and are conveyed by the facial nerve (CN VII) which gives off the chorda tympani. Preganglionic parasympathetic nerve fibers from the chorda tympani (CN VII) join the lingual nerve posteriorly in the infratemporal fossa to synapse with postganglionic parasympathetic fibers in the

submandibular ganglion and leave to innervate the submandibular and sublingual glands

The sympathetic root is derived from a plexus around the facial artery which is formed by postganglionic sympathetic fibers which arise from superior cervical sympathetic ganglion of the sympathetic trunk, and pass through the submandibular ganglion without relay to supply the blood vessels of submandibular and sublingual salivary glands.



Arteries: facial (covered before) and lingual.

Lingual artery

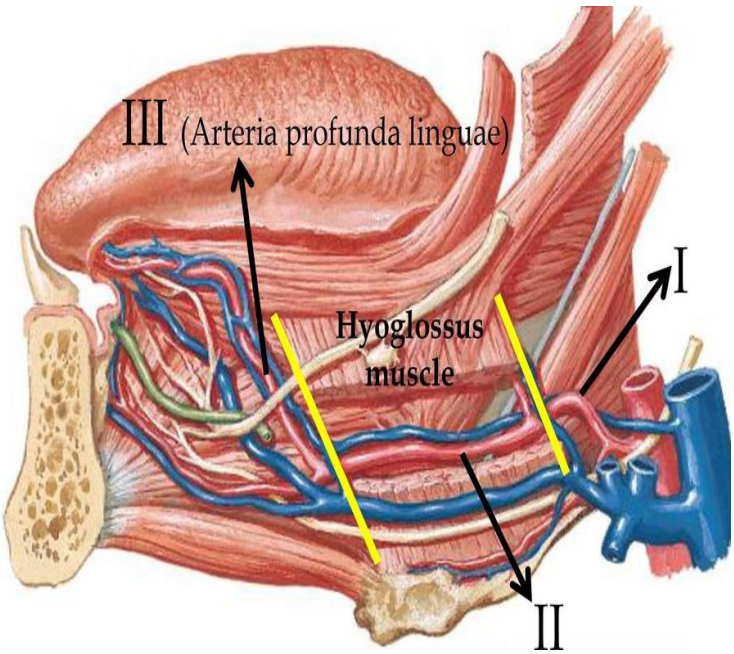
Lingual artery arises from the anterior surface of the external carotid artery just above the superior thyroid artery at the level of the hyoid bone, passes deep to the hypoglossal nerve [XII], between the middle constrictor and hyoglossus muscles, it can be located easily in the tongue.

The artery is divided in to three parts by the hyoglossus muscle: the first part start from it`s emerging from the external carotid artery to the posterior border of the hyoglossus muscle, this part lies in the carotid triangle, the second part lies deep to the hyoglossus muscle while the third part extends from the anterior border of the muscle up to it`s termination.

- *The first part : gives a branch "suprahyoid branch"* which travels along the superior border of the hyoid bone, it anastomoses with it`s counterpart on the contralateral side to supply the muscles attaching to the hyoid bone.
- *The second part : gives a branch "dorsal lingual branches*" arise from the second part forming anastomoses with their contralateral counterparts to supply the base of the tongue and it`s mucous membrane, as well as the palatoglossal arch, tonsil, soft palate and epiglottis. These branches are normally two to three small vessels that branch off the lingual artery medial to the hyoglossus muscle and pass into the posterior aspect of the tongue.
- *The third part also called the arteria profunda linguae* forms the terminal portion of the lingual artery, it supplies the body of the tongue, the artery is located on the inferior aspect of the tongue close to the lingual frenulum, it passes between the genioglossus medially and

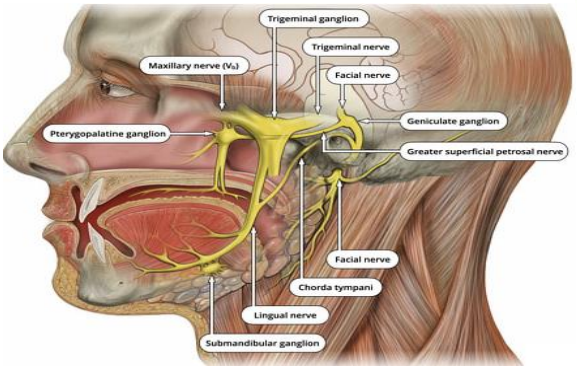
the inferior longitudinal muscle laterally to reach the apex of the tongue.it gives a branch called the sublingual branch.

- *sublingual branch* arises from the third part and supplies the sublingual gland, mylohyoid muscle and the buccal and gingival mucous membranes, it arises at the anterior border of the hyoglossus muscle and travels between the genioglossus and mylohyoid muscles to reach the sublingual glands.



Nerves

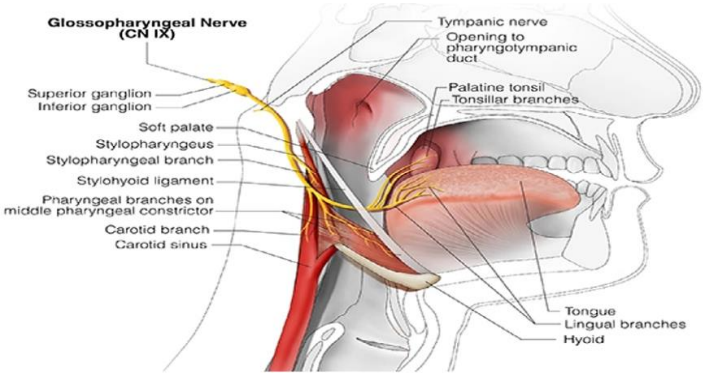
Lingual nerve



It is a branch from the posterior division of the mandibular division of trigeminal nerve [V3], descending in front of the inferior alveolar nerve and enters the mouth , it then runs forward on the side of the tongue and crosses the submandibular duct. In it`s course, it is joined by the chorda tympani nerve and it supplies the mucous membrane of the anterior two thirds of the tongue and the floor of the mouth, it also gives off preganglionic parasympathetic secretomotor fibers to the submandibular ganglion.

Glossopharyngeal nerve [IX]

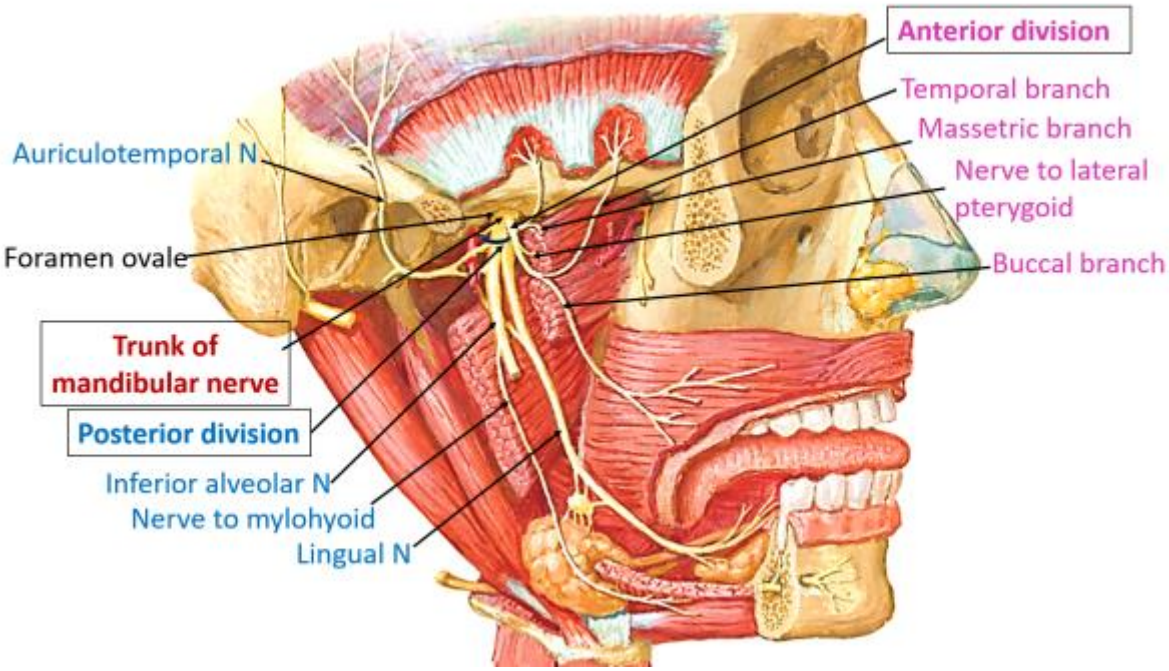
Gives rise to a lingual branch passes to the mucous membrane of the posterior third of the tongue (including the vallate papillae).



Hypoglossal nerve [XII]

It gives the following branches in the region:

- muscular branches to all the muscles of the tongue except the palatoglossus (pharyngeal plexus)
- nerve to the geniohyoid muscle (C1), the hypoglossal nerve innervates the muscles of the tongue (except the palatoglossus which is innervated by the pharyngeal nerve plexus), therefore controls the shape and movements of the tongue.


Anterior division
Temporal branch
Massetric branch
Nerve to lateral pterygoid
Buccal branch
Auriculotemporal N
Foramen ovale
Trunk of mandibular nerve
Posterior division
Inferior alveolar N
Nerve to mylohyoid
Lingual N

Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 2

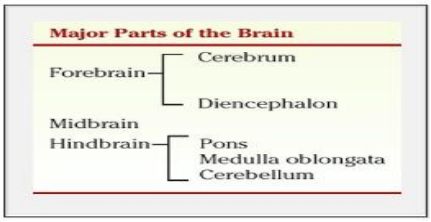
Gross Anatomy
Head & Neck
Lec. : 16
Date: Sunday; 12th. Mar.

Head & Neck

Nervous system

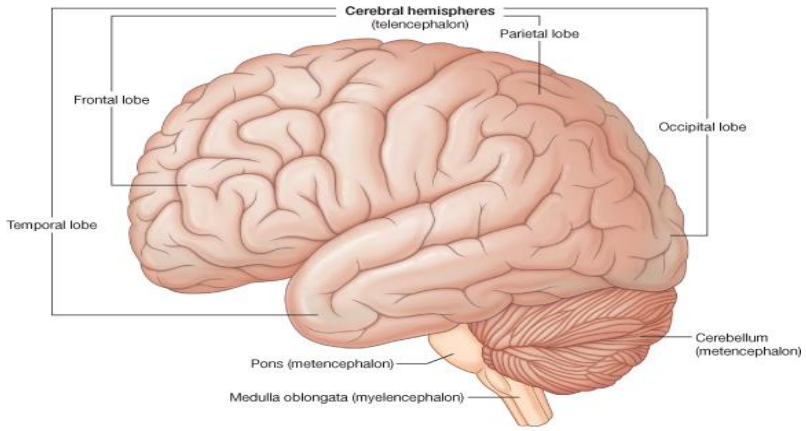
The Brain

The brain is that part of the central nervous system that lies inside the cranial cavity, it is continuous with the spinal cord through the foramen magnum, it is divided in to three main parts; forebrain, midbrain and hindbrain.



During development the brain can be divided into five continuous parts, from rostral (or cranial) to caudal they are:

- the *telencephalon (cerebrum),* which becomes the large cerebral hemispheres, the surface of which consists of elevations (gyri) and depressions (sulci) and is partially separated by a deep longitudinal fissure, filling the area of the skull above the tentorium cerebelli and are subdivided into lobes due to their position.

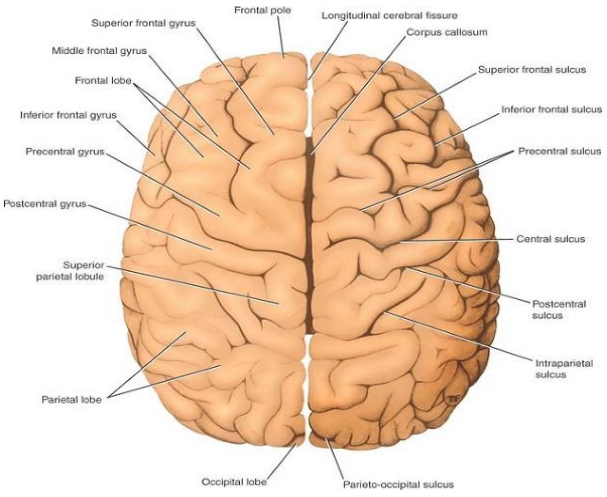


- the *diencephalon*, which is hidden from view in the adult brain by the cerebral hemispheres, consists of the thalamus, hypothalamus, and other related structures, and is considered to be the most rostral part of the brainstem.
- the *mesencephalon (midbrain),* which is the first part of the brainstem seen when an intact adult brain is examined, and is at the junction between and in both the middle and posterior cranial fossae.
- the *metencephalon,* which gives rise to the cerebellum (consisting of two lateral hemispheres and a midline part in the posterior cranial fossa below the tentorium cerebelli) and the pons (anterior to the cerebellum, a bulging part of the brainstem in the most anterior part of the posterior cranial fossa against the clivus and dorsum sellae).
- the *myelencephalon (medulla oblongata),* the caudal most part of the brainstem, which ends at the foramen magnum or the uppermost rootlets of the first cervical nerve and to which cranial nerves VI to XII are attached.

Forebrain

Cerebrum

The cerebrum is the largest part of the brain and consists of two cerebral hemispheres connected by a mass of white matter called the corpus callosum, each hemisphere extends from the frontal to the occipital bones, above the anterior and middle cranial fossae; and, posteriorly, above the tentorium cerebelli, the hemispheres are separated by a deep cleft, the longitudinal fissure, into which projects the falx cerebri.

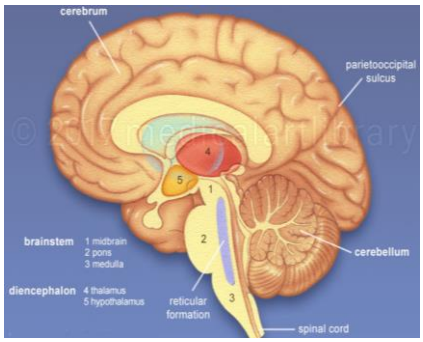


The surface layer of each hemisphere is called the cortex and is composed of gray matter, the cerebral cortex is thrown into folds, or gyri, separated by fissures, or sulci, by this means the surface area of the cortex is greatly increased. Several large sulci divide the surface of each hemisphere into lobes, the lobes are named for the bones of the cranium under which they lie.

The frontal lobe is situated in front of the central sulcus and above the lateral sulcus, the parietal lobe is situated behind the central sulcus and above the lateral sulcus, the occipital lobe lies below the parieto-occipital sulcus, below the lateral sulcus is situated the temporal lobe.

The precentral gyrus lies immediately anterior to the central sulcus and is known as the motor area, the large motor nerve cells in this area control voluntary movements on the opposite side of the body, most nerve fibers cross over to the opposite side in the medulla oblongata as they descend to the spinal cord. In the motor area, the body is represented in an inverted position, with the nerve cells controlling the movements of the feet located in the upper part and those controlling the movements of the face and hands in the lower part.

The postcentral gyrus lies immediately posterior to the central sulcus and is known as the sensory area, the small nerve cells in this area receive and interpret sensations of pain, temperature, touch, and pressure from the opposite side of the body.



The superior temporal gyrus lies immediately below the lateral sulcus, the middle of this gyrus is concerned with the reception and interpretation of sound and is known as the auditory area.

Broca's area, or the motor speech area, lies just above the lateral sulcus, it controls the movements employed in speech, it is dominant in the left hemisphere in right-handed persons and in the right hemisphere in left-handed persons.

The visual area is situated on the posterior pole and medial aspect of the cerebral hemisphere in the region of the calcarine sulcus, it is the receiving area for visual impressions.

The cavity present within each cerebral hemisphere is called the lateral ventricle, the lateral ventricles communicate with the third ventricle though the interventricular foramina.

Lobes of the cerebrum

The cerebral hemispheres have distinct fissures, which divide the brain into lobes, each hemisphere has 4 lobes: frontal, temporal, parietal, and occipital , each lobe may be divided, once again, into areas that serve very specific functions. It's important to understand that each lobe of the brain does not function alone, there are very complex relationships between the lobes of the brain and between the right and left hemispheres.

Frontal lobe

- Personality, behavior, emotions
- Judgment, planning, problem solving
- Speech: speaking and writing (Broca's area)
- Body movement (motor strip)
- Intelligence, concentration, self awareness.

Parietal lobe

- Interprets language, words
- Sense of touch, pain, temperature (sensory strip)
- Interprets signals from vision, hearing, motor, sensory and memory

Occipital lobe

Interprets vision (color, light, movement)

Temporal lobe

- Understanding language (Wernicke's area)
- Memory
- Hearing
- Sequencing and organization

Messages within the brain are carried along pathways, they can travel from one gyrus to another, from one lobe to another, from one side of the brain to the other, and to structures found deep in the brain (e.g. thalamus, hypothalamus).

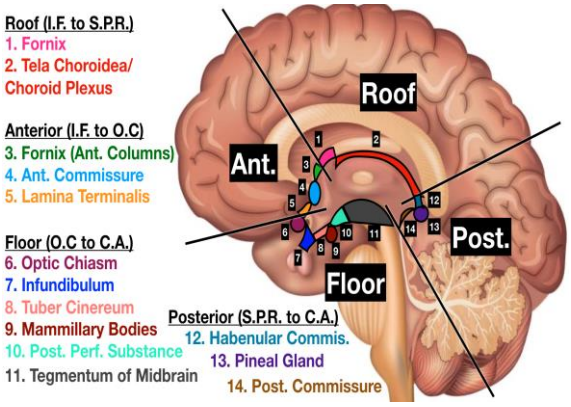
Diencephalon

The diencephalon is almost completely hidden from the surface of the brain, it consists of a dorsal thalamus and a ventral hypothalamus, the thalamus is a large mass of gray matter that lies on either side of the third ventricle, it is the great relay station on the afferent sensory pathway to the cerebral cortex.

The hypothalamus forms the lower part of the lateral wall and floor of the third ventricle, the following structures are found in the floor of the third ventricle from before backward: the optic chiasma, the tuber cinereum and the infundibulum, the mammillary bodies, and the posterior perforated substance.

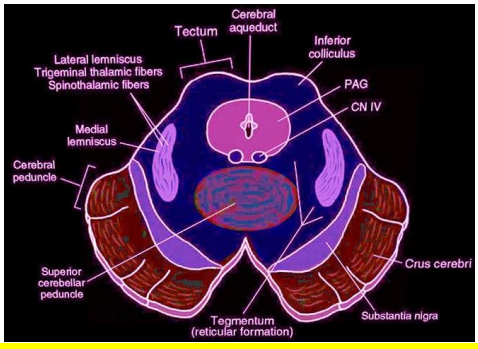
The thalamus serves as a relay station for almost all information that comes and goes to the cortex.

The hypothalamus is located in the floor of the third ventricle and is the master control of the autonomic system, it plays a role in controlling behaviors such as hunger, thirst, sleep, and sexual response, it also regulates body temperature, blood pressure, emotions, and secretion of hormones.



Midbrain

It is the narrow part of the brain that passes through the tentorial notch and connects the forebrain to the hindbrain , it comprises two lateral halves called the cerebral peduncles; each of these is divided into an anterior part, the crus cerebri, and a posterior part, the tegmentum, by a pigmented band of gray matter, the substantia nigra.

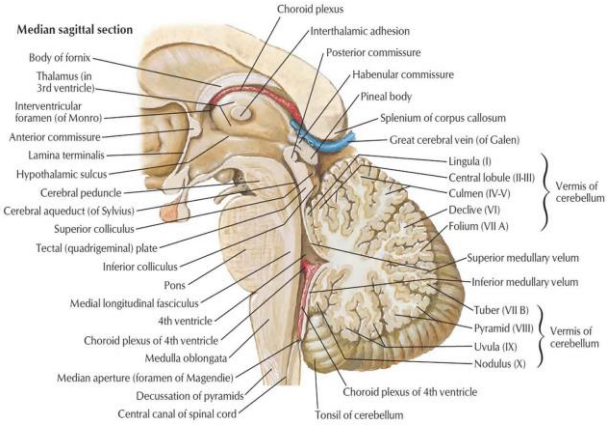


The narrow cavity of the midbrain is the cerebral aqueduct, which connects the third and fourth ventricles, the tectum is the part of the midbrain posterior to the cerebral aqueduct; it has four small surface swellings, namely, the two superior and two inferior colliculi, the colliculi are deeply placed between the cerebellum and the cerebral hemispheres.

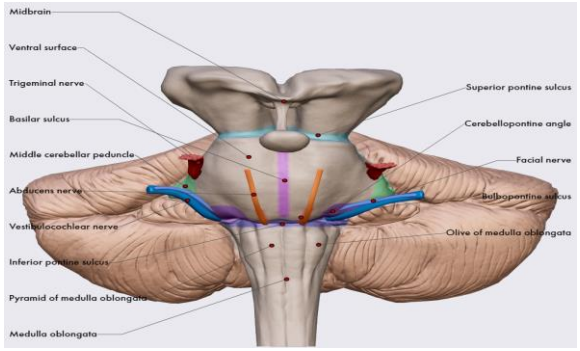
The pineal body is a small glandular structure that lies between the superior colliculi, it is attached by a stalk to the region of the posterior wall of the third ventricle, the pineal gland commonly calcifies in middle age, and thus it can be visualized on radiographs.

Hindbrain

Hind brain is formed of the pons, medulla oblongata and the cerebellum. *Brain stem* is a term used to refer to the collection of the midbrain , pons and medulla oblongata, it is located in posterior cranial fossa.

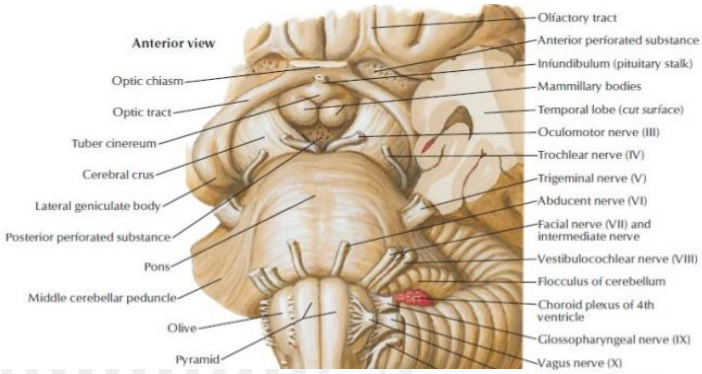


The pons is situated on the anterior surface of the cerebellum below the midbrain and above the medulla oblongata, it is composed mainly of nerve fibers, which connect the two halves of the cerebellum, it also contains ascending and descending fibers connecting the forebrain, the midbrain, and the spinal cord, some of the nerve cells within the pons serve as relay stations, whereas others form cranial nerve nuclei.



The pons, as part of the brainstem lies between the midbrain and the medulla oblongata, it is involved in many important functions, such as the regulation of breathing, sleep-wake cycle.

It forms the middle segment of the brainstem, sitting on the clivus, a shallow depression on the anterior aspect of the posterior cranial fossa, it consists of two main parts: the ventral (basilar/basal) surface and the dorsal surface; pontine tegmentum, which forms part of the floor of the fourth ventricle, the two surfaces of the pons are marked by unique features and protuberances that are formed by various tracts and nuclei.



The surface of the basal pons bears a shallow midline groove called the basilar sulcus through which the basilar artery runs, emerging directly from the anterolateral aspect of the pons at the mid-pontine level is the trigeminal nerve (CN V), the nerve exits the pons as a large sensory root which lies inferior and lateral to a small motor root.

A transverse sulcus on the ventral aspect of the brainstem, the superior pontine sulcus, delineates the midbrain - pontine junction while the inferior pontine sulcus, delineates the pontomedullary junction, three cranial nerves emerge within this sulcus: the abducens nerve (CN VI), which is the most medial, the facial (CN VII) and the vestibulocochlear (VIII) nerves, which lie laterally.

The dorsal surface of the pons has a diamond shaped depression that represents the floor of the fourth ventricle, the dorsal surface of the pons also bears a shallow midline groove, the dorsal median sulcus, which is continuous with that of the medulla and the spinal cord.

The medulla oblongata

The medulla oblongata is conical in shape and connects the pons above to the spinal cord below, a median fissure is present on the anterior surface of the medulla, and on each side of this is a

swelling called the pyramid, the pyramids are composed of bundles of nerve fibers that originate in large nerve cells in the precentral gyrus of the cerebral cortex, the pyramids taper below, and here most of the descending fibers cross over to the opposite side, forming the decussation of the pyramids.

Posterior to the pyramids are the olives, which are oval elevations produced by the underlying olivary nuclei, behind the olives are the inferior cerebellar peduncles, which connect the medulla to the cerebellum.

On the posterior surface of the inferior part of the medulla oblongata are the gracile and cuneate tubercles, produced by the medially placed underlying nucleus gracilis and the laterally placed underlying nucleus cuneatus.

The medulla oblongata is conical in shape, it`s broad part joins the pons above and narrow part becomes continuous with the spinal cord, the junction between medulla and spinal cord lies at the level of the upper border of Atlas (first cervical vertebra). It`s length is about 3 cm and it`s width is about 2 cm at it`s upper end ,it gives attachment to the rootlets of the hypoglossal nerve and the rootlets of 9^{th}, 10^{th} and 11^{th} cranial nerves.

Cranial nerves related to the brainstem

- the third and fourth cranial nerves emerge from the surface of the midbrain,
- the fifth cranial nerve emerges from the pons,
- the sixth, seventh and eighth cranial nerves emerge at the junction of the pons and medulla while
- the ninth, tenth, eleventh and twelfth cranial nerves emerge from the surface of the medulla.

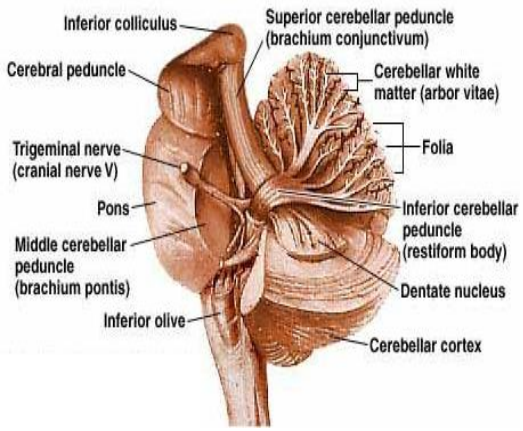
Functions

The brainstem has three broad functions:

- ✓ serves as a conduit for the ascending and descending tracts connecting the spinal cord to the different parts of the higher centers in the forebrain.
- ✓ contains important reflex centers associated with the control of respiration and cardiovascular system and with the control of consciousness.
- ✓ contains the important nuclei of cranial nerves III through XII.

The cerebellum

The cerebellum, which stands for “little brain”, has an important role in motor control, so cerebellar dysfunction often presenting motor signs, in particular, it is active in the coordination, precision and timing of movements, as well as in motor learning.



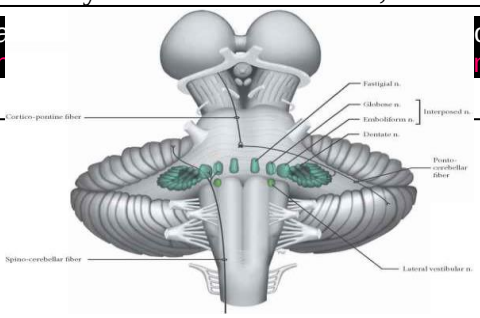
The cerebellum is located at the back of the brain, immediately inferior to the occipital and temporal lobes within the posterior cranial fossa, it lies at the same level of and posterior to the pons, from which it is separated by the fourth ventricle, it is separated from these lobes by the tentorium cerebelli, a tough layer of dura mater.

The cerebellum consists of two hemispheres connected by a median portion, the vermis, it is connected to the midbrain by the superior cerebellar

peduncles, to the pons by the middle cerebellar peduncles and to the medulla by the inferior cerebellar peduncles.

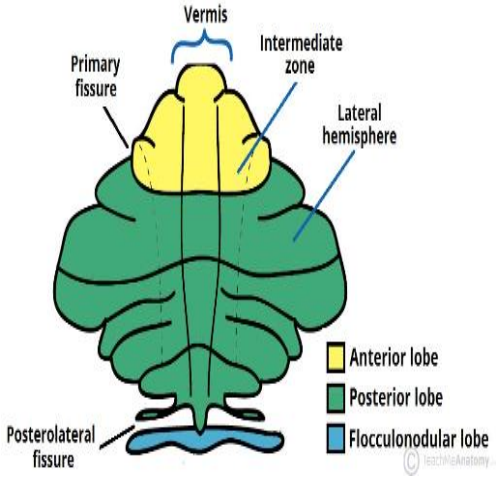
The surface layer of each cerebellar hemisphere, called the cortex, is composed of gray matter, the cerebellar cortex is thrown into folds, or folia, separated by closely set transverse fissures, certain

The superior olivary nuclei are thought to be involved in hearing, a on of sounds. The inferior olivary nuclei receive movement-related ir ng the spinal cord and motor cortex.



- *Grey matter:* located on the surface of the cerebellum, it is tightly folded, forming the cerebellar cortex.
- *White matter:* located underneath the cerebellar cortex, embedded in the white matter are the four cerebellar nuclei , from lateral to medial ; the four deep cerebellar nuceli are: *dentate, emboliform, globose, and fastigii.*

There are three ways that the cerebellum can be subdivided – anatomical lobes, zones and functional divisions;



Anatomical lobes

There are three anatomical lobes that can be distinguished in the cerebellum; the anterior, posterior and the flocculonodular lobes, these lobes are divided by two fissures; the primary and posterolateral fissures.

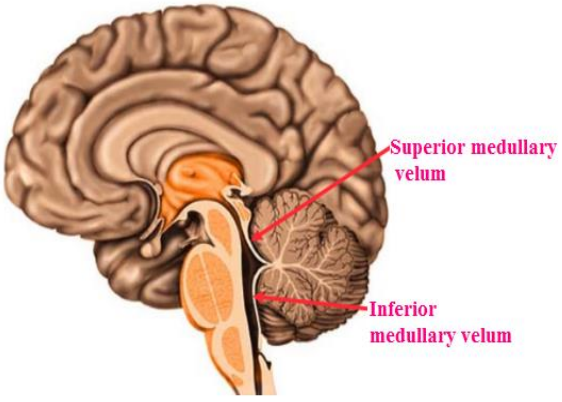
Zones

There are three cerebellar zones, in the midline of the cerebellum is the vermis, either side of the vermis is the intermediate zone, lateral to the intermediate zone are the lateral hemispheres, no difference in gross structure between the lateral hemispheres and intermediate zones can be identified.

Functional divisions

The cerebellum can also be divided by function, there are three functional areas of the cerebellum; the cerebrocerebellum, the spinocerebellum and the vestibulocerebellum.

- *Cerebrocerebellum* , the largest division, formed by the lateral hemispheres, it is involved in planning movements and motor learning, it also regulates coordination of muscle activation and is important in visually guided movements.
- *Spinocerebellum* , comprised of the vermis and intermediate zone of the cerebellar hemispheres and involved in regulating body movements by allowing for error correction, it also receives proprioceptive information.
- *Vestibulocerebellum* , the functional equivalent to the flocculonodular lobe, it is involved in controlling balance and ocular reflexes, mainly fixation on a target.



The cerebellum plays an important role in the control of muscle tone and the coordination of muscle movement on the same side of the body.

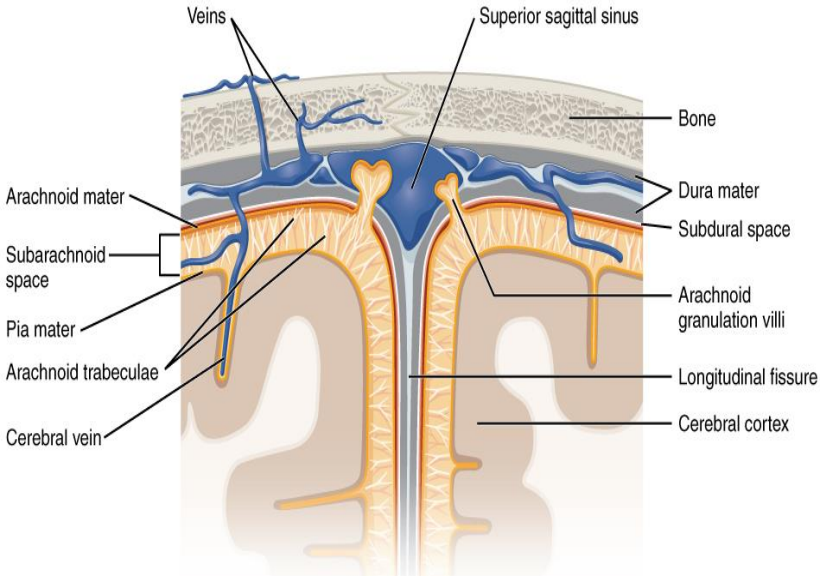
The cavity of the hindbrain is the fourth ventricle ,this is bounded in front by the pons and the medulla oblongata and behind by the superior and inferior medullary vela and the cerebellum,

The inferior roof of the fourth ventricle is formed by the superior medullary velum which is located on the midline between the superior cerebellar peduncles on both sides, while the inferior roof is formed by the inferior cerebellar peduncles and two thin membranes: tela choroidea.

the fourth ventricle is connected above to the third ventricle by the cerebral aqueduct, and below it is continuous with the central canal of the spinal cord, it communicates with the subarachnoid space through three openings in the lower part of the roof: a median and two lateral openings.

The meninges

The brain in the skull and the spinal cord in the vertebral column are surrounded by three protective membranes, or meninges: the dura mater, the arachnoid mater, and the pia mater.



Dura matter

The dura mater is conventionally described as two layers: the endosteal layer and the meningeal layer, they are closely united except along certain lines, where they separate to form venous sinuses.

The endosteal layer is nothing more than the ordinary periosteum covering the inner surface of the skull bones, it does not extend through the foramen magnum to become continuous with the dura mater of the spinal cord, but around the margins of all the foramina in the skull it becomes continuous with the periosteum on the outside of the skull bones. At the sutures it is continuous with the sutural ligaments, it is most strongly adherent to the bones over the base of the skull.

The meningeal layer is the dura mater proper, it is a dense, strong, fibrous membrane covering the brain and is continuous through the foramen magnum with the dura mater of the spinal cord, it provides tubular sheaths for the cranial nerves as the latter pass through the foramina in the skull, outside the skull the sheaths fuse with the epineurium of the nerves. The dura mater of the spinal column is composed of the meningeal layer and does not contain a periosteal layer.

The meningeal layer sends inward four septa that divide the cranial cavity into freely communicating spaces lodging the subdivisions of the brain, the function of these septa is to restrict the rotatory displacement of the brain.

The falx cerebri is a sickle-shaped fold of dura mater that lies in the midline between the two cerebral hemispheres, it`s narrow end in front is attached to the internal frontal crest and the crista galli, it`s broad posterior part blends in the midline with the upper surface of the tentorium cerebelli, the superior sagittal sinus runs in it`s upper fixed margin, the inferior sagittal sinus runs in it`s lower concave free margin, and the straight sinus runs along it`s attachment to the tentorium cerebelli.

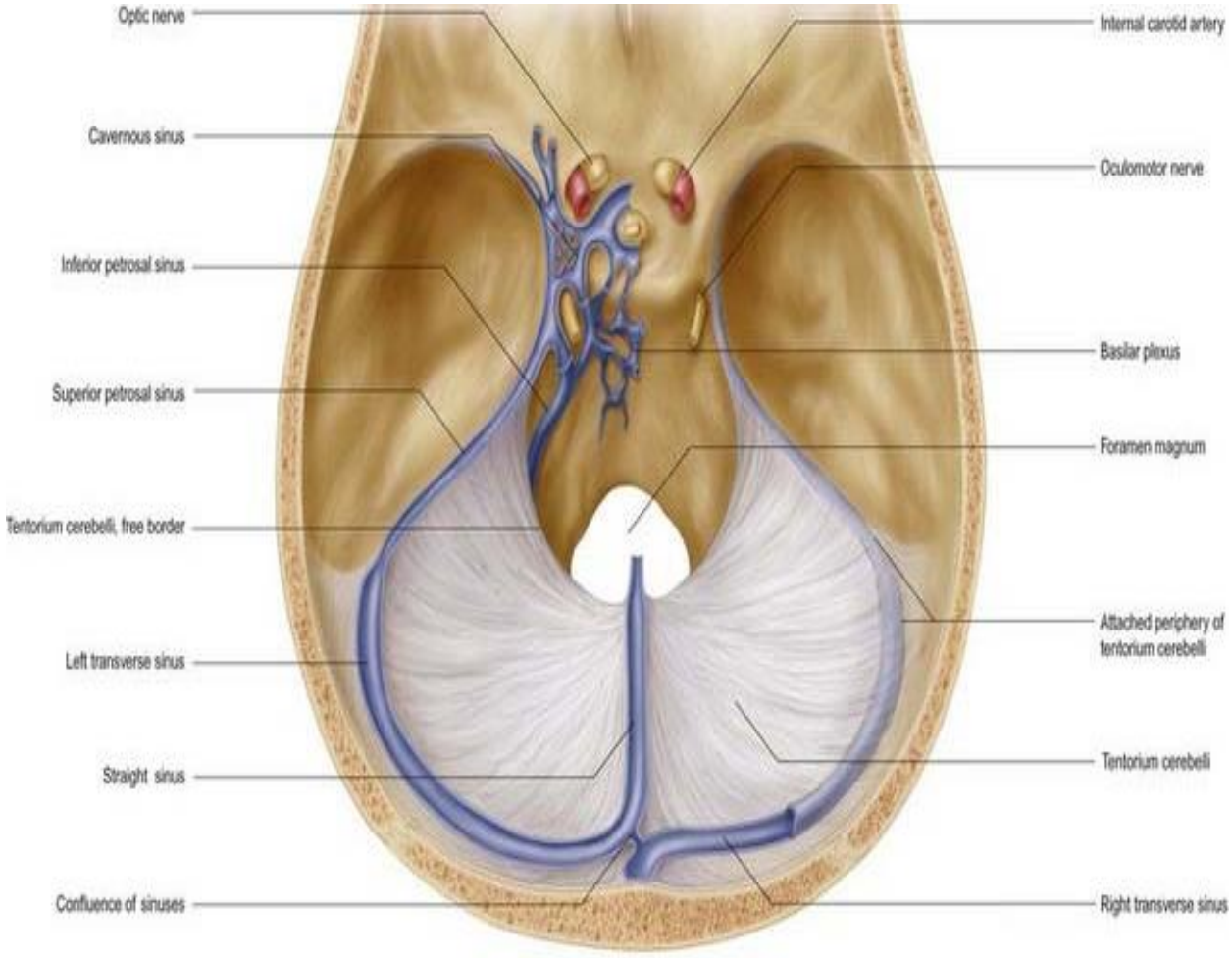
The tentorium cerebelli is a crescent-shaped fold of dura mater that roofs over the posterior cranial fossa, it covers the upper surface of the cerebellum and supports the occipital lobe of the cerebral hemispheres, in front is a gap, the tentorial notch, for the passage of the midbrain, thus producing an inner free border and an outer attached or fixed border.

The fixed border is attached to the posterior clinoid processes, the superior borders of the petrous bones, and the margins of the grooves for the transverse sinuses on the occipital bone. The free border runs forward at it`s two ends, crosses the attached border, and is affixed to the anterior clinoid process on each side.

At the point where the two borders cross, the third and fourth cranial nerves pass forward to enter the lateral wall of the cavernous sinus close to the apex of the petrous part of the temporal bone, the

lower layer of the tentorium is pouched forward beneath the superior petrosal sinus to form a recess for the trigeminal nerve and the trigeminal ganglion.

The falx cerebri and the falx cerebelli are attached to the upper and lower surfaces of the tentorium, respectively, the straight sinus runs along it`s attachment to the falx cerebri, the superior petrosal



sinus along it`s attachment to the petrous bone, and the transverse sinus along it`s attachment to the occipital bone.

The falx cerebelli is a small, sickle-shaped fold of dura mater that is attached to the internal occipital crest and projects forward between the two cerebellar hemispheres, it`s posterior fixed margin contains the occipital sinus.

The diaphragma sellae is a small circular fold of dura mater that forms the roof for the sella turcica, a small opening in it`s center allows passage of the stalk of the pituitary gland.

Pituitary gland (Hypophysis cerebri)

It is a small, oval structure attached to the undersurface of the brain by the infundibulum, the gland is well protected by virtue of it`s location in the sella turcica of the sphenoid bone.

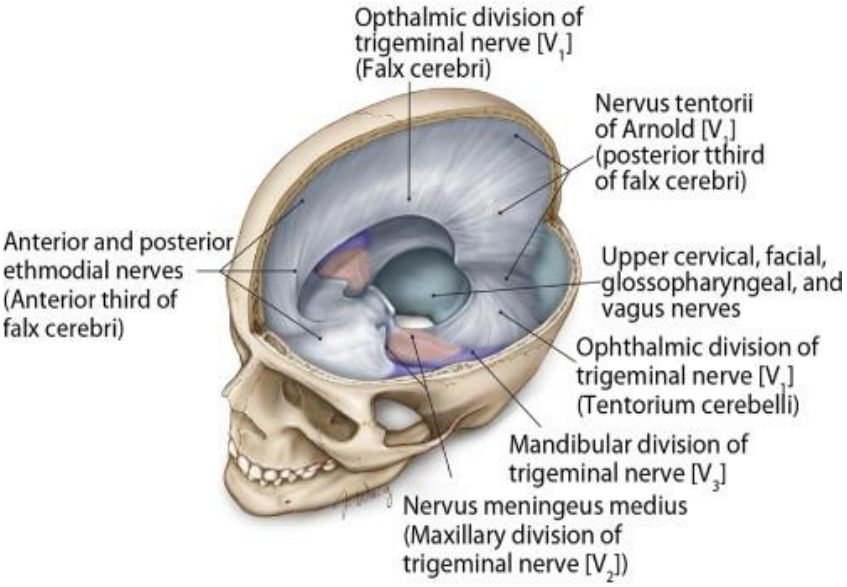
The *epidural space* is a potential space between the dura mater and the skull, if there is hemorrhaging in the brain, blood may collect here, adults are more likely than children to bleed here as a result of closed head injury.

The *subdural space* is another potential space lies between the dura mater and the arachnoid mater, if a bleeding occurs in the cranium; blood may collect here and push down on the lower

layers of the meninges. If bleeding continues, brain damage will result from this pressure, children are especially likely to have bleeding in the subdural space in cases of head injury.

Dural nerve supply

Innervation of the dura matter is by small meningeal branches of all three divisions of the trigeminal nerve [V_1, V_2, and V_3] and the first, second, and sometimes, third cervical nerves and branches from the sympathetic system pass to the dura, numerous sensory endings are in the dura, the dura is sensitive to stretching, which produces the sensation of headache.



In the anterior cranial fossa meningeal branches from the ethmoidal nerves, which are branches of the ophthalmic nerve [V_1], supply the floor and the anterior part of the falx cerebri, *the ophthalmic nerve [V_1] also runs posteriorly supplying the posterior part of the falx cerebri and the tentorium cerebelli.*

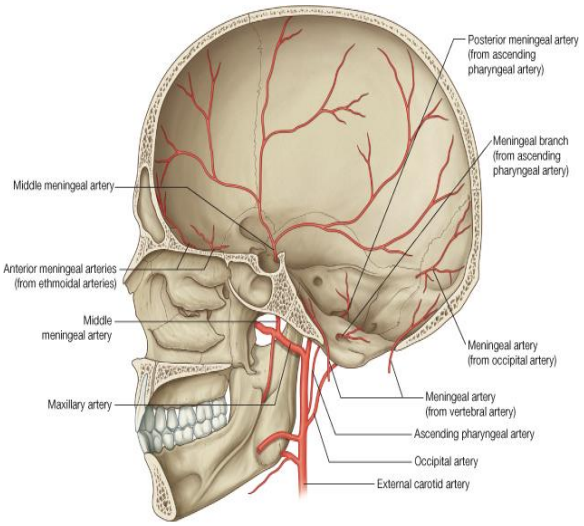
The middle cranial fossa is supplied medially by meningeal branches from the maxillary nerve [V_2] and laterally by meningeal branches from the mandibular nerve.

The posterior cranial fossa is supplied by meningeal branches from the first, second, and sometimes, the third cervical nerves, which enter the fossa through the foramen magnum, the hypoglossal canal, and the jugular foramen.

Stimulation of the sensory endings of the trigeminal nerve above the level of the tentorium cerebelli produces referred pain to an area of skin on the same side of the head. Stimulation of the dural endings below the level of the tentorium produces referred pain to the back of the neck and back of the scalp along the distribution of the greater occipital nerve.

Dural arterial supply

- the *anterior meningeal arteries in the anterior cranial fossa.
- the **middle and ***accessory meningeal arteries in the middle cranial fossa.
- the ****posterior meningeal artery and other meningeal branches in the posterior cranial fossa.



Numerous arteries supply the dura mater from the internal carotid, maxillary, ascending pharyngeal, occipital, and vertebral arteries. From a clinical standpoint, the most important is the middle meningeal artery, which is commonly damaged in head injuries.

The middle meningeal artery arises from the maxillary artery in the infratemporal fossa entering the cranial cavity through the foramen spinosum lying between the meningeal and endosteal layers of dura, then runs forward and laterally in a groove on the upper surface of the squamous part of the temporal bone, then divideds in to two branches; the anterior (frontal) branch deeply grooves or tunnels the anteroinferior angle of the parietal bone, and it`s course corresponds

roughly to the line of the underlying precentral gyrus of the brain. The posterior (parietal) branch curves backward and supplies the posterior part of the dura mater.

Dural venous drainage

The meningeal veins lie in the endosteal layer of dura, the middle meningeal vein follows the branches of the middle meningeal artery and drains into the pterygoid venous plexus or the sphenoparietal sinus. The veins lie lateral to the arteries.

Arachnoid matter

The arachnoid mater is a delicate, impermeable membrane covering the brain and lying between the pia mater internally and the dura mater externally, it is separated from the dura by a potential space, the subdural space, and from the pia by the subarachnoid space, which is filled with cerebrospinal fluid.

The arachnoid bridges over the sulci on the surface of the brain, and in certain situations the arachnoid and pia are widely separated to form the subarachnoid cisternae.

In certain areas the arachnoid projects into the venous sinuses to form arachnoid villi, the arachnoid villi are most numerous along the superior sagittal sinus, aggregations of arachnoid villi are referred to as arachnoid granulations, arachnoid villi serve as sites where the cerebrospinal fluid diffuses into the bloodstream.

It is important to remember that structures passing to and from the brain to the skull or it`s foramina must pass through the subarachnoid space, all the cerebral arteries and veins lie in the space, as do the cranial nerves.

The arachnoid fuses with the epineurium of the nerves at their point of exit from the skull, in the case of the optic nerve, the arachnoid forms a sheath for the nerve that extends into the orbital cavity through the optic canal and fuses with the sclera of the eyeball, thus, the subarachnoid space extends around the optic nerve as far as the eyeball.

Pia matter

This thin inner layer of the meninges is in direct contact with and closely covers the cerebral cortex and spinal cord , it is a vascular membrane that closely invests the brain, covering the gyri and descending into the deepest sulci, it extends over the cranial nerves and fuses with their epineurium, cerebral arteries entering the substance of the brain carry a sheath of pia with them.

The rich supply of blood vessels in the pia matter provide nutrients to nervous tissue, it also contains the choroid plexus, a network of capillaries and ependyma (specialized ciliated epithelial tissue) that produce cerebrospinal fluid, choroid plexus is located within the cerebral ventricles.

Pia mater covering the spinal cord is composed of two layers, an outer layer consisting of collagen fibers and an inner layer that encases the entire spinal cord, spinal pia mater is thicker and less vascular than pia mater that covers the brain.

Clinical problems

Meningitis

Meningitis is a dangerous condition that causes inflammation of the meninges, it is typically precipitated by an infection of the cerebrospinal fluid. Pathogens such as bacteria, viruses, and fungi can induce meningeal inflammation, meningitis may result in brain damage, seizures, and can be fatal if not treated.

Meningiomas

Meningiomas are tumors that develop in the meninges, they originate in the arachnoid matter and put pressure on the brain and spinal cord as they grow larger, most meningiomas are benign and grow slowly, however, some may develop rapidly and become cancerous, meningiomas can grow to become very large and treatment often involves surgical removal.

Hematomas

Damage to blood vessels in the brain can cause blood to collect in brain cavities and brain tissue forming a hematoma, hematomas in the brain cause inflammation and swelling that can damage brain tissue, two common types of hematomas that involve the meninges are epidural hematomas and subdural hematomas.

Epidural hematoma occurs between the dura mater and the skull, it is typically caused by damage to an artery or venous sinus as a result of severe trauma to the head, while the subdural one occurs between the dura matter and arachnoid, it is usually caused by head trauma that ruptures veins, subdural hematoma can be acute and develop rapidly or it can develop slowly over a period of time.

Ventricles of the brain

There are four fluid-filled cavities located within the brain; two lateral ,the third and fourth ventricles, the two lateral ones communicate with the third ventricle through the interventricular foramina; the third communicates with the fourth ventricle through the cerebral aqueduct, the fourth ventricle, is continuous with the narrow central canal of the spinal cord and, through the three foramina in it`s roof, with the subarachnoid space, the ventricles are lined with ependyma[1] and filled with cerebrospinal fluid.

Cerebrospinal fluid is produced by the choroid plexuses of the two lateral ventricles, the third and fourth ventricles. The size and shape of the cerebral ventricles may be visualized clinically using computed tomography (CT) scans and magnetic resonance imaging (MRI).

Lateral ventricles

There are two large lateral ventricles, one in each cerebral hemisphere, it is roughly a C-shaped cavity and may be divided into a body, which occupies the parietal lobe from which anterior, posterior, and inferior horns extend into the frontal, occipital, and temporal lobes, respectively.

The lateral ventricle communicates with the cavity of the third ventricle through the interventricular foramen, this opening lies in the anterior part of the medial wall of the ventricle.

Third ventricle

The third ventricle is a slit like cleft between the two thalami, it communicates anteriorly with the lateral ventricles through the interventricular foramina (of Monro) and posteriorly with the fourth ventricle through the cerebral aqueduct (of Sylvius).

Cerebral aqueduct

The cerebral aqueduct (aqueduct of Sylvius), is a narrow channel about ¾ of an inch (1.8 cm) long, connects the third ventricle with the fourth one, direction of flow of cerebrospinal fluid (CSF) is from the third to the fourth ventricle.

Fourth ventricle

The fourth ventricle extends from the cerebral aqueduct to the obex, (from the Latin for *barrier*) is the point in the human brain at which the fourth ventricle narrows to become the central canal of the spinal cord, it is filled with cerebrospinal fluid.

The fourth ventricle has a diamond shape in cross-sections of the human brain, it is located within the pons or in the upper part of the medulla, cerebrospinal fluid entering the fourth ventricle through the cerebral aqueduct can exit to the subarachnoid space of the spinal cord via two *lateral foramina of Luschka* and one *medial foramen of Magendie*

The ventricles are filled with cerebrospinal fluid, which is produced by the choroid plexuses of the two lateral ventricles, the third ventricle and the fourth ventricle.

---

[1] *The squamous-to-columnar epithelial cell lining of the cerebral ventricles and the central canal of the spinal cord, the lining is composed of a single cell layer, most of the cells have microvilli and motile cilia on their outer surface.*

Choroid plexus

The choroid plexus is a plexus of cells that produces the cerebrospinal fluid in the ventricles of the brain, it consists of modified ependymal cells.

Choroid plexus is present in all components of the ventricular system except for the cerebral aqueduct, frontal and occipital horns of the lateral ventricle. In the inferior horn of the lateral ventricles and the third ventricle choroid plexus is found in the superior part only.

The choroid plexus consists of many capillaries, separated from the ventricles by choroid epithelial cells, fluid filters through these cells from blood to become cerebrospinal fluid.

In addition to cerebrospinal fluid production, the choroid plexus act as a filtration system, removing metabolic waste, foreign substances, and excess neurotransmitters from the cerebrospinal fluid. In this way the choroid plexus has a very important role in helping to maintain the delicate extracellular environment required by the brain to function optimally.

Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 2

Gross Anatomy
Head & Neck
Lec. : 17
Date: Sunday; 26th. Mar.

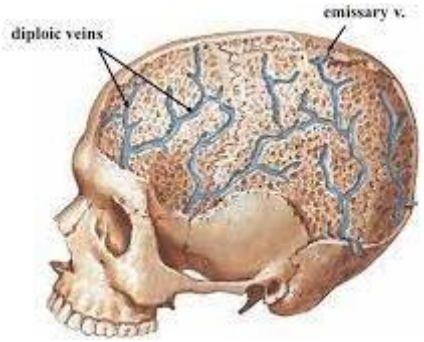
Head & Neck

Blood supply of the brain

Veins of the head and neck

The veins of the head and neck may be divided into:

- Veins of the brain, venous sinuses, diploic veins, and emissary veins.
- Veins of the scalp, face, and neck.



Diploic veins

The diploic veins occupy channels within the bones of the vault of the skull.

Emissary veins

The emissary veins are valveless veins that pass through the skull bones, they connect the veins of the scalp to the venous sinuses (and are an important route for the spread of infection).

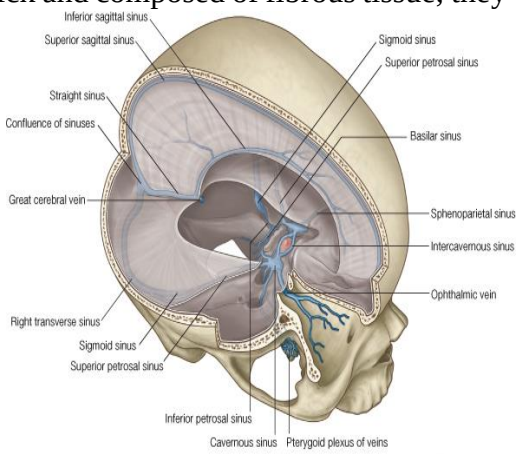
Veins of the brain

The veins of the brain are thin walled and have no valves, they consist of the cerebral veins, the cerebellar veins, and the veins of the brainstem, all of which drain into the neighboring venous sinuses, the veins of the brain have no muscular tissue in their thin walls.

The great cerebral vein "*vein of Galen*" is formed by the union of the two internal cerebral veins and drains into the straight sinus.

The venous blood sinuses

The venous sinuses of the cranial cavity are blood-filled spaces situated between the layers of the dura mater; they are lined by endothelium, their walls are thick and composed of fibrous tissue; they have no muscular tissue, they have no valves, receiving tributaries from the brain, the diploe of the skull, the orbit, and the internal ear.



Superior sagittal sinus

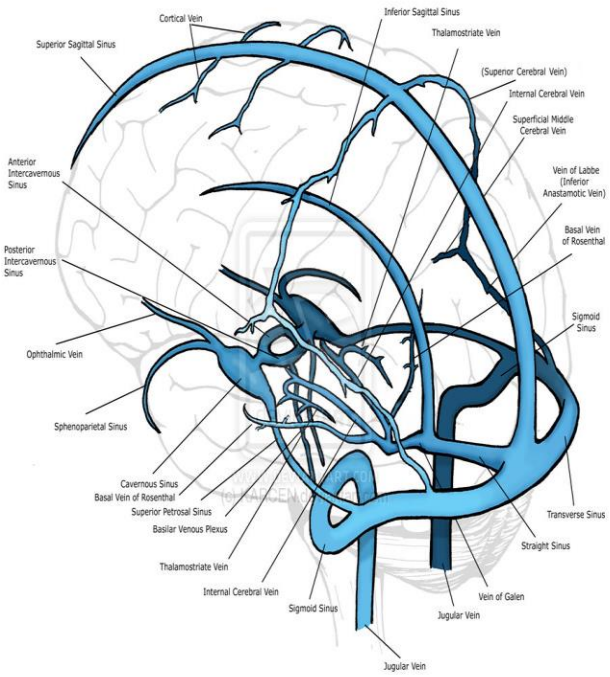
The superior sagittal sinus lies in the upper fixed border of the falx cerebri, it runs backward and becomes continuous with the right transverse sinus, the sinus communicates on each side with the venous lacunae. Numerous arachnoid villi and granulations project into the lacunae, the superior sagittal sinus receives the superior cerebral veins.

Inferior sagittal sinus

The inferior sagittal sinus lies in the free lower margin of the falx cerebri, running backward and joins the (great cerebral vein) Vein of Galen, to form the straight sinus, it receives cerebral veins from the medial surface of the cerebral hemisphere. The great cerebral vein draining deep areas of the cerebral hemispheres, cerebral veins from the posterior part of the cerebral hemispheres, superior cerebellar veins, and veins from the falx cerebri.

The straight sinus

The straight sinus continues posteriorly along the junction of the falx cerebri with the tentorium cerebelli and ends in the confluence of sinuses, usually bending to the left to empty into the transverse sinus, the straight sinus usually receives blood from the inferior sagittal sinus.



Confluence of sinuses

The superior sagittal and straight sinuses, and the occipital sinus (in the falx cerebelli) empty into the confluence of sinuses, which is a dilated space at the internal occipital protuberance and is drained by the right and left transverse sinuses.

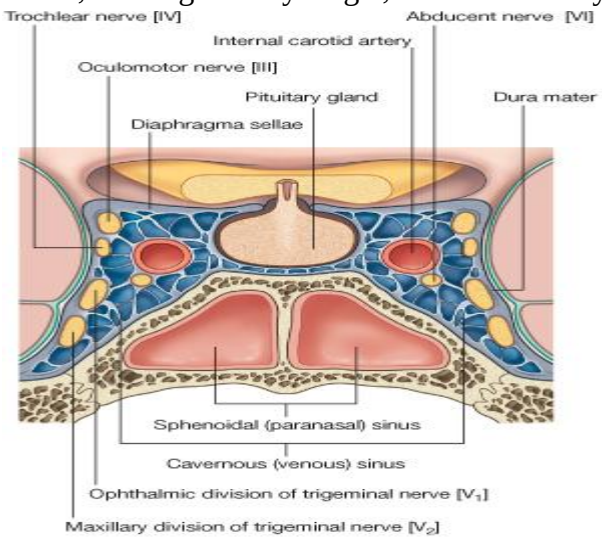
The paired transverse sinuses extend in horizontal directions from the confluence of sinuses where the tentorium cerebelli joins the posterior and lateral walls of the cranial cavity, they end on each side by becoming the sigmoid sinus.

Transverse sinuses

The transverse sinuses also receive blood from the superior petrosal sinus, veins from the inferior parts of the cerebral hemispheres, the cerebellum, diploic and emissary veins. As the transverse sinuses leave the surface of the occipital bone, they become the sigmoid sinuses.

Occipital sinus

It is situated in the attached margin of the falx cerebelli, and is generally single, but occasionally there are two , it commences around the margin of the foramen magnum by several small venous channels, one of which joins the terminal part of the transverse sinus; it communicates with the vertebral venous plexuses and ends in the confluence of the sinuses.



Sigmoid sinuses

The sigmoid sinuses are the direct continuation of the transverse sinuses, each sinus turns downward behind the mastoid antrum of the temporal bone grooving the parietal, temporal, and occipital bones, and then leaves the skull through the jugular foramen to end at the beginning of the internal jugular veins. The sigmoid sinuses also receive blood from cerebral, cerebellar, diploic and emissary veins.

Cavernous sinuses

The paired cavernous sinuses lie against the lateral aspect of the body of the sphenoid bone on either side of the sella turcica, they are of great clinical importance because of their connections and the structures that pass through them.

The cavernous sinuses receive blood not only from cerebral veins, but also from the ophthalmic veins (from the orbit) and emissary veins (from the pterygoid plexus of veins in the infratemporal fossa), these connections provide pathways for infections to pass from extra cranial sites into

intracranial locations, in addition, because structures pass through the cavernous sinuses and are located in the walls of these sinuses they are vulnerable to injury due to inflammation.

Anteriorly, the sinus receives the inferior ophthalmic vein and the central vein of the retina, the sinus drains posteriorly into the transverse sinus through the superior petrosal sinus. Connecting the right and left cavernous sinuses are the intercavernous sinuses on the anterior and posterior sides of the pituitary stalk.

Structures passing through each cavernous sinus are:

- the internal carotid artery.
- the abducent nerve [VI].

Structures in the lateral wall of each cavernous sinus are, from superior to inferior:

- the oculomotor nerve [III].
- the trochlear nerve [IV].
- the ophthalmic nerve [V_1].
- the maxillary nerve [V_2].

Sphenoparietal sinuses

Sphenoparietal sinuses drain into the anterior ends of each cavernous sinus, these small sinuses lie along the inferior surface of the lesser wings of the sphenoid and receive blood from the diploic and meningeal veins.

Superior and inferior petrosal sinuses

The superior petrosal sinuses drain the cavernous sinuses into the transverse sinuses, each superior petrosal sinus begins at the posterior end of the cavernous sinus, passes posterolaterally along the superior margin of the petrous part of each temporal bone, and connects to the transverse sinus, the superior petrosal sinuses also receive cerebral and cerebellar veins.

The inferior petrosal sinuses also begin at the posterior ends of the cavernous sinuses passing posteroinferiorly in a groove between the petrous part of the temporal bone and the basal part of the occipital bone, ending in the internal jugular veins. They assist in draining the cavernous sinuses, and also receive blood from cerebellar veins, and veins from the internal ear and brainstem.

Basilar sinuses

Basilar sinuses connect the inferior petrosal sinuses to each other and to the vertebral plexus of veins, they are on the clivus, just posterior to the sella turcica of the sphenoid bone.

Arteries of the brain

The brain is supplied by the two internal carotid and the two vertebral arteries, the four arteries anastomose on the inferior surface of the brain forming the circle of Willis (circulus arteriosus).

Internal carotid artery

The internal carotid artery begins at the bifurcation of the common carotid artery at the level of the upper border of the thyroid cartilage, it supplies the brain, the eye, the forehead, and part of the nose, it ascends in the neck embedded in the carotid sheath with the internal jugular vein and vagus nerve, at first it lies superficially; it then passes deep to the parotid salivary gland.

The internal carotid artery leaves the neck by passing into the cranial cavity through the carotid canal in the petrous part of the temporal bone, passing upward and forward in the cavernous venous sinus (without communicating with it).

The artery then leaves the sinus and passes upward again medial to the anterior clinoid process of the sphenoid bone and inclines backward, lateral to the optic chiasma, and terminates by dividing into the anterior and the middle cerebral arteries.

Branches of the internal carotid artery

There are no branches in the neck, many important branches, however, are given off inside the skull.

Ophthalmic artery

The ophthalmic artery arises from the internal carotid artery as it emerges from the cavernous sinus, it passes forward into the orbital cavity through the optic canal, and it gives off the *central artery of the retina*, which enters the optic nerve and runs forward to enter the eyeball, the central artery is an end artery and the only blood supply to the retina.

Posterior communicating artery

The posterior communicating artery runs backward to join the posterior cerebral artery.

Anterior choroidal artery

Originates from the distal carotid artery 5 mm after the origin of the posterior communicating artery and just before the carotid terminus, it serves structures in the prosencephalon, diencephalon, and mesencephalon

Anterior cerebral artery

The anterior cerebral artery is a terminal branch of the internal carotid artery, it passes forward between the cerebral hemispheres and then winds around the corpus callosum of the brain to supply the medial and the superolateral surfaces of the cerebral hemisphere, it is joined to the artery of the opposite side by the anterior communicating artery.

Middle cerebral artery

The middle cerebral artery is the largest terminal branch of the internal carotid artery and it runs laterally in the lateral cerebral sulcus of the brain, it supplies the entire lateral surface of the cerebral hemisphere except the narrow strip along the superolateral margin (which is supplied by the anterior cerebral artery) and the occipital pole and inferolateral surface of the hemisphere (both of which are supplied by the posterior cerebral artery).

The middle cerebral artery thus supplies all the motor area of the cerebral cortex except the leg area, it also gives off central branches that supply central masses of gray matter and the internal capsule of the brain.

The vertebral artery

Paired vertebral arteries provide blood supply for the upper part of the spinal cord, brainstem, cerebellum, and posterior part of the brain, each artery originates from the first part of the subclavian artery.

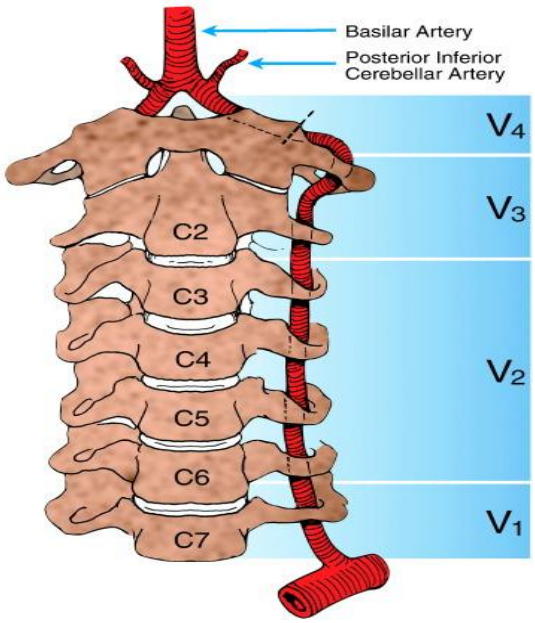
The vertebral artery ascends in the neck through the foramina in the transverse processes of the upper six cervical vertebrae, it passes medially above the posterior arch of the atlas and then ascends through the foramen magnum into the skull, on reaching the anterior surface of the medulla

oblongata of the brain at the level of the lower border of the pons, it joins the vessel of the opposite side to form the basilar artery.

The basilar artery ascends in a groove on the anterior surface of the pons, giving off branches to the pons, the cerebellum, and the internal ear, finally it divides into the two posterior cerebral arteries.

On each side, the posterior cerebral artery curves laterally and backward around the midbrain. Cortical branches supply the inferolateral surfaces of the temporal lobe and the visual cortex on the lateral and the medial surfaces of the occipital lobe.

Basilar and internal carotid arteries give off multiple communicating branches which anastomose with each other at the base of the brain, forming the hexagonal vascular network called the circle of Willis which connects the anterior and posterior brain circulations, this reflects the importance of the vertebral artery for the human organism.



Segments: there are four segments of the vertebral artery, following it`s way through the neck;

- *Preforaminal* ; from subclavian artery to transverse foramen of C6.
- *Foraminal* ; through the transverse foramina of C6 to C2.
- *Extradural "atlantic" ;* from the transverse foramen of axis to the vertebral canal, this segment begins after the artery passes through the transverse foramen of the axis (C2) where it is subdivided into two parts; vertical and horizontal. The vertical part courses superiorly, crossing the root of the C2 spinal nerve and entering the transverse foramen of the atlas (C1).

  After passing through the transverse foramen of atlas, the horizontal part begins, the artery curves medially and posteriorly, passing behind the superior articular process of the atlas and reaches the groove on the upper surface of the posterior arch of the atlas, from there, it passes under the posterior atlantooccipital membrane and enters the vertebral canal. The horizontal part is contained in the occipital triangle.
- *Intradural "intracranial"*; from the vertebral canal to the inferior border of pons. After entering the vertebral canal, the vertebral artery pierces the dura mater and courses superiorly over the anterior surface of the medulla oblongata, at the lower border of the pons, it merges with the opposite vertebral artery and forms the basilar artery.

Branches:

- Anterior spinal
- posterior spinal
- posterior inferior cerebellar
- meningeal
- medullary
- basilar arteries

- *Branches in the neck:* Spinal and muscular arteries
- *Branches in the skull:* Meningeal, anterior and posterior spinal, posterior inferior cerebellar, medullary arteries.

Along it`s course, the vertebral artery gives rise to the following branches:

- Anterior spinal artery from it`s intradural segment, this artery originates from two smaller vessels from each vertebral artery which unite around the intradural segment, it then passes through the foramen magnum and descends along the anterior aspect of the spinal cord, supplying it`s anterior portion.
- May give off the posterior spinal artery; although this vessel usually arises from the posterior inferior cerebellar artery.
- Posterior inferior cerebellar artery originates from each vertebral arteries intracranial segment and supplies the cerebellum.
- Meningeal branches from it`s intracranial part near the foramen magnum, for supplying the meninges.
- Medullary arteries from its intracranial part that supply the medulla oblongata.

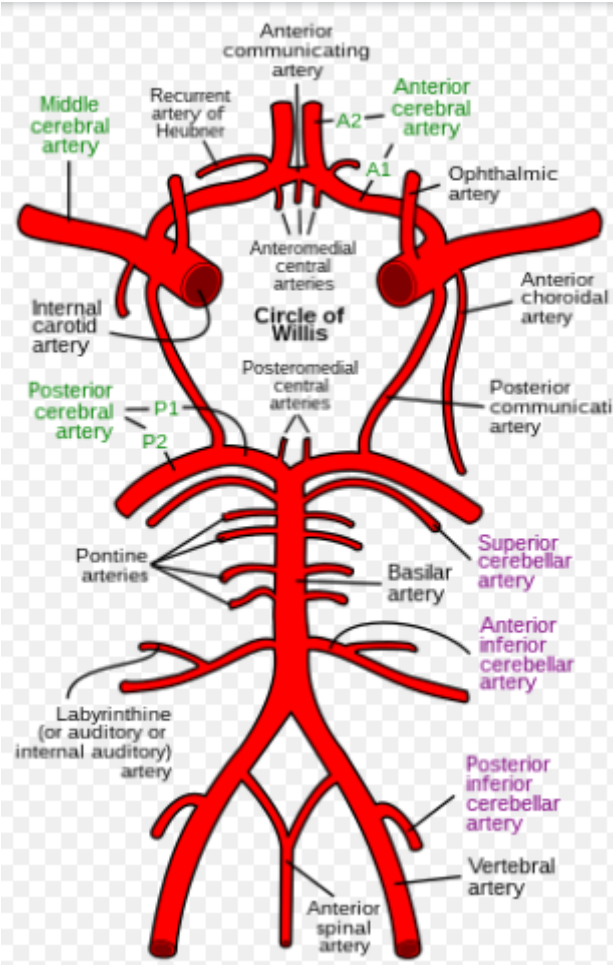
The terminating branch of the vertebral artery is the basilar artery, which contributes to the circle of Willis, the basilar artery ascends along the ventral surface of the pons in it`s basilar groove, giving the following branches:

- Several pontine arteries
- Anterior inferior cerebellar artery
- Internal auditory (labyrinthine) artery
- Superior cerebellar artery , and terminates as it bifurcates into two posterior cerebral arteries " posterior cerebral arteries originate from the basilar artery in 70% of persons, but may arise from the posterior communicating artery in 20% of persons, and it is mixed in 10%".

Each posterior cerebral artery anastomoses with the posterior communicating artery a branch of the internal carotid artery. This is how the communication between vertebral and internal carotid arteries is established.

Circle of Willis

The circle of Willis lies in the subarachnoid space at the base of the brain, it is formed by the anastomosis between the branches of the two internal carotid arteries and the two vertebral arteries. Cortical and central branches arise from the circle and supply the brain.



Clinical notes:

Frequent location of aneurysm is the anterior communicating artery (35%), followed by the internal carotid artery (30%-including the carotid artery itself, the posterior communicating artery, and the ophthalmic artery), the middle cerebral artery (22%), and finally, the posterior circulation sites, most commonly the basilar artery.

Common carotid artery (covered before)

Carotid sinus

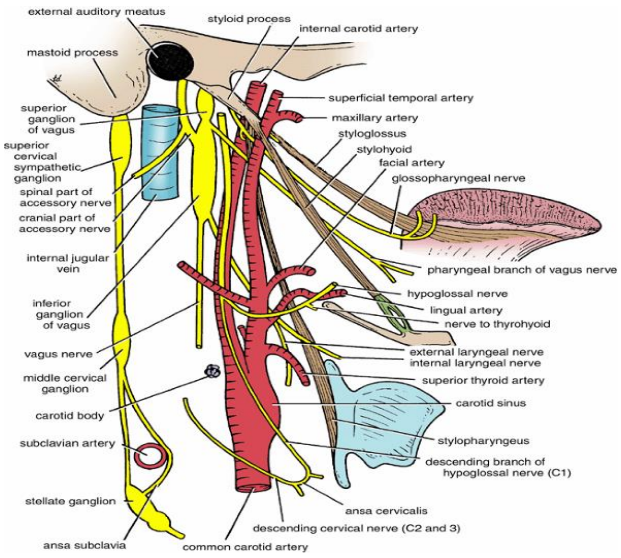
At its point of division, the terminal part of the common carotid artery or the beginning of the internal carotid artery shows a localized dilatation, called the carotid sinus ,the tunica media of the sinus is thinner than elsewhere, but the adventitia is relatively thick and contains numerous nerve endings derived from the glossopharyngeal nerve.

Carotid sinus serves as a reflex pressoreceptor mechanism: A rise in blood pressure causes a slowing of the heart rate and vasodilatation of the arterioles.

Carotid Body

The carotid body is a small structure that lies posterior to the point of bifurcation of the common carotid artery, it is innervated by the glossopharyngeal nerve, the carotid body is a chemoreceptor, being sensitive to excess carbon dioxide and reduced oxygen tension in the blood.

Such a stimulus reflexly produces a rise in blood pressure and heart rate and an increase in respiratory movements.



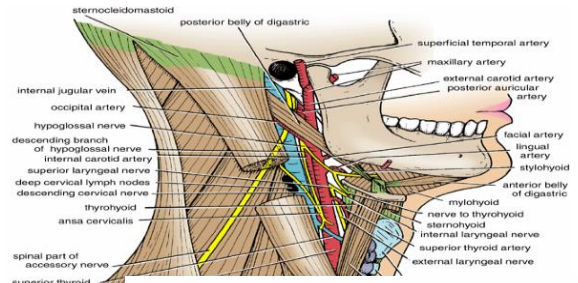
Clinical notes

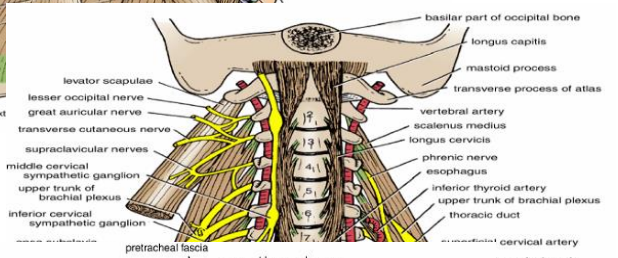
Carotid sinus hypersensitivity

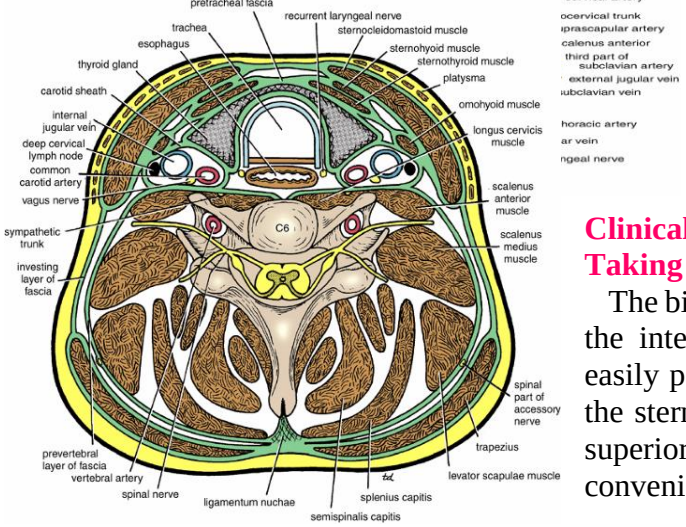
In cases of carotid sinus hypersensitivity, pressure on one or both carotid sinuses can cause excessive slowing of the heart rate, a fall in blood pressure, and cerebral ischemia with fainting.

The common carotid artery is embedded in a connective tissue sheath, called the carotid sheath, throughout its course and is closely related to the internal jugular vein and vagus nerve.

Relations of the common carotid artery







- *Anterolaterally*: the skin, the fascia, the sternocleidomastoid, the sternohyoid, the sternothyroid, and the superior belly of the omohyoid.
- *Posteriorly:* the transverse processes of the lower four cervical vertebrae, the prevertebral muscles, and the sympathetic trunk , in the lower part of the neck are the vertebral vessels.
- *Medially:* the larynx and pharynx and, below these, the trachea and esophagus , the lobe of the thyroid gland also lies medially.
- *Laterally:* the internal jugular vein and, posterolaterally, the vagus nerve.

Branches of the common carotid artery

Apart from the two terminal branches, the common carotid artery gives off no branches

Clinical notes

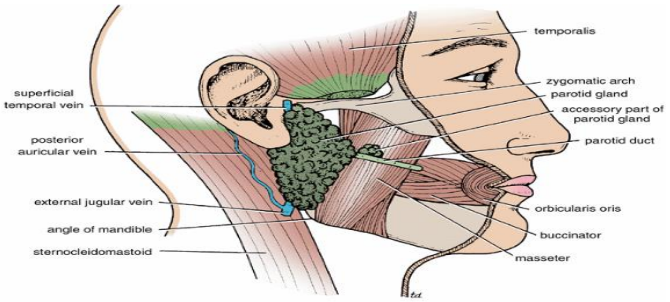
Taking the carotid pulse

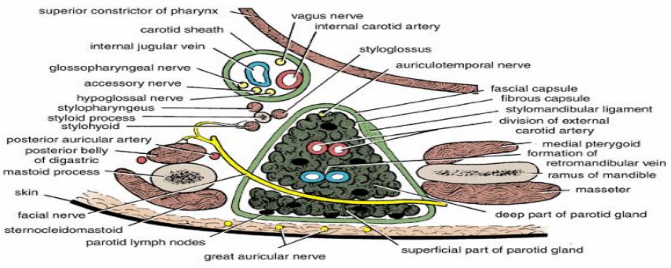
The bifurcation of the common carotid artery into the internal and external carotid arteries can be easily palpated just beneath the anterior border of the sternocleidomastoid muscle at the level of the superior border of the thyroid cartilage, this is a convenient site to take the carotid pulse.

External carotid artery (covered before)

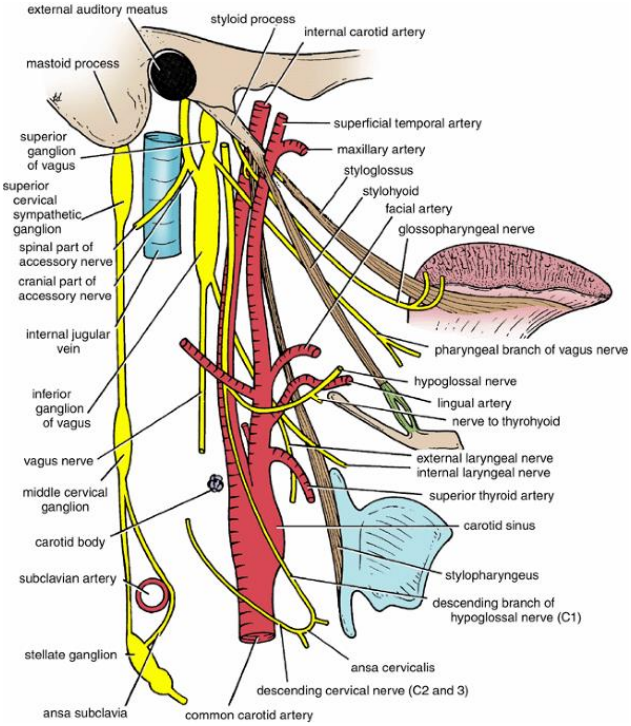
Relations of the external carotid artery

- *Anterolaterally:* the artery is overlapped at its beginning by the anterior border of the sternocleidomastoid. Above this level, the artery is comparatively superficial, being covered by skin and fascia. It is crossed by the hypoglossal nerve , the posterior belly of the digastric muscle, and the stylohyoid muscles. Within the parotid gland, it is crossed by the facial nerve , the internal jugular vein first lies lateral to the artery and then posterior to it.
- *Medially:* The wall of the pharynx and the internal carotid artery, the stylopharyngeus muscle, the glossopharyngeal nerve, and the pharyngeal branch of the vagus pass





between the external and internal carotid arteries.



The posterior choridal artery

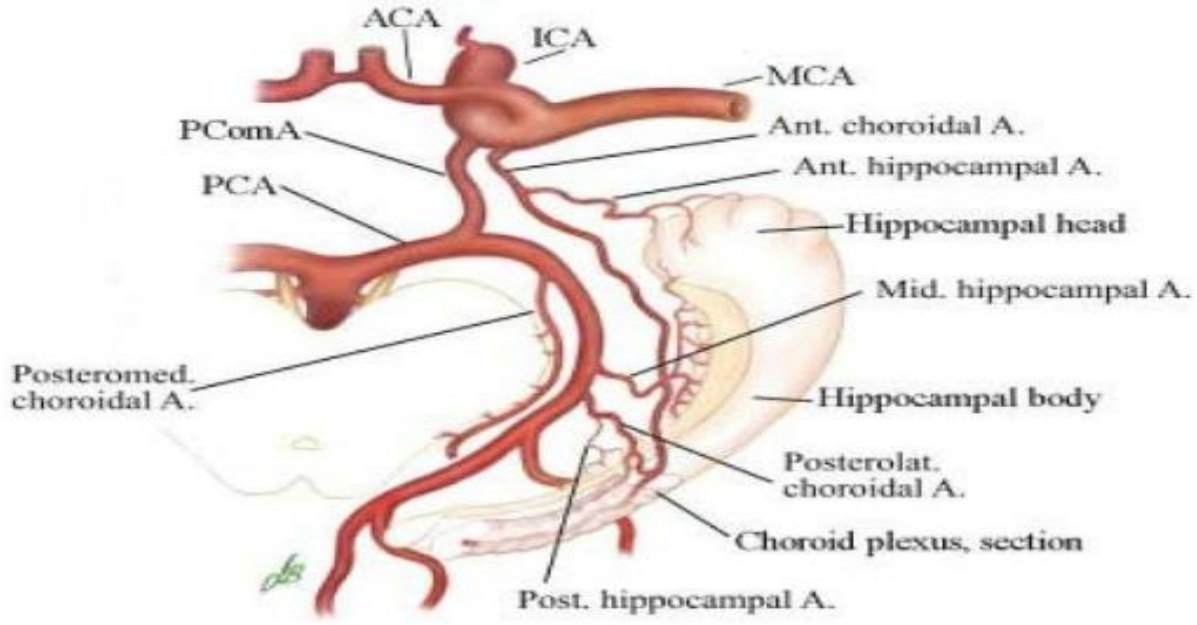
Courses from the basilar artery towards the occiput around the cerebral peduncle and over the tentorium cerebelli to ultimately supply the occipital lobe, posteromedial temporal lobes, midbrain, thalamus, choroid plexus, and part of the lateral and third ventricles.

There are five main segments of the PCA:

P1: The P1 segment is located within the interpeduncular cistern and courses from the termination of the basilar artery to the posterior communicating artery, passing over the oculomotor nerve (CN III). This segment gives off small paramedian arteries that supply the rostral midbrain and thalamoperforating arteries which supply part of the thalamus. It may also give off the artery of Percheron, which is a rare anatomic variant that can supply the thalamus and midbrain bilaterally. Embolism to this anatomic variant may result in bilateral paramedian thalamic lesions. Patients may present with symptoms such as memory impairment, altered sensorium, and vertical

gaze palsy. Since these vessels are not visible with conventional vascular imaging, diagnosis may be difficult.

P2: The P2 segment begins at the posterior communicating artery and curves around the ambient cistern of the midbrain, and courses above the tentorium cerebelli. The main branch of this segment is the posterior choroidal artery, but it also gives rise to peduncular perforating arteries that supply the lateral midbrain as well as thalamogeniculate arteries that supply the ventrolateral portion of the thalamus. This segment further subdivides into P2A (anterior) sub-segment located within the crural cistern and P2P (posterior, ambient) sub-segment located in the ambient cistern.



P3: The P3 segment of the PCA refers to the part of the artery that runs through the quadrigeminal cistern. The quadrigeminal cistern not only contains this portion of the PCA but also contains the posterior choroidal arteries, superior cerebellar arteries, the trochlear nerve (CN IV), and a confluence of veins. This segment commonly gives off anterior and posterior inferior temporal arteries.

P4: The P4 segment is the last segment of the PCA as it ends in the calcarine sulcus. The P4 segment most commonly gives rise to the parieto-occipital branches and the calcarine artery, which supplies areas bordering the calcarine sulcus and the medial surface of the occipital lobe.

P5: The terminal branches of the parieto-occipital and the calcarine arteries are included as the P5 segment.

Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 2

Gross Anatomy
Head & Neck
Lec. : 18
Date: Sunday, April 2 2023

Head & Neck

Cranial nerves

The cranial nerves are named as follows:

- I. Olfactory
- II. Optic
- III. Oculomotor
- IV. Trochlear
- V. Trigeminal
- VI. Abducent
- VII. Facial
- VIII. Vestibulocochlear
- IX. Glossopharyngeal
- X. Vagus
- XI. Accessory
- XII. Hypoglossal

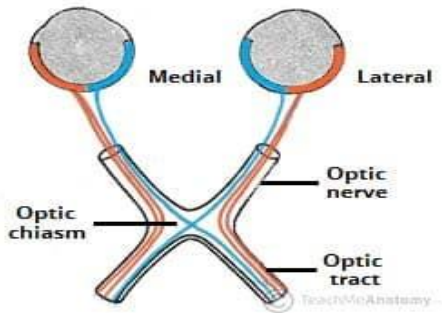
Olfactory, optic, and vestibulocochlear nerves are entirely sensory; oculomotor, trochlear, abducent, accessory, and hypoglossal nerves are entirely motor; the remaining are mixed.

Olfactory nerve

The olfactory nerve arises from olfactory receptor nerve cells in the olfactory mucous membrane which is situated in the upper part of the nasal cavity above the level of the superior concha. Bundles of these fibers pass through the openings of the cribriform plate of the ethmoid bone to enter the olfactory bulb in the cranial cavity, olfactory bulb is connected to the olfactory area of the cerebral cortex by the olfactory tract, (covered in Lec. 3).

Optic nerve

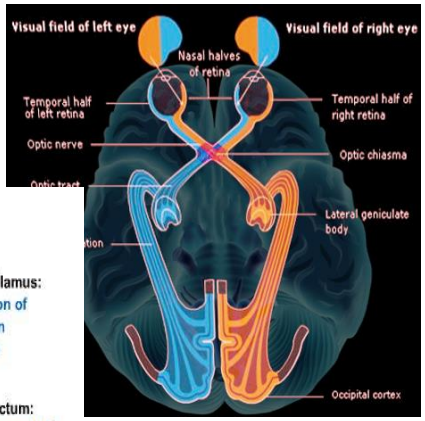
The optic nerve is composed of the axons of the cells of the ganglionic layer of the retina, emerging from the back of the eyeball and leaves the orbital cavity through the optic canal to enter the cranial cavity where it unites with that of the opposite side to form the optic chiasma.

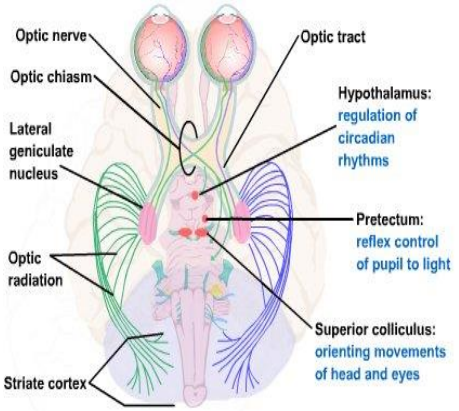


In the chiasma, the fibers from the medial half of each retina cross the midline and enter the optic tract of the opposite side, whereas the fibers from the lateral half of each retina pass posteriorly in the optic tract of the same side. Most of the fibers of the optic tract terminate by synapsing with nerve cells in the lateral geniculate body, axons of the nerve cells of the lateral

geniculate body pass posteriorly as the optic radiation and terminate in the visual cortex of the cerebral hemisphere.

Few fibers pass to the colliculus are concerned pretectal nucleus and the superior with light reflexes, (covered in Lec. 2).

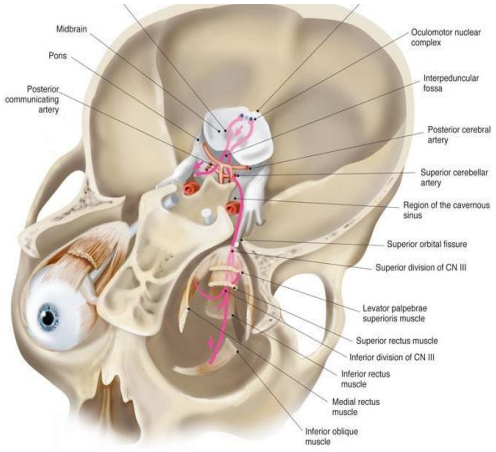




Oculomotor nerve

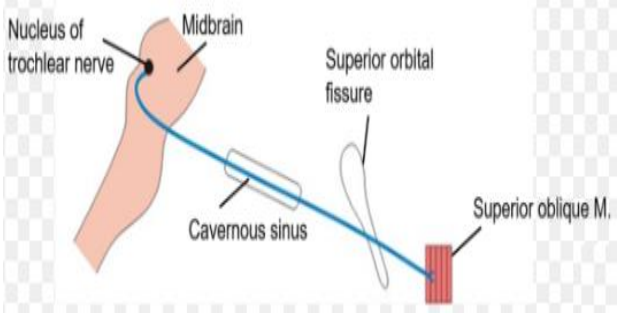
The oculomotor nerve emerges on the anterior surface of the midbrain and passes forward between the posterior and superior cerebellar arteries, it then continues into the middle cranial fossa in the lateral wall of the, cavernous sinus where it divides into a superior and an inferior ramus, which enter the orbital cavity through the superior orbital fissure. The nerve supplies the following:

- The extrinsic muscles of the eye: the levator palpebrae superioris, superior rectus, medial rectus, inferior rectus, and inferior oblique.
- The intrinsic muscles of the eye: the constrictor pupillae of the iris and the ciliary muscles are supplied by the parasympathetic component of the oculomotor nerve, these fibers synapse in the ciliary ganglion and reach the eyeball in the short ciliary nerves.



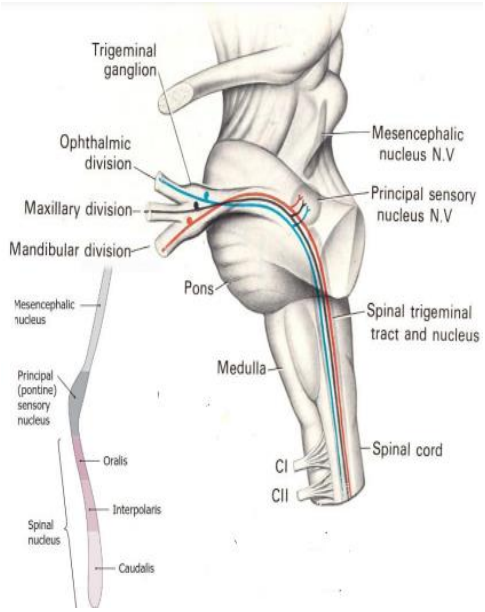
The oculomotor nerve, therefore, is entirely motor, it is responsible for lifting the upper eyelid; turning the eye upward, downward, and medially; constricting the pupil; and accommoda tion of the eye, (covered in Lec. 2).

Trochlear nerve



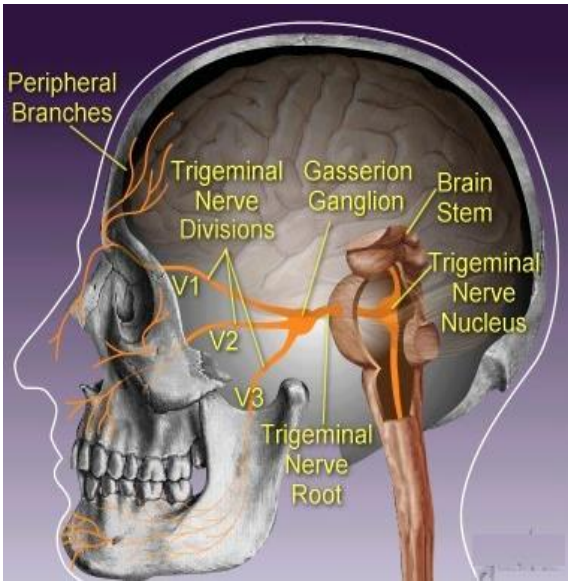
The trochlear nerve is the most slender of the cranial nerves, having crossed the nerve of the opposite side, it leaves the posterior surface of the midbrain and passes forward through the middle cranial fossa in the lateral wall of the cavernous sinus and enters the orbit through the superior orbital fissure, it supplies the superior oblique muscle of the eyeball (extrinsic muscle). Trochlear nerve is entirely motor and assists in turning the eye downward and laterally, (covered in Lec. 2).

Trigeminal nerve



The trigeminal nerve is the largest cranial nerve, it is formed of a small motor root and a large sensory root, the large sensory root expands to form the trigeminal ganglion *"Gasserion or Semilunar ganglion"*, trigeminal ganglion that lies within a pouch of dura mater called the trigeminal cave *"Mickeles cave"* and containing the cell bodies of incoming sensory-nerve fibers, the trigeminal ganglion is analogous to the dorsal root ganglia of the spinal cord, which contain the cell bodies of incoming sensory fibers from the rest of the body.

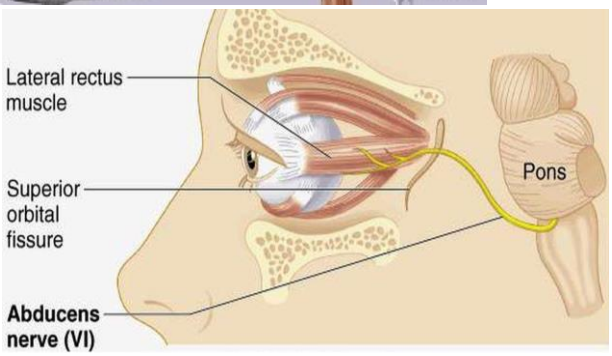
From the trigeminal ganglion, a single large sensory root (portio major) enters the brainstem at the level of the pons. Immediately adjacent to the sensory root, "situated below the sensory ganglion", a smaller motor root (portio minor) emerges from the pons "their cell bodies are located in the nucleus of the fifth nerve deep within the pons, motor fibers pass through the trigeminal ganglion without synapsing on their way to peripheral muscles.



The motor root of the trigeminal nerve is completely separate from it, ophthalmic [V1], maxillary [V2], and mandibular [V3] nerves arise from the anterior border of the ganglion, (these structures are covered before).

Abducent nerve

A small nerve emerges from the anterior surface of the hindbrain between the pons and the medulla oblongata and passes forward with the internal carotid artery through the cavernous sinus in the middle cranial fossa to enter the orbit through the superior orbital fissure, it supplies the lateral rectus muscle and is therefore responsible for turning the eye laterally, (covered in Lec. 2).



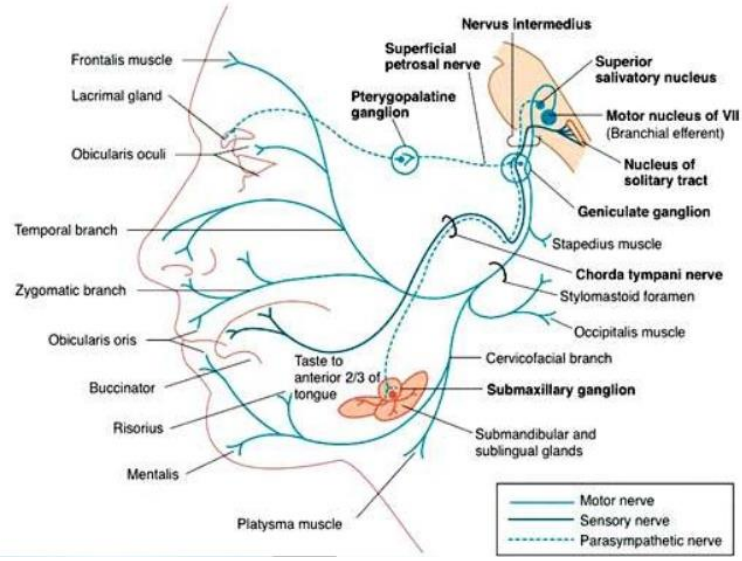
Facial nerve

Having a motor and a sensory root (nervus intermedius) , the nerve emerges on the anterior surface of the hindbrain between pons and the medulla oblongata, the roots pass laterally in the posterior cranial fossa with the vestibulocochlear nerve and enter the internal acoustic meatus in the petrous part of the temporal bone.

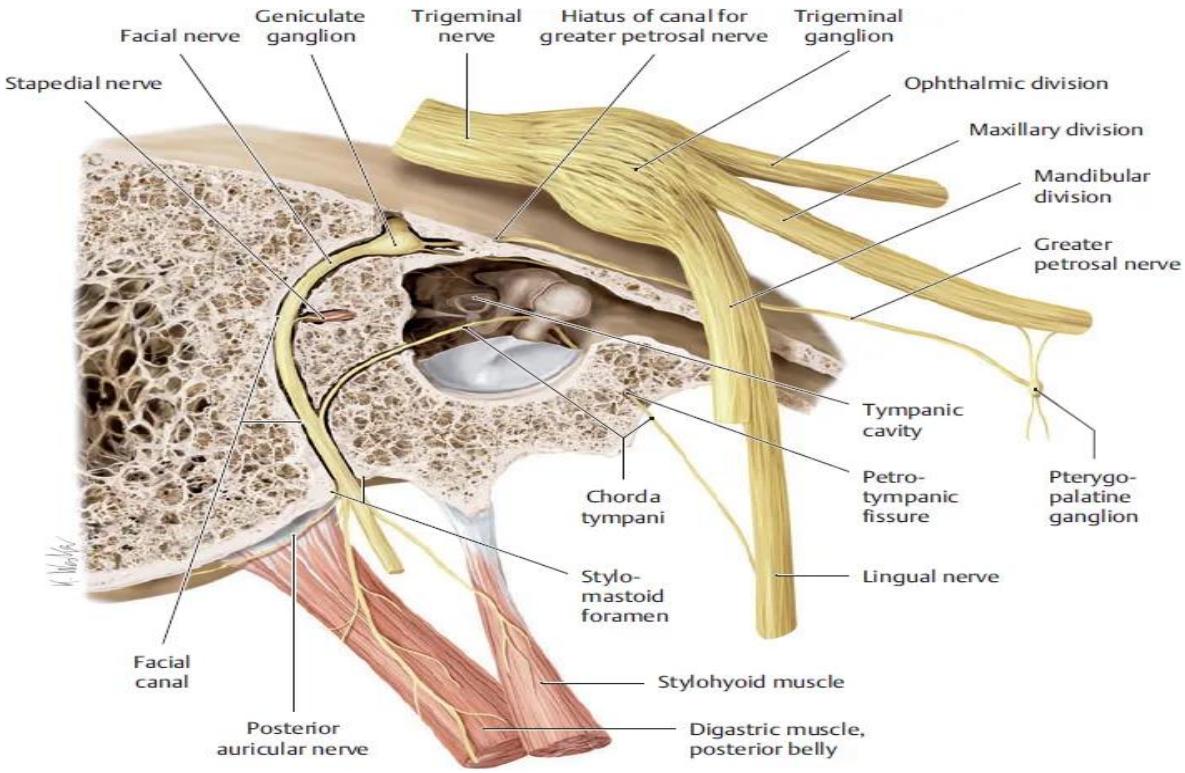
At the bottom of the meatus, the nerve enters the facial canal that runs laterally through the inner ear, reaching the medial wall of the middle ear (tympanic cavity), the nerve swells to form the sensory geniculate ganglion , the nerve then bends sharply backward above the promontory and, at

the posterior wall of the middle ear, bends down on the medial side of the aditus of the mastoid antrum.

The nerve descends behind the pyramid and it emerges from the temporal bone through the stylomastoid foramen , passing forward through the parotid gland to it`s distribution , through it`s course it gives rise to the following branches:



- Greater petrosal nerve arises from the nerve at the geniculate ganglion , it contains preganglionic parasympathetic fibers that synapse in the pterygopalatine ganglion, the postganglionic fibers are secretomotor to the lacrimal gland and the glands of the nose and the palate, it also contains taste fibers from the palate.
- Nerve to stapedius supplies the stapedius muscle in the middle ear.

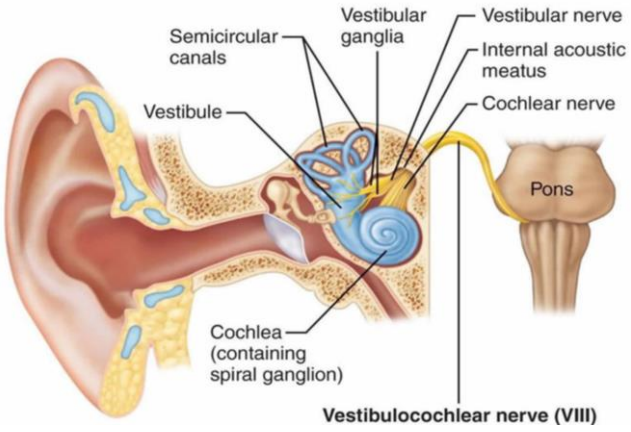


- Chorda tympani arises from the facial nerve in the facial canal in the posterior wall of the middle ear , it runs forward over the medial surface of the upper part of the tympanic membrane and leaves the middle ear through the petrotympanic fissure, thus entering the infratemporal fossa and joining the lingual nerve, the chorda tympani contains preganglionic parasympathetic secretomotor fibers to the submandibular and the sublingual salivary glands. It also contains taste fibers from the anterior two thirds of the tongue and floor of the mouth.
- Posterior auricular, the posterior belly of the digastric and the stylohyoid nerves are muscular branches given off by the facial nerve as it emerges from the stylomastoid foramen.

- Five terminal branches to the muscles of facial expression, these are the temporal, the zygomatic, the buccal, the mandibular, and the cervical branches (covered before in Lec. 4 & 9).

Vestibulocochlear nerve

The vestibulocochlear nerve is a sensory nerve that consists of two sets of fibers: vestibular and cochlear, they leave the anterior surface of the brain between the pons and the medulla oblongata, they cross the posterior cranial fossa and enter the internal acoustic meatus with the facial nerve.



Vestibular fibers

Are the central processes of the nerve cells of the vestibular ganglion situated in the internal acoustic meatus originating from the vestibule and the semicircular canals; therefore, they are concerned with the sense of position and movements of the head.

Cochlear fibers

The cochlear fibers are the central processes of the nerve cells of the spiral ganglion of the cochlea, originating in the spiral organ of Corti and are therefore concerned with hearing.

Glossopha[illegible]l nerve
Vagus ner[illegible]
Accessory [illegible] covered in Lec. 14
Hypoglossa[illegible]ve

Ophthalmic nerve [V1] (covered in Lec. 2 & 5)

The ophthalmic nerve is purely sensory , it runs forward in the lateral wall of the cavernous sinus in the middle cranial fossa and divides into three branches, the lacrimal, frontal, and nasociliary nerves, which enter the orbital cavity through the superior orbital fissure , it`s braches include:

- *The lacrimal nerve* runs forward on the upper border of the lateral rectus muscle , it is joined by the zygomaticotemporal branch of the maxillary nerve, which contains the parasympathetic secretomotor fibers to the lacrimal gland, the nerve then enters the lacrimal gland and gives branches to the conjunctiva and the skin of the upper eyelid.
- *The frontal nerve* runs forward on the upper surface of the levator palpebrae superioris muscle and divides into the supraorbital and supratrochlear nerves , these nerves leave the orbital cavity and supply the frontal air sinus and the skin of the forehead and the scalp.
- *The nasociliary nerve* crosses the optic nerve, runs forward on the upper border of the medial rectus muscle, and continues as the anterior ethmoid nerve through the anterior ethmoidal foramen to enter the cranial cavity, then descends through a slit at the side of the crista galli to enter the nasal cavity and gives off two internal nasal branches and it then supplies the skin of the tip of the nose with the external nasal nerve. It`s branches include the following:

- Sensory fibers to the ciliary ganglion
- Long ciliary nerves that contain sympathetic fibers to the dilator pupillae muscle and sensory fibers to the cornea
- Infratrochlear nerve that supplies the skin of the eyelids
- Posterior ethmoidal nerve that is sensory to the ethmoid and sphenoid sinuses

Maxillary Nerve [V2] (covered in Lec. 5 & 10)

The maxillary nerve arises from the trigeminal ganglion in the middle cranial fossa, it passes forward in the lateral wall of the cavernous sinus and leaves the skull through the foramen rotundum and crosses the pterygopalatine fossa to enter the orbit through the inferior orbital fissure , it then continues as the infraorbital nerve in the infraorbital groove, and it emerges on the face through the infraorbital foramen. It gives sensory fibers to the skin of the face and the side of the nose , it`s branches include:

- *Meningeal branches*
- *Zygomatic branch*, which divides into the zygomaticotemporal and the zygomaticofacial nerves that supply the skin of the face, the zygomaticotemporal branch gives parasympathetic secretomotor fibers to the lacrimal gland via the lacrimal nerve
- *Ganglionic branches*, which are two short nerves that suspend the pterygopalatine ganglion in the pterygopalatine fossa , they contain sensory fibers that have passed through the ganglion from the nose, the palate, and the pharynx, they also contain postganglionic parasympathetic fibers that are going to the lacrimal gland.
- *Posterior superior alveolar nerve* , which supplies the maxillary sinus as well as the upper molar teeth and adjoining parts of the gum and the cheek
- *Middle superior alveolar nerve* , which supplies the maxillary sinus as well as the upper premolar teeth, the gums, and the cheek
- *Anterior superior alveolar nerve* , which supplies the maxillary sinus as well as the upper canine and the incisor teeth

Mandibular Nerve [V3] (covered in Lec. 5)

The mandibular nerve is both motor and sensory, the sensory root leaves the trigeminal ganglion and passes out of the skull through the foramen ovale to enter the infratemporal fossa, the motor root of the trigeminal nerve also leaves the skull through the foramen ovale and joins the sensory root to form the trunk of the mandibular nerve, and then divides into a small anterior and a large posterior division. Branches from the main trunk of the mandibular nerve

- *Meningeal branch*
- *Nerve to the medial pterygoid muscle*, which supplies not only the medial pterygoid, but also the tensor veli palatini muscle.

Branches from the anterior division of the mandibular nerve

- *Masseteric nerve* to the masseter muscle
- *Deep temporal nerves* to the temporalis muscle
- *Nerve to the lateral pterygoid muscle*
- *Buccal nerve* to the skin and the mucous membrane of the cheek, the buccal nerve does not supply the buccinator muscle (which is supplied by the facial nerve), and it is the only sensory branch of the anterior division of the mandibular nerve.

Branches from the posterior division of the mandibular nerve

- *Auriculotemporal nerve*, which supplies the skin of the auricle , the external auditory meatus, the temporomandibular joint, and the scalp, this nerve also conveys postganglionic parasympathetic secretomotor fibers from the otic ganglion to the parotid salivary gland.

- *Lingual nerve*, which descends in front of the inferior alveolar nerve and enters the mouth , it then runs forward on the side of the tongue and crosses the submandibular duct. In its course, it is joined by the chorda tympani nerve and it supplies the mucous membrane of the anterior two thirds of the tongue and the floor of the mouth, it also gives off preganglionic parasympathetic secretomotor fibers to the submandibular ganglion.
- *Inferior alveolar nerve* which enters the mandibular canal to supply the teeth of the lower jaw and emerges through the mental foramen (mental nerve) to supply the skin of the chin , before entering the canal, it gives off the mylohyoid nerve which supplies the mylohyoid muscle and the anterior belly of the digastric muscle.
- *Communicating branch*, which frequently runs from the inferior alveolar nerve to the lingual nerve.

Components and functions of cranial nerves

Nerve		Components	Function	Opening in Skull
I.	Olfactory	Sensory	Smell	Openings in cribriform plate of ethmoid
II.	Optic	Sensory	Vision	Optic canal
III.	Oculomotor	Motor	Lifts upper eyelid, turns eyeball upward, downward, and medially; constricts pupil; accommodates eye	Superior orbital fissure
IV.	Trochlear	Motor	Assists in turning eyeball downward and laterally	Superior orbital fissure
V.	Trigeminal			
	Ophthalmic division	Sensory	Cornea, skin of forehead, scalp, eyelids, and nose; also mucous membrane of paranasal sinuses and nasal cavity	Superior orbital fissure
	Maxillary division	Sensory	Skin of face over maxilla and the upper lip; teeth of upper jaw; mucous membrane of nose, the maxillary air sinus, and palate	Foramen rotundum
	Mandibular division	Motor	Muscles of mastication, mylohyoid, anterior belly of digastric, tensor veli palatini, and tensor tympani	Foramen ovale
		Sensory	Skin of cheek, skin over mandible, lower lip, and side of head; teeth of lower jaw and temporomandibular joint; mucous membrane of mouth and anterior two thirds of tongue	

VI.	Abducent	Motor	Lateral rectus muscle: turns eyeball laterally	Superior orbital fissure
VII.	Facial	Motor	Muscles of face, cheek, and scalp; stapedius muscle of middle ear; stylohyoid; and posterior belly of digastric	Internal acoustic meatus, facial canal, stylomastoid foramen
		Sensory	Taste from anterior two thirds of tongue, floor of mouth, and palate	
		Secretomotor	Submandibular and sublingual salivary parasympathetic glands, lacrimal gland, and glands of nose and palate	
VIII.	Vestibulocochlear			
	Vestibular	Sensory	Position and movement of head	Internal acoustic meatus
	Cochlear	Sensory	Hearing	
IX.	Glossopharyngeal	Motor	Stylopharyngeus muscle: assists swallowing	
		Secretomotor parasympathetic	Parotid salivary gland	Jugular foramen
		Sensory	General sensation and taste from posterior third of tongue and pharynx; carotid sinus and carotid body	
X.	Vagus	Motor	Constrictor muscles of pharynx and intrinsic muscles of larynx; involuntary muscle of trachea and bronchi, heart, alimentary tract from pharynx to splenic flexure of colon; liver and pancreas	Jugular foramen
		Sensory	Taste from epiglottis and vallecula and afferent fibers from structures named above	
XI.	Accessory			
	Cranial root	Motor	Muscles of soft palate, pharynx, and larynx	Jugular foramen
	Spinal root	Motor	Sternocleidomastoid and trapezius muscles	
XII.	Hypoglossal	Motor	Muscles of tongue controlling its shape and movement (except palatoglossus)	Hypoglossal canal

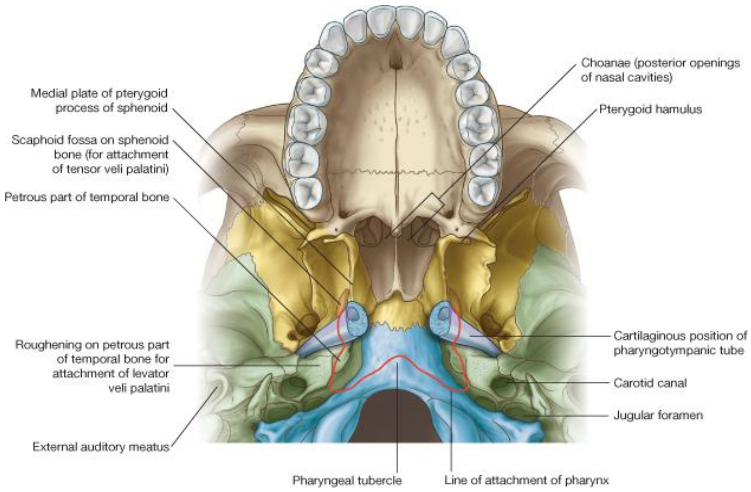
Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 2

Gross Anatomy
Head & Neck
Lec. : 19
Date: Sun. 9 April. 2023

The Neck

Pharynx

The pharynx is situated behind the nasal cavities, the mouth, and the larynx so it is divided into nasal, oral, and laryngeal parts, the pharynx is funnel shaped, it`s upper, wider end lying under the skull and it`s lower, narrow end becomes continuous with the esophagus opposite the sixth cervical vertebra.



The pharynx has a musculomembranous wall, which is deficient anteriorly, where it is replaced by the posterior openings into the nose (choanae), the opening into the mouth, and the inlet of the larynx.

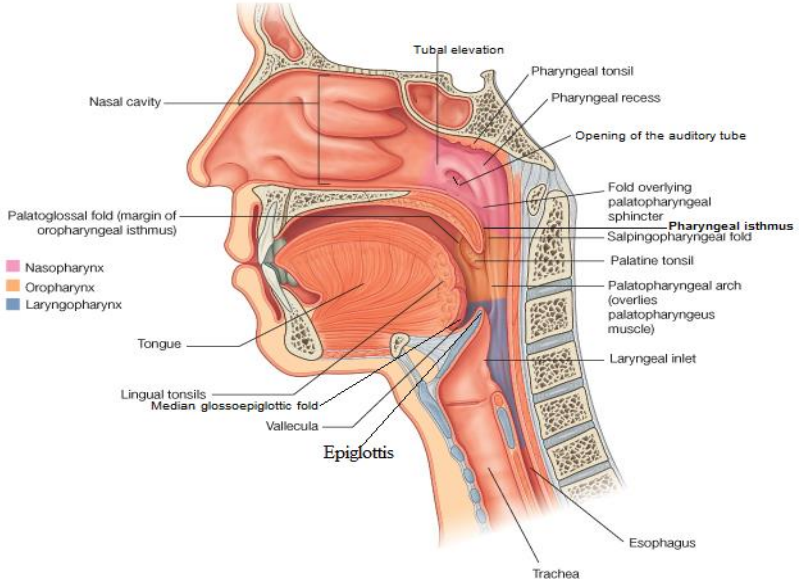
By means of the auditory tube, the mucous membrane of the pharynx is continuous with that of the tympanic cavity.

Interior of the pharynx

The pharynx is divided into three parts: nasal, oral pharynx and laryngeal pharynx.

Nasal pharynx

It lies above the soft palate and behind the nasal cavities, in the submucosa of the roof is a collection of lymphoid tissues called the pharyngeal tonsil, the pharyngeal isthmus is the opening in the floor between the soft palate and the posterior pharyngeal wall.



On the lateral wall is the opening of the auditory tube, the elevated ridge of which is called the tubal elevation, the pharyngeal recess is a depression in the pharyngeal wall behind the tubal elevation. the salpingopharyngeal fold is a vertical fold of mucous membrane covering the salpingopharyngeus muscle.

Oral pharynx

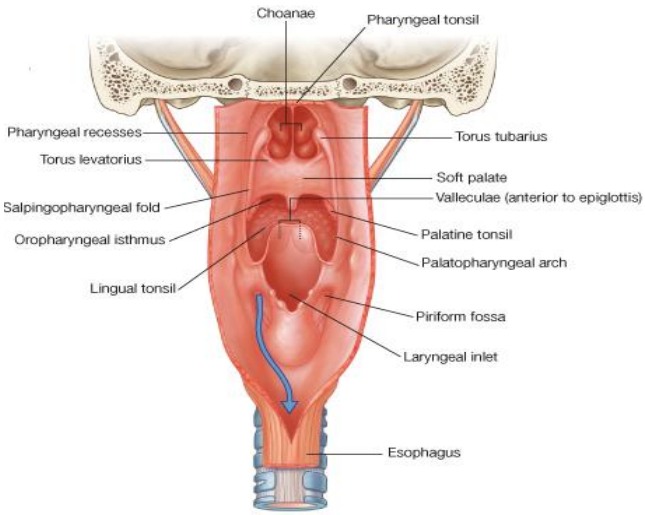
It lies behind the oral cavity, the floor is formed by the posterior one third of the tongue and the interval between the tongue and epiglottis, in the midline is the median glossoepiglottic fold, and on each side the lateral glossoepiglottic fold, the depression on each side of the median glossoepiglottic fold is called the vallecula.

On the lateral wall on each side are the palatoglossal and the palatopharyngeal arches or folds and the palatine tonsils between them, the palatoglossal arch is a fold of mucous membrane covering the palatoglossus muscle.

The interval between the two palatoglossal arches is called the oropharyngeal isthmus and marks the boundary between the mouth and pharynx, the palatopharyngeal arch is a fold of mucous membrane covering the palatopharyngeus muscle.

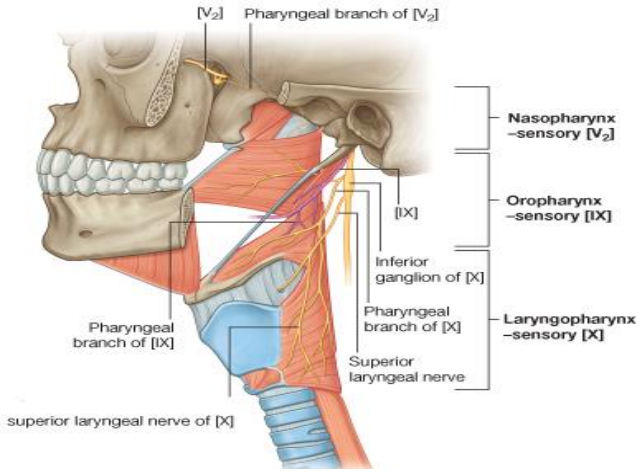
Laryngeal pharynx

This lies behind the laryngeal inlet, the lateral wall is formed by the thyroid cartilage and the thyrohyoid membrane, the piriform fossa is a depression in the mucous membrane on each side of the laryngeal inlet.



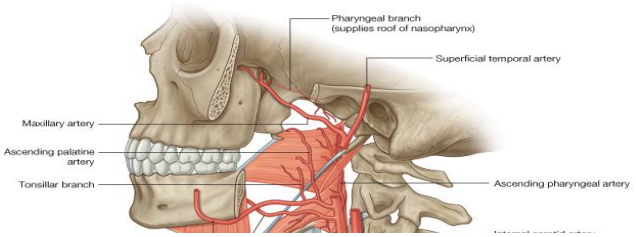
Sensory nerve supply of the pharyngeal mucous membrane

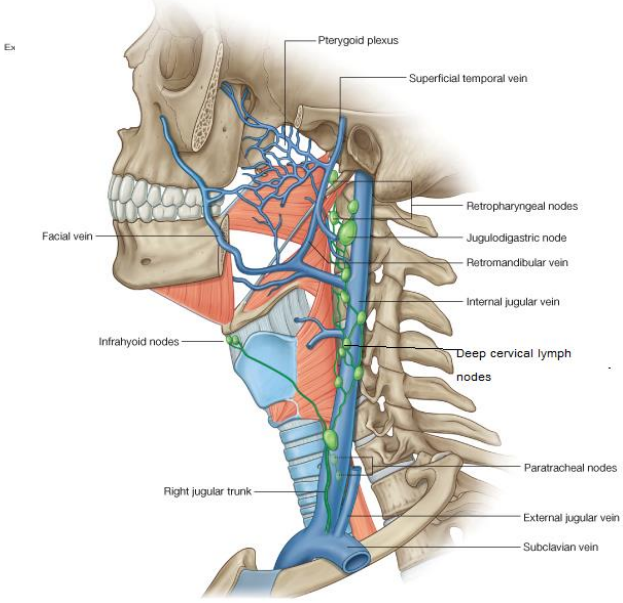
- *Nasal pharynx:* maxillary nerve [V2].
- *Oral pharynx:* pharyngeal branches from the glossopharyngeal nerve [IX] sensory and motor branch from the vagus nerve [X] .
- *Laryngeal pharynx (around the entrance into the larynx):* internal laryngeal nerve branch of the superior laryngeal nerve which in turn a branch of the vagus nerve[X].



Blood supply of the pharynx

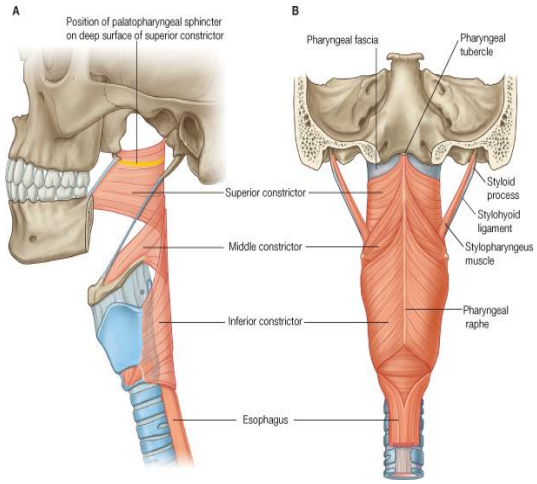
Ascending pharyngeal, tonsillar branches of facial arteries, and branches of maxillary and lingual arteries.





Lymph drainage of the pharynx

Directly into the deep cervical lymph nodes or indirectly via the retropharyngeal or paratracheal nodes into the deep cervical nodes.



Muscles of the pharynx

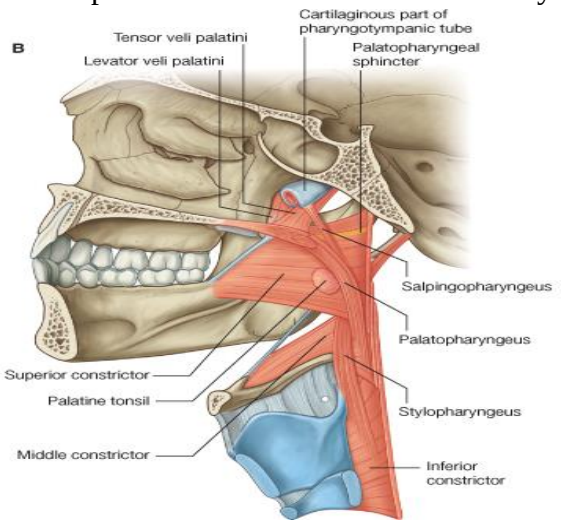
The wall of the pharynx consist of the superior, middle, and inferior constrictor muscles, whose fibers run in a somewhat circular direction, and the stylopharyngeus and salpingopharyngeus muscles, whose fibers run in a somewhat longitudinal direction.

The three constrictor muscles extend around the pharyngeal wall to be inserted into a fibrous band or raphe that extends from the pharyngeal tubercle on the basilar part of the occipital bone of the skull down to the esophagus.

The three constrictor muscles overlap each other so that the inferior constrictor lies on the outside of the lower part of the middle constrictor and the middle constrictor lies outside the lower part of the superior constrictor.

Palatine tonsils

The palatine tonsils are two masses of lymphoid tissue, each located in the depression on the lateral wall of the oral part of the pharynx between the palatoglossal and palatopharyngeal arches, each tonsil is covered by mucous membrane, and it`s free medial surface projects into the pharynx, the surface is pitted by numerous small openings that lead into the tonsillar crypts.



The tonsil is covered on it`s lateral surface by a fibrous capsule, the tonsil reaches it`s maximum size during early childhood, but after puberty it`s size decreases considerably.

Blood supply

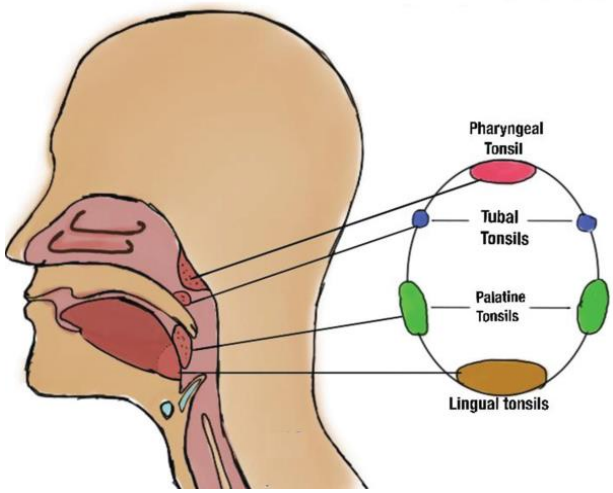
The tonsillar branch of the facial artery, the veins pierce the superior constrictor muscle and join the external palatine, the pharyngeal, or the facial veins.

Lymph drainage of the tonsil

The upper deep cervical lymph nodes, just below and behind the angle of the mandible.

Waldeyer's ring of lymphoid tissue

The lymphoid tissue that surrounds the opening into the respiratory and digestive systems forms a ring, the lateral part of the ring is formed by the palatine tonsils and tubal tonsils (lymphoid tissue around the opening of the auditory tube in the lateral wall of the nasopharynx), the pharyngeal tonsil in the roof of the nasopharynx forms the upper part, and the lingual tonsil on the posterior third of the tongue forms the lower part.



Muscles of the pharynx

Muscle	Origin	Insertion	Nerve Supply	Action
Superior constrictor	Medial pterygoid plate, pterygoid hamulus, Pterygomandibular ligament, mylohyoid line of mandible	Pharyngeal tubercle of occipital bone, raphe in midline posteriorly	Pharyngeal plexus	Aids soft palate in closing off nasal pharynx, propels bolus downward
Middle constrictor	Lower part of stylohyoid ligament, lesser and greater cornu of hyoid bone	Pharyngeal raphe		Propels bolus downward
Inferior constrictor	Lamina of thyroid cartilage, cricoid cartilage			
Cricopharyngeus	Lowest fibers of inferior constrictor muscle			Sphincter at lower end of pharynx
Stylopharyngeus	Styloid process of temporal bone	Posterior border of thyroid cartilage	Glossopharyngeal nerve	Elevates larynx during swallowing
Palatopharyngeus	Palatine aponeurosis		Pharyngeal plexus	Elevates wall of pharynx, pulls palatopharyngeal arch medially
Salpingopharyngeus	Auditory tube	Blends with palatopharyngeus		Elevates pharynx

Clinical notes

Pharyngeal pouch

Examination of the lower part of the posterior surface of the inferior constrictor muscle reveals a potential gap between the upper oblique and the lower horizontal fibers (cricopharyngeus), this area is marked by a dimple in the lining mucous membrane, it is believed that the function of the cricopharyngeus is to prevent the entry of air into the esophagus.

Should the cricopharyngeus fail to relax during swallowing, the internal pharyngeal pressure may rise and force the mucosa and submucosa of the dimple posteriorly, to produce a diverticulum.

Once the diverticulum has been formed, it may gradually enlarge and fill with food with each meal, unable to expand posteriorly because of the vertebral column, it turns downward, usually on the left side, the presence of the pouch filled with food causes difficulty in swallowing (dysphagia).

Cervical tuberculous osteomyelitis and the pharynx

Pus arising from tuberculosis of the upper cervical vertebrae is limited in front by the prevertebral layer of deep fascia, a midline swelling is formed and bulges forward in the posterior wall of the pharynx, the pus then tracks laterally and downward behind the sternocleidomastoid.

Rarely, the abscess may track downward behind the prevertebral fascia to reach the superior and posterior mediastina in the thorax , it is important to distinguish this condition from an abscess involving the retropharyngeal lymph nodes, these nodes lie in front of the prevertebral layer of fascia but behind the fascia, which covers the outer surface of the constrictor muscles, such an abscess usually points on the posterior pharyngeal wall and, if untreated, ruptures into the pharyngeal cavity.

Al- Muthan`na University
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Dept. of Anatomy
Semester: 2

Gross Anatomy
Head & Neck
Lec. : 20
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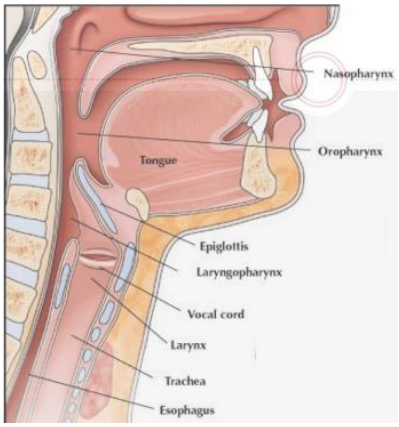
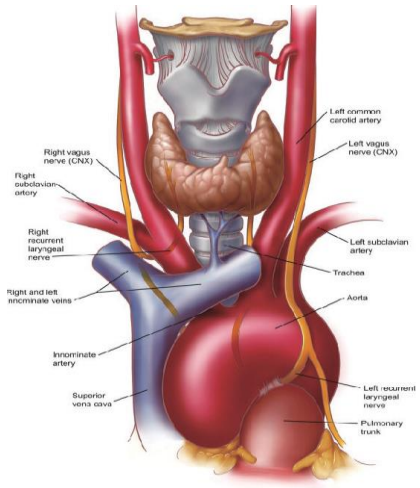
The Neck

Larynx

The larynx is the organ that provides a protective sphincter at the inlet of the trachea and responsible for voice production, it is situated below the tongue and the hyoid bone and between the great blood vessels of the neck and lies at the level of the fourth, fifth, and sixth cervical vertebrae, it opens above into the laryngeal part of the pharynx and below is continuous with the trachea.

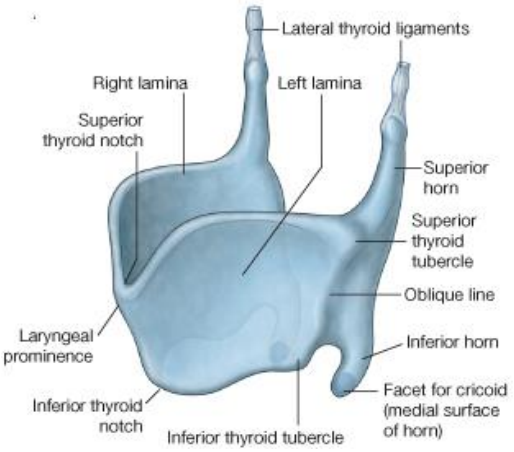


The larynx is covered in front by the infra-hyoid muscles and at the sides by the thyroid gland. The framework of the larynx is formed of cartilages that are held together by ligaments and membranes, moved by muscles, and lined by mucous membrane.

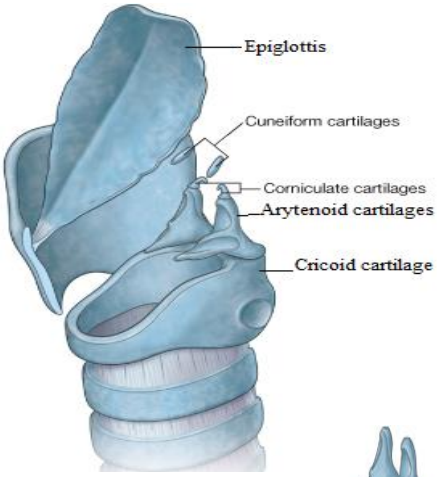


Cartilages of the larynx

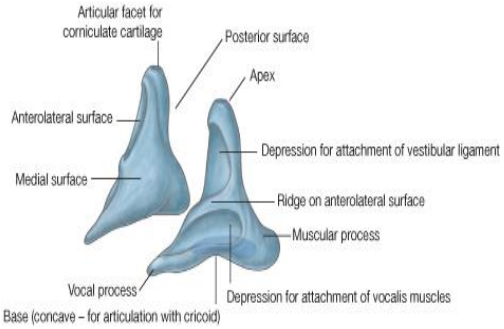
- **Thyroid cartilage:** it`s the largest cartilage of the larynx and consists of two laminae of hyaline cartilage that meet in the midline in the prominent V angle (the so-called Adam's apple). The posterior border extends upward into a superior cornu and downward into an inferior cornu, on the outer surface of each lamina is an oblique line for the attachment of muscles.



- **Cricoid cartilage:** this cartilage is formed of hyaline cartilage and shaped like a signet ring, having a broad plate behind and a shallow arch in front, the cricoid cartilage lies below the thyroid cartilage, and each side of the lateral surface is on a facet for articulation with the inferior cornu of the thyroid cartilage. Posteriorly, the lamina has on it`s upper border on each side a facet for articulation with the arytenoid cartilage, all these joints are synovial.



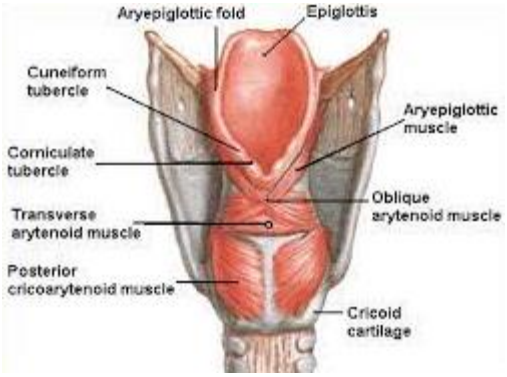
- **Arytenoid cartilages:** there are two arytenoid cartilages, which are small and pyramid shaped and located at the back of the larynx, they articulate with the upper border of the lamina of the cricoid cartilage.



Each cartilage has an apex above that articulates with the small corniculate cartilage, a base below that articulates with the lamina of the cricoid cartilage, and a vocal process that projects forward and gives attachment to the vocal ligament, a muscular process that projects laterally gives attachment to the posterior and lateral cricoarytenoid muscles.

- **Corniculate cartilages:** two small conical-shaped cartilages articulate with the arytenoid cartilages, they give attachment to the aryepiglottic folds.

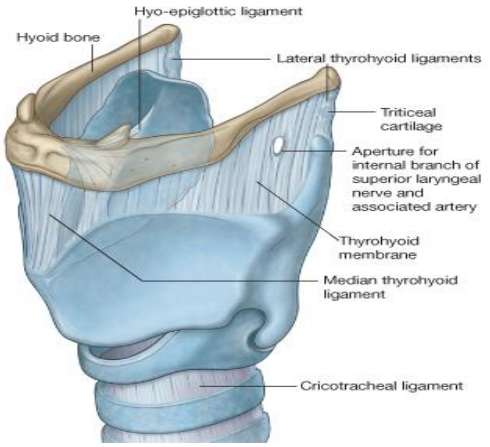
- **Cuneiform cartilages:** these two small rod-shaped cartilages are found in the aryepiglottic folds and serve to strengthen them.
- **Epiglottis:** this leaf-shaped lamina of elastic cartilage lies behind the root of the tongue, it`s stalk is attached to the back of the thyroid cartilage, the sides of the epiglottis are attached to the arytenoid cartilages by the aryepiglottic folds of mucous membrane, the upper edge of the epiglottis is free.



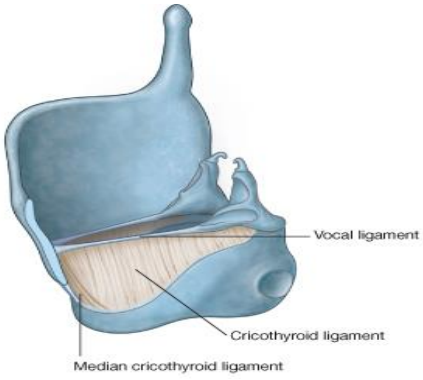
The covering of mucous membrane passes forward onto the posterior surface of the tongue as the median glossoepiglottic fold; the depression on each side of the fold is called the vallecula, laterally the mucous membrane passes onto the wall of the pharynx as the lateral glossoepiglottic fold.

Membranes and ligaments of the larynx

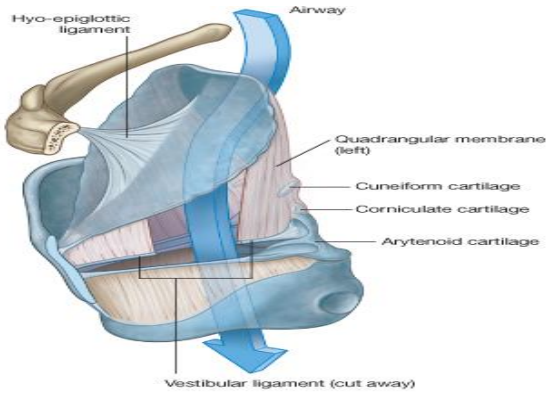
- **Thyrohyoid membrane:** this connects the upper margin of the thyroid cartilage to the hyoid bone, in the midline it is thickened to form the median thyrohyoid ligament, it is pierced on each side by the superior laryngeal vessels and the internal laryngeal nerve, a branch of the superior laryngeal nerve, on either sides the ligament thickens forming the lateral thyrohyoid ligaments.



- **Cricothyroid ligament:** the lower margin is attached to the upper border of the cricoid cartilage, the upper margin of the ligament, instead of being attached to the thyroid cartilage, ascends on the medial surface of the thyroid cartilage, it`s upper free margin, composed almost entirely of elastic tissue, forms the important *vocal ligament on each side*, the vocal ligaments form the interior of the vocal folds (vocal cords), the anterior end of each vocal ligament is attached to the thyroid cartilage, and the posterior end is attached to the vocal process of the arytenoid cartilage



- **Cricotracheal ligament:** connects the cricoid cartilage to the first ring of the trachea.
- **Quadrangular membrane:** extends between the epiglottis and the arytenoid cartilages, it`s thickened inferior margin forms the vestibular ligament, and the vestibular ligaments form the interior of the vestibular folds



Inlet of the larynx

The inlet of the larynx lies backward and upward into the laryngopharynx, the opening is wider in front than behind and is bounded in front by the epiglottis, laterally by the aryepiglottic fold of mucous membrane, and posteriorly by the arytenoid cartilages with the corniculate cartilages.

The cuneiform cartilage lies within and strengthens the aryepiglottic fold and produces a small elevation on the upper border.

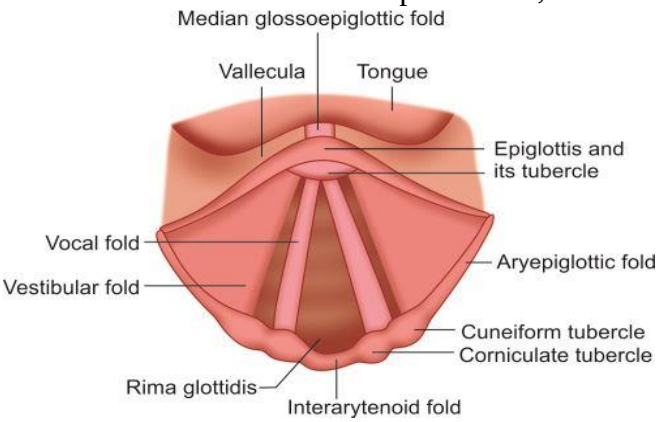
Laryngeal folds

Vestibular fold

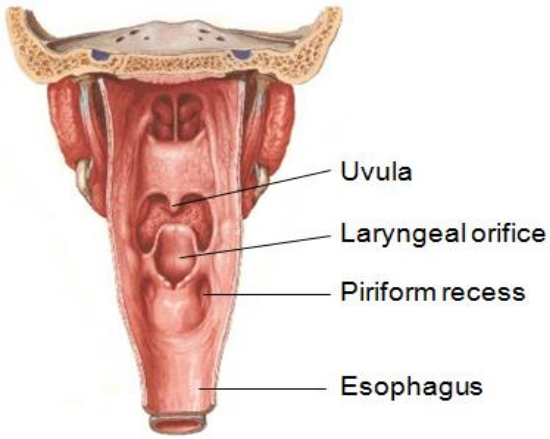
The vestibular fold is a fixed fold on each side of the larynx, formed by the mucous membrane covering the vestibular ligament and is vascular and pink in color.

Vocal fold (Vocal cord)

The vocal fold is a mobile fold on each side of the larynx and is concerned with voice production, formed by mucous membrane covering the vocal ligament and is avascular and white in color, it moves with respiration and it`s white color is easily seen when viewed with a laryngoscope.



The gap between the vocal folds is called the rima glottidis or glottis, the glottis is the narrowest part of the larynx and measures about 2.5 cm from front to back in adult males and less in the female. In children the lower part of the larynx within the cricoid cartilage is the narrowest part.



Piriform fossa

A recess on either side of the aryepiglottic fold and the inlet of the larynx, it is bounded medially by the aryepiglottic fold and laterally by the thyroid cartilage and the thyrohyoid membrane.

Muscles of the larynx

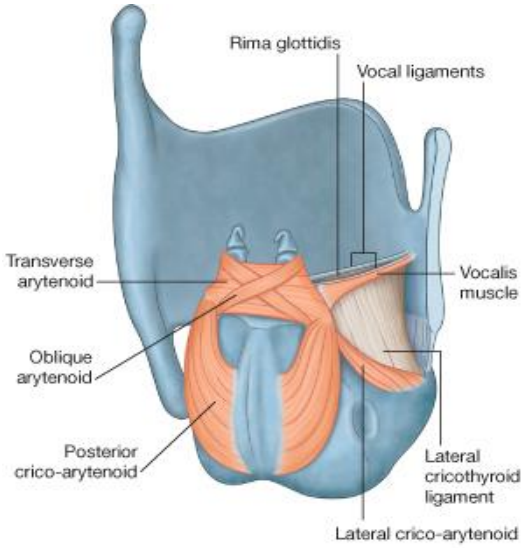
The muscles of the larynx may be divided into two groups: extrinsic and intrinsic.

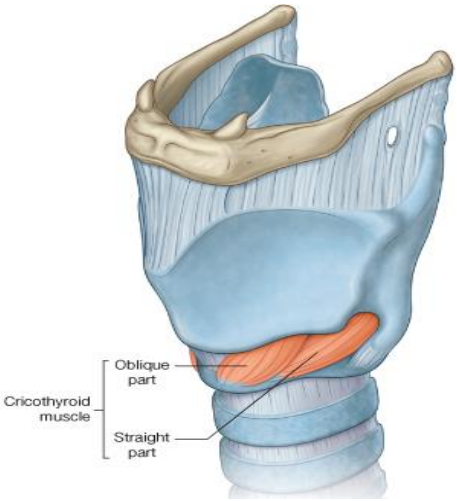
Extrinsic muscles

These muscles move the larynx up and down during swallowing, note that many of these muscles are attached to the hyoid bone, which is attached to the thyroid cartilage by the thyrohyoid membrane, it follows that movements of the hyoid bone that are accompanied by movements of the larynx.

Elevation: digastric, the stylohyoid, the mylohyoid, the geniohyoid, the stylopharyngeus, the salpingopharyngeus, and the palatopharyngeus muscles.

Depression: sternothyroid, the sternohyoid, and the omohyoid muscles





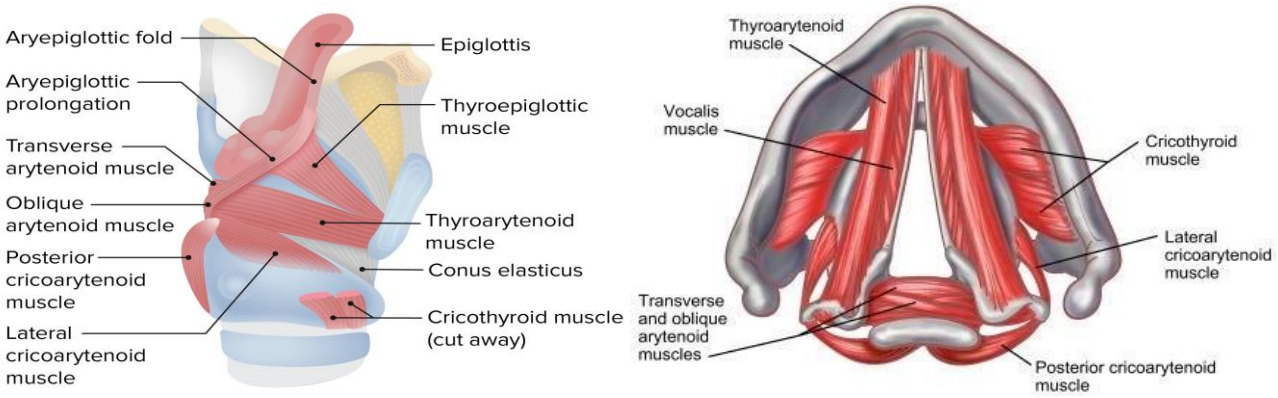
Intrinsic muscles

Two muscles modify the laryngeal inlet:

- *Narrowing the inlet;* oblique arytenoid muscle
- *Widening the inlet;* thyroepiglottic muscle.

Five muscles move the vocal folds (cords):

- *Tensing the vocal cords;* cricothyroid muscle
- *Relaxing the vocal cords;* thyroarytenoid (vocalis) muscle
- *Adducting the vocal cords;* lateral cricoarytenoid muscle
- *Abducting the vocal cords;* posterior cricoarytenoid muscle
- *Approximates the arytenoid cartilages;* transverse arytenoid muscl



Intrinsic muscles of the larynx

Muscle	Origin	Insertion	Nerve supply	Action
Muscles controlling the laryngeal inlet				
Oblique arytenoid	Muscular process of arytenoid cartilage	Apex of opposite arytenoid cartilage	Recurrent laryngeal nerve	Narrows the inlet by bringing the aryepiglottic folds together
Thyroepiglottic	Medial surface of thyroid cartilage	Lateral margin of epiglottis and aryepiglottic fold	Recurrent laryngeal nerve	Widens the inlet by pulling the aryepiglottic folds apart
Muscles Controlling the movements of the vocal folds (Cords)				
Cricothyroid	Side of cricoid cartilage	Lower border and inferior cornu of thyroid cartilage	External laryngeal nerve	Tenses vocal cords
Thyroarytenoid (vocalis)	Inner surface of thyroid cartilage	Arytenoid cartilage	Recurrent laryngeal nerve	Relaxes vocal cords
Lateral cricoarytenoid	Upper border of cricoid cartilage	Muscular process of arytenoid cartilage	Recurrent laryngeal nerve	Adducts the vocal cords by rotating arytenoid cartilage
Posterior cricoarytenoid	Back of cricoid cartilage	Muscular process of arytenoid cartilage	Recurrent laryngeal nerve	Abducts the vocal cords by rotating arytenoid cartilage
Transverse arytenoid	Back and medial surface of arytenoid cartilage	Back and medial surface of opposite arytenoid cartilage	Recurrent laryngeal nerve	Closes posterior part of rima glottidis by approximating arytenoid cartilages

Movements of the vocal folds (Cords)

The movements of the vocal folds depend on the movements of the arytenoid cartilages, which rotate and slide up and down on the sloping shoulder of the superior border of the cricoid cartilage.

The rima glottidis is opened by the contraction of the posterior cricoarytenoid, which rotates the arytenoid cartilage and abducts the vocal process, the elastic tissue in the capsules of the cricoarytenoid joints keeps the arytenoid cartilages apart so that the posterior part of the glottis is open.

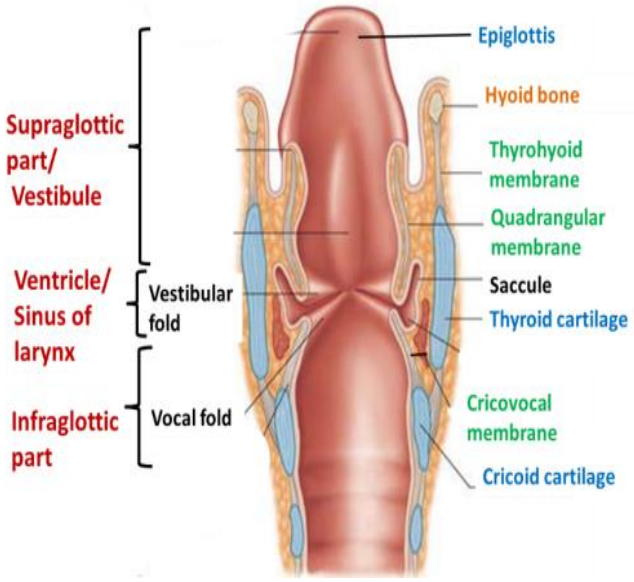
Mucous membrane of the larynx

The mucous membrane of the larynx lines the cavity is ciliated columnar epithelium , on the vocal cords, where the mucous membrane is subject to repeated trauma during phonation, is covered with stratified squamous epithelium.

Cavity of the larynx

The cavity of the larynx extends from the inlet to the lower border of the cricoid cartilage, where it is continuous with the cavity of the trachea, it is divided into three regions:

- The vestibule, which is situated between the inlet and the vestibular folds.
- The middle region, which is situated between the vestibular folds above and the vocal folds below
- The lower region, which is situated between the vocal folds above and the lower border of the cricoid cartilage below



Sinus of the larynx

The sinus of the larynx is a small recess on each side of the larynx situated between the vestibular and vocal folds, it is lined with mucous membrane.

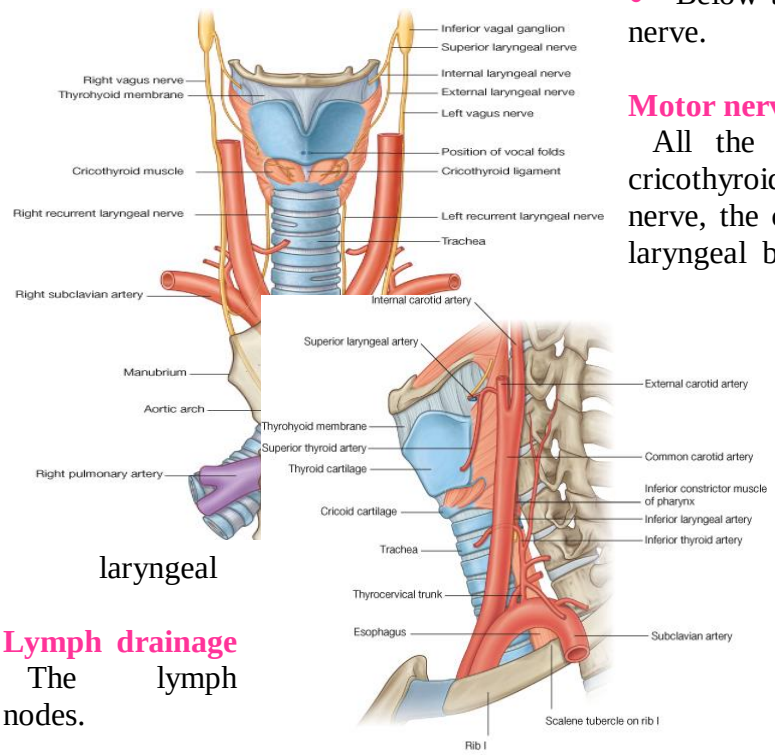
Saccule of the larynx

The saccule of the larynx is a diverticulum of mucous membrane that ascends from the sinus ,the mucous secretion lubricates the vocal cords.

Nerve supply of the larynx

Sensory nerves

- Above the vocal cords: internal laryngeal branch of the superior laryngeal branch of the vagus.
- Below the level of the vocal cords; recurrent laryngeal nerve.



Motor nerves

All the intrinsic muscles of the larynx except the cricothyroid muscle are supplied by the recurrent laryngeal nerve, the cricothyroid muscle is supplied by the external laryngeal branch of the superior laryngeal branch of the vagus.

laryngeal

Blood supply of the larynx

- Upper half of the larynx; superior laryngeal branch of the superior thyroid artery
- Lower half of the larynx; inferior branch of the inferior thyroid artery

Lymph drainage of the larynx

The lymph vessels drain into the deep cervical group of nodes.

The laryngeal ventricle, (also called the ventricle of the larynx, laryngeal sinus, or Morgagni's sinus) HYPERLINK "https://en.wikipedia.org/wiki/Laryngeal_ventricle" \l "cite_note-1" [1] is a fusiform fossa, situated between the vestibular and vocal folds on either side, and extending nearly their entire length, there is also a sinus of Morgagni in the pharynx.

The fossa is bounded, above, by the free crescentic edge of the vestibular ligament; below, by the straight margin of the vocal fold and laterally, by the mucous membrane covering the

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Ear

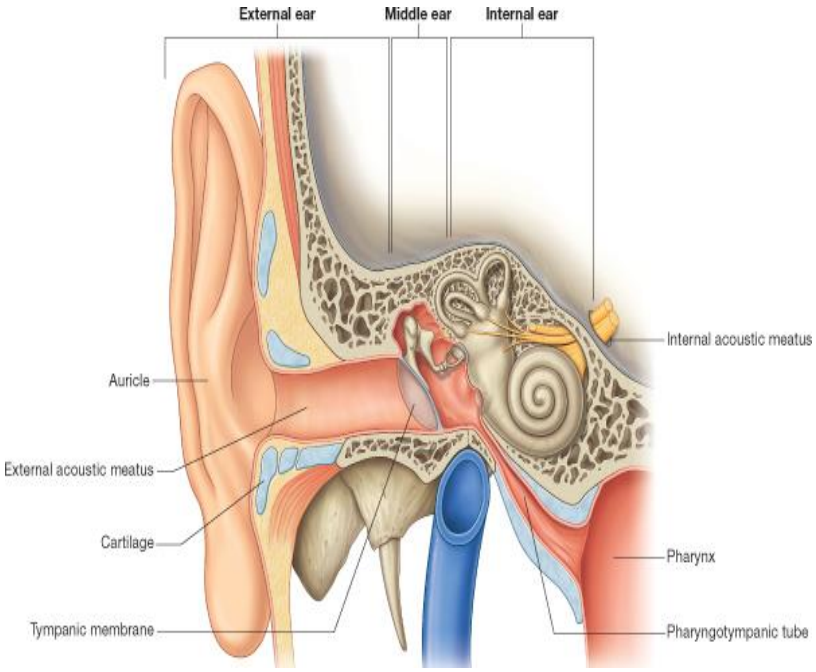
The ear is the organ of hearing and balance, it has three parts; external, middle and internal.

External ear

The external ear consists of two parts. The auricle (pinna) and the external acoustic meatus, the auricle has a characteristic shape and collects air vibrations, it consists of a thin plate of elastic cartilage covered by skin and possesses both extrinsic and intrinsic muscles.

The external auditory meatus is a curved tube that leads from the auricle to the tympanic membrane, it conducts sound waves from the auricle to the tympanic membrane.

The framework of the outer third of the meatus is elastic cartilage, and the inner two thirds is bone, formed by the tympanic plate. The meatus is lined by skin, and it`s outer third is provided with hairs and sebaceous glands, the latter are modified sweat glands that secrete a yellowish brown wax. The hairs and the wax provide a sticky barrier that prevents the entrance of foreign bodies.

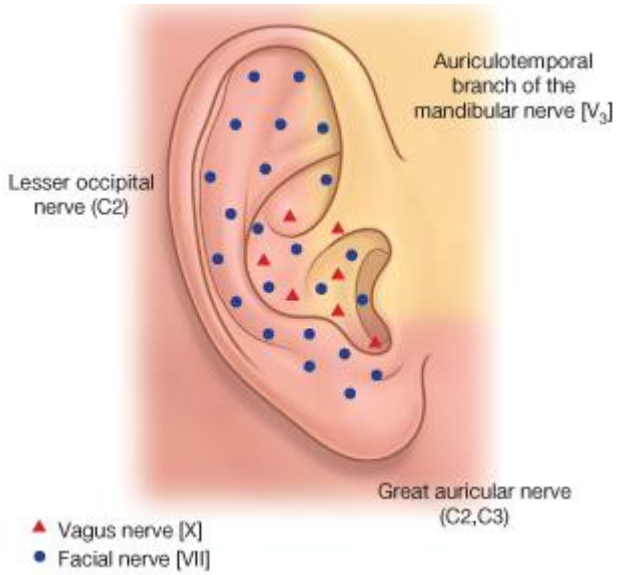


Innervation

Both groups of auricular (extrinsic and intrinsic muscles) are innervated by the facial nerve [VII].

Sensory innervation of the auricle is from many sources

- Outer more superficial surfaces of the auricle are supplied by the great auricular and lesser occipital nerves from the cervical plexus and the auriculotemporal branch of the mandibular nerve [V_3].
- Deeper parts of the auricle are supplied by branches from the facial [VII] and the vagus nerves [X].



Vessels

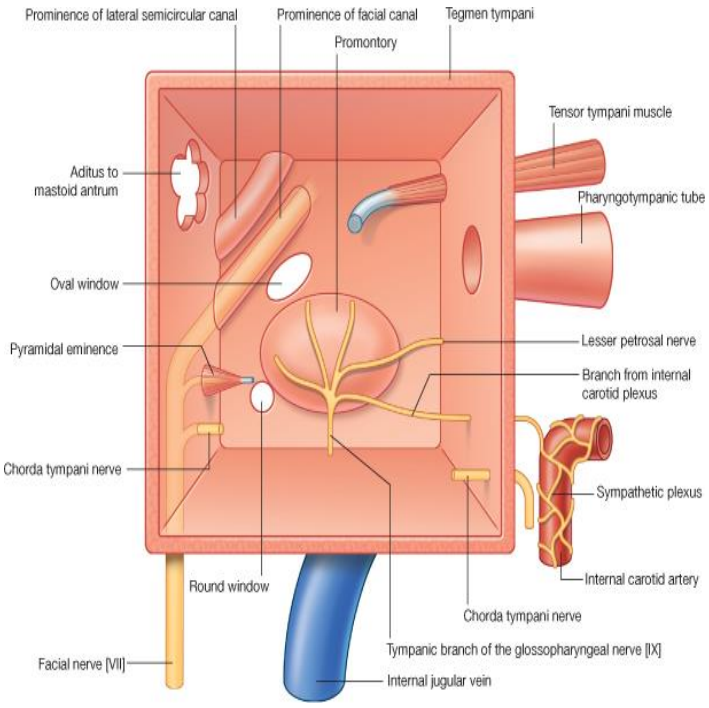
The arterial supply to the auricle is from numerous sources, the external carotid artery supplies the posterior auricular artery, the superficial temporal artery supplies anterior auricular branches, and the occipital artery supplies a branch.

Venous drainage

Is through vessels following the arteries, while lymphatic drainage of the auricle passes anteriorly into parotid nodes and posteriorly into mastoid nodes, and possibly into the upper deep cervical nodes.

Middle ear (Tympanic cavity)

The middle ear is an air-containing cavity in the petrous part of the temporal bone and is lined with mucous membrane, it contains the auditory ossicles, whose function is to transmit the vibrations of the tympanic membrane (eardrum) to the perilymph of the internal ear.



It is a narrow, oblique, slitlike cavity whose long axis lies approximately parallel to the plane of the tympanic membrane, it communicates in front through the auditory tube with the nasopharynx and behind with the mastoid antrum.

The middle ear has a roof, floor, anterior, posterior, lateral, and medial walls.

The roof is formed by a thin plate of bone, the tegmen tympani, which is part of the petrous temporal bone, it separates the tympanic cavity from the meninges and the temporal lobe of the brain in the middle cranial fossa.

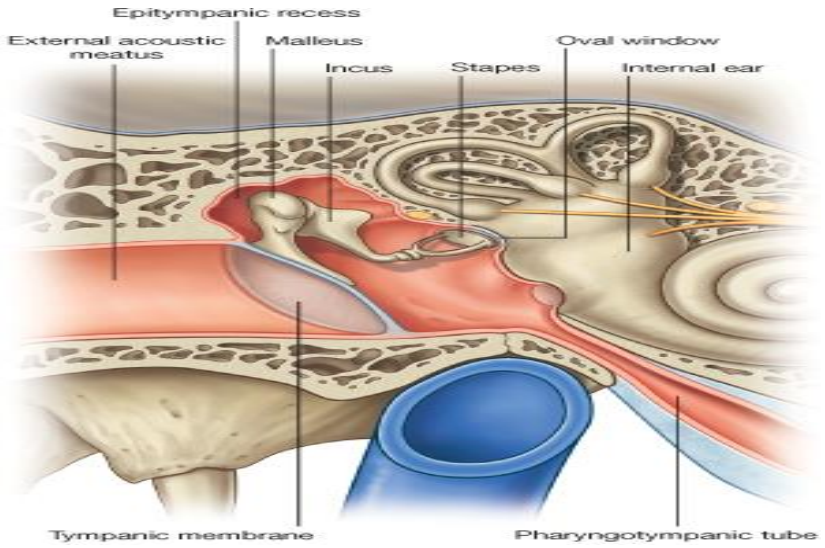
The floor is formed by a thin plate of bone, which may be partly replaced by fibrous tissue, it separates the tympanic cavity from the superior bulb of the internal jugular vein.

The anterior wall is formed below by a thin plate of bone that separates the tympanic cavity from the internal carotid artery, at the upper part of the anterior wall are the openings into two canals, the lower and larger of these leads into the auditory tube. and the upper and smaller is the entrance into the canal for the tensor tympani muscle .

The posterior wall has in it`s upper part a large, irregular opening, the aditus to the mastoid antrum, below this is a small, hollow, conical projection, the pyramid, from whose apex emerges the tendon of the stapedius muscle.

The lateral wall is largely formed by the tympanic membrane.

The medial wall is formed by the lateral wall of the inner ear, the greater part of the wall shows a rounded projection, called the promontory, which results from the underlying first turn of the cochlea.



Above and behind the promontory lies the fenestra vestibuli, which is oval shaped and closed by the base of the stapes, on the medial side of the window is the perilymph of the scala vestibuli of the internal ear.

Below the posterior end of the promontory lies the fenestra cochleae, which is round and closed by the secondary tympanic membrane.

Tympanic membrane

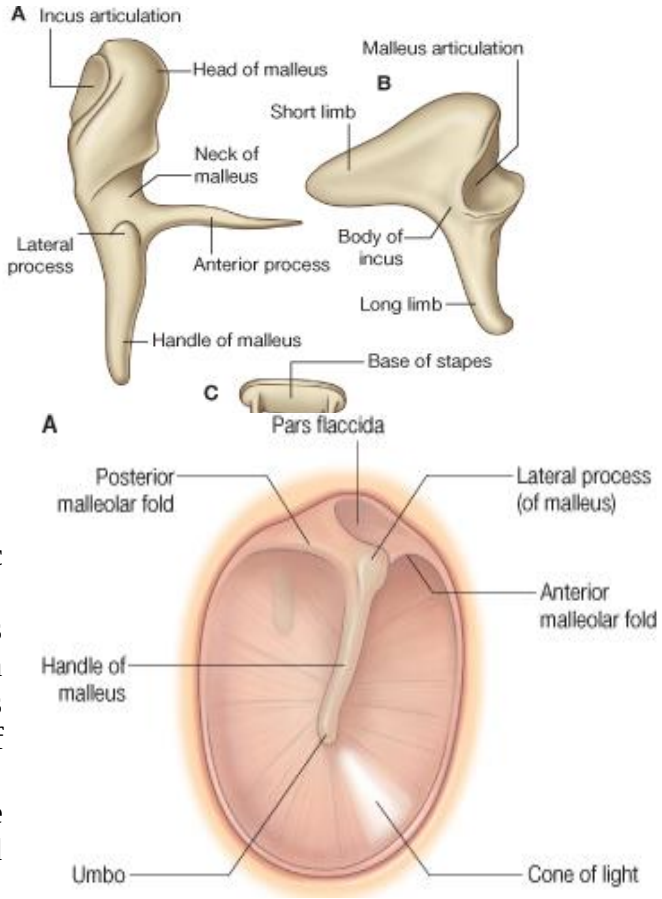
The tympanic membrane is a thin, fibrous membrane that is pearly gray, the membrane is obliquely placed, facing downward, forward, and laterally, it is concave laterally, and at the depth of the concavity is a small depression, the umbo, produced by the tip of the handle of the malleus, when the membrane is illuminated through an otoscope, the concavity produces a cone of light which radiates anteriorly and inferiorly from the umbo.

The tympanic membrane is circular and measures about 1 cm in diameter, the circumference is thickened and is slotted into a groove in the bone, the groove, or tympanic sulcus, is deficient superiorly, which forms a notch, from the sides of the notch, two bands, termed the anterior and posterior malleolar folds, pass to the lateral process of the malleus. The small triangular area on the tympanic membrane that is bounded by the

folds is slack and is called the pars flaccida . The remainder of the membrane is tense and is called the pars tensa.

The handle of the malleus is bound down to the inner surface of the tympanic membrane by the mucous membrane.

The tympanic membrane is extremely sensitive to pain and is innervated on it`s outer surface by the auriculotemporal nerve and the auricular branch of the vagus nerve.



Auditory ossicles

The auditory ossicles are the malleus, incus and stapes.

The malleus is the largest ossicle and possesses a head, a neck, a long process or handle, an anterior process, and a lateral process.

The head is rounded and articulates posteriorly with the incus, the neck is the constricted part below the head. The handle passes downward and backward and is firmly attached to the medial surface of the tympanic membrane, it can be seen through the tympanic membrane on otoscope examination.

The anterior process is a spicule of bone that is connected to the anterior wall of the tympanic cavity by a ligament, the lateral process projects laterally and is attached to the anterior and posterior malleolar folds of the tympanic membrane.

The incus possesses a large body and two processes, the body is rounded and articulates anteriorly with the head of the malleus.

The long process descends behind and parallel to the handle of the malleus, it`s lower end bends medially and articulates with the head of the stapes, it`s shadow on the tympanic membrane can sometimes be recognized on otoscope examination.

The short process projects backward and is attached to the posterior wall of the tympanic cavity by a ligament.

The stapes has a head, a neck, two limbs, and a base .

The head is small and articulates with the long process of the incus.

The neck is narrow and receives the insertion of the stapedius muscle.

The two limbs diverge from the neck and are attached to the oval base.

The edge of the base is attached to the margin of the fenestra vestibuli by a ring of fibrous tissue, the anular ligament.

Muscles of the ossicles

These are the tensor tympani and the stapedius muscles, shown in the table below:

Muscle	Origin	Insertion	Nerve Supply	Action
Tensor tympani	Wall of auditory tube and wall of it`s own canal	Handle of malleus	Mandibular division of trigeminal nerve	Dampens down vibrations of tympanic membrane
Stapedius	Pyramid (bony projection on posterior wall of middle ear)	Neck of stapes	Facial nerve	Dampens down vibrations of stapes

Auditory tube

The auditory tube connects the anterior wall of the tympanic cavity to the nasal pharynx. Its posterior third is bony, and its anterior two thirds is cartilaginous, as the tube descends it passes over the upper border of the superior constrictor muscle, it serves to equalize air pressures in the tympanic cavity and the nasal pharynx.

Mastoid antrum

The mastoid antrum lies behind the middle ear in the petrous part of the temporal bone, it communicates with the middle ear by the aditus.

Relations of the mastoid antrum

These are important in understanding the spread of infection.

Anterior wall is related to the middle ear and contains the aditus to the mastoid antrum.

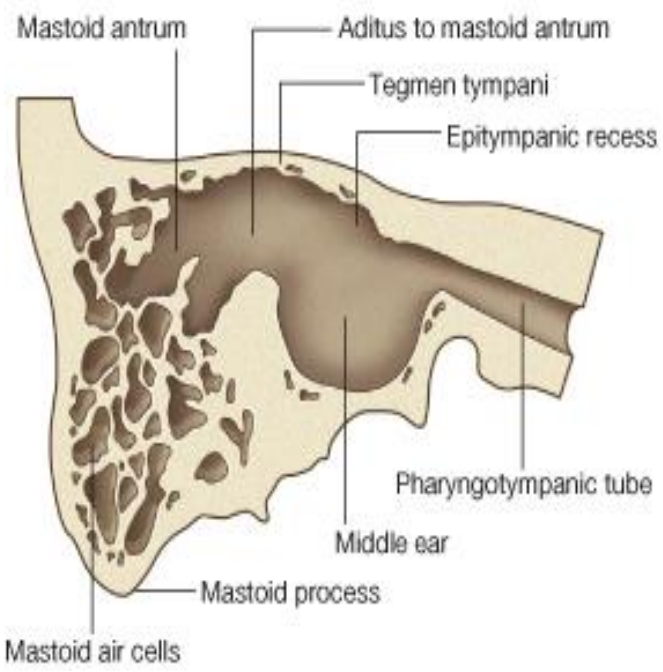
Posterior wall separates the antrum from the sigmoid venous sinus and the cerebellum.

Lateral wall is (1.5 cm) thick and forms the floor of the suprameatal triangle.

Medial wall is related to the posterior semicircular canal.

Superior wall is the thin plate of bone, the tegmen tympani, which is related to the meninges of the middle cranial fossa and the temporal lobe of the brain.

Inferior wall is perforated with holes, through which the antrum communicates with the mastoid air cells.



Mastoid air cells

The mastoid process begins to develop during the second year of life, the mastoid air cells are a series of communicating cavities within the process that are continuous above with the antrum and the middle ear, they are lined with mucous membrane.

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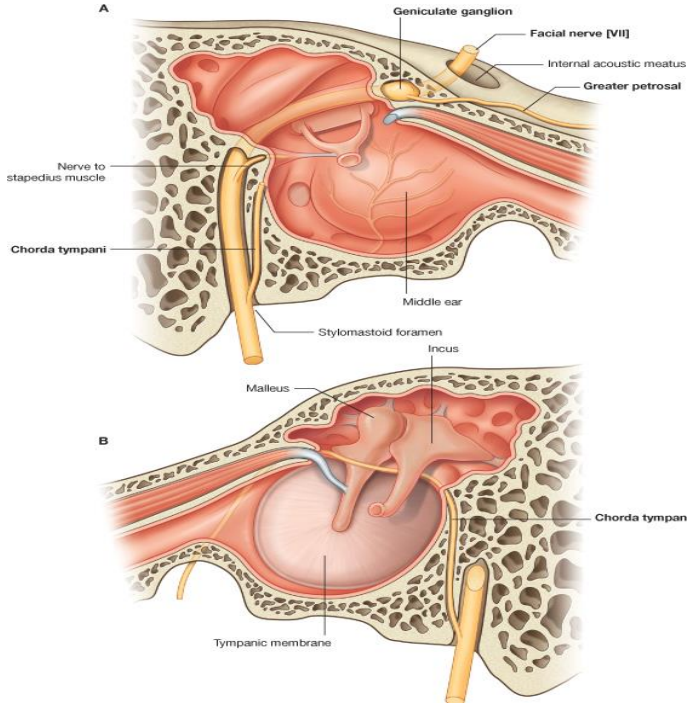
Ear

Facial nerve

On reaching the bottom of the internal acoustic meatus, it enters the facial canal and expands to form the sensory geniculate ganglion, the nerve then bends sharply backward above the promontory.

On arriving at the posterior wall of the middle ear, it curves downward on the medial side of the aditus of the mastoid antrum, descending in the posterior wall of the middle ear, behind the pyramid, and finally emerges through the stylomastoid foramen into the neck.



Important branches of the intrapetrous part of the facial nerve

- The greater petrosal nerve arises from the facial nerve at the geniculate ganglion, it contains preganglionic parasympathetic fibers that pass to the pterygopalatine ganglion and are there relayed through the zygomatic and lacrimal nerves to the lacrimal gland; other postganglionic fibers pass through the nasal and palatine nerves to the glands of the mucous membrane of the nose and palate, it also contains many taste fibers from the mucous membrane of the palate.

The nerve emerges on the superior surface of the petrous part of the temporal bone and is eventually joined by the deep petrosal nerve from the sympathetic plexus on the internal carotid artery and forms the nerve of the pterygoid canal, which passes forward and enters the pterygopalatine fossa, where it ends in the pterygopalatine ganglion.

- The nerve to the stapedius arises from the facial nerve as it descends in the facial canal behind the pyramid, it supplies the muscle within the pyramid.
- The chorda tympani arises from the facial nerve just above the stylomastoid foramen, it enters the middle ear close to the posterior border of the tympanic membrane running forward over the tympanic membrane and crosses the root of the handle of the malleus, it lies in the interval between the mucous membrane and the fibrous layers of the tympanic membrane, the nerve leaves the middle ear through the petrotympanic fissure and enters the infratemporal fossa, where it joins the lingual nerve.

The chorda tympani contains:

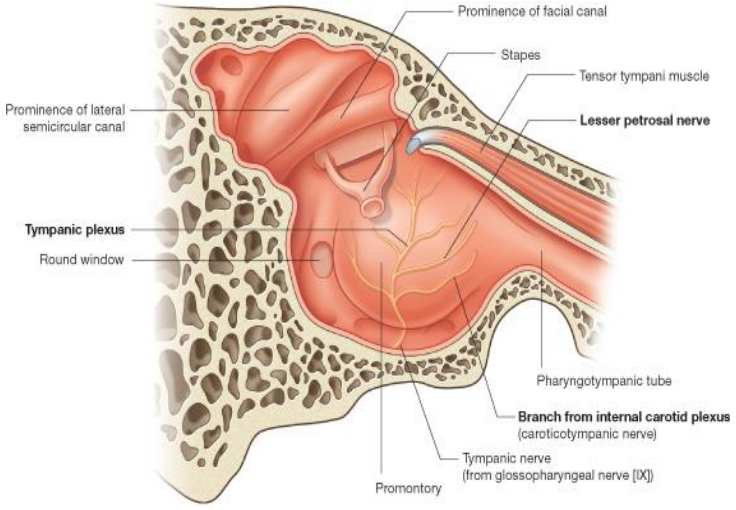
- Taste fibers from the mucous membrane covering the anterior two thirds of the tongue (not the vallate papillae) and the floor of the mouth, the taste fibers are the peripheral processes of the cells in the geniculate ganglion.
- Preganglionic parasympathetic secretomotor fibers that reach the submandibular ganglion and are there relayed to the submandibular and sublingual salivary glands.

Tympanic nerve

It arises from the glossopharyngeal nerve, just below the jugular foramen, passing through the floor of the middle ear and onto the promontory, here it splits into branches, which form the tympanic plexus, the tympanic plexus supplies the lining of the middle ear and gives off the lesser petrosal nerve**,** which sends secretomotor fibers to the parotid gland via the otic ganglion, it leaves the skull through the foramen ovale and joins the otic ganglion.

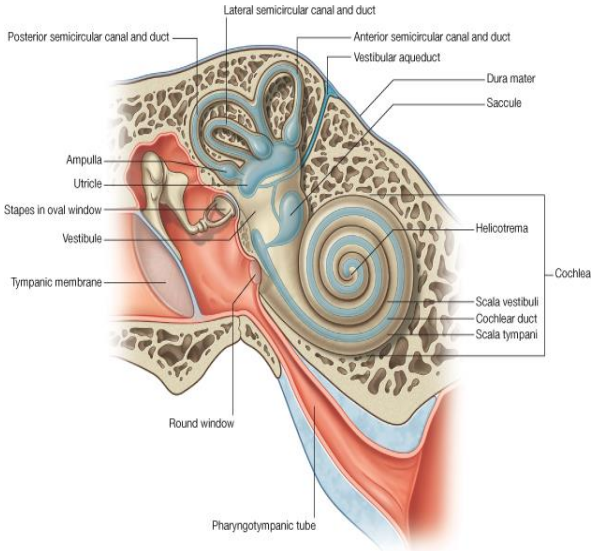
Internal ear or Labyrinth

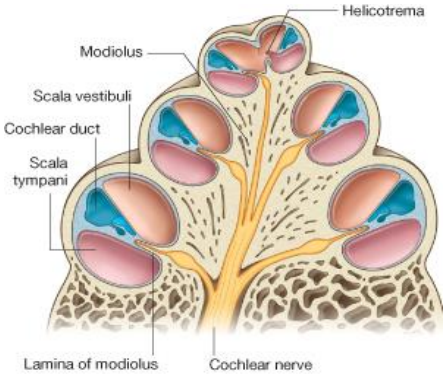
The labyrinth is situated in the petrous part of the temporal bone, medial to the middle ear, it consists of the bony labyrinth, comprising a series of cavities within the bone, and the membranous labyrinth, comprising a series of membranous sacs and ducts contained within the bony labyrinth.



Bony labyrinth

The bony labyrinth consists of three parts: the vestibule, the semicircular canals, and the cochlea, these are cavities situated in the substance of dense bone, they are lined by endosteum and contain a clear fluid, the perilymph, in which is suspended the membranous labyrinth.





The vestibule, the central part of the bony labyrinth, lies posterior to the cochlea and anterior to the semicircular canals, in its lateral wall are the fenestra vestibuli, which is closed by the base of the stapes and its anular ligament, and the fenestra cochleae, which is closed by the secondary tympanic membrane.

Lodging within the vestibule are the saccule and utricle of the membranous labyrinth, the three semicircular canal anterior, posterior, and lateral open into the posterior part of the vestibule, each canal has a swelling at one end called the ampulla, the canals open into the vestibule by five orifices, lodged within the canals are the semicircular ducts.

The anterior semicircular canal is vertical and placed at right angles to the long axis of the petrous bone, the posterior canal is also vertical but is placed parallel with the long axis of the petrous bone, the lateral canal is set in a horizontal position, and it lies in the medial wall of the aditus to the mastoid antrum, above the facial nerve canal.

The cochlea resembles a snail shell, it opens into the anterior part of the vestibule, basically, it consists of a central pillar, the modiolus, around which a hollow bony tube makes two and one half spiral turns, each successive turn is of decreasing radius so that the whole structure is conical, the apex faces anterolateral and the base faces posteromedially, the first basal turn of the cochlea is responsible for the promontory seen on the medial wall of the middle ear.

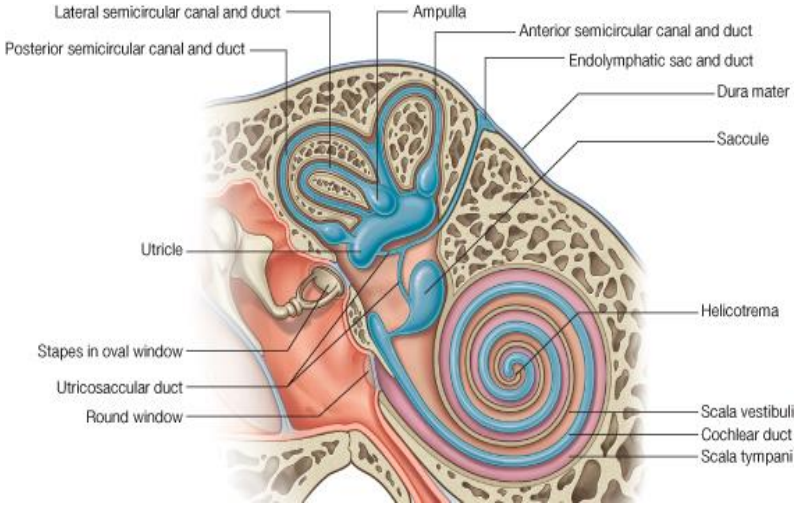
The modiolus has a broad base, which is situated at the bottom of the internal acoustic meatus, it is perforated by branches of the cochlear nerve, a spiral ledge, the spiral lamina, winds around the modiolus and projects into the interior of the canal and partially divides it, the basilar membrane stretches from the free edge of the spiral lamina to the outer bony wall, thus dividing the cochlear canal into the scala vestibuli above and the scala tympani below.

The perilymph within the scala vestibuli is separated from the middle ear by the base of the stapes and the anular ligament at the fenestra vestibule, the perilymph in the scala tympani is separated from the middle ear by the secondary tympanic membrane at the fenestra cochleae.

Membranous labyrinth

The membranous labyrinth is lodged within the bony labyrinth, it is filled with endolymph and surrounded by perilymph, it consists of the utricle and saccule, which are lodged in the bony vestibule; the three

semicircular ducts, which lie within the bony semicircular canals; and the duct of the cochlea, which lies within the bony cochlea, all these structures freely communicate with one another.



The utricle is the larger of the two vestibular sacs, it is indirectly connected to the saccule and the ductus endolymphaticus by the ductus utriculosaccularis.

The saccule is globular and is connected to the utricle, as described previously, the ductus endolymphaticus, after being joined by the ductus utriculosaccularis, passes on to end in a small blind pouch, the saccus endolymphaticus, this lies beneath the dura on the posterior surface of the petrous part of the temporal bone.

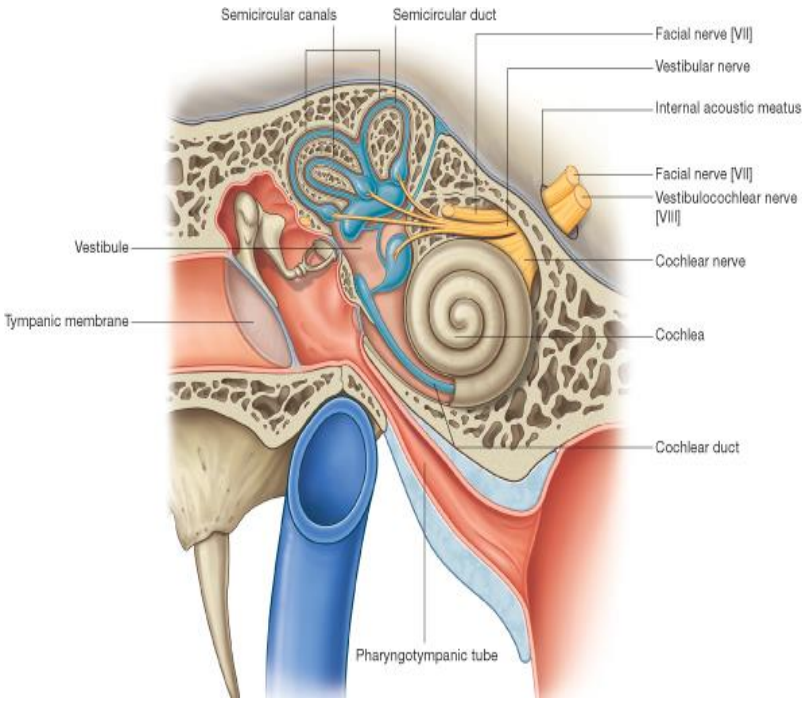
The semicircular ducts, although much smaller in diameter than the semicircular canals, have the same configuration, they are arranged at right angles to each other so that all three planes are represented.

The duct of the cochlea is triangular in cross section and is connected to the saccule by the ductus reunions, the highly specialized epithelium that lies on the basilar membrane forms the spiral organ of Corti and contains the sensory receptors for hearing.

Vestibulocochlear nerve

On reaching the bottom of the internal acoustic meatus, the nerve divides into vestibular and cochlear portions.

The vestibular nerve is expanded to form the vestibular ganglion, the branches of the nerve then pierce the lateral end of the internal acoustic meatus and gain entrance to the membranous labyrinth, where they supply the utricle, the saccule, and the ampullae of the semicircular ducts.



The cochlear nerve divides into branches, which enter foramina at the base of the modiolus, the sensory ganglion of this nerve takes the form of an elongated spiral ganglion that is lodged in a canal winding around the modiolus in the base of the spiral lamina.

The peripheral branches of this nerve pass from the ganglion to the spiral organ of Corti.