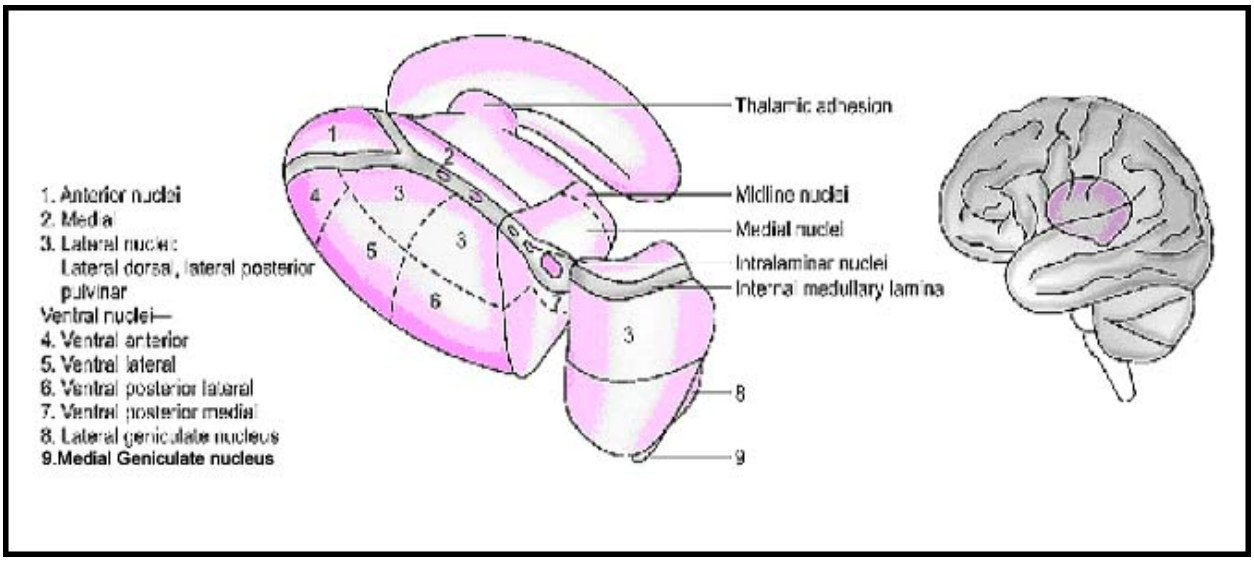
BRAIN

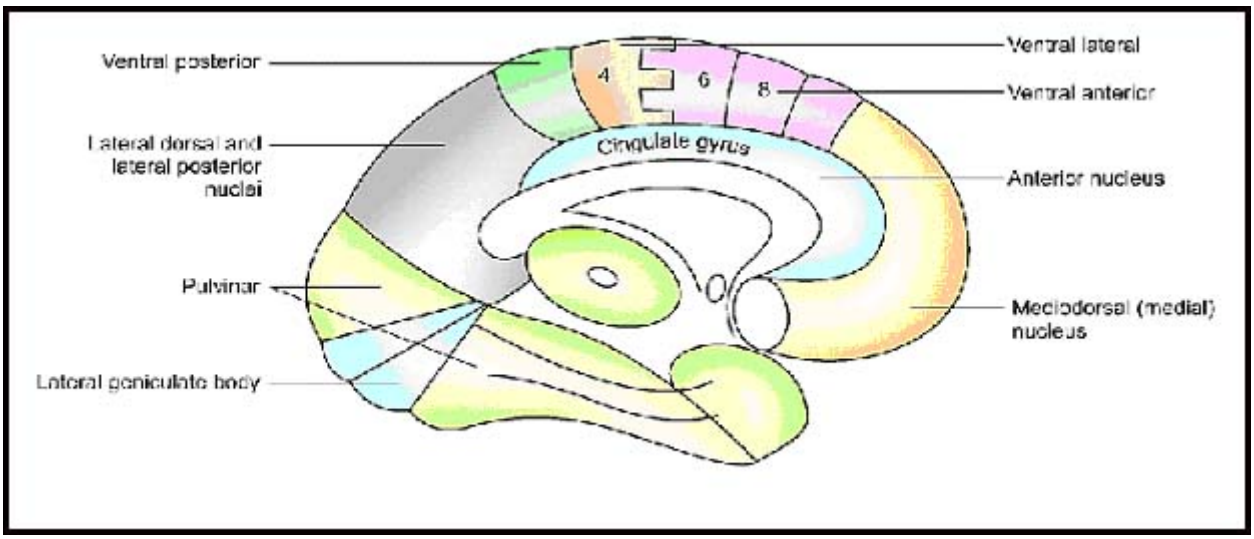
Enumerate connections of thalamic nuclei. Correlate connections of thalamus with their functions?

NUCLEI OF THALAMUS

Thalamus is a large obliquely placed collection of grey matter situated in the lateral wall of third ventricle and floor of central part of lateral ventricle: It comprises of number of nuclei. It is divided by a Y-shaped internal medullary lamina into anterior, medial and lateral parts. Each part contains nuclei.



I. **Anterior part** : Anterior nucleus
II**. Medial part** : Medial nucleus
III. **Lateral part** :
1. Ventral nucleus
a. Ventroanterior
b. Ventrointermediate
c. Ventroposterior:
i. Lateral
ii. Medial



2. **Lateral Nucleus**
   a. Dorsal
   b. Posterior
   c. Pulvinar

Internal medullary lamina contains–Centromedian nucleus and intralaminar nucleus. Their connections are as follows:

S.No.	Nucleus	Afferents	Efferents
1.	Anterior nucleus	Mamillothalamic tract	Cingulate gyrus.
2.	Medial nucleus (dorso-medial)	Hypothalamus, other thalamic nuclei, corpus striatum, area 6 of cerebral cortex.	Hypothalamus, other thalamic nuclei corpus striatum
3.	Ventro anterior	Globus pallidus	Premotor cortex area 6,8.
4.	Ventrointermediate	Cerebellum (dentato-thalamic)	Motor and premotor areas 4,6.
5.	Ventro-post-lat.	Spinal and medial lemnisci	Postcentral gyrus area 3,1,2.
6.	Ventro-post-med. thalamic fibres	Trigeminal and solitarius lemnisci	Postcentral gyrus area 3,1,2
7.	Lat. dorsal	Other thalamic nuclei	Precuneus and cingulate gyrus
8.	Lat. posterior	Sup, parietal lobule.	Superior parietal lobule.
9.	Pulvinar	Geniculate bodies.	Parietal, temporal and occipital lobes
10.	Intralaminar and midline	Reticular formation	All parts of cerebral cortex.
11.	Midline-centro median nucleus	Corpus striatum, collaterals from lemnisci.	Other thalamic nuclei and corpus striatum Not connected to cerebral cortex.

Functions are according to connections of various nuclei (1-11)

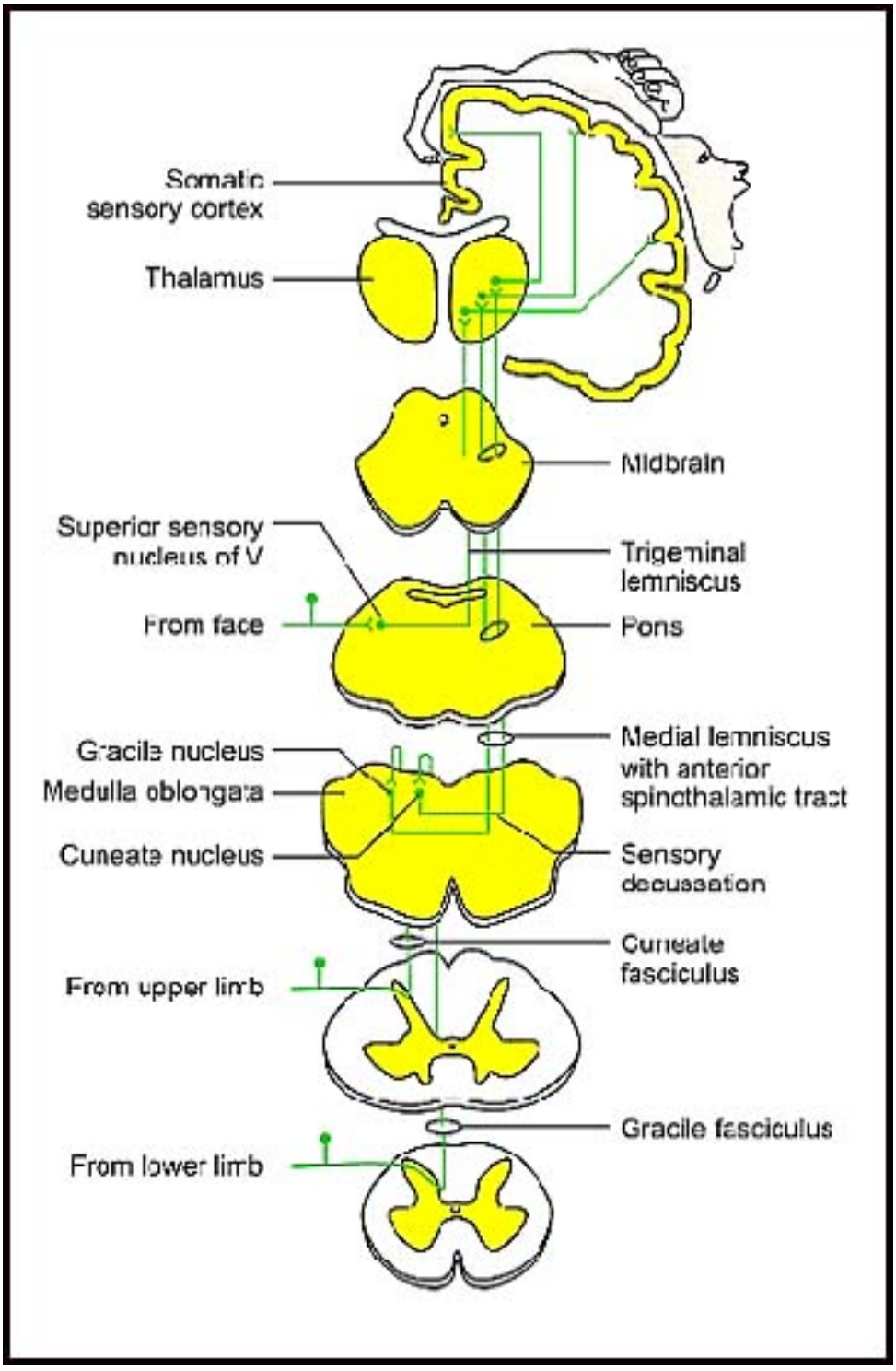
1. Controls emotional aspects of behaviour.
2. Centre for integration of visceral and somatic functions.
3. Relay station for striatal impulses (extrapyramidal)
4. Relay station for cerebellar impulses and modulates its activity.
5. Relay station for exteroceptive and proprioceptive impulses.
6. Relay station for impulses from face and special sense of taste.
7. Integrates sensory information.
8. Integrates and coordinate sensory information.
9. Integrates visual stimuli with other sensations.
10. Responsible for maintaining state of alertness and wakefulness.
11. Receive pain fibres.

Trace the proprioceptive impulses from the shoulder joint to the level of perception?

Shoulder Joint is supplied by axillary nerve, suprascapular nerve. Their root value is C5, C6. Proprioceptive are: (i) unconscious and (ii) conscious types.

1. Unconscious proprioceptive sensations from shoulder joint are carried by accessory cuneate nucleus. This nucleus appears at the level of sensory decussation in medulla oblongata dorsolateral to the nucleus cuneatus. It receives afferents from the lateral fibres in the fasciculus cuneatus which are derived from cervical segments. The efferents from the accessory cuneate nucleus form posterior external arcuate fibres and reach the cerebellum through ipsilateral inferior cerebellar peduncle.

2. Proprioceptive sensations from shoulder joint enter through the dorsal nerve root to reach the posterior white column forming the fasciculus cuneatus. Fasciculus cuneatus relays in nucleus cuneatus-fibres decussate in medulla oblongata to form medial lemniscus which ascends in pons and midbrain to reach ventroposterior lateral nucleus of thalamus relay to reach area 3,1,2 of cerebral cortex.

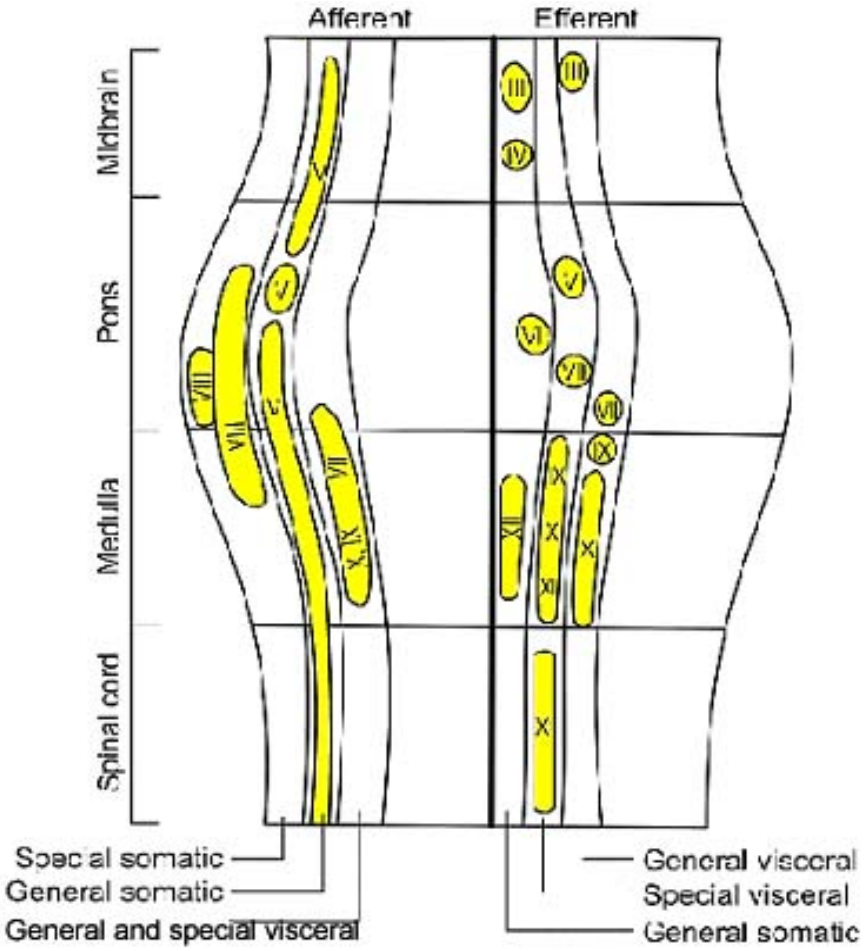

Somatic sensory cortex
Thalamus
Midbrain
Superior sensory nucleus of V
Trigeminal lemniscus
From face
Pons
Medial lemniscus with anterior spinothalamic tract
Gracile nucleus
Medulla oblongata
Cuneate nucleus
Sensory decussation
Cuneate fasciculus
From upper limb
Gracile fasciculus
From lower limb

Enumerate

a. Cranial nerve nuclei belonging to general somatic efferent column.

GENERAL SOMATIC EFFERENT COLUMN NUCLEI

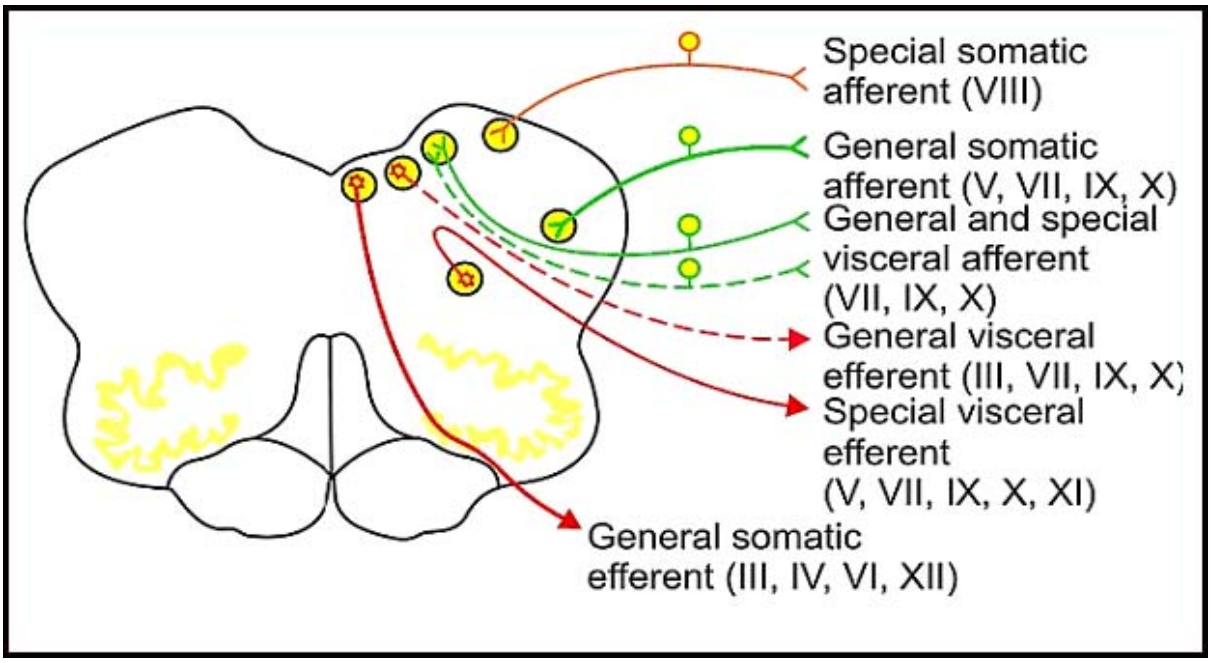
-3rd nerve nucleus	at the level of	Sup. colliculus of midbrain.
-4th nerve nucleus	at the level of	Inf. colliculus of midbrain.
-6th nerve nucleus	at the level of	Lower part of pons.
-12th nerve nucleus	at the level of	Lower part of medulla oblongata.



b. Cranial nerve nuclei belonging to special visceral efferent column of brain stem.

SPECIAL VISCERAL EFFERENT COLUMN NUCLEI

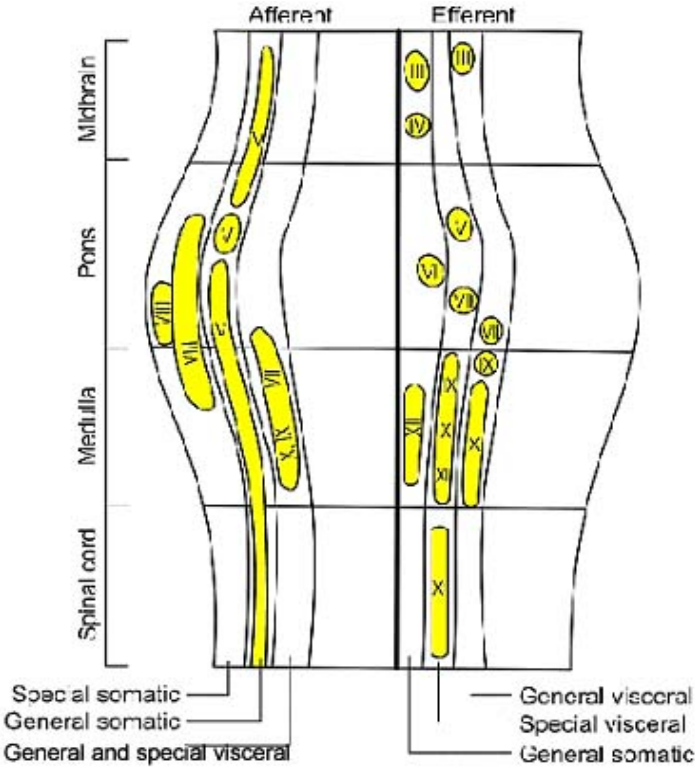
-5th nerve nucleus	upper pons.
-7th nerve nucleus	lower pons.
-For 9th, 10th, 11th nerves (nucleus ambiguus).	medulla oblongata.



c. Nuclei belonging to general visceral efferent column.

GENERAL VISCERAL EFFERENT COLUMN NUCLEI

-Lacrimatory nucleus and Superior salivatory nucleus	At the level of ponto-medullary junction for the 7th nerve.
-Inferior salivatory nucleus	At upper part of medulla oblongata for 9th nerve.
-Dorsal nucleus of vagus	At upper part of medulla oblongata for 10th nerve.



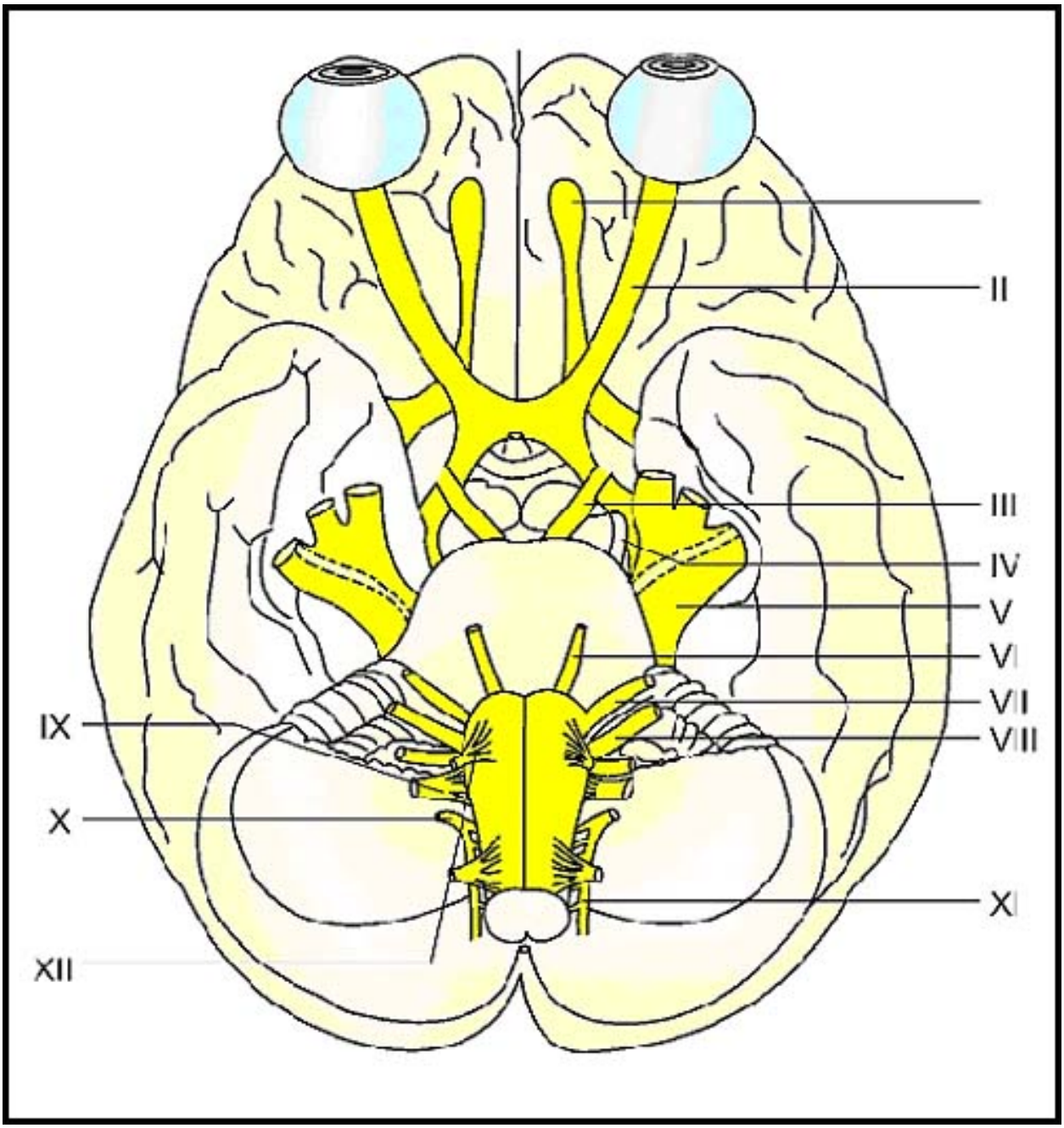
d. Nucleus of general and special visceral afferent column.

GENERAL AND SPECIAL VISCERAL AFFERENT
The sensory nuclear columns from medial to lateral side are:
Nucleus of tractus solitarius in medulla oblongata. It receives taste fibres from 7,9,10 nerves; also receives general visceral afferent fibres from gut, salivary glands, carotid body, carotid sinus. Thus it is the nucleus for general visceral afferent and special visceral afferent columns.

e. Cranial nerve nuclei belonging to general somatic afferent column.

GENERAL SOMATIC AFFERENT COLUMN
Nucleus of spinal tract of V nerve — Receives fibres of carrying pain and temperature from the face.
Superior sensory nucleus of V nerve — Receives fibres carrying touch and pressure from the face.

Mesencephalic nucleus of V nerve — Receives proprioceptive fibres from muscles of mastication, extraocular muscles, facial muscles and muscles of tongue.


II
III
IV
V
VI
VII
VIII
IX
X
XI
XII

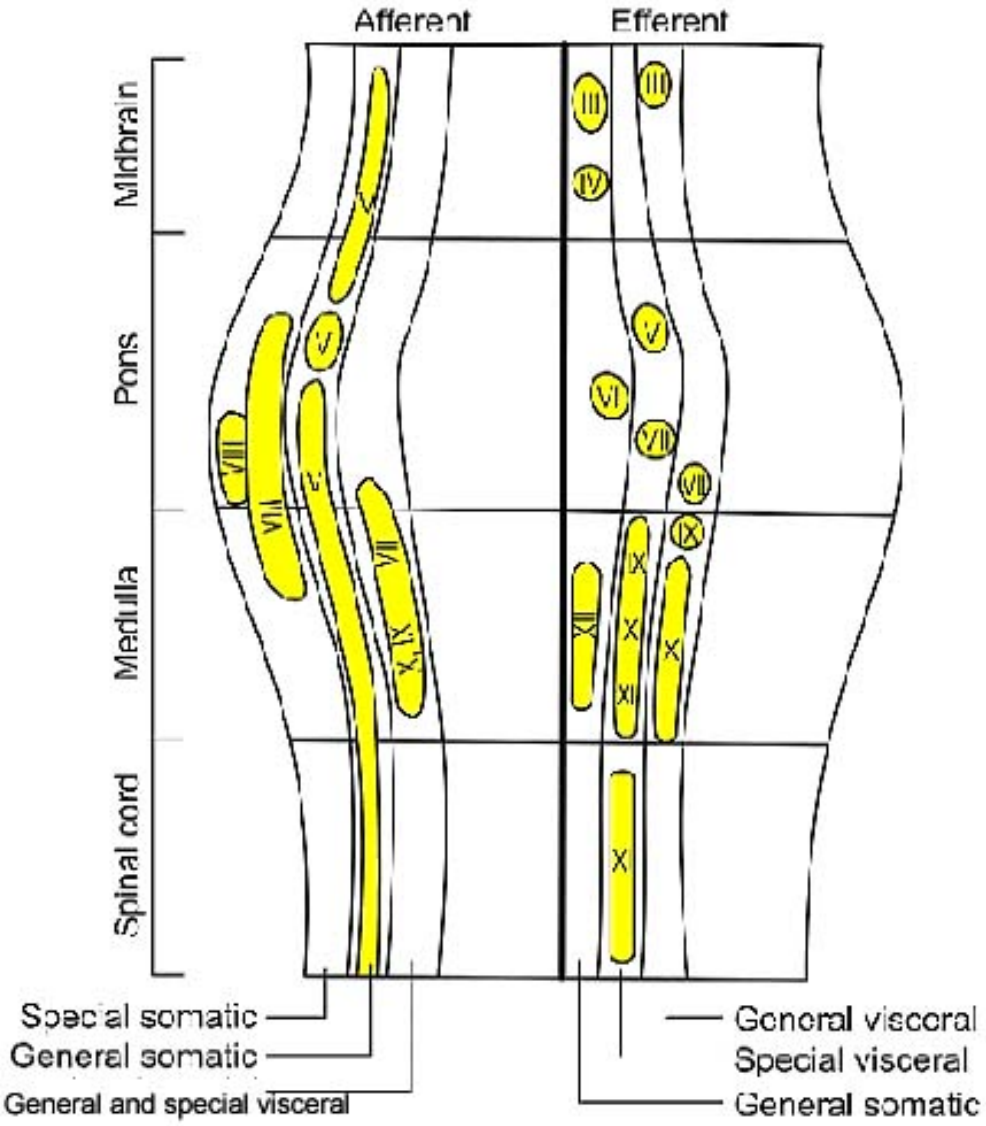
f. Nuclei of special somatic afferent column.

SPECIAL SOMATIC AFFERENT COLUMN

-Vestibular nerve and Cochlear nerve or 8th Nerve

Vestibular Nucleus—- Superior, medial, lateral & spinal

Cochlear Nucleus— Dorsal and ventral.



g. Enumerate the functional components of cranial nerves III to XII.

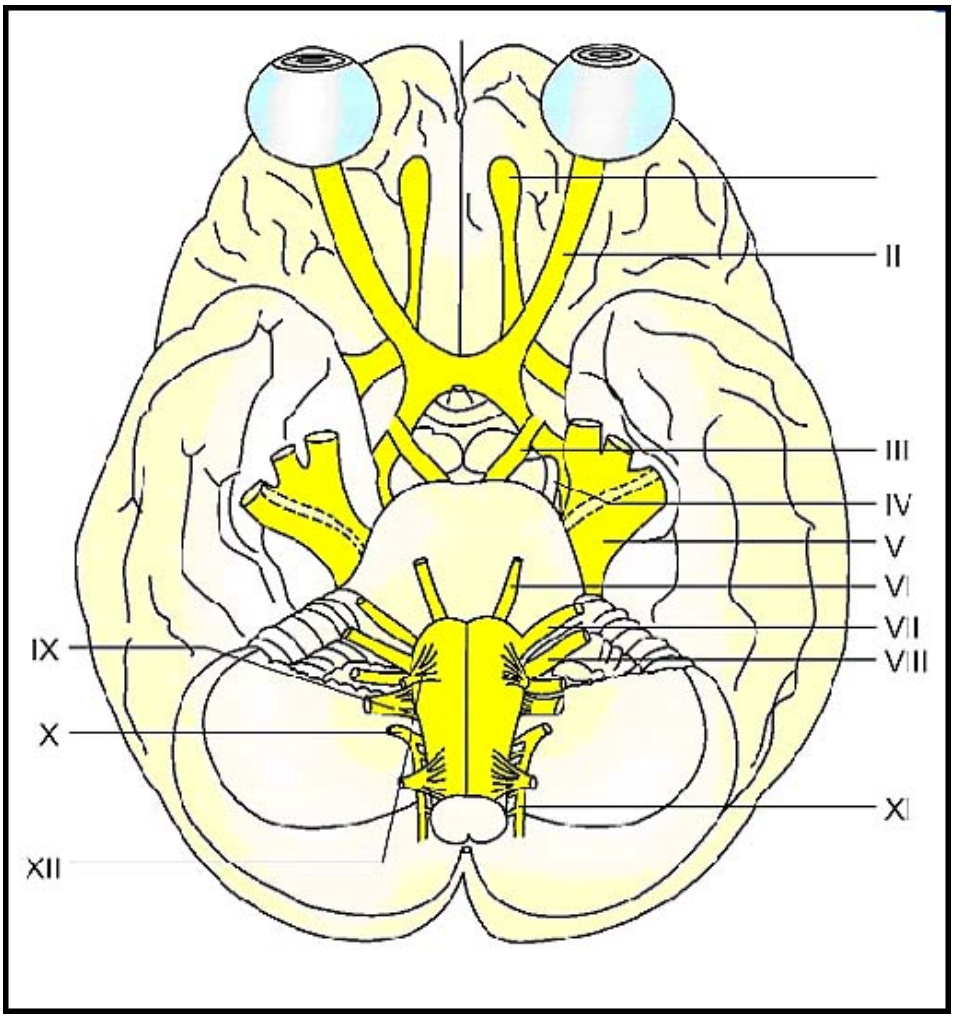
OCULOMOTOR NUCLEI

General somatic efferent:

Oculomotor nucleus in midbrain at the level of superior colliculus for superior rectus, levator palpabrae superioris, inferior rectus, medial rectus and inferior oblique muscles.

General visceral efferent:

Edinger-Westphal situated cranial to somatic component for the supply of ciliaris and sphincter pupillae muscles via the ciliary ganglion.



General somatic afferent:
Receives proprioceptive fibres from the muscles, supplied by third cranial nerve. Nucleus is mesencephalic nucleus of trigeminal nerve.

Trochlear Nerve Nucleus

General somatic efferent:- Trochlear nucleus in midbrain at the level of inferior colliculus for only superior oblique muscle.

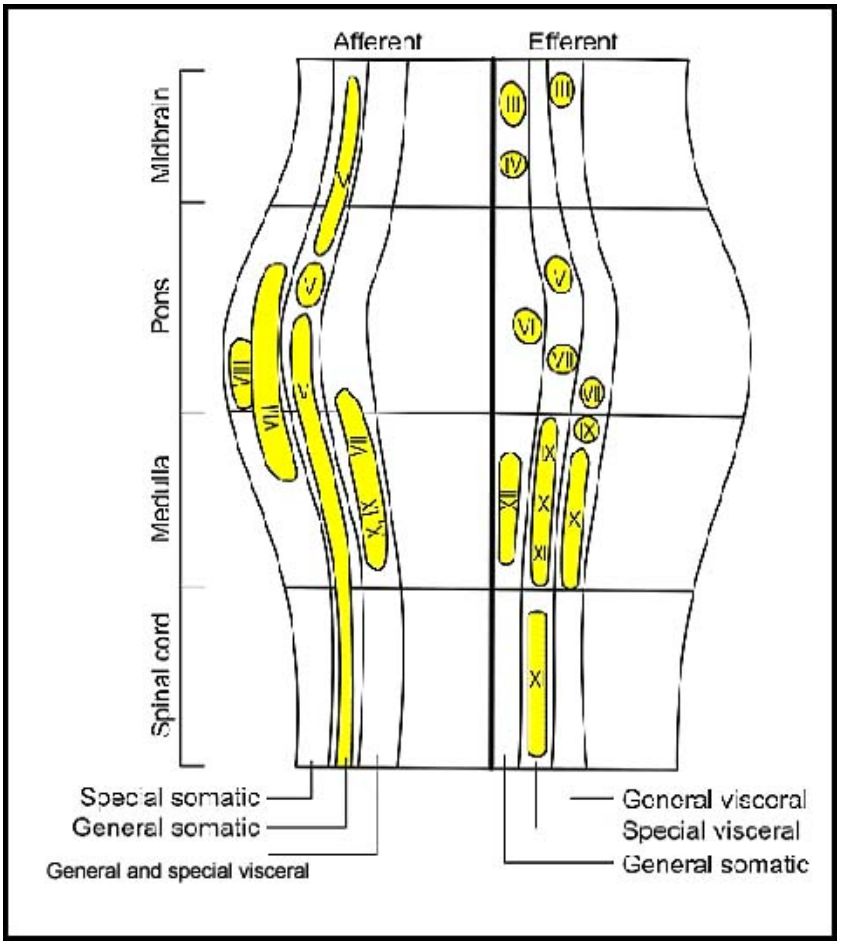
General somatic afferent: Receives proprioceptive fibres from superior oblique muscle.

TRIGEMINAL NERVE NUCLEI - 3 sensory and one motor.

General somatic efferent: -

-Three sensory nuclei of trigeminal form a continuous column in brainstem and extend into the upper spinal cord as well. Mesencephalic in midbrain for proprioceptive impulses from muscles of mastication, face, orbit, and tongue.

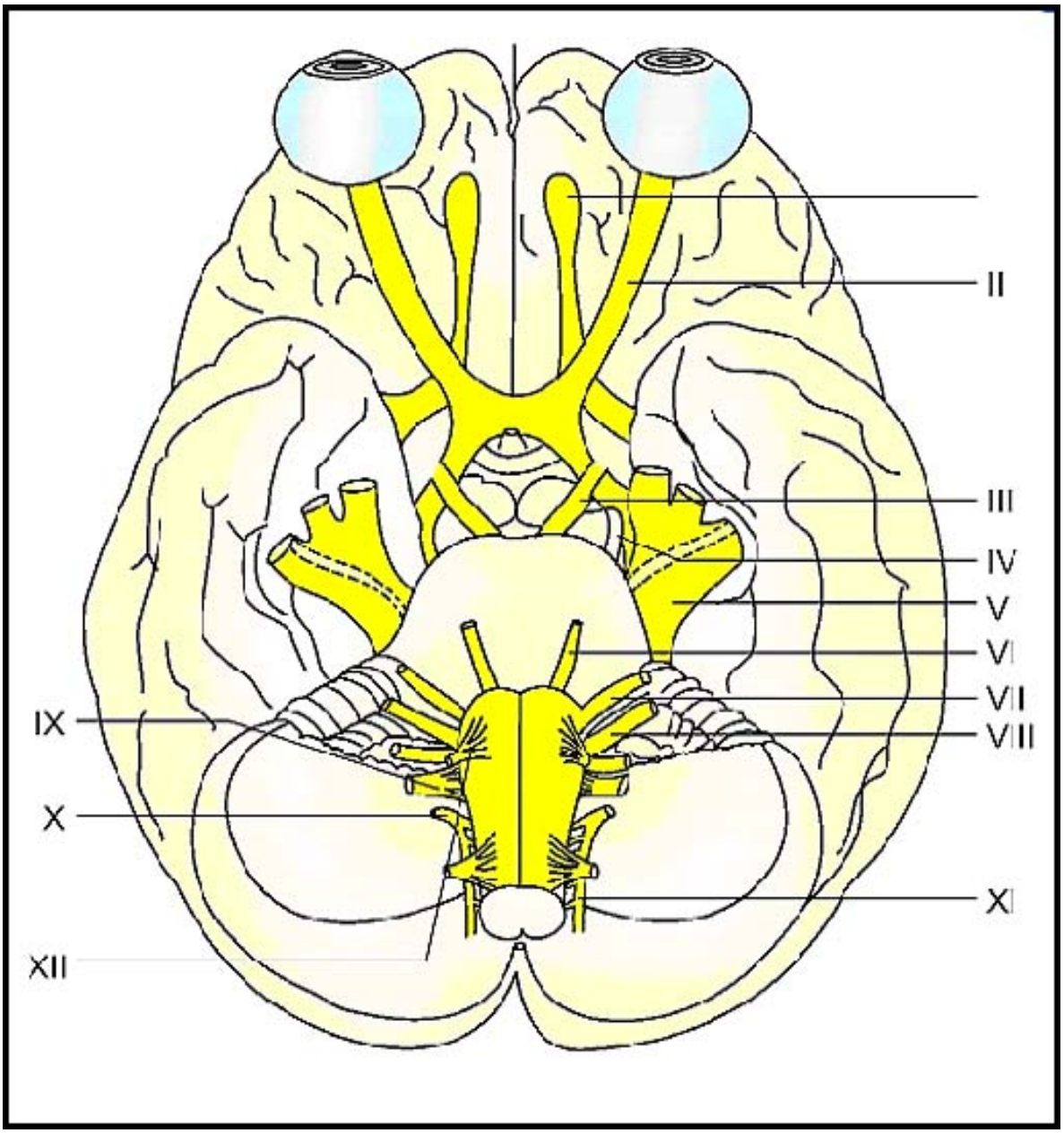
-Spinal nucleus in lower pons, medulla and upper cervical spinal cord for receiving pain and temperature from trigeminal area. It also receives afferent fibres from glosso pharyngeal and vagus nerves.



Special visceral efferent: - Motor nucleus of trigeminal at the level of upper pons for the muscles derived from first brachial arch. It supplies 8 muscles derived from I bronchial arch.

Abducent Nerve Nucleus

General somatic efferent:- Abducent nucleus in lower part of pons for supply of lateral rectus only.
General somatic efferent:- Mesencephalic nucleus of V, for receiving proprioceptive impulses from the lateral rectus muscle.



FACIAL NERVE NUCLEUS

Two motor and two sensory

1. **Special visceral efferent**: Facial nerve nucleus in lower pons.

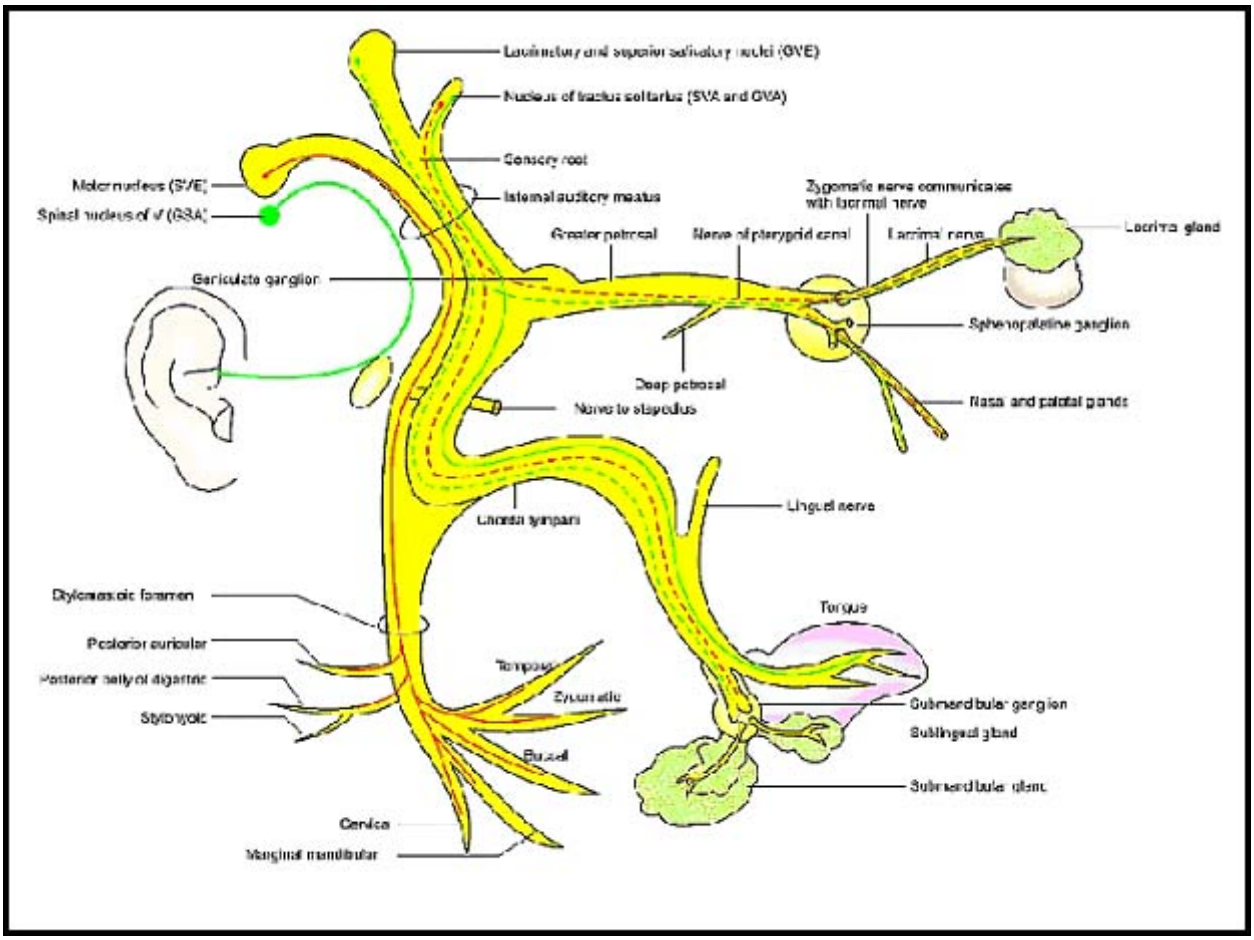
2. **General visceral efferent :**

-Lacrimatory nucleus in lower pons, secretomotor to pterygopalatine ganglia for the supply of lacrimal, palatal and nasal glands.

-Superior salivatory nucleus in lower pons-secretomotor to submandibular ganglia for the supply of submandibular & sublingual salivary glands.

3.Special visceral afferent and general visceral afferent

-Nucleus of tractus solitarius in upper medulla for taste fibres of chorda tympani nerve from most of the anterior two-thirds of tongue and of greater petrosal from soft palate. It also receives afferent impulses from various glands supplied by facial nerve.

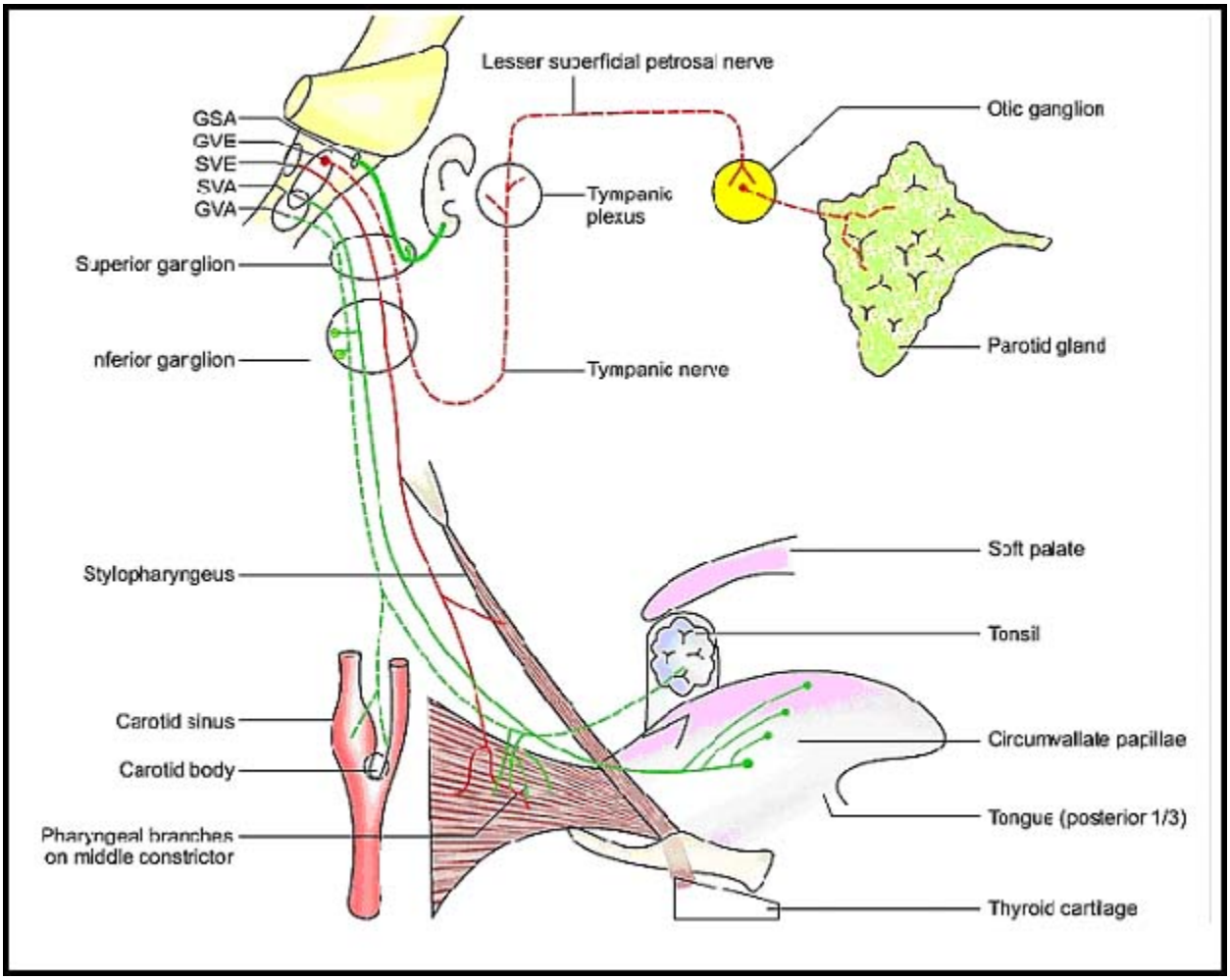


4.**General somatic afferent :-**
-Mesencephalic nucleus of V for proprioceptive impulses from facial muscles.

VESTIBULO-COCHLEAR NERVE NUCLEI- Six, Sensory

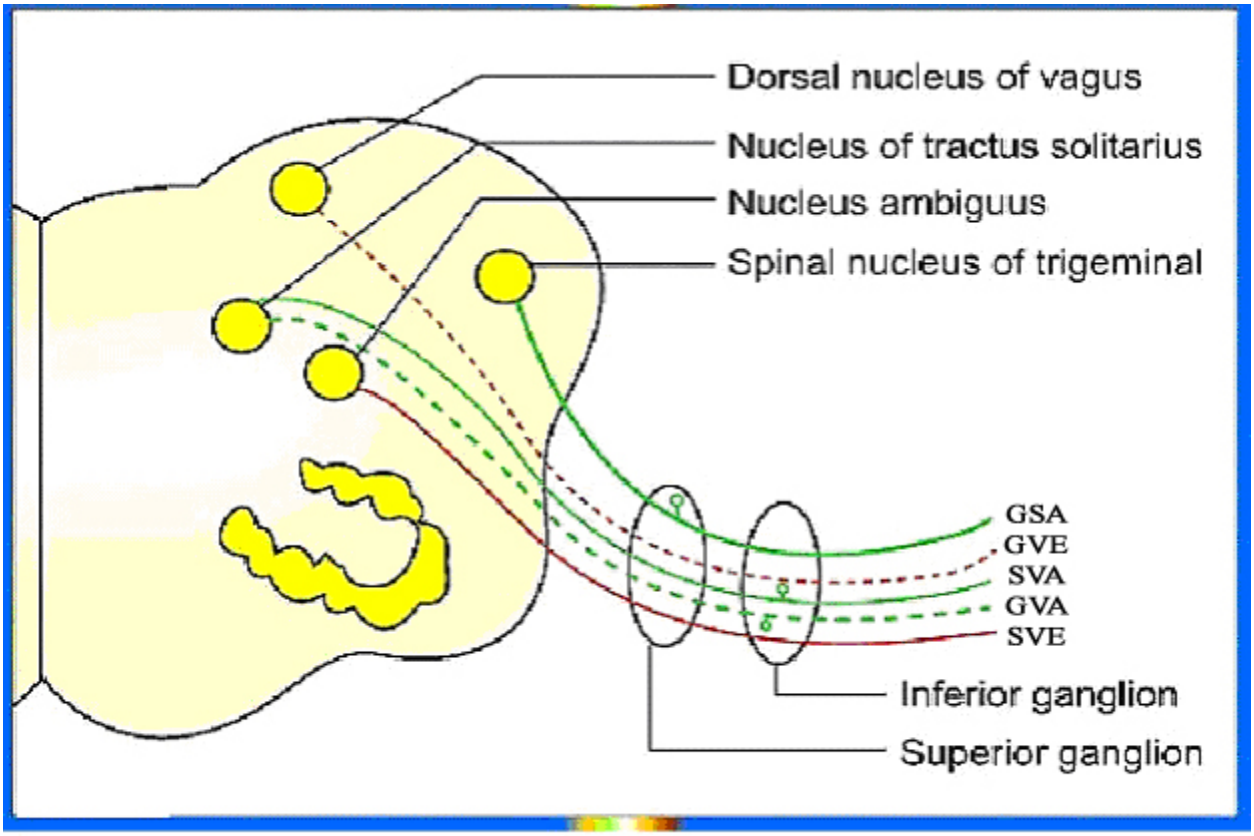
Special somatic efferent :
-Four vestibular nuclei at ponto medullary junction for equilibrium.
Special somatic efferent :
-Two cochlear nuclei, one ventral and one dorsal for hearing.

GLOSSOPHARYNGEAL NERVE NUCLEI - Two motor and two sensory
Special visceral efferent :
1.Nucleus ambiguus in upper medulla for the supply of stylopharyngeus only
2. **General visceral efferent** – Inferior salivatory nucleus in lower pons –
-Secretomotor to otic ganglion for the supply of parotid gland.



3. **Special and general visceral afferent**
- Nucleus of tractus solitarius for taste fibres from posterior one third of tongue and circumvallate papillae and for carotid body and carotid sinus, tonsil , palate.
4. **General somatic afferent**
-Mesencephalic nucleus of V for proprioceptive impulses from stylopharyngeus.

VAGUS NERVE NUCLEI – Two motor and two sensory
1. **Special visceral efferent :**
- Nucleus ambiguus in upper medulla for muscles of soft palate, pharynx, larynx and upper oesophagus.
2**. General visceral afferent :**
-Dorsal motor nucleus of vagus for cardiac muscle and smooth muscle of thoracic and abdominal viscera.

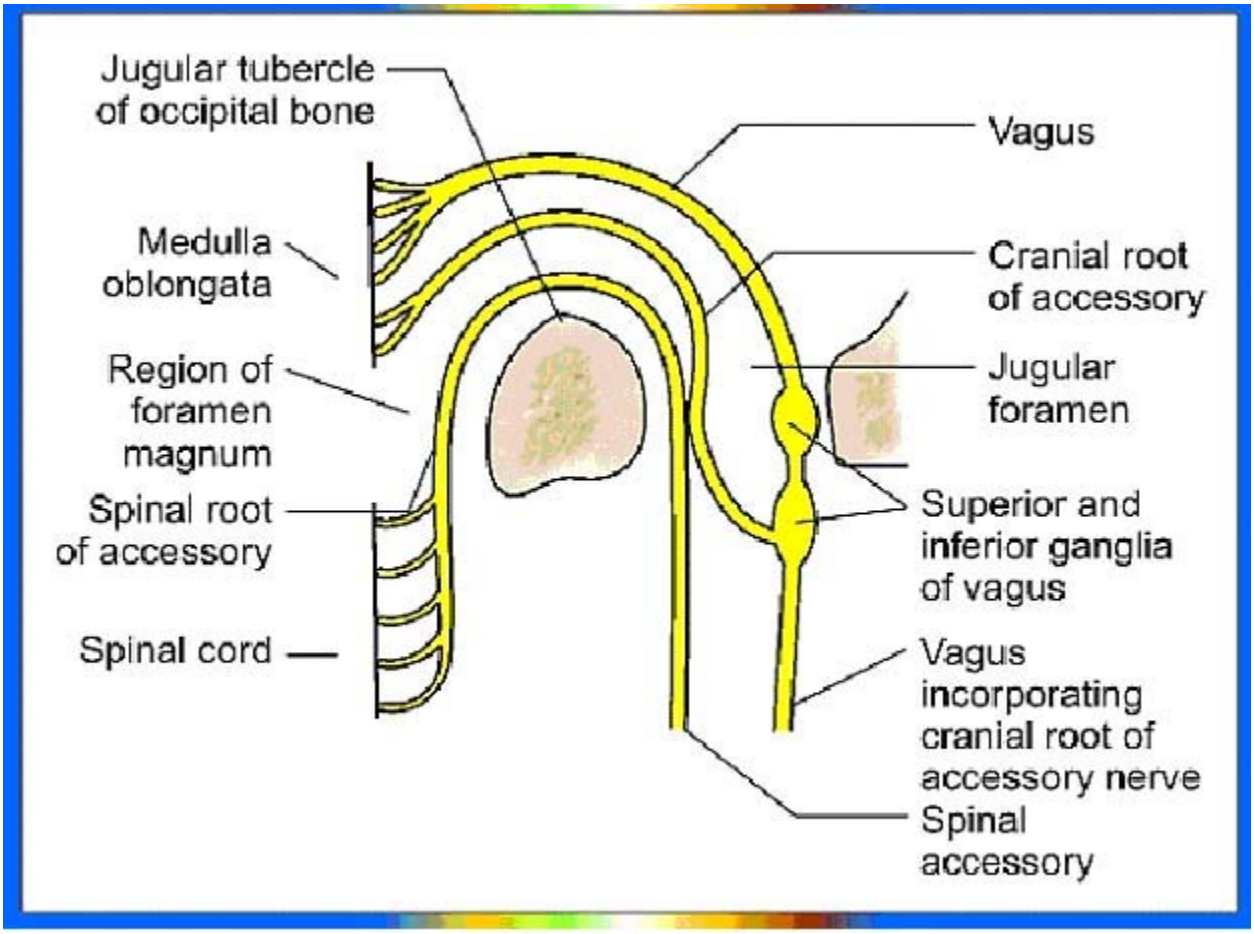


3. **Special and general visceral afferent** :
-Nucleus of tractus solitarius for afferent impulses from thoracic and abdominal viscera, taste fibres from posterior most part of tongue and epiglottis.
4. **General somatic afferent** :

- Spinal nucleus of V nerve for skin of external auditory meatus and mucous membrane of pharynx and larynx.

ACCESSORY NERVE NUCLEI – 2 motor

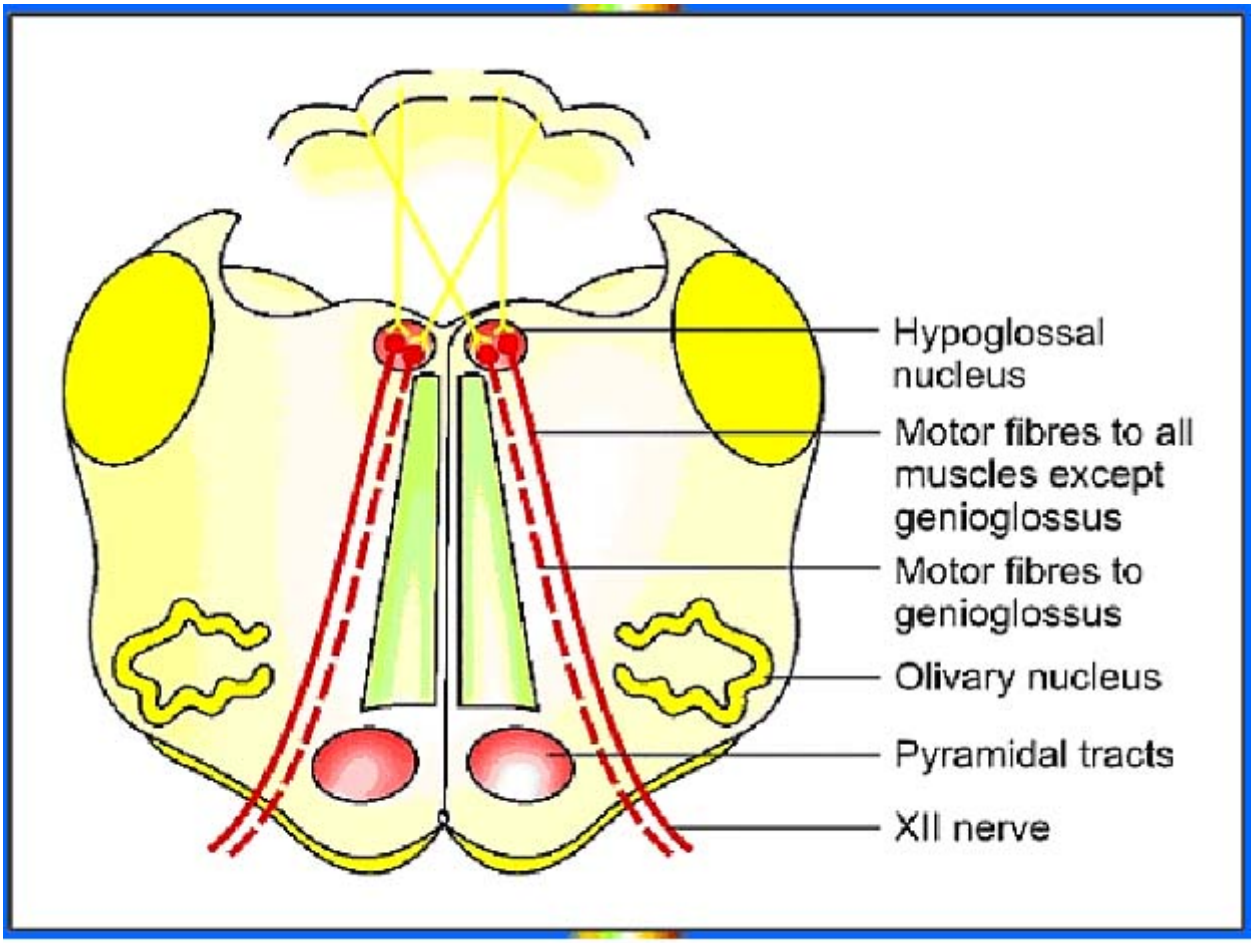
-**Branchial efferent** : Nucleus ambiguus in upper medulla for cranial root of accessory nerve. These fibres join the vagus and get distributed through its branches to the palate and pharynx.



-**Branchial efferent** : Anterior horn cells of upper five cervical segments of spinal cord form the spinal root of accessory nerve for the motor supply of sternocleidomastoid and trapezius muscles.

HYPOGLOSSAL NUCLEUS – One motor and one sensory

1. **General somatic efferent**: Hypoglossal nucleus in upper medulla for most of the extrinsic and all the intrinsic muscles of the tongue.

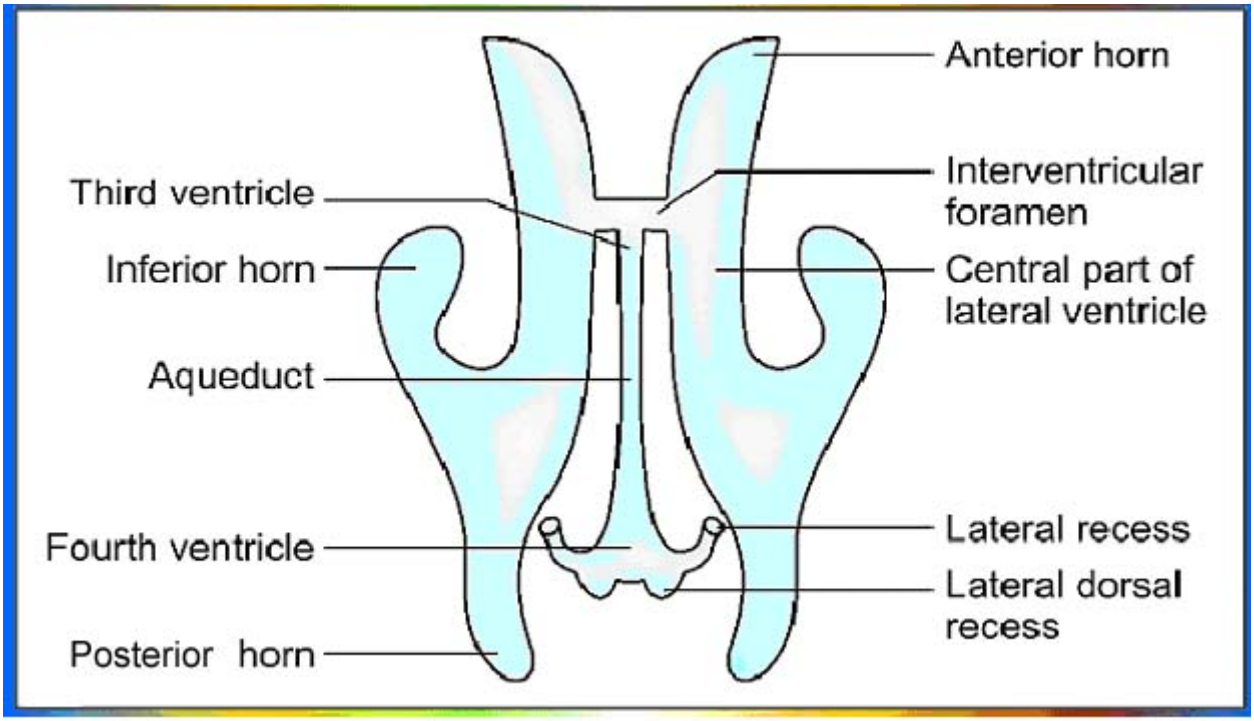


2. **General somatic afferent** :
-Mesencephalic nucleus of V for proprioceptive impulses from muscles of tongue.

Describe briefly boundaries of third ventricle.

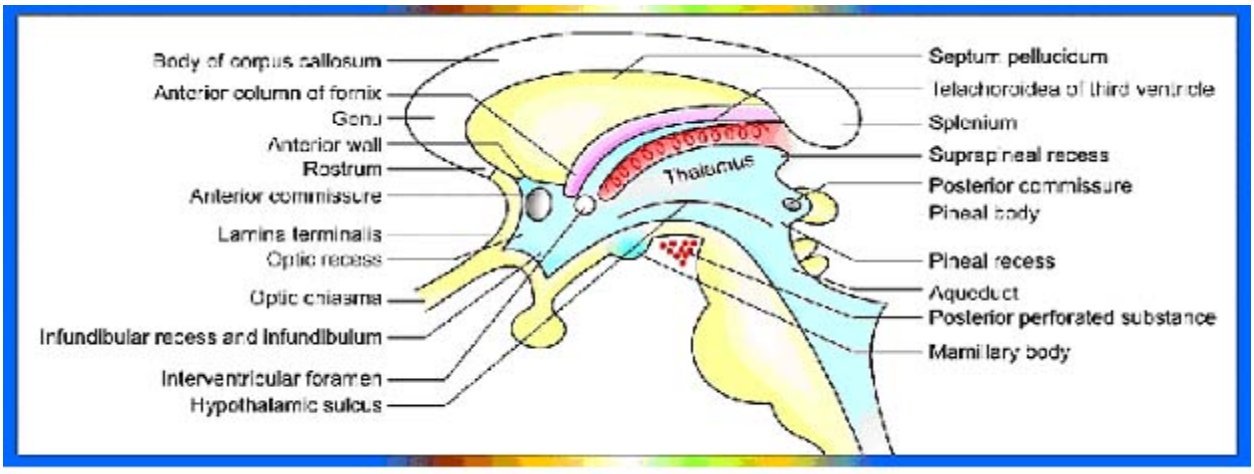
III VENTRICLE

The third ventricle is a chink like cavity between the two thalami. It is the cavity of the diencephalon, and communicates antero-superiorly with the lateral ventricle through the interventricular foramen.



It communicates postero inferiorly with the fourth ventricle through the aqueduct of Sylvius. Its boundaries are:-

1. Anterior wall is formed by lamina terminals, anterior commissure and anterior column of fornix.



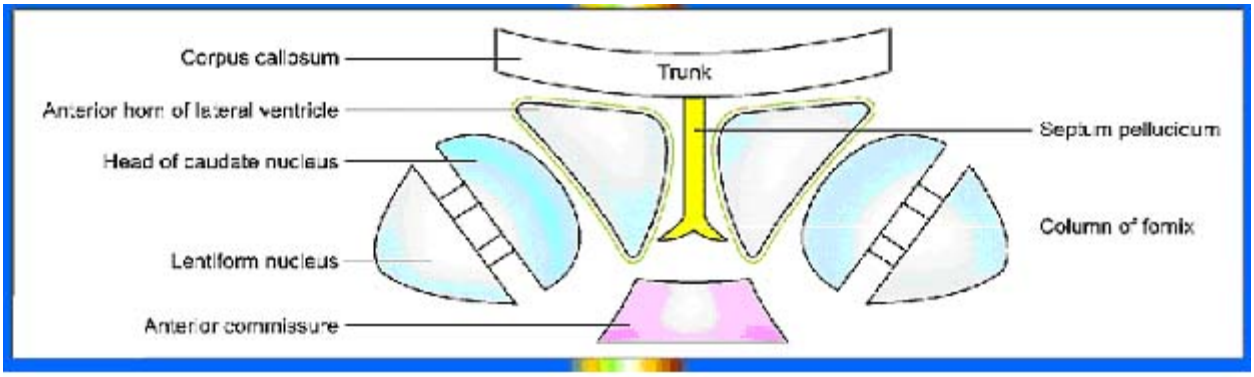
2. Roof is formed by the ependyma stretching between the two thalami. The telachoroidea is above the ependyma. Thus tela choroidea and ependyma bulge downwards into the cavity of third ventricle as choroid plexuses.

3. Floor is formed by optic chiasma, tubercinerium, infundibulum, mamillary bodies, posterior perforated substance and tegmentum of midbrain.
4. Lateral wall is marked by the hypothalamic sulcus which extends from the interventricular foramen to the aqueduct. Above the sulcus the wall is formed by thalamus. Below the sulcus it is formed by medial surface of hypothalamus, epithalamus.
Recesses of third ventricle are:

a. Optic recess – just above the optic chiasma
b. Infundibular recess – extends into the infundibulum.
c. Pineal recess – towards the pineal body.
d. Suprapineal recess – above the pineal body.

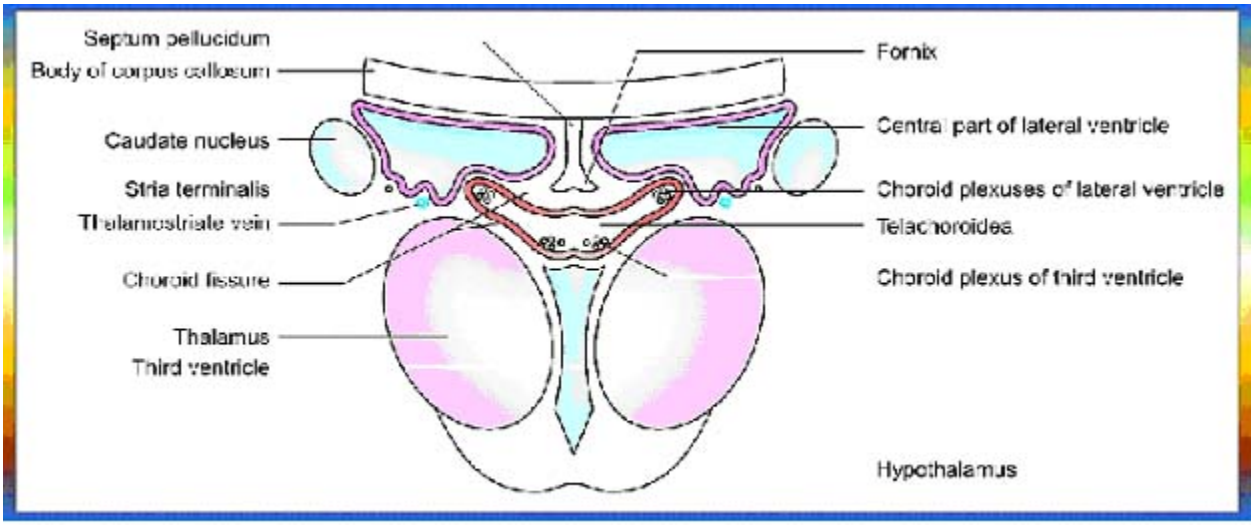
b. Boundaries of various horns of lateral ventricle.

VARIOUS HORNS OF LATERAL VENTRICLE
Anterior horn:



-Roof – Anterior part of trunk of corpus callosum.
-Anterior end – Genu and rostrum of corpus callosum.
-Floor – Head of caudate nucleus.

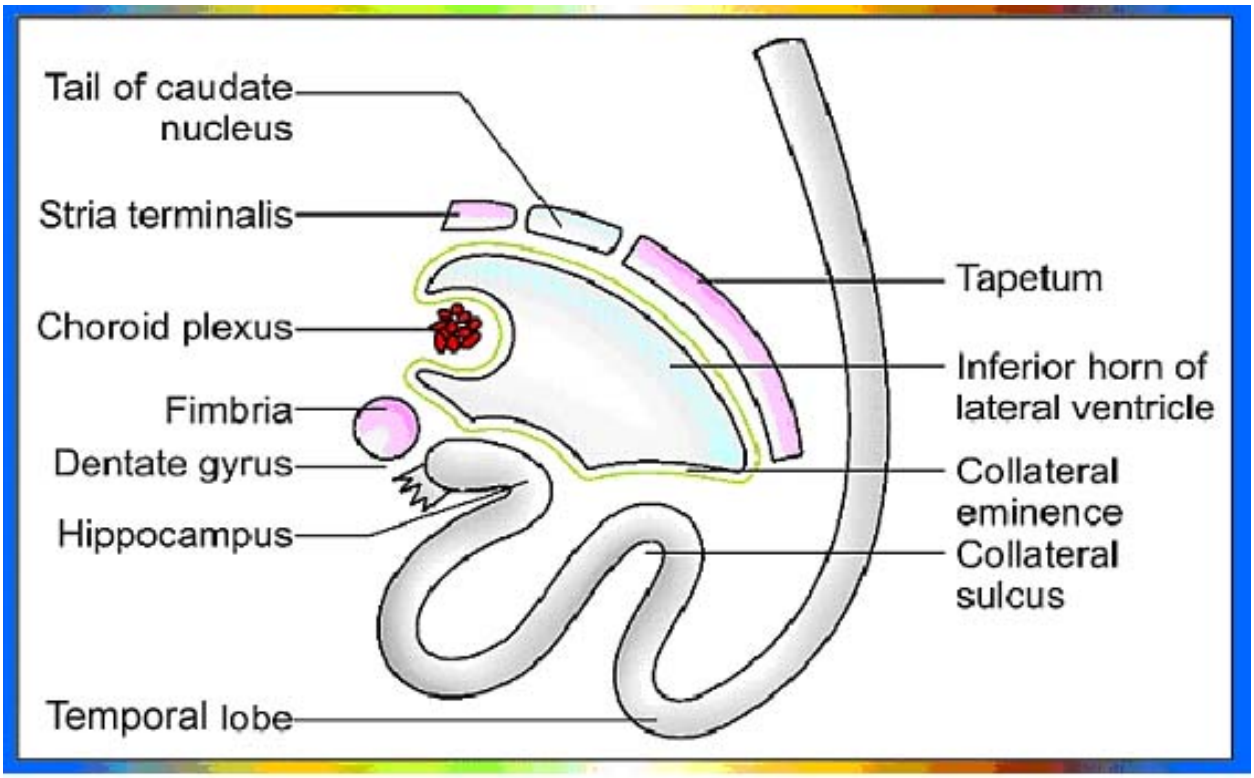
Medial wall – Septum pellucidum and column of fornix.



-Roof – Trunk of corpus callosum.
-Floor – Superior surface of thalamus, thalamostriate vein, stria terminalis and body of caudate nucleus.
-Medial wall – Septum pellucidum, body of fornix.

Body or Central part:

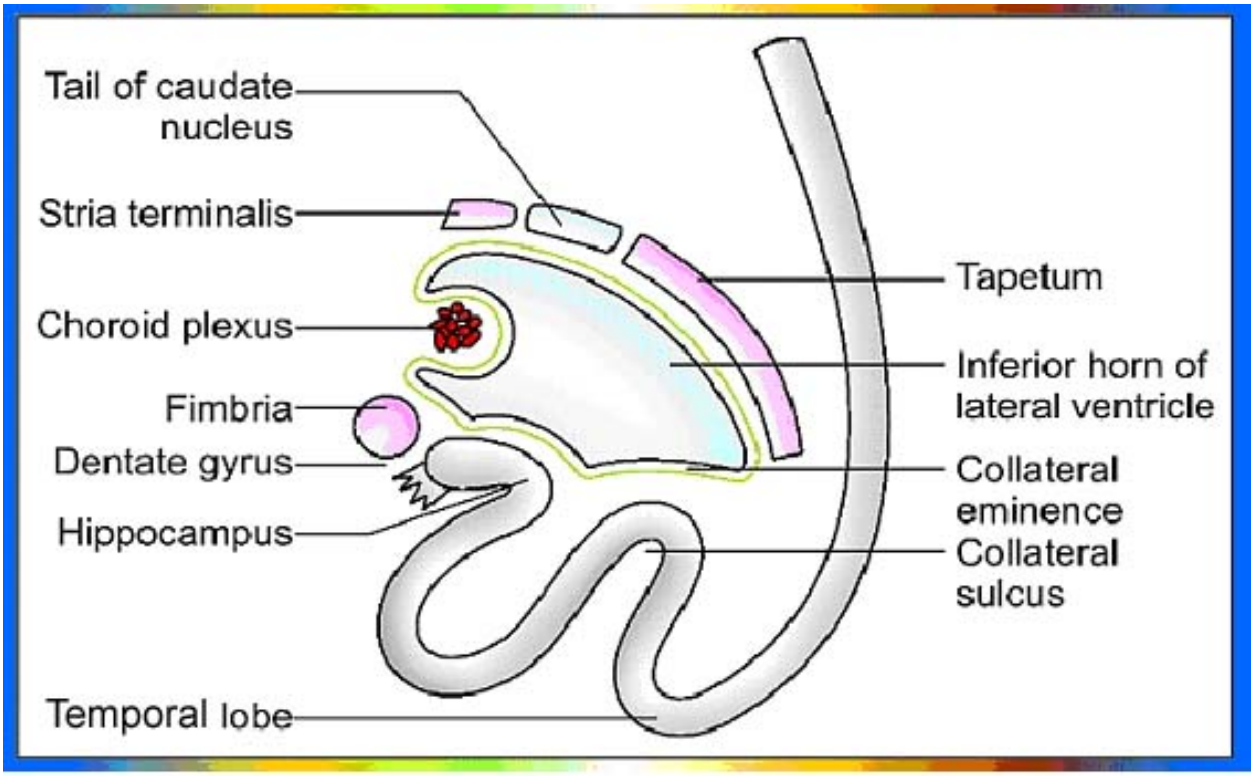
-Roof and lateral wall – Tapetum, tail of caudate nucleus, stria terminalis, amygdaloid nucleus.



-Floor – Pes hippocampus, hippocampus, alveus, fimbria, dentate gyrus, collateral eminence.

Inferior horn:

-Roof and lateral wall – Tapetum of corpus callosum.



Posterior horn:

-Medial wall – Bulb of posterior horn above and calcar avis below

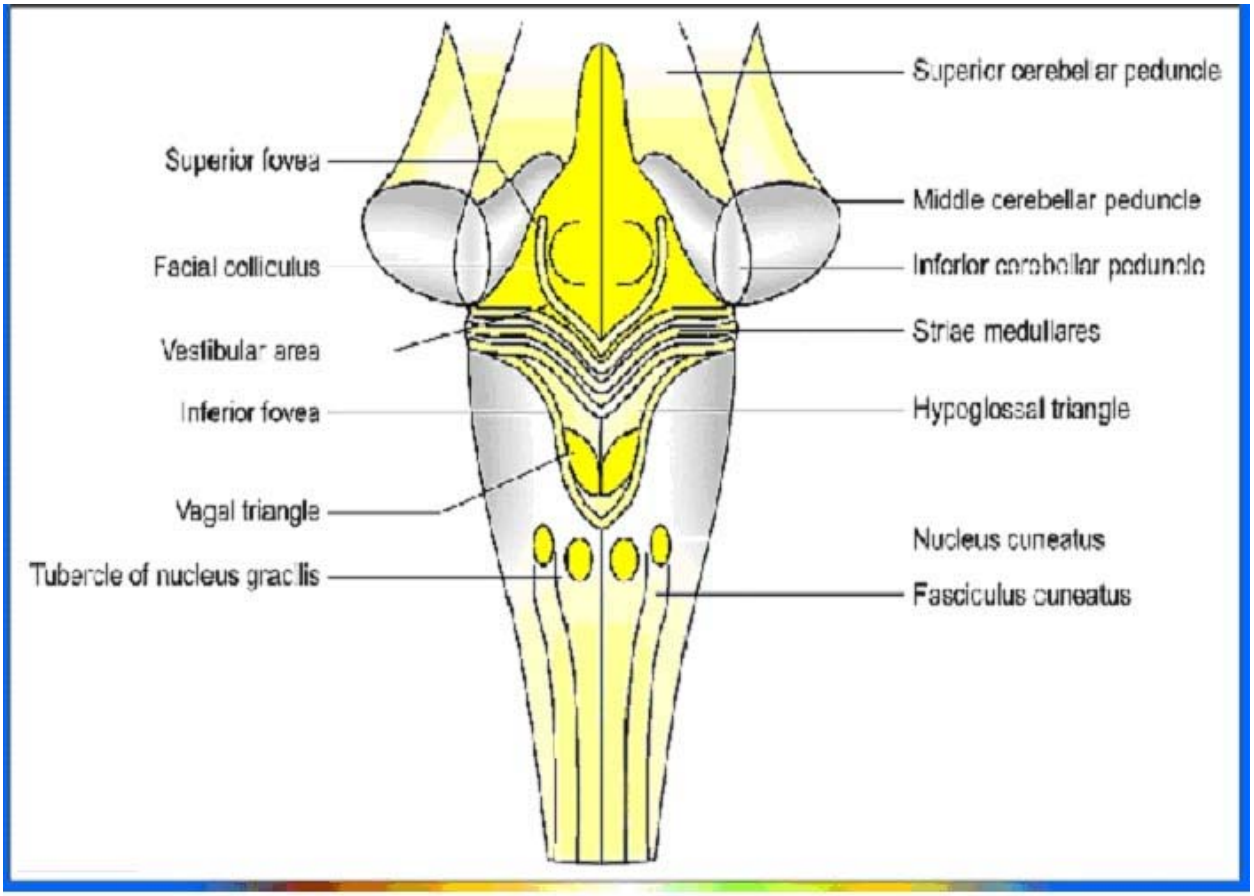
Boundaries of fourth ventricle.

FOURTH VENTRICLE

It is the tent-shaped cavity of the hindbrain. It is situated between the pons and upper part of medulla oblongata in front and cerebellum behind. So it lies dorsal to pons and upper part of medulla oblongata and ventral to cerebellum. It has lateral boundaries, roof, floor and cavity.

Lateral boundaries:

Superolaterally by superior cerebellar peduncles and inferolaterally by gracile, cuneate tubercles and inferior cerebellar peduncles.

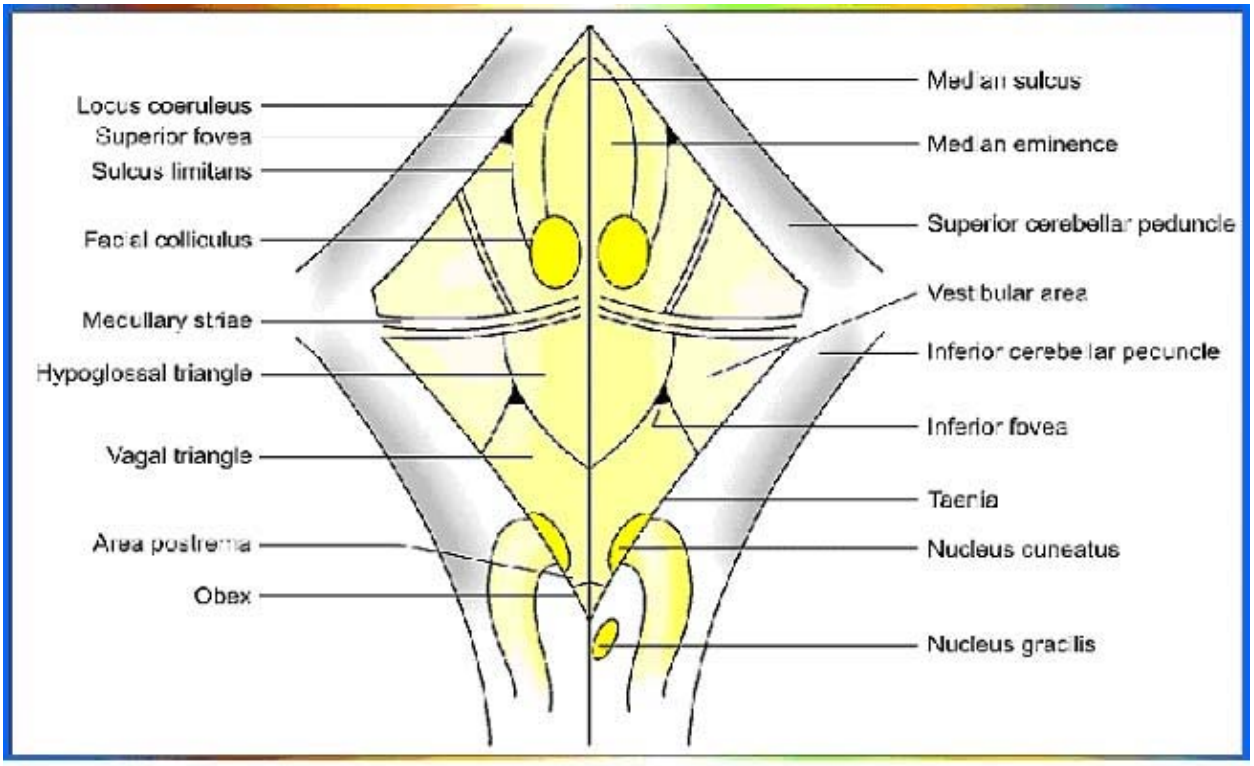


Floor:

It is also called 'Rhomboid fossa'. It is divisible into:

-Upper triangular part formed by dorsal surface of pons.

-Intermediate part at the junction of pons and medulla. It is prolonged laterally over inferior cerebellar peduncle as the floor of the lateral recess.



-A lower triangular part formed by dorsal surface of medulla.

Structures seen in the floor

Median sulcus divides the floor in two symmetrical halves.

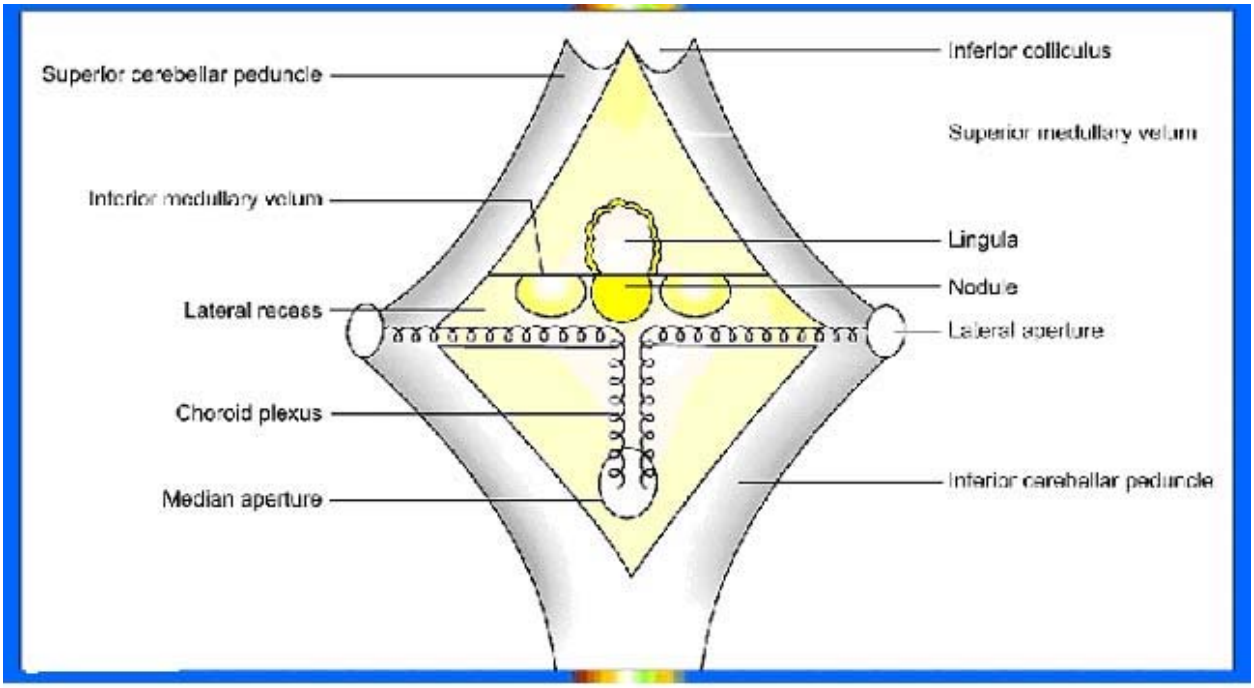
Median eminence is present on either side of the median sulcus and is wider above than below. In the upper part it presents “facial colliculus” just below and medial to a depression called superior fovea. Facial colliculus is formed by the looping of fibres of facial nerve around the nucleus of the sixth nerve. The lower part of median eminence is occupied by hypoglossal triangle overlying the hypoglossal nucleus.

Median eminence is limited laterally by sulcus limitans. Its upper part is marked by superior fovea and lower part by inferior fovea. An oblique line descends from inferior fovea towards midline It divides median eminence into two parts, the hypoglossal triangle medially and vagal triangle laterally. These overlie 12th and 10th nucleus

Vestibular area lies partly in pons and partly in medulla. It overlies the vestibular nuclei.

Roof:

Superior or cranial part of the roof is formed by superior cerebellar peduncles and superior medullary velum.



Inferior or caudal part of the roof is formed by inferior medullary velum forming the bed for tonsil of cerebellum situated on each side of the nodule of inferior vermis

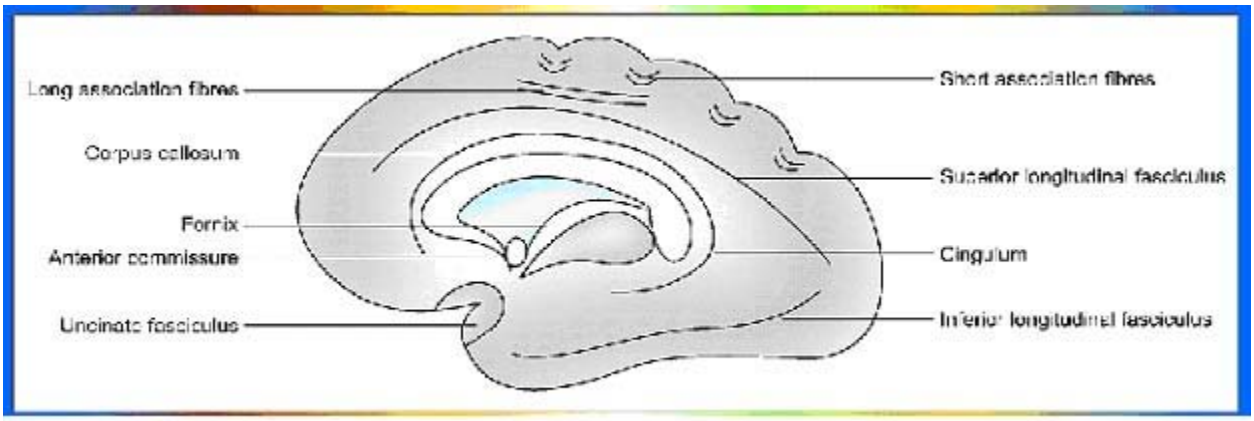
(a) It is prolonged dorsally cranial to nodule of inferior vermis as the median dorsal recess.
(b) It extends above the inferior medullary velum as the lateral dorsal recess.
(c) It also extends laterally between the inferior cerebellar peduncle and floccules as the lateral recess which open into the subarachnoid space as lateral aperture. In the lowest part of median plane lies the median aperture which opens into the cerebellomedullary cistern.

Aperture in the roof
-One median aperture or foramen of Megendie.
Two lateral apertures or foramen of Luschka.

Enumerate various association fibres.

ASSOCIATION FIBRES

Long association:
Uncinate fasciculus connects temporal lobe to motor speech area and orbital cortex.



Cingulum connects cingulate gyrus to the parahippocampal gyrus.
Superior longitudial fasciculus connects the frontal to occipital lobes.
Inferior longitudinal fasciculus connects occipital to temporal lobe.

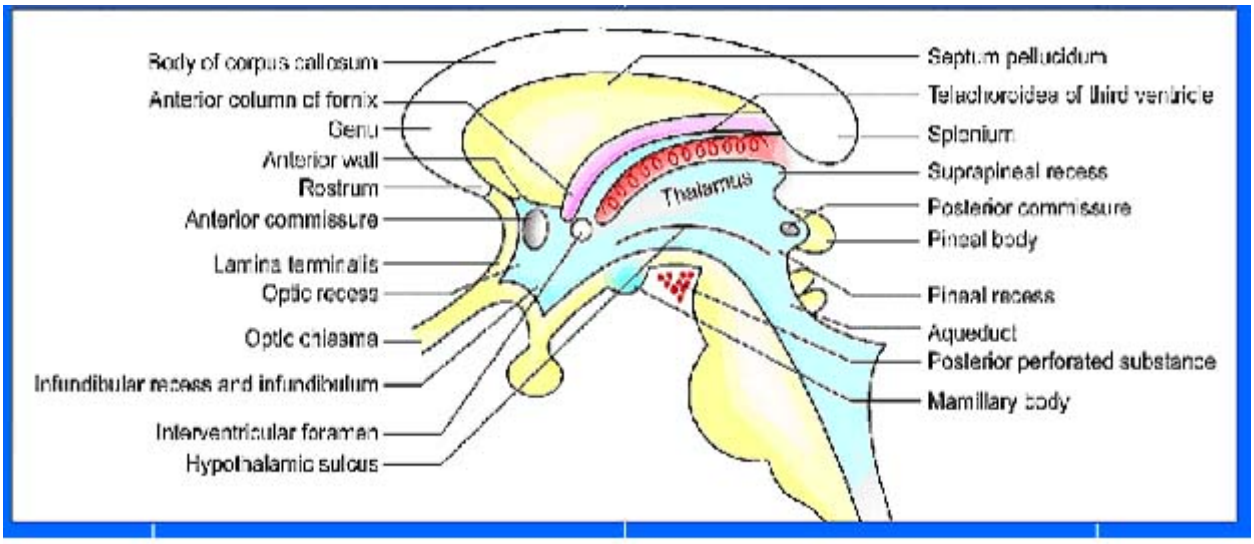
Short Association:
These are also known as arcuate fibres and connect adjacent gyri to one another.

Enumerate Various commissural fibers. Add a note on corpus callosum?

COMMISSURAL FIBRES
These fibres connect identical area of the two cerebral hemisphere. These are:-

1. **Anterior commissure** – It is a rounded bundle lying anterior to anterior column of fornix and the interventricular foramen. It crosses the median plane in the superior part of lamina terminalis. It connects the archipallium i.e. olfactory bulbs, piriform area and anterior parts of

temporal lobes.

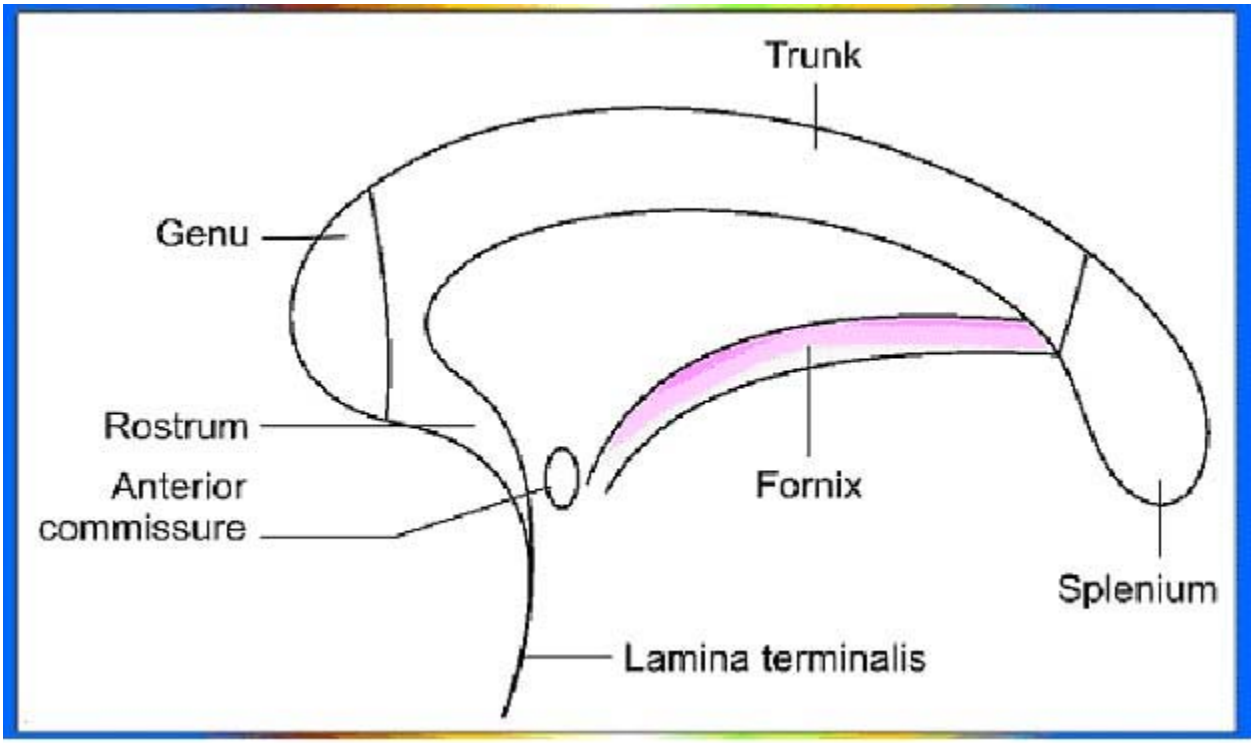


2. **Posterior commissure** – This delicate bundle crosses the median plane dorsal to the upper part of aqueduct.

3. Habenular commissure – It connects the habenular nuclei of two sides.

4. **Commissure of fornix** – Connects the crura of fornix and thus the hippocampus formations of two sides.

5. **Corpus callosum** – It is the largest commissure of brain. It is about 10cm. in length.



Parts:-

a. **Genu**- It is the anterior end of corpus collosam and lies about 4 cm behind the frontal pole. Its fibres curve forwards and connect the lateral and medial surfaces of the two frontal lobes. These are called as forceps minor fibres.

b. **Rostrum** - It is the part of corpus callosum which is directed downwards & backwards from the genu till the lamina terminals in front of anterior commissure. Its fibres connect the orbital surfaces of the two frontal lobes.

c. **Trunk** – It is the middle part between the genu and posterior part or splenium. Its superior surface is convex and inferior is concave. Its fibres connect the two parietal lobes. Tapetum is formed by fibres from the trunk and splenium which do not intersect the fibres of corona radiata.

d. **Splenium** – It is the posterior thickest part of corpus callosum. It lies 6 cm in front of occipital pole. Fibres radiating from splenium are called forceps major. These curve backwards and medially and connect the two occipital poles.

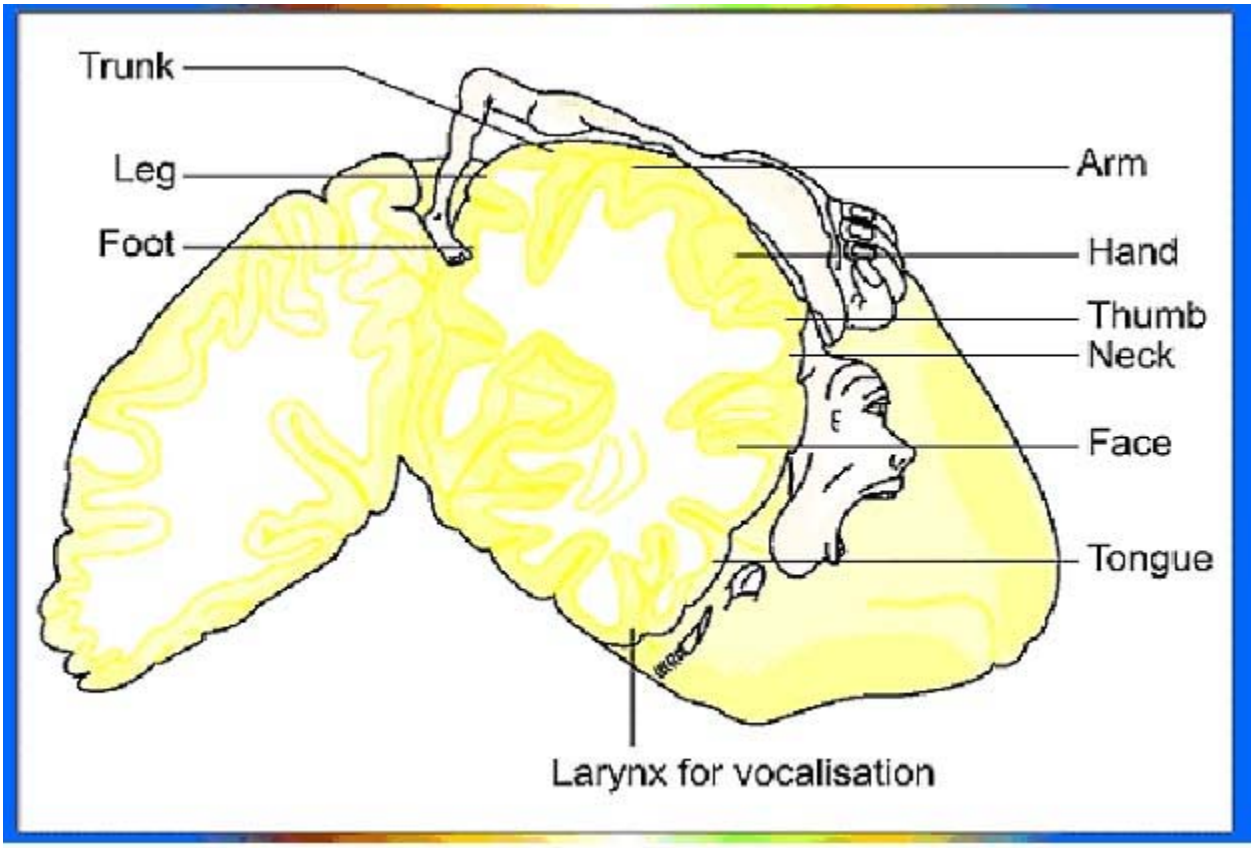
Describe the functional areas of brain?

FUNCTIONAL AREAS OF BRAIN

1. Ms I or primary motosensory area: This includes premotor regions/ areas 4, 6 & 8 of Brodmann and the motor area (area 4) is located in the precentral gyrus including the anterior wall of central sulcus and the paracentral lobule on the medial surface of cerebral hemisphere.

The cortical representation in the motor area is inverted; pharyngeal region and tongue are most ventral in the lowest part of precentral gyrus, followed by face, hand, arm, trunk and thigh; the leg foot and perineum are represented on the medial surface in the paracentral lobule.

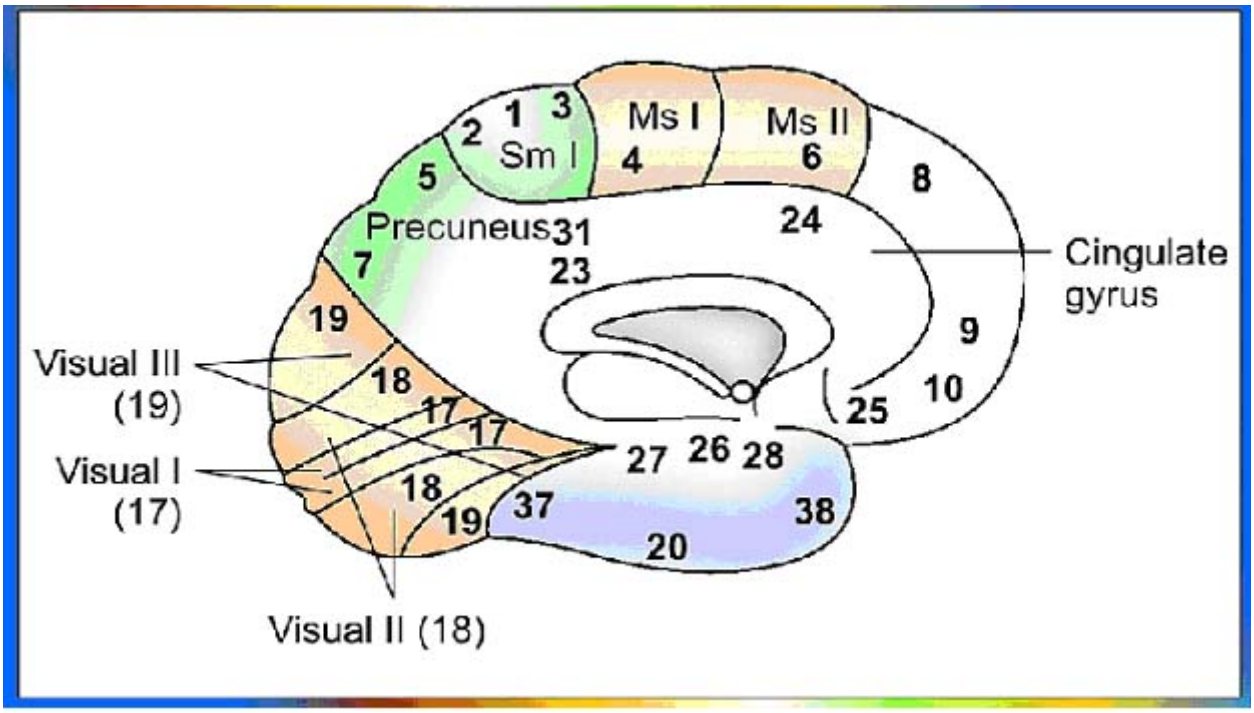
Area for the face particularly the lips, tongue, larynx & hand particularly the thumb is more than the other parts. So area in the brain is proportional to the intricacy of the movements. Further it is the movements of the joints rather than the individual muscles which are represented in the cerebralcortex.



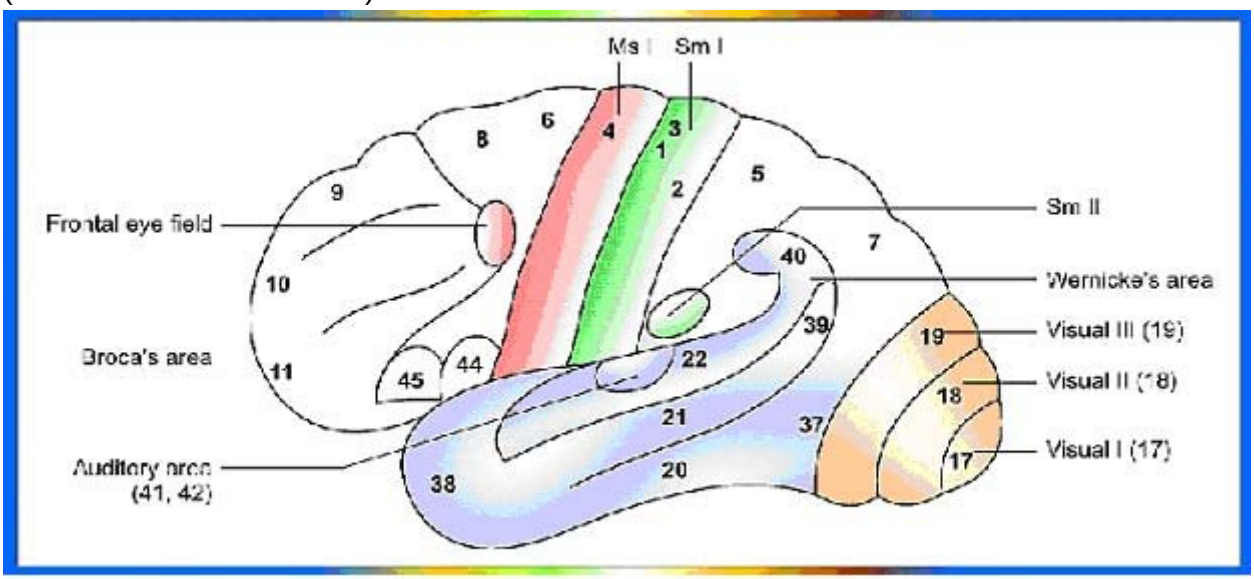
Premotor area (areas 6 and 8) is also part of Ms I area. It corresponds to areas 6 & 8 and receives impulses also from thalamus and hypothalamus area. It is situated in the gyrus anterior to precentral gyrus on the superolateral surface. This part of Ms I area programmes skilled motor activity and directs the primary motor area in its execution. Both these areas receive fibres from cerebellum after relay in the ventro- anterior nucleus of the thalamus. Also receives fibres from thalamus and hypothalamus nuclei. MS1 areas give origin to corticospinal and corticonuclear fibres.

2. Ms II area: This is part of motor area which on the medial surface of cerebral hemisphere is anterior to the paracentral lobule. It differs from the main area in that its stimulation produces

bilateral movements.



3. Sm I area : It occupies postcentral gyrus and the posterior part of the paracentral lobule on the medial surface. It corresponds to area 3,1,2 of Brodmann. The representation of the body is upside down or inverted. Area is proportional to the intricacy of sensations received from it. So tongue, lips, larynx, fingers and thumb have large areas assigned to them, Ventroposterior (medial and lateral divisions) nucleus of thalamus is the main source of afferent fibres.



This area appreciates touch, kinaesthetic and vibration sense.

4. Sm 11 area : It is situated in the superior lip of the posterior ramus of lateral sulcus with

postcentral gyrus. The part of the body are represented bilaterally. Afferents are received from spinothalamic and trigeminothalamic tracts.

5. Motor speech area : It corresponds to area 44,45 of Brodmann. It occupies the opercular and triangular portions of inferior frontal gyrus. In right handed persons this area is present in left hemisphere and in 70% of left handed population it is also present in left hemisphere.

6. Frontal eye field : It corresponds to area 8 of Brodmann and is situated in the middle of middle frontal gyrus just anterior to precentral gyrus. It causes conjugate movements of the eyes.

7. Speech area of Wernicke : It is also called the sensory language area. It comprises auditory association area and supramarginal and angular gyri.

8. Association area in the superior parietal lobule of the superolateral surface and in the precuneus on the medial surface. It corresponds to areas 5 & 7 of Brodmann. It is connected to Sm I and reciprocally connected to dorsal nuclei of thalamus.

9. Vision : Primary visual area is located above and below the calcarine sulcus on medial surface of occipital lobe and corresponds to area 17 of Brodmann. This area is continuous above and below with area 18 and beyond 18 with 19. These areas 18 & 19 are called visual association area. These areas give efferent fibres to frontal eye field. Macular area is represented near the occipital pole and the peripheral area is represented more anteriorly.

10. Hearing : The primary auditory area lies in the temporal lobe. It lies in the anterior transverse temporal gyrus and extends to a small extent on the superior temporal gyrus. It corresponds to areas 41 and 42 of Brodmann. And receives afferents from the medial geniculate body. The auditory association area 22 lies behind the primary area.

11. Taste : It is located in the dorsal wall of the posterior ramus of lateral sulcus and corresponds to area 43 of Brodmann. This area is situated adjacent to MsI area for tongue.

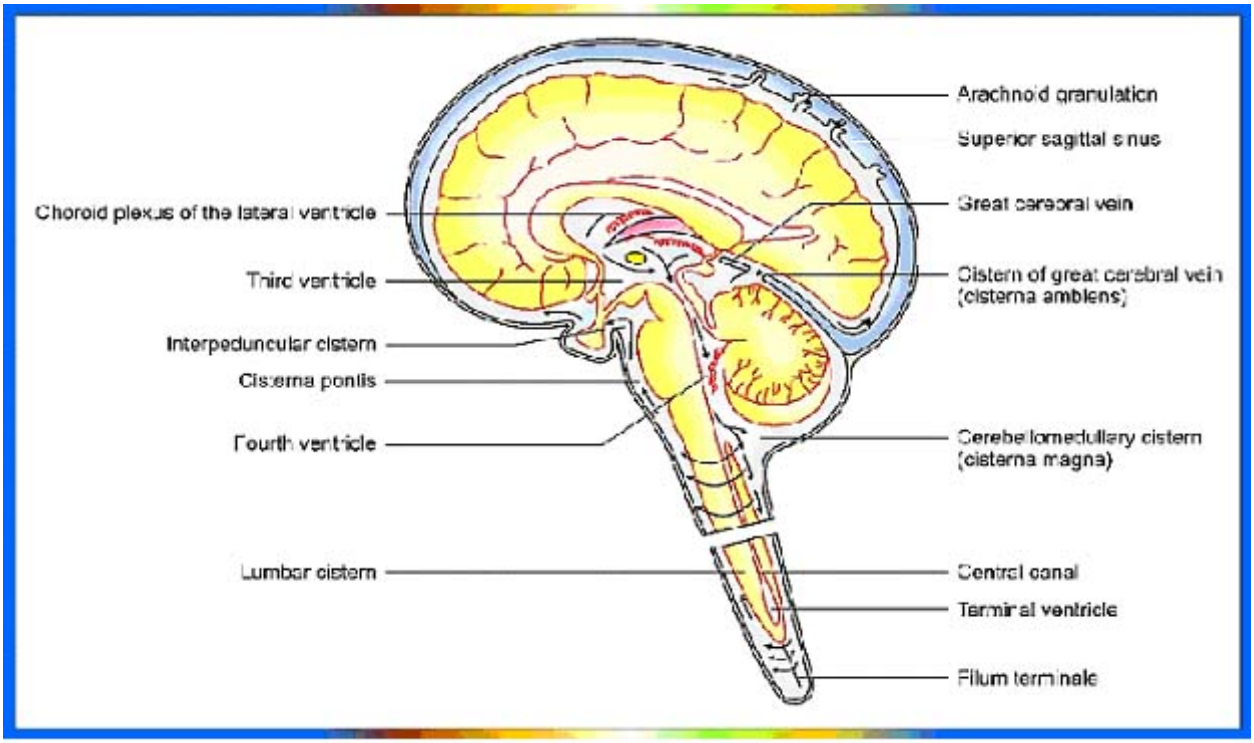
12. Smell : Ends in piriform lobe.

Enumerate the contents and functions of various cisterns?

SUBARACHNOID CISTERNS

The subarachnoid space shows dilatations at some places. These are found where the brain, closely covered with pia mater, lies some distance from arachnoid lining the dura mater. Cisterns are found around brain stem, cerebellum, on the base of brain, around free margin of tentorium cerebelli and in association with the major blood vessels.

1. Cerebellomedullary cistern: Lies in the angle between cerebellum and medulla oblongata. It is related to occipital bone. Inferiorly it is continuous with the subarachnoid space of spinal medulla. It can be approached with a needle passed antero-superiorly through the posterior atlanto-occipital membrane between the posterior arch of atlas and posterior margin of foramen magnum. This is known as cisternal puncture.



2. Cisterna pontis: It lies anterior to pons and medulla oblongata and contains vertebral and basilar arteries. It is continuous posteriorly with cerebello medullary cistern, inferiorly with the spinal subarachnoid space and superiorly with the interpeduncular cistern.

3. Interpeduncular cistern: It fills the interpeduncular fossa. The arachnoid does dip in the fossa but stretches between the-two temporal lobes of brain on either side. It is continuous with cistern of lateral sulcus. Pulsation of arteries help to force cerebrospinal fluid from the cisterns onto the surface of brain.

4. Cistern of lateral sulcus: It is related to main stem of lateral sulcus and contains the middle cerebral artery, deep and superficial middle cerebral veins.

5. Cisterna ambiens: It is around the mid brain. It contains posterior cerebral artery, great cerebral vein and trochlear nerve.

The various cisterns communicate with each other and subarachnoid space in relation to brain and spinal medulla. The only communication with the ventricles of brain is through three small foramina in the roof of fourth ventricle of brain.

Blockage of these foramina due to scar tissue following injury or infection prevents escape of cerebrospinal fluid from ventricles of brain and raises the intracranial pressure.

Describe internal capsule under headings of parts, arrangement of fibres, blood supply, and clinical anatomy?

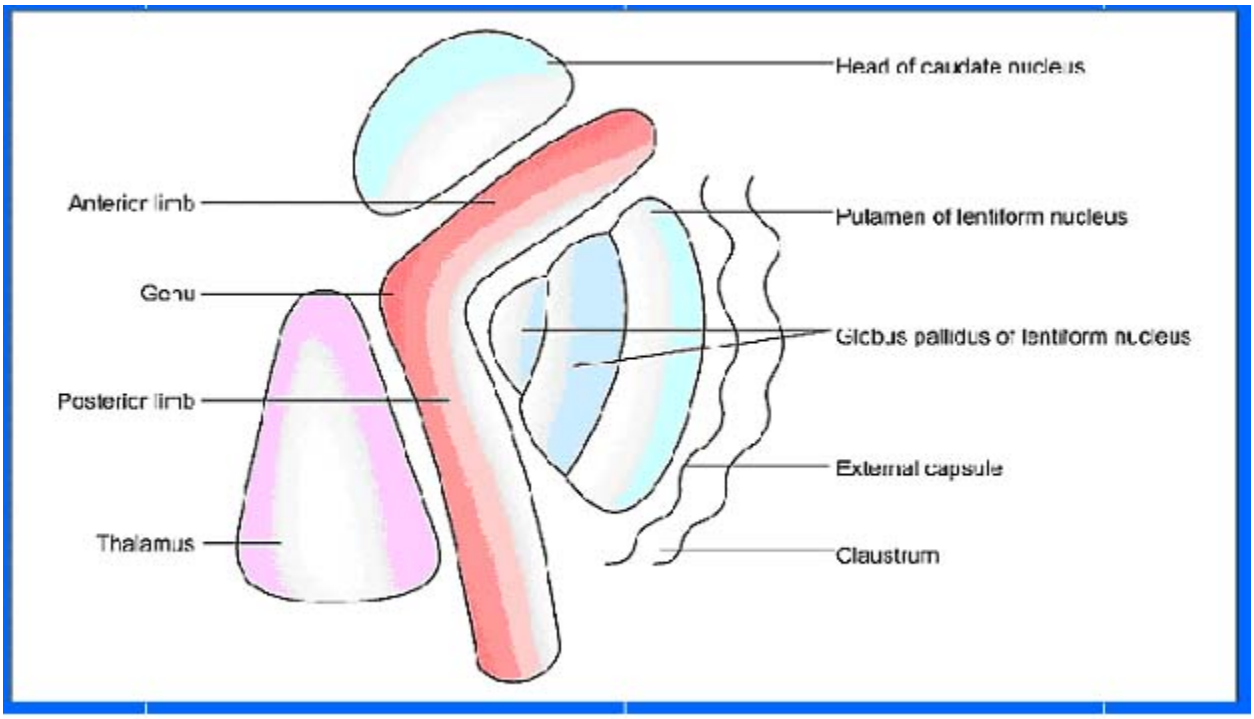
INTERNAL CAPSULE

1. Introduction: Internal capsule is a fan like mass of white fibres.

2. **Situation:** Between caudate nucleus and the thalamus medially and the lentiform nucleus laterally. It is continuous above with the corona radiata and below with cerebral peduncle. On a horizontal section of brain it appears V-shaped with its concavity directed laterally which is occupied by lentiform nucleus. Internal capsule contains fibres going to and coming from cerebral cortex. These fibres are densely crowded and even the pinpoint lesions can give rise to widespread lesions of the body.

3. Parts:

a. Anterior limb: Lies between the head of the caudate nucleus and lentiform nucleus.



b. Posterior limb: Present between thalamus and the lentiform nucleus.

c. Genu: Is the bend between the anterior and posterior limbs.

d. Retrolentiform part: Situated behind the lentiform nucleus.

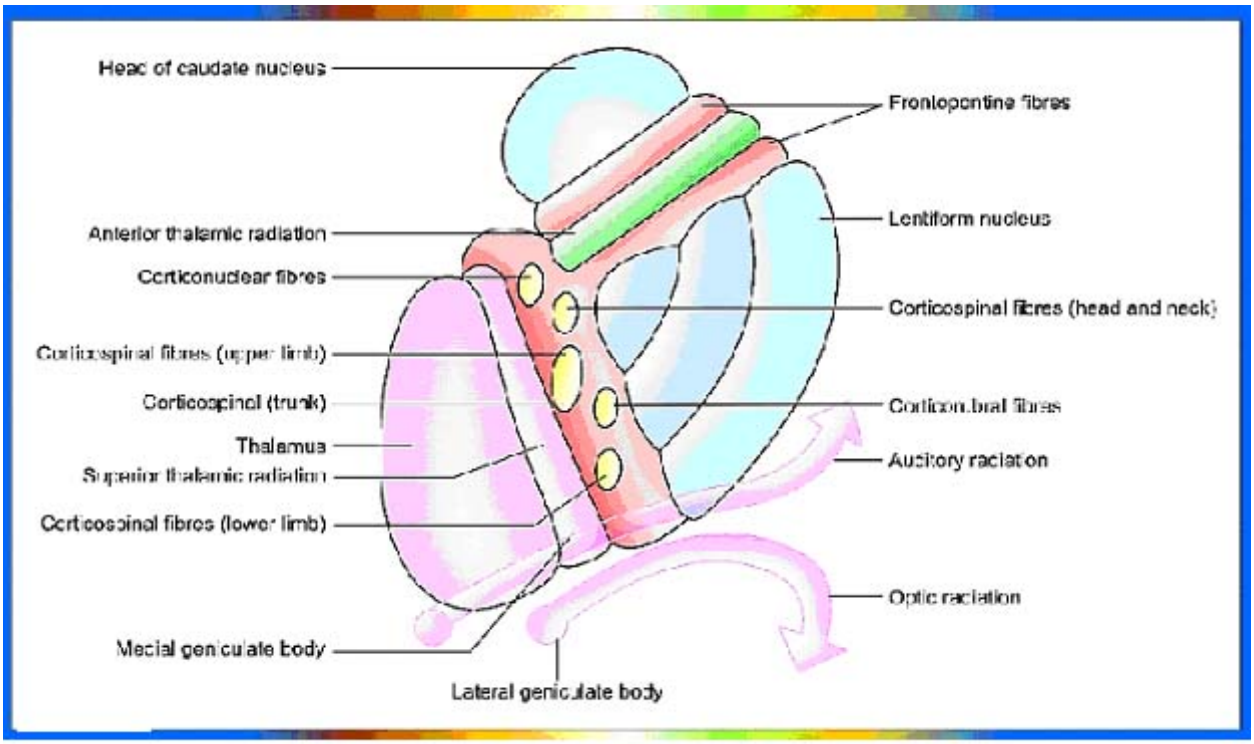
e. Sublentiform part: Situated below the lentiform nucleus.

4. Constituent fibres of the internal capsule:

a. Anterior limb contains:

i. Anterior thalamic radiation containing reciprocal connections between:

•Medial nucleus of thalamus and prefrontal cortex.



•Anterior nucleus of thalamus and cingulate gyrus.

ii. Frontopontine fibres from the frontal cortex to the nuclei pontis.

b. Posterior limb for convenience is divided into two parts, anterior two-thirds and posterior one third.

i. Anterior two-third contains:

•Corticospinal fibres from the motor cortex to anterior horn cells.

•Parietopontine fibres from parietal cortex to nuclei pontis.

•Superior thalamic radiation with reciprocal connections of ventral nuclei of thalamus with parietal lobe.

ii. Posterior one-third contains:

•Thalamocortical fibres or somesthetic sensory fibres from ventral posterior nucleus of thalamus to the postcentral gyrus.

•Corticorubral from premotor area to red nucleus.

c**. Genu** contains:

i. Corticonuclear fibres from:

•The frontal eye fields to nuclei of 3rd, 4th, and 6th cranial nerves.

•Motor cortex for the face to the nuclei of 5th, 7th and 12th nerves and nucleus ambiguus.

ii. Cortico-reticular fibres from cerebral cortex to the segmental reticular formation.

d. Retrolenticular part contains:

i. Posterior thalamic radiation having reciprocal connections of lateral geniculate body and occipital lobe.

ii. Optic radiation from lateral geniculate body to the striate area of cerebral cortex.

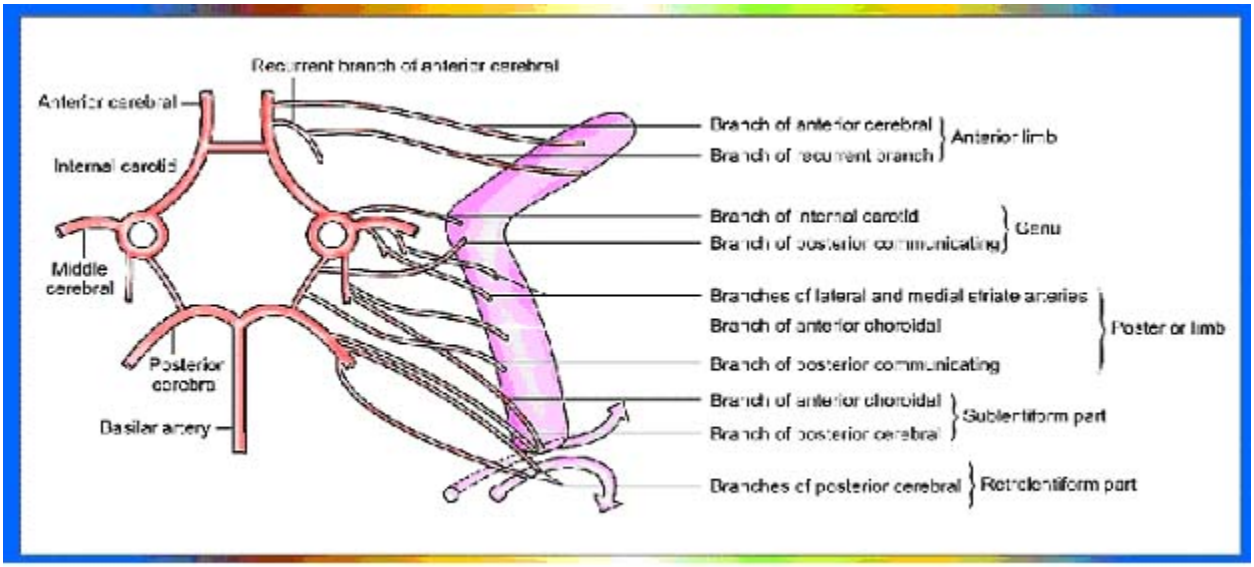
iii. Occipitopontine from the occipital cortex to the nuclei points.

e. Sublentiform part contains the auditory radiation from medial geniculate body to the auditory area of cortex. Sublentiform part contains the auditory radiation from medial geniculate body to the auditory area of cortex and parietopontine and occipitopontine fibres.

5. Blood supply

i. Anterior limb by

-Recurrent branch of anterior cerebral artery.



-Anterior ceberal artery.

ii. Posterior limb by

-Lateral striate branch of middle cerebral.

-Medial striate branch of middle cerebral

iii. Genu by

-Direct branches from internal carotid.

-Posterior communicating artery.

iv. Retrolentiform part by branches of posteriorcerebral.

v. Sublentiform part by.

-Anterior choroidal artery.
-Direct branches of the posterior cerebral artery.
Applied Anatomy: Hemiplegia is one of he commonest nervous conditions and is usually the result of thrombosis or rupture of one of the lateral striate arteries. This branch is often called Charcot's artery of cerebral haemorrhage. Hemiplegia is characterised by a spastic paralysis of one half of the body.
A small lesion in the internal capsule gives rise to extensive effects, on account of a variety of fibres being packed in a very small area. Lesion of the genu leads to paralysis of the face and a monoplegia-paralysis of the upper limb of the opposite side on account of the involvement of cortico-bulbar and adjacent corticospinal fibres for the upper limb.Lesions of anterior two thirds of posterior limb lead to a loss of sensation on the opposite side.Lesions in posterior one third of posterior limb and retrolentiform part involving optic and auditory radiations would lead to visual and auditory defects.

Discuss the circulation of cerebrospinal fluid.

Answer

VENTRICULAR SYSTEM OF CNS

Cerebrospinal fluid formed in the right ventricle and left lateral ventricles

↓

Passes through interventricular foramen

↓

Into the third ventricle

↓

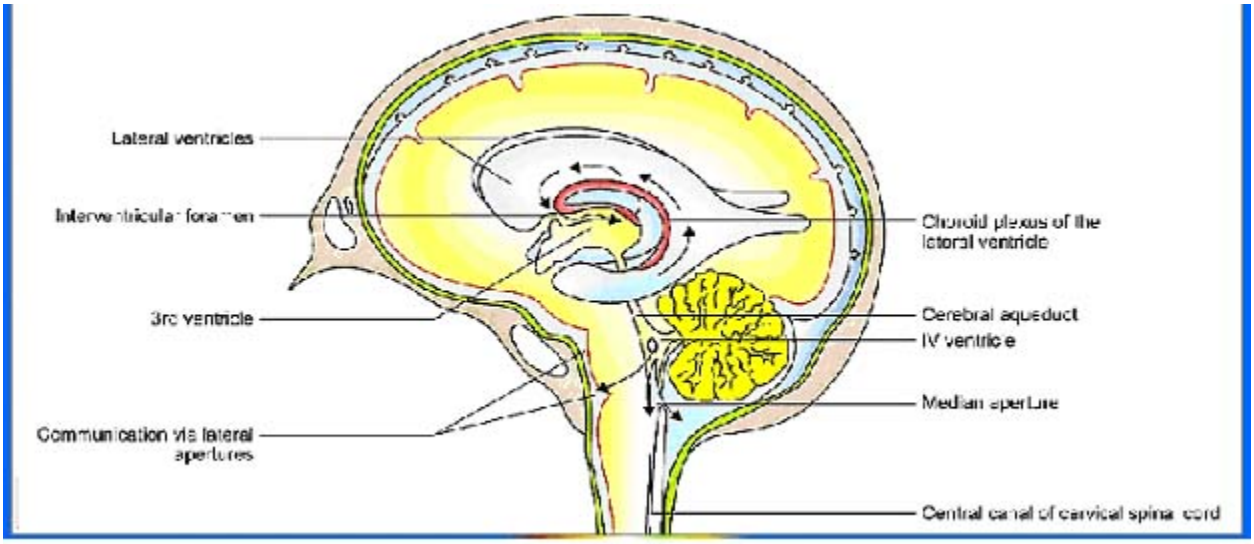
Via aqueduct of midbrain

↓

Into fourth ventricle

↓

Into central of spinal cord ↓ Absorbed in the spinal cord	Median aperture of 1V ventricle ↓ Cerebello medullary and pontine cisterns ↓ Tentorial notch ↓ Lateral and superior surfaces of cerebrum ↓ Arachnoid granulations ↓	Two lateral apertures passes into ↓ Subarachnoid space around spinal cord and cauda equina ↓ Absorbed in veins of spinal cord.
	↓ Superior sagittal sinus	



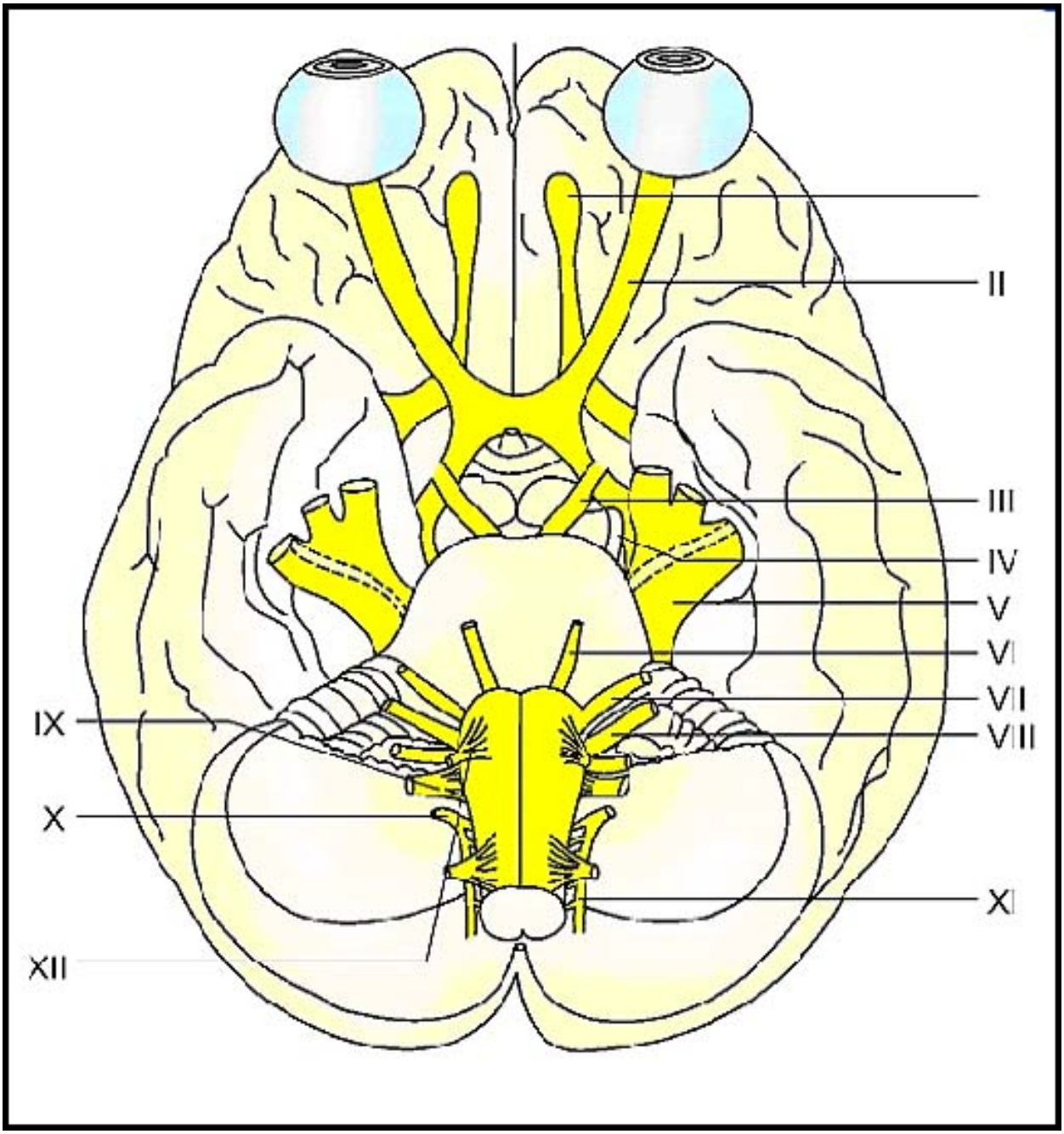
CSF is formed by the choroid plexus of lateral ventricles (mainly in its body and inferior horn), third and 1V ventricles. It flows through the ventricular system. Some of it exits through three apertures present in the roof of 1V ventricle, from where it is absorbed by the veins.
Cerebrospinal fluid provides oxygen and nourishment to the nervous tissue. It also takes away the waste products to the venous circulation. It also regulates its contents.
CSF can be obtained for diagnosis and prognosis of neurological diseases through lumbar or cisternal puncture.

What are the functions of mesencephalic nucleus? Where is it located?

Functions of Mesencephalic Nucleus
Mesencephalic nucleus of V nerve is located in the midbrain for proprioception from muscles of mastication, face, tongue & orbit.

Give the location of Edinger Westphal nucleus and trace the fibres to the periphery?

Edinger Westphal Nucleus
This nucleus belongs to general visceral efferent column of nuclei and is related to oculomotor nerve nucleus at the level of superior colliculus of mid brain.



Its fibres join the oculomotor nerve and pass through its branch to inferior oblique. This branch provides motor root to the ciliary ganglion. After relay in the ciliary ganglion, 10-15 short ciliary nerves arise which supply the ciliaris and constrictor pupillae muscles. Both these intraocular muscles help in accommodation.

Trace pathways of light reflex, accommodation reflex and corneal reflex?

Answer

CONSENSUAL LIGHT REFLEX

Light thrown in one eye

↓

Optic nerve

↓

optic chiasma

↓

optic tract

↓

Pretectal nucleus of same and opposite sides.


Edinger westphal nuclei of both sides
Fibres join respective III nerve
Branch to inferior oblique
Ciliary ganglion relay
Short ciliary nerves
Constrictor pupillae of both sides

↓

Both pupils constrict.

Accommodation reflex

While attempting to read

↓

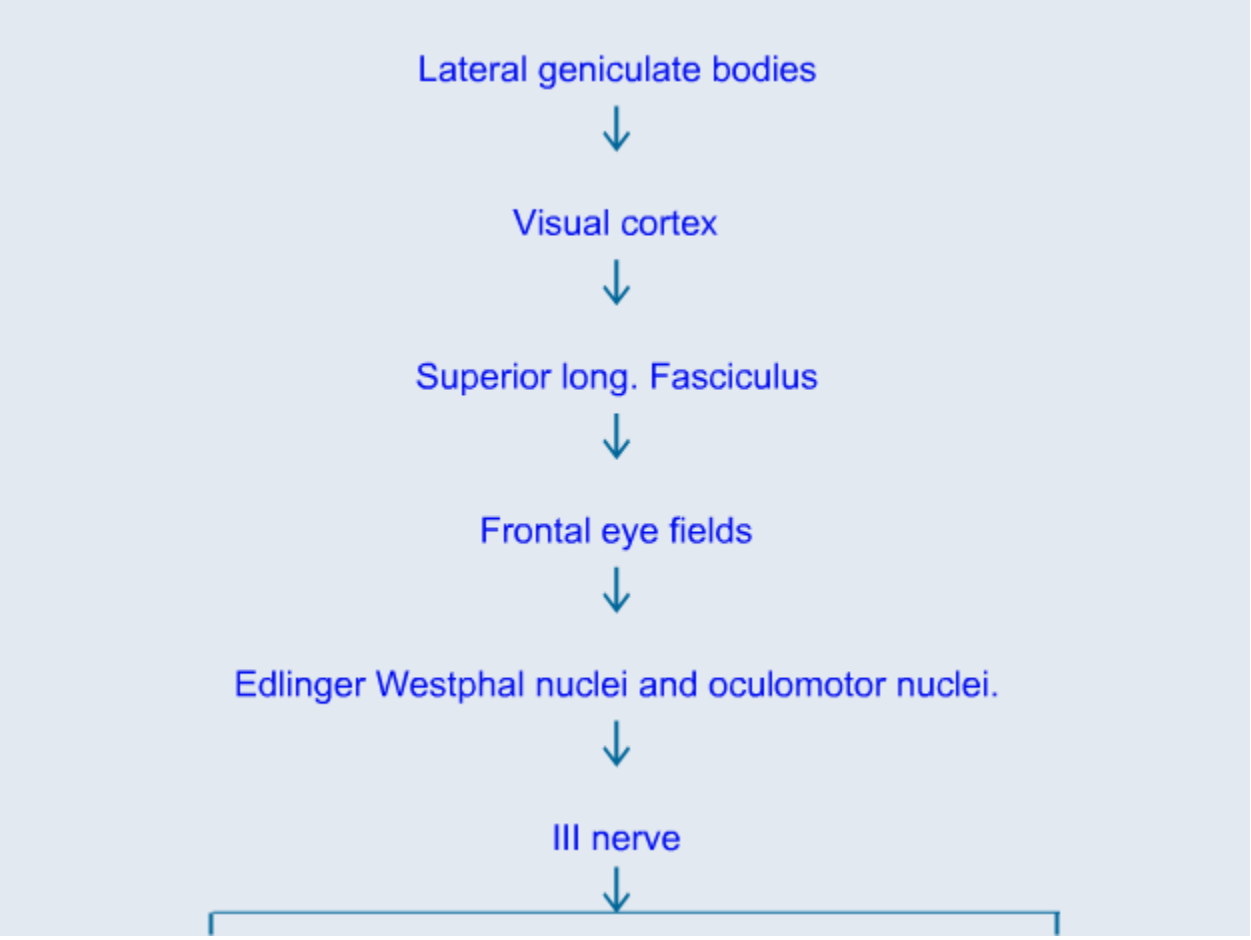
Optic nerves

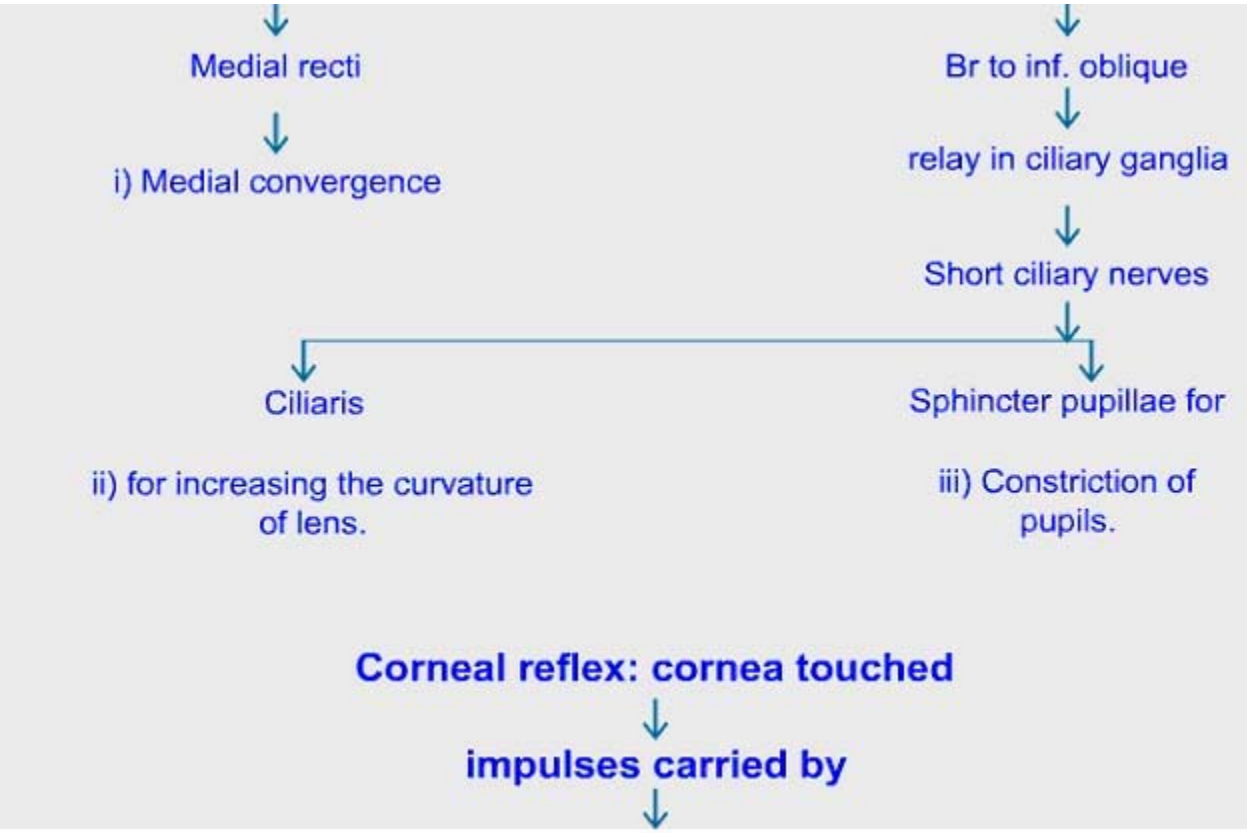
↓

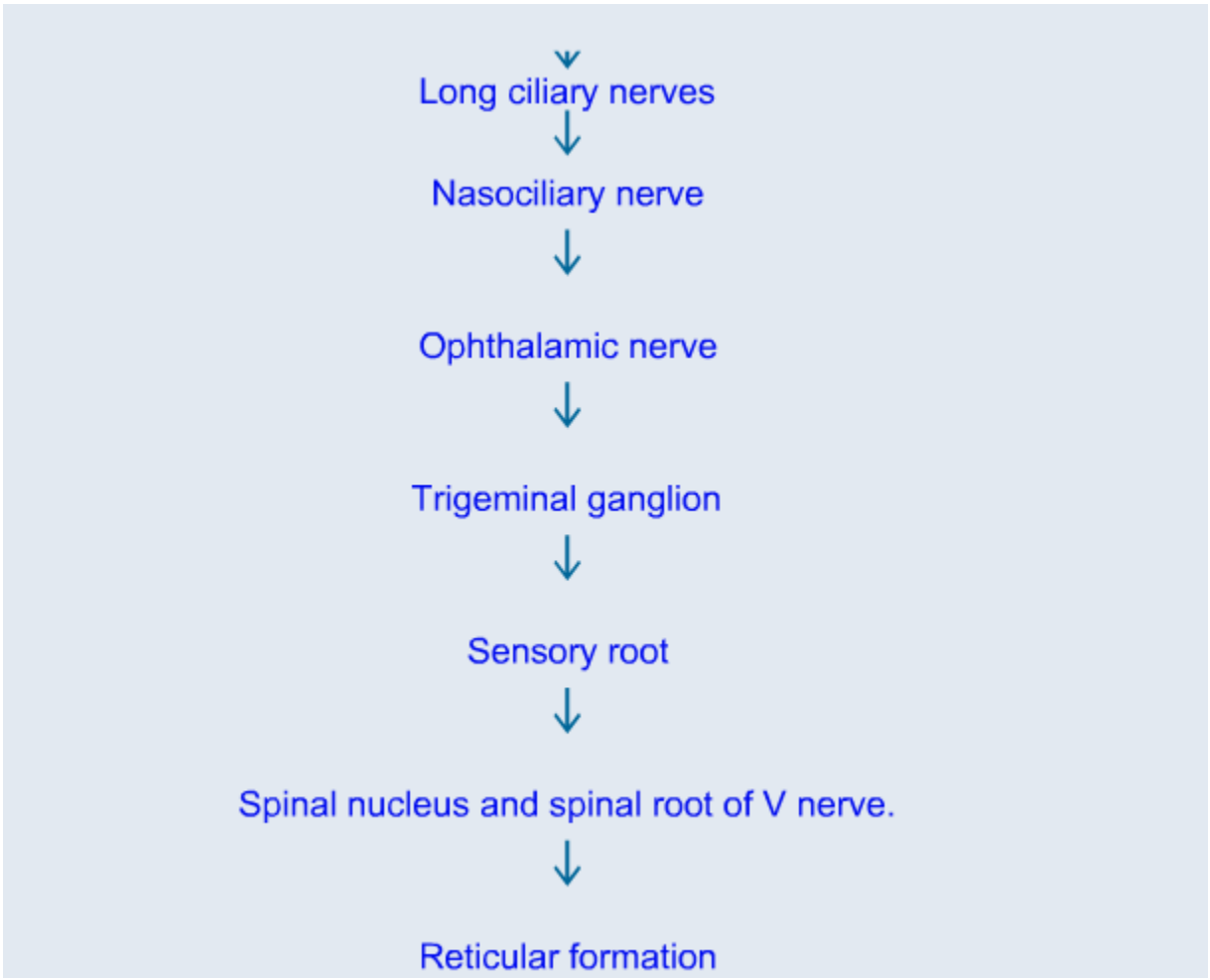
Optic chiasma

↓

Optic tracts


Lateral geniculate bodies
Visual cortex
Superior long. Fasciculus
Frontal eye fields
Edlinger Westphal nuclei and oculomotor nuclei.
III nerve


Medial recti
i) Medial convergence
Br to inf. oblique
relay in ciliary ganglia
Short ciliary nerves
Ciliaris
ii) for increasing the curvature of lens.
Sphincter pupillae for
iii) Constriction of pupils.
Corneal reflex: cornea touched
impulses carried by


Long ciliary nerves
Nasociliary nerve
Ophthalamic nerve
Trigeminal ganglion
Sensory root
Spinal nucleus and spinal root of V nerve.
Reticular formation

↓

Facial motor nucleus in pons

↓

Zygomatic br. of facial n

↓

Orbicularis oculi muscle

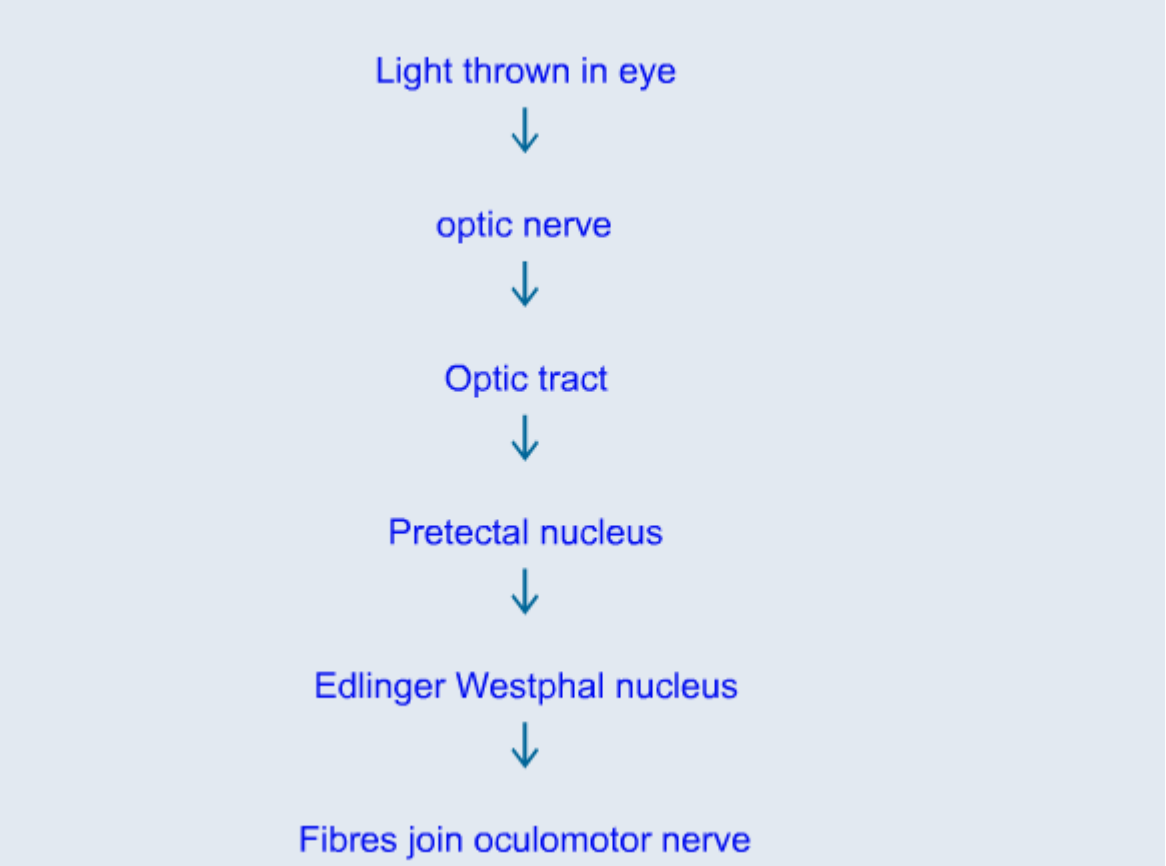
↓

Eyelids close.

Light reflex.

↓

Light thrown in eye


Light thrown in eye
optic nerve
Optic tract
Pretectal nucleus
Edlinger Westphal nucleus
Fibres join oculomotor nerve

↓

Pass in br. to inf. oblique muscle

↓

Ciliary ganglion-relay

↓

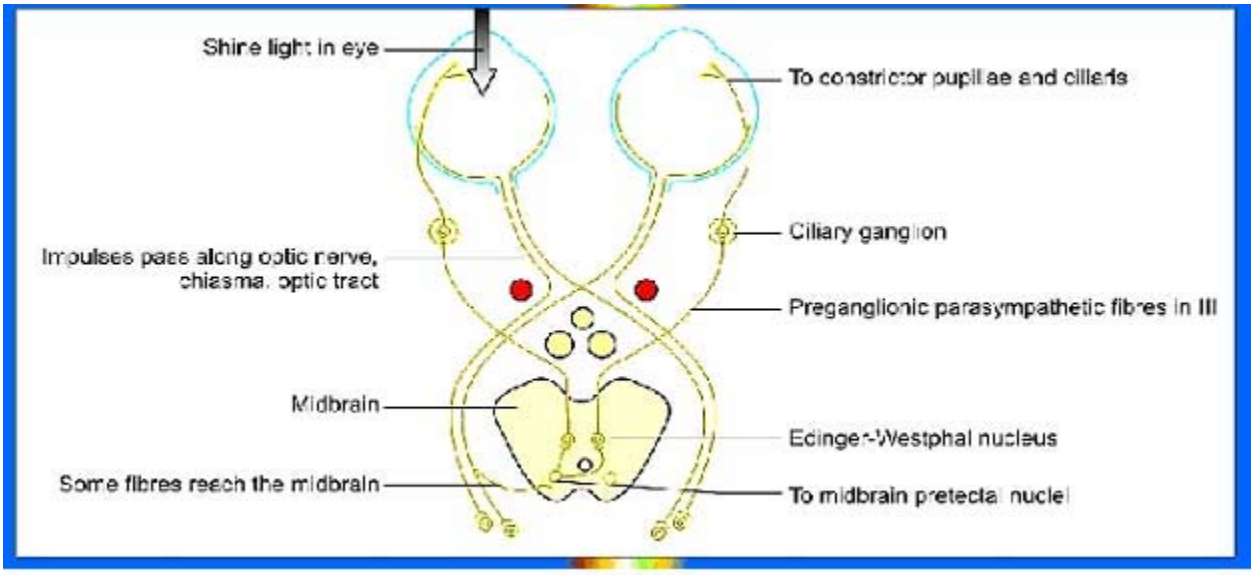
Short ciliary nerves.

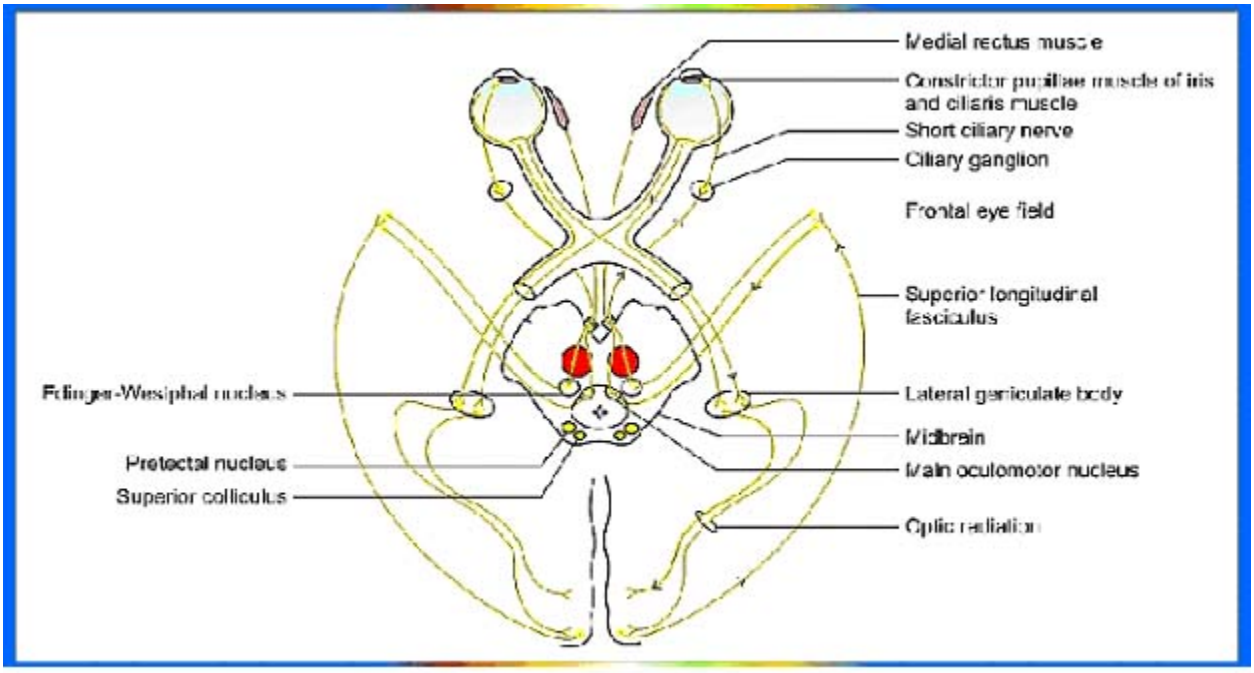
↓

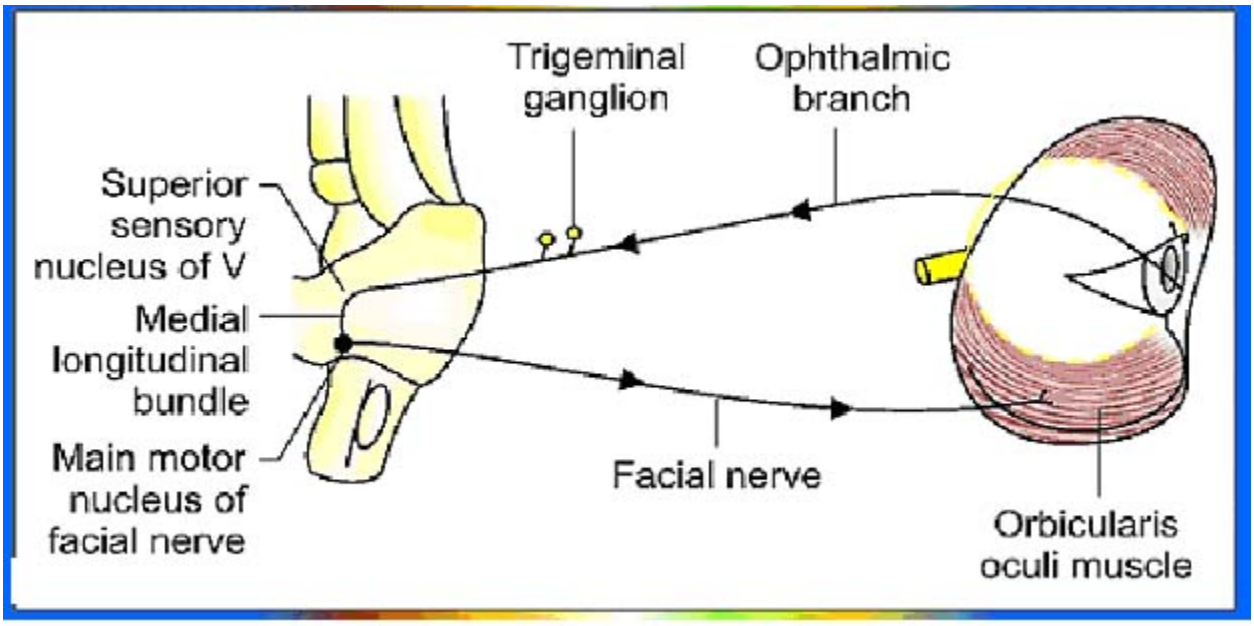
Sphincter pupillae muscle

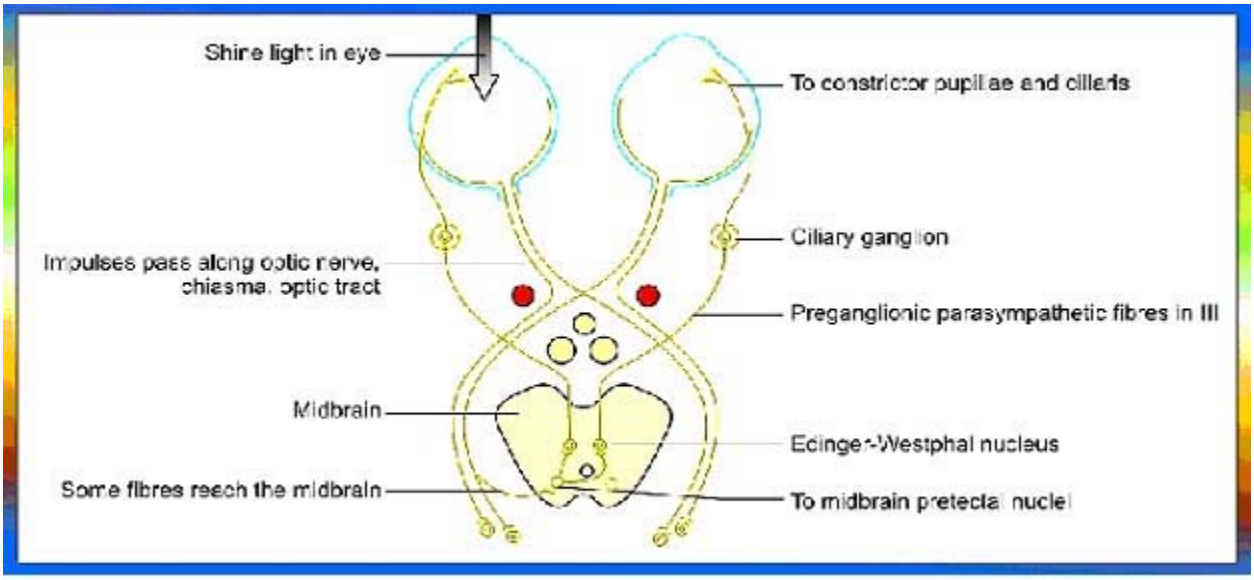
↓

Pupil constricts




Medial rectus muscle
Constrictor pupillae muscle of iris and ciliaris muscle
Short ciliary nerve
Ciliary ganglion
Frontal eye field
Superior longitudinal fasciculus
Edinger-Westphal nucleus
Lateral geniculate body
Midbrain
Pretectal nucleus
Main oculomotor nucleus
Superior colliculus
Optic radiation


Trigeminal ganglion
Ophthalmic branch
Superior sensory nucleus of V
Medial longitudinal bundle
Main motor nucleus of facial nerve
Facial nerve
Orbicularis oculi muscle

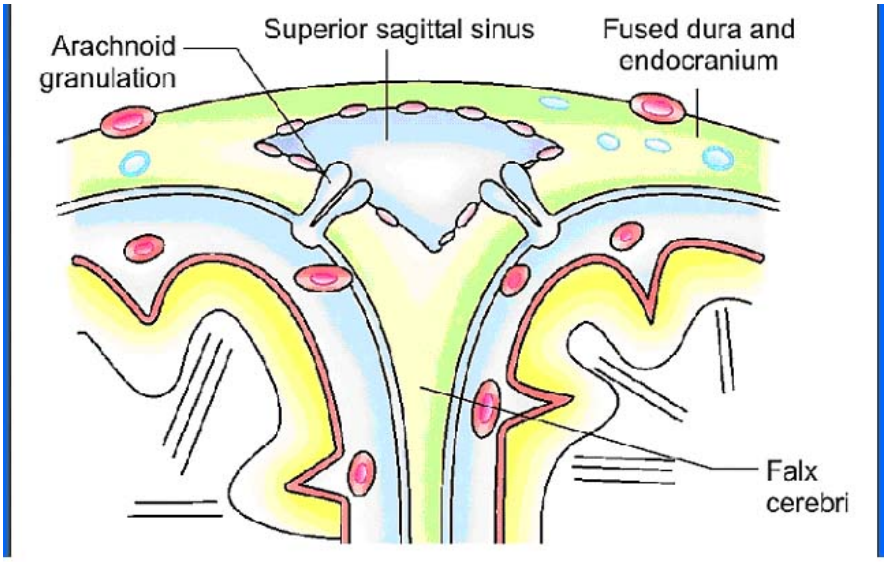


Describe the folds of duramater under headings of position attachments and sinuses enclosed ?

Folds of Duramater

1. Fold Falx Cerebri

Sickle shaped, separates the right from left cerebral hemisphere. Superior convex margins are attached to sides of the groove lodging the sup.sagittal sinus. Inf.concave margin is free.



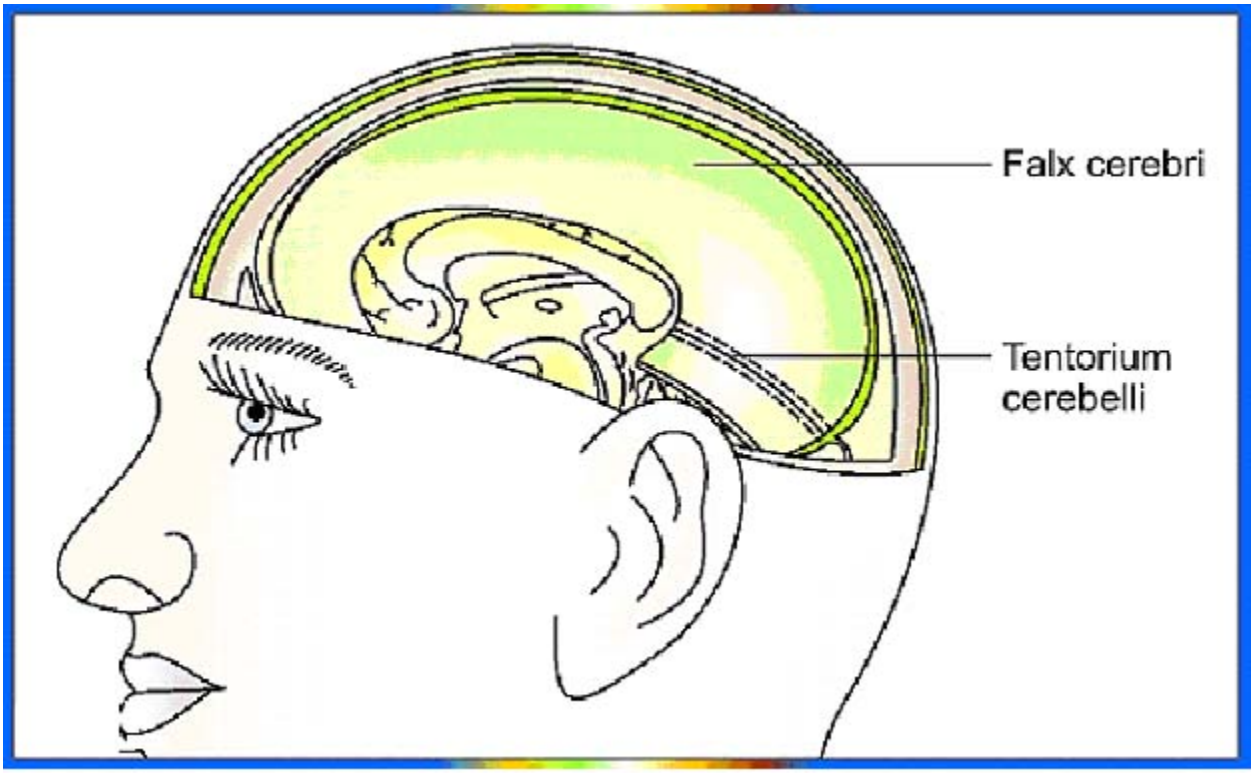
Attachments ant-to crista galli; post-upper surface of tentorium cerebelli.Venous sinuses enclosed Superior sagittal sinus and inferior sagittal sinus.

2. Tentorium cerebelli

Tent shaped separates the cerebral hemispheres from hind brain and lower part of mid-brain. Lifts off the weight of occipital lobes from the cerebellum.Has a free anterior margin , ends are attached to ant. clinoid process. Rest is free and concave. Post or attached margin-to the lips of groove containing trans. sinus and superior .petrosal sinus and post clinoid process.
Venous sinuses enclosed are transverse sinuses.

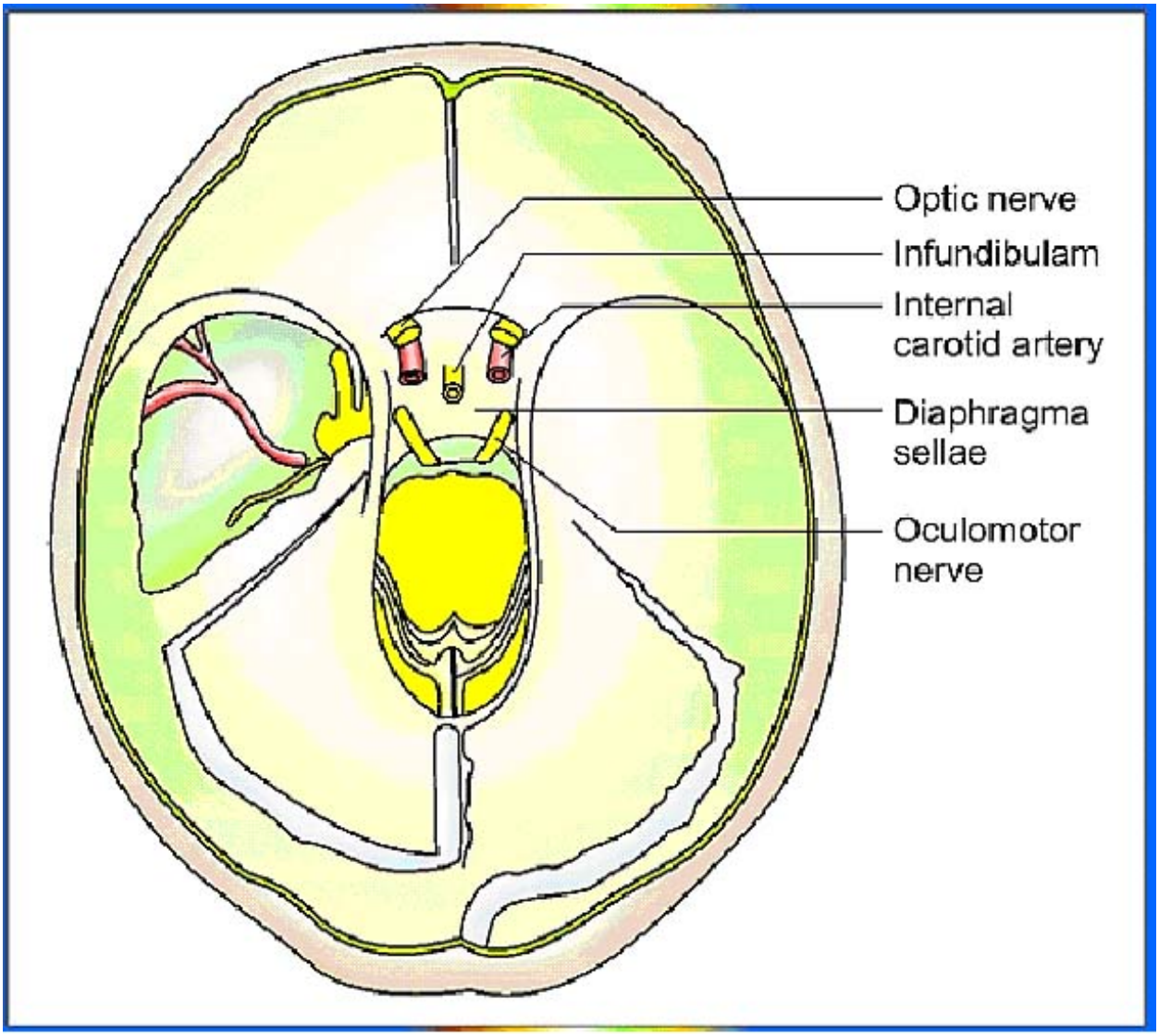
3. Falx cerebelli

Small sickle shaped fold, partly separating two cerebellar hemispheres.Base is attached to post part of inferior surface of tentorium cerebelli. Apex reaches till foramen magnum. Venous sinus enclosed is occipital sinus.



4. Diaphragm sellae

Small horizontal fold of dura matter.Ant.-to tuberculum sellae, Post,-to dorsum sellae, sides with dura mater of middle cranial fossa.



Venous sinuses enclosed are anterior & posterior intercavernous sinuses.

Enumerate the connections of cerebellum

CONNECTIONS AND FUNCTIONS OF CEREBELLUM

Connections of Cerebellum

The fibres entering or leaving the cerebellum are grouped to form three peduncles which connect the cerebellum to the midbrain, the pons and the medulla. The constituent fibres in them are given in following table.

It is clear from Table that the middle and inferior peduncles are chiefly afferent to the cerebellum

and that the superior cerebellar peduncle is chiefly efferent in nature.

Grey Matter of Cerebellum

It consists of the cerebellar cortex and the cerebellar nuclei. There are four pairs of nuclei:
(1) the nucleus dentatus is neocerebellar;
(2) the nucleus globosus and
(3) the nucleus emboliformis are palaeocerebellar; and
(4) the nucleus fastigii is archicerebellar.

Functions of Cerebellum

The cerebellum controls the same side of the body, i.e. its influence is ipsilateral. This is in marked contrast to other parts of the brain most of which control the opposite half (contra lateral) of the body. The functions of the cerebellum are as follows:

Clinical Anatomy

Cerebellar Syndrome. Cerebellar lesions give rise to symptoms and signs which together constitute the cerebellar syndrome. It is characterized by:
i. muscular hypotonia
ii.Intention tremors (tremors only during movements) tested by finger-nose and heel-knee tests
iii. Adiadochokinesia which is the inability to perform rapid and regular alternating movements, like pronation and supination
iv. Nystagmus (to and fro oscillatory movements of the eyeballs while looking to either side)
v. scanning speech (jerky and explosive)
vi. ataxic gait (unsteady gait).

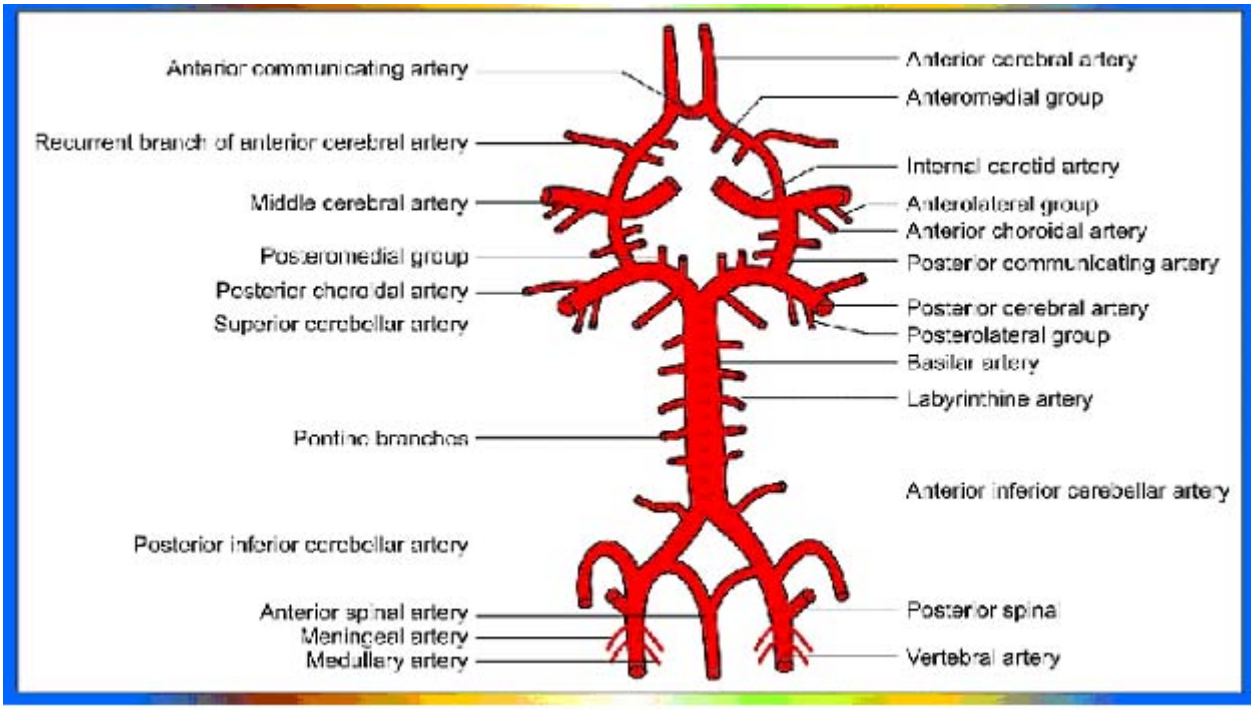
Development

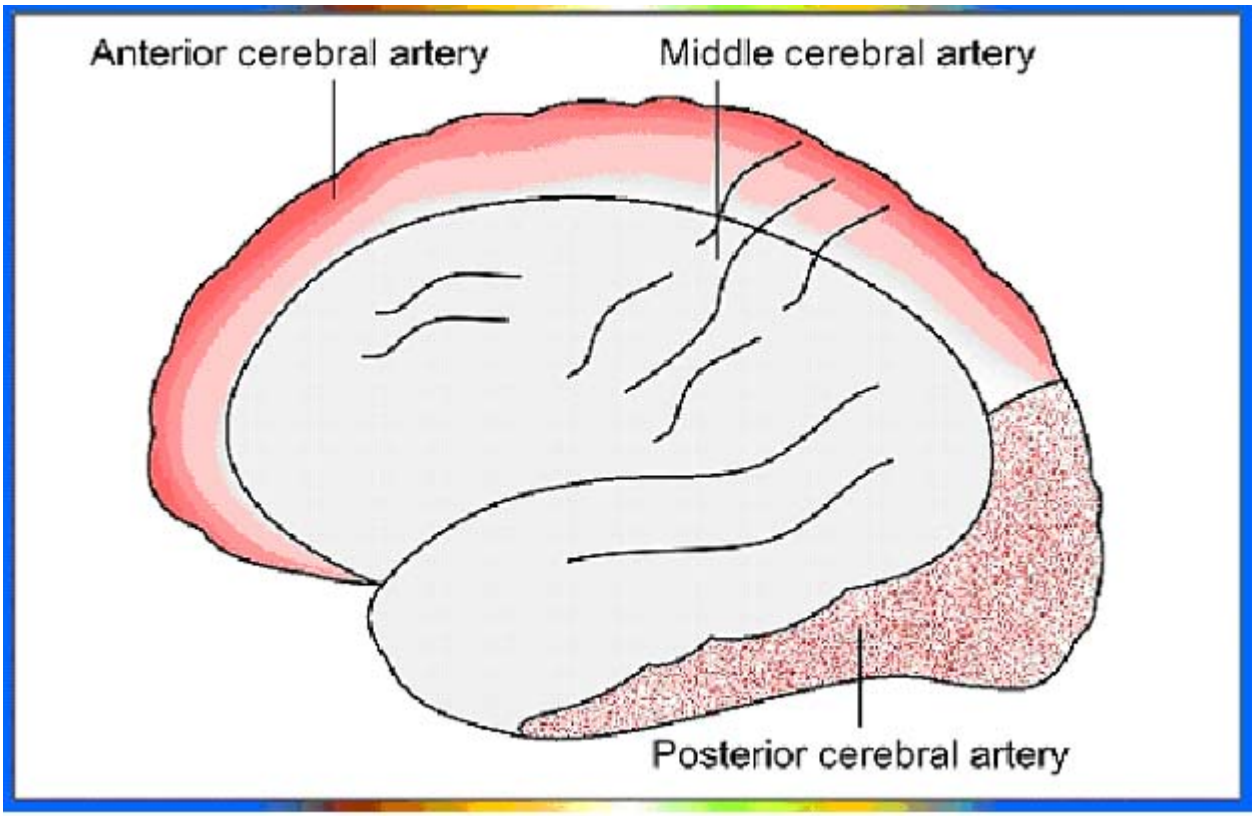
Cerebellum develops from the neurons of alar lamina of metencephalic part of the rhombencephalic vesicle. These neurons migrate dorsally and form the rhombic lip which forms the cerebellum.

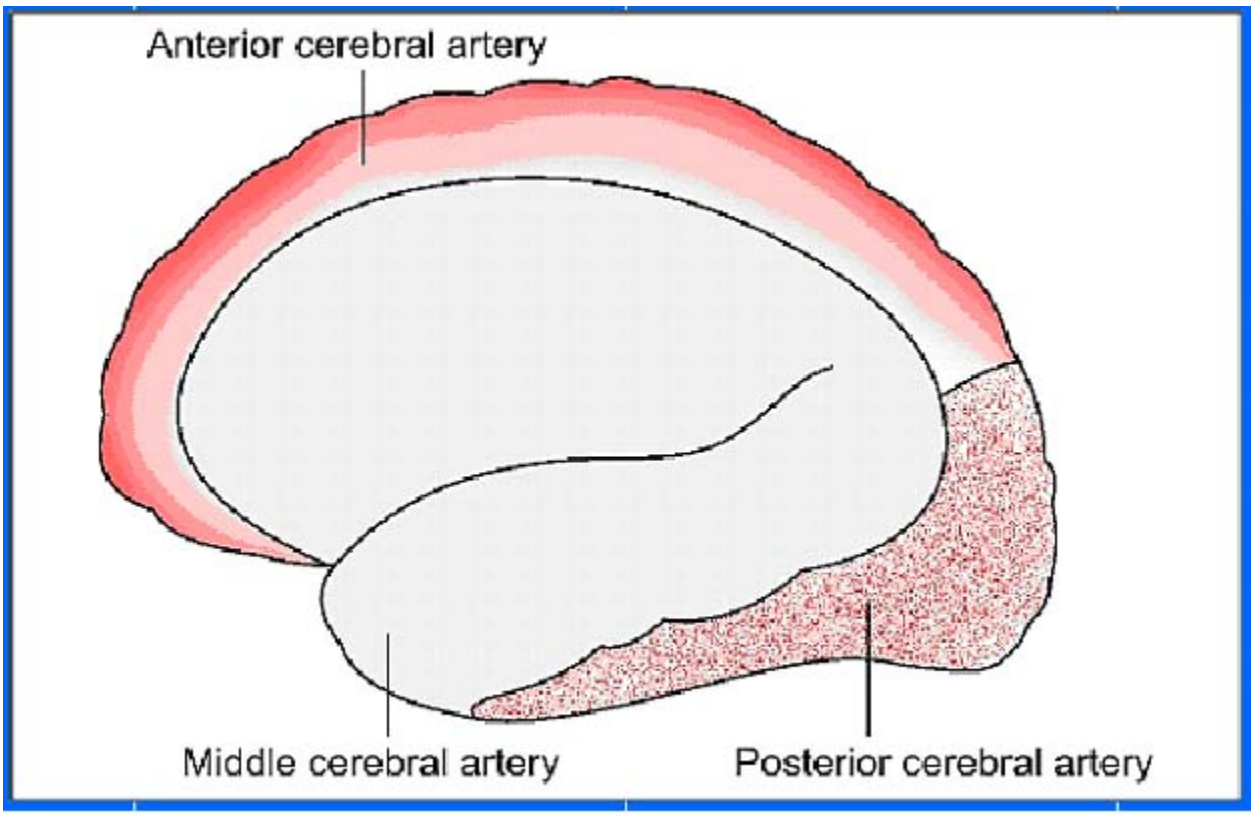
Table. Constituents of the Cerebellar Peduncles

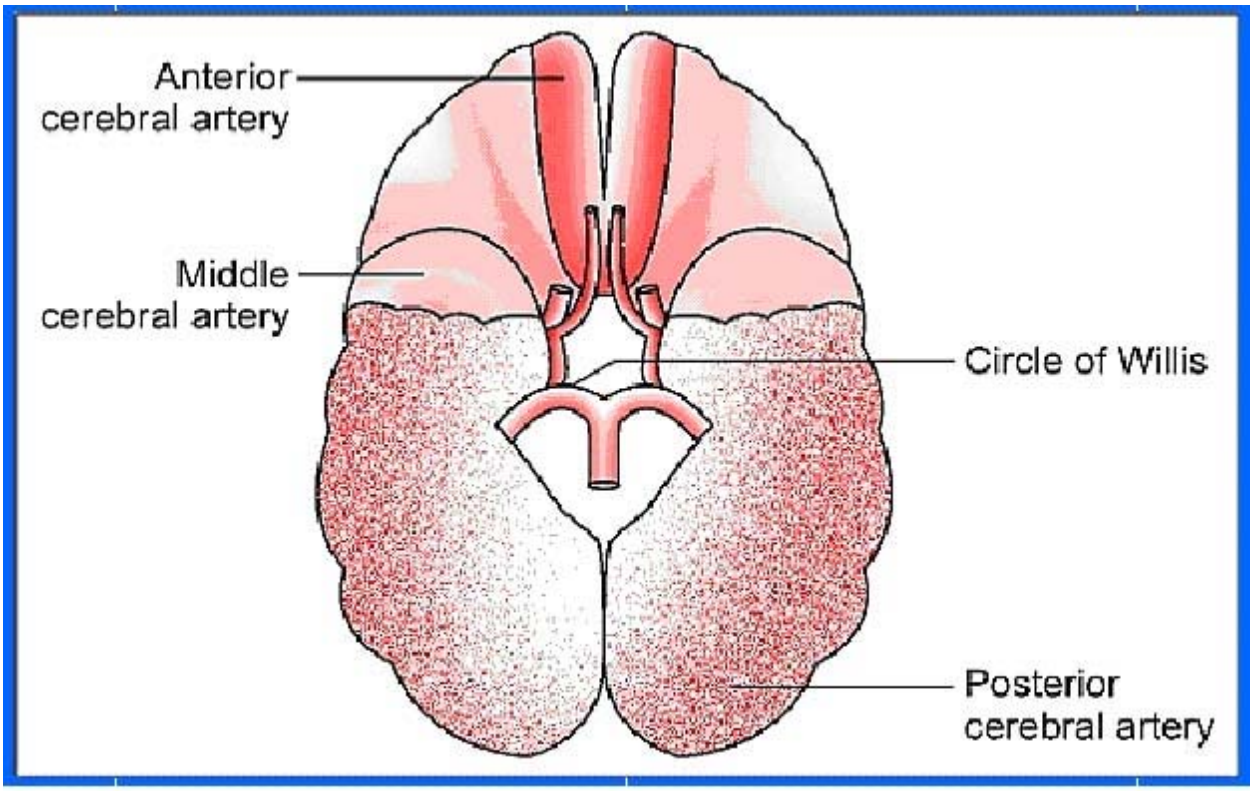
Peduncle	Afferent Tracts	Efferent Tracts
Superior cerebellar peduncle	Anterior spinocerebellar, Tectocerebellar, Dentato-olivary, Fastigo-reticular	Cerebellorubral Dentato-thalamic,
Middle cerebellar peduncle	Ponto cerebellar (part of the corticoponto-cerebellar pathway)	----------
Inferior cerebellar peduncle	Posterior spinocerebellar Cuneocerebellar, (posterior external acute fibres) Cerebello-olivary Olivocerebellar Parolivocerebellar Reticulocerebellar	Cerebellovestibular Cerebelloreticular
	Vestibulocerebellar Anterior external arcuate fibres Striae medullares Trigeminocerebellar	

Describe the blood supply of cerebral hemisphere






Anterior cerebral artery
Middle cerebral artery
Posterior cerebral artery


Anterior cerebral artery
Middle cerebral artery
Circle of Willis
Posterior cerebral artery

Chiefly by the poster medial and poster lateral central branches of the posterior cerebral artery.
Partly by the anteromedial central branches.

BLOOD SUPPLY OF BRAIN AND SPINAL CORD

Arterial supply: Two vertebral and two internal carotid arteries supply the brain.

A. Vertebral artery is a branch of subclavian artery, and on its course is divided in four parts. The fourth part lies in the cranial cavity and gives following branches:-

i. Posterior spinal artery

ii. Posterior inferior cerebellar artery: This is the largest branch of vertebral artery. It runs a tortuous course in relation to olive, lower boarder of pons and vallecula of cerebellum and gives branches to the lower part of pons, poster lateral part of medulla and inferior surface of medulla oblongata.

iii. Anterior spinal artery

iv. Medullary branches

The two vertebral arteries join with each other at the lower border of pons to form a single median Basilar artery. It runs on the ventral surface of pons and ends by dividing into two posterior cerebral arteries. The branches of basilar artery are pair of:-

i. Anterior inferior cerebellar arteries.

ii. Labyrinthine arteries for the internal ear

iii. Pontine branches

iv. Superior cerebellar arteries

v. Posterior cerebellar arteries

B. Internal carotid artery enters the cranial cavity through the carotid canal and superior aspect of foramen lacerum. It traverses the cavernous sinus. It gives ophthalmic artery as it emerges from the sinus and ends on the lateral side of optic chiasma by dividing into following branches:

i. Posterior communicating

Ii. Anterior choroidal

iii. Anterior cerebral - small terminal branch

iv. Middle cerebral - larger terminal branch.

The terminal branches of vertebral and internal carotid arteries join to form an arterial circle at the base of brain, called the circle of Willis. The two anterior cerebrals are joined by anterior communicating artery. The middle and posterior cerebrals are joined by posteriorcommunicating artery.

The branches of circle of Willis are:

i. Central branches: These are present in four sets, anteromedial, anterolateral, poster lateral and poster medial.

ii. Cortical branches supply different regions of the cortex.

iii. Choroidal branches from internal carotid and posterior cerebral arteries.

Arterial supply of cerebral cortex

The cerebral cortex is supplied by cortical branches of anterior, middle and posterior cerebral arteries.

The greater part of the superolateral surface is supplied by the middle cerebral artery.

The areas not supplied by this artery are as follows:

i. A strip about 2cm. wide along the super medial border extending from the frontal pole to the parieto-occiptal sulcus is supplied by the anterior cerebral artery.
ii. The area belonging to the occipital lobe is supplied by the posterior cerebral artery.
iii. The inferior temporal gyrus is also supplied by the posterior cerebral artery.
The main artery supplying the medial surface is the anterior cerebral. The area of this surface belonging to the occipital lobe is supplied by the posterior cerebral artery. The lateral part of the orbital surface is supplied by the middle cerebral artery & the medial part by the anterior cerebral artery.
The tentorial surface is supplied by the posterior cerebral artery. The temporal pole is, however, supplied by the middle cerebral artery. From the above description it will be clear that the main somatic motor and sensory areas are supplied by the middle cerebral artery except in their uppermost parts (leg areas) which are supplied by the anterior cerebral. The auditory area is supplied by the middle cerebral artery and the visual area by the posterior cerebral artery.

Arterial supply of other parts of cerebral hemisphere.

C. Internal capsule

It is supplied by the central branches of
i. The middle cerebral artery, (lenticulostriate branches)
ii. The anterior cerebral artery (Heubner's recurrent branch)
iii. The posterior communicating artery
iv. The anterior choroidal artery

Corpus Striatum

The Choroid Plexuses

The choroid plexuses of the lateral and third ventricles are supplied by the anterior choroidal artery (branch of internal carotid) and the posterior choroidal artery (branch of the posterior cerebral artery). The choroid plexus of the fourth ventricle is supplied by a branch from the posterior inferior cerebellar artery.

Cerebellum is supplied by superior cerebellar, anterior inferior and posterior inferior cerebellar arteries. The veins of cerebellum drain into neighboring venous sinuses. The midbrain is supplied by branches from the posterior cerebral arteries including their poster medial and poster lateral central branches.

The pons is supplied by branches of basilar artery. The medulla oblongata is supplied by branches of vertebral and branches of posterior inferior cerebellar arteries.
Veins of midbrain, pons and medulla drain into neighboring venous sinuses.

Spinal cord is supplied by three arteries one anterior spinal and a pair of posterior spinal arteries. Anterior spinal artery lies in the anterior median sulcus while the posterior spinal artery

run along the line of attachment of dorsal nerve root one on each side.

Veins draining the spinal cord are arranged in six sets - anteromedial, posteromedian, a pair each of anterolateral and poster lateral channels. These veins drain into various intersegmental veins.

External cerebral veins

Super lateral surface: - Upper set drains into superior sagittal sinus, lower set drains into superficial middle cerebral vein.
Medial surface: - Upper set into superior sagittal sinus, lower set into inferior sagittal sinus.
Inferior surface:- Anterior set into superficial cerebral vein, posterior set into basal vein, transverse sinus

Internal cerebral veins:

The internal cerebral vein is formed by union of thalamostriate and choroidal veins. The internal cerebral veins join to form great cerebral vein. The important tributaries of great cerebral vein are the basal veins (one on each side) formed by union of anterior cerebral vein, deep middle cerebral vein and striate veins. Now the great cerebral vein joins the inferior sagittal sinus to form straight sinus.

The branches of internal carotid and three cerebral arteries are presented in the following table.

	Internal Carotid	Anterior Cerebral	Middle Cerebral	Posterior Cerebral
Cortical	-----	Anterior Cerebral surface including a strip along supero-medial border and medial part of orbital surface	Most of superolateral surface, temporal pole and lateral part of orbital surface	Area of occipital lobe, inferior temporal gyrus and the tentorial surface
Central		Medial striate	Lateral striate	Posteromedial set
Choroidal	Anterior choroidal			Posterior choroidal
Communicating	Posterior communicating	Anterior communicating	-----	-----

Terminal	Ant cerebral, middle cerebral	Cortical	Cortical	Cortical

Clinical anatomy

The arterial diseases are very common. These manifest in different ways:

- Haemorrhage
- Thrombosis
- Embolism

Hypertensive encephalopathy

The cortical branches anastomose to some extent before these pierce the brain substance, while central branches are end arteries.

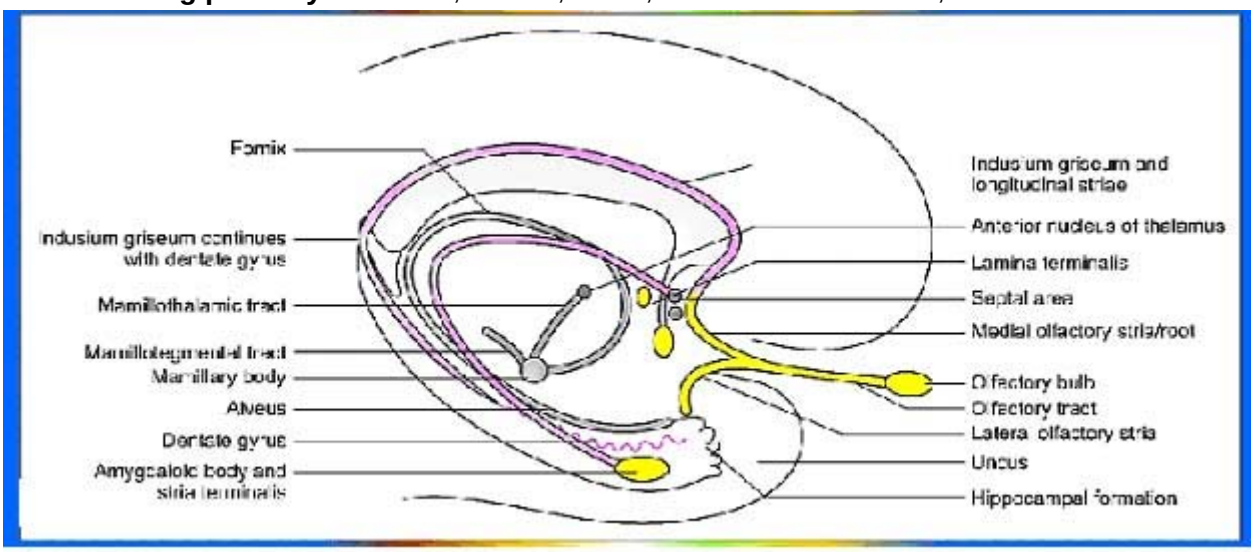
Enumerate the parts of limbic system. Mention its functions ?

TERMS ASSOCIATED WITH LIMBIC SYSTEM

1. Limbic lobe : Cingulate gyrus, parahippocampal gyrus and subcallosal sulcus.

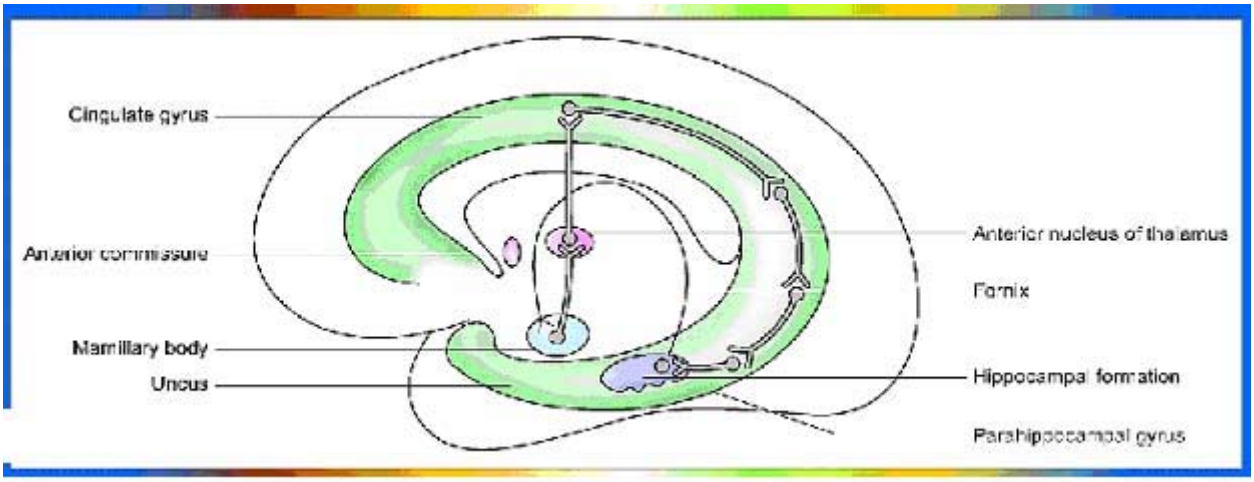
2. Hippocampal formation : Comprises hippocampus, dentate gyrus, part of parahippocampal gyrus.

3. Connecting pathways : Alveus, fimbria, fornix, mamillothalamic tract, stria terminalis.

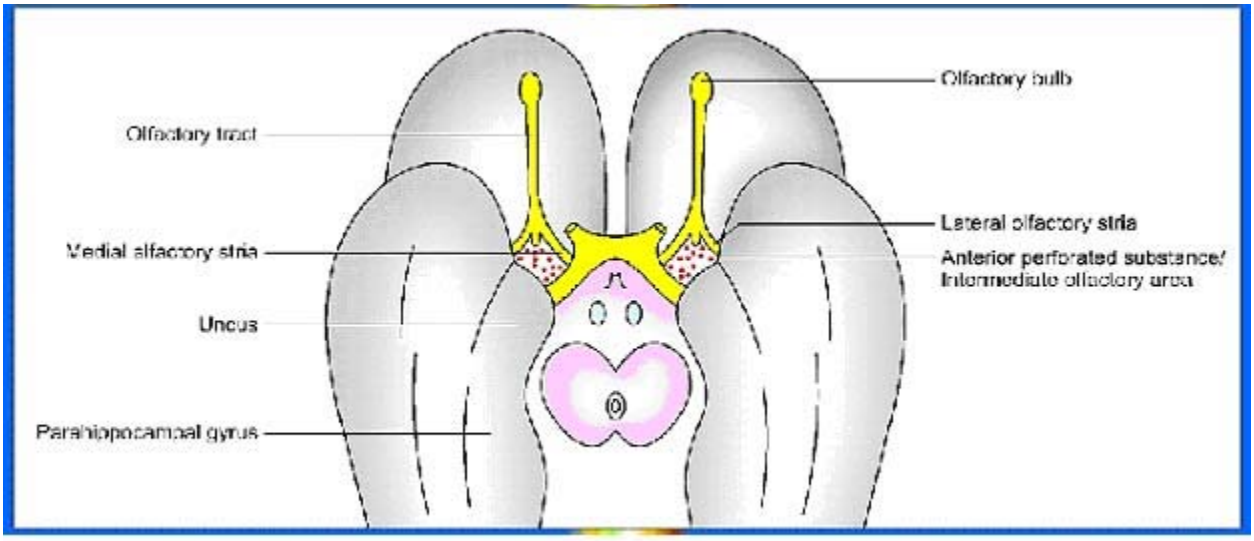


4. Limbic system : 1 + 2 + 3 + amygdaloid nucleus, hypothalamus and anterior nucleus of thalamus.

Papez circuit



i. Hippocampal formation
ii. Mamillary body, Mamillothalamic tract.



iii. Anterior nucleus of thalamus
iv. Cingulate gyrus

Functions

1. Limbic system controls food habits for survival.
2. Controls sex behaviour for survival of species.
3. Controls emotional behaviour. It requires integration of olfactory, somatic and visual impulse reaching the brain.

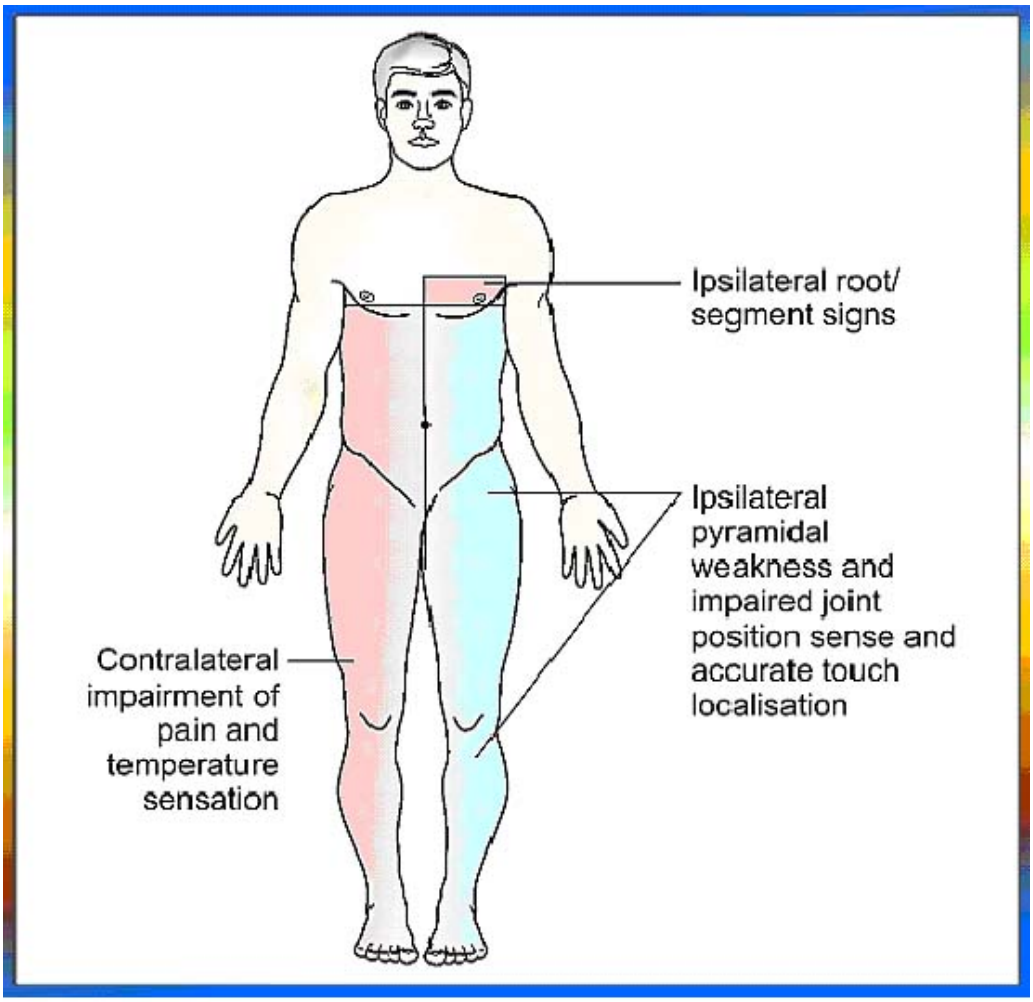
Clinical Terms

Clinical Terms

1. **Brown - Sequard Syndrome**

The signs and symptoms are due to injury to one - half of the spinal cord. These are :-

- Ipsilateral upper motor neuron paralysis
- Ipsilateral loss of conscious proprioception
-Contralateral loss of pain and temperature



These are due to injury to various tracts below the level of injury.

a.Ipsilateral lower motor neuron paralysis

b.Ipsilateral loss of sensation over the dermatome.

These a & b are due to injury to nerve root, at the level of injury.

2.Cauda equine Syndrome

It occurs due to compression of Cauda equina in the vertebral canal. L2-S5 nerve roots are affected. Its features are :

-Loss of knee and ankle jerks

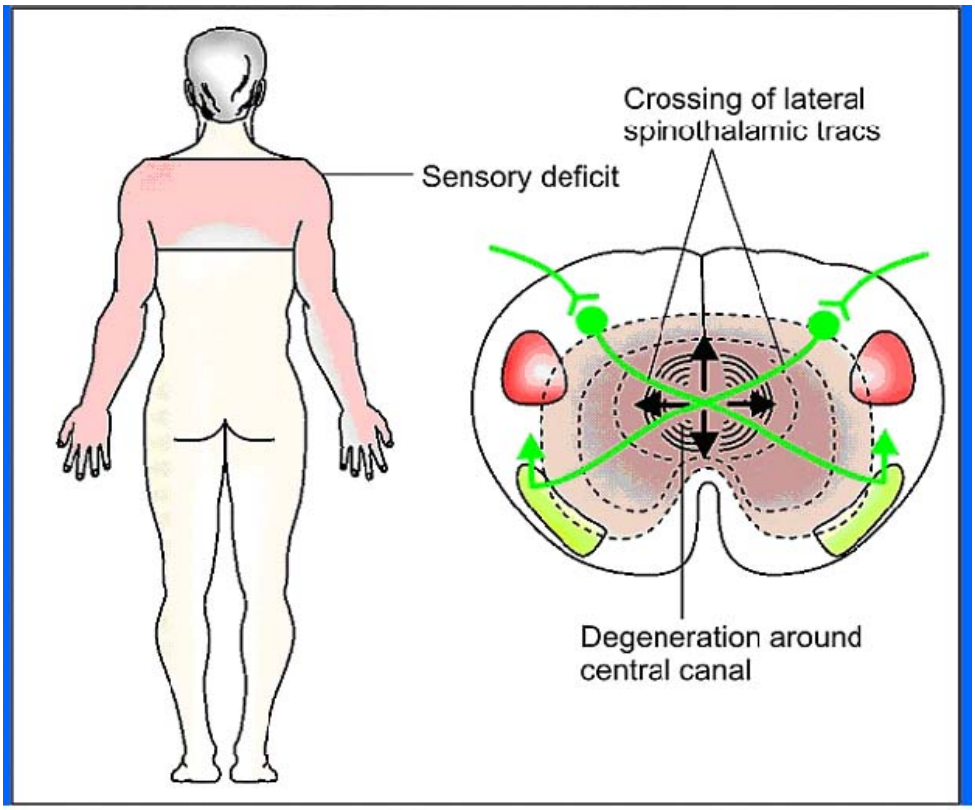
-Sensory loss in nerve root distribution

-Asymmetric areflexic lower motor neuron type of paralysis

-Later involvement of bowel and bladder

3.Syringomyelia

There are cavities around the central canal. There is bilateral loss of spinothalamic fibres. Lateral spinothalamic tracts cross at once while anterior spinothalamic first ascend and then cross. There is loss of pain and temperature at one level and loss of touch and pressure at another level. So it is called "dissociated sensory loss".



4.Conus Medullaris Syndrome

It is produced due to pressure of conus medullaris of spinal cord from where S2, S3 and S4 nerves arise. The symptoms and signs are:-

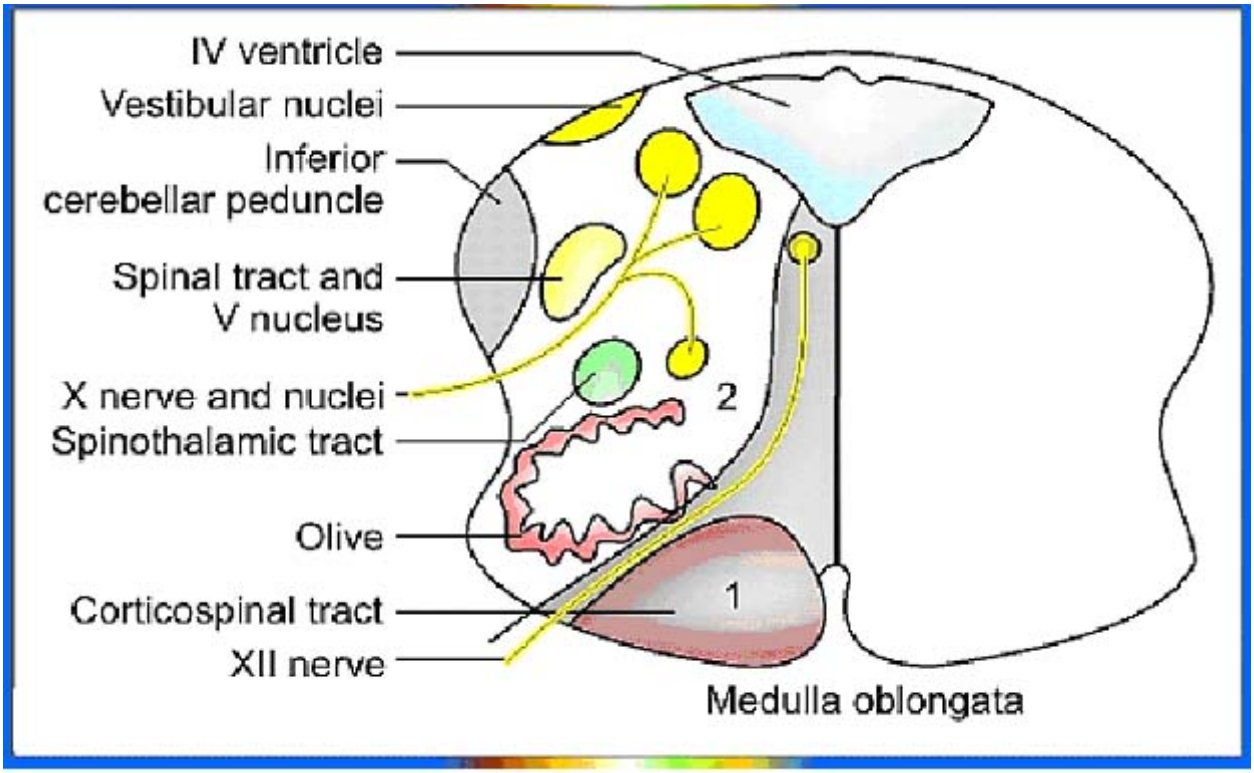
-Saddle shaped anesthesia on the bottom

-Loss of anal sphincteric reflex

-Urinary bladder and bowel get affected early

There is no motor weakness and patient has normal knee and ankle reflexes.

5



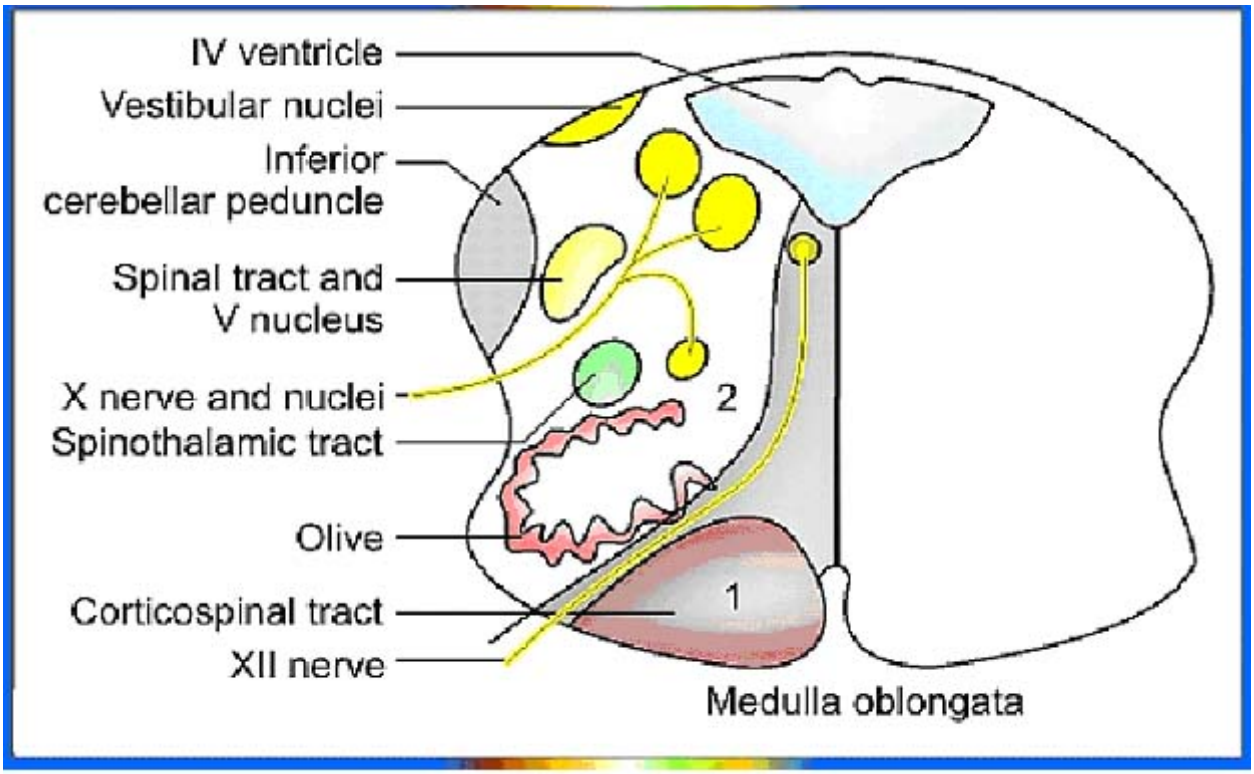
5.Medial Medullary Syndrome:

This syndrome occurs due to thrombosis of anterior spinal artery. There is paralysis of muscles of tongue on same side, associated with hemiplegia and loss of position sense in limbs on the opposite side.

6.Tabes Dorsalis:

Tabes Dorsalis affects the posterior white column of spinal cord. It leads to bilateral loss of proprioceptive sensations and tactile discrimination below the side of lesion. The finger nose test is past pointing with eyes closed.

7. Lateral medullary syndrome or Wallenberg's Syndrome.



The lateral medullary syndrome leads to symptoms as:-

-On the side of lesion-

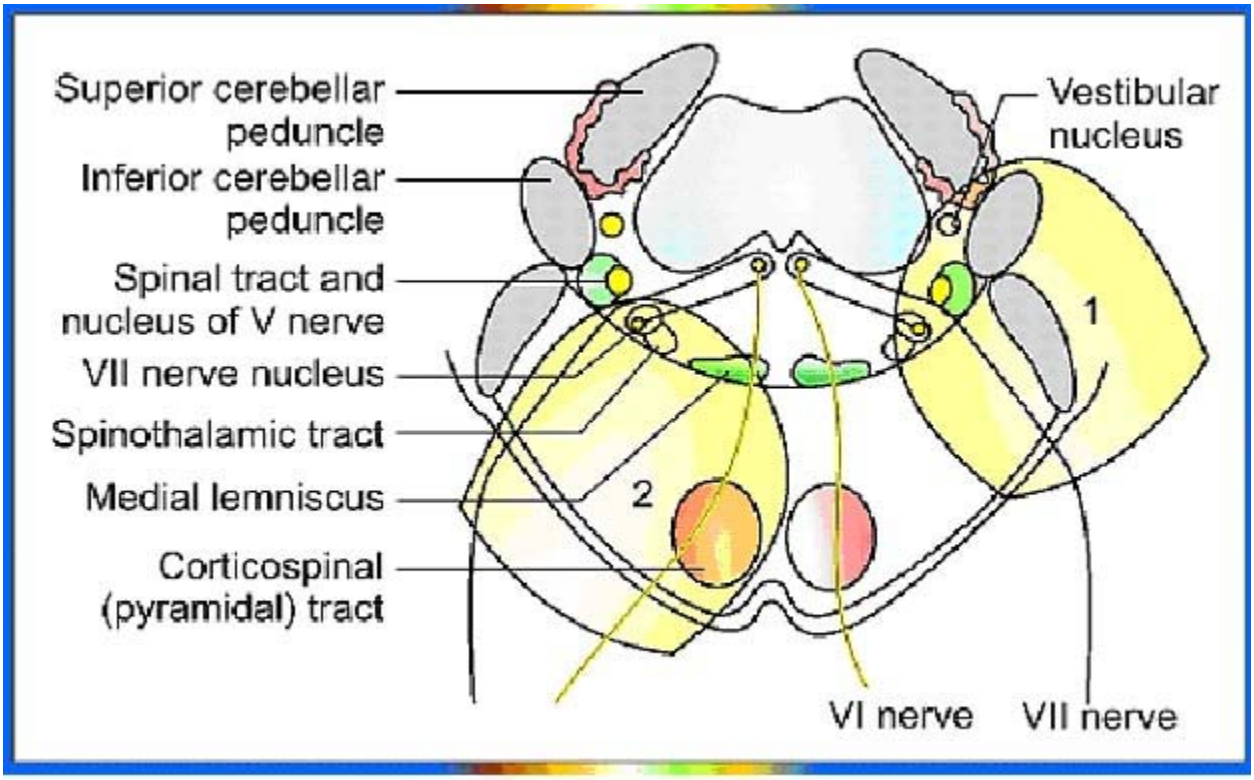
Vertigo, vomiting, nystagmus (vestibular nuclei affected) ataxia of limbs (inferior cerebellar peduncle). Horner's Syndrome (sympathetic fibres), dysphagia, hoarseness (nucleus ambiguus).

-On the opposite side of lesion:

Loss of pain & temperature from limbs & trunk.

8.Cerebellopontine angle Syndrome:

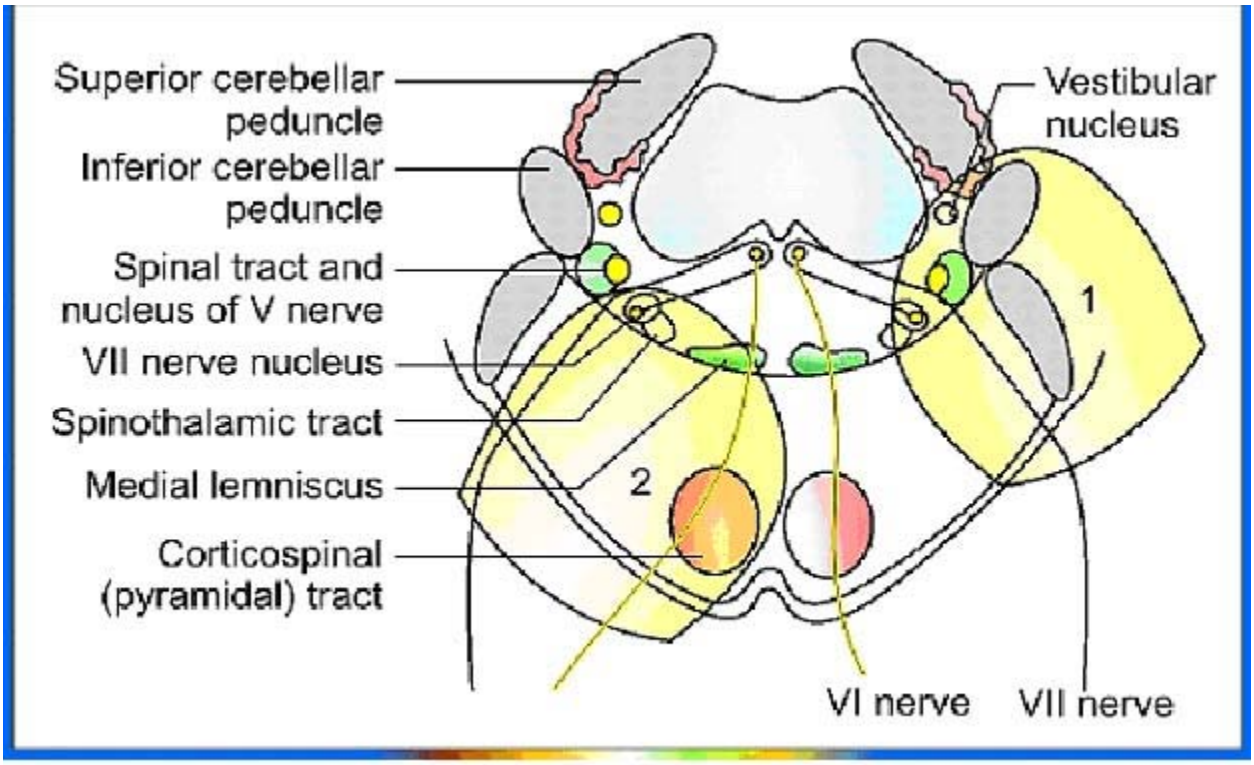
The anatomical structures located in cerebello pontine angle are choroid plexus of 4th ventricle, 7th and 8th nerves. A tumour here gives symptoms:-



Facial nerve paralysis & 8th nerve paralysis leading to deafness and vertigo . Flocculus of cerebellum involved leads to ataxia on the affected side.

9. Millard -Gubler's Syndrome

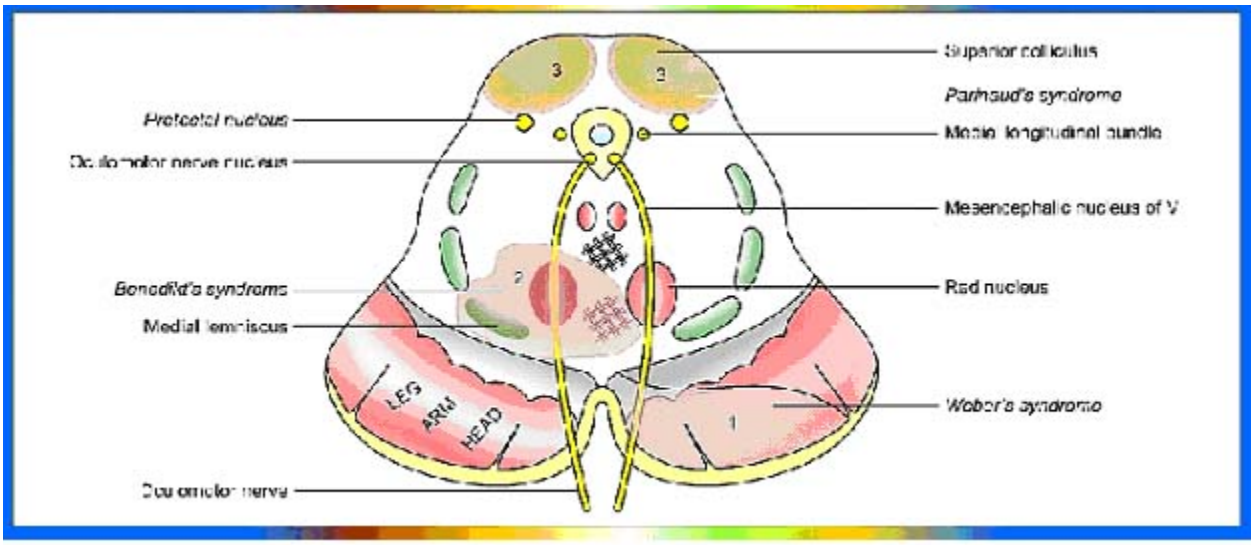
Millard -Gubler's syndrome occurs due to lesion in the lower pons affecting



pyramidal tract fibres of 6th and 7th cranial nerves. The symptoms are:-

- Ipsilateral medial squint
- Ipsilateral paralysis of muscles of facial expression
- Contra lateral hemiplegia

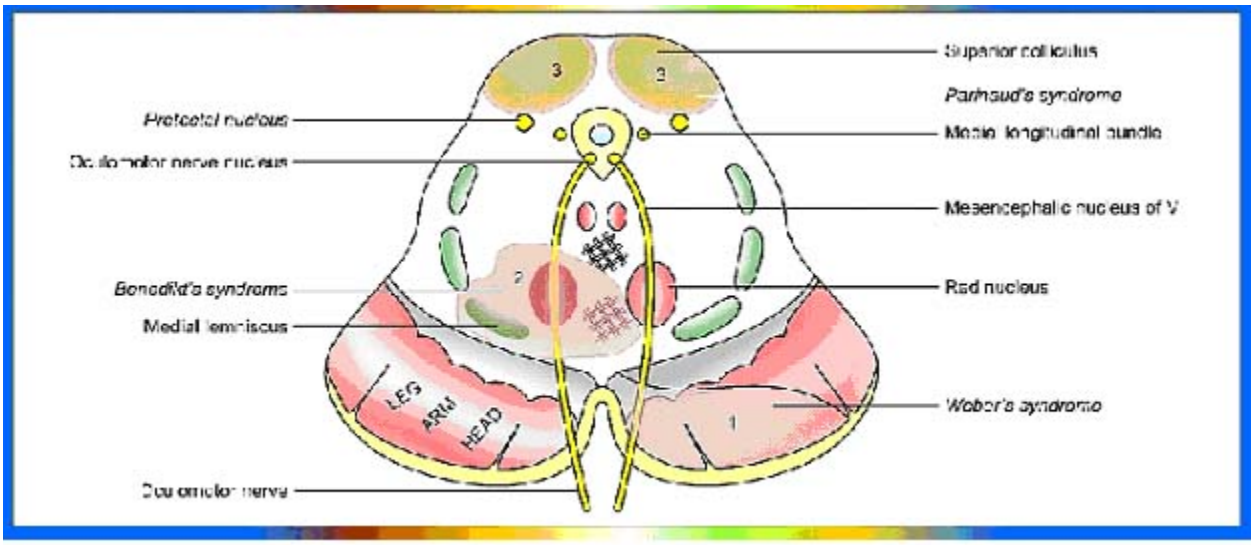
10.Benedikt's syndrome



Benedikt's syndrome results due to lesion of tegmentum of midbrain involving superior brachium, fibres of 3rd nerve, red nucleus and medial lemniscus.

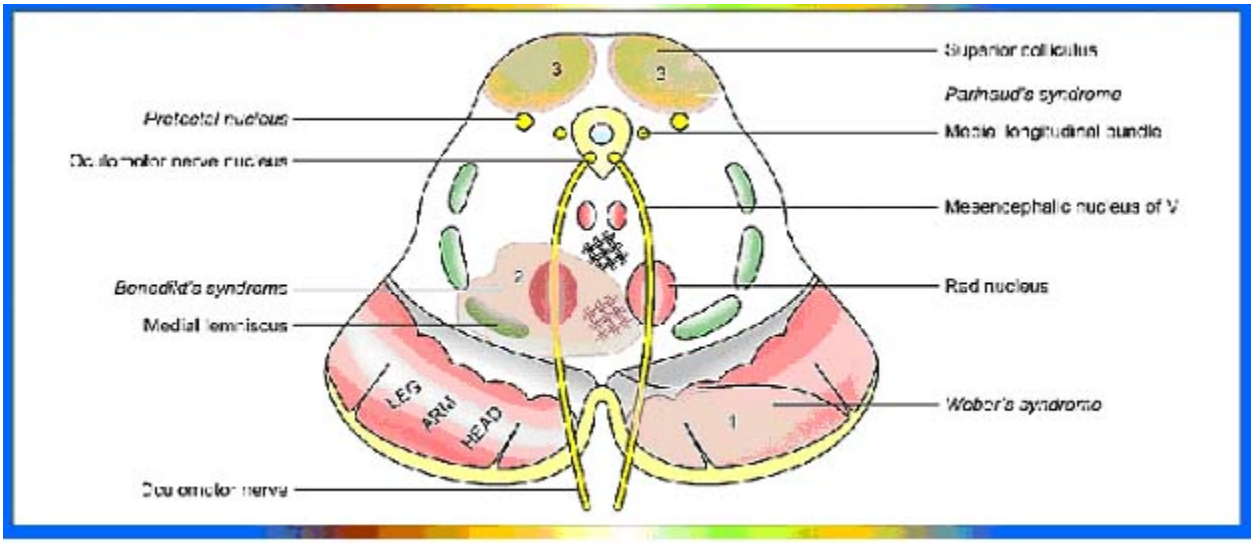
11.Weber's Syndrome

Weber's syndrome involves corticospinal tract and 3rd nerve nucleus. There is lateral squint on same side and hemiplegia on the opposite side of body.



12.Perinaud's Syndrome:

This syndrome occurs due to compression of superior colliculi when these get pressed by tumor of pineal gland. There is paralysis of upper gaze only. Other eye movements are unaffected.



13.Thalamic syndrome

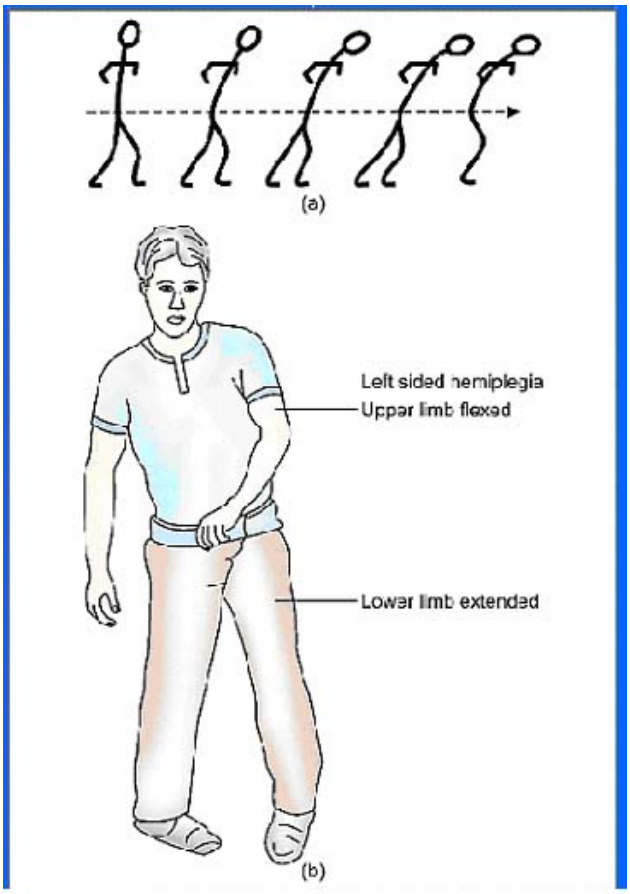
Thalamic syndrome is due to a vascular lesion. It is characterized by disturbances of sensations, hemiparesis or hemiplegia with hyperesthesia and severe spontaneous pain. Pleasant as well as unpleasant sensations are exaggerated.

14.Subarachnoid hemorrhage:

Subarachnoid hemorrhage is the collection of blood in the subarachnoid spaces at the base of brain. These are also called the cisterns. The circle of Willis lies in the interpeduncular cistern. Any small branch usually due to persistent hypertension may rupture to give rise to subarachnoid hemorrhage.

15.Cerebral stroke

The neurological signs and symptoms due to lack of blood supply constitute the cerebral stroke. It is mostly due to rupture of any of the arteries especially central branch of middle cerebral artery supplying the internal capsule.



16.Charcot's artery of cerebral hemorrhage

The largest branch of anterolateral central branches of middle cerebral artery is called Charcot's artery of cerebral hemorrhage. It supplies internal capsule which has motor fibres for one side of body. Damage to artery causes opposite side hemiplegia.

17.Sparing of macula in thrombosis of posterior cerebral artery: Macula is represented at the occipital pole. It is supplied by branches of middle cerebral artery or by anastomosis between middle and posterior cerebral arteries. So thrombosis of posterior cerebral artery does not harm the macula.

18.Hydrocephalus

Hydrocephalus is an abnormal increase in the volume of CSF within the skull. It may be due to increased production, blockage in circulation over decreased absorption of CSF. Hydrocephalus may be "internal" within ventricular system causing increased intracranial pressure and brain damage. It CSF accumulates in the subarachnoid space the condition is called external hydrocephalus.

19. Parkinsonism

Lesion of corpus stratum leads to Parkinsonism. It gives rise to:-

-Lead pipe rigidity or hypertonicity
-Movements are slow
-Loss of automatic associated movements and also loss of facial expression
- Involuntary movement like tremors, pin rolling movements of hand
-Bends forwards during walking

20.Babinski sign

In case of lesion of corticospinal tract there is dorsiflexion of big toe and fanning of other toes in response to scratching the skin on the lateral side of sole. This sign is positive in case of upper motor neuron lesion. When corticospinal tract is damaged, the influence of other tracts becomes obvious which cause dorsiflexion of 1st toe and fanning of other toes. In infants and children up to two years .Babinski sign is normally present as the tracts are not fully myelinated.

HEAD AND NECK

Enumerate

a. Layers of scalp with their description

b. Diploic veins of scalp

c. Lacrimal apparatus

d. Emissary veins

e. Anterior triangle

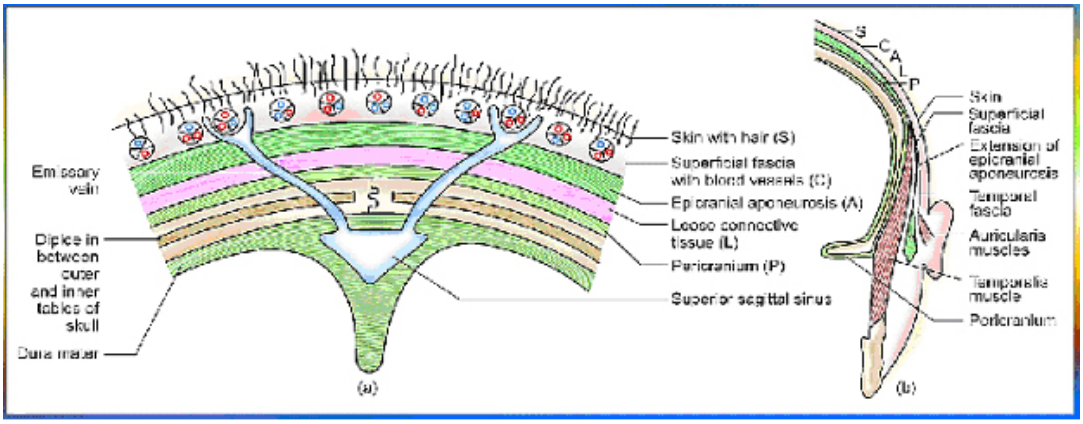
(a) SCALP

Extent: Anteriorly – supraorbital margins; Posteriorly – highest nuchal line; Laterally on each side – superior temporal lines.

The scalp consists of
1. Skin
2. Subcutaneous tissue
3. Aponeurosis of occipitofrontalis muscle
4. Loose areolar tissue
5. Pericranium

1. Skin is the thickest and most hairy with lots of sebaceous glands. Sebaceous cysts are common in the skin. The first three layers are inseparable.

2. Subcutaneous tissue is firm and contains blood vessels and nerves.
   Arteries: These are derived from both external carotid and internal carotid.



From internal carotid are: (i) Supratrochlear and (ii) supraorbital.
From external carotid are (iii) Superficial temporal, (iv) posterior auricular and (v) occipital.

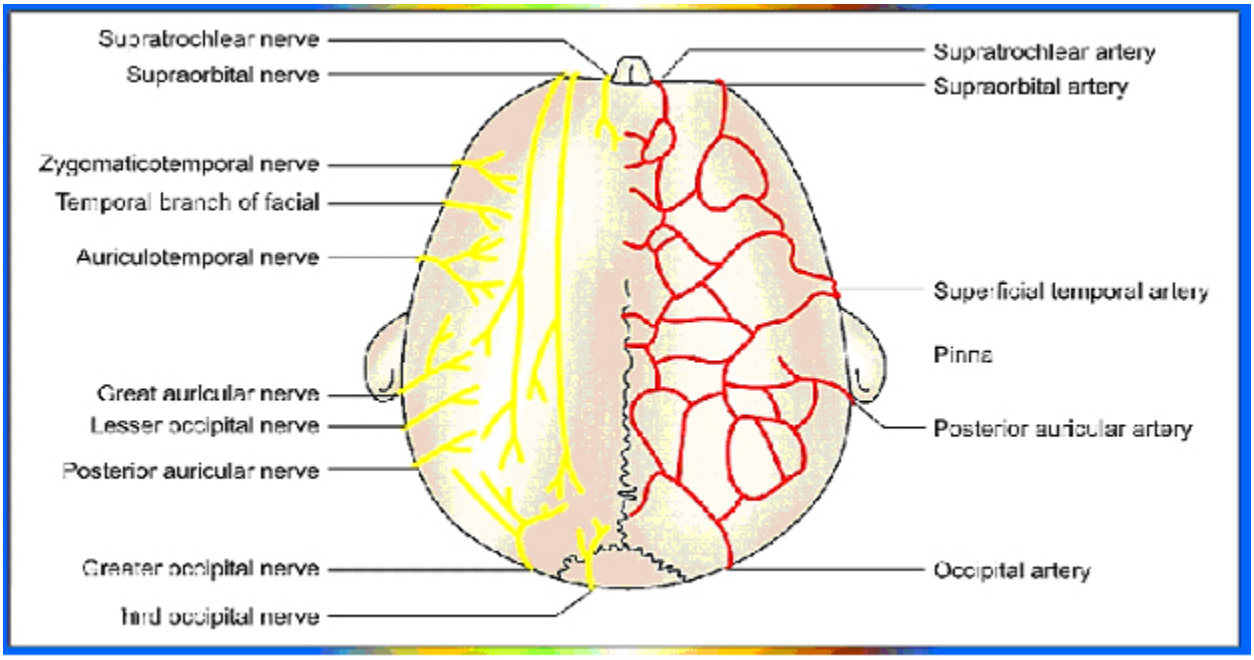
Arteries (i)–(iii) are in front of ear while (iv) and (v) are behind the ear.

Veins: Supraorbital and supratrochlear veins join to form the facial vein.

Superficial temporal and maxillary veins join to form retromandibular vein which divides into anterior and posterior divisions. Anterior divisions of retromandibular vein joins the facial vein and drains into internal jugular vein. Posterior division of retromandibular vein joins the posterior auricular vein to form external jugular vein. Occipital vein drains into suboccipital venous plexus which drains into vertebral vein.

Lymph drainage: From posterior half, the lymph drains into posterior auricular and occipital nodes, while lymph from anterior half ends in preauricular nodes.

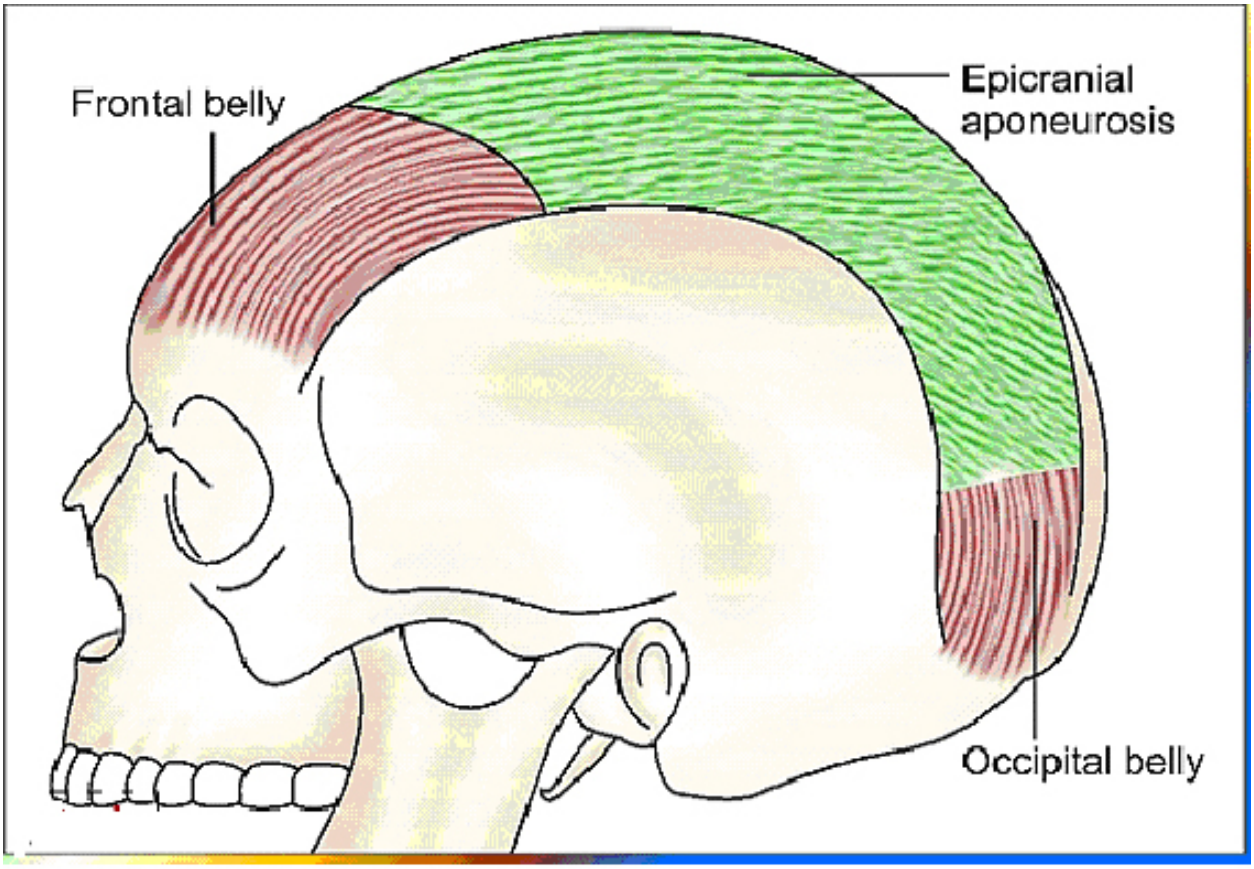
Sensory nerve supply: In front of the ear accompanying the arteries are supratrochlear, supraorbital nerves branches of ophthalmic division and auriculotemporal nerve branch of mandibular division of trigeminal nerve.



Behind the ear are third occipital (dorsal ramus C3), greater occipital (dorsal ramus C2), and lesser occipital (ventral ramus of C2).

Motor nerve supply: Anterior to the ear is temporal branch of facial, while behind the ear is posterior auricular branch of facial nerve.

3. Aponeurosis of occipitofrontalis muscle. Occipitalis arises from highest nuchal line and gets inserted into the aponeurosis. Frontalis arises from the front of aponeurosis. It has no bony attachment. It passes forwards to get continuous with orbicularis oculi and skin overlying this muscle. In the median plane it fuses with procerus muscle.



Nerve supply: Occipital belly by posterior auricular nerve; frontal belly by temporal branches of facial nerve.
Actions: The muscle raises the eyebrows and produce horizontal wrinkles on the forehead

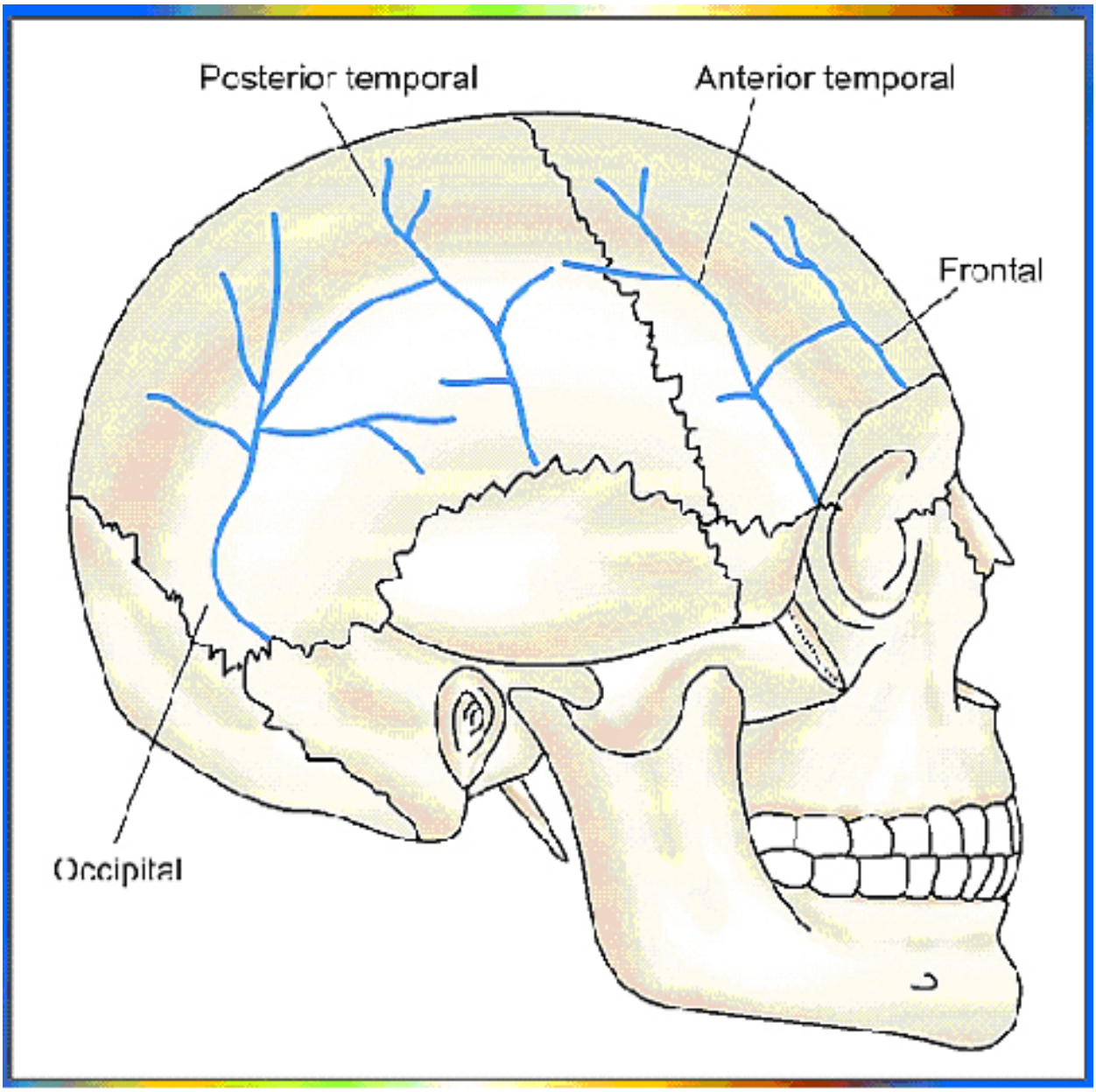
4. Loose areolar tissue is a space between layers 1,2,3 combined and 5th layer. Through it pass emissary veins from the veins of scalp to venous sinuses of cranial cavity. The space extends beneath orbicularis oculi into eyelids. Bleeding in this space may appear as subconjunctival haemorrhage and causes ‘‘black eye’’.

5. Pericranium is the periosteum of the outer table of skull. It is continuous through the sutural ligament with the endocranium. Bleeding deep to pericranium are localised and take the shape of the bone.
Clinical anatomy: Sebaceous cysts are common.

(b) DIPLOIC VEINS
These are large veins without any valves situated in the spongy substance of the cranial bones. These start developing after birth at about 4 years. These diploic veins drain into the

neighbouring venous sinuses. These bring the formed elements of blood, i.e. RBC, granular series of WBC and platelets from the diploe into the general circulation.

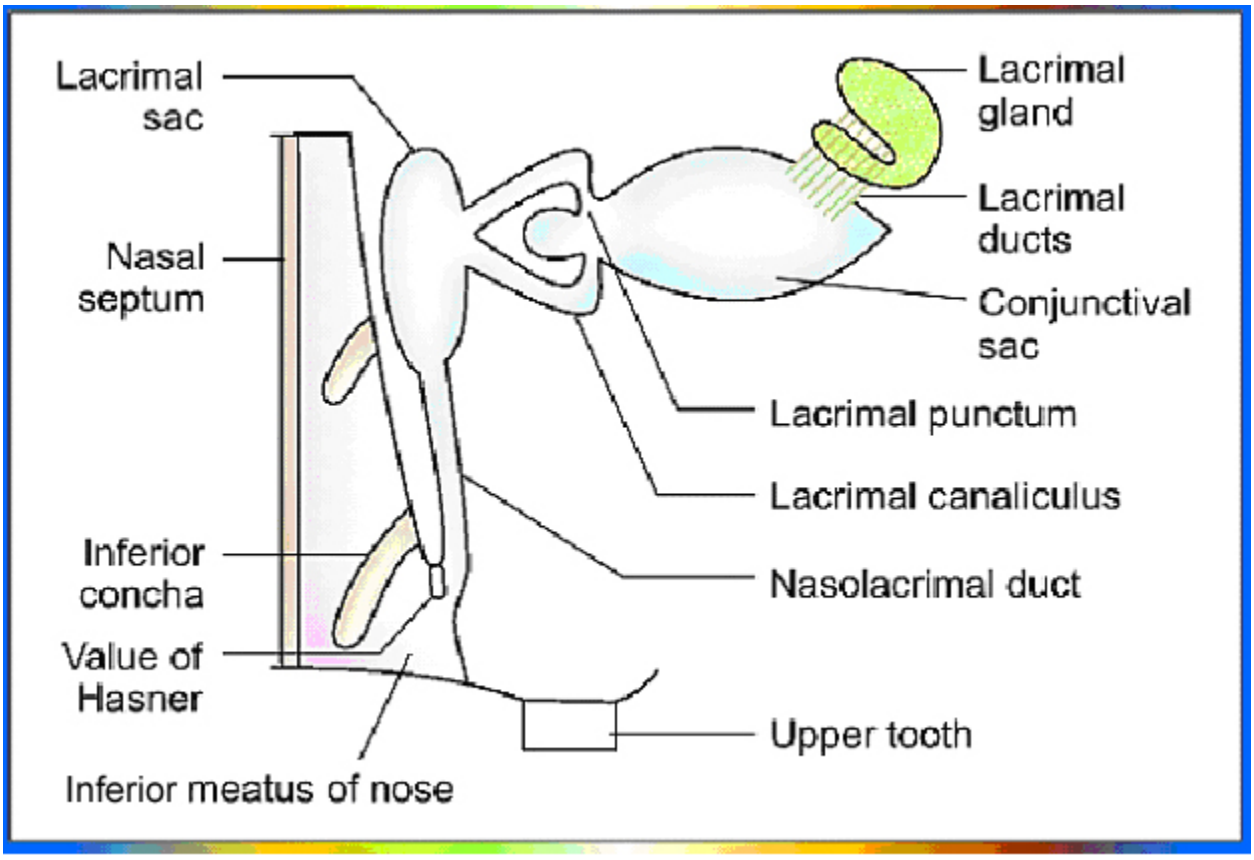
The large diploic veins are:
1. Frontal diploic vein which drains into supraorbital vein.2. Anterior temporal diploic vein drains the blood from frontal and parietal bones into sphenoparietal sinus.
3. Posterior temporal diploic vein drain into the lateral part of transverse sinus.
4. Occipital diploic vein also ends into the transverse sinus near the confluence of sinuses.



(c) LACRIMAL APPARATUS

The lacrimal apparatus consists of the following parts:

1. Lacrimal gland



2. The conjunctival sac
3. The lacrimal sac
4. The nasolacrimal duct

1. Lacrimal gland is located in the lacrimal fossa of the lateral part of roof of orbit.It has a main part lying in the lateral part of the orbit and a small palpebral part placed in upper eyelid. 10-15 ducts arise from the main part and after traversing the palpebral part open into the superior fornix of the conjunctiva. The gland is supplied by lacrimal branch of ophthalmic artery.

Nerve supply

Sympathetic by plexus around internal carotid artery called the deep petrosal nerve.

Parasympathetic arise from lacrimatory nucleus — facial nerve — greater petrosal nerve joins deep petrosal — nerve of pterygoid canal — pterygopalatine ganglion (relay) — postganglionic fibres join back into maxillary — pass with zygomatic branch — zygomaticotemporal branch-communicating branch to lacrimal nerve — lacrimal gland.

2. Conjunctival sac: It is a closed sac when the two lids are in apposition. The lacrimal fluid is received in the conjunctival sac and it flows due to contraction of orbicularis oculi towards the medial side of the eye into the lacrimal puncta on the medial ends of the free margin of the eyelids.

3. Lacrimal canaliculi: Start from each lacrimal punctum and open by a common opening into the lateral wall of lacrimal sac.

4. Lacrimal sac: It is covered by lacrimal fascia laterally. Attached to the fascia is lacrimal part of orbicularis oculi muscle. Lacrimal part dilates the sac to suck the lacrimal fluid during blinking of the eyelids.

5. Nasolacrimal duct: It is 18 mm long and starts from the lower end of the lacrimal sac. It passes downwards, backwards and laterally to drain into the anterior part of inferior meatus of nasal cavity. Lacrimal fold present at the lower end of the duct prevents the ascent of the nasal secretions.

(d) EMISSARY VEINS

The emissary veins connect the intracranial venous sinuses with the extracranial veins. These have no valves, so blood can flow in either direction.These veins help to lower intracranial pressure. Infection from extracranial veins can reach the intracranial venous sinuses through these emissary veins. Various emissary veins are tabulated:

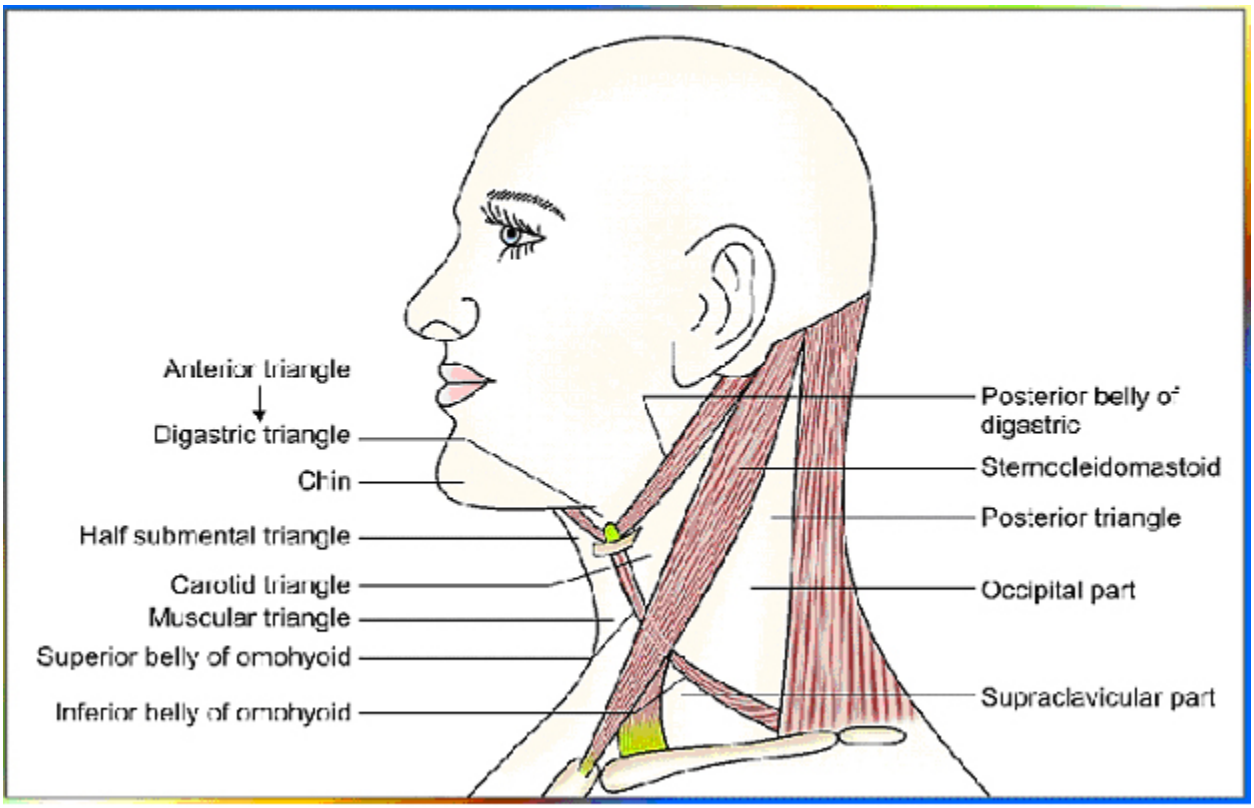
Emissary vein	Foramen	Vein/Venous sinus	Extracranial vein
Parietal emissary vein	Parietal foramen	Sup. sagittal	Veins of scalp
Mastoid emissary vein	Mastoid foramen	Trans. sinus	Veins of scalp
Emissary vein	Hypoglossal canal	Sigmoid sinus	Int. jug. Vein
Ophthalmic vein	Superior orbital fissure	Facial vein	Cavernous sinus
Emissary vein	Foramen ovale	Cavernous sinus	Pteygoid venous plexus
Emissary vein	Emissary sphenoidal foramen	Cavernous sinus	Pterygoid venous plexus
2-3 emissary veins	Foramen lacerum	Cavernous sinus	Pharyngeal venous plexus.
Internal Corotid venous plexus	Carotid canal	Cavernous sinus	Internal jugular vein.

(e) ANTERIOR TRIANGLE

Anterior triangle of neck lies anterior to the sternocleidomastoid muscle.

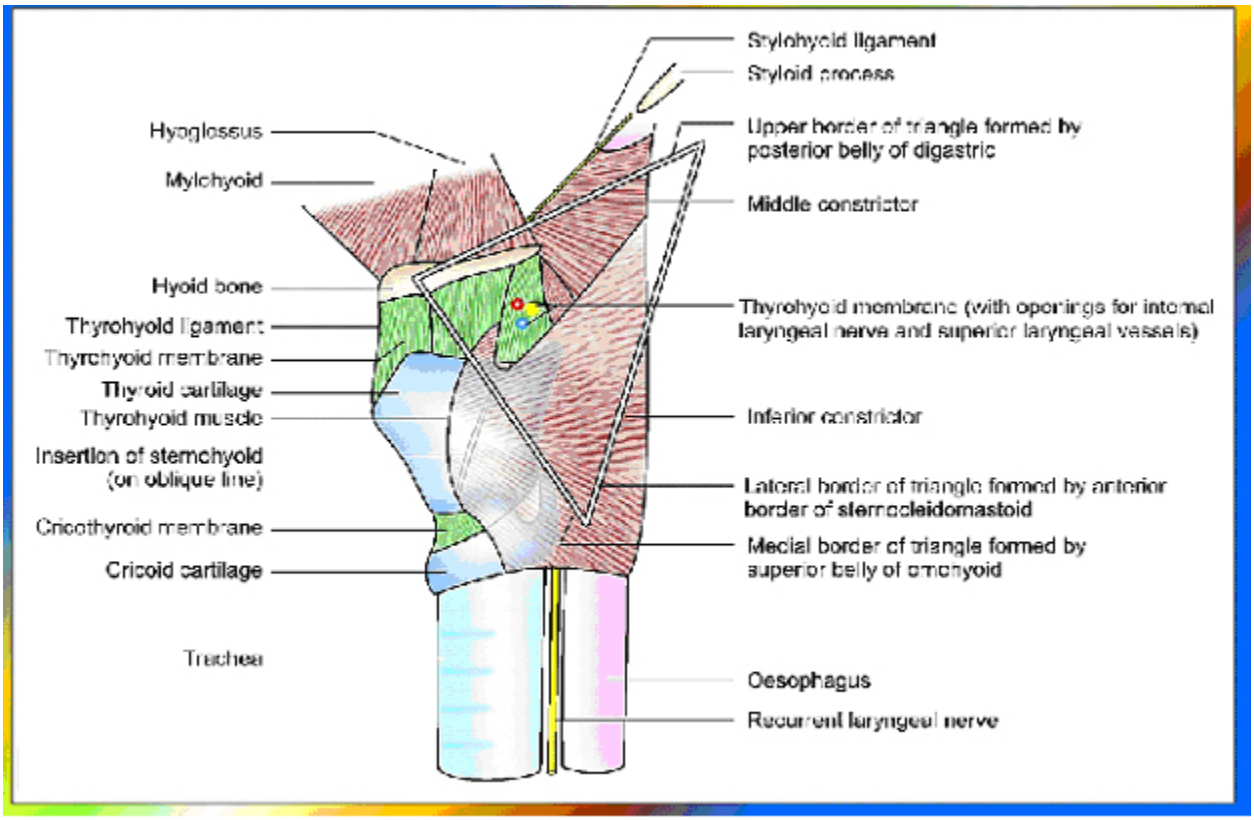
Its boundaries are:-
Anteriorly: Anterior median line of neck.
Posteriorly: Anterior border of sternocleidomastoid muscle.
Superiorly: Base of mandible and a line drawn from angle of mandible to the mastoid process.
This triangle is subdivided into digastric, muscular, carotid and submental triangles by the two

bellies of digastric muscle and the superior belly of omohyoid muscle.



Digastric triangle: Bounded above by base of mandible, on sides by both bellies of digastric, roof by deep cervical fascia and floor by mylohyoid and hyoglossus muscles. It contains submandibular salivary gland, lymph nodes, parts of facial artery, hypoglossal nerve and nerve to mylohyoid.

Muscular triangle forms the lower and anterior part of anterior triangle. It is bounded by anterior median line of neck, superior belly of omohyoid and lower part of anterior border of sternocleidomastoid. It contains sternohyoid, sternothyroid and thyrohyoid muscles.
Carotid triangle is the largest subdivision of anterior triangle It is bounded by
anterior border of sternocleidomastoid, posterior belly of digastric and superior belly of omohyoid. Roof is formed by deep cervical fascia and the floor is constituted by middle constrictor, inferior constrictor, thyrohyoid and hyoglossus muscles.



Contents: Parts of internal and external carotid arteries. ECA gives superior thyroid, ascending pharyngeal, lingual, facial and occipital arteries. Internal jugular vein and its tributaries. Vagus nerves with its superior laryngeal branch, spinal accessory, hypoglossal, ansa cervicalis.
Submental triangle is bounded by both anterior bellies of digastric muscles, roof by two mylohyoid muscles, floor by deep cervical fascia, apex at symphysis menti and base at the body of hyoid bone.

It contains a few lymph nodes that drain the tip of tongue, median part of chin and lower lip.

Give an account of cervical fascia including its importance.

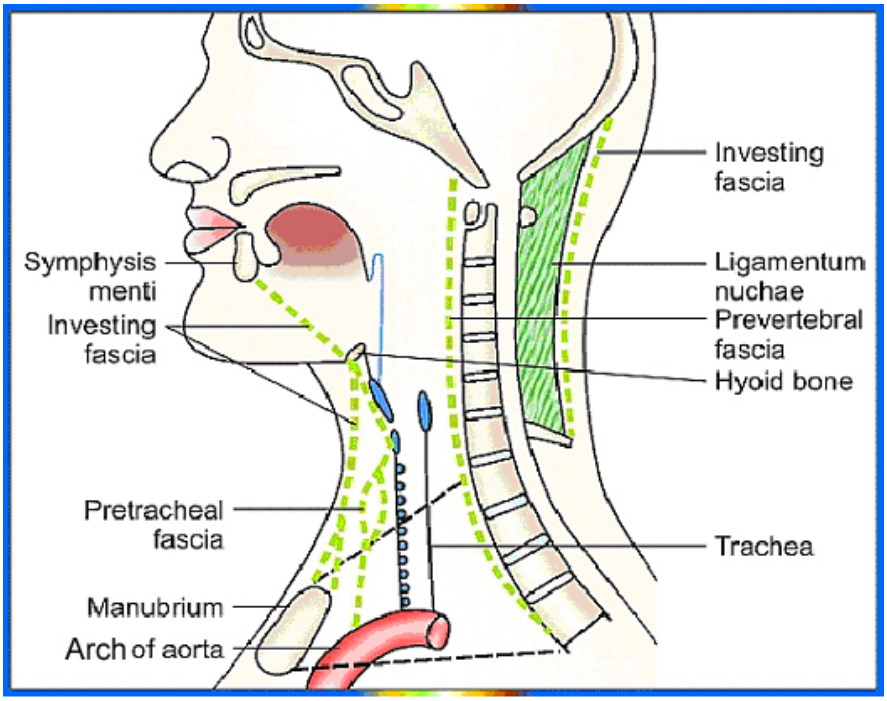
CERVICAL FASCIA

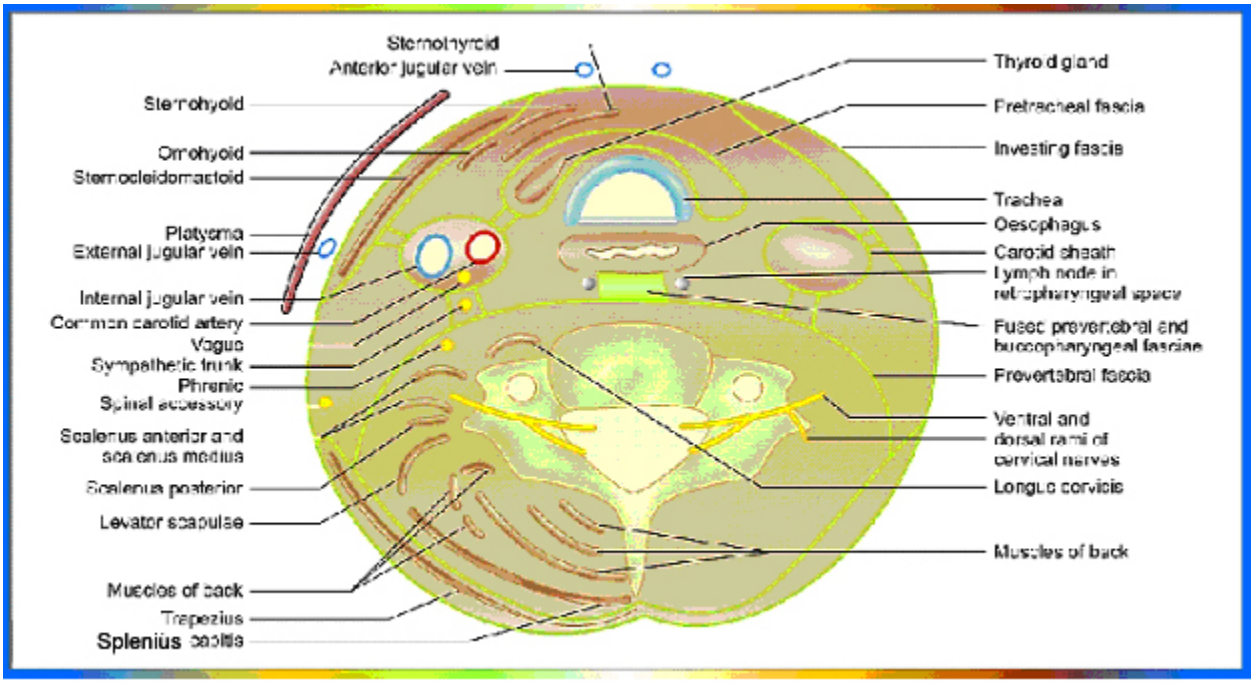
The deep fascia of the neck forms a tight sleeve around the structures of the neck giving at a proper shape. The deep fascia is condensed to form following layers:

A. Investing layer,
B. Pretracheal layer,
C. Prevertebral layer,
D. Carotid sheath,
E. Buccopharyngeal fascia,
F. Pharyngobasilar fascia.

A. Investing layer: It surrounds the neck like a collar. It is attached:

1. Superiorly to external occipital protuberance, superior nuchal line, mastoid process and the base of mandible. Between the mastoid process and the base of mandible the fascia splits to enclose the parotid gland. The superficial lamina is thick being called parotid fascia is attached to the zygomatic arch. The deep thin lamina is attached to styloid process and extends between the styloid process and the angle of mandible as stylomandibular ligament.





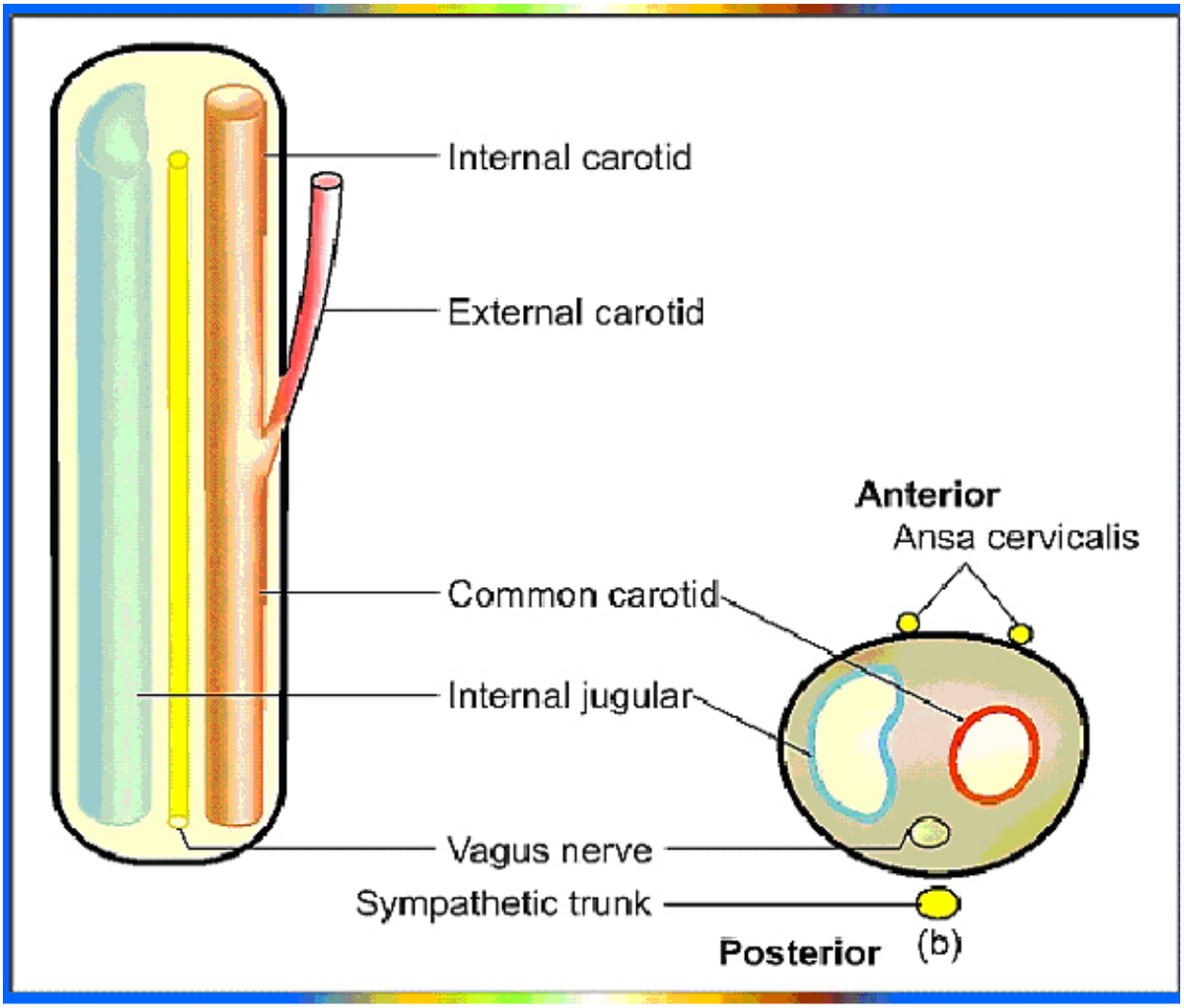
2. Inferiorly it is attached to spine of scapula, acromion, clavicle and manubrium.
3. Posteriorly it is attached to ligamentum nuchae and spine of cervical seventh vertebra.
4. Anteriorly it is attached to the hyoid bone and symphysis menti.

This fascia encloses and forms:
1. Two muscles, i.e. trapezius posteriorly and sternocleidomastoid anterolaterally.
2. Two spaces, i.e. suprasternal space containing the sternal heads of sternocleidomastoid muscles, jugular venous arch, interclavicular ligament and lymph node. Supraclavicular space above the clavicle is traversed by the external jugular vein. The fascia is firmly attached round the vein preventing its collapse.
3. Two glands, e.g. parotid and submandibular salivary glands.
4. Two pulleys for the tendons of digastric and omohyoid muscles.

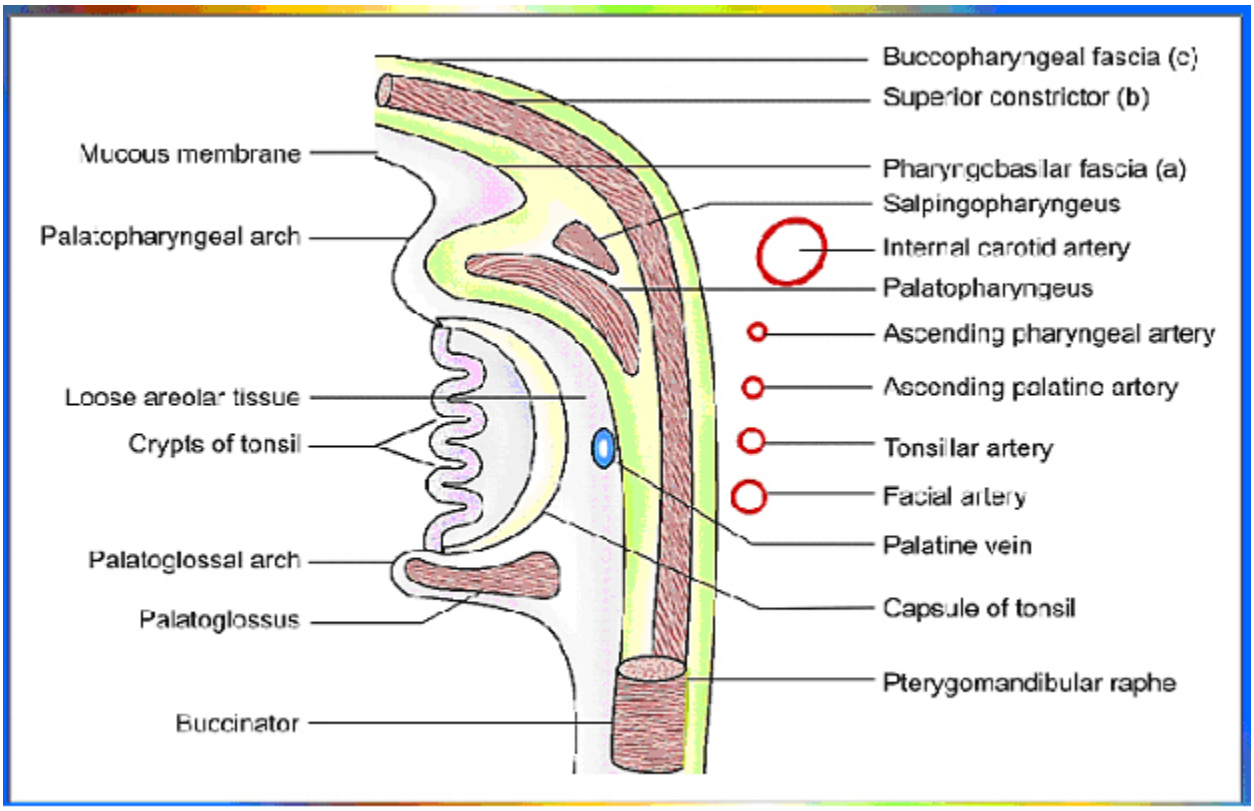
B. Pretracheal fascia. It encloses and suspends the thyroid gland. It is attached above to the hyoid bone, oblique line of thyroid cartilage and cricoid cartilage.
After enclosing the thyroid gland it passes down into the superior mediastinum and fuses with the arch of aorta. The pretracheal layer forms the ‘false capsule’ for the thyroid gland. The capsule is thick on the posterior surface of thyroid gland.
On each side the capsule forms a ‘suspensory ligament’ for the gland. Because of its attachment to the cartilages of larynx the thyroid gland or its swellings move with deglutition.

C. Prevertebral fascia: It forms the fascial floor of the posterior triangle. Above it is attached to the base of skull, below it fuses with the anterior longitudinal ligament of thoracic 3rd or 4th vertebra. Anteriorly it is separated from pharynx by retropharyngeal space. Prevertebral fascia provides a sheath, to axillary vessels and brachial plexus. This sheath known as the 'Axillary sheath', is thick over the artery and thin over the vein.

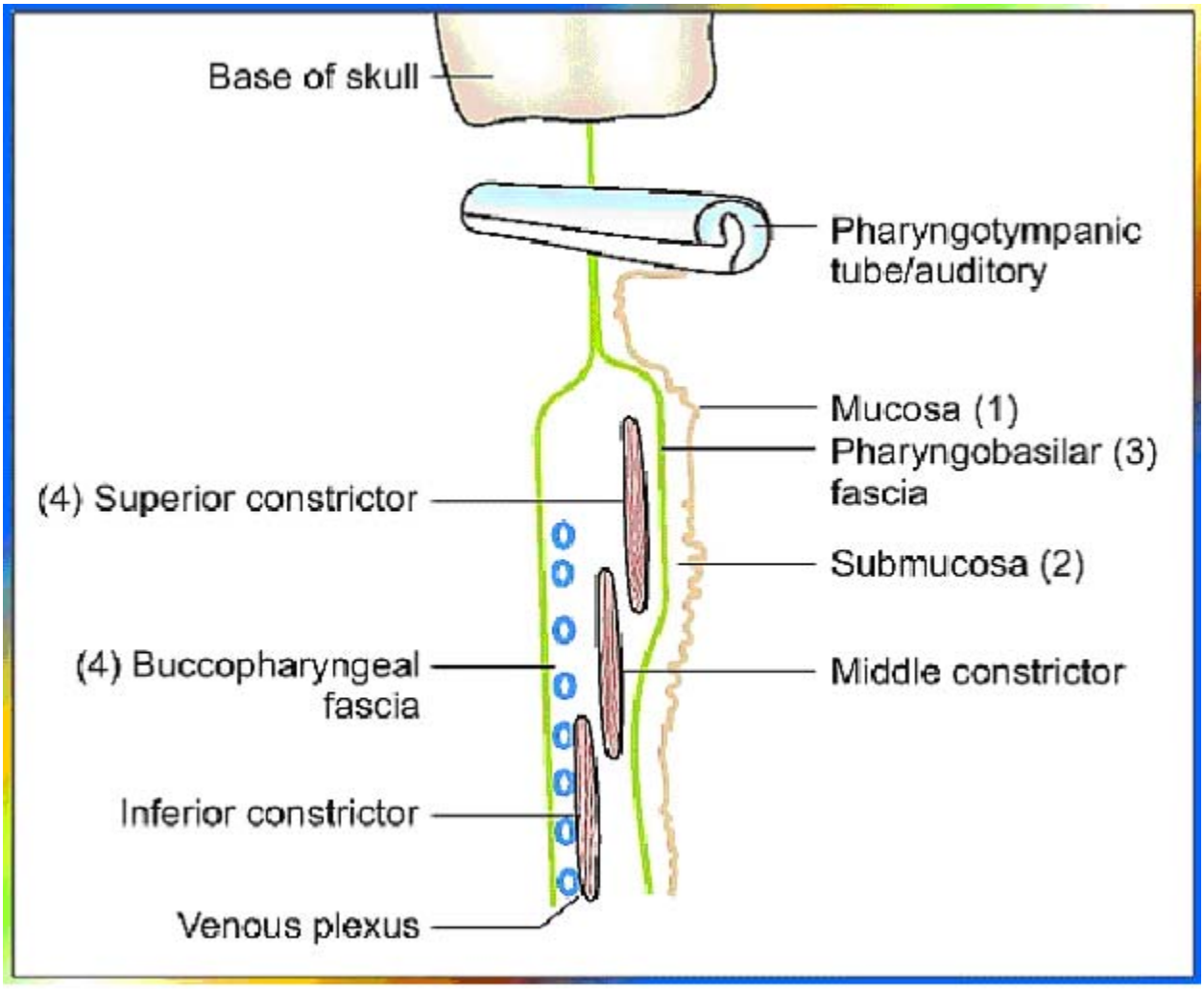
D. Carotid sheath: It is the condensation of fascia around the carotid arteries, common, and internal carotid; internal jugular vein and vagus nerves. It is formed by fusion of investing layer, pretracheal and prevertebral layers. In its anterior wall lies the ansa cervicalis while cervical sympathetic chain is embedded in its posterior wall. The sheath is thin around the vein.



E. Buccopharyngeal fascia: This fascia covers the buccinator muscle and extends posteriorly to cover the superior constrictor muscle. It is pierced by the parotid duct.



F. Pharyngobasilar fascia: It is thickened fascia between the upper free margin of superior constrictor and the base of skull. It extends from pharyngeal tubercle above, to carotid canal laterally and the posterior border of medial pterygoid plate anteriorly. This fascia holds the nasopharynx permanently open for breathing.



Importance of cervical fascia

Parotid swellings due to mumps or infection are painful as the fascia over the gland is thick and adherent to the gland. This fascia is supplied by great auricular nerve.

Thyroid gland and its swellings move with deglutition as the gland is attached to cartilages of larynx by suspensory ligaments.

Tuberculosis of the cervical vertebrae leads to cold abscess. It starts behind the prevertebral fascia. It may be seen in the median plane in the posterior wall of pharynx. It may extend and be seen in the posterior triangle of neck or in the axilla.

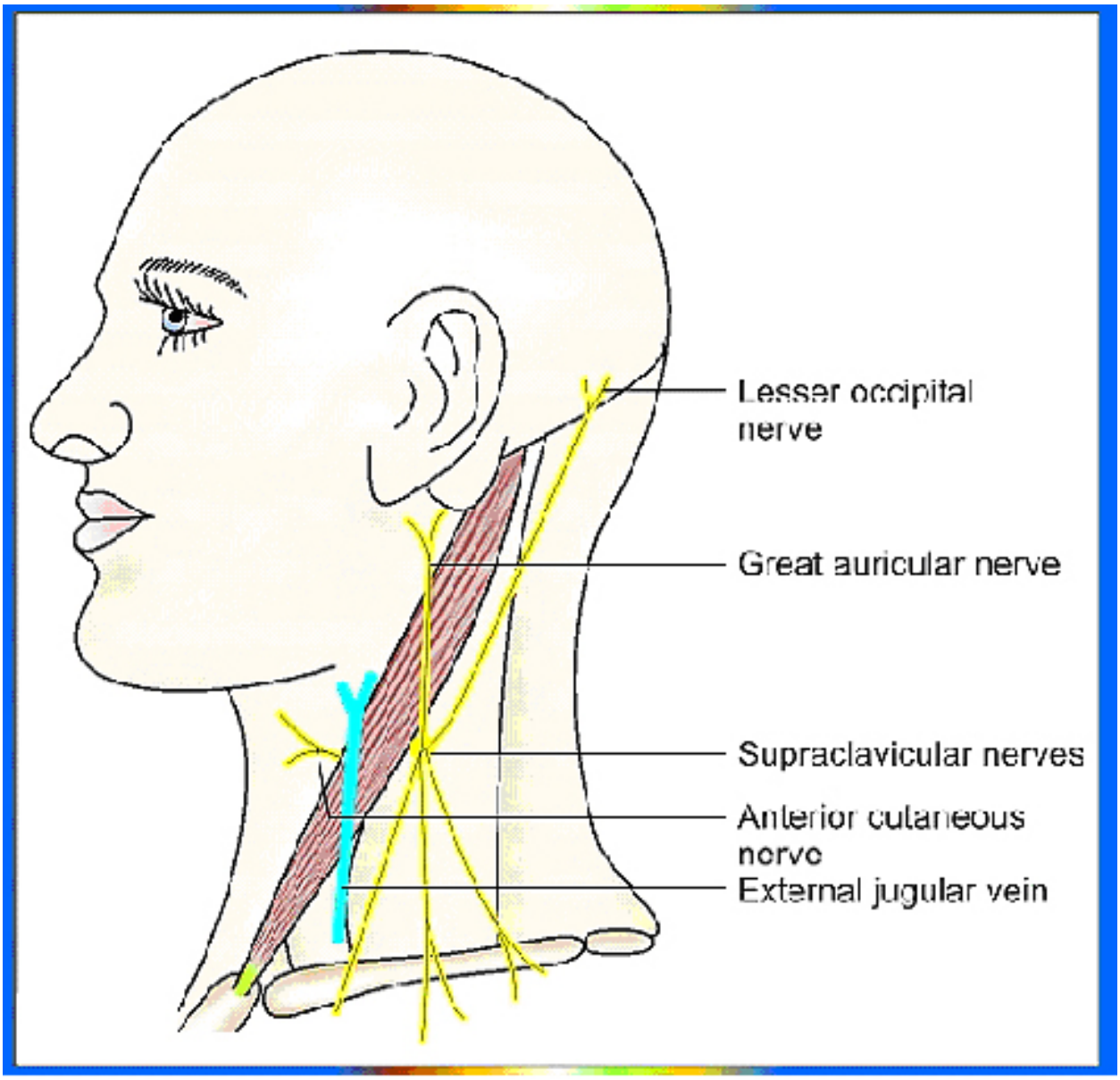
Acute infections of the lymph nodes present in the retropharyngeal space lie anterior to prevertebral fascia. This swelling is seen in paramedian position. External jugular vein pierces the investing layer to drain into the subclavian vein. As external vein jugular pierces the fascia and the fascia gets firmly attached around the vein. If the vein gets cut, it is prevented from collapsing due to the firm attachment of the fascia to the wall of the vein. So air gets into the distal end of the vein and air embolism may result in death. To prevent air embolism the fascia also should be cut.

What are the boundaries & contents of posterior triangle of neck?

POSTERIOR TRIANGLE

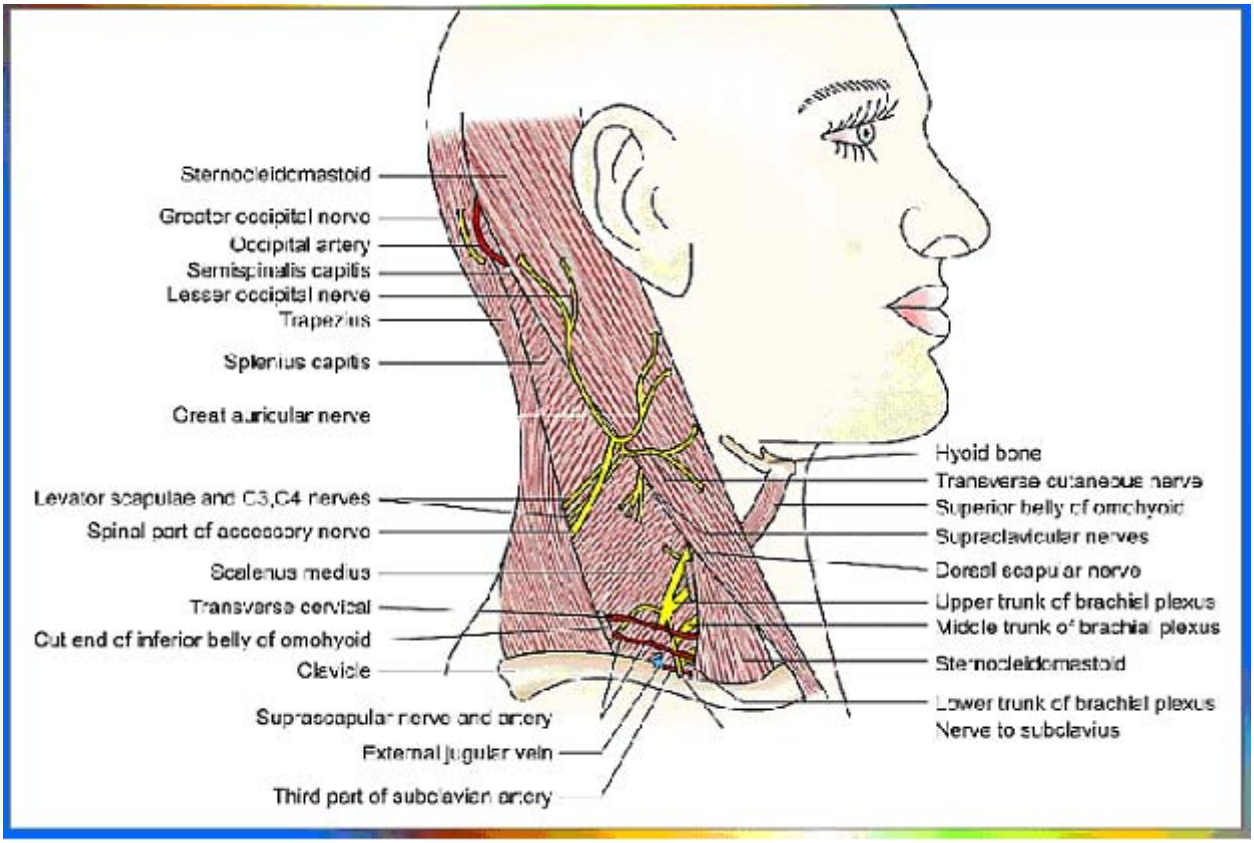
This is a triangular depressed space present above the middle one third of clavicle and behind the sternocleidomastoid muscle.

Boundaries anteriorly: Posterior border of sternocleidomastoid muscle.



Posteriorly: Anterior border of trapezius.
Base: Middle one-third of clavicle.
Apex-Point where sternocleidomastoid and trapezius come close to the superior nuchal line.
Roof: Investing layer of cervical fascia. As the fascia encloses trapezius posterolaterally, the two layers fuse to form the roof the posterior triangle. It again splits anterolateraly to enclose the sternocleidomastoid muscle. Lying just deep to the roof is the spinal accessory nerve, which supplies both the boundary muscles.
Floor: Posterior triangle has the muscular floor covered by the prevertebral fascia.
The muscles are scalenus medius, levator scapulae, splenius capitis. Scalenus anterior, mostly deep to sternocleidomastoid, may form the floor occasionally.

Contents
Accessory nerve lies embedded in the or deep to investing layer of fascia. It appears slightly above the middle of the posterior border of sternocleidomastoid muscle, runs in the posterior triangle close to its roof, and passes deep to trapezius 5 cm above the clavicle.

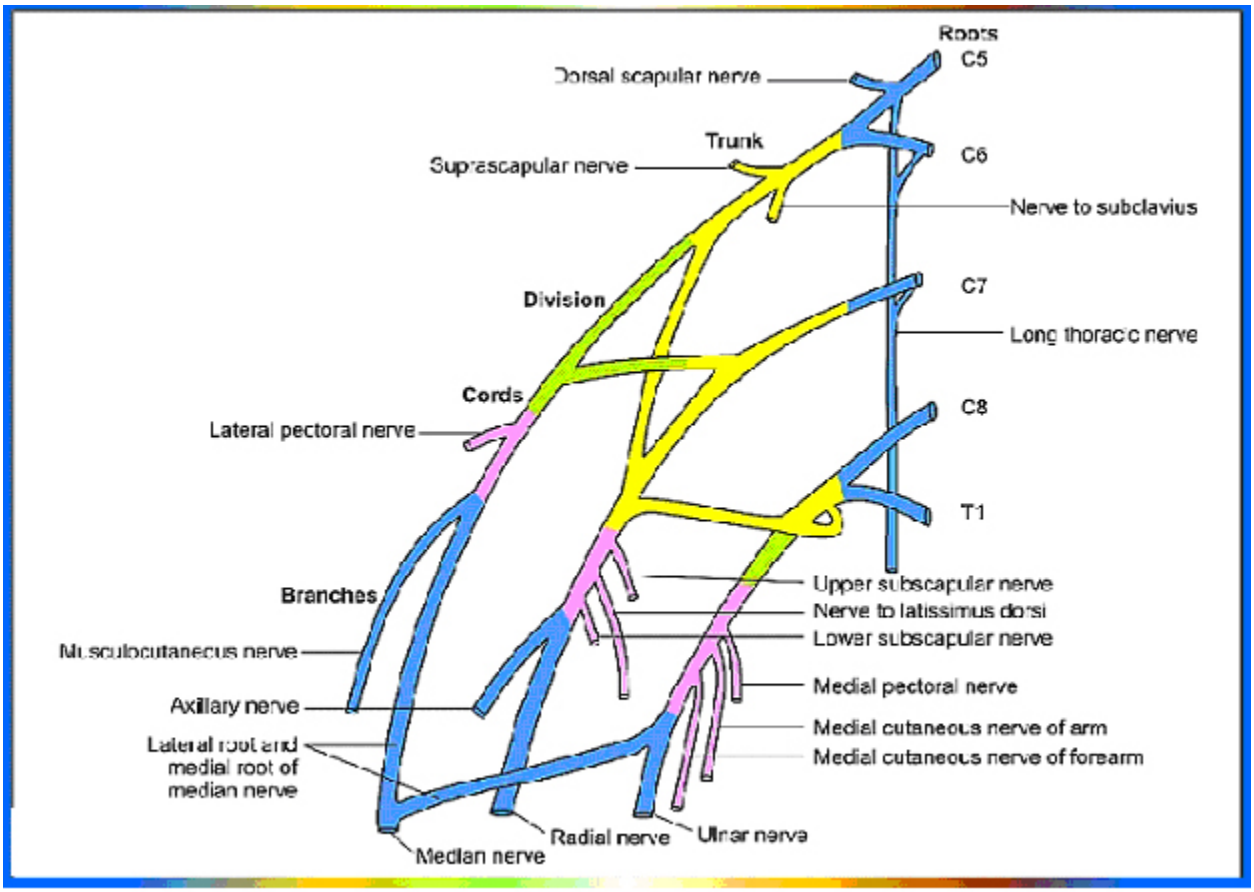


Cervical plexus

Four cutaneous branches of cervical plexus, e.g. lesser occipital, great auricular, transverse cutaneous nerve of neck and supraclavicular nerves pierce the fascia of the floor and fascia of the roof to become cutaneous.Proprioceptive fibres to trapezius and levator scapulae from C 3 and C4 rami.

Brachial plexus

Ventral rami of cervical 5 and 6 segments of spinal cord and upper, middle and lower trunks of brachial plexus.



Nerve to rhomboideus (dorsal scapular) (C5) for the supply of rhomboideus minor and major muscles.

Nerve to serratus anterior (C 6, C7, C8) passes behind the brachial plexus to supply all its digitations.

Nerve to subclavius (C 5, C6) runs in front of brachial plexus to supply subclavius. It may give a accessory phrenic nerve which joins the phrenic nerve.

Suprascapular nerve (C5, C6) passes backwards over the shoulder to supply supraspinatus and infraspinatus muscles.

Blood Vessels

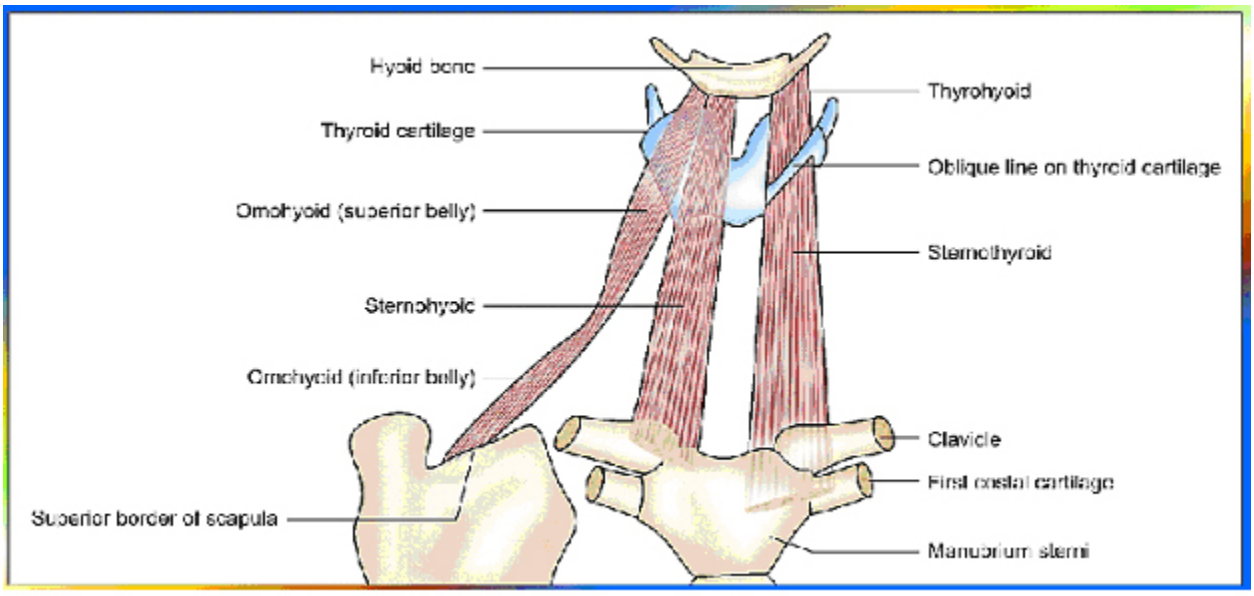
Subclavian artery-Third part of subclavian artery lies deep in the lower part of the triangle.
The two branches of first part of the artery namely suprascapular and transverse cervical also traverse the lower part of post. triangle to go to the back to take part in the anastomoses around the scapula.
Occipital artery is a branch of the external carotid artery. It crosses the apex of posterior triangle.
Suprascapular and transverse cervical vena comitantes accompany the arteries of their names and drain into the external jugular vein.
External jugular vein runs vertically in the superficial fascia of the roof of the triangle. It pierces the investing layer to drain into the subclavian vein. Wall of the vein is adherent investing layer of to the fascia where the latter is pierced. If the vein gets cut its distal end cannot collapse, and air entry causes air-embolism. Its tributaries are transverse cervical, suparascapular & anterior jugular veins.

Inferior belly of omohyoid. It passes from the scapular region through lower part of posterior triangle, then deep to sternocleidomastoid in the form of a tendon which is kept in position by a pulley formed by the investing layer of deep fascia. This muscle appears to divide the triangle into a larger upper occipital triangle and a lower smaller subclavian triangle.

Describe the infrahyoid and sternocleidomastoid muscles?

INFRAHYOID MUSCLES AND STERNOCLEIDOMASTOID MUSCLE
Infrahyoid muscles are described below:

Sternohyoid – From back of upper part of manubrium to the lower border of body of hyoid bone.



Nerve supply by branch of ansa cervicalis which enters the lower part of the muscle.

Omohyoid – Lying lateral to sternohyoid is the superior belly which extends from lateral part of inferior border of hyoid bone. It descends over carotid sheath and over scalenus anterior as its tendon. Into the tendon is inserted the inferior belly which arises from the upper border of scapula near the suprascapular notch.

Nerve supply – Superior belly by superior root of ansa cervicalis; inferior belly by ansa itself.

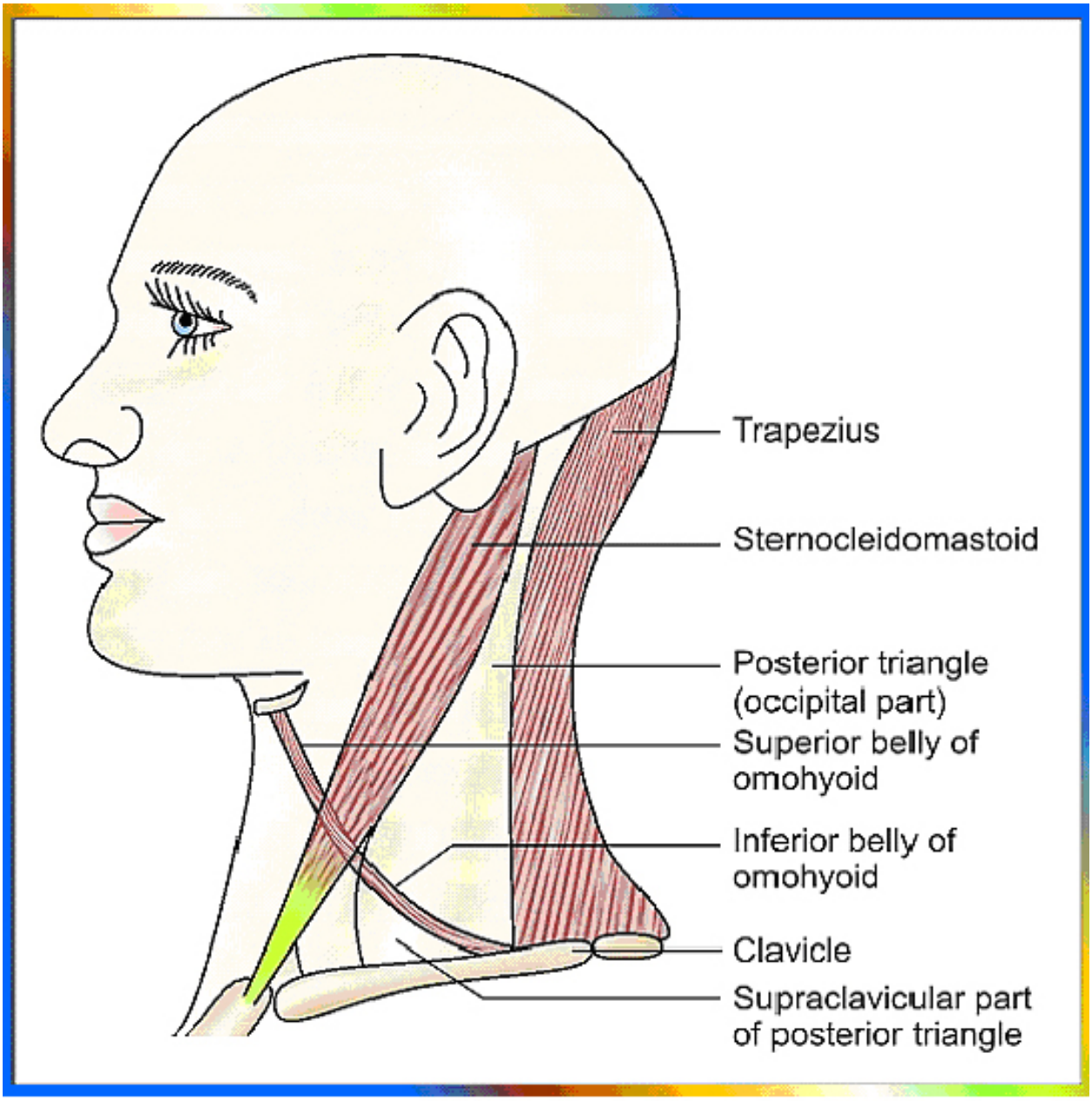
Thyrohyoid – Forms the deeper layer of infrahyoid muscles. Arises from oblique line of thyroid cartilage and gets inserted into greater cornua of hyoid bone.
Nerve supply- By fibres of cervical one through hypoglossal nerve.
Sternothyroid-Arises from posterior surface of manubrium to get inserted into the oblique line of thyroid cartilage.
Nerve supply-From ansa cervicals to the lower part of the muscle.

Actions:

These muscles enable the elevators of larynx to act gradually.
They prevent ascent of hyoid bone when mandible is lowered.
These muscles stabilise the hyoid bone.

Sternocleidomastoid muscle

Introduction: It is a very important landmark of the neck, placed obliquely from the manubrium and clavicle to the mastoid process and superior nuchal line of the skull. It is so named as it extends between the sternum (manubrium), clavicle on one hand till the mastoid process on the other.



Origin: It arises by two heads:

The sternal head is tendinous arising from superolateral part of the front of manubrium sterni. The clavicular head arises from superior surface of medial one-third of clavicle. The fibres of the clavicular head join the sternal head in the middle of the neck. A small depression-lesser supraclavicular fossa is present between the two heads. This fossa overlies the internal jugular vein, which can be approached from this fossa.

Insertion – It is inserted into:

The lateral surface of the mastoid process by a thick tendon.
Into the lateral one-third of superior nuchal line of occipital bone by an aponeurosis.

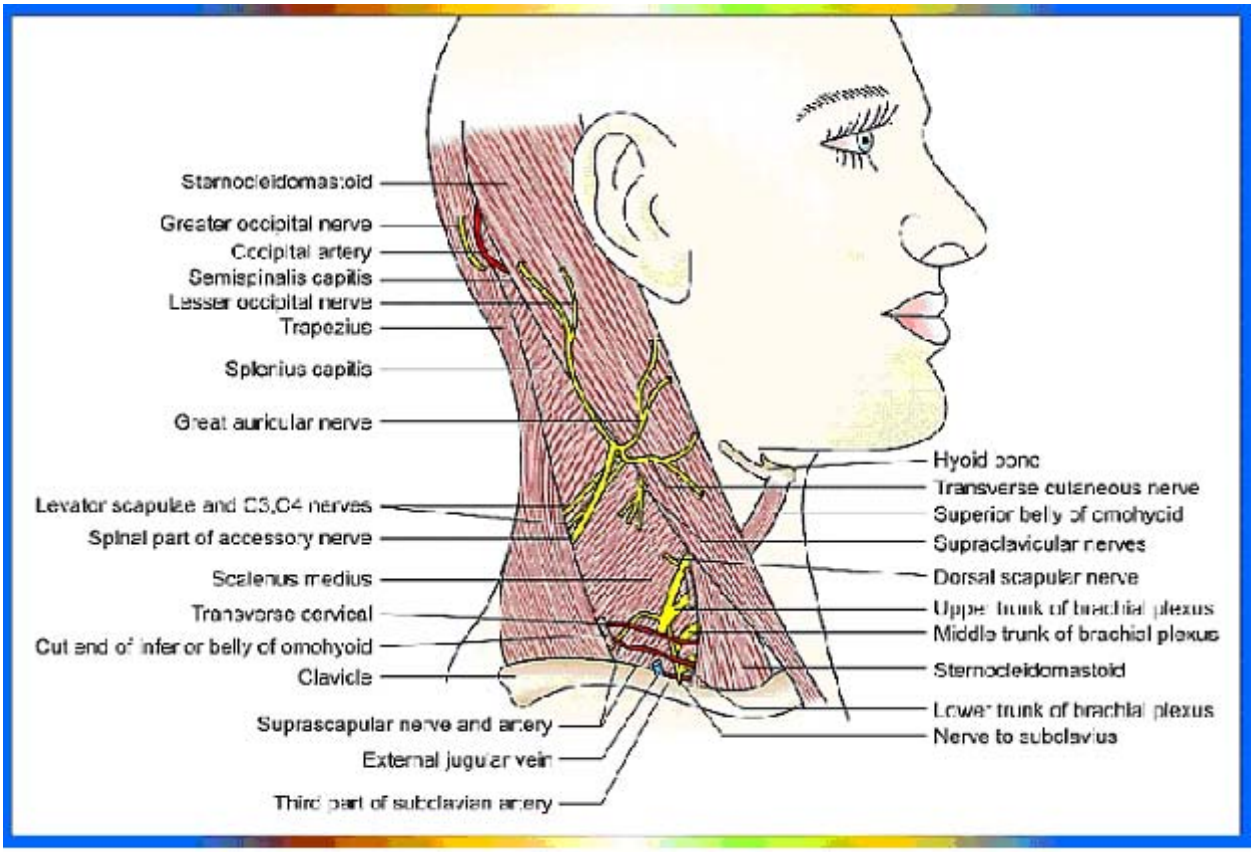
Nerve Supply
Motor fibres are supplied by the spinal root of accessory nerve. The nerve enters the muscle above its upper one-third, courses through the muscle, giving branches to it, and leaves the muscle through its posterior border just above its middle.
The nerve pierces the investing layer of deep fascia as the muscle is enclosed by the fascia.
It also receives proprioceptive fibres from ventral rami of C2, C3 segments.

Actions:
One muscle on contraction tilts the head towards the shoulder of the same side.
It rotates the head so that occiput turns to the same side and chin turns to the opposite side.
Both muscles acting together draw the head forwards as in eating or lifting the head from pillow.
Both muscles extend the atlanto-occipital joint, so as to peep above the other's heads.
Flex the neck against resistance. Act as muscle of forced inspiration.

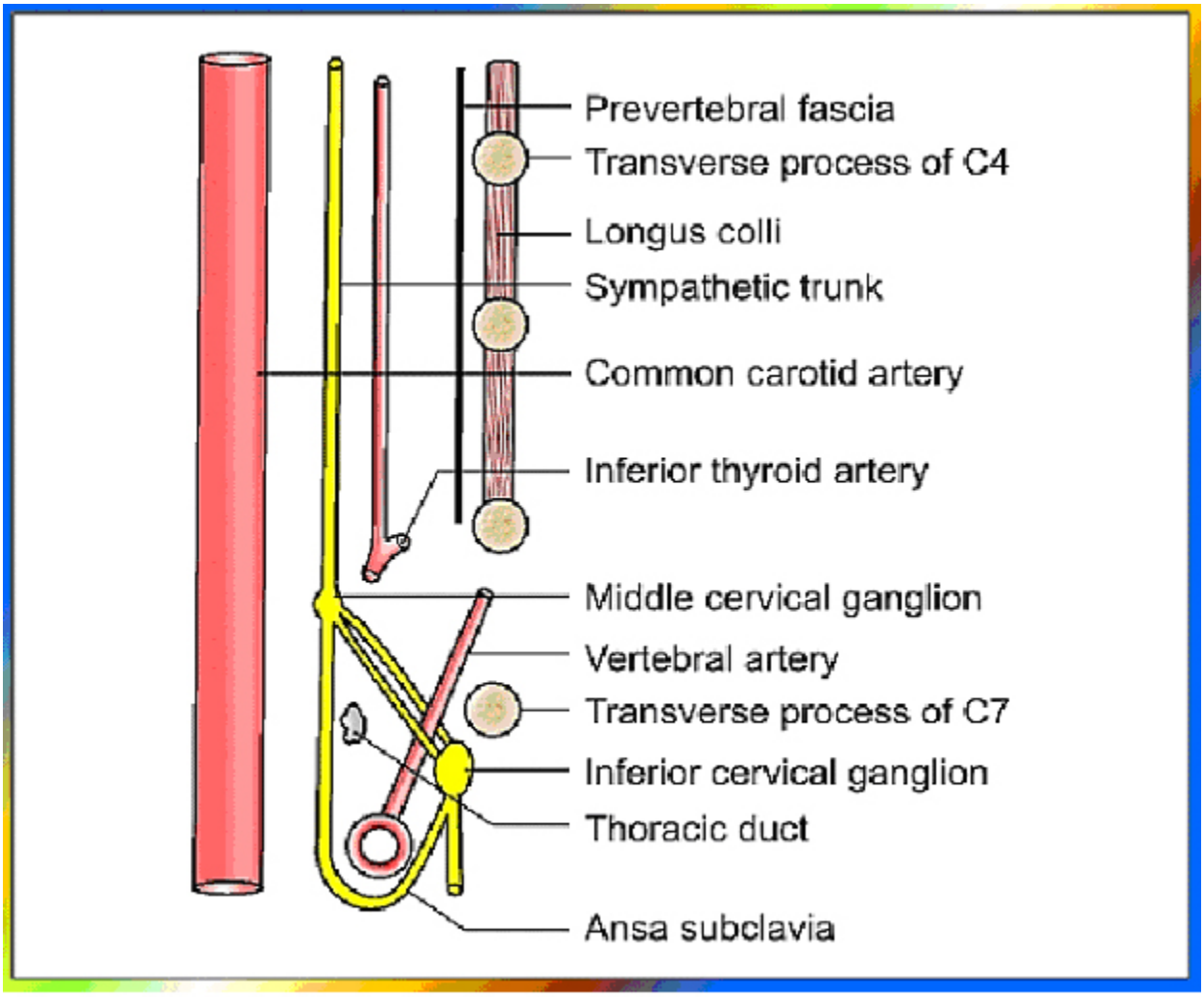
Relations:
This muscle divides each side of the neck into two triangles–anterior triangle anterior to it and posterior triangle posterior to the muscle. It is enclosed by the investing layer of cervical fascia.
Superficial relations: Superficial fascia and superficial lamina of investing layer, platysma, external jugular vein with superficial cervical lymph nodes, branches of cervical plexus-transverse cervical, great auricular and supraclavicular nerves.

Deep relations: Joint—Sternoclavicular joint.

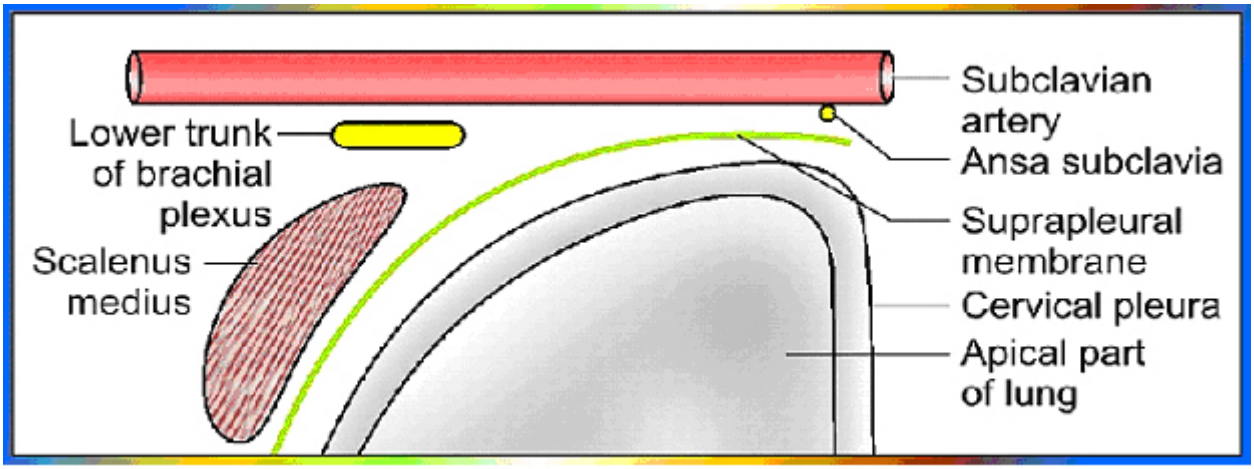
Bones – Mastoid process.
Muscles – Scalenus anterior, scalenus medius, levator scapulae, splenius capitis, posterior belly of digastric.



Arteries – Common carotid and its branches, the internal carotid, external carotid and occipital of ECA. Subclavian and its branches, suprascapular and transverse cervical.



Veins – Internal jugular, anterior jugular, facial and lingual.



Nerves – Phrenic, ansa cervicalis, cervical plexus, upper part of brachial plexus, vagus, accessory.

Lymph nodes – Deep cervical group of lymph nodes.

Blood supply – It is supplied by four branches; two from occipital artery and one each from superior thyroid and suprascapular arteries. Veins drain into corresponding veins.

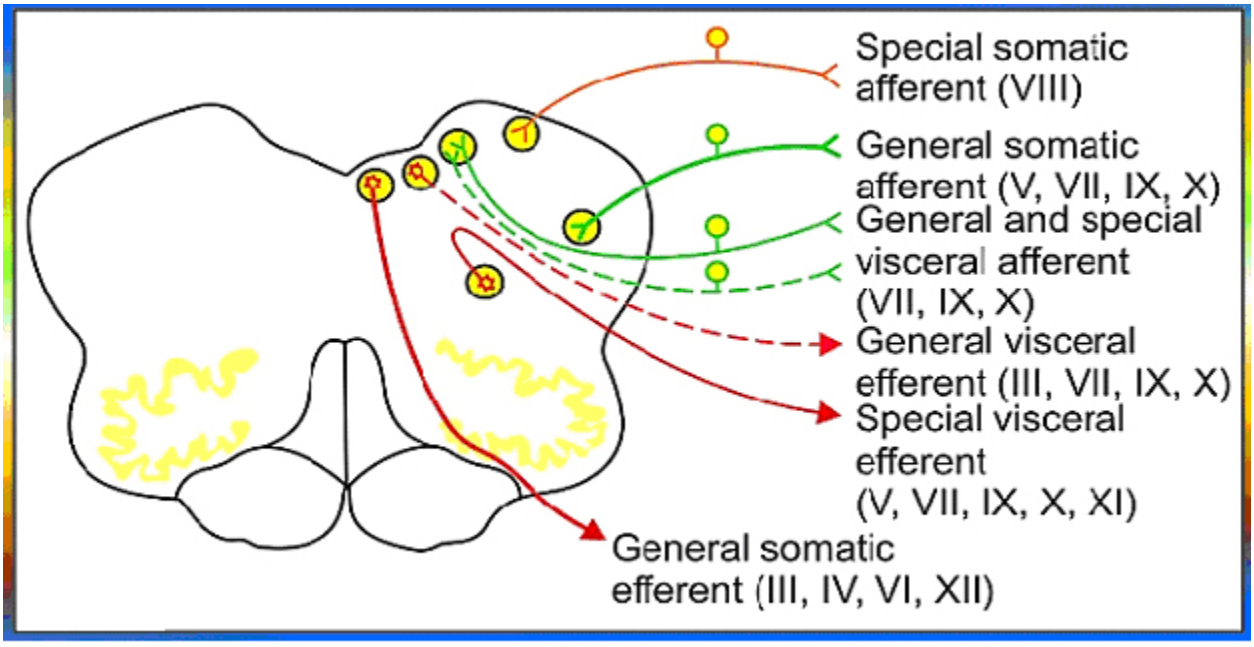
Applied – If the nerve supply to the muscle is injured, it leads to paralysis of the muscle causing wry neck or torticollis. In this condition the head is bent to one side and the chin points to the other side. Torticollis may be congenital due to birth injury or acquired due to injury to the nerve later.

Enumerate branches of oculomotor nerve.

OCULOMOTOR NERVE

Nuclear columns/functional components:

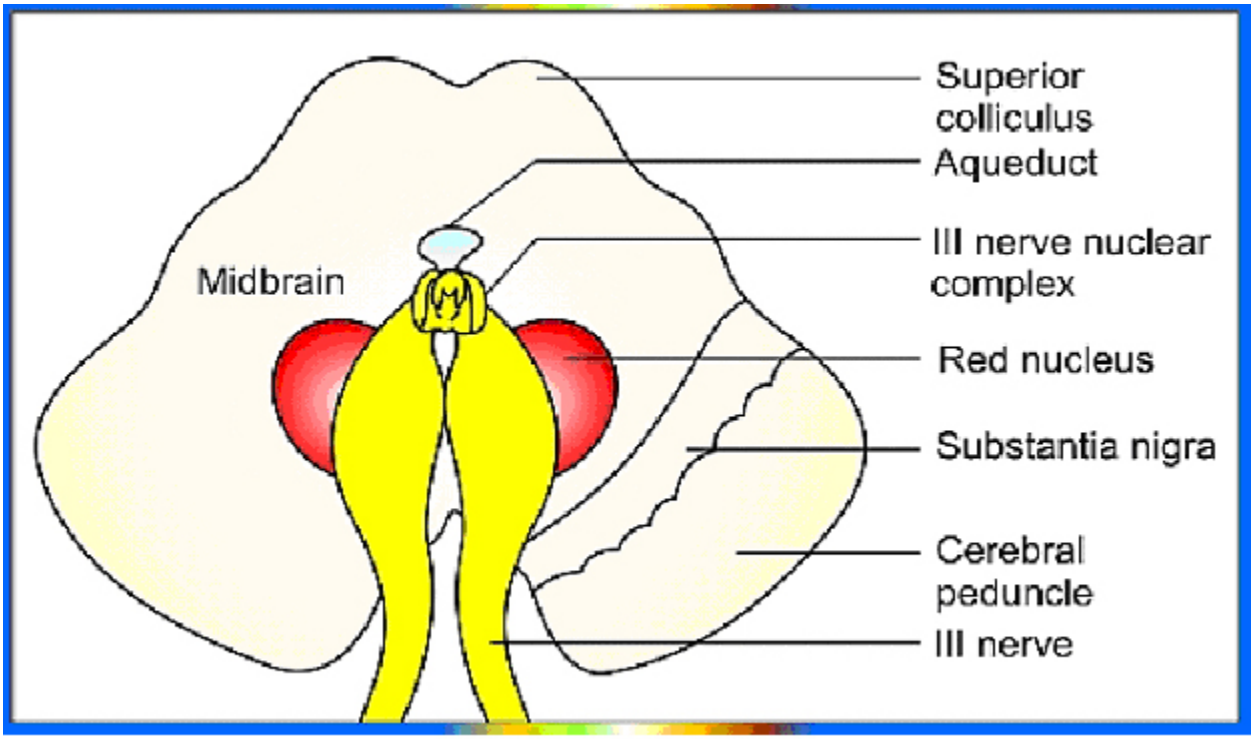
General somatic efferent column, nucleus is of oculomotor nerve.



General visceral efferent column, nucleus of Edinger-Westphal for the supply of intraocular muscles.

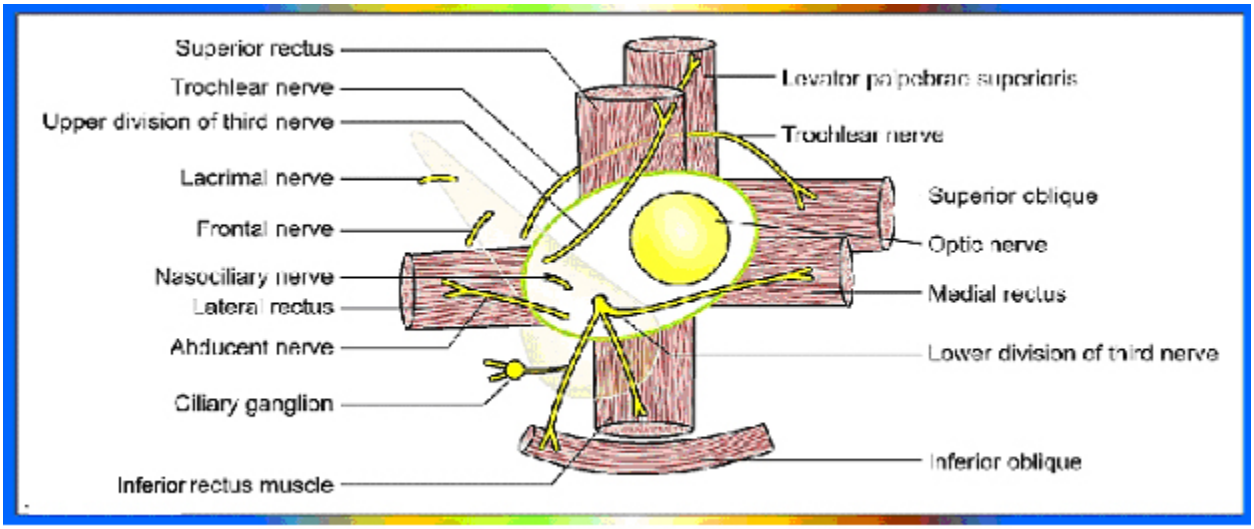
General somatic afferent column for proprioceptive impulses from eye muscles.

Nuclei are situated in midbrain at the level of superior colliculus. Fibres of Edinger-Westphal nucleus join those of the oculomotor nerve. The nerve is seen at the medial end of crus cerebri of midbrain.



Course

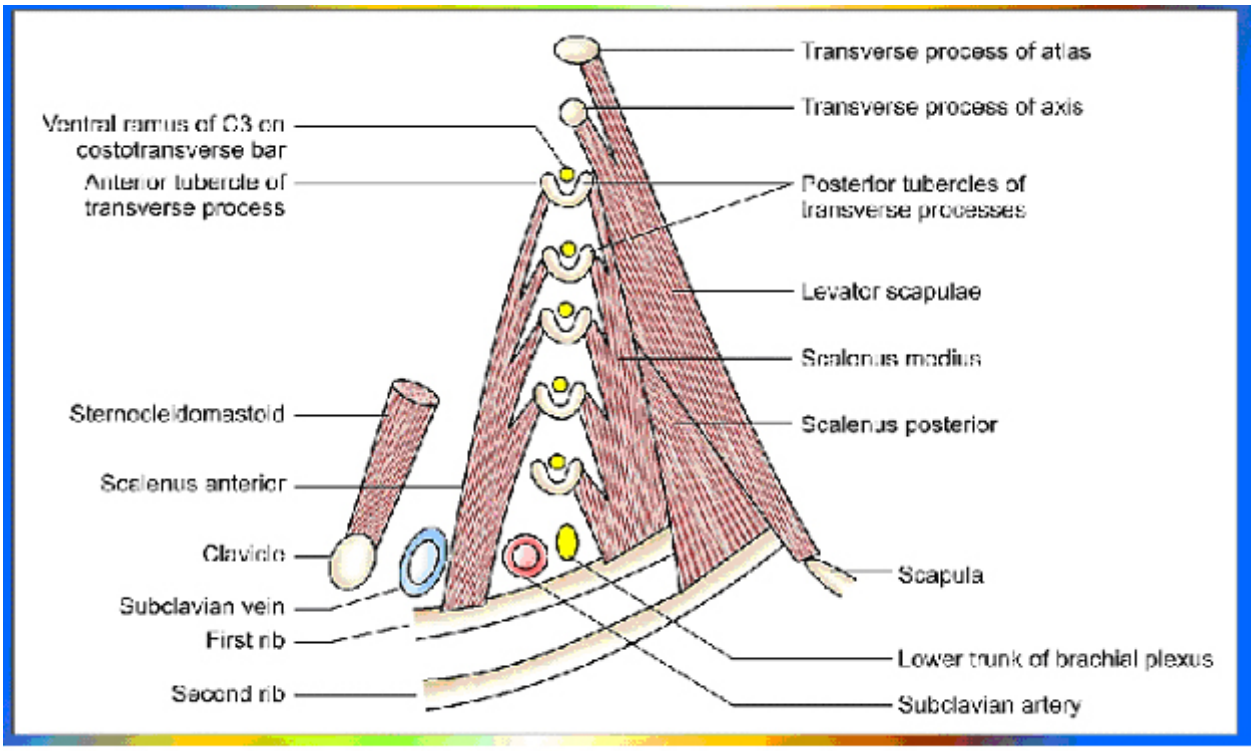
It enters the cavernous sinus and is placed in its lateral wall most anteriorly. As it traverses the sinus it divides into its two divisions in its anterior part. Both the divisions pass through the middle part of the superior orbital fissure.



The superior division enters the orbit, turns upwards lateral to optic nerve and supplies superior rectus and superficially placed levator palpebrae superioris.
The inferior division also enters the orbit, passes below the optic nerve and divides into three branches–for medial rectus, inferior rectus and inferior oblique muscles.
The nerve to inferior oblique gives a branch for the ciliary ganglion. This branch brings the fibres of Edigner-Westphal nucleus (GVE) to the ganglion for relay. The postganglionic fibres end up in supplying the ciliaris for accommodation and constrictor pupillae (sphincter pupillae) for narrowing the size of the pupil. Both these are intraocular muscles.
Paralysis of the third nerve results in partial ptosis, dilatation of pupil, loss of accommodation, diplopia and lateral squint. The eye looks downwards and outwards

Describe attachments, nerve supply and actions of scalenus anterior, orbicularis oculi, buccinator muscles.

SCALENUS ANTERIOR, ORBICULARIS OCULI, BUCCINATOR MUSCLES.
Scalenus anterior
Origin – Origin of scalenus anterior is from the anterior tubercles of 3-6 cervical “typical” vertebrae.
Insertion – The tendon of the muscle gets inserted into the scalene tubercle on the inner border of 1st rib.



Relations

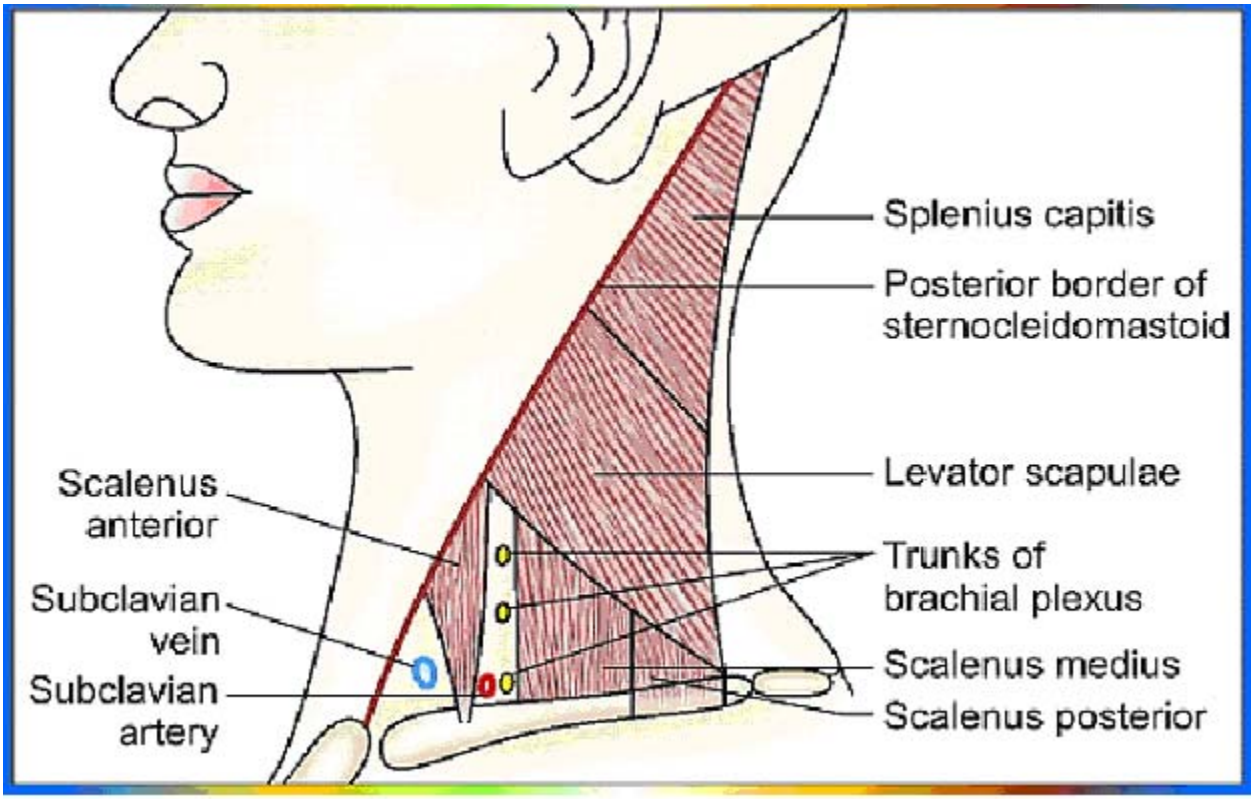
Anterior relations

Phrenic nerve crosses it vertically from its lateral to its medial border; ascending cervical artery ascends medial to the nerve. This muscle is covered by prevertebral fascia.

Suprascapular and transverse cervical arteries pass across the muscle from medial to lateral side.

Carotid sheath lies medial to the muscle.

Subclavian artery is divided into 3 parts by this muscle, 1st part is medial, 2nd part is behind the muscle and 3rd part is lateral to the muscle.



Vertebral artery its first branch passes up in the pyramidal space between the longus colli and scalenus anterior muscle to reach foramen transversarium of 6th cervical vertebra.
Thyrocervical arises lateral to vertebral and divides into :
Inferior thyroid which makes a bold loop medially.
Suprascapular passes across scalenus anterior.
Transverse cervical also passes across scalenus anterior above the suprascapular artery.
Internal thoracic artery travels downwards towards the thoracic wall.

Posterior relations
Behind scalenus anterior is scalenus medius and separating the two are 2nd part of subclavian artery and roots of brachial plexus. Subclavian artery gives costocervical trunk which gives off superior intercostal for 1st and 2nd posterior intercostal spaces and deep cervical which runs up behind cervical transverse processes.

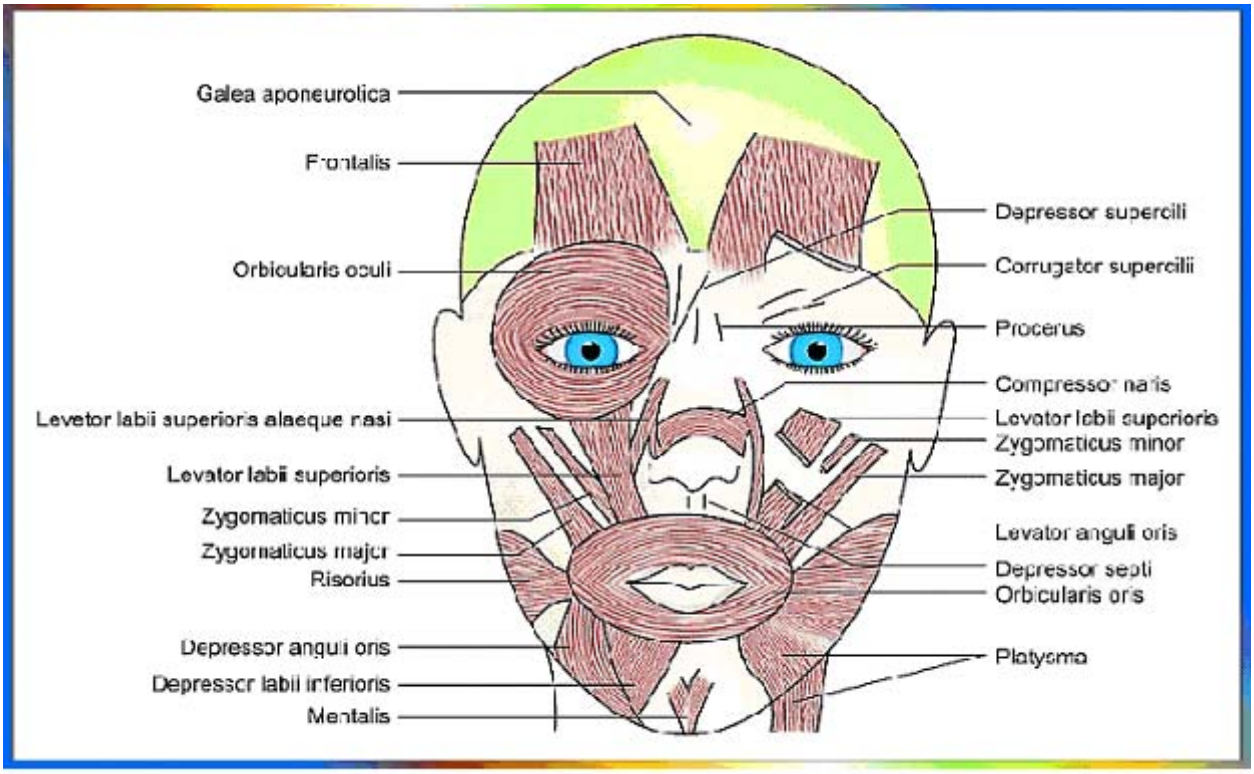
Lateral relations – Third part of subclavian artery and trunks, upper middle and lower of brachial plexus emerge from the lateral border of scalenus anterior muscle. Third part of subclavian may give a branch the dorsal scapular which replaces the deep branch of transverse cervical in taking part in the anastomoses around the scapula.

Action: It helps in flexion and rotation of neck. It stabilises first rib.

ORBICULARIS OCULI

Orbicularis oculi is made up of three parts, the orbital, palpebral and lacrimal parts. It forms a strong sphincter around the palpebral fissure. Palpebral part arises from the medial palpebral ligament, arches across both the upper and lower eyelids, lies superficial to the tarsal plates, passes laterally to interdigitate and form lateral palpebral raphe.

Orbital part fibres are larger and arise from the nasal part of frontal process of maxilla and anterior lacrimal crest. These fibres loop around the orbital margin in circles/loops. Lacrimal fibres are deeper. These are attached to the lacrimal sac and posterior lacrimal crest. These pass laterally to merge with upper and lower palpebral fibres.



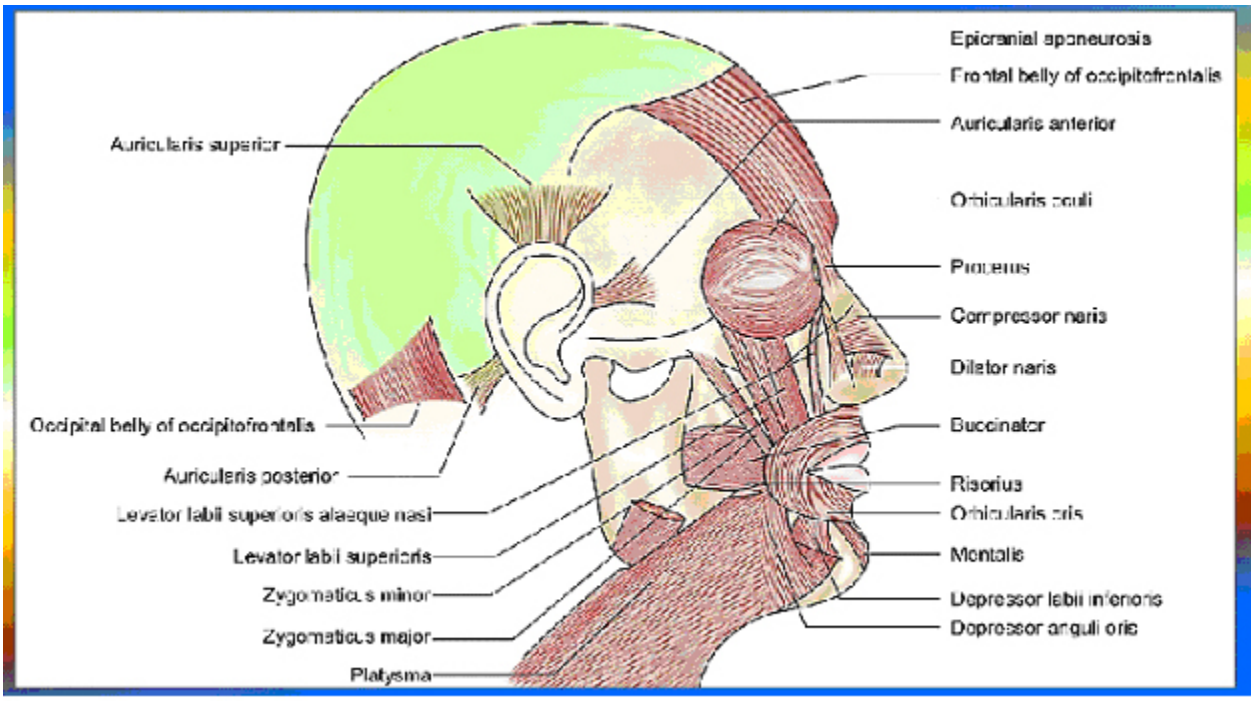
Nerve supply is by zygomatic and temporal branches of facial nerve/CN VII

Actions: Orbital part closes the lids tightly and protects the delicate eyeball from sun, dust, wind, water, etc. Since its origin is medial and insertion is lateral it pulls the lids medially, thus spreading the lacrimal fluid from lateral to medial side.

Palpebral part closes the lids gently (as in classroom nap), while the lacrimal part dilates the lacrimal sac, creates a partial vacuum and drain the lacrimal fluid from the conjunctival sac.
Applied: In the case of paralysis, the lower lid eyelid remains down and fluid flows on the cheek. This leads to secondary infection of the conjunctiva.

BUCCINATOR

Origin of buccinator is from the outer surface of maxilla opposite the molar teeth, from the oblique line of mandible, from pterygomandibular raphe.



Insertion: The upper and lower fibres pass to the respective lips, the middle fibres decussate at the modiolus (situated about 1 cm lateral to angle of mouth) so that upper fibres go to lower lip and lower fibres reach the upper lip. All these fibres form part of the orbicularis oculi muscle to get inserted into the skin of the two lips.

Nerve supply: The buccal branches of facial nerve supply this muscle.
Proprioceptive fibres are supplied by buccal branch of mandibular nerve.

Actions: It pushes the pieces of food into the mouth cavity for chewing and grinding. When the air is puffed into the cheek the muscle is relaxed. During gradual pushing out of the air, the

muscle contracts, as in whistling.

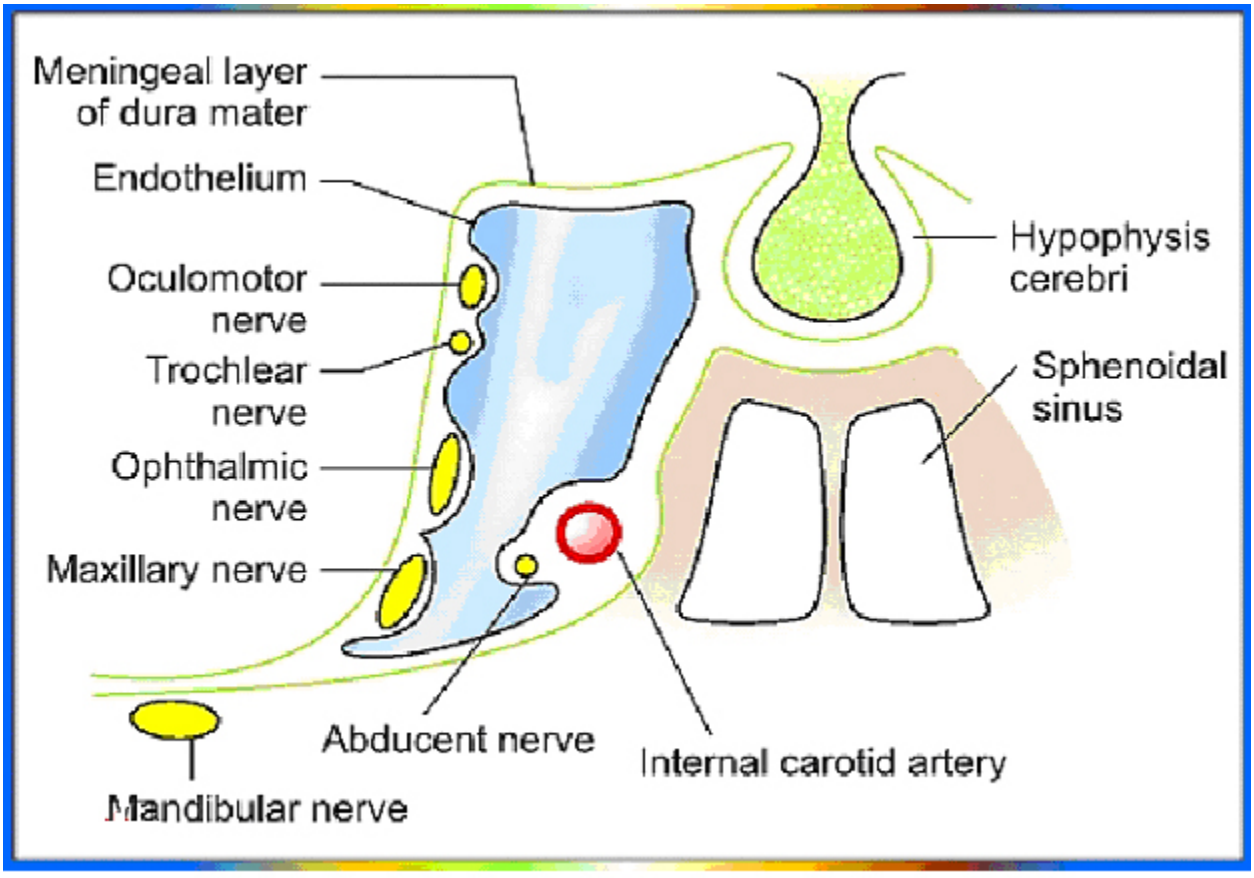
Applied: If the muscle is paralysed the food on that side tends to remain in the vestibule of mouth, which dribbles out.

Discuss contents and connections of cavernous sinus. Enumerates the tributaries of cavernous sinus.

CAVERNOUS SINUS

The cavernous sinus is large venous space on each side of the body of sphenoid bone, present in the middle cranial fossa. It is called cavernous as it is divided by trabeculae into number of smaller spaces.

The sinus is present between the endosteal layer which forms its floor and the meningeal layer which forms its roof, lateral and medial walls.



Size: It is 2 cm long extending from apex of petrous temporal bone to the medial end of superior orbital fissure. It is 1cm wide.

Relations

I. **Outside the cavernous sinus**
Medially: Hypophysis cerebri and sphenoidal air sinus.
Laterally: Temporal lobe of cerebrum and uncus.
Superiorly: Optic tract, internal carotid artery.
Inferiorly: Foramen lacerum.

II. **II. Within the lateral wall of cavernous sinus**: These are from above downwards

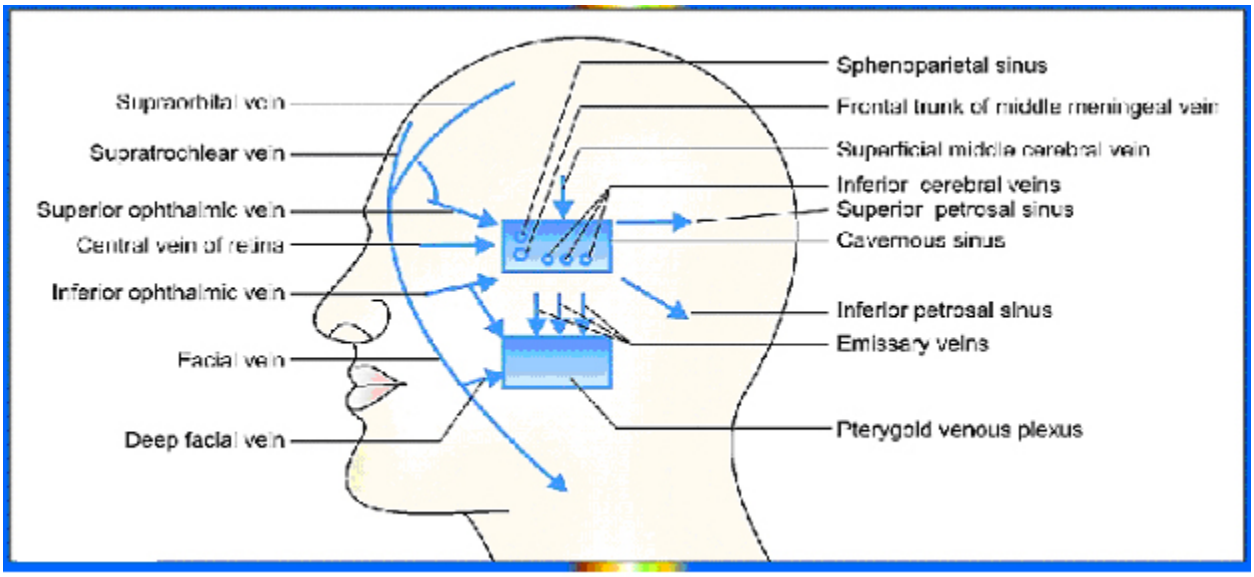
Oculomotor nerve: It divides into two terminal branches in the anterior part of the sinus.
Trochlear nerve: It passes forwards and leaves the sinus through the superior orbital fissure.
Ophthalmic nerve: Lies below the trochlear nerve. In the anterior part of the sinus it terminates by dividing into three branches, frontal, nasociliary and lacrimal.
Maxillary nerve: Leaves the sinus by passing through foramen rotundum.
Trigeminal ganglion with its dural cave projects in the posterior part.
Through the centre of sinus: Internal carotid artery with sympathetic plexus derived from superior cervical ganglion passes through its centre. It is accompanied by abducent nerve on its inferolateral aspect

Tributaries of Cavernous sinus: It receives following tributaries:

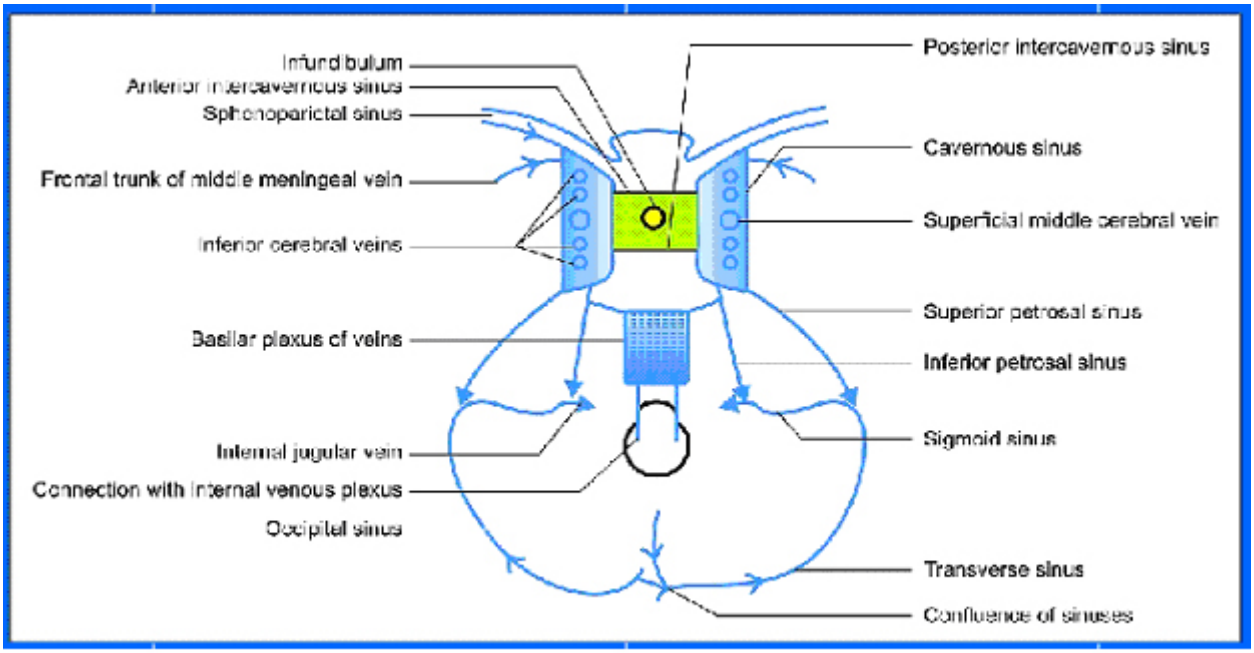
From the orbit	• Superior ophthalmic vein • Inferior ophthalmic vein • Central vein of retina
From the meninges	• Frontal trunk of middle meningeal vein, sphenoparietal sinus
From the brain	• Superficial middle cerebral vein

Cavernous sinus communicates with the following veins/sinuses:

• Transverse sinus via the superior petrosal sinus.



• Internal jugular vein via the inferior petrosal sinus.



• Pterygoid venous plexus via emissary vein through foramen ovale and foramen lacerum.

• Facial vein through superior ophthalmic vein.

• Opposite cavernous sinus through anterior and posterior intercavernous sinuses.

Clinical anatomy

• Cavernous sinus may get thrombosed through infection or sepsis in the dangerous area of face, nasal cavities, paranasal air sinuses.

• Head injury may produce communication between the cavernous sinus and internal carotid

artery. If it occurs the eyeball pulsates with each heart beat.

Describe the attachments & actions of extraocular muscles. Enumerate the connections of ciliary ganglion.

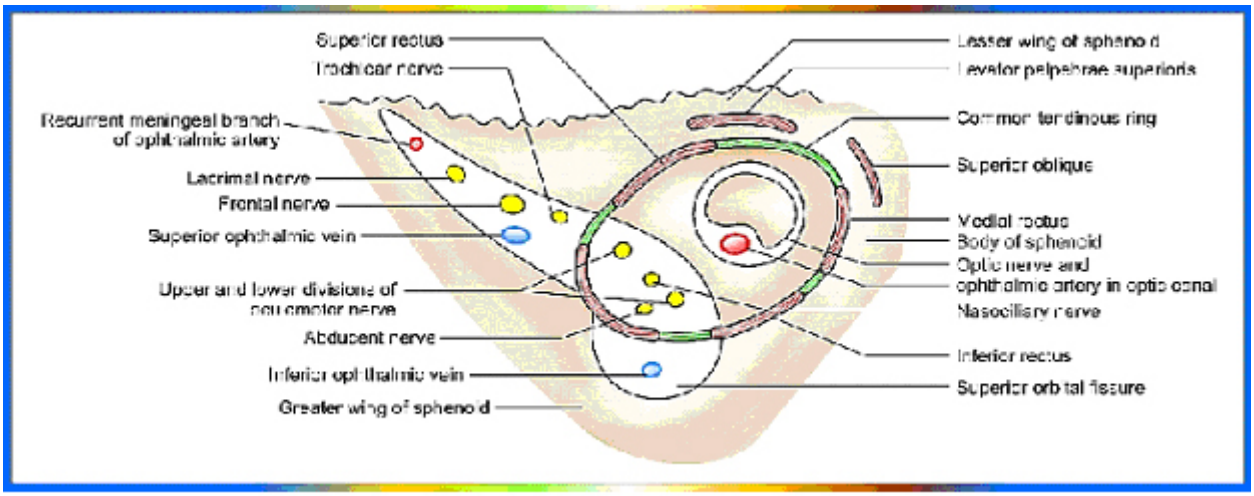
EXTRAOCULAR MUSCLES AND CILIARY GANGLION

Extraocular muscles

There are 7 extraocular muscles. These are four recti–superior rectus, inferior rectus, medial and lateral recti; 2 oblique–superior oblique and one inferior oblique; and one levator palpebrae superioris.

All four recti arise from a tendinous ring attached to the orbital surface of apex of orbit. It also encloses the optic canal and middle part of superior orbital fissure.

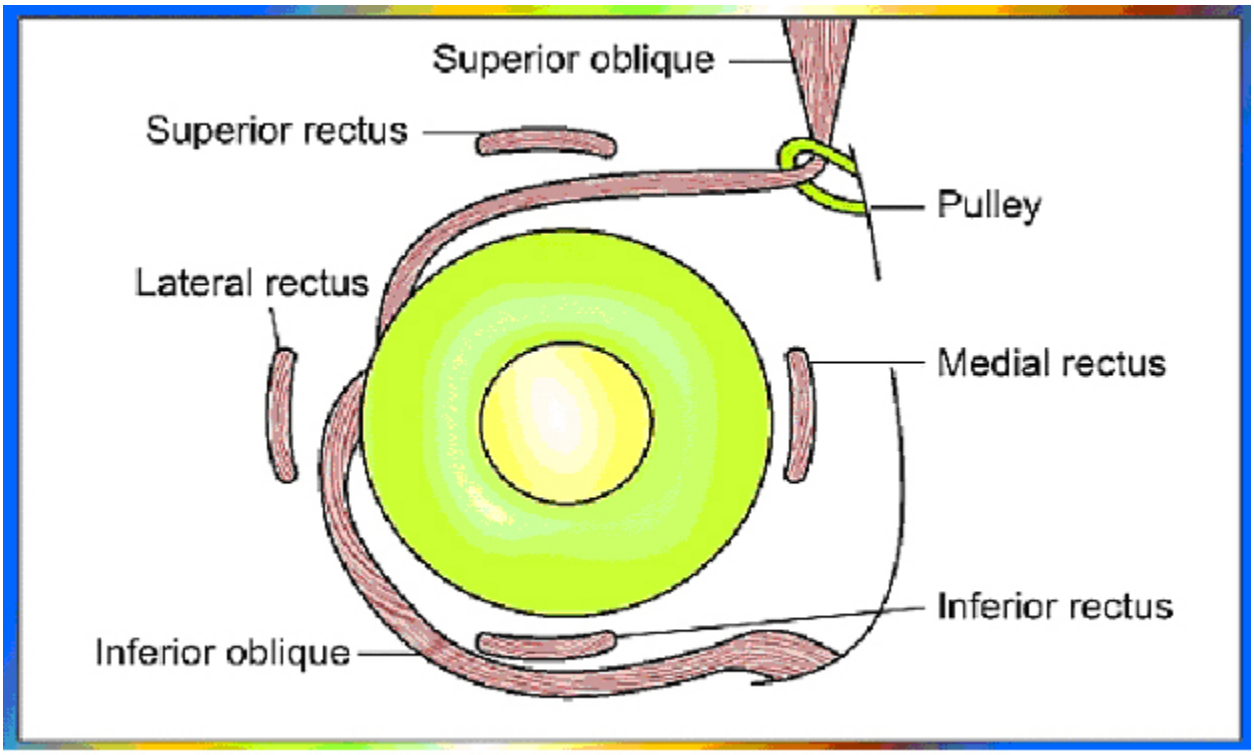
Superior rectus: Arises from the superior aspect of tendinous ring, passes forwards and laterally to get inserted into the sclera about 6 cm behind corneo-scleral junction.

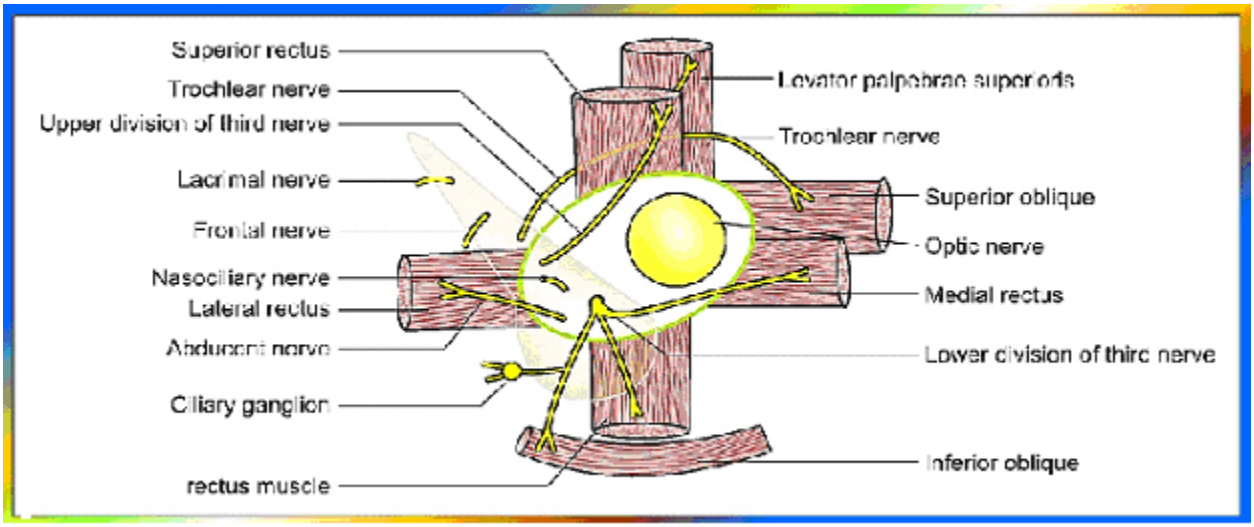


Nerve supply: Superior division of 3rd nerve.

Action: elevation, medial rotation and intortion.

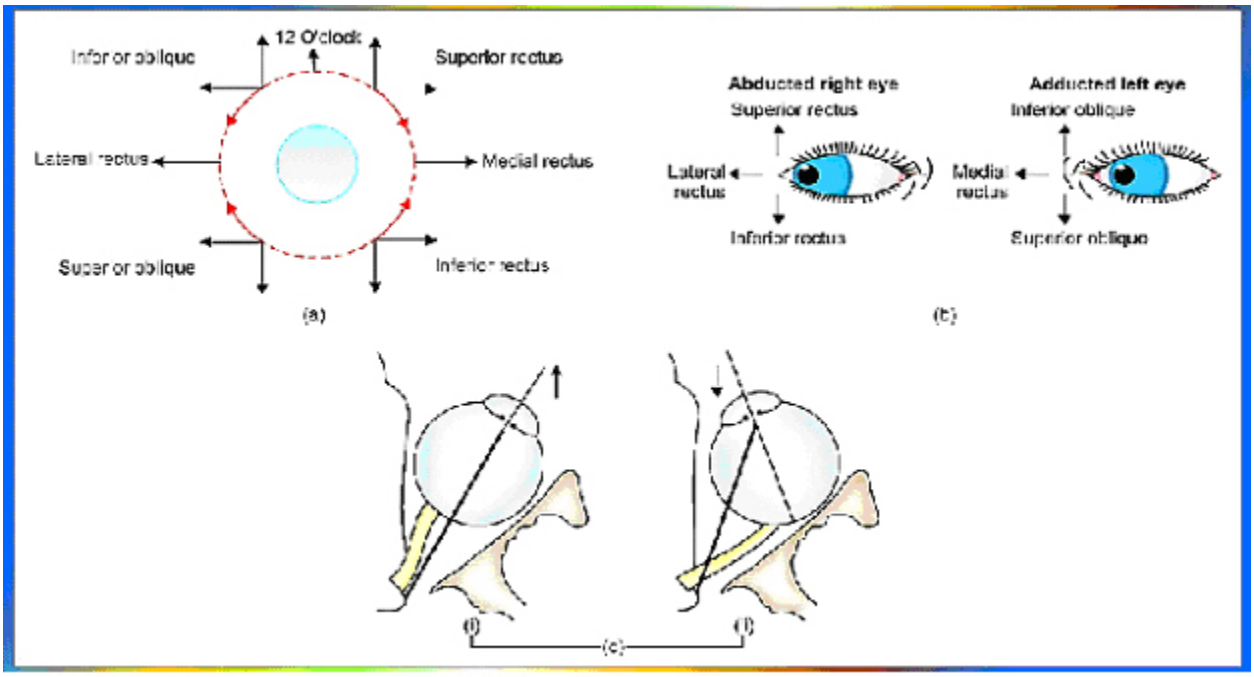
Inferior rectus: Origin: From inferior aspect of the tendinous ring.





Insertion: About 6 cm behind corneoscleral junction.
Nerve supply: Oculomotor through its inferior division.

Action: Depression, medial rotation and extortion.



Medial rectus: Arises from the medial aspect of the tendinous ring. Passes directly forwards.

Insertion: Into the sclera about 6 mm behind corneoscleral junction.

Nerve supply: Inferior division of oculomotor nerve.

Actions: Rotates the eyeball medially around a vertical axis.

Lateral rectus: Arises from lateral part of the tendinous ring. Additional head arises from the part of bone (orbital surface of greater wing of sphenoid) lateral to tendinous ring.

Insertion: Into the sclera about 6 mm behind the corneoscleral junction.

Nerve supply: By the abducent (6th) nerve. This muscle has extremely rich nerve supply.

Action: Rotates the eyeball laterally around a vertical axis.

Superior oblique: Arises from the body of sphenoid superomedial to the optic canal. The muscle passes forwards and its tendon passes through the fibrocartilaginous pulley present in

the trochlear fossa of frontal bone. The tendon passes downwards laterally and backwards deep to superior rectus and gets inserted in the sclera behind the equator of eyeball between superior and lateral recti muscles.

Nerve supply: Trochlear or 4th cranial nerve supplies only this muscle.

Actions: Turns the posterior pole upwards and medially towards the pulley resulting in the anterior pole ie cornea looking downwards and laterally (cheating muscle). Also causes intortion.

Inferior oblique: Arises from the orbital surface of maxilla lateral to the lacrimal groove. It passes inferior to inferior rectus and then deep to lateral rectus to get inserted into posterolateral quadrant of the eyeball behind its equator, a little below and lateral to the superior oblique.

Nerve Supply: By the inferior division of oculomotor nerve, which also gives a branch to the ciliary ganglion.

Actions: This muscle has origin anteriorly and insertion posteriorly. It pulls the insertion (posterior pole) downwards and medially, resulting in the anterior pole (cornea) turning upwards and laterally. Also causes extortion of the eyeball.

Levator palpebrae superiosis: Arises above the tendinous ring, superomedial to the origin of superior rectus. It lies above the superior rectus muscle.

Insertion: Is in two lamellae. The upper lamella is voluntary and inserted into superior conjunctival fornix, anterior surface of superior tarsus and into the skin of upper eyelid, while the inferior lamella (involuntary) is inserted into the upper margin of superior tarsus.

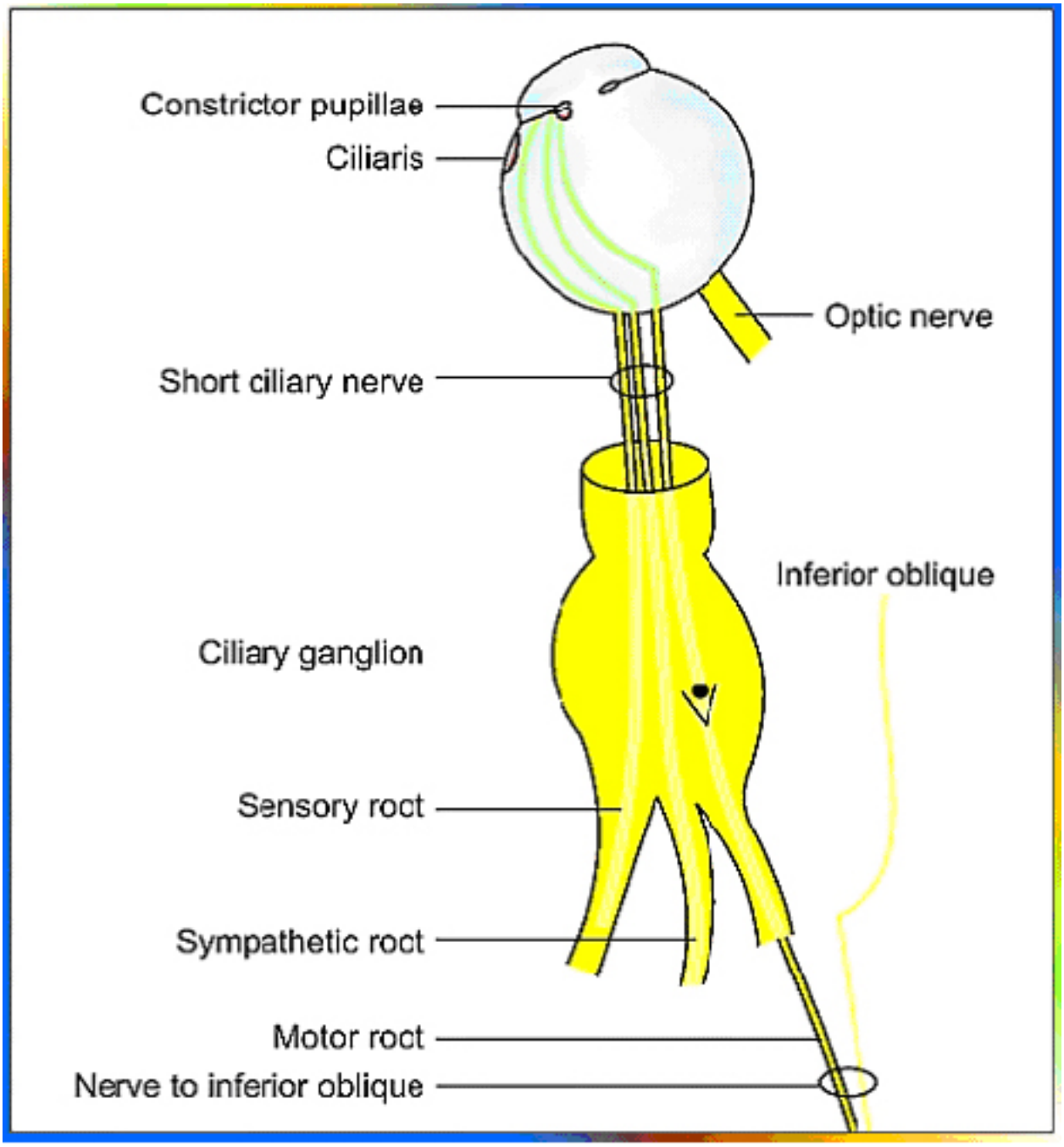
Nerve supply: The voluntary or upper lamella is supplied by the upper division of oculomotor nerve. The involuntary or inferior lamella is supplied by sympathetic fibres from superior cervical ganglion. The latter gets affected in Horner’s syndrome and cause partial ptosis.

Actions: Causes elevation of the upper eyelid and upper fornix of conjunctiva. It is antagonistic to orbicularis oculi muscle.

CILIARY GANGLION

It is present in the orbit between the optic nerve and lateral rectus muscle.

Roots: Sensory – Long ciliary nerve.



Sympathetic: Long ciliary nerve from plexus around ophthalmic artery.

Motor: Branch to inferior oblique. These fibres arise from Edinger-Westphal nucleus, join oculomotor nerve and leave it via the nerve to inferior oblique muscle. These relay in the ciliary ganglion to give postganglionic branches.

Branches 10-12 short ciliary nerves. These supply sphincter pupillae or constrictor pupillae for the constriction of the pupil, ciliaris muscle for increasing the curvature of anterior surface of lens during accommodation of the eye.

Describe gross features and nerve supply of parotid gland. Add a note on its clinical anatomy.

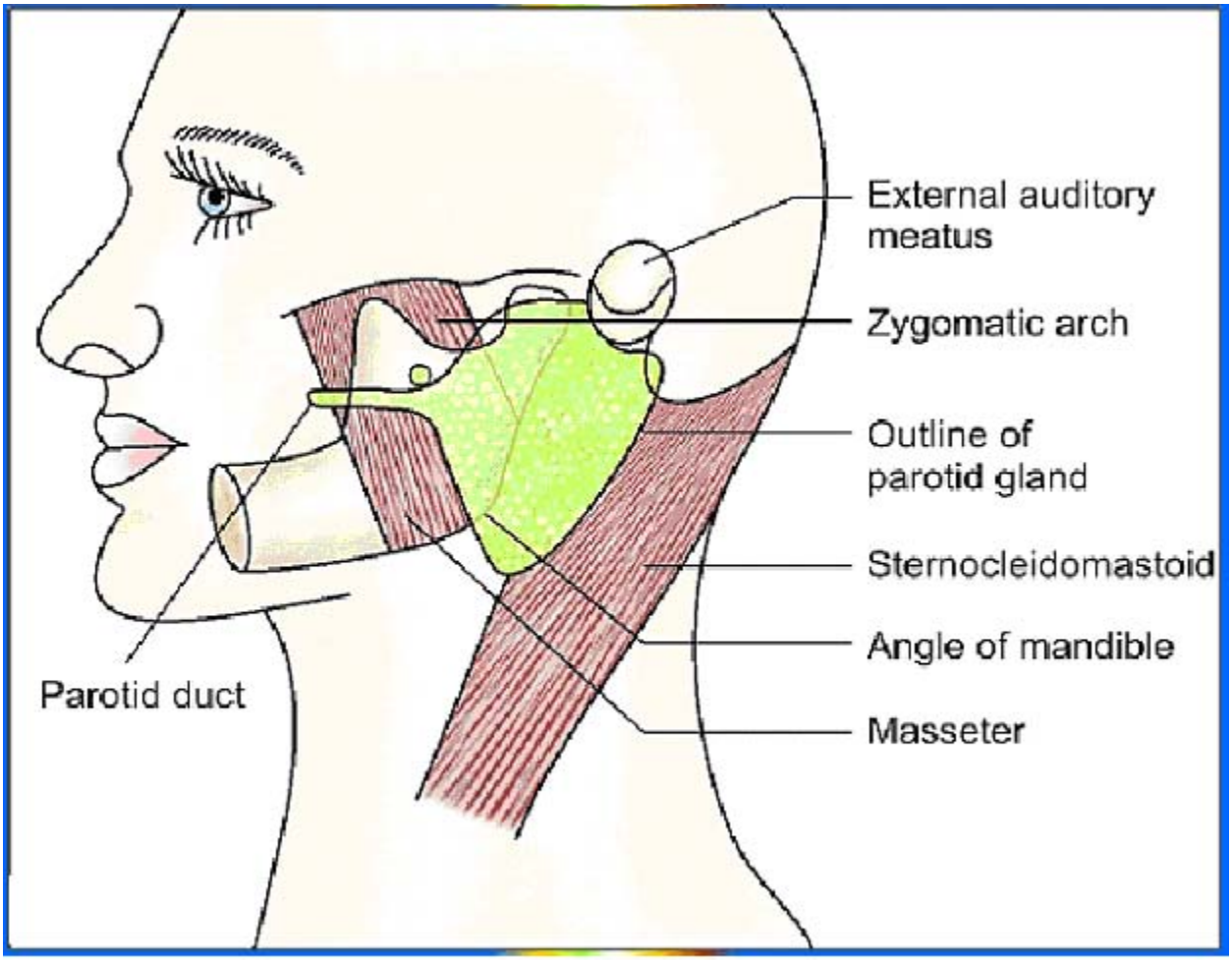
PAROTID GLAND

Parotid gland is the largest pair of salivary parotid gland near the ear. It forms saliva which keeps oral cavity moist and helps in speech and bolus formation.

Saliva contains ptyalin for digestion of starch.

Parotid gland is predominantly serous in nature and weighs about 25 gm. It is irregularly lobulated, roughly pyramidal in shape with base directed upwards.

Extent: Anteriorly till the ramus of mandible, superiorly till cartilagineous part of external auditory meatus. Posteriorly till the mastoid process and sternocleidomastoid muscle.

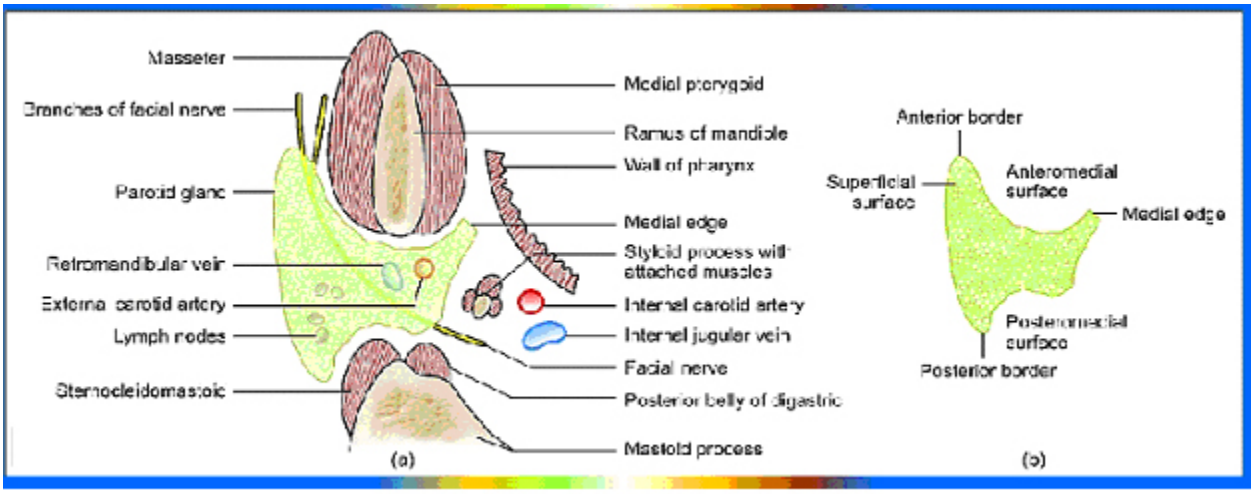


Inferiorly: 2 cm below the angle of mandible.
Capsules: Parotid gland is surrounded by two capsules:-

False capsule formed by splitting of investing layer of cervical fascia attached above to the zygomatic arch. The deep part of the fascia becomes thickened to form stylomandibular ligament which extends between styloid process and angle of mandible and separates parotid from the submandibular gland. The skin and capsule over parotid gland is supplied by great auricular nerve (c2,c3).True capsule formed by condensation of connective tissue of the parotid gland.

Gross features:
Upper end is in the form of small superior surface. This is related to the cartilaginous part of external auditory meatus.
The Lower end is the apical part of the gland and is seen in the carotid triangle of the neck.
Superficial surface is seen in the region of face and is related to parotid lymph nodes.
Anteromedial surface is related to the ramus of mandible and the two muscles inserted into it,

namely masseter on superficial aspect and medial pterygoid on its deep aspect. Upper part of the gland is wrapped around capsule of temporomandibular joint. The two terminal branches of external carotid artery leave through this surface.



Posteromedial surface is related to mastoid process and its attached important muscles the sternocleidomastoid muscle and posterior belly of digastric. Deep to mastoid process it is related to styloid apparatus which separates it from the carotid sheath. The external carotid artery enters through lower part of this surface.

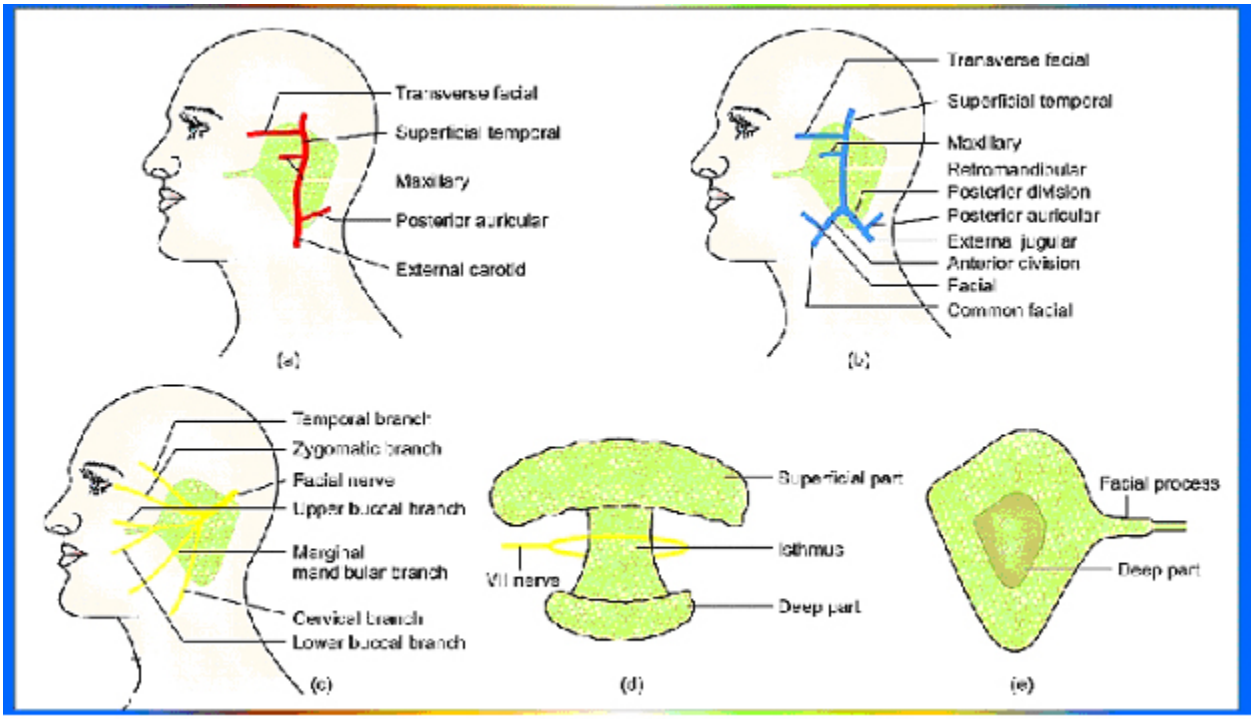
Medial border separates the anteromedial from posteromedial surfaces and is close to the pharynx.

Anterior border is irregularly convex border separating the superficial from anteromedial surface. Parotid duct and branches of facial nerve emerge from the anteromedial surface and pass forwards deep to the anterior border.

Structures embedded in the gland:

External carotid artery, its two terminal branches superficial temporal and maxillary and some branches of the superficial temporal artery.

Retromandibular vein lies superficial to the artery. It is formed by union of maxillary and superficial temporal veins.

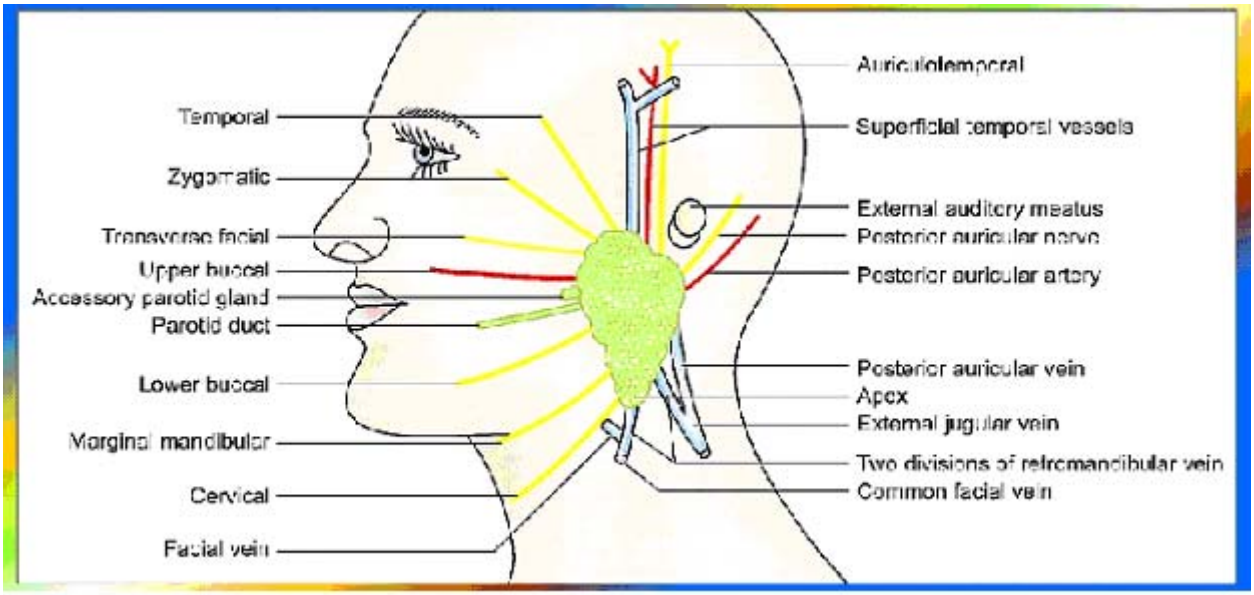


Facial nerve and its five terminal branches lie superficial to the vein. These divide the gland into superficial and deep parts.
Parotid group of lymph nodes lie within the fascial capsule and in the substance of the gland.

Structures seen emerging from parotid gland:

Upper end: Auriculotemporal nerve and superficial temporal vessels.

Convex anterior border: From above downwards these are temporal branch, zygomatic branch, transverse facial vessels, upper buccal branch, parotid duct, lower buccal branch, mandibular branch.



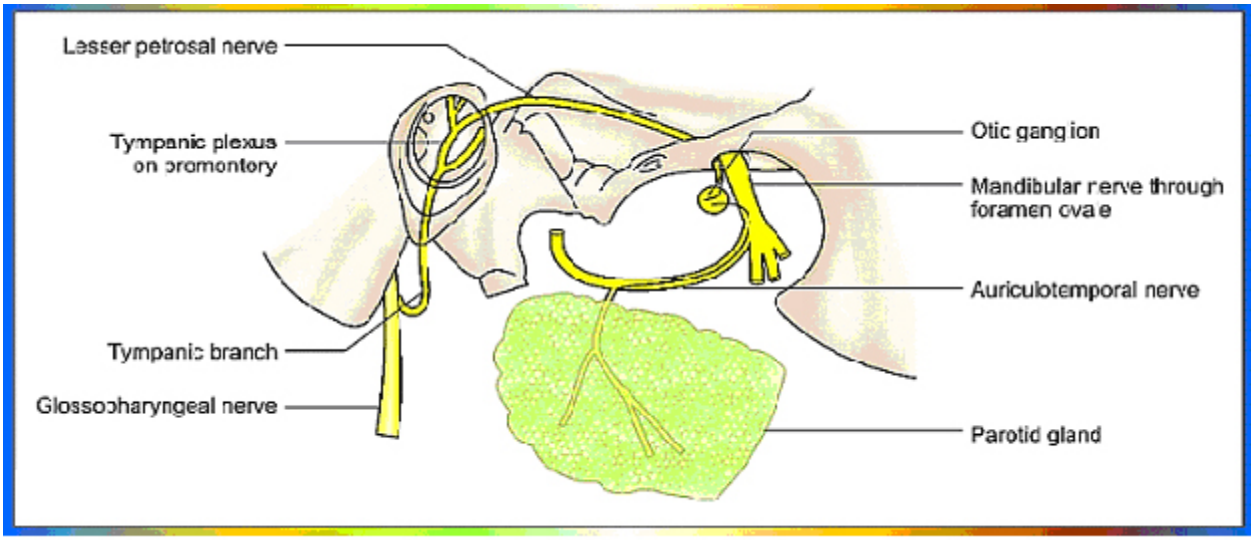
Lower end: Cervical branch, anterior division of retromandibular vein.
Posterior border: Posterior auricular nerve and vessels in the upper part and posterior divisions of retromandibular vein in its lower part.
Parotid duct – It begins near the anterior border of the gland. A small accessory lobe is usually attached above the duct. The duct crosses the upper border of masseter and lies one cm above the zygomatic arch. It pierces the following structures:
Buccal pad of fat,
Buccopharyngeal fascia,
Buccinator muscle,
Mucous membrane of the cheek.
It opens into the vestibule of the mouth opposite the second upper molar tooth.

Blood Supply
The arterial supply is from external carotid, superficial temporal and maxillary arteries as all these arteries are embedded in its substance. The venous drainage is into the retromandibular vein.

Lymph drainage: The lymph drains into parotid group of lymph nodes and thence into the upper group of deep cervical lymph nodes.

Nerve supply sensory: Auriulotemporal nerve
Sympathetic: Plexus around middle meningeal artery.
Secretomotor: Preganglionic fibres begin from inferior salivatory nucleus — IX nerve — tympanic branch — tympanic plexus — lesser petrosal nerve — otic ganglion — relay —

auriculotemporal nerve — parotid gland.



Development: A groove that appears in the ectoderm of the stomodeum becomes converted into a tunnel. From the blind end of the tunnel cells proliferate to form the gland. This gland is not divided into distinct lobes and lobules, and is an integral gland.

Clinical anatomy:
Parotid abscess is acute infection of parotid gland. For its drainage the incision should be horizontal, so that least damage is done to the branches of facial nerve which are emerging from its convex anterior border horizontally.
Mumps is a viral disease involving all the salivary glands. It may also cause orchitis. Mixed parotid tumour of the gland is common. It usually involves the superficial lobe.
Histology: Parotid gland is a predominantly serous salivary gland.

Describe the gross anatomy and nerve supply of submandibular and sublingual glands.

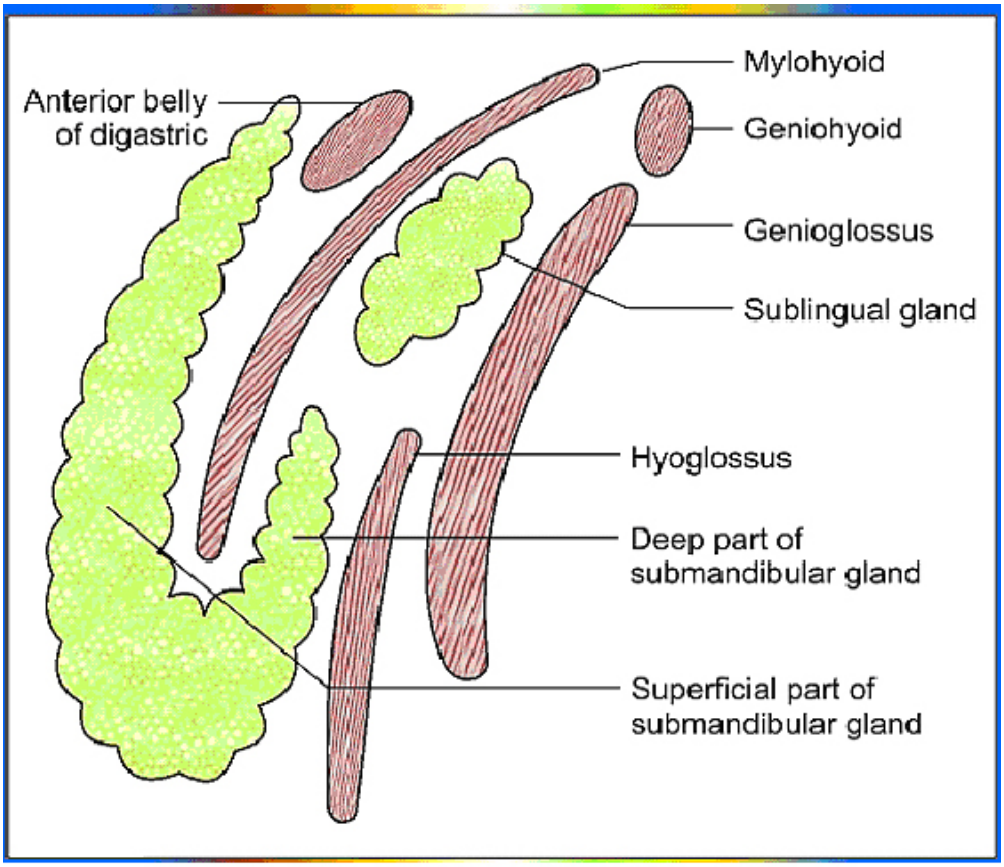
SUBMANDIBULAR SALIVARY GLAND

It is the second largest salivary gland in the body. It is a mixed type of gland. Acini are mostly serous with some being of mucus variety. Gland is enclosed by false capsule formed by cervical fascia and true capsule formed from the connective issue of the gland.

PARTS: The gland is divided by the posterior border of mylohyoid into:

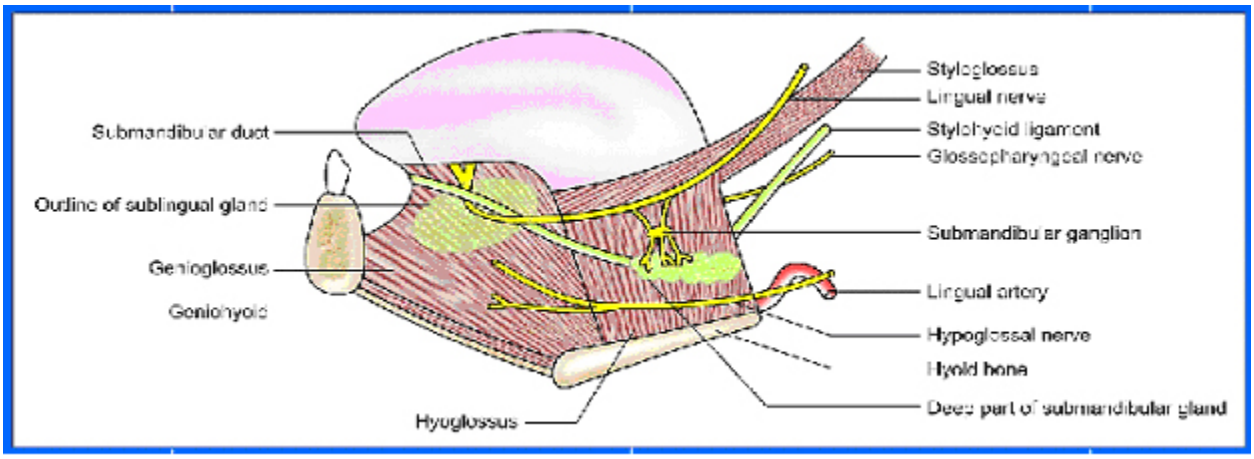
1 Superficial part–It is situated in the digastric triangle of the neck in the submandibular fossa of mandible. It has three surfaces:-

Inferolateral surface is superficial and covered by deep cervical fascia, platysma and skin. It is crossed by common facial vein.



Lateral surface is related to submandibular fossa of the mandible, medial pterygoid muscle and nerve to mylohyoid muscle.
Medial surface is related to mylohyoid, anterior and posterior bellies and intermediate tendon of digastric muscle and hypoglossal nerve.

11 Deep part:-Lies medial to mylohyoid on the superficial surface of hyoglossus muscle. Above the gland are styloglossus muscle, lingual nerve, submandibular ganglion. Below the gland are hypoglossal nerve and greater cornua of hyoid bone.



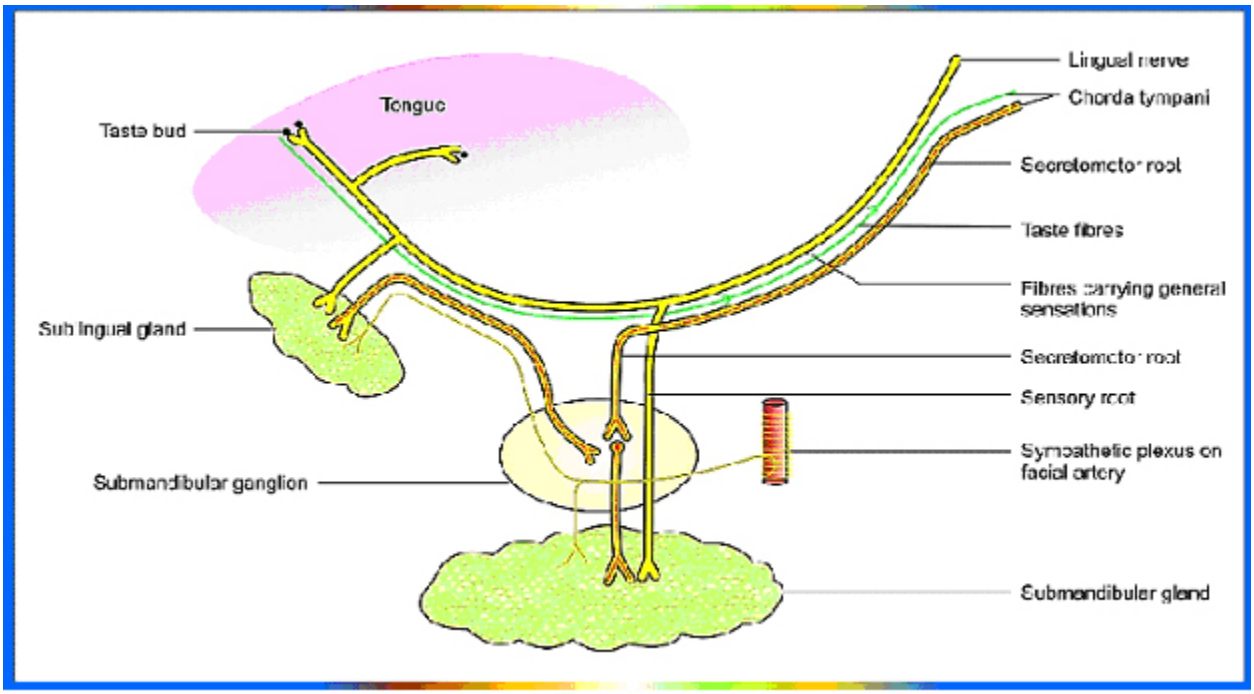
Submandibular duct: The duct begins from the deep part of the gland and passes superficial to hyoglossus muscle. It is about 5 cm long. It twists around lingual nerve, passes deep to sublingual salivary gland to open in the floor of mouth at medial end of sublingual fold.

Blood Supply: Glandular branches of facial artery supply the gland. Veins drain into the facial vein.

Lymphatic drainage: Lymph drains into the submandibular group of lymph nodes situated in the substance of the gland and thence into the deep cervical group of lymph nodes.

Nerve supply:
Sensory nerves are from the lingual nerve.
Sympathetic nerves are from sympathetic plexus around the facial artery.
Secretomotor fibres are from superior salivatory nucleus -Nervus intermedius —facial —chorda tympani — joins lingual nerve — submandibular ganglion — relay — both parts of the gland.

SUBLINGUAL SALIVARY GLAND



It is the smallest salivary gland. It is predominantly mucus in nature with a few serous acini as serous demilunes. The gland comfortably occupies the sublingual fossa of the mandible above the mylohyoid muscle.

The gland lies lateral to genioglosssus and causes the sublingual fold in the floor of the mouth. The duct of submandibular gland and lingual nerve twisting around each other pass deep to the gland.

Blood supply: Arterial supply is from sublingual branch of lingual artery. Veins drain into the lingual vein.

Lymphatic drainage: Into the submandibular group of lymph nodes.

Nerve supply: Sensory-lingual nerve.

Sympathetic: Plexus around facial artery.

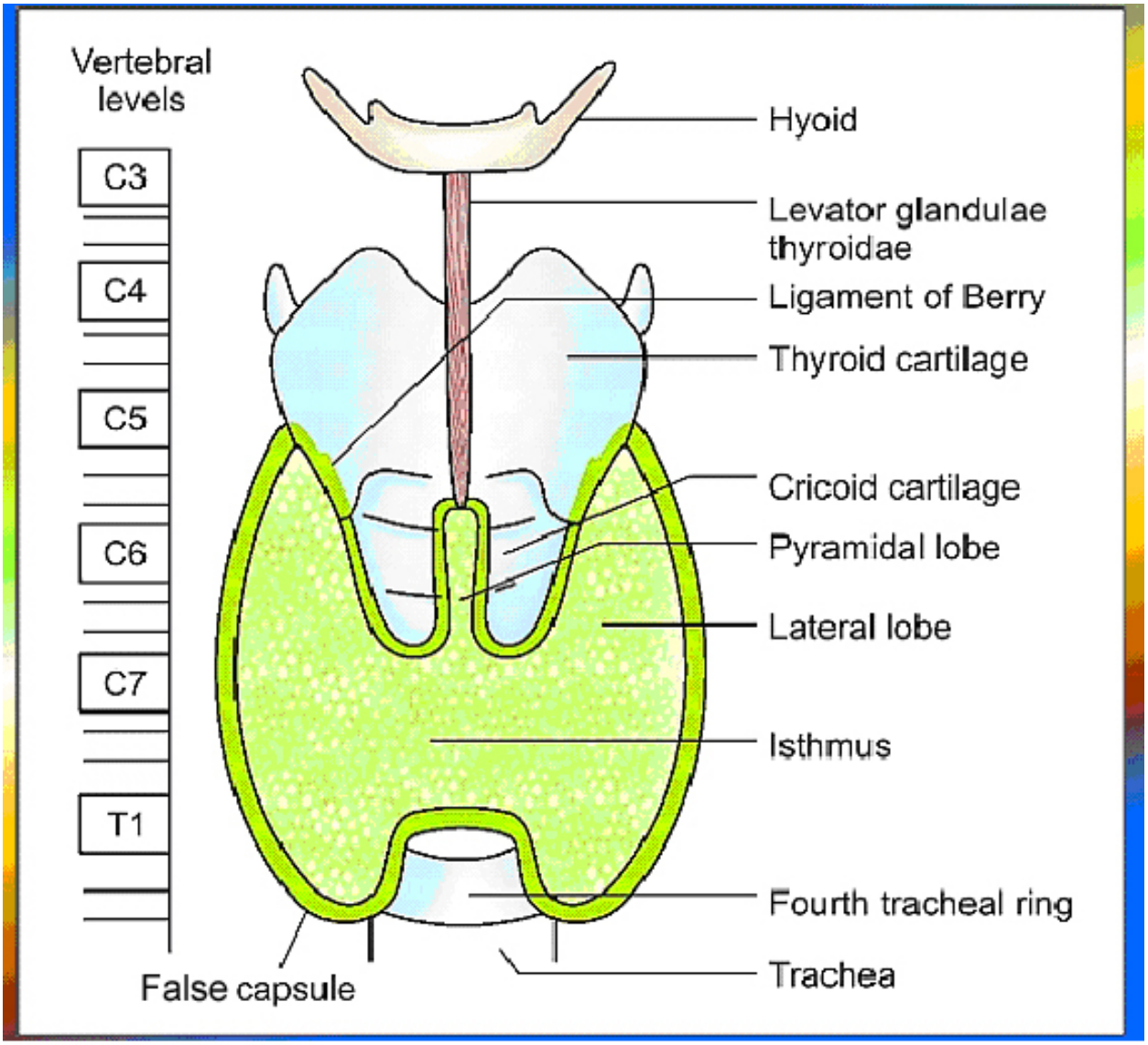
Secretomotor: postganglionic fibres from submandibular ganglion join back into lingual nerve and supply the gland.

Describe the gross anatomy and clinical anatomy of thyroid gland.

THYROID GLAND

The thyroid gland acts like a shield for trachea. It is situated in the lower part of front and sides of neck. It consists of two lobes joined by a isthmus. Sometimes the third lobe or pyramidal lobe may project upwards from isthmus.

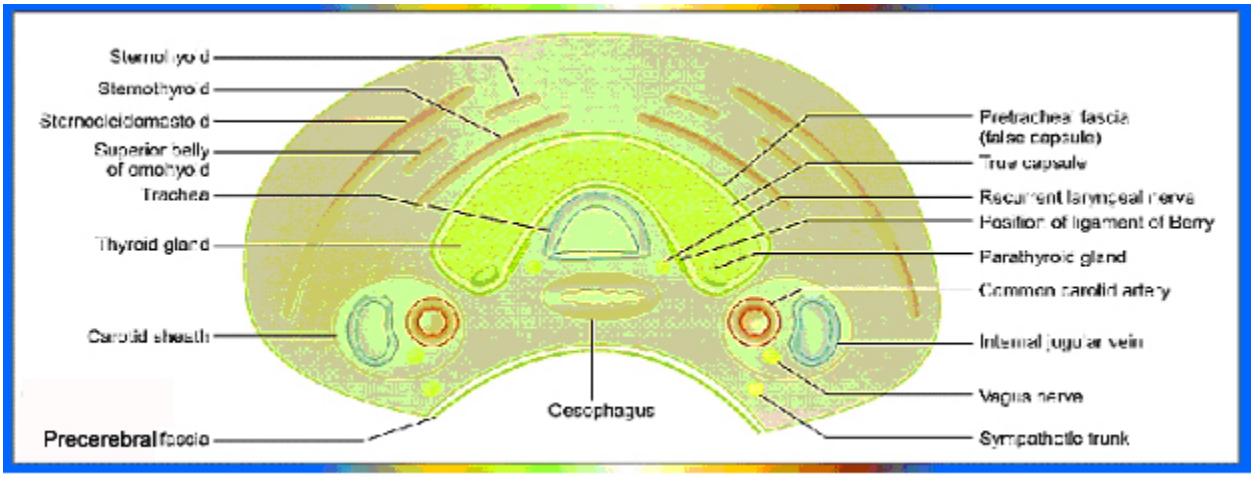
The gland lies opposite cervical 5,6,7 and thoracic one vertebrae. Isthmus, 1.2 cm x 1.2 cm embraces the 2nd and 3rd tracheal rings. Each lobe 5 cm x 2.5 cm extends from middle of thyroid cartilage to 5th tracheal ring.



Capsules: False capsule is thickening of pretracheal fascia which also suspends the gland by ligaments of Berry. True capsule is the condensation to the connective tissue of the gland. The capillary plexus is situated deep to the true capsule of the gland.

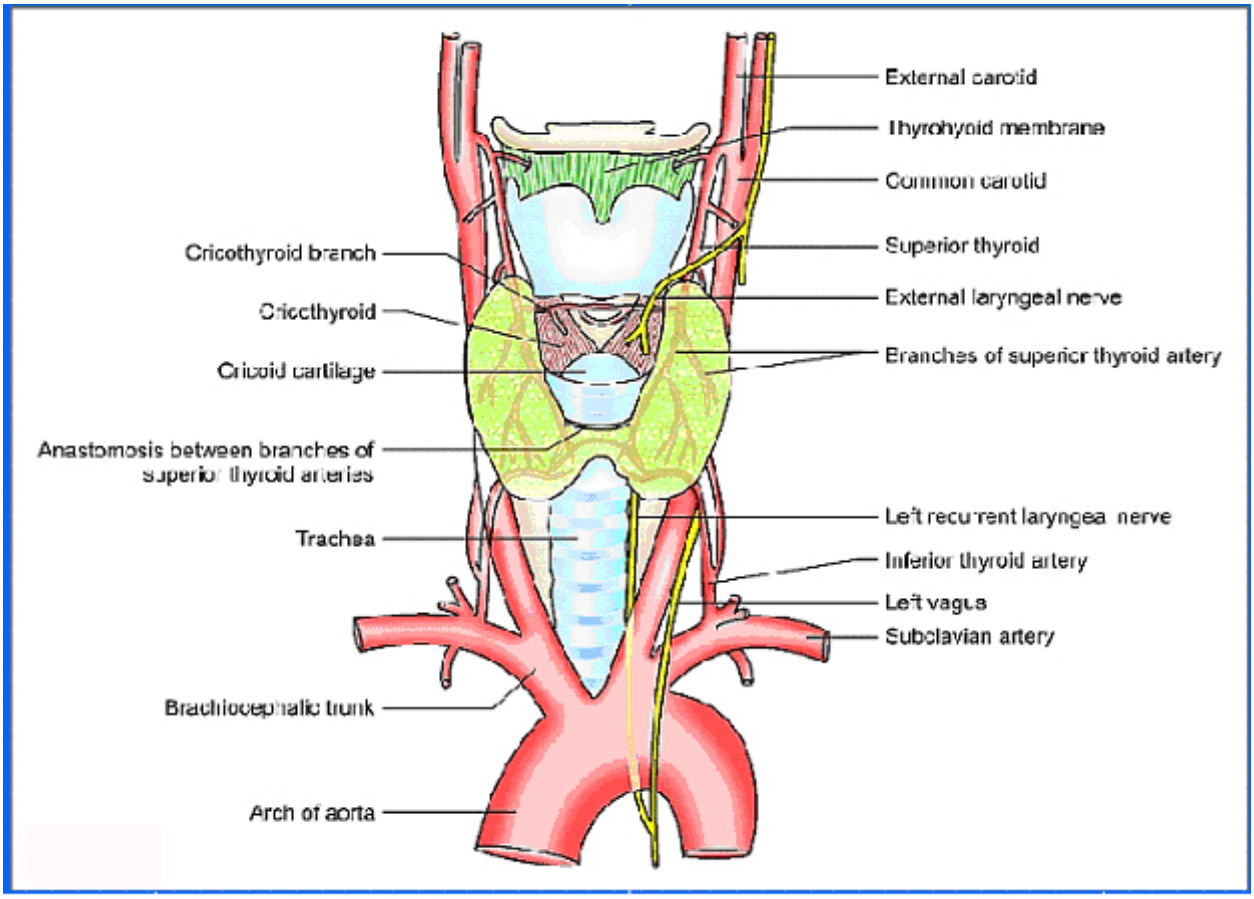
Relations:-

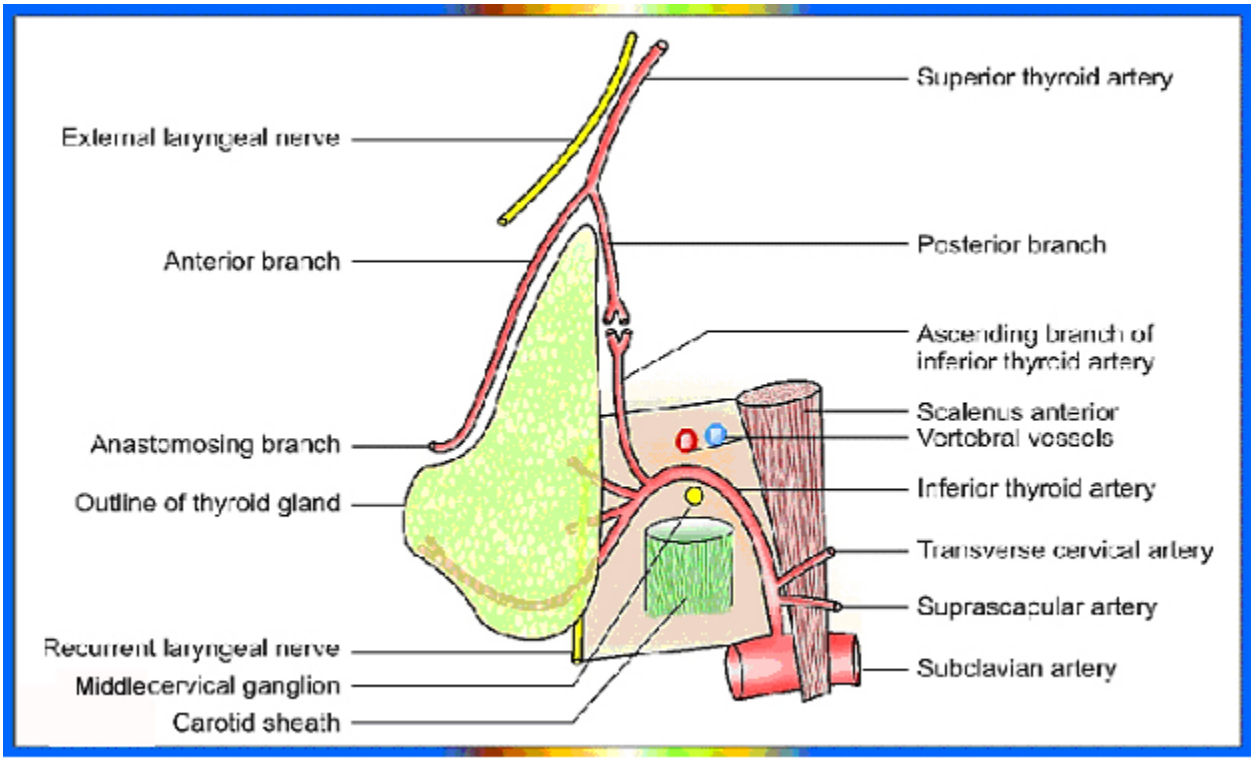
Isthmus	Ant surface: Sternothyroid, sternohyoid, omohyoid muscles, fascia, skin. Post surface: 2nd and 3rd tracheal rings.Upper border: Anastomosis between anterior branches of superior thyroid arteries of right and left sides.Inferior border: Inferior thyroid veins.
Lobes	Apex: Situated upwards and laterally till the oblique line of thyroid cartilage.Base: Till 4th or 5th tracheal ring.
The surfaces of the lobes	Lateral: Sternocleidomastoid, sternohyoid, superior belly of omohyoid, sternothyroid.Medial: Trachea, oesophagus, cricothyroid with external laryngeal nerve, inferior constrictor with recurrent laryngeal nerve.Posterior: Carotid sheath.
The borders of the lobes	Anterior: Thin, related to anterior branch of superior thyroid artery Posterior: Inferior thyroid artery, anastomosis between superior and inferior thyroid arteries; parathyroid glands and thoracic duct (on left side only)



Arterial Supply: Two arteries are present on each side. The third one is occasionally present. It is the first branch of external carotid artery. It runs downwards intimately related to external laryngeal nerve.

Superior thyroid artery: It gives branches to neighbouring muscles, pierces pretracheal fascia to reach upper pole of the lobe, where it terminates into anterior and posterior branches. The latter anastomoses with ascending branch of inferior thyroid artery. The anterior branch runs along anterior border of the lobe and upper border of isthmus to anastomose with the similar artery of the opposite side.


External carotid
Thyrohyoid membrane
Common carotid
Cricothyroid branch
Superior thyroid
Cricothyroid
External laryngeal nerve
Cricoid cartilage
Branches of superior thyroid artery
Anastomosis between branches of superior thyroid arteries
Left recurrent laryngeal nerve
Trachea
Inferior thyroid artery
Left vagus
Subclavian artery
Brachiocephalic trunk
Arch of aorta



Inferior thyroid artery: It is branch of thyrocervical trunk which is a branch of 1st part of subclavian artery. The inferior thyroid artery runs first upwards, then medially, and finally downwards till the lower pole of thyroid gland. Near the lower pole it divides into 4-5 branches which individually pierce the pretracheal fascia to reach the lower pole of the gland. One of its branch, the ascending branch runs up to anastomose with the posterior branch of superior thyroid artery and supplies both the parathyroid glands. Its branches are related to recurrent laryngeal nerve which of course is always behind pretracheal fascia.
Thyroidea ima artery: It is a single artery present in 3% subjects. It arises from brachiocephalic trunk or arch of aorta to reach the isthmus of the gland.

Venous drainage:
Three veins are present on each side. These are:
Superior thyroid vein: Accompanies the superior thyroid artery and drains into internal jugular vein.
Middle thyroid vein: It is unaccompanied by any artery. It is a short wide vein emerging from the middle of the lobe and drains in the internal jugular vein.
Inferior thyroid vein: Emerges at the lower border of isthmus and drain into left brachiocephalic vein.

Clinical anatomy:
Since pretracheal fascia enclosing the thyroid gland is attached to the thyroid and cricoid

cartilages, any swelling of the thyroid gland moves with act of deglutition or swallowing.
The external laryngeal nerve is intimately related to superior thyroid artery. To protect the nerve during the thyroidectomy, artery is ligated with the apex of the lobe of the gland.

The recurrent laryngeal nerve is related to the branches of inferior thyroid artery while it is close to the gland. So the artery is ligated little away from the gland during thyroid removal.
In partial or subtotal thyroidectomy, the posterior parts of both the lobes are retained behind, so that the parathyroid glands are also retained. The gland is removed with the true capsule to prevent capillary haemorrhage.

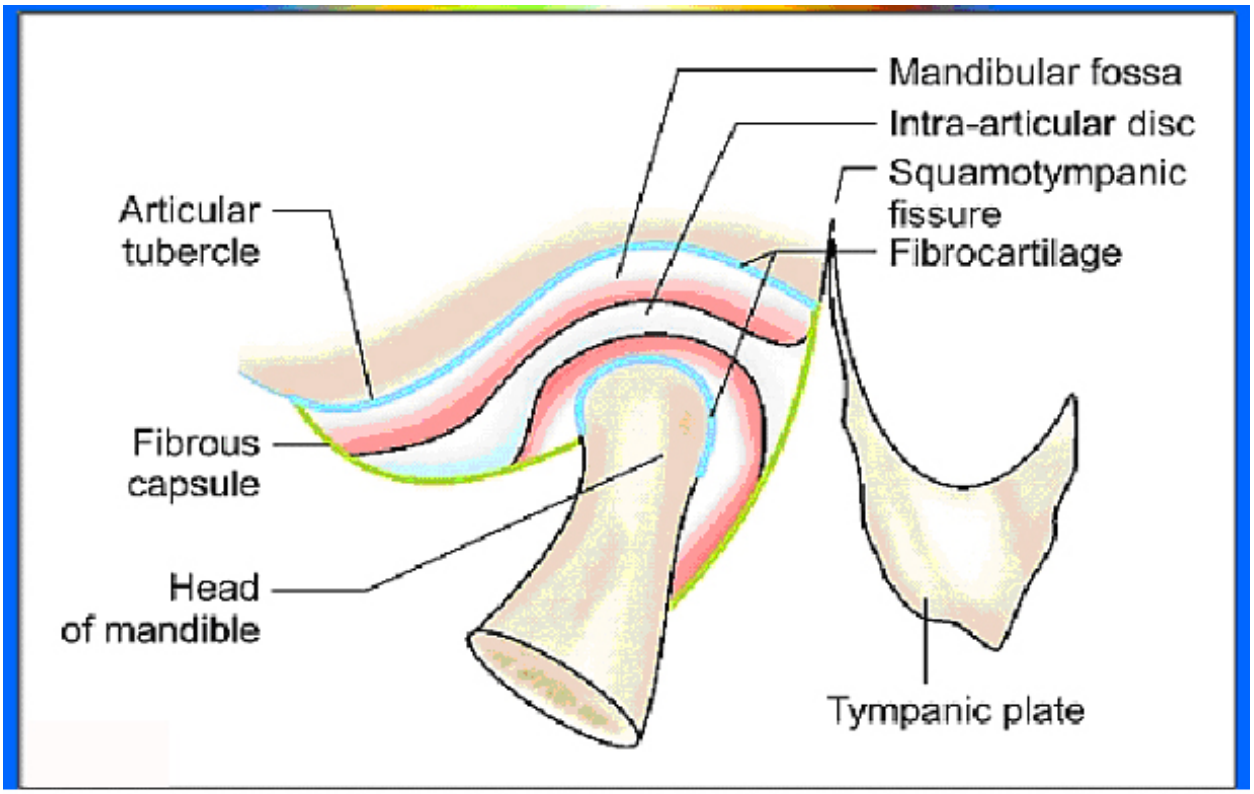
Benign tumours of thyroid causes pressure symptoms on the neighbouring structures. Malignant tumours cause pressure symptoms and even nerve paralyses.

Describe temporo - mandibular joint under headings of capsule, joint cavities, movements with their muscles.

TEMPOROMANDIBULAR JOINT

It is a synovial joint of bicondylar variety. The cavity is present between the head (condyle) of the mandible and the undersurface of the squamous part of the temporal bone i.e. the articular fossa and articular eminence. Both the temporomandibular joints are functionally one joint as movements in the two joints occur simultaneously. Both the articular surfaces are covered by fibro cartilages.

The joint is characterised by the presence of fibrocartilaginous articular disc.

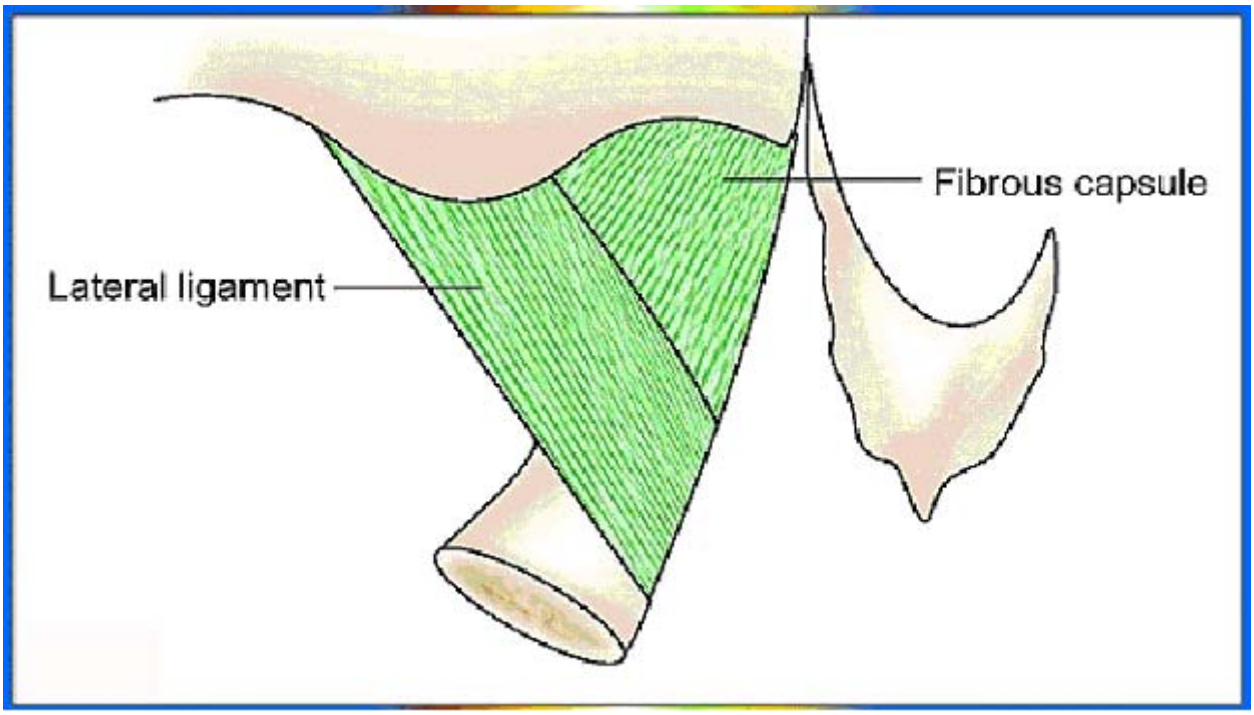


Capsule: Above it is attached to the margins of articular fossa and eminence and squamotympanic fissure. Below it is loosly attached to the mandible all around the articular surface of the head.

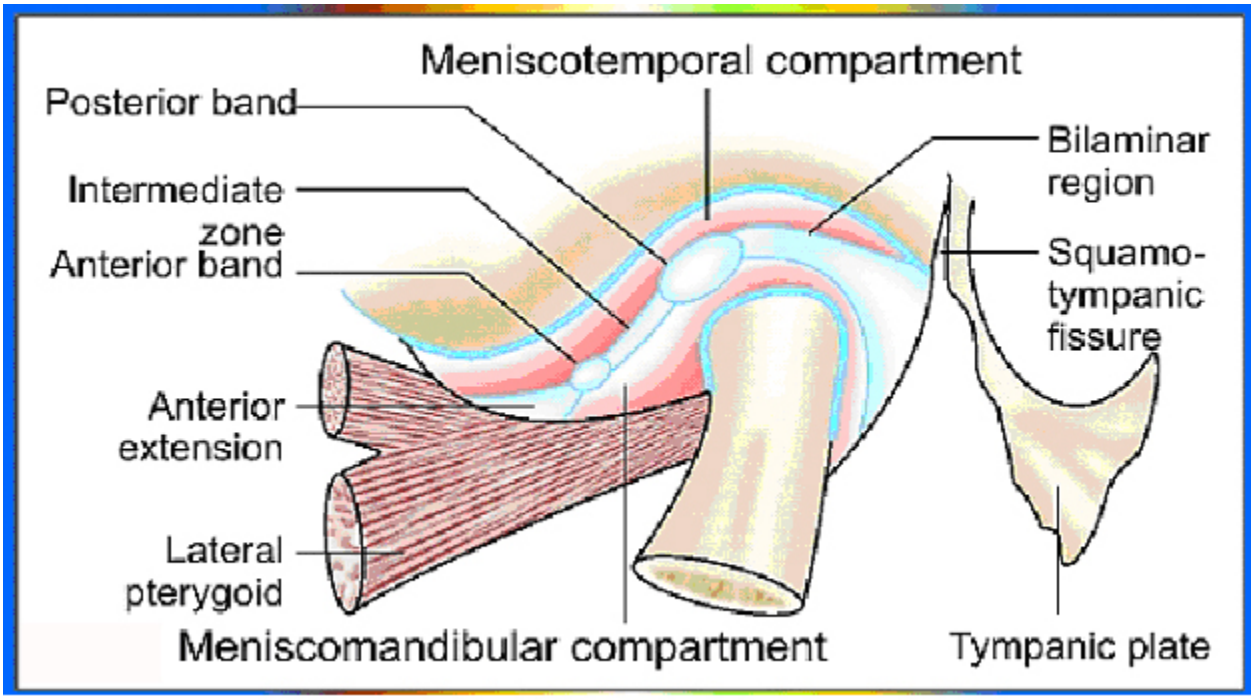
Ligaments:

Lateral temporomandibular ligament: It is attached above to the articular tubercle of the zygomatic arch. The fibres pass obliquely downwards and backwards to be attached to the

posterior border of neck of the mandible. It is true ligament of the joint.



Articular disc is a fibrocartilaginous disc that divides the cavity into two smaller cavities. It is attached all along its periphery to the inner surface of the articular capsule. The superior surface is concavo-convex for the articular fossa and eminence. Similarly its inferior surface is concave for the head of the mandible.



Anteriorly the disc is continuous with the tendon of lateral pterygoid muscle, of which it is the fibrosed part Posteriorly the disc divides into two laminae. The upper lamina is attached to the margin of mandibular fossa, the lower is attached to the neck of mandible, between the two is a pad of loose connective tissue with blood vessels and sensory nerves. The disc has two transverse thickened bands. The disc divides the joint cavity into an upper compartment which permits gliding movements, and a lower compartment which allows rotatory movements.
Sphenomandibular ligament lies between the spine of sphenoid to the lingula of the mandible. It is an accessory ligament of the joint.

Stylomandibular ligament extends between the apex and anterior surface of the styloid process to the angle of mandible. It is also an accessory ligament.

Arterial Supply: Branches of superficial temporal and maxillary arteries.
Nerve Supply: Auriculotemporal nerve and nerve to masseter muscle.

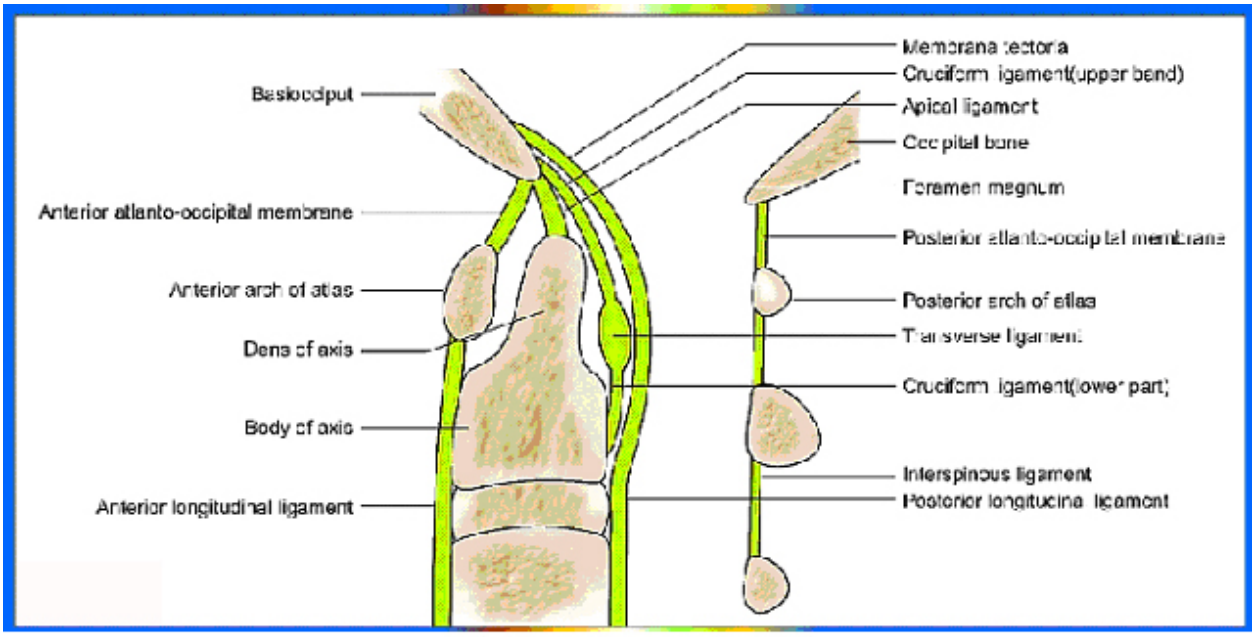
Movements: These are two joints which always act together, although they may be having different movements. These are depression, elevation protraction, retraction and side to side movements.

During depression or opening of the mouth, the mandibular head rotates around a horizontal axis in hinge like movement, occurring in the lower compartment between the inferior aspect of the disc and the head of the mandible, while gliding movement occurs in the upper compartment between the articular disc and the mandibular fossa of the temporal bone.

Muscle responsible for this movement are:
Mylohyoid, digastric, geniohyoid. Most important muscle is the lateral pterygoid which pulls the disc forwards and rotates the neck of the mandible. Its origin is anterior and little lower than its insertion. Infrahyoid muscles e.g. thyrohyoid, sternohyoid, omohyoid stabilise the hyoid one.
Elevation is done by temporalis, masseter and medial pterygoid. Their insertions are lower than the origins.
Protraction is done by the medial and lateral pterygoids of the two sides (4 muscles) acting together.
Retraction is done by the posterior fibres of temporalis.
Side to movement is made possible by the medial and lateral pterygoid of each side acting alternately.

Enumerate the ligaments connecting axis vertebra with occipital bone. Name the ligaments of atlanto-occipital and atlanto axial joints.

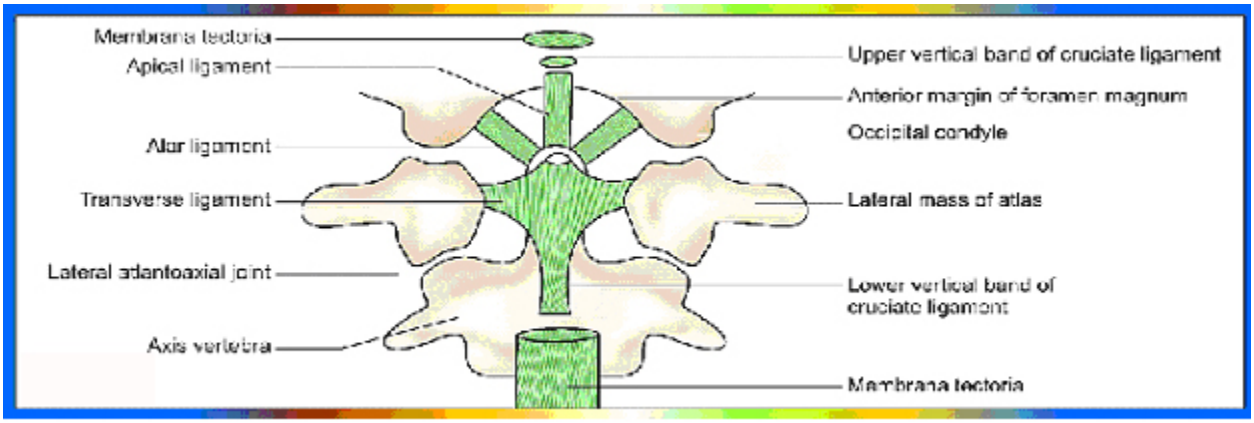
ATLANTO-OCCIPITAL JOINT
This is the joint between the occipital condyles and the superior articular facets of atlas vertebra.
Type: Condyloid variety of synovial joint.
Capsule- The articular capsule surrounds the joint all around. It is reinforced by membranes: Anterior atlanto- occipital membrane connects the anterior arch of atlas to the anterior margin of foramen magnum.



Posterior atlanto- occipital membrane spans between the posterior arch of atlas and posterior margin of foramen magnum. It also arches over the grooves for the vertebral arteries.

Movements: The movements occur at both the joints simultaneously. These are:
Flexion– Rectus capitis anterior and longus capitis. It is like saying 'yes'.
Extension– Upper part of trapezius of both sides, splenius capitis, rectus capitis posterior minor and major, obliquus capitis superior.
Lateral flexion– Rectus capitis lateralis, semispinalis capitis, sternocleidomastoid and upper part of trapezius of same side.

ATLANTO-AXIAL JOINTS
These are three joints: One median atlanto-axial and two lateral atlanto-axial joints.
Median atlanto axial joint is a pivot variety of synovial joint between the dens of axis as pivot and anterior arch of atlas and transverse ligament acting as ring.
Articular capsule is loose and is lined by synovial membrane.



Transverse ligament of atlas is a check band attached to the two medial tubercles on the medial aspects of lateral masses of atlas vertebra.
Lateral atlanto axial joints are two plane joints of synovial variety between the inferior articular facets of atlas and superior articular processes of axis vertebra.
The articular capsule is thin and is attached to the margins of articular surfaces.
Anterior longitudinal ligament extending between the body of axis and anterior arch of atlas acts as an accessory ligament.

Movements: These occur simultaneously at the three joints. There is rotation of atlas and skull on axis vertebra with dens acting as a pivot. It is like saying “No”.
The muscles responsible are obliquus capitis inferior, rectus capitis posterior major, splenius capitis of one side and sternocleidomastoid of opposite side.

Ligaments connecting axis and occipital bone.
These various ligaments are one membrana tectoria, two alar ligaments and median apical ligaments.

Membrana tectoria: It is the upward continuation of the posterior longitudinal ligaments. It is attached below to, posterior surface of body of axis and above to the basilar part of occipital bone.
Alar ligaments are attached to either side of dens of axis and rough surface on medial aspect of occipital condyle. Excessive rotation is checked by alar ligaments.
Median apical ligament of the dens extends from the basilar part of occipital bone to the tip of the dens. It is a remnant of the notchord.

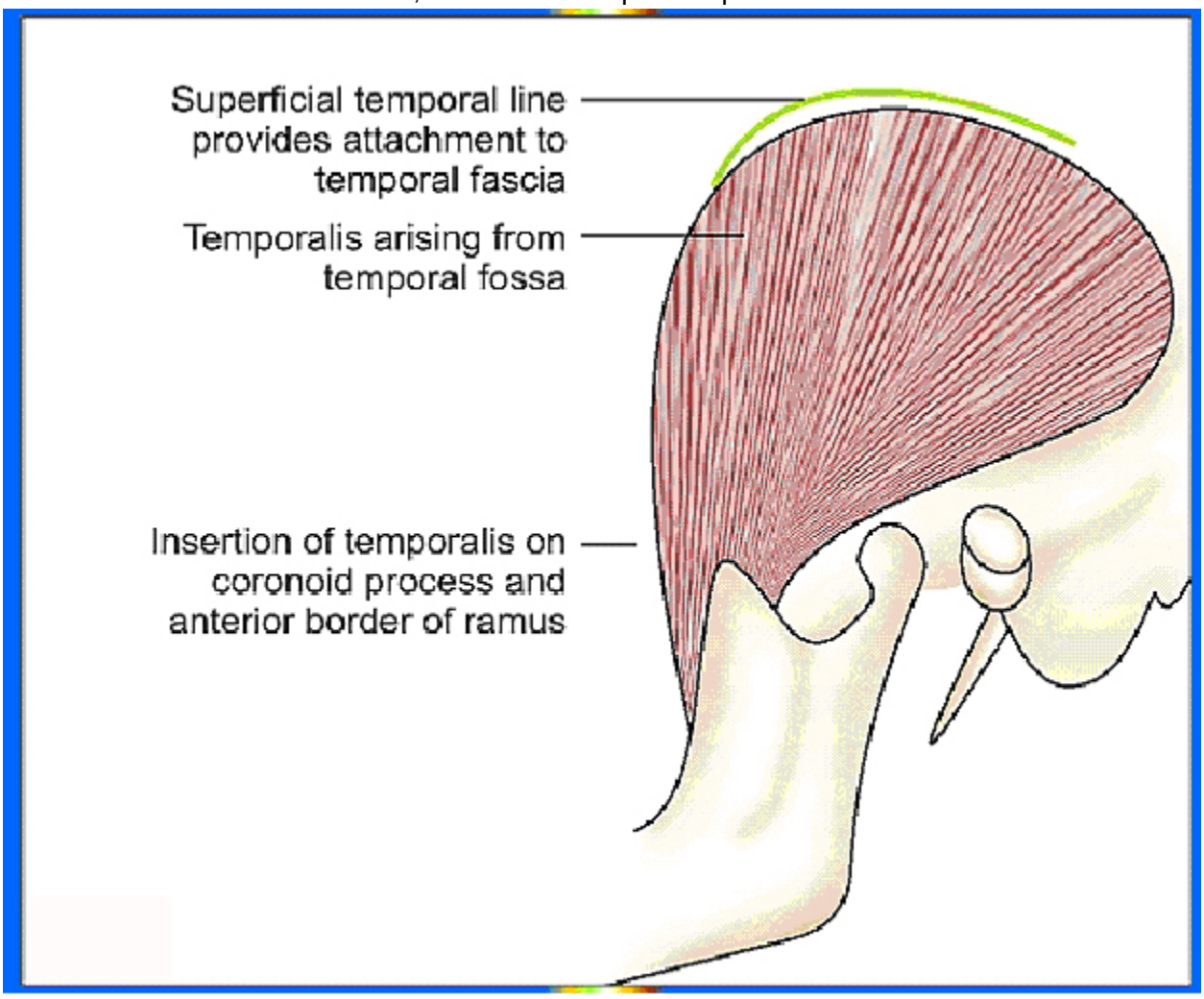
Give the attachments, and actions of muscles of mastication.

MUSCLES OF MASTICATION

The following are the muscles of mastication:

Temporalis

Origin – From temporal fossa below the inferior temporal line and deep surface of temporalis fascia. Anterior fibres are vertical, middle are oblique and posterior are horizontal.



Insertion – Fan shaped muscle is inserted into the posterior border, apex, anterior border of the coronoid process of mandible. It also extends along till the posterior end of the alveolar border.

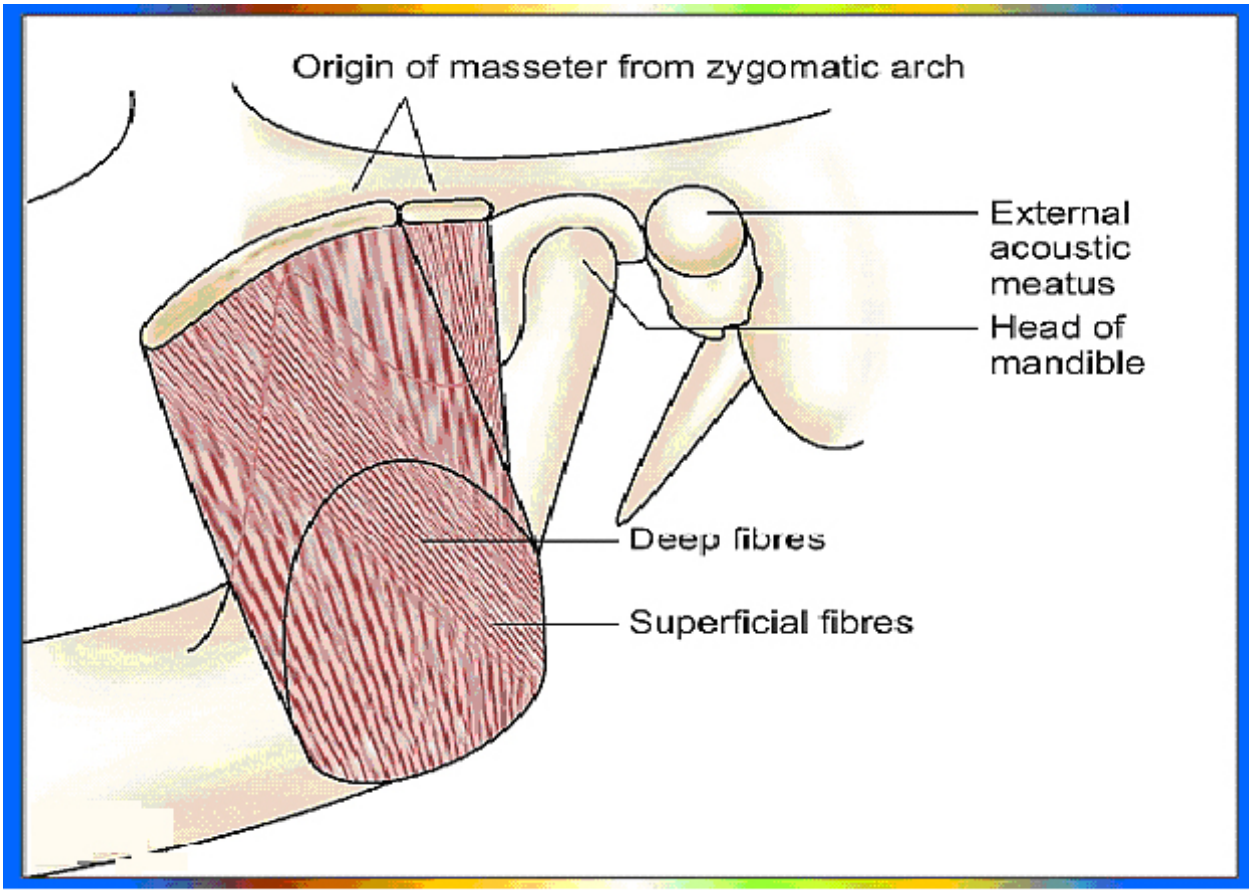
Blood supply – Branches of maxillary and superficial temporal arteries. Veins drain into maxillary and superficial temporal vein.

Nerve supply – Two branches from anterior division of mandibular nerve supply the muscle from its deep aspect.

Actions –Vertical fibres just elevate the mandible as the origin is higher than insertion. Posterior horizontal fibres retract actively the protracted mandible.
These fibres are arising posterior to their insertion which is anterior. Oblique help in both movements.

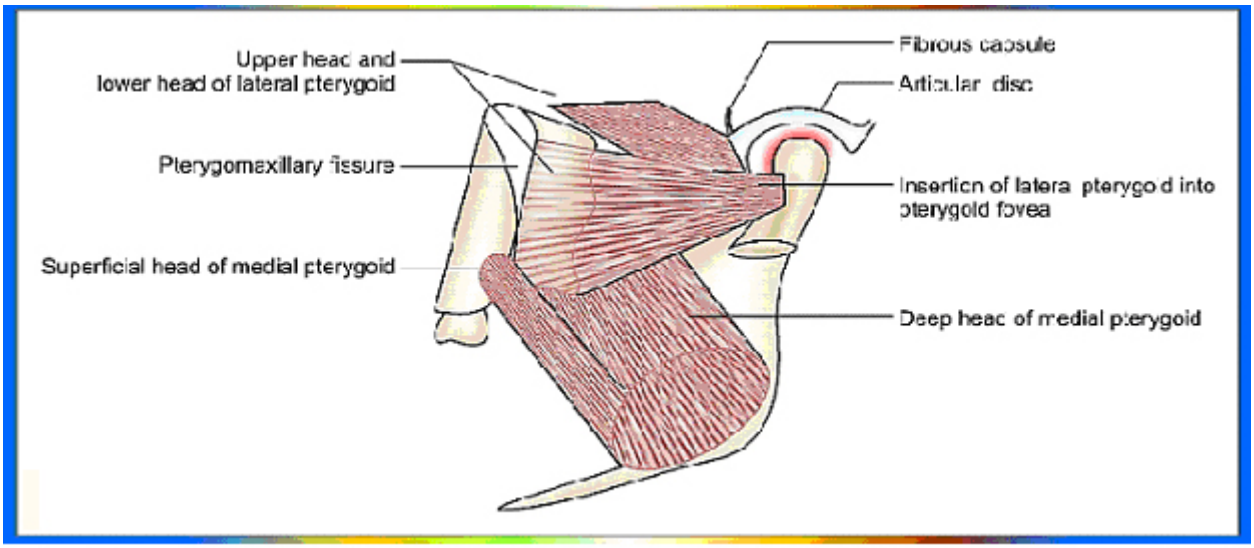
Masseter: Masseter is a quadrilateral origin muscle of mastication.

Origin: Superficial fibers from lower border of the zygomatic arch. Fibres pass downwards backwards.



Insertion: Into the lateral surface of ramus of mandible. Deep fibres arise from the deep surface of arch and are inserted vertically into upper border of ramus.
Nerve supply: From the anterior division of mandibular nerve. This nerve passes through the mandibular notch to enter the deep surface of the masseter.
Action: The muscle as a whole elevates the mandible. It also causes protraction of

temporomandibular joint.Deep fibres cause simple elevation.
Lateral Pterygoid- Origin: Lateral pterygoid arises by two heads, upper and lower. Upper head arises from roof of infratemporal fossa and lower head arises from lateral surface of lateral pterygoid plate.



Insertion: The two heads join to form a tendon which gets inserted into the front of neck of mandible. Fibres of upper head pass into the capsule to get attached to the concavo-convex articular disc.

Nerve Supply: From a branch of anterior division of mandibular nerve.

Actions: Since the origin is anterior to its insertion the muscle pulls the disc forwards due to gliding movements in upper compartment. It also causes rotatory movements in the lower compartment of TM joint. Both these movements are responsible for active opening of the mouth.It also causes protraction, chewing and side to side movements.

Medial pterygoid – Medial pterygoid comprises two heads.
The origin: The deep big head arises from the medial surface of lateral pterygoid plate. Its superficial smaller head takes origin from maxillary tuberosity. The two heads enclose the lower head of lateral pterygoid. Then it passes downwards and backwards.

Insertion: The muscle is inserted into the medial surface of angle of mandible.

Nerve supply: By a branch of the trunk of mandibular nerve. This nerve also gives a twig to the otic ganglion which passes unrelayed through the ganglion to supply tensor veli palatini medially

and tensor tympani laterally.

Actions: This muscle also elevates and protracts the mandible. It helps in chewing. It also causes side to side movement of TM joint along with lateral pterygoid muscle.

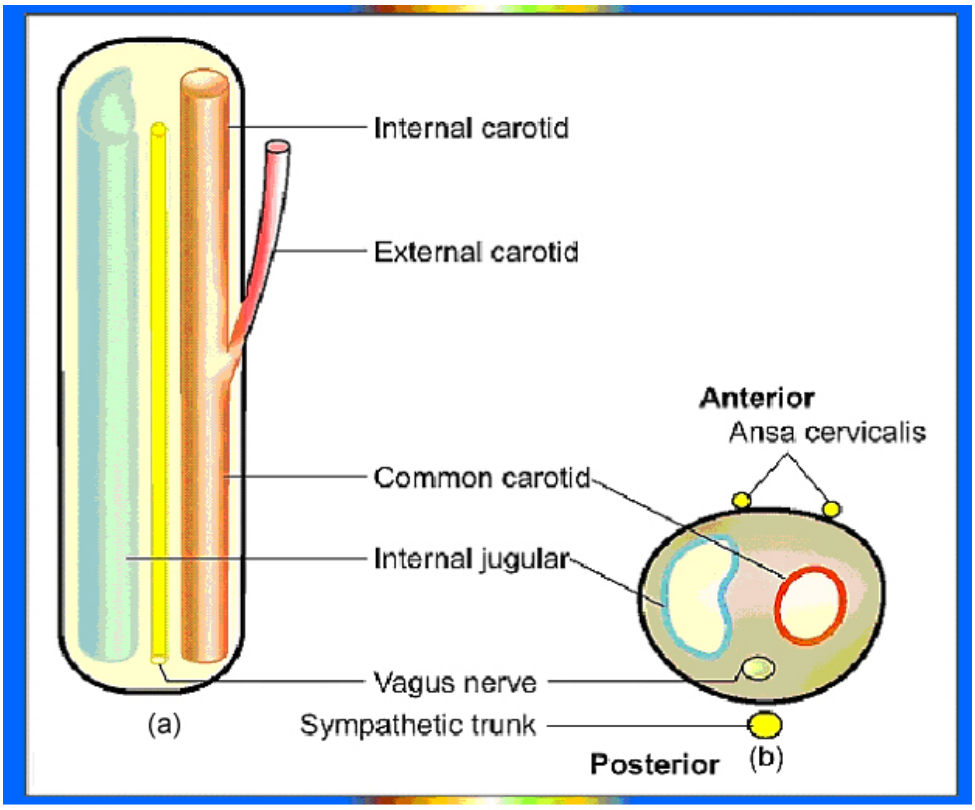
Describe the course and branches of internal carotid, subclavian and external carotid arteries.

INTERNAL CAROTID, SUBCLAVIAN AND EXTERNAL CAROTID ARTERIES

Internal carotid artery

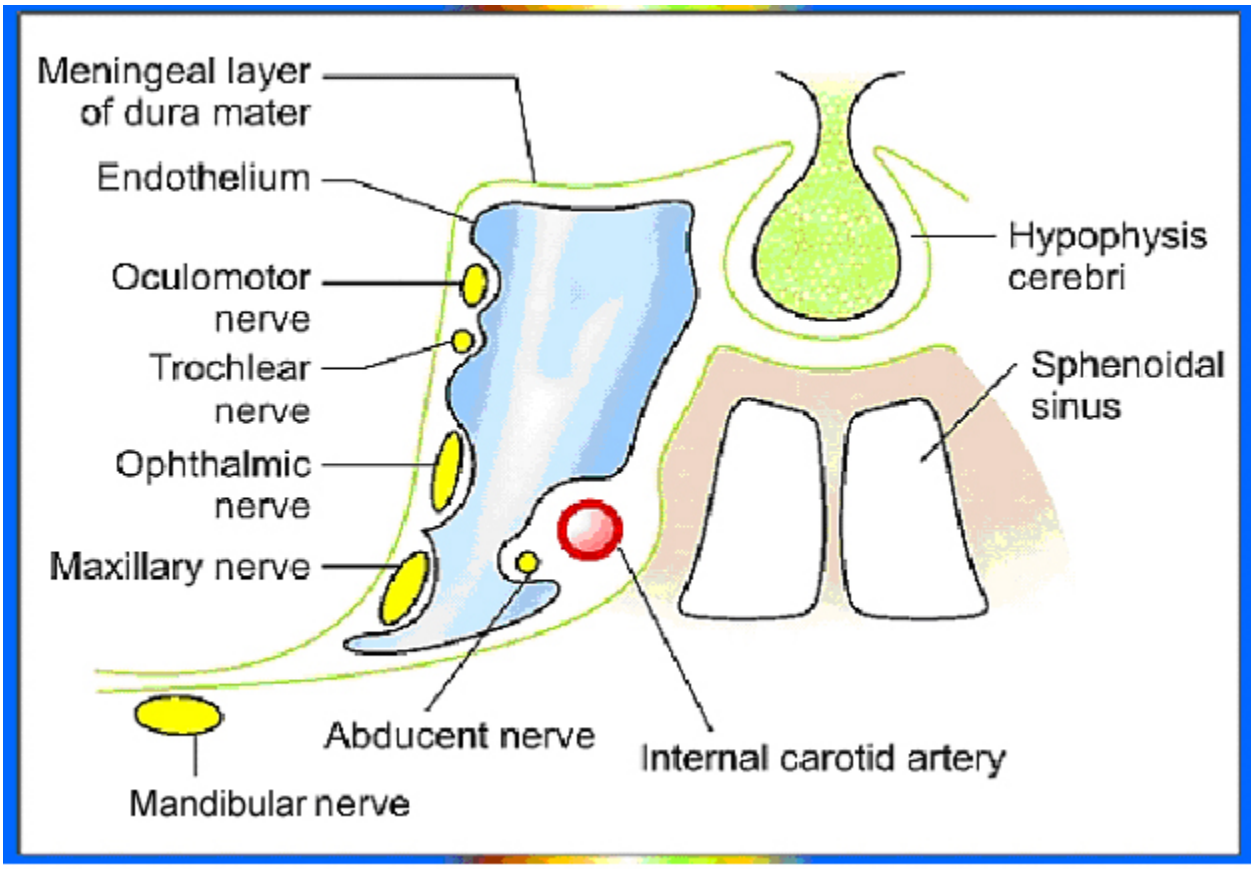
Internal carotid artery is a branch of common carotid artery given off at the level of upper border of thyroid cartilage. Its parts are:

Cervical part- From origin till base of skull. Gives no branch.

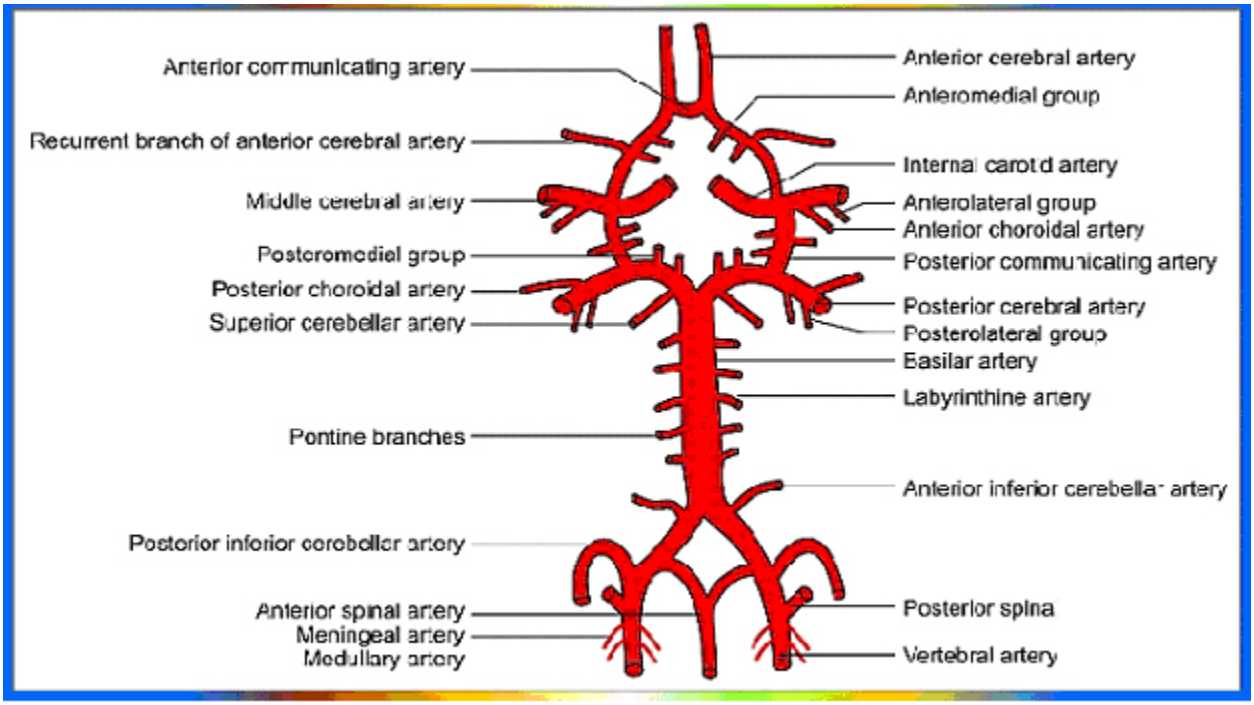


Petrous part-It passes through the carotid canal then it bends upwards above the cartilage of foramen lacerum to enter middle cranial fossa. It gives caroticotympanic branch for middle ear and pterygoid branch for pterygoid canal.

Cavernous part-It runs through the lower and medial part of cavernous sinus. It curves upwards to pierce the roof of cavernous sinus medial to anterior clinoid process. Its branches supply trigeminal ganglion and pituitary gland.

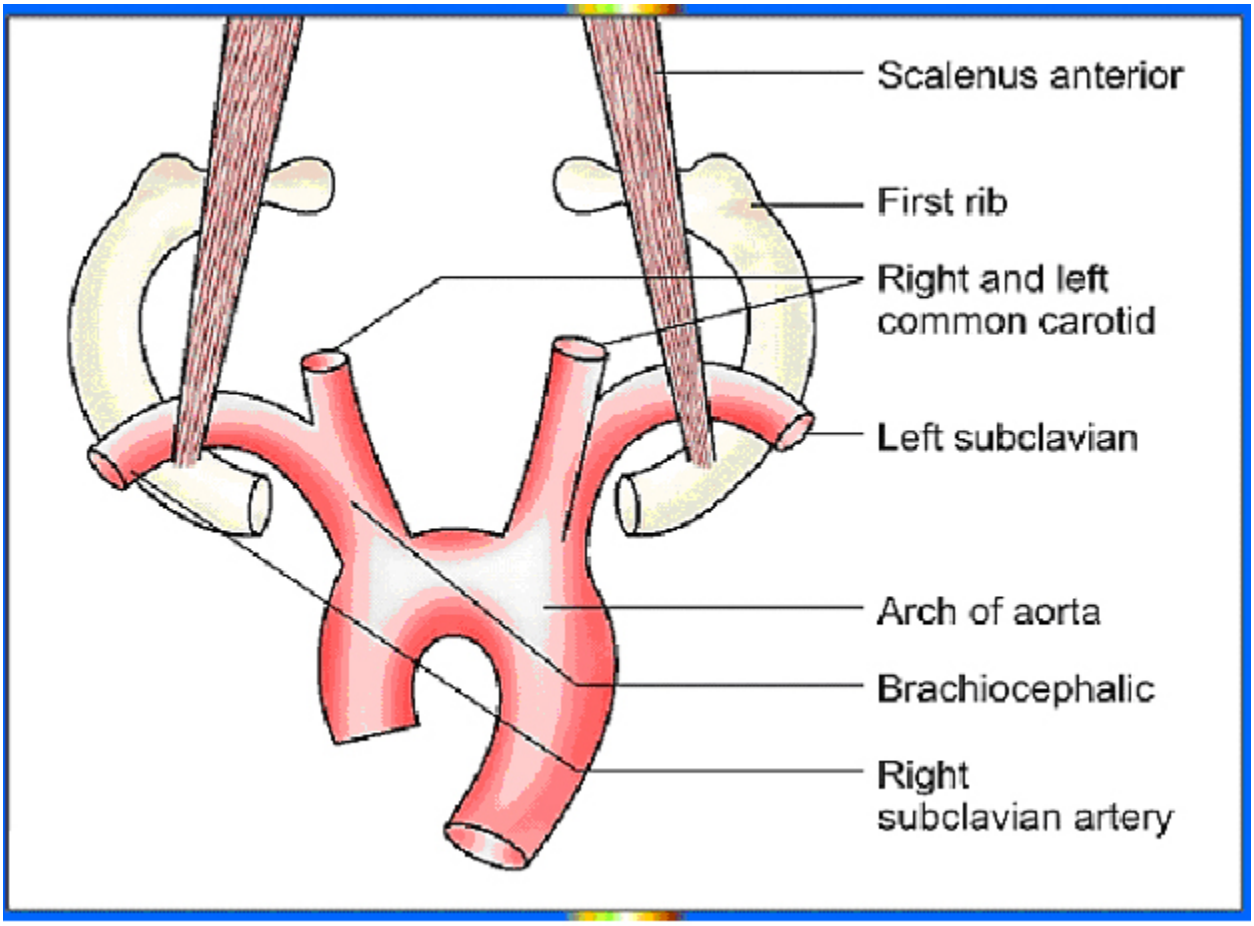


Cerebral part- As internal cartid artery leaves cavernous sinus, it gives ophthalmic artery. Then the artery runs backwards on the roof and ascends up to anterior perforated substance where it divides into its terminal branches, the anterior cerebral, middle cerebral, posterior communicating
and the anterior choroidal.

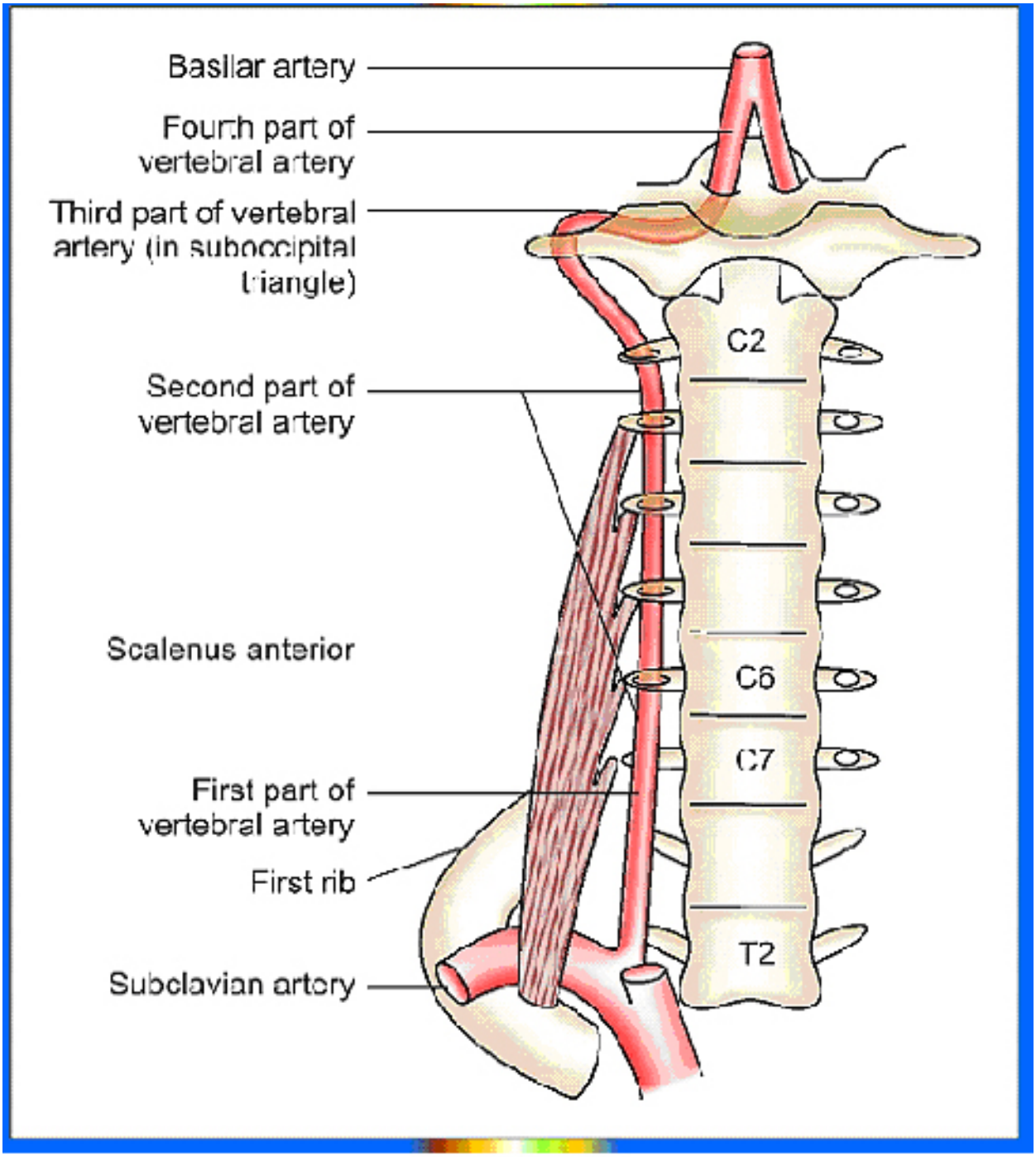


Subclavian artery

The subclavian artery is a branch of brachiocephalic trunk on the right side and a branch of arch of aorta on the left side. It is divided into 3 parts by scalenus anterior muscle which passes across the artery. 1st part is medial, 2nd is posterior and 3rd part is lateral to the muscle. The branches of 1st three parts are:



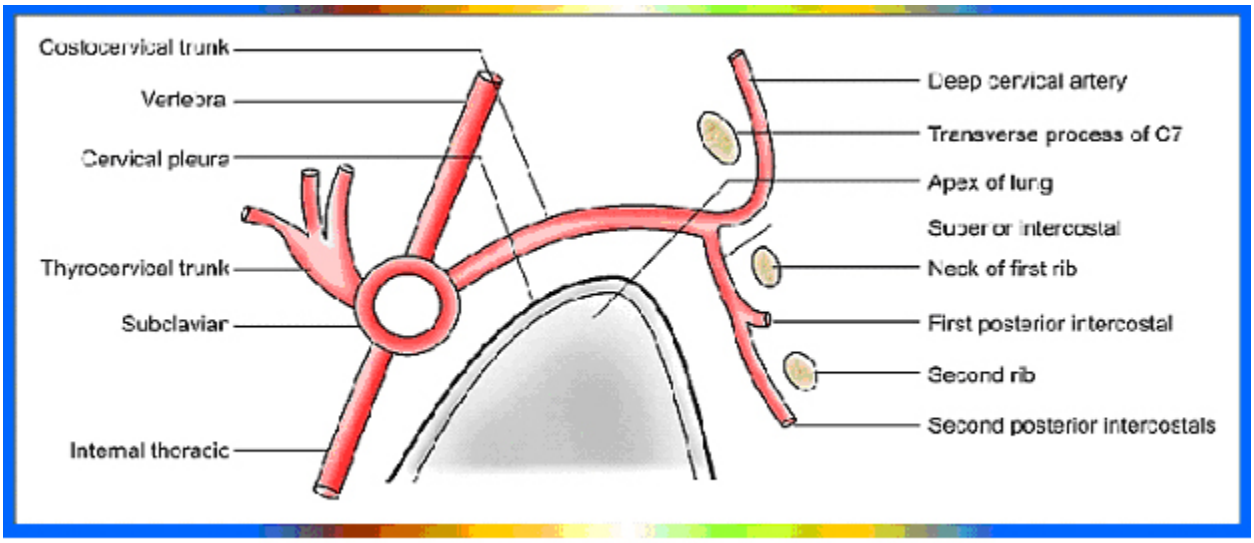
1st part-Vertebral with 4 parts -1st part in the neck, gives no branches



-2nd part in foramen tranversarium of 6th–1st cervical vertebrae.
-3rd part on the posterior arch of atlas
-4th part-enters the cranial cavity and gives meningeal, anterior `spinal, posterior spinal,

posterior inferior cerebellar and medullary branches.

Thyrocervical trunk i) Inferior thyroid gives muscular, glandular branches.



ii) Transverse cervical for muscles attached to scapula, divides into superficial and deep branches.

iii) Suprascapular for muscles attached to scapula.

Internal thoracic -For the anterior thoracic wall. Supplies intercostal branches to 1-6 anterior intercostal spaces.

2nd part-Costocervical It divides into:

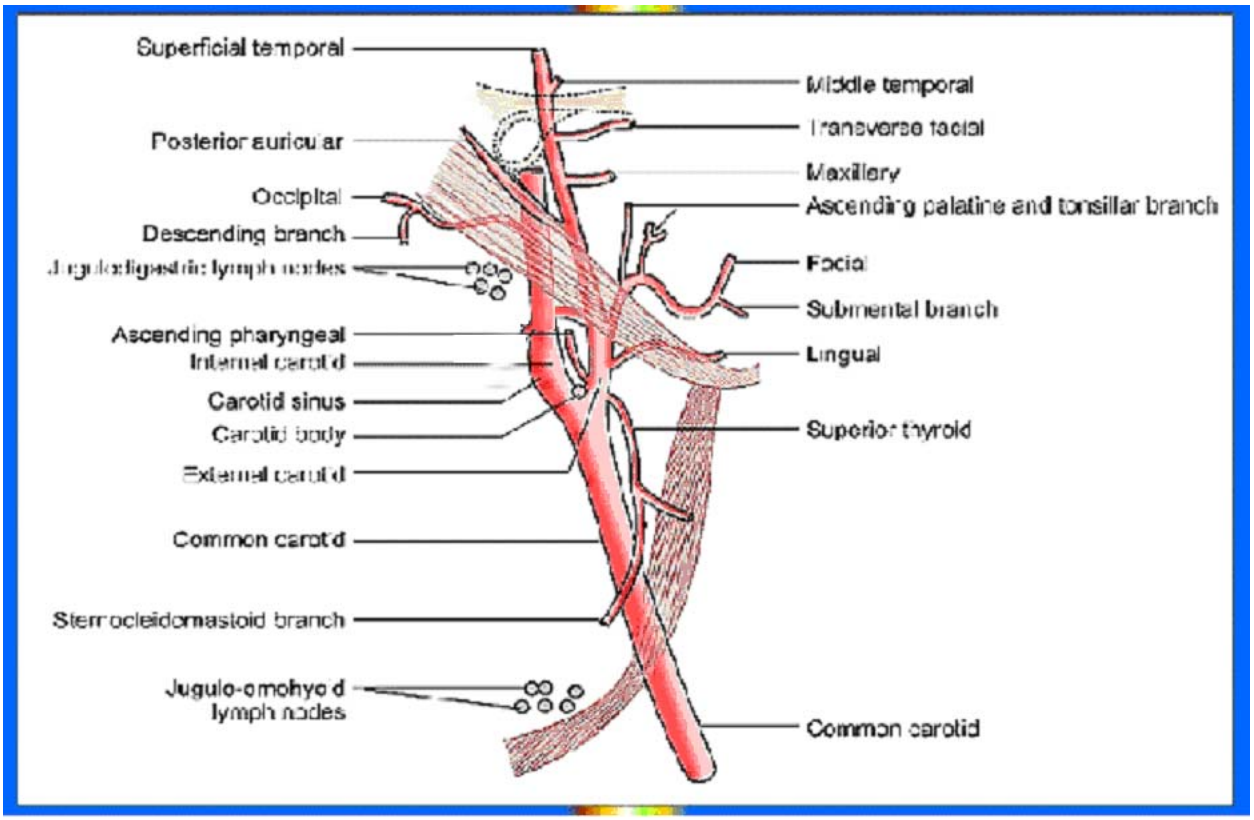
i) Superior intercostal for supplying 1st and 2nd posterior intercostal spaces.

ii) Deep cervical for muscles of back.

3rd part - It gives no branch. Occasionally it may give dorsal scapular, which replaces the deep branch of transverse cervical artery.

External Carotid Artery

It is one of the terminal branches of the common carotid artery. It supplies structures outside the skull in the upper part of neck. It ascends through the carotid triangle and then deep to posterior belly of digastric, finally courses through the substance of the parotid gland. Near the upper end of the gland, behind the neck of the mandible it divides into its two terminal branches i.e. maxillary and superficial temporal.



The branches of external carotid artery are:

Superior thyroid artery: It descends downwards and reaches the upper pole of thyroid gland. It gives:

Sternomastoid branch for the muscle.

Glandular branches-

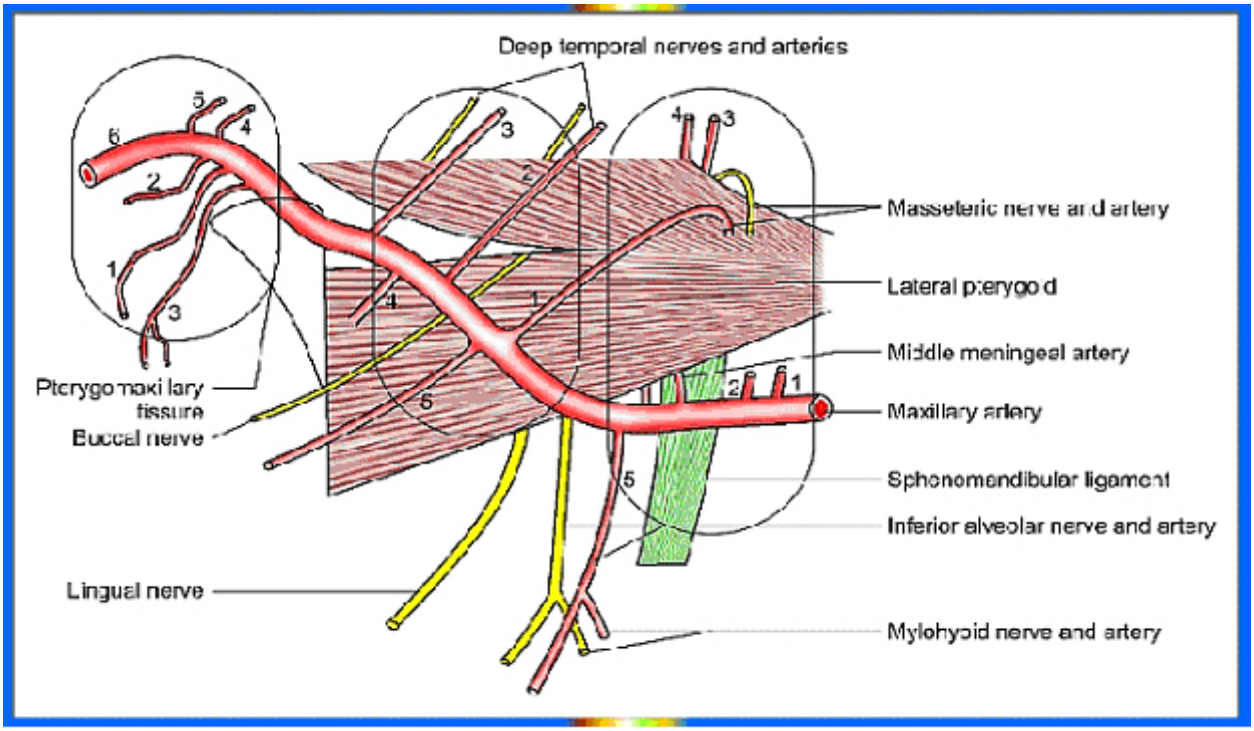
Occipital: It arises from the posterior aspect of external carotid artery. It passes along the lower border of posterior belly of digastric muscle, then in a groove on the medial surface of mastoid process, and reaches the back of scalp after piercing the trapezius muscle.

These are closely related to external laryngeal nerve. Just above the apex of the lateral lobe the glandular branches pierce the pretracheal fascia to reach the apex of the lateral lobe where it divides into anterior and posterior branches. The anterior branch descends along the anterior border of the lobe and then along upper border of isthmus to anastomose with fellow of opposite side. The posterior branch descends along the posterior border to anasotmose with ascending

branch of inferior thyroid artery along which the superior and inferior parathyroid glands are situated.

Superior laryngeal branch which passes through thyrohyoid membrane with internal laryngeal nerve to supply the larynx.

Its branches are: Two muscular branches to the sternocleidomastoid muscle and mastoid branch to supply the mastoid air cells and dura mater.



Ascending pharyngeal artery ascends in between the internal and external carotid arteries. Gives meningeal and tympanic branches.
Lingual artery is given off near the greater cornua of hyoid bone. It is tortuous to accommodate itself to the moving tongue. Its branches are:

Suprahyoid branch.
2-3 dorsal lingual branches for the supply of posterior part of tongue, tonsil and palate.
Profunda branch to supply the interior of tongue.

Facial artery: It arises opposite the angle of mandible. It ascends deep to Wmandible, grooving in the posterior end of submandibular salivary gland. Enters the face at the anteroinferior angle

of masseter where it is palpable.

Branches in the face are inferior labial, superior labial, lateral nasal and angular branches. Besides it gives small muscular and cutaneous branches.

Posterior auricular: It runs along the upper border of posterior belly of digastric muscle. As its name implies it gives branches to the auricle. In addition it gives a stylomastoid branch for the supply of middle ear.

Superficial temporal: It is one of the terminal branches of the external carotid artery. It crosses the zygomatic arch and ascends in the temporal region and the scalp. It branches are:
Transverse facial which lies along the lower border of zygomatic arch.
Zygomatico orbital passes along the upper border of zygomatic arch.
Auricular branches for the auricle.
Middle temporal lies in a groove on the side of skull after piercing the temporal fascia and temporalis muscle.
Superficial temporal ends by giving:
Frontal branch to supply scalp in the frontal region.
Temporal branch to supply various layers of the temporal region.
Maxillary artery is also one of the terminal branches of external carotid artery given off behind the neck of mandible. The artery passes forwards and medially. It is divided into 3 parts:
1st part extends from its origin to the lower border of lateral pterygoid muscle its branches are:
Anterior tympanic for the middle ear cavity.

Deep auricular
Middle meningeal for the supply of duramater, inner table of skull and diploe. Its anterior branches is likely to be injured at the point known as pterion.
Anterior superior alveolar for supply of incisor and canine teeth.
Accessory meningeal for the supply of meninges.

The second part crosses superficial to lower head of lateral pterygoid muscle. Its branches are:
Anterior and posterior deep temporal nerves for the supply of temporalis muscle.
Masseteric branch for the supply of masseter muscle.
Pterygoid branches for the supply of lateral and medial pterygoid muscles.
Buccal branch for the cheek muscles.

The third part enters the pterygo-maxillary fissure and lies within the pterygo-palatine fossa. It branches are

Posterior superior alveolar branches for supply of molar teeth,
Greater palatine branch for nasal cavity and hard palate,
Pharyngeal branch for pharynx via palatino-vaginal canal,
Sphenopalatine branch for lateral wall and septum of nose.
Infraorbital branch for incisor, canine and premolar teeth.
Artery to accompany nerve to pterygoid canal.

Enumerate branches of ophthalmic nerve, maxillary, mandibular nerves, and cervical plexus.

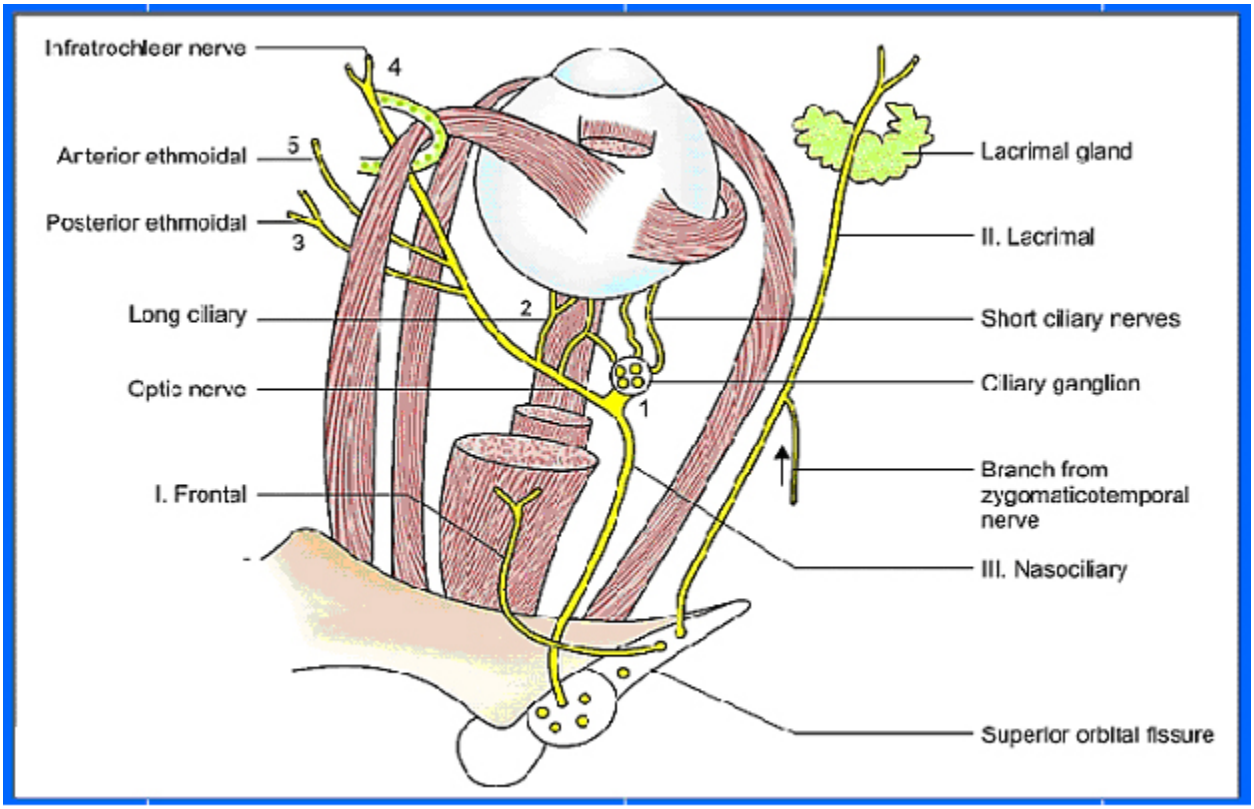
OPHTHALMIC, MAXILLARY, MANDIBULAR NERVES AND CERVICAL PLEXUS

Ophthalmic nerve is the smallest purely sensory division of the trigeminal nerve given off from the trigeminal ganglion. It runs in the lateral wall of cavernous sinus.
There, it picks up fibres from sympathetic plexus along the internal carotid artery.
At the anterior end of cavernous sinus it gives a meningeal branch for the dura mater of middle cranial fossa and divides into three branches:

Frontal: It gives supratrochlear for the conjunctiva, skin of upper eyelid (medial part) and skin of forehead.
Supraorbital which, passes through the supraorbital foramen and supplies the palpebral and ocular conjunctiva, skin of upper eyelid, frontal air sinus, and skin of the forehead till the vertex.
Nasociliary is sensory to anterior and middle ethmoidal air sinuses, eyeball, nasal cavity, skin of external nose and dilator pupillae through sympathetic fibres. It is placed between the two divisions of 3rd nerve as it passes through superior orbital fissure.

Branches -

Posterior ethmoidal for the mucous membrane of posterior ethmoidal and sphenoidal air sinuses.



Two or three ciliary branches carrying sensory fibres to the cornea and sympathetic fibres to the dilator pupillae muscle.

Branch to ciliary ganglion: Nasociliary nerve gives a communicating branch to the ganglion. Infratrochlear is smaller terminal branch of nasociliary. Supplies skin and conjunctiva of medial end of upper eyelid and bridge of the nose.

Anterior ethmoidal nerve-Supplies mucous membrane of middle and anterior ethmoidal air cells, mucous membrane of anterosuperior part of nasal wall and septum of nose. Lastly it comes out of the nasal cavity as external nasal nerve for the supply of ala, vestibule and tip of the nose.

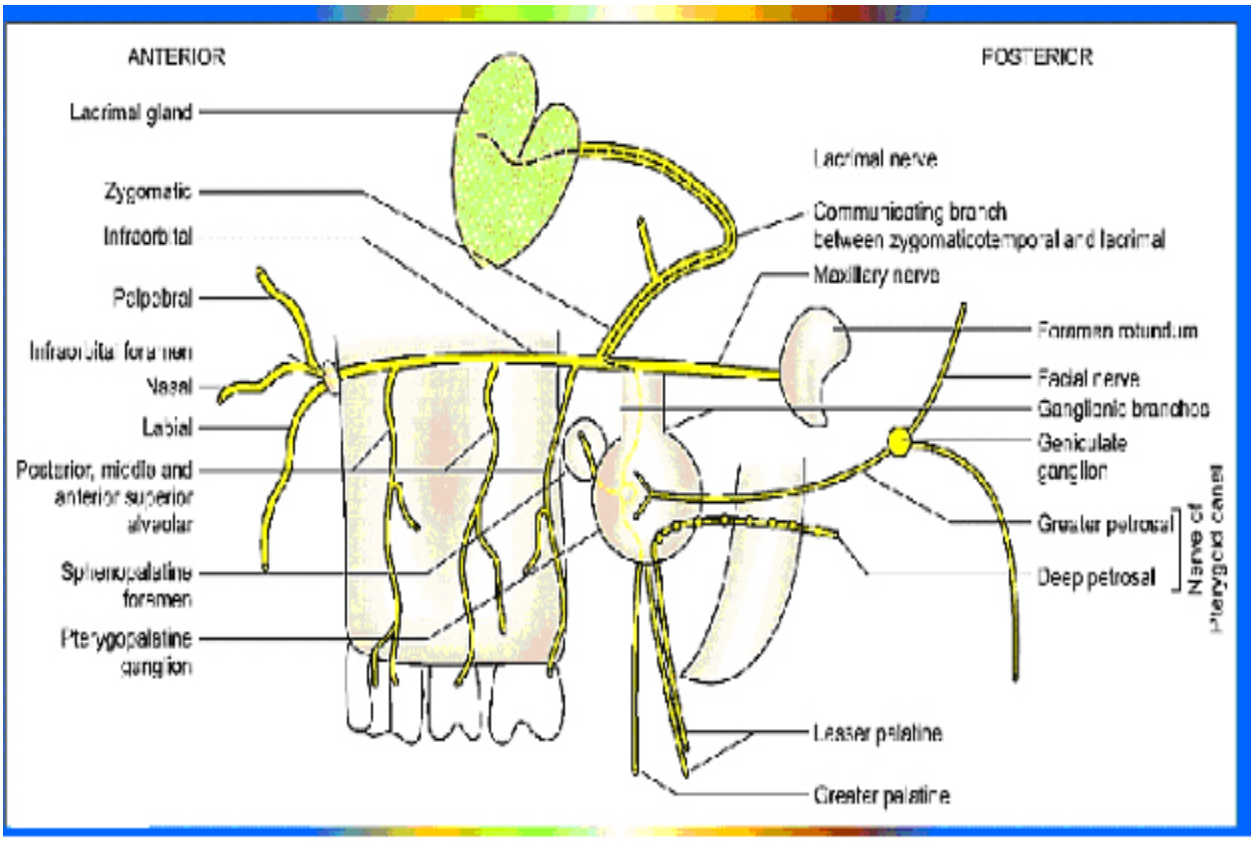
Lacrimal: It is the smallest branch of ophthalmic nerve. It supplies skin of lateral part of upper eyelid and the conjunctiva. The secretomotor fibres it picks up from zygomaticotemporal nerve are given off to the lacrimal gland.

Herpes zoster may affect any of three divisions of cranial nerve V. Spatial arrangement of face in spinal nucleus of V in brain stem with regard to pain sensation and is like "onion skin" pattern. Fibres from central area of face reach the cranial part of nucleus, from lateral area reach the caudal part of nucleus while fibres from lateral most area reach the caudalmost part of spinal nucleus.

MAXILLARY NERVE

It is called maxillary nerve as it is intimately related all around to the maxilla bone, supplying maxillary air sinus and all teeth attached to the maxilla bone. It is the second branch of the trigeminal ganglion. It traverses through the cavernous sinus below the ophthalmic nerve. Leaves the anterior end of this sinus to pass through the foramen rotundum. Then it travels through the upper part of pterygo- (spheno palatine) fossa.

Course and branches:



Foramen rotundum-Leaves the skull.

Upper part of pterygo palatine fossa -
Connected by two ganglionic branches to the pterygopalatine ganglion. Gives zygomatic branch which tranverses the inferior orbital fissure to reach the orbit. It further divides into zygomatico-facial and zygomatico-temporal nerves. The latter nerve passes on the secretomotor fibres to the lacrimal nerve for the supply of lacrimal gland.

Posterior superior alveolar nerve 2-3 in number, run on the posterior wall of maxilla to supply the maxillary air sinus, and upper molar teeth.
Continues as infra-orbital nerve: This passes forwards along floor of the orbit enters the infra orbital canal and traverses it. Branches are:

Middle superior alveolar branches for the supply of premolar teeth.
Anterior superior alveolar branches for the supply of canine and incisor teeth. Finally it reaches anteroinferior part of lateral wall and floor of the nose.Enters the face through Infraorbital foramen and gives: Palpebral branches to the skin of lower eyelid and conjunctiva (palpebral and ocular)

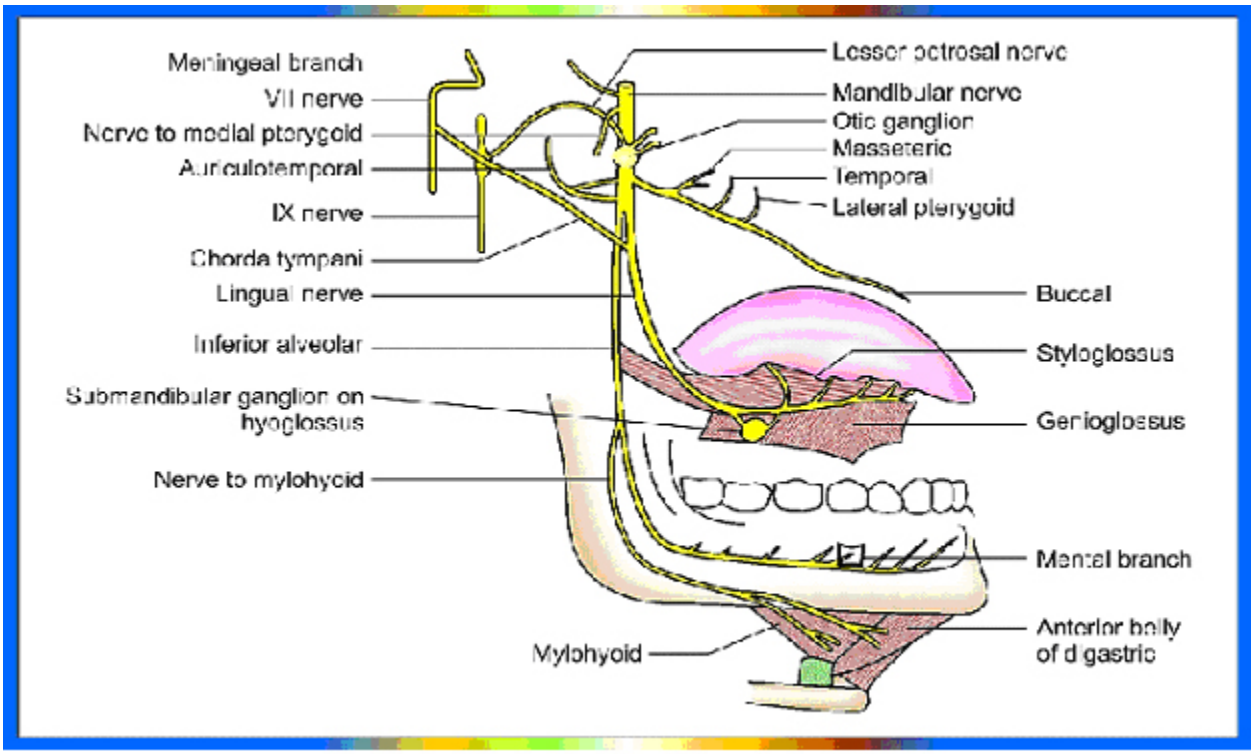
Nasal branches for the skin of side of nose.

Labial branches to the skin and mucous membrane of upper lip.

Mandibular Nerve

This is the largest division of trigeminal nerve. It is called so because it supplies the lower teeth attached to the mandible. Many of its branches eg.
auriculotemporal, lingual, inferior alveolar are closely related or pass through canals in the mandible. It is the only mixed branch of cranial nerve V. It supplies eight (8) muscles derived from 1st branchial or pharyngeal arch in addition to the skin and mucous membrane of the mouth.

The mandibular division leaves the skull through the foramen ovale accompanied by its small motor root to form its trunk.



1.Meningeal branch passes into the cranial cavity through foramen spinosum.

2.Nerve to medial pterygoid. It gives a branch that traverses through otic ganglion to supply medially placed tensor veli palatini andlaterally positioned tensor tympani. These fibres do not relay. Otic ganglion is placed deep to the mandibular nerve. Functionally otic ganglion is related to cranial nerve IX nerve and topographically to V3 cranial nerve.

Muscular branches to lateral pterygoid, deep temporal nerves to temporalis and masseteric branch to the masseter muscle. The last branch supplies the temporomandibular joint.
Sensory branch is called the buccal branch. It suplies small area of skin of cheek and secretomotor fibres from otic ganglion for mucous glands in the mouth.

Posterior division

1. **Auriculotemporal nerve** arises by two roots which surround the middle meingeal artery. It carries secretomotor fibres from the otic ganglion for the parotid salivary gland. It also supplies skin of auricle, external auditory meatus, temple and temporomandibular joint.

2. **Lingual nerve** is the upper terminal of mandibular. It is joined by chorda tympani (branch of facial nerve). Lingual nerve grooves the mandible below third molar tooth.
   The nerve and submandibular duct twist around on the surface of hyoglossus to supply general sensation to anterior two-thirds of tongue. The taste from anterior two-thirds except from the vallate papillae is carried by lingual nerve for chorda tympani nerve. It also gives two ganglionic branches for submandibular ganglion.

3. **Inferior alevolar nerve** is the larger of two terminal branches of posterior division. Runs on the lateral surface of medial pterygoid muscle. After giving a branch-nerve to mylohyoid which supplies mylohyoid and anterior belly of digastric; it enters the mandibular canal of the mandible and supplies 3 molar and 2 premolars. In the canal it divides into mental branch (which is sensory to the skin of lower lip and also carrying secretomotor fibres to the labial glands of lower lip) and incisive branch for supplying the lower canine and incisor teeth.

CERVICAL PLEXUS

The cervical plexus is formed by ventral rami of C 1, C2, C3, C4 nerves. The ventral ramus of cervical 1 runs along the cranial nerve XII medially. During its course it gives a branch, superior limb of ansa cervicalis. The C1 along X11 cranial nerve gives off motor fibres to geniohyoid and thyrohyoid muscles.
Branches from ventral rami of C2 and C3 join together medially to form inferior limb of ansa cervicalis. The two limbs join to form ansa (the loop). Branches from superior limb only go to superior belly of omohyoid while branches from the ansa supply

Sternohyoid
Sternothyroid
Inferior belly of omohyoid.
Lateral branches are four cutaneous branches, These are:
Lessor occipital-VR of C2
Great auricular-VR of C2, C3.
Transverse cutaneous nerve of neck—VR of C2, C3.

Supraclavicular nerves-VR of C 3, C4.

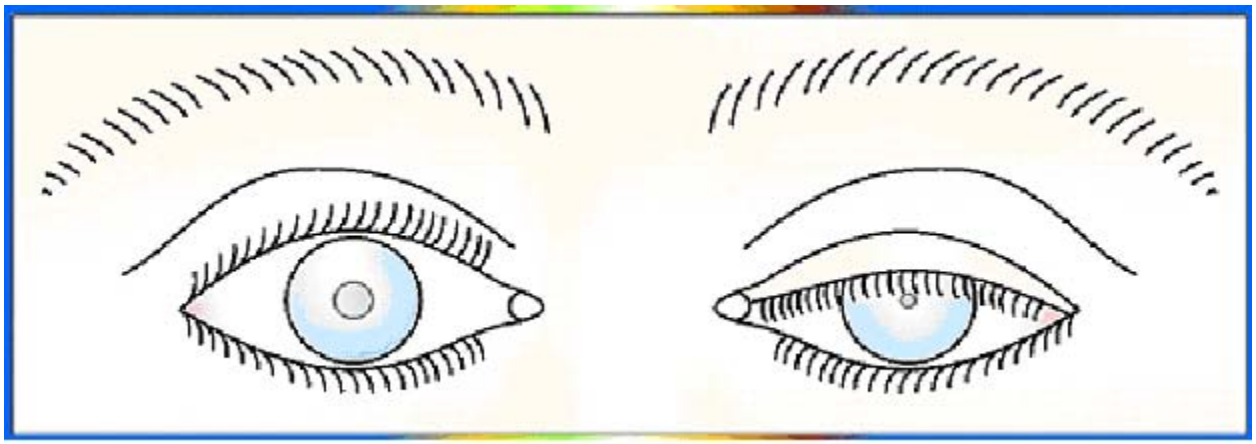
Enumerate the components of Horner's Syndrome.

HORNER'S SYNDROME

This syndrome is produced due to loss of sympathetic fibres of T1 segment of spinal cord. The pathway is as shown.

Cells in hypothalamus — brainstem — lateral horn of T1 segment of spinal cord — preganglionic fibres enter sympathetic trunk via white ramus communicans ofT1 — pass up to superior cervical ganglion — relay — postganglionic fibres accompany internal carotid artery — leave the artery to join ophthalmic nerve — nasociliary nerve — long ciliary nerve for the supply of the cornea, choroid of eyeball, dilator pupillae, smooth part of levator palpebrae superioris muscle If these fibres get interrupted the losses lead to Horner's syndrome;-

Constriction of pupil due to loss of dilator pupillae muscle.



Ptosis (partial drooping due to loss of sympathetic nerve supplying part of levator palpebrae superioris).

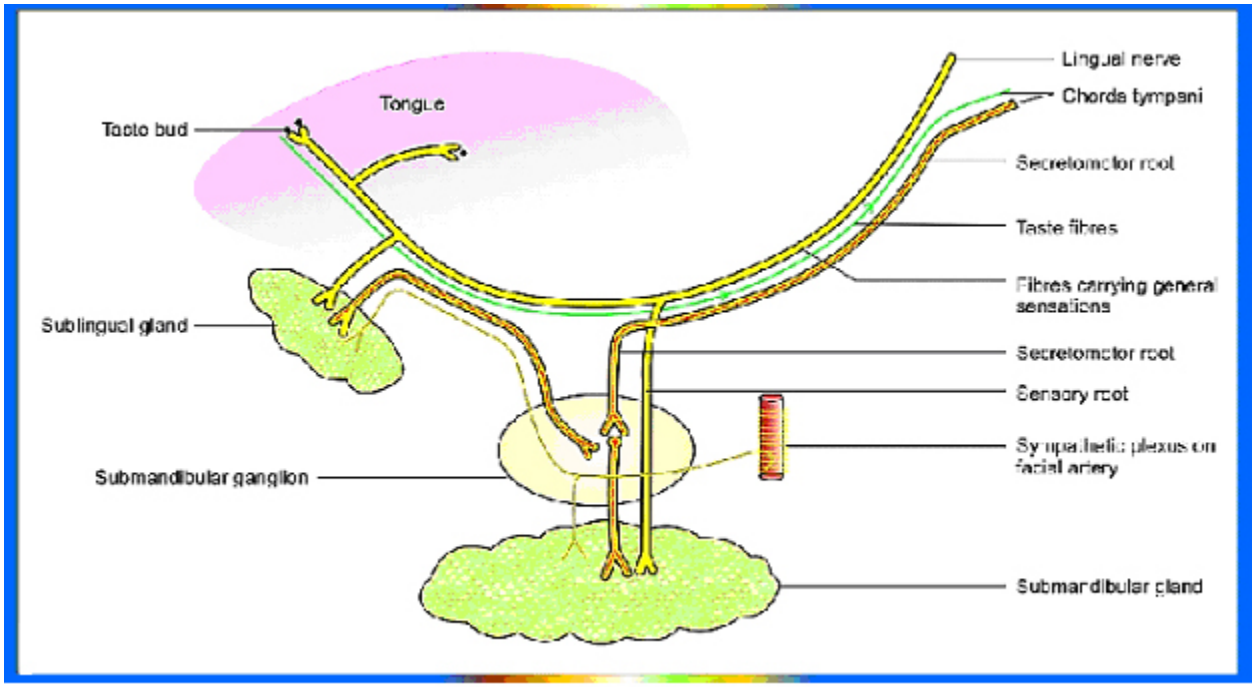
Anhydrosis - loss of sweating on the head and neck of the same side. The sympathetic effects on the skin are sudomotor (increase sweat) vasomotor and pilomotor. As these are lost, the sweating on the skin of head and neck is lost.

Enophthalamos - due to loss of smooth muscles behind the eyeball.

What are the roots and branches of otic, submandibular and pterygopalatine ganglia?

SUBMANDIBULAR, PTERYGOPALATINE AND OTIC GANGLIA

Submandibular Ganglion: The submandibular ganglion lies superficial to hyoglossus muscle. It is connected to the lingual nerve.



Roots: The sensory root is given by two branches of lingual nerve.

The sympathetic root is provided by the sympathetic plexus around the facial artery. This plexus arises from the superior cervical ganglion of sympathetic chain.

Parasympathetic or secretomotor root arises from the chorda tympani branch of cranial nerve VII. The chorda tympani nerve joins lingual nerve, the parasympathetic fibres get relayed in the submandibular ganglion.

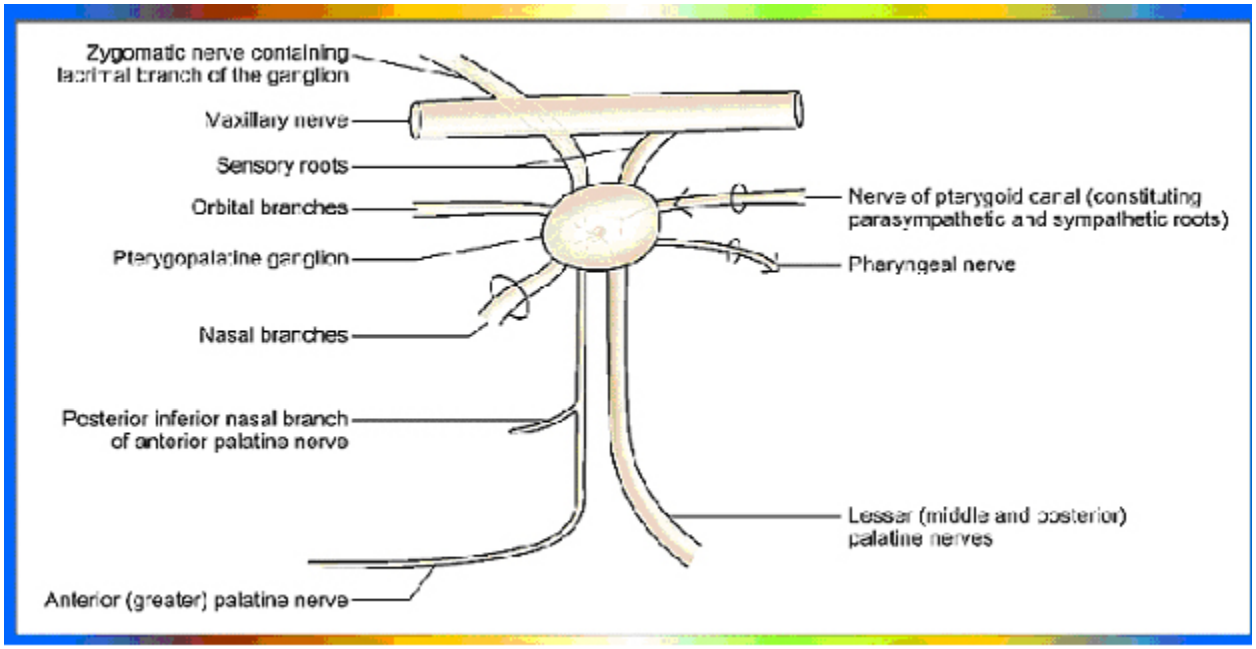
Branches:-

To both deep and superficial parts of the submandibular salivary gland.

To sublingual salivary gland through the lingual nerve.

PTERYGOPALATINE GANGLION

This is the largest parasympathetic ganglion and is suspended via the maxillary division of V cranial nerve. Functionally it is connected to carnial nerve VII. It is called "Hay - fever" ganglion.



Roots:-

Sensory root - Maxillary nerve.
Sympathetic root - Plexus around internal carotid artery arising from superior cervical ganglion. This root is called the deep petrosal nerve.
Secretomotor or parasympathetic root - Greater petrosal nerve from nerve to pterygoid canal. Fibres of greater petrosal nerve relay in the ganglion.
The greater petrosal and deep petrosal nerves join to form the nerve of pterygoid canal.

Branches
For lacrimal gland-The postganglionic fibres pass via the zygomatic branch of maxillary nerve. These fibres hitch hike through zygomatico temporal nerve into the communicating branch between zygomatico-temporal and lacrimal nerve, then to lacrimal nerve and ends in the lacrimal gland.

Nasopalatine nerve-This nerve passes along nasal septum to end in the anterior part of hard palate.

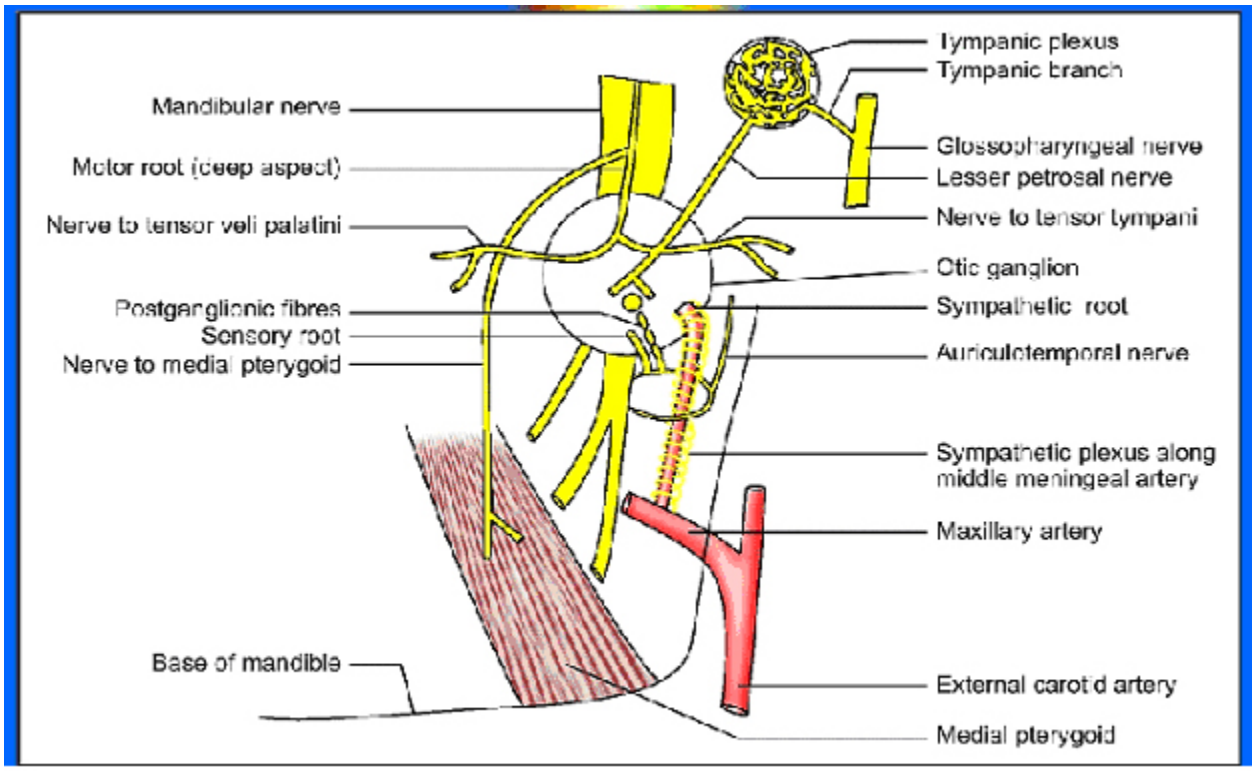
Palatine branches-These pass through greater and lesser palatine foramina to supply sensory and secretomotor fibres to mucous membrane and glands of the soft and hard palate.
Nasal branches are posterior superior medial for the supply of glands and mucous membrane of nasal septum and posterior superior lateral for the supply of glands and mucous membrane of lateral wall of the nose.
Orbital branches for the supply of orbital periosteum.
Pharyngeal branches for the pharyngeal wall.

Otic Ganglion

Otic ganglion lies deep to the trunk of mandibular nerve between the nerve and tensor tympani muscle. Its roots are:-

Sensory-By auriculotemporal nerve.
Sympathetic-By sympathetic plexus around middle meningeal artery.
Secretomotor root-By lesser petrosal nerve from the tympanic plexus formed by tympanic branch of carnial nerve 1X. Fibres of lessor petrosalnerve relay in otic ganglion. Postganglionic fibres reach the parotid through the auriculo temporal nerve.
Motor root - By a branch from nerve to medial pterygoid muscle

Tensor tympani muscle.



Tensor palati muscle.

Communicating branches to chorda tympani and nerve of pterygoid canal.
Communicating branch to auriculo temporal nerve which carries secretomotor fibres to the parotid salivary gland.

Describe the functional components, intracranial course, extracranial course, branches and applied aspects of VII, IX and XII nerves.

FACIAL, GLOSSOPHARYNGEAL AND HYPOGLOSSAL NERVES

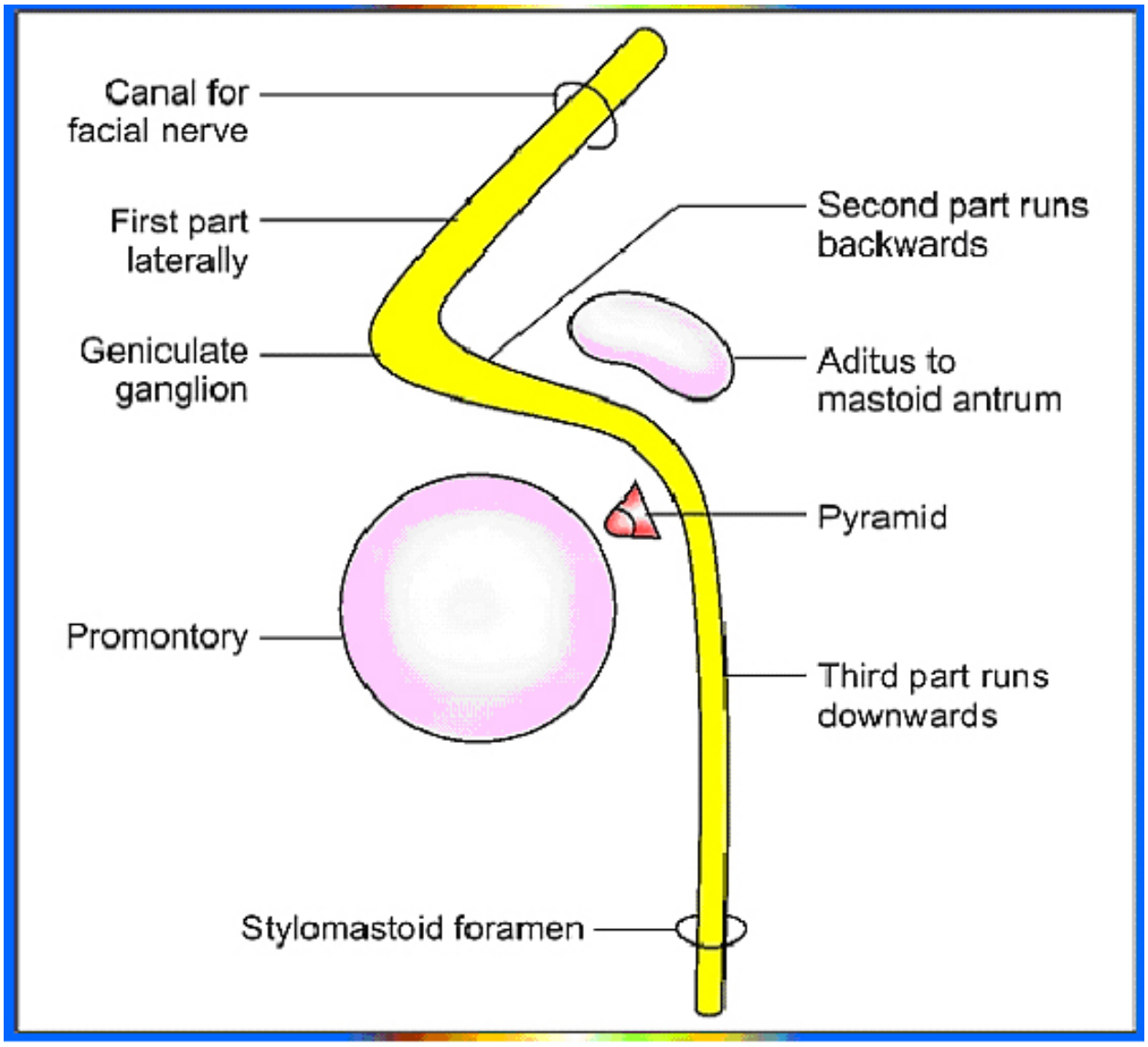
FACIAL NERVE

It is called facial nerve as this nerve supplies all the muscles of facial expression developed from 2nd pharyngeal/branchial arch. Its various nuclear components are:-

Special visceral efferent for the supply of muscles of facial expression.
General visceral efferent for the supply of lacrimal, nasal, palatal, pharyngeal glands through greater petrosal nerve (which forms nerve to pterygoid canal by joining with deep petrosal nerve (sympathetic fibres) and for submandibular and sublingual salivary glands through chorda tympani nerve.
Special visceral afferent for receiving taste fibres from anterior two-thirds of tongue except the circumvallate papillae.
General visceral afferent for receiving afferent fibres from the glands.
General somatic afferent column for receiving proprioceptive fibres from muscles of facial expression.

The main nerve emerges at the lower border of pons above the olive.
The nervus intermedius composed of 2nd, 3rd & 4th nuclear components join the main nerve. These two enter the internal acoustic meatus. The two nerves run laterally in the petrous bone where these fuse to form a single trunk. Then the nerve forms a bend, which is enlarged to form geniculate ganglion. It runs posteriorly in the medial wall of middle ear. Finally it curves downwards traversing the facial canal. Lastly the nerve exits through the cranial cavity

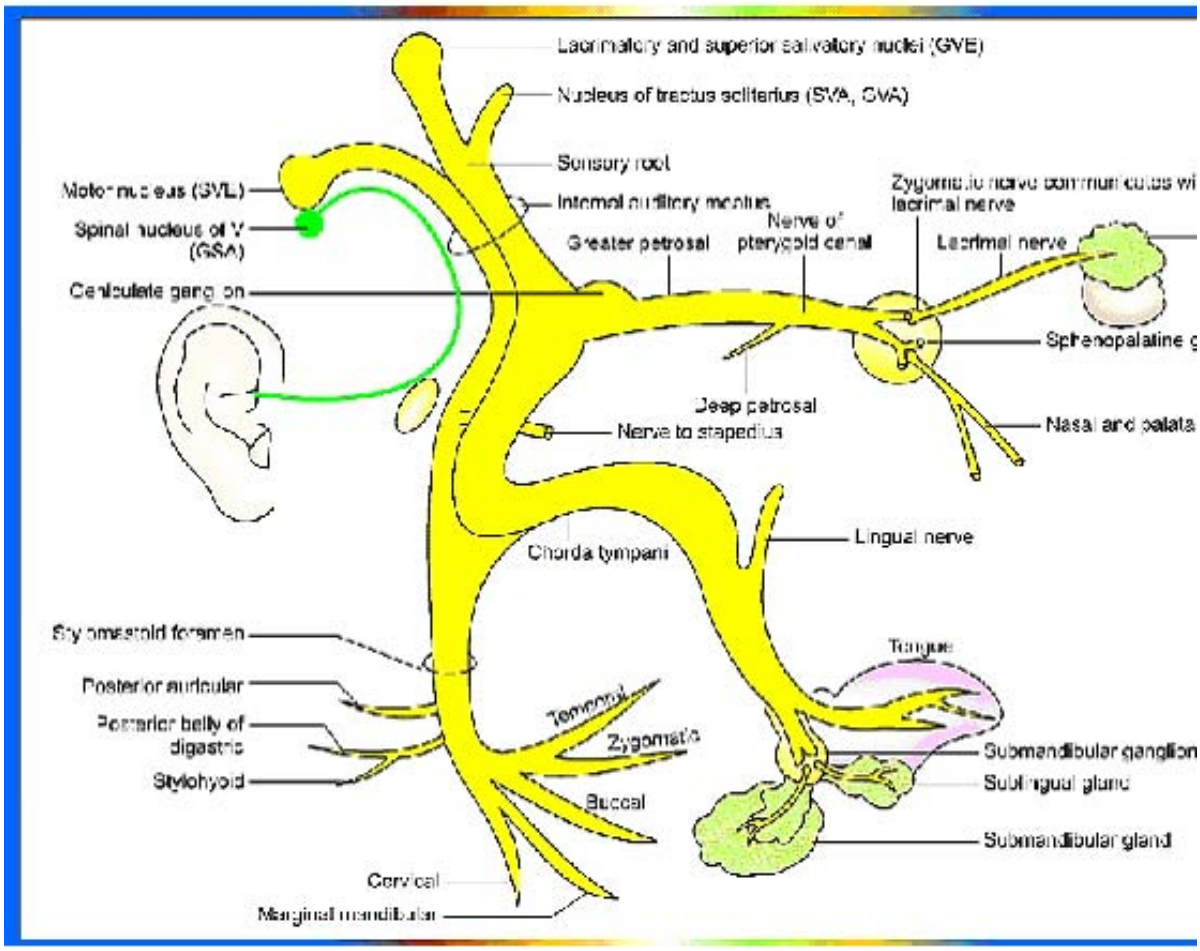
by passing through the stylomastoid foramen as purely motor nerve.



Intracranial branches:-

Through geniculate ganglion-greater petrosal nerve (from nervus intermedius) joins with deep petrosal (sympathetic fibres) to form nerve of pterygoid canal.
Branch to stapedius-given off from facial nerve as it traverses the facial canal.
Chorda tympani nerve, also arises from nervus intermedius 6 mm above the stylomastoid foramen. This nerve passes through post wall, lat wall, anterior wall of middle ear,

petrotympanic fissure and joins lingual nerve. It lies on medial side of spine of sphenoid.



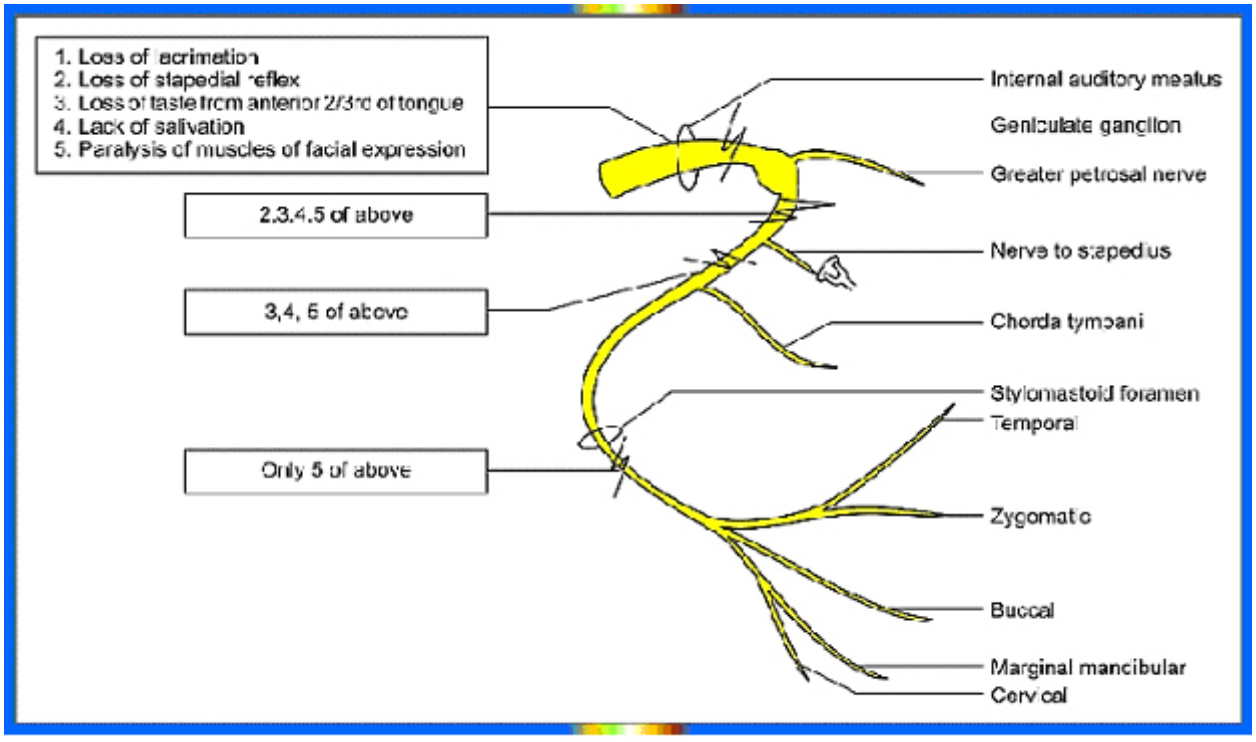
Extracranial course-The nerve gives two branches and enters posteromedial surface of parotid gland. It divides rejoins and finally emerge as 5 main branches.
Posterior auricular branch for the supply of auricular muscles and occipital belly of occipitofrontalis muscles.

Muscular branch which supplies posterior belly of digastric and stylohyoid muscle.Then it passes through parotid gland and divides into various branches.
Temporal branches emerge from the upper border of the gland cross zygomatic arch to supply frontalis part of occipitofrontalis muscle.
Zygomatic branches supply orbicularis oculi. Paralysis of this muscle causes epiphora and prevents blinking.
Buccal branches usually pass above and below the parotid duct. These supply buccinator,

muscles of nose and upper lip. Their paralysis causes dribbling from the mouth.

Marginal mandibular usually runs along the lower border of mandible. Injury of this nerve causes paralysis of depressors of lower lip.
Cervical branch exits from the lower border of parotid gland to supply platysma.

Clinical anatomy
Bell's palsy-Sudden paralysis of facial nerve at the stylomastoid foramen.
Result in asymmetry of corner of mouth, inability to close the eye, disappearance of naso-labial fold and loss of-wrinkling of skin of forehead.
Symptoms are ipsilateral.
Lesion above the origin of chorda tympani nerve will show symptoms of Bell's palsy plus loss of taste from anterior two thirds of tongue except vallate papillae.
Lesion above the origin of nerve to stapedius will cause symptons 1 & 2 & further causes hyperacusis.
Lesions 1, 2 & 3 are lower motor neuron type. Upper motor neuron paralysis will
not affect the upper part of face ie orbicularis oculi, only lower half of contralateral face is affected. The upper half of face has bilateral representation, whereas lower half has only ipsilateral representation.



General visceral efferent-the inferior salivatory nucleus for the supply of parotid salivary gland after relay in the otic ganglion.
General visceral afferent and special visceral afferent-nucleus of tractus solitarius as it receives general sensations from post one third of tongue, tonsil pharynx, carotid body, carotid sinus. It

also receives taste from posterior one third of tongue and vallate papillae. All these sensations reach the inferior ganglion of the nerve via the peripheral process of the ganglion cells. Their central process reach the nucleus of tractus solitarius.
General somatic afferent column receives proprioceptive sensations from the stylopharyngeus muscle.

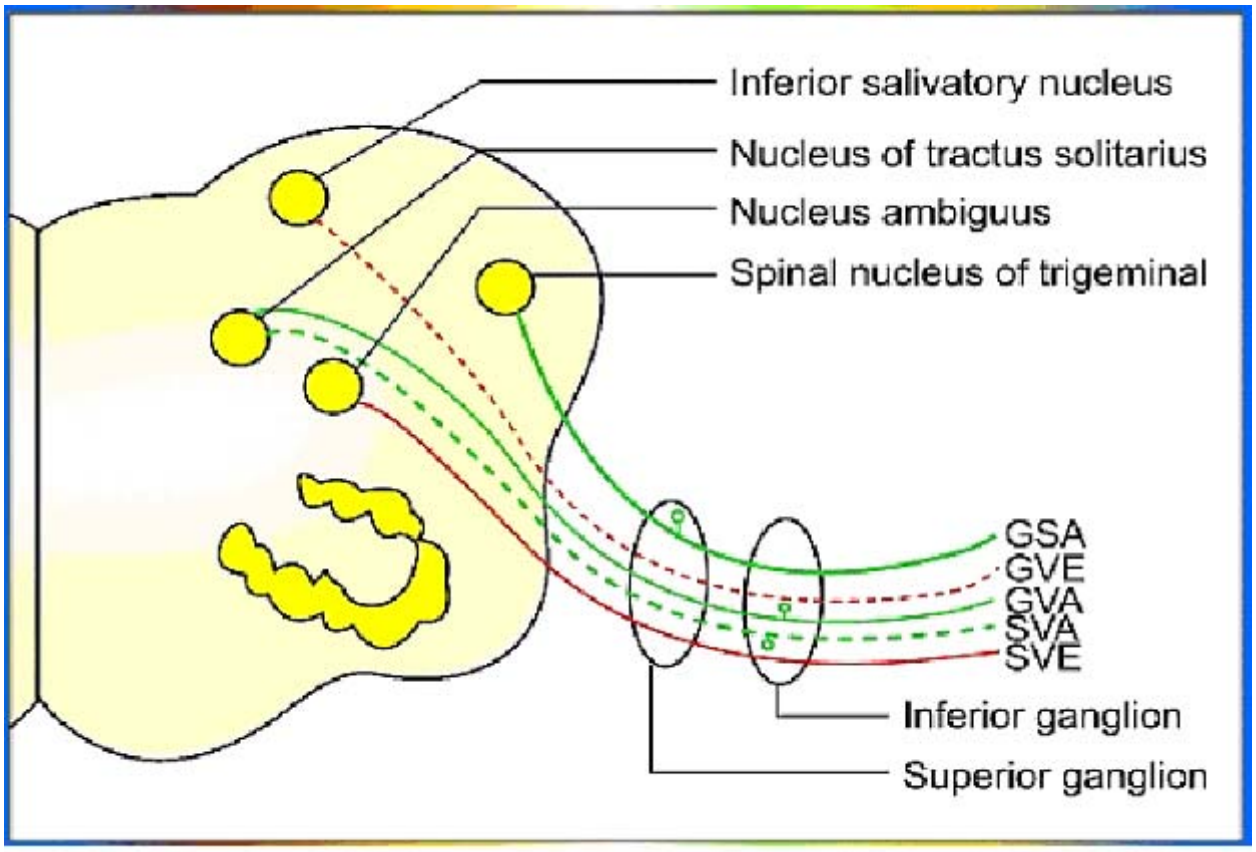
Branches

The superior ganglion is small and is a detached part of the inferior ganglion.
The inferior ganglion is larger and its central processes carry all the sensory fibres (general and special sensation) of the nerve.
It curves medially across the stylopharyngeus muscle and supplies it.
It then enters the pharynx through the interval between superior and middle constrictor muscles and ends by dividing into its terminal branches.

GLOSSOPHARYNGEAL NERVE

Introduction-it is named so, as it supplies one muscle of the pharynx-the stylopharyngeus and carries general sensation and taste from posterior one-third of the tongue and vallate papillae.

It is the nerve of 3rd branchial arch.



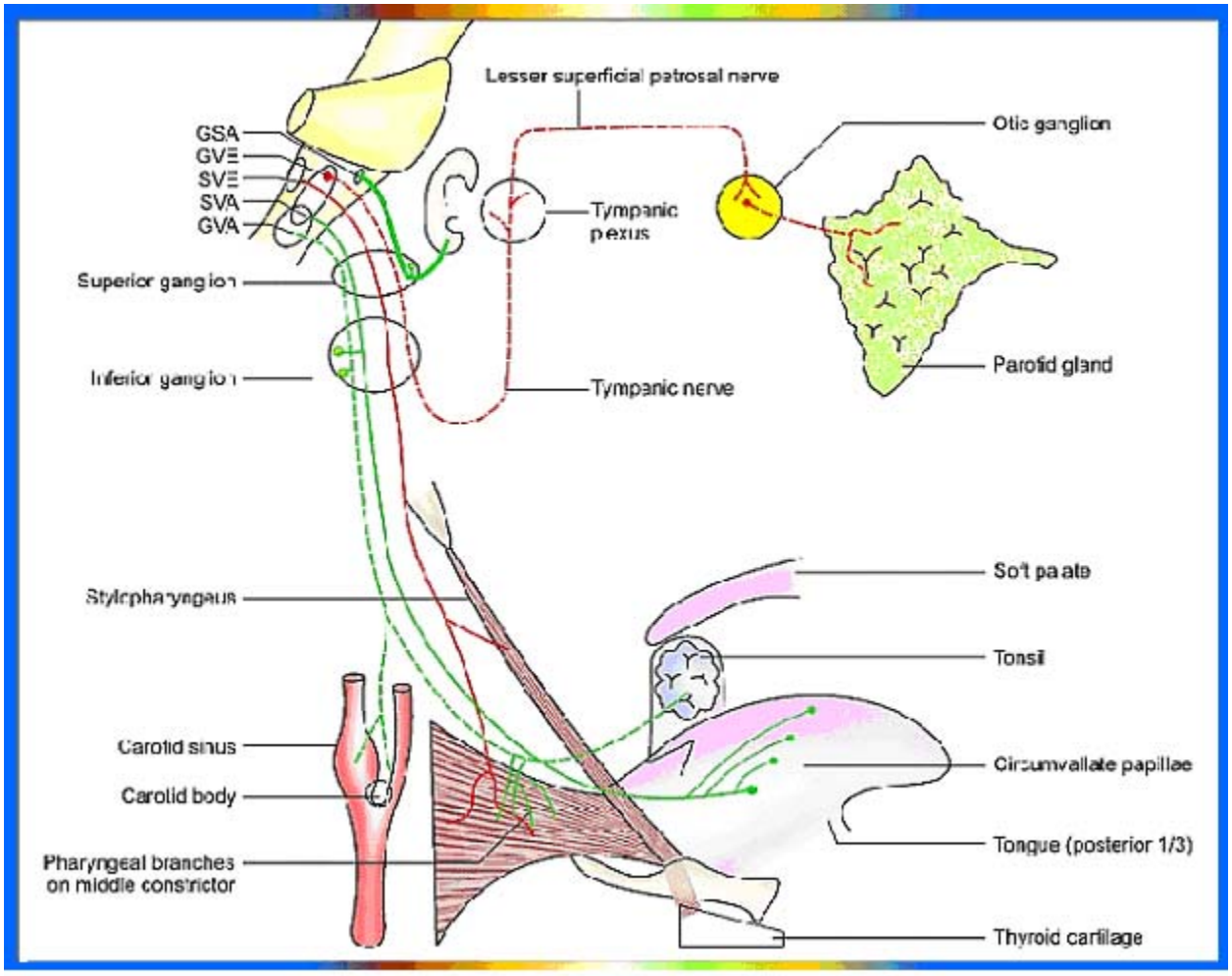
Intracranial course-The fibres of the nerve arise from the respective nuclear columns at the level of medulla oblongata. The nerve fibres pass between olive and inferior cerebellar peduncle.
It is attached at the base of the brain in the posterolateral sulcus between olive and inferior cerebellar peduncle by 3-4 rootlets.
The rootlets join to form the nerve which enters the middle part of the jugular foramen in a separate sheath of dura mater.

There are two ganglia in its upper most part:-
Communicating to V11, X, superior cervical ganglion of sympathetic chain.
Distribution to:
Tympanic branch enters middle ear cavity-tympanic plexus on promontary-supplies middle ear, auditory tube and gives-lesser petrosal nerve-otic gang-relay -join auriculotemporal nerve-parotid salivary gland.

Sino-carotid nerve for carrying baroreceptor and chemoreceptor sensations from carotid sinus and carotid body respectively.
Tonsillar branches for the supply of sensory fibres to the palatine tonsil.
Lingual branches for the supply of general sensations and taste fibres for posterior one-third of tongue including the circumvallate papillae present anterior to the sulcus terminalis of the

tongue.

Special visceral efferent (nucleus ambiguus) for the supply only one muscle-the stylopharyngeus.



Clinical anatomy:-
On tickling the posterior wall of pharynx, there is reflex contraction of muscles of pharynx. If 9th nerve is paralysed, no such contraction occurs. Further taste from posterior one-third of tongue and circumvallate papillae is not appreciated in 9th nerve paralysis. The 9th nerve is mostly paralysed along with 10th nerve.

HYPOGLOSSAL NERVE
Introduction: As the name implies it is the nerve supplying muscles of tongue (glossal means tongue) and is purely motor nerve. Functional components or nuclear columns:

It belongs to general somatic efferent column. Its nucleus is situated in the medulla in the floor of 1V ventricle deep to hypoglossal triangle.
General somatic afferent column the nucleus is spinal nucleus of V which receives proprioceptive impulses from muscles of tongue.

The rootlets are attached in the groove between the pyramid and olive. The rootlets join to form two bundles which pierce the dura mater separately near the anterior condylar canal or hypoglossal canal.

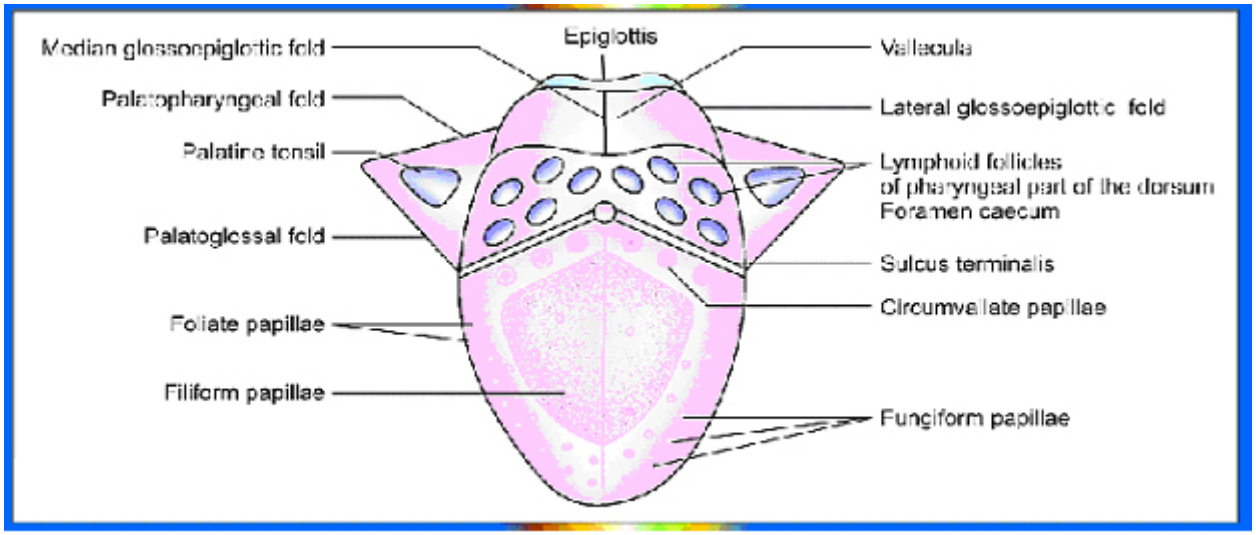
It enters the neck through anterior condylar canal and is placed deeper than IX, X, XI nerves.
It descends between internal jugular vein and internal carotid artery.
It curves around the vagus nerve as it passes deep to posterior belly of digastric muscle.
The hypoglossal nerve makes a wide curve, crossing the internal carotid,external carotid and the loop of the lingual artery.
The nerve passes above the hyoid bone in submandibular region, superficial to hyoglossus where it ends by dividing into its muscular branches.

Of communication with vagus, ventral ramus of first cervical nerve, lingual nerve and superior cervical ganglion of sympathetic chain.
Of distribution:-
To the three extrinsic muscles of tongue namely styloglossus, genioglossus and hyoglossus and to four intrinsic muscles namely superior longitudinal, inferior longitudinal, transverse and vertical muscles.
It carries fibres of ventral ramus of first cervical which gets distributed asmeningeal branch, superior limb of ansa cervicalis, branch to thyroid and geniohyoid muscles.

Clinical Anatomy.
It this nerve is injured the intrinsic and most of the extrinsic muscles of the same side to tongue are paralysed. If paralysed tongue is protruded, its tip gets deviated to the affected side.

Describe the gross features of tongue, including its development.

TONGUE
Tongue is a muscular and mobile organ under voluntary control. (We can keep quiet, if we want) performing the functions of swallowing, speech, mastication of food and taste (all the eating places are due to taste only).
Tongue is divided into two parts by an inverted ‘V’ shaped sulcus-sulcus terminalis. The parts are:-
Anterior two-thirds is the oral part



Posterior one-third is the pharyngeal part.
At the apex of the sulcus terminalis is the “foramen caecum” from where the thyroid gland develops.
Oral part: Dorsal surface-divided into two equal halves by a median sulcus. 3 types of papillae are present:

Circumvallate 8-10 in number. These are large, depressed from the surface and bear numerous taste buds.
Fungiform are club shaped on the dorsum. These have few taste buds.
Filiform are numerous papillae on the dorsum. These make the surface rough for licking. Do not contain taste buds.

Ventral surface reveals:

Motor supply – Three out of four extrinsic muscles and all intrinsic muscles are supplied by X11 nerve. Only palatoglossus is supplied by cranial root of X1 nerve via X nerve.

Development:
Tongue muscles develop from occipital myotomes and are supplied by X11 nerve
Mucosa of anterior 2/3 is from endoderm lining the midline tuberculum impar (unpaired and soon disappears) and two lateral swellings of 1st branchial arch-the lingual swellings.
The mucosa of posterior 1/3 is from endodermal lining of the midline hypobranchial eminence formed by 3rd arch, while that of posterior most part is from fourth branchial arch. Tissues of 2nd brachial arch are not represented in the tongue.
Thyroglossal duct travels downwards from the junction between tuberculum impar and hypobranchial eminence.

Clinical anatomy: **Ectopic thyroid –** Thyroid tissue formed from the thyroglossal duct may not descend and form lingual thyroid. Any swelling on the tongue should be examined carefully

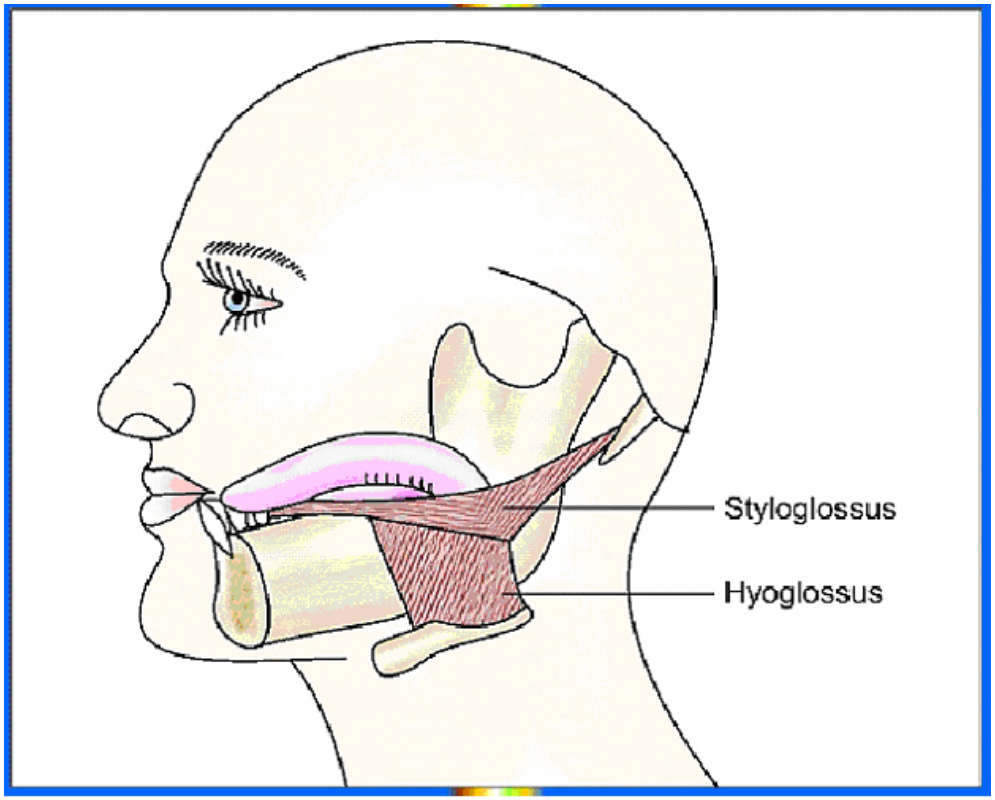
before removal, lest it may be thyroid tissue.
Tongue is examined for anaemia, jaundice, dehydration and vitamin deficiencies.
Examination of cervical lymph nodes is very important for grading the tumour of the tongue.
Any chronic ulceration of tongue should be followed up carefully. It may develop into cancer.

Frenulum of tongue-fold of mucous membrane in the median plane.
Profunda vein on either side.
Fimbriated folds of mucous membrane laterally on each side.

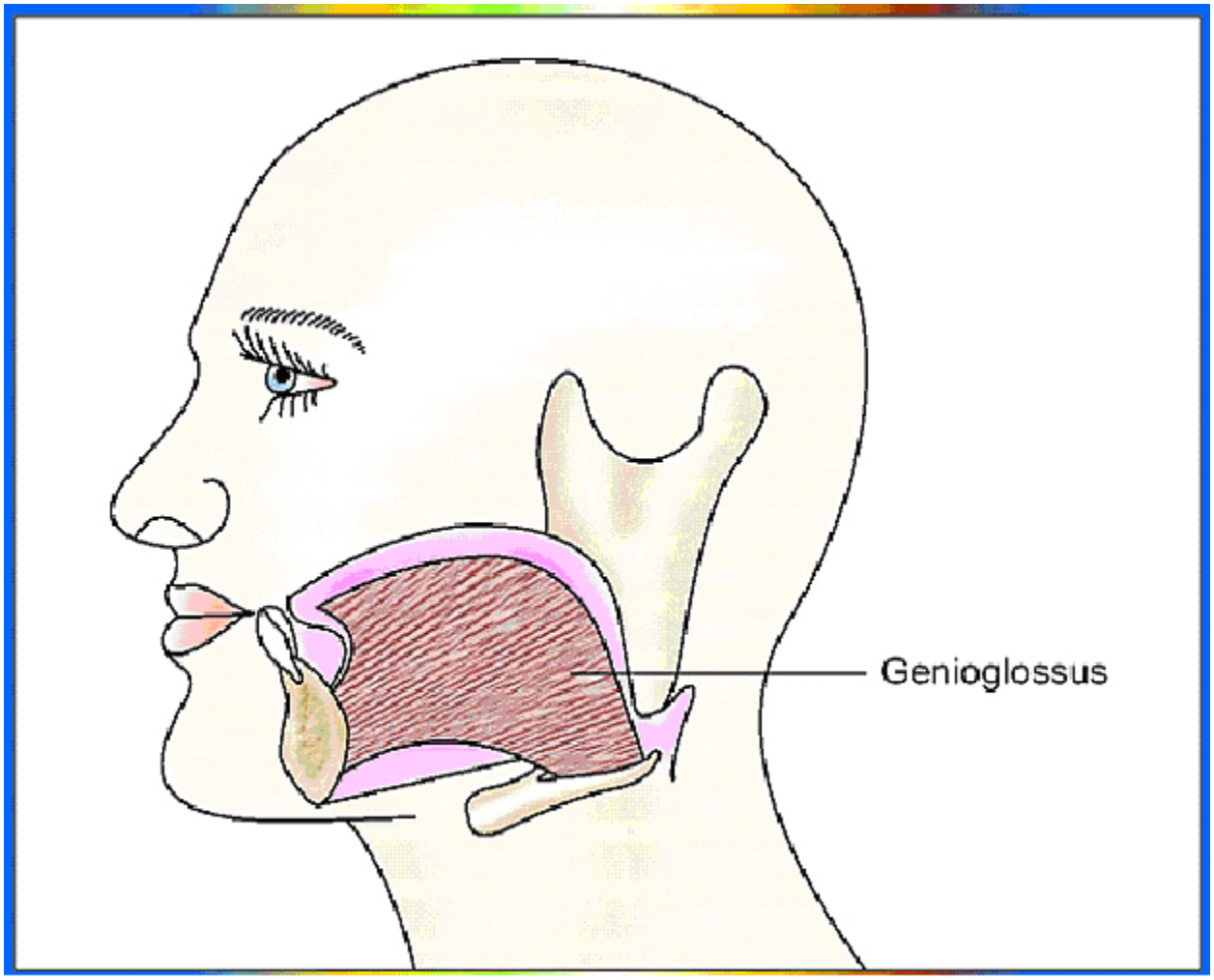
Floor of the mouth cavity reveals sublingual folds-formed by sublingual salivary glands. On the medial ends of the folds there are the openings of submandibular salivary glands.
Pharyngeal part-It is irregular as it contains lymphoid follicles called "lingual tonsil". It also contains scattered taste buds in its epithelium.

Root of the tongue occupies ventral surface of tongue and attaches it to the mandible soft palate, styloid process and hyoid bone and prevents it from being swallowed. Muscles of tongue are extrinsic and intrinisic.

EXTRINSIC MUSCLE
Hyoglossus - Arises form superior surface of greater cornua of hyoid bone. It is a quadrangular in shape.



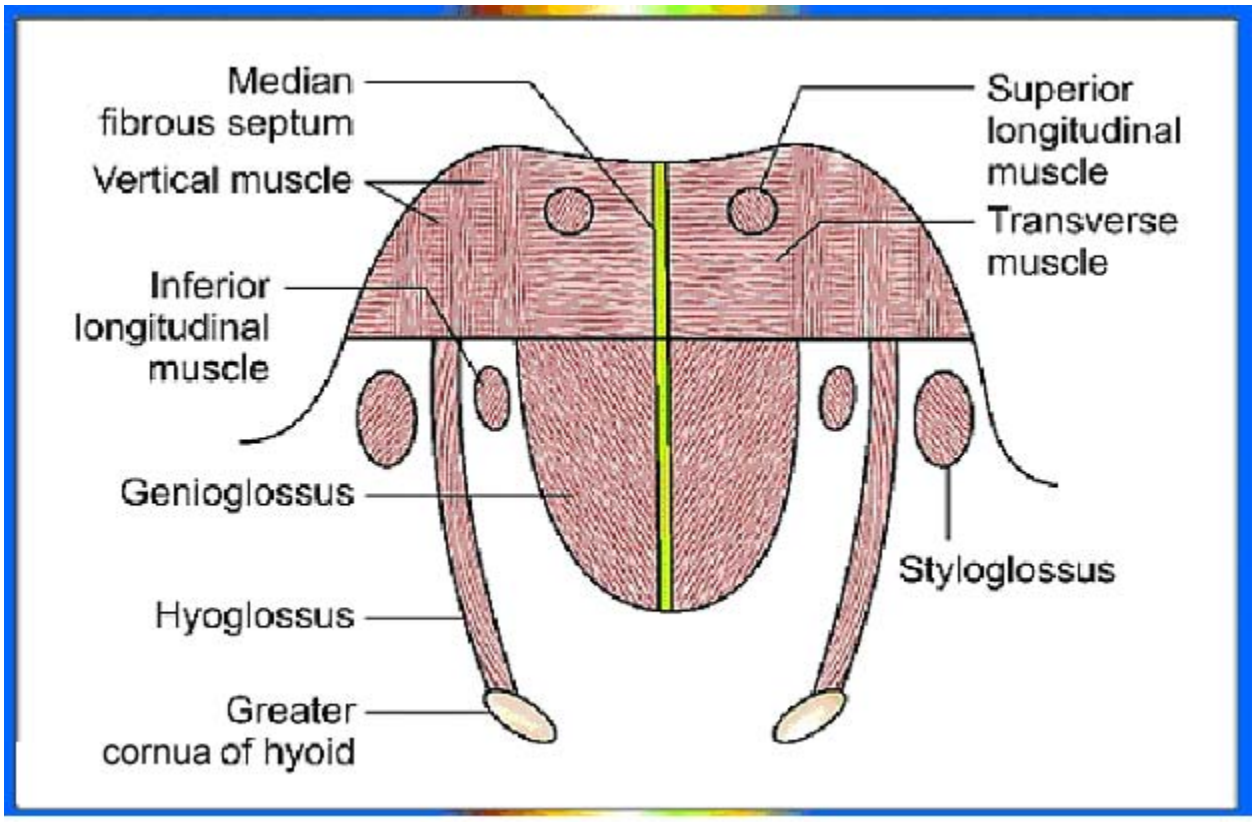
Insertion-Into the lateral border of tongue.
Action-Depresses the side of the tongue.
Styloglossus - Arises from antero-lateral surface of styloid process near its tip.
Insertion-Lateral border of tongue, lateral to hyoglossus.
Action-It draws the tongue upwards & backwards.
Genioglossus - Arises from upper genial tubercle of the mandible. It is a fan shaped muscle.



Insertion-It ascends deep to hyoglossus to get inserted into ventral surface of tongue.
Actions-Since its origin is anterior to its insertion it pulls the tongue anteriorly, ie protrudes the tongue. It also makes the dorsum hollow.
Palatoglossus - Arises from inferior surface of the palatine aponeurosis.
Insertion-Into the side of tongue.
Action-The two muscles acting together close the oropharynegeal isthnus. It elevates the root of the tongue.

INTRINSIC MUSCLES

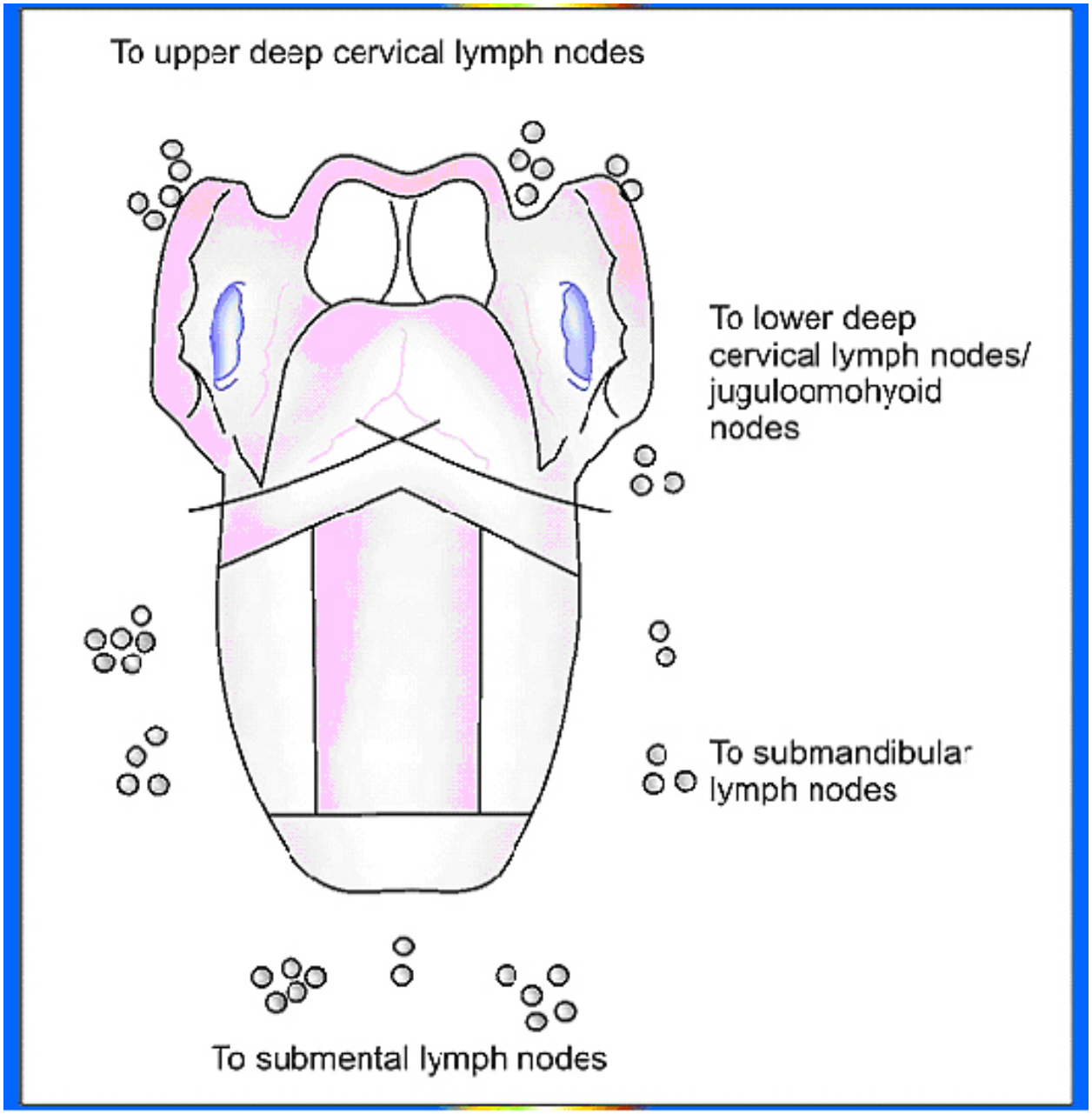
Transverse muscles – Arise from fibrous median raphe of tongue. Fibres cross transversely.



Insertion: Into the lateral border of tongue.
Action: These fibres make the tongue thinner and longer.
Vertical muscles – Arise form dorsum of tongue. Fibres descend vertically.
Insertion: Into ventral surface of tongue.
Action: Makes the tongue wider.
Superior longitudinal – Arises from submucous tissue posteriorly near the epiglottis.
Insertion: Into the mucous membrane of the tip of the tongue close to its dorsal aspect.
Action: Thins the tip upwards. It makes tongue wider and shorter.
Inferior longitudinal – Arises form submucous tissue near the root of the tongue.
Insertion: Into the mucous membrane of the tip of tongue on its ventral aspect.
Action: Makes the tongue wider and shorter; turns the tip upwards.
Hyoglossus, styloglossus and genioglossus (except palatoglossus) and all intrinsic muscles are supplied by hypoglossal (XII cranial) nerve. Palatoglossus is supplied by cranial root of accessory nerve.

Blood supply: Tongue gets a very rich blood supply. It is mainly supplied by a pair of lingual arteries, branches of external carotid artery on each side. These arteries are tortuous so as to allow for various and varied movements of tongue.

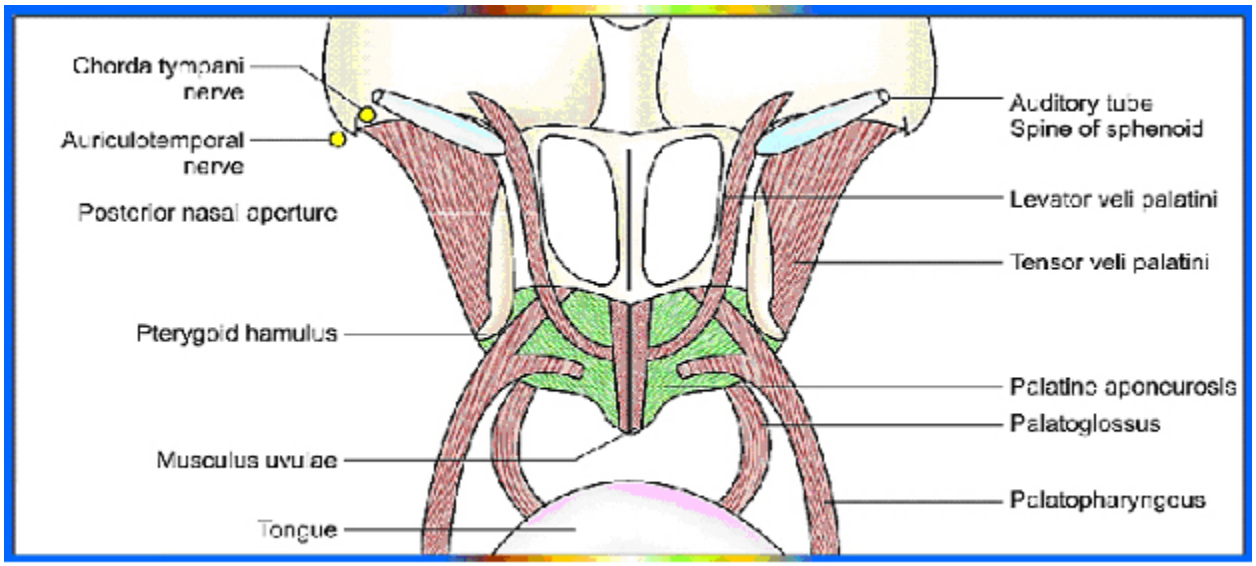
Each artery is divided into various parts.
Ist part-Artery forms a loop crossed by X11 nerve above the greater cornua of hyoid bone.
2nd Part-Runs behind hyoglossus muscle, above the hyoid bone. It gives 2-3 dorsal lingual branches to supply posterior part of tongue, soft palate, tonsil and pharynx.
3rd Part-Runs upwards along the anterior border of hyoglossus muscle.
4th part-Passes on the ventral surface of tongue up to its tip. This part is called the “profunda (deep) artery”. It supplies deeper structures of anterior part of the tongue.



Enumerate the attachments of muscles of soft palate with their nerve supply.

THE SOFT PALATE

Soft palate as the name indicates is a mobile shelf like fold of mucous membrane attached to the posterior border of hard palate. At the sides it fuses with the lateral wall of pharynx. Uvula is a conical projection projecting from the middle of its posterior border, It is situated at junction of nasopharynx and oropharynx. Its superior surface forms sloping floor of the nasopharynx, Its inferior surface forms the roof of oropharynx. Soft palate is aponeurosis covered by epithelium on both its surfaces enclosing various muscles and mucous and serous glands.



Various muscles are:

Palatoglossus - Arises from inferior surface of palatine aponeurosis.

Insertion: Into the side of tongue.

Action: Closes the oropharyngeal isthmus.

Palatopharyngeus – Arises as two separate fascicles. The posterior fasciculus from superior aspect of palatine aponeurosis and the anterior fasciculus from posterior border of hard palate.

Insertion: Upper part of muscle raises palatopharyngeal fold. The two parts are inserted into the posterior border of thyroid cartilage and median raphe of pharynx.

Action: Pulls the pharynx upwards and forwards during deglutition.

Tensor veli palatini – Arises from scaphoid fossa of pterygoid process and lateral surface of auditory tube.

Insertion: Into the palatine aponeurosis.

Action: Tenses the soft palate so that other muscles may elevate or depress it without altering

its shape. It helps to open the auditory tube.
Levator palati- Arises from rough area on the inferior surface of petrous temporal bone. Insertion: Into the superior surface of palatine aponeurosis.
Action: Elevates the soft palate to close the nasopharynx.
Musculus uvulae – Arises from posterior nasal spine of palatine bone.
Insertion: Into mucous membrane of uvula.
Action: Elevates and retracts the uvula.

Blood Supply of Palate:
The arterial supply:-

1. Greater palatine artery runs in the greater palatine canal. It is a branch of maxillary artery.
2. Tonsillar branches of facial artery.
3. Dorsal lingual branches of lingual artery.
4. Ascending palatine-A branch of facial artery.

Veins from the soft palate drain into the pterygoid venous plexus which in turn drains into the internal jugular vein. This plexus also communicates with deep facial vein and cavernous venous sinus.

Nerve Supply of Palate
Motor nerves- Cranial root of X1 nerve via pharyngeal branch of X supply palatopharyngeus, palatoglossus, levator veli palatini and musculus uvulae. Nerve to medial pterygoid through otic ganglion supplies only tensor veli palatini muscle.

Sensory nerves- Greater palatine nerve, lesser palatine nerve, glossopharyngeal nerve. Lesser palatine nerves also carry postganglionic secretomotor fibres to the palatal glands from pterygopalatine ganglion. These nerves also carry fibres from taste buds on the oral surface of soft palate.

Gag reflex- Afferents from mucous membrane on post. part of tongue and posterior pharyngeal wall-1X n and dorsal nuc. of X, nucleus ambiguuns X+X1 are efferent nerves - pharyngeal muscles contract.

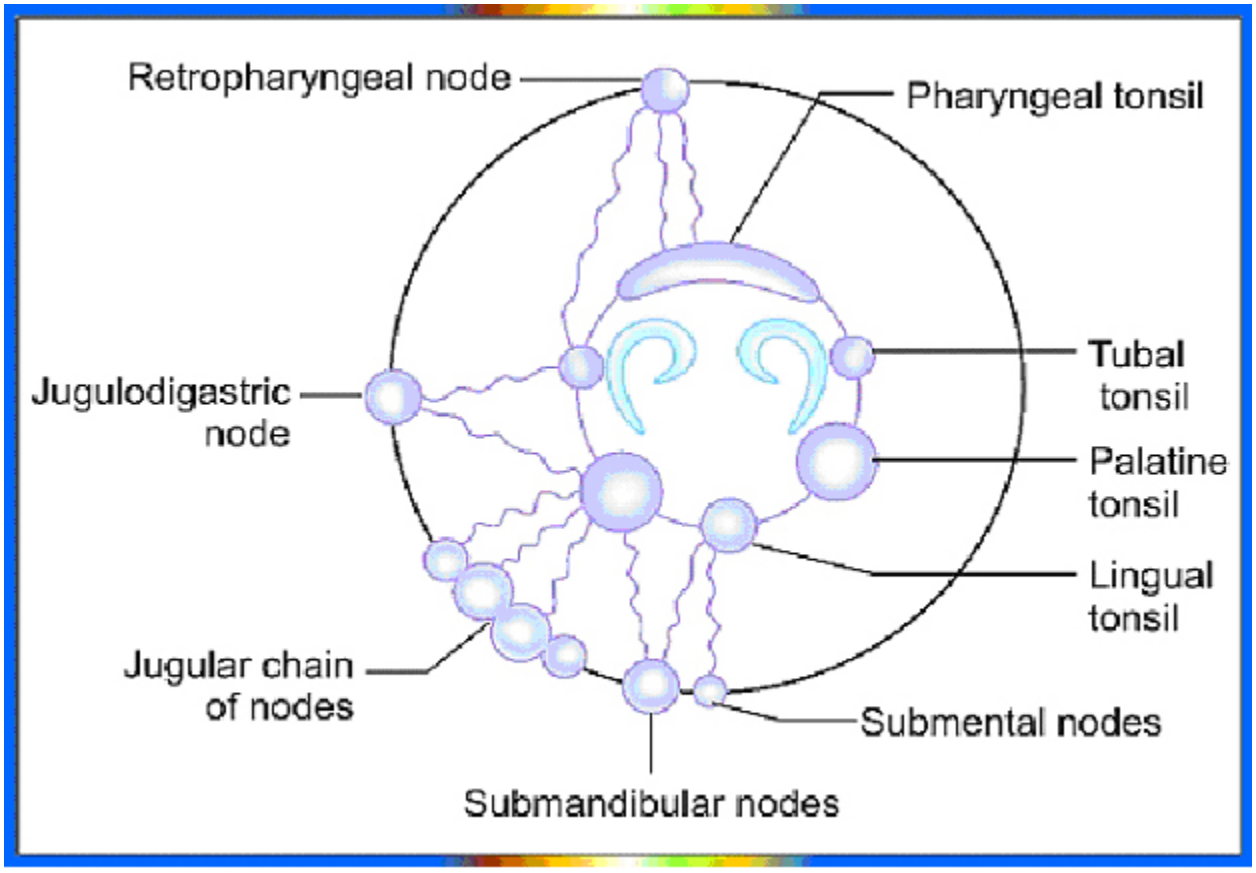
Structure- Soft palate is covered with non-keratinised stratified squamous epithelium on oral surface. The anterior part of its nasal surface is covered with columnar epithelium with goblet cells. Submucosa on both surfaces contain mucous and serous glands. On the oral surface of soft palate there are scattered taste buds and lymphoid follicles.

Enumerate the relations and arterial supply of palatine tonsil. What is its clinical anatomy.

Palatine Tonsil

Palatine tonsil is a mass of lymphoid tissue in the lateral wall of oropharynx.

Palatine tonsil forms part of the Waldeyer's ring present at the oropharyngeal isthmus. Its components are lingual tonsil, palatine tonsil, tubal tonsil and oropharyngeal (adenoids) tonsil. The size of palatine tonsil is variable as it undergoes hypertrophy after infection. It is larger in children than in adults.

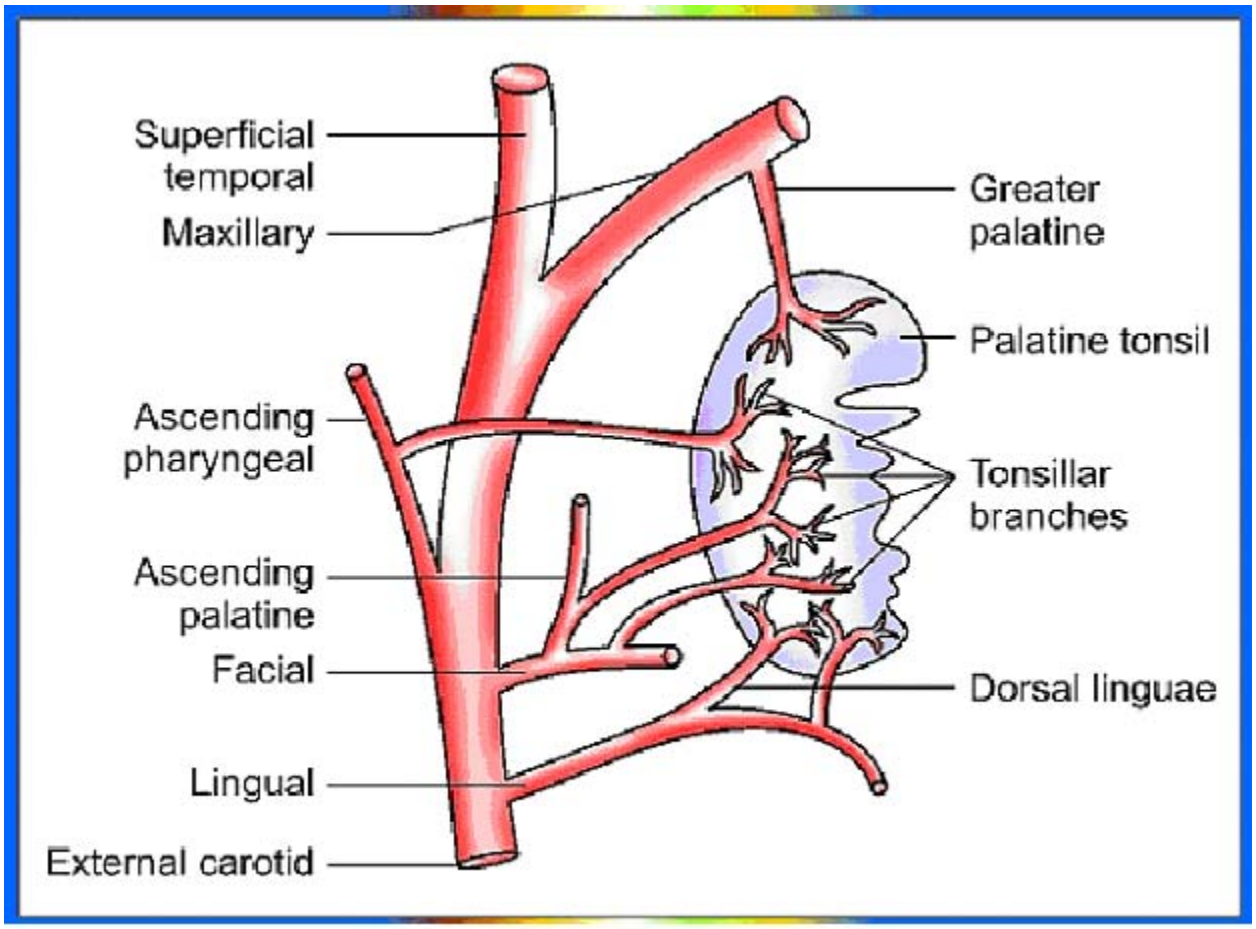


The palatine tonsil occupies the triangular tonsillar fossa between palatoglossal arch anteriorly and palatopharyngeal arch posteriorly. It extends from the level of soft palate above to the level of tongue below.

Surfaces –Lateral surface is related to a paratonsillar vein and superior constrictor muscle. The tonsillar artery enters this surface. Internal carotid artery lies 2.5 cm behind and lateral to tonsil. Medial surface is free and projects into the oropharynx. It presents 10-15 deep tonsillar

clefts. The upper part of this surface contains a deep intratonsillar cleft.

Arterial supply of tonsil



Tonsillar branch of facial artery is the main artery.
Other are: Dorsal lingual branches of facial artery.
-Ascending palatine branch of facial artery.
-Ascending pharyngeal branch of external carotid artery.
-Greater palatine branch of maxillary artery

Venous drainage of tonsil: One or more veins from the lateral aspect pierce superior constrictor and end in pharyngeal venous plexus. A large paratonsillar vein lies deep to the tonsil

Sensory nerve supply: Glossopharyngeal nerve and lesser palatine branches of pterygopalatine ganglion carrying fibres of maxillary nerve.

Lymphatic drainage: Lymph vessels mainly drain into the jugulodigastric lymph ode
Clinical anatomy: It usually enlarges due to infection in children. During infection the tonsil usually hypertrophies. Tonsillectomy is the removal of the tonsils. Since it produces antibodies its removal should be done after failure of other treatment.
Pain of tonsillitis may be referred to the middle ear as IX nerve supplies sensory fibres to both the tonsil and middle ear. Thus pain may be referred from one area to the other.

Describe the attachments of muscles of pharynx. Enumerate the structures passing through various gaps in relation to these muscles.

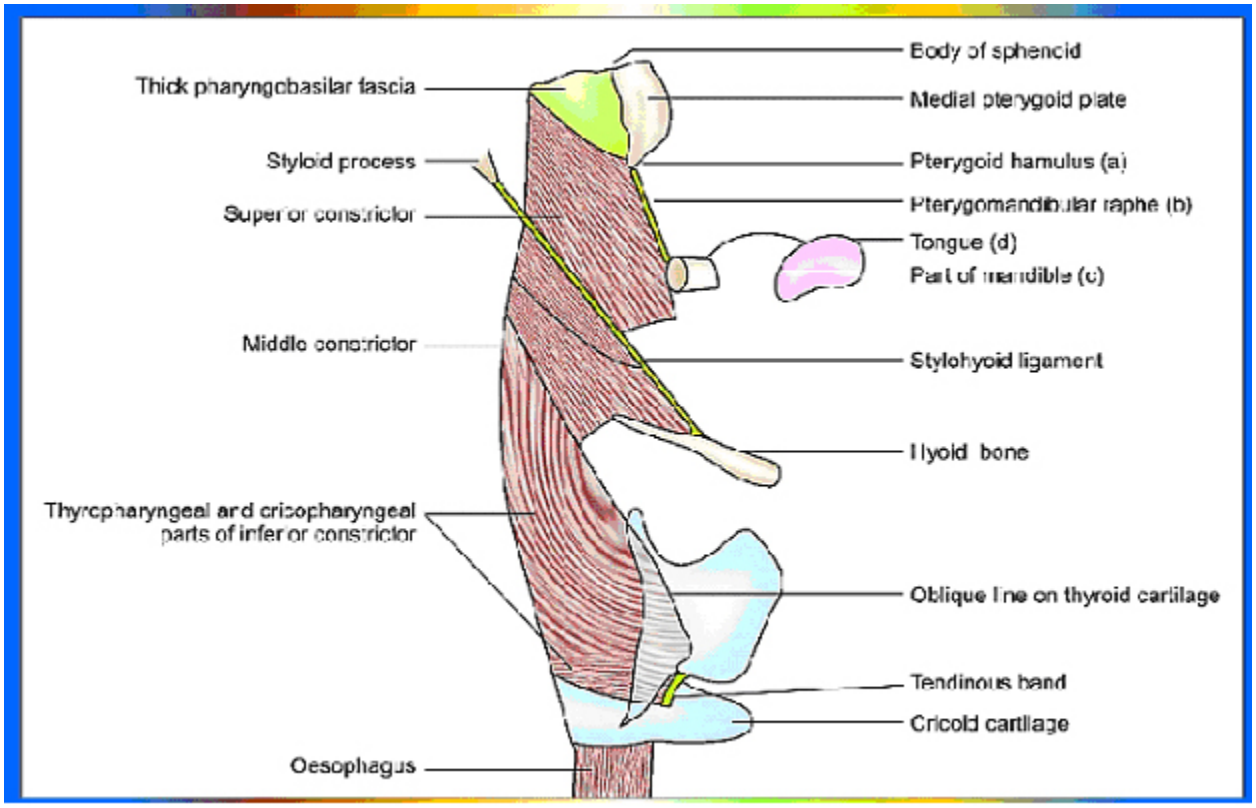
The pharynx
The wall of pharynx comprises of the following layers:

Buccopharyngeal fascia
Muscular coat made of three constrictors, the superior, middle and inferior which form incomplete circular layer and inner longitudinal layer formed by stylopharyngeus, salpingopharyngeus and palatopharyngeus muscles.
Pharyngobasilar fascia thickened in the interval between upper concave margin of superior constrictor and base of skull.
Submucous layer
Mucous membrane

MUSCULAR COAT

1. Superior constrictor is thin and quadrangular muscle belly

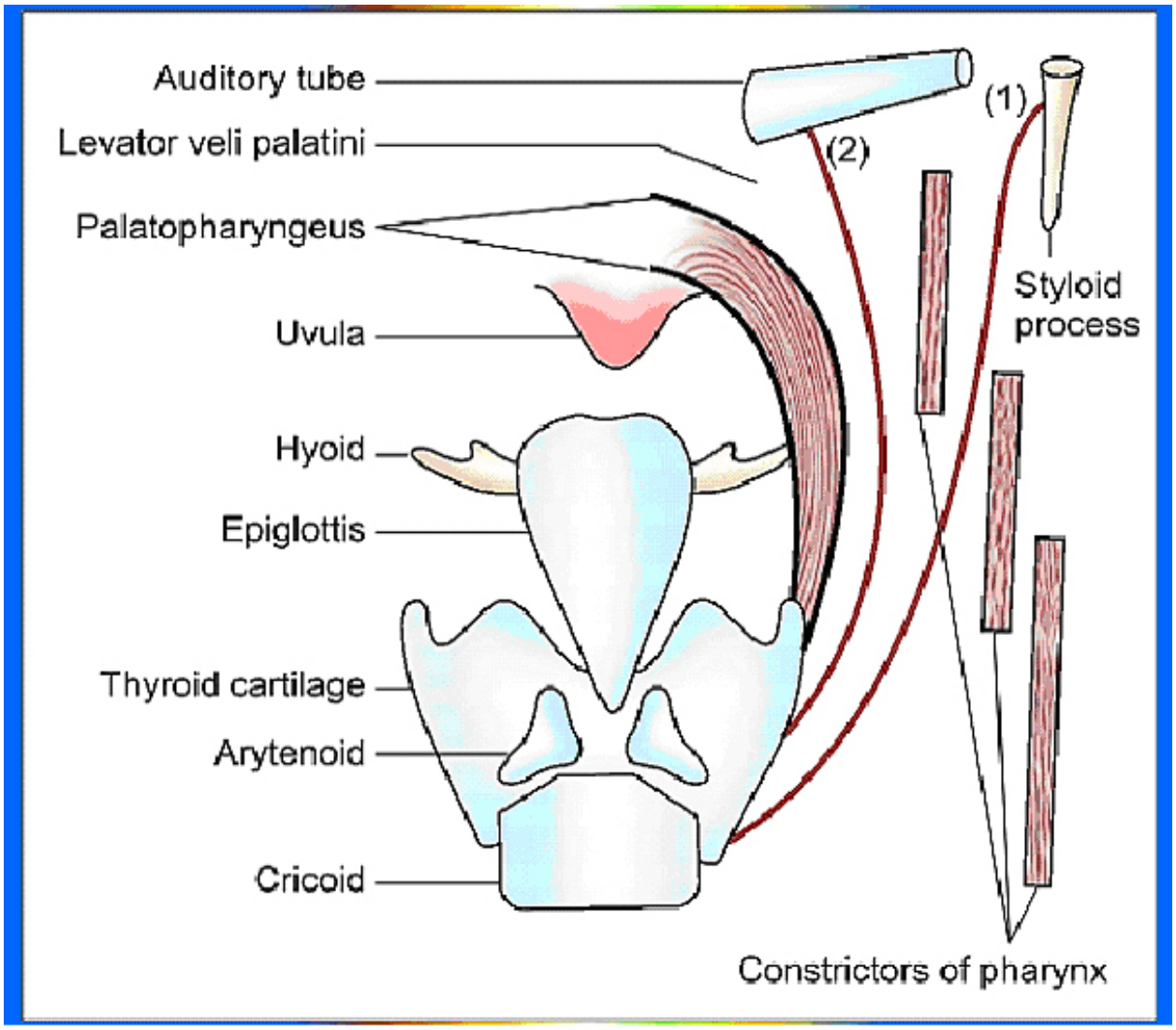
Origin: Pterygoid hamulus



Pterygomandibular raphe
Posterior end of mylohyoid line

Side of tongue.
Insertion: Fibrous median raphe on back of pharynx. Some fibres even reach pharyngeal tubercle on basi-occiput.
- Middle constrictor has fan shaped muscle belly
Origin: Lower part of stylohyoid ligament, lesser cornua of hyoid bone, whole length of upper border of greater cornua of hyoid bone.
Insertion: Fibrous median raphe.
- Inferior constrictor is thick and triangular muscle belly. Its fibres ascend upwards and medially.
Origin: Side of cricoid cartilage (cricopharyngeus part), oblique line of thyroid cartilage. (thropharyngeus part)
Insertion: Fibrous median raphe on back of pharynx.
Nerve supply of 3 constrictors
Superior, middle and inferior constrictors are supplied by pharyngeal plexus of nerves formed by cranial part of accessory nerve through vagus and sympathetic fibres. In addition the inferior constrictor gets an additional supply from recurrent laryngeal nerve.
Actions: Helps in downward passage of bolus of food.
Stylopharyngeus: Long and slender muscle belly which passes betweensuperior and middle

constrictors.



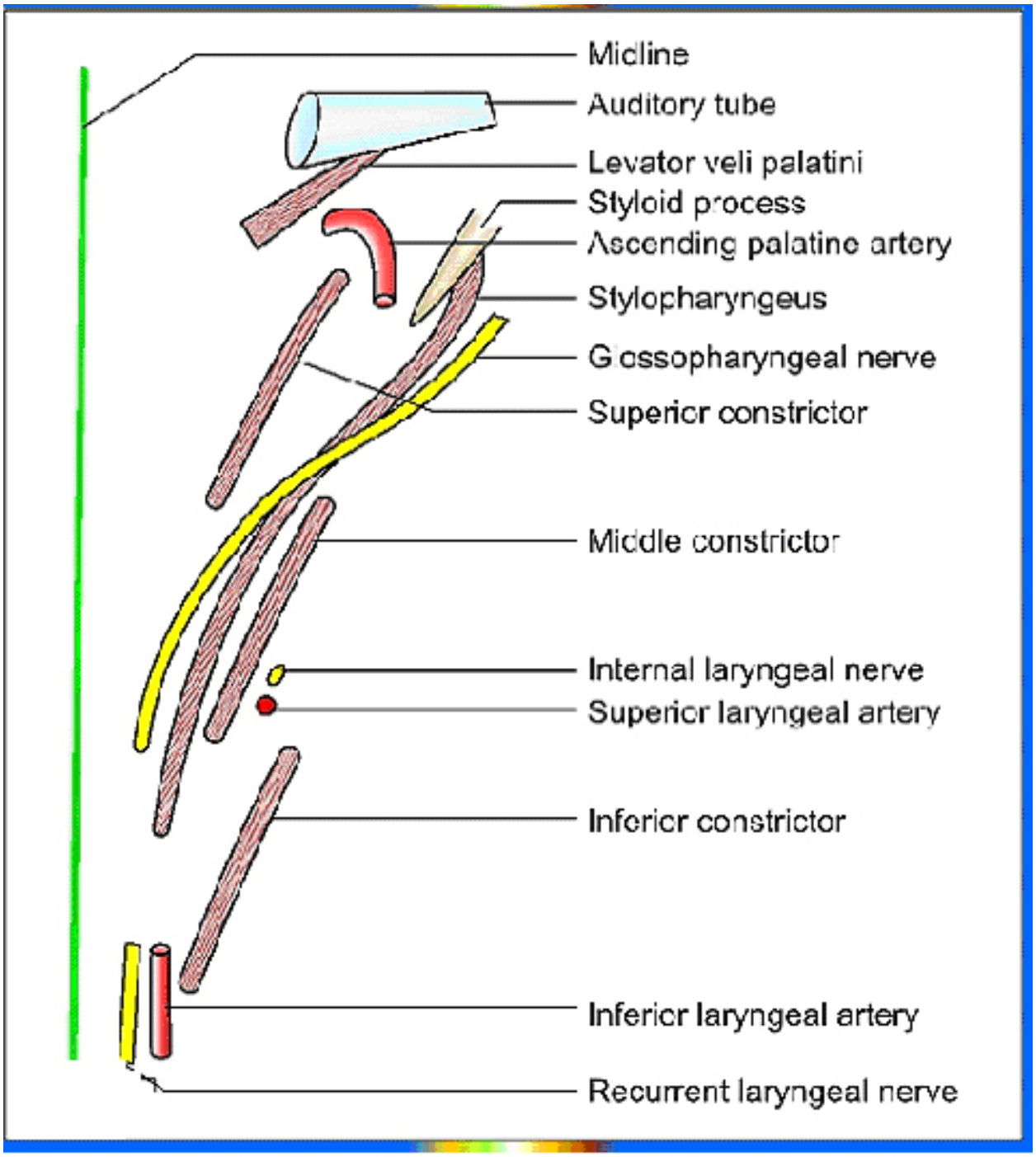
Origin: Medial side of base of styloid process.
Insertion: Posterior border of thyroid cartilage.
Nerve supply: Glossopharyngeal or IX cranial nerve. Since this is the nerve of third branchial arch, it supplies this muscle. Stylopharyngeus develops from mesoderm of third branchial arch.
Action: It elevates the pharynx during swallowing and speech.
Palatopharyngeus: It consists of two fasciculi that are separated by levator veli palatini.
Origin: Ant. fasciculus arises from posterior border of hard palate. Posterior fasciculus Arises from the palatine aponeurosis.
Insertion: It descends in the palatopharyngeal arch and gets inserted into the posterior border of lamina of thyroid cartilage and also the wall of pharynx and its median raphe.
Nerve supply: Cranial root of accessory nerve through vagus.
Action: Pulls the pharynx upwards and forwards during swallowing.

Salpingo-pharyngeus: it is a thin and long muscle situated in the fold of same name.
Origin: Tubal elevation.
Insertion: Posterior border of thyroid cartilage.
Nerve supply: Cranial accessory nerve through vagus.

Actions: Elevates pharynx during speech and swallowing.
Gaps in the pharyngeal wall
Arterial supply of pharynx - It is supplied by
- Ascending pharyngeal artery-branch of external carotid artery.
- Ascending palatine artery-branch of facial artery.
- Branches of third part of maxillary artery.
- Dorsal lingual branches of lingual artery.

Venous drainage: Plexus of veins mainly drains into the internal jugular vein. It also communicates with pterygoid venous plexus
Nerve supply of pharynx:
Sensory nerves from IX (glossopharyngeal) cranial nerve
Motor nerves from cranial root of XI via X nerve.
Sympathetic nerves from superior cervical ganglion.

Gap above the superior constrictor filled by thickened pharyngo-basilar fascia over which levator palati, auditory tube and tensor veli palatini are present.
Gap between superior and middle constrictor: Through this gap the stylopharyngeus muscle and glossopharyngeal nerve enter the pharyngeal wall.Gap between middle and inferior constrictor: Through this gap internal laryngeal nerve with superior laryngeal artery (branch of superior thyroid artery) descend downwards.



Gap at the lower border of inferior constrictor: Through this gap the recurrent laryngeal branch of vagus accompanied by inferior laryngeal artery branch of inferior thyroid artery of subclavian artery pass. These supply the larynx.

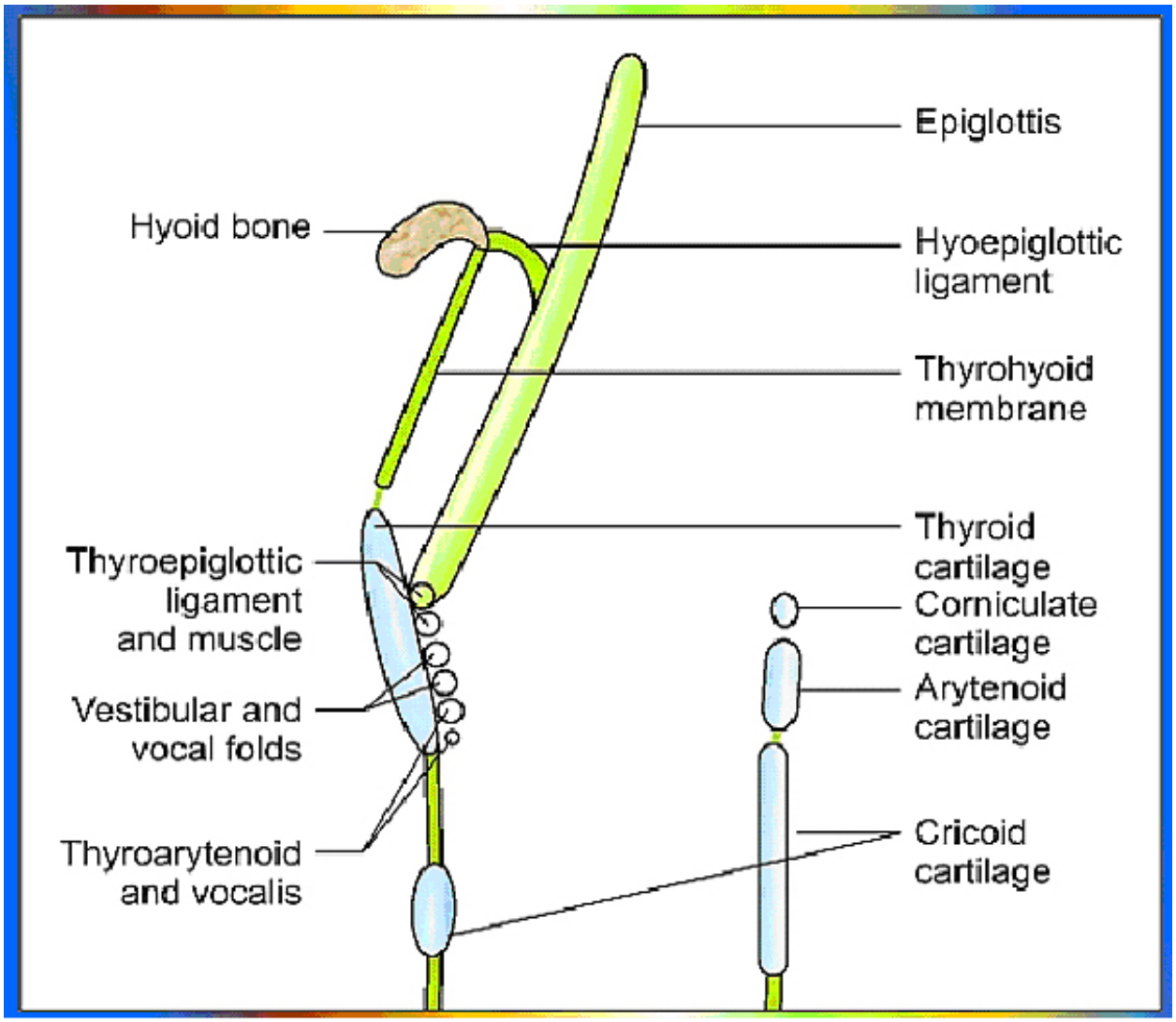
LARYNX

Describe the gross anatomy of larynx and muscles acting on the vocal cords .Write briefly on recurrent laryngeal nerve.

LARYNX

Larynx is situated at the upper end of trachea at the level of C4-C6. It functions during phonation and as protective sphincter for the air passages. Larynx consists of cartilages, ligaments and membranes

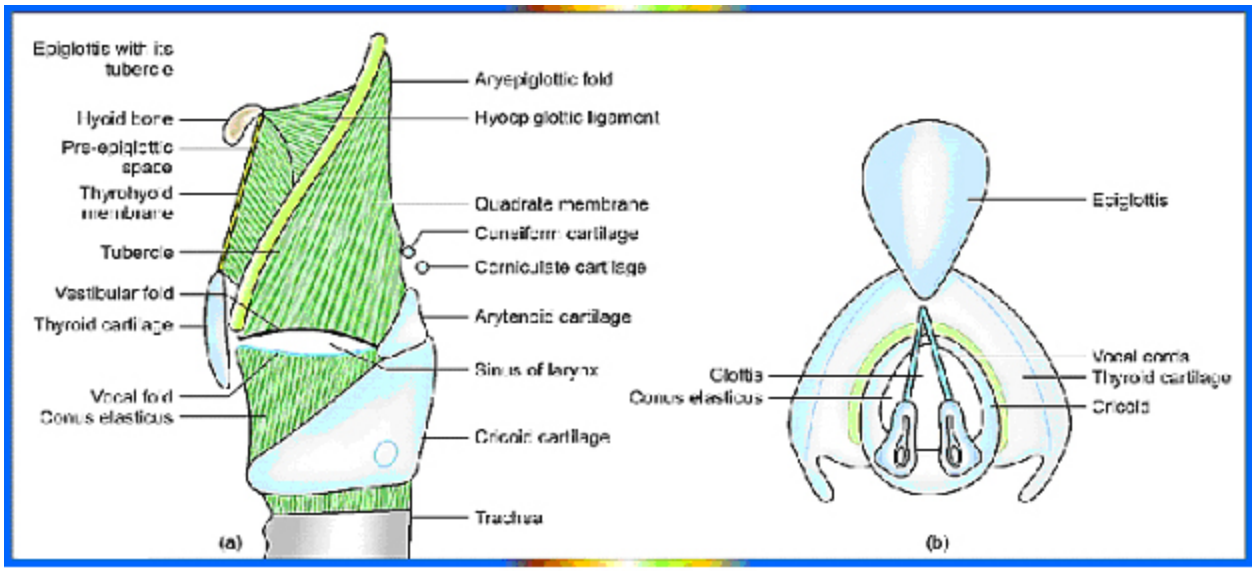
Cartilages are thyroid, cricoid and epiglottis. The thyroid and cricoid are hyaline and epiglottis is elastic cartilage while arytenoid, corniculate and cuneiform are paired elastic cartilages.



Membranes and ligaments are:
Extrinsic: Thyrohyoid, cricothyroid, thyroepiglottic, hyoepiglottic.

Intrinsic: Cricovocal, quadrangular, vocal cords which are parts of cricovocal ligament.

Cricothyroid membrane is made up mainly of elastic tissue and is continuous on the two sides. It is thickened to form median cricothyroid ligament and two lateral cricovocal membranes. The latter are attached to the upper border of cricoid cartilage below and deep to the lamina of thyroid cartilage on each side. Each of this membrane has free thickened upper margin which is attached anteriorly to the back of angle of thyroid at the midpoint of its lower border and thyroid notch and posteriorly to the vocal process of arytenoid cartilage. This free edge of cricovocal membrane is called the vocal cord.



The free lower edge of the quadrangular membrane placed between arytenoid cartilage and epiglottis forms the ventricular fold. The upper free margin of this membrane forms aryepiglottic fold.
Inlet of the larynx is bounded behind by the transverse mucosal fold between the arytenoid cartilages, at the sides and back by aryepiglottic folds and anteriorly by the upper edge of the epiglottis. It faces backwards and upwards. The space between the inlet and vestibular fold is called the vestibule.

Ventricle or sinus of larynx is the horizontal groove formed by outpouching of the mucous membrane between the vestibular and vocal ligaments.

Laryngeal saccule is a pouch of mucous membrane extending from the anterior end of the ventricle between the vestibular fold and the thyroid lamina. Glottis is the space between the two vocal folds (vocal cords). Its anterior 3/5th is formed by the vocal cords while post 2/5th is

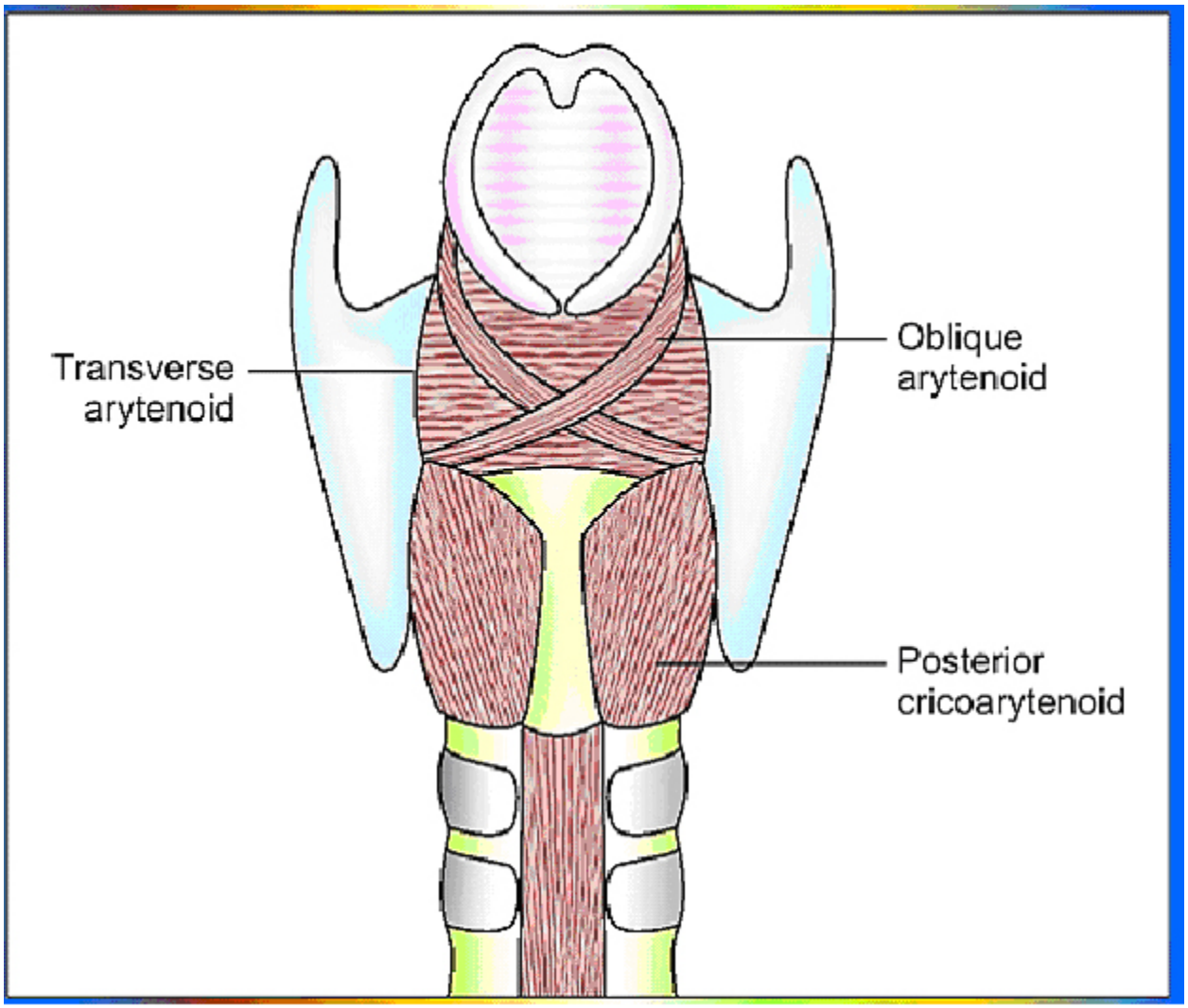
formed by the medial margins of the arytenoid cartilages.

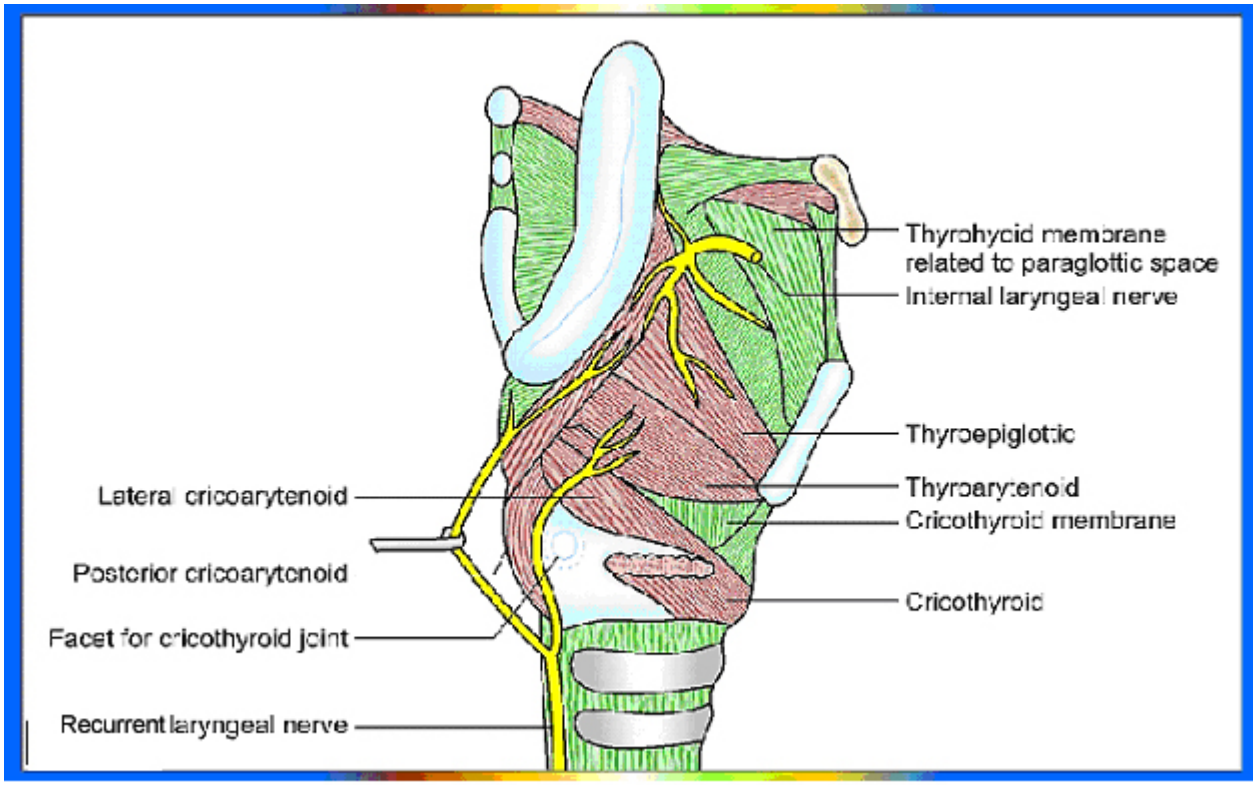
During resting phase or quiet respiration, the glottis is triangular. Its length in females is 1.7 cm and in males it is 2.3 cm. During phonation the vocal cords are adducted. During deep forced breathing the arytenoids move laterally and the glottis is triangular in shape.

MUSCLES OF LARYNX

Extrinsic muscles elevate or depress the larynx. Elevators are mylohyoid, geniohyoid, digastric muscles. Depressors are sternohyoid, sternothyroid.

Intrinsic muscles of larynx are classified according to their actions-
-Closure of inlet – Aryepiglottic muscle.





-Opening of inlet – Thyroepiglottic muscle.
-Tensor of vocal cord-Cricothyroid
-Relaxor of vocal cord-Thyroarytenoid
-Abductor of vocal cord-Posterior cricoarytenoid only.
-Adductor of vocal cord-Lateral cricoarytenoid, transverse arytenoid, oblique arytenoid.

All intrinsic muscles of larynx are supplied by recurrent laryngeal nerve, branch of vagus except cricothyroid which is supplied by external laryngeal nerve and is also placed on the outer aspect of larynx. The fibres of recurrent laryngeal nerve belong to cranial accessory nerve and reach the muscles via vagus nerve. The cell body is present in nucleus ambiguus.

Aryepiglottic muscle arises from the apex of arytenoid cartilage and passes into the aryepiglottic fold to reach the side of epiglottis. It closes the inlet of larynx.
Thyroepiglottic muscle arises from the angle of thyroid cartilage, to reach the side of epiglottis through the aryepiglottic membrane and fold. These abduct aryepiglottic fold and pull the epiglottis anteriorly. It opens the inlet of larynx.

Cricothyroid muscle- It is placed on the outer aspect of laryngeal cartilages. It is triangular in shape. Arises from the lateral aspect of cricoid arch and gets inserted into the inferior horn and lower border (close to the inferior horn) of thyroid cartilage.
The muscles act on both the cricothyroid joints and rock the thyroid cartilage forwards on the

arch of cricoid. Thus it causes tensing of the vocal cords.

Thyroarytenoid muscle arises from the angle of thyroid cartilage and extends to the nterolateral surface of arytenoid cartilage and lateral surface of its vocal process. It pulls the arytenoid forwards causing relaxation of the vocal cords.
Posterior cricoarytenoid muscle arises from back of lamina of cricoid cartilage. Its upper fibres run transversely, middle fibres pass obliquely and lower ones pass vertically to get inserted into the posterior aspect of the muscular process of arytenoid cartilage. The muscle pulls the muscular process medially thus pushing the vocal process laterally and abducting the vocal cord. It is the only abductor of vocal cord and is responsible for opening glottis. It is called “safety muscle”.

Lateral cricoarytenoid muscle arises from the upper border of cricoid arch. It passes backwards and upwards to get inserted into the anterior aspect of muscular process laterally, thus pushing the vocal process medially and adducting the vocal cord.
Transverse arytenoid spans across the posterior surfaces of arytenoid cartilages.
Oblique arytenoid extends between the muscular process of one arytenoid to the apex of the other arytenoid. Both these muscles also cause adduction of vocal cords.

Blood supply-
Superior laryngeal artery-a branch of superior thyroid artery enters the larynx by piercing the thyrohyoid membrane below the internal laryngeal nerve. The vein follows the artery. It supplies upper half of larynx.
Inferior laryngeal artery-a branch of inferior thyroid artery beneath the inferior constrictor muscle. This artery accompanies the recurrent laryngeal nerve for the supply of lower half of larynx.

Nerve supply
Right recurrent laryngeal nerve, a branch of vagus hooks around the right subclavian artery in the neck, while the left nerve hooks around the arch of aorta in the thorax. The nerve of either side enter the pharynx by passing under the lower border of inferior constrictor muscle behind the cricothyroid joint. It usually divides at the level of upper border of isthmus of thyroid gland into anterior motor branch and posterior sensory branch. It then pierces the laryngeal wall’s quadrangular membrane to enter the larynx. It supplies all the intrinsic muscles of larynx. It is sensory to the vocal cords and area of larynx below vocal cords.
If one nerve is completely paralysed the cord takes up paramedian position. Quiet respiration is possible. Any increased volume of air can cause stridor. Initially the voice is hoarse, gradually the voice recovers.

Acute bilateral complete paralysis of recurrent laryngeal nerve–there is inspiratory stridor and tracheostomy is essential.
The recurrent laryngeal nerve runs with inferior thyroid artery close to the gland.
But the two are away from each other away from the gland. So the artery is ligated away from

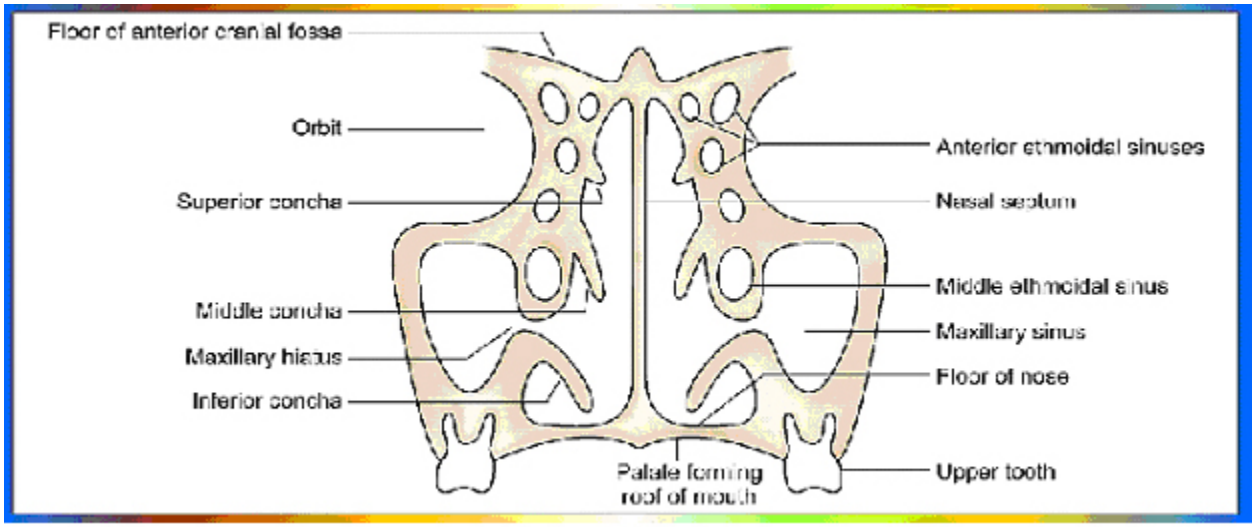
the gland during thyroidectomy.

External laryngeal nerve supplies only one muscle-cricothyroid. It runs with superior thyroid artery. To prevent damage to the nerve during thyroidectomy, the artery is ligated with the apex of the lateral lobe of the gland. Injury to external laryngeal nerve causes temporary hoarseness and monotonous tone of voice.
Sympathetic fibres from middle and inferior cervical sympathetic ganglia are vasoconstrictor in nature and reach the larynx along with blood vessels.

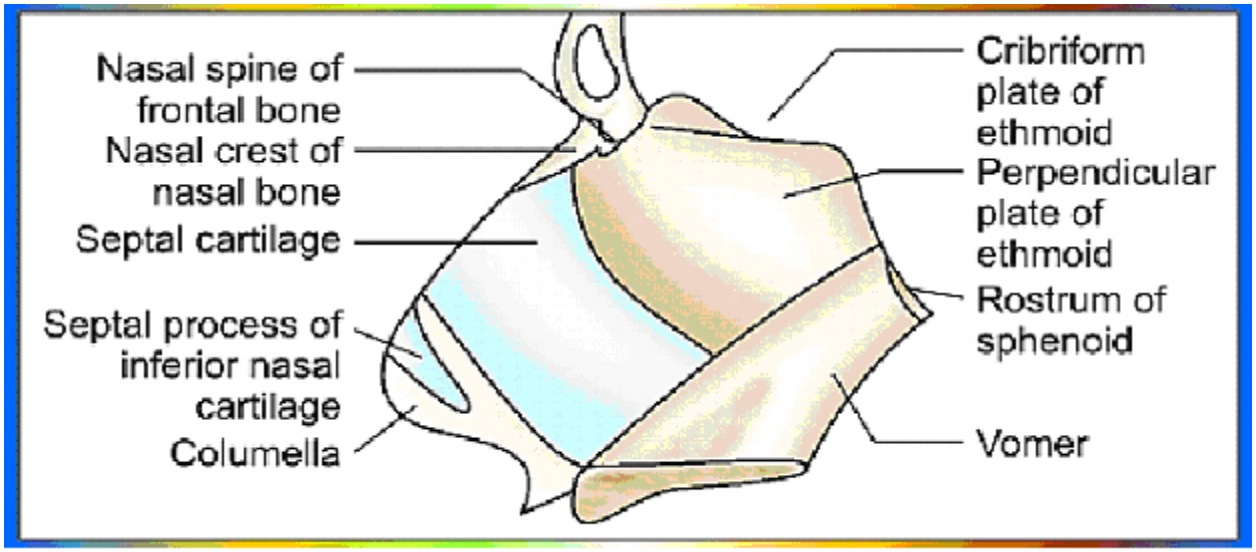
Describe the nasal cavity. Enumerate the arterial and nerve supply of lateral wall of nose and nasal septum.

NASAL CAVITY

Nose is divided into two cavities by the nasal septum. Each nasal cavity opens to exterior by anterior nares and behind into the nasopharynx through posterior nares. Each cavity is made of lateral wall, medial wall, roof and floor.



Roof is formed in the central part by cribriform plate of ethmoid bone, on its anterior slope by nasal spine of frontal bone and nasal bones; and at the posterior slope by body of sphenoid bone.
Floor is formed by hard palate, comprised of palatal process of maxilla and horizontal plate of palatine bone.
Medial wall or septum is formed postero-superiorly by perpendicular plate of ethmoid, postero-inferiorly by vomer and anterosuperiorly by septal cartilage.



Septum is usually deviated to one or other side usually the right side.
Anteroinferior corner of septum is mobile. It is formed by medial crura of paired major alar cartilages.

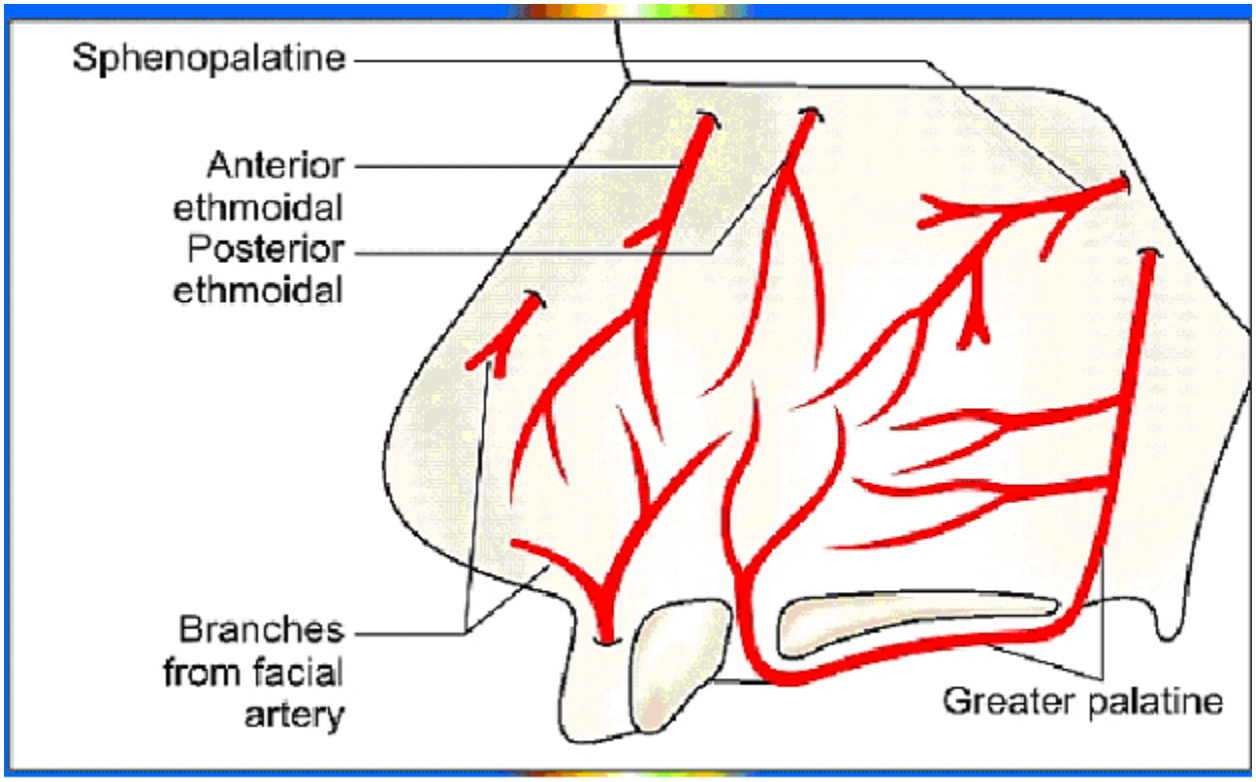
Lateral wall: Formed by the nasal bone and frontal process of maxilla.
Lacrimal bone articulates with frontal process of maxilla and with inferior concha.
It encloses the nasolacrimal duct which opens into the inferior meatus of nose 1 cm behind the anterior end of the concha.
Nasal cavity is broader below and narrower above. Three conchae project from its lateral wall into its cavity. Below the conchae are the respective meatuses, above the superior conchae is the recess called as sphenoethmoidal recess. It receives the ostium of sphenoidal air cells.

Conchae and Meatuses
Superior concha is smallest. Its lower edge overlies the superior meatus. Into this meatus the posterior ethmoidal air cells drain.
Middle concha is positioned between superior and inferior conchae. Both these conchae are parts of ethmoid bone. It overhangs the middle meatus. The flat area in front of the concha is the atrium of nose, The sphenopalatine foramen is situated behind this concha. Middle meatus reveals a bulge “ethmoidal bulla” beneath the concha. It is produced by the bulging of middle ethmoidal air cells which open on the bulla or above it. Anterior and below the bulla is a curved slit-the hiatus semilunaris, which leads into infundibulum. This infundibulum is continuous with frontonasal recess into which frontal air sinus opens. Anterior ethmoidal air cells drain into the infundibulum. Maxillary air sinus drains into the hiatus semilunaris by one or two ostia.
Inferior concha is a separate bone and is the largest concha. It overlies the inferior meatus, into the anterior part of which drains the nasolacrimal duct from the tear-producing lacrimal gland of the body.

Anterial supply-of lateral wall

Anterosuperior quadrant-Anterior ethmoidal assisted by post. ethmoidal arteries.

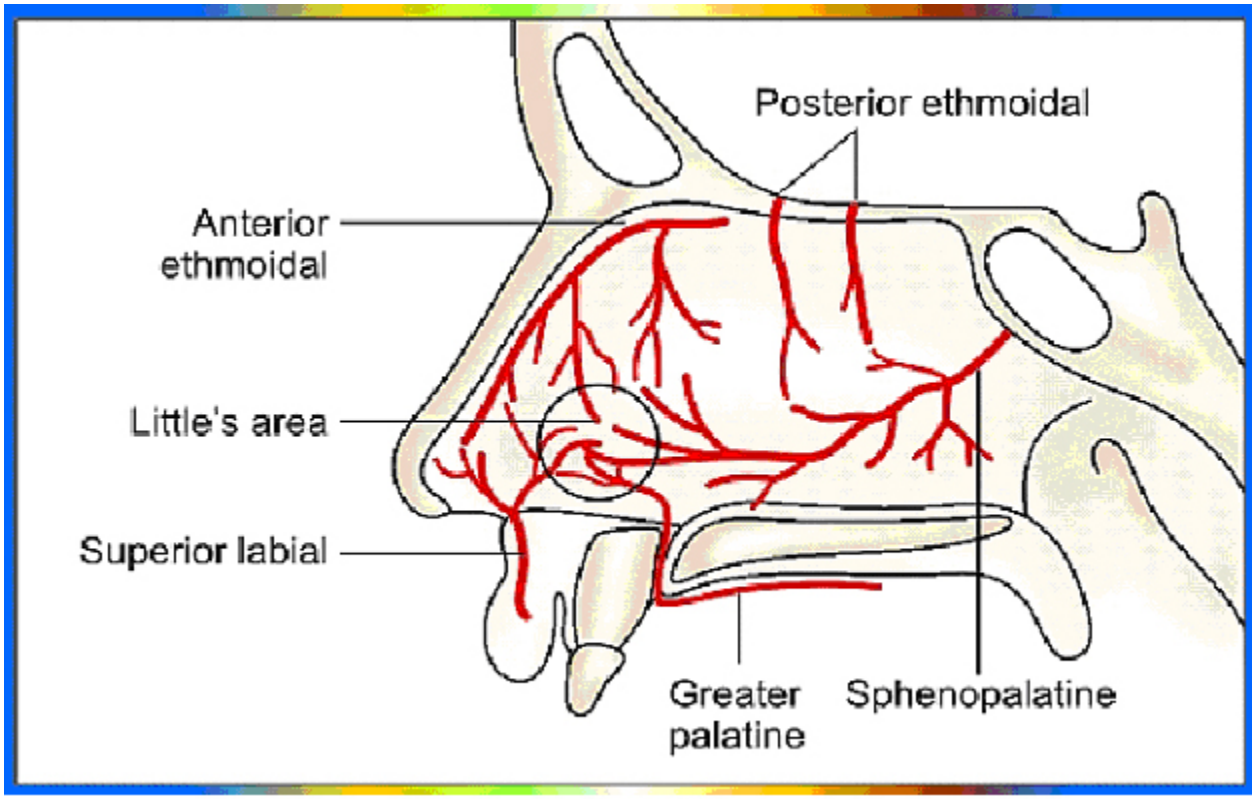
Anteroinferior quadrant-Branches of superior labial branch of facial artery.



Posteroinferior quadrant-Branches of greater palatine artery.

Posterosuperior quadrant-Branch of sphenopalatine artery.

Arterial supply of nasal septum:

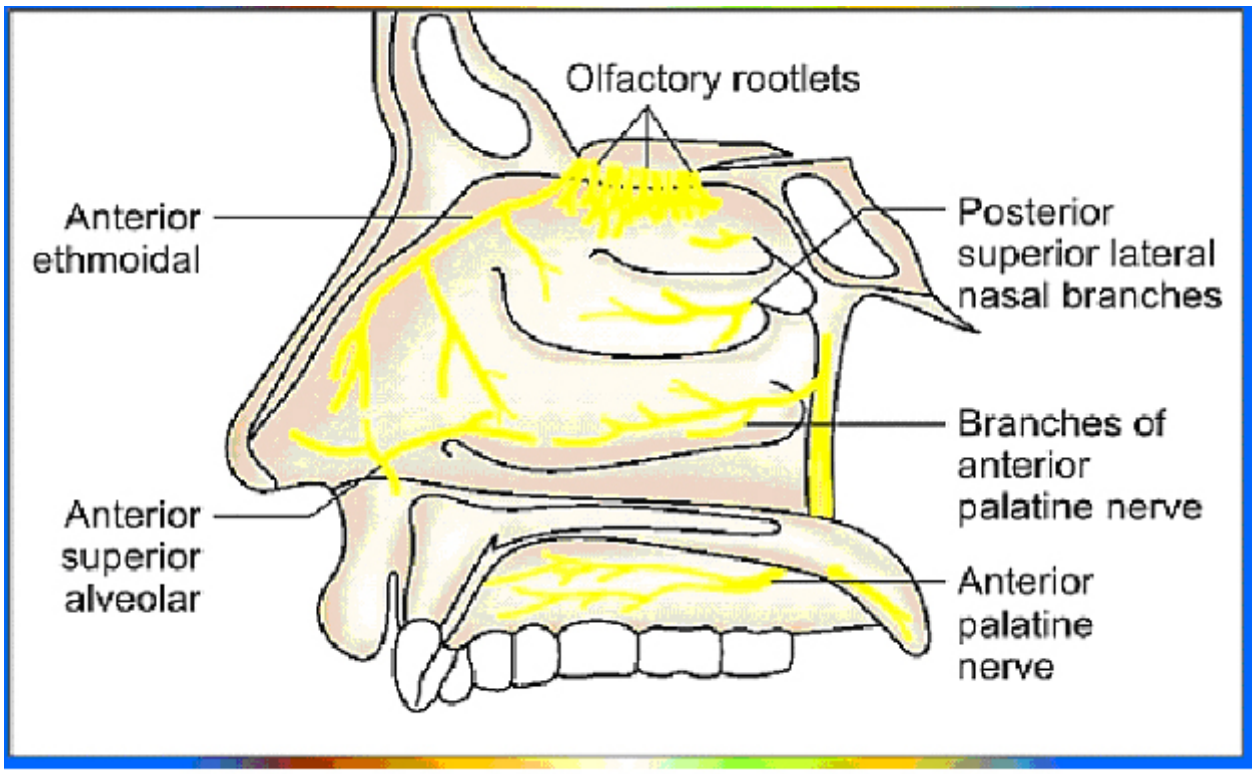


Anterorsuperior part-Anterior and post ethmoidal arteries.

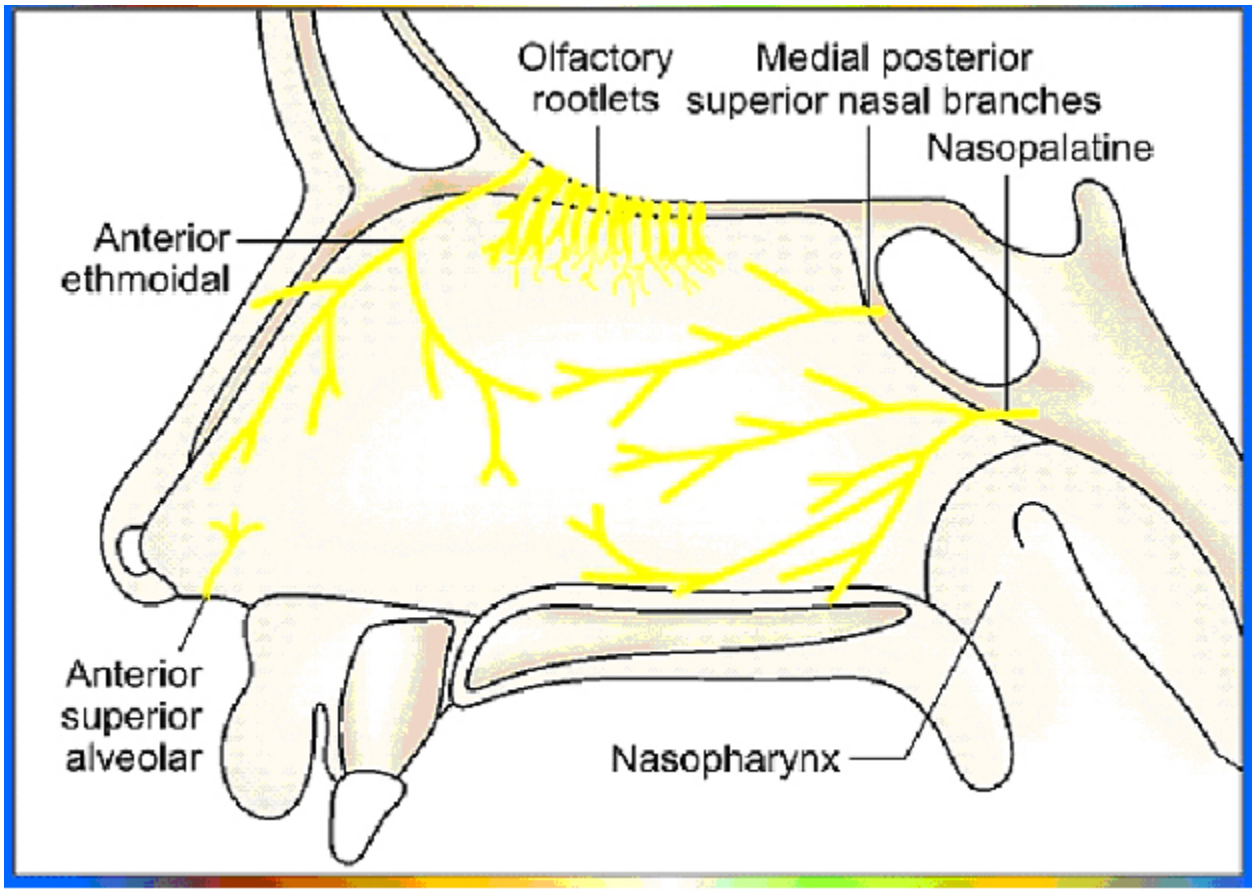
Posteroinf. part-Sphenopalatine artery.

Antero inferior part-Septal branch of superior labial branch of facial artery. These three arteries anastomose in the anteroinferior part of septum. This area is called “Little’s Area”, a common site for epistaxis.

Posterosuperior part – Posterior ethmoidal artery.
Veins accompany the arteries and drain into pterygoid plexus, facial and ophthalmic veins.
Lymphatics drain into submandibular, deep cervical and retropharyngeal lymph nodes.
Nerve supply is of two types-special sense of smell or olfaction and general sensations.
Olfactory area situated in the roof, upper parts of lateral wall and septum are supplied by 1st cranial or olfactory nerve.



The respiratory area of lateral wall is divided into four segments:
Anterosuperior by anterior ethmoidal nerve.
Anteroinferior by anterior superior alveolar nerve.
Posterosuperior by lateral post. sup. nasal branches from pterygopalatine ganglion.



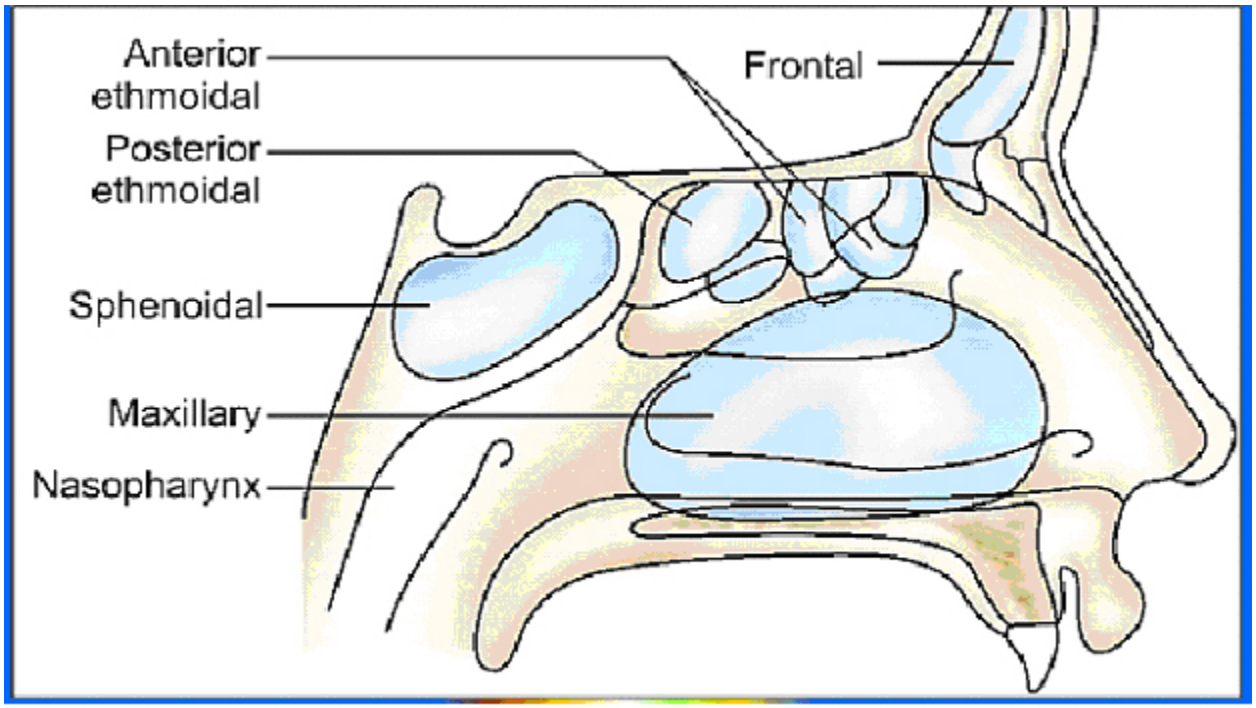
Posteroinferior by nasal branches of anterior palatine nerve.
Nerves of the nasal septum are:
Olfactory in the upper part
Respiratory area is supplied by:
Anterosuperior part by anterior ethmoidal nerve. Posteroinferior part by nasopalatine branch of pterygopalatine ganglion. Posterosuperior part by medial post. sup. nasal branches of pterygopalatine ganglion.

Write short notes on maxillary, ethmoidal and frontal air sinus.

PARANASAL AIR SINUSES
Six pairs of air sinuses are present. All these drain or open into the nasal cavity.

Functions:
Warm up the inspired air.

Humidify the inspired air
Lightens up the weight of skull.
Maxillary and 3 pairs of ethmoidal sinuses are on the sides of lateral wall of nose.
Frontal and sphenoid are close to the median plane, though the septum separating them is hardly ever median, leading to asymmetry of these sinuses.
MAXILLARY AIR SINUS:
It is a air space within the body of the maxilla. It is pyramidal in shape with apex in the zygomatic process of the maxilla. It is 3.5 cm. high, 2.5 cm wide and 3.5 cm.
deep.
Base at the lateral wall of the nose.



Roof of sinus is the floor of orbit.
Floor of sinus is the alveolar part of maxilla.
Behind the sinus are pterygopalatine and infratemporal fossae.
It a just a slit like sinus at birth, it increases at 8 years and then after puberty. The opening or ostium of maxillary sinus is not at its floor but is high up on its medial wall and is 2-4 mm in diameter. It opens at the posterior part of infundibulum in the middle meatus situated in the lateral wall of the nose.

Blood supply- facial, maxillary, infraorbital and greater palatine. Veins follow the arteries to pterygoid venous plexus.

Lymph drainage – To submandibular lymph nodes.

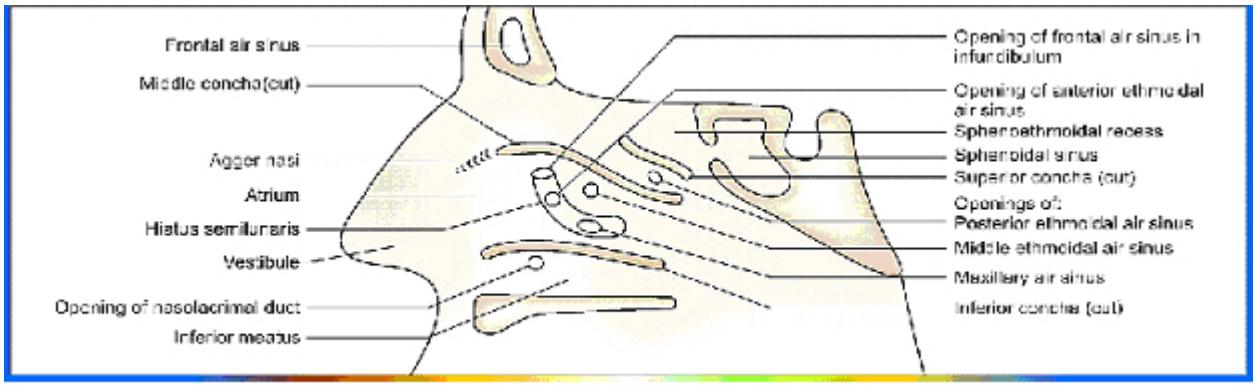
Nerve supply – By branches of maxillary nerve. These are infraorbital and anterior, middle and posterior superior alveolar nerves. These alveolar nerves supply both the upper teeth and the maxillary air sinus.

Clinical – As the opening of sinus is not at its floor it cannot empty completely.
This leads to chronic sinusitis.

ETHMOIDAL SINUSES

Each ethmoidal sinus is present between the lateral wall of nose and medial wall of orbit. Each sinus is divided into a number of cells. These air cells or sinus is divided into three groups anterior, middle and posterior.

Anterior ethmoidal air cells (sinuses) lie in the anterior part of the sinus. These are completed by frontal and lacrimal bone. These drain into the infundibulum in the middle meatus of nose.
Middle ethmoidal air cells also drain into the middle meatus. Some of the air cells project as convexity in this meatus under the middle concha. This convexity is called as “bulla ethmoidalis”. Middle air cells open on the bulla or above the bulla to drain into the middle meatus.
Posterior ethmoidal air cells are present in the posterior part. These drain into the superior meatus of the nose.



Blood supply – Is from branches of anterior and posterior ethmoidal, supraorbital and sphenopalatine arteries. Veins drain into facial, maxillary and superior ophthalmic veins.

Lymph drainage – Into retropharyngeal and submandibular lymph nodes.

Nerve supply – Anterior ethmoidal nerve for anterior and middle ethmoidal air cells. Post. ethmoidal nerve for posterior ethmoidal air cells. Branches from lateral posterior superior nasal nerves (of pterygopalatine ganglia) also supply these sinuses. So pain can be referred both to ophthalmic and maxillary divisions of V nerve.

FRONTAL AIR SINUS

These are not present at birth, but appear at the age of two years. It extends above the

eyebrow and into medial part of roof of orbit. The sinuses of two sides are asymmetrical as the septum is not median. This sinus drains through the anterior end of infundibulum into the middle meatus of nose.

Blood supply – By supraorbital and anterior ethmoidal arteries Veins drain into facial and superior ophthalmic veins.

Lymph drainage- Into the submandibular lymph nodes.

Nerve supply- By supraorbital nerve.

SPHENOIDAL AIR SINUS
Pair of these sinuses are situated in the body of sphenoid bone. These are not symmetrical. It lies beneath the pituitary fossa to extend into the basiocciput. At birth these are very small and enlarge after puberty. The sinus drains through its ostium into the sphenoethmoidal recess (above the superior meatus of nose).

Blood supply: By the posterior ethmoidal artery. Veins drain into ophthalmic veins.
Lymph drainage: Is into the retropharyngeal nodes.
Nerve supply: By the posterior ethmoidal nerve.

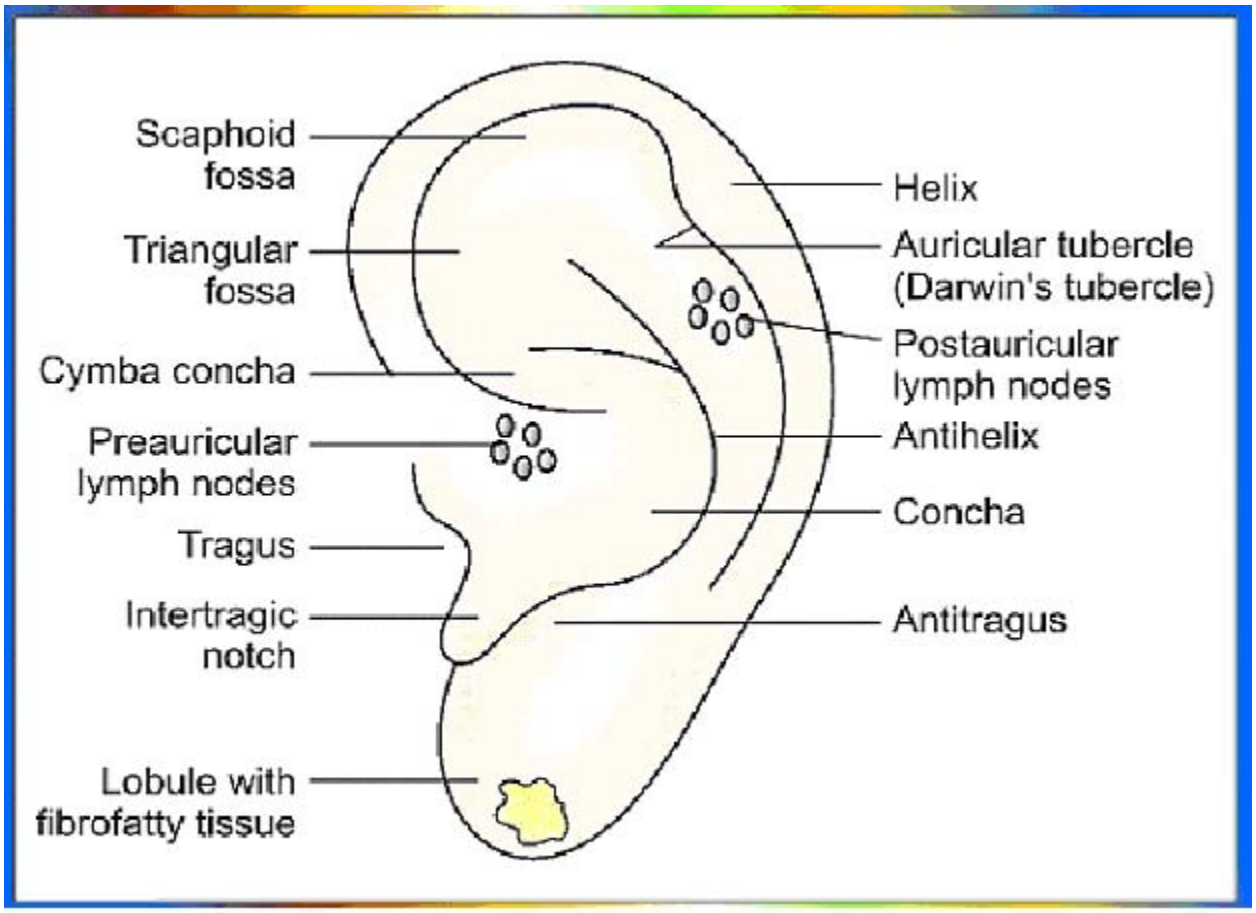
Describe boundaries, contents, nerve supply, blood supply and applied significance of tympanic cavity. Write a note on the auditory tube.

EAR
External ear
Auricle is made up of yellow elastic cartilage. It is prolonged inwards as the cartilaginous part of external auditory meatus. The meatus is a sinuous tube 3 cm in length. Its anteroinferior wall is longest and posterosuperior wall is the shortest.
Outer third is cartilaginous while inner two-thirds is bony.

Blood supply of auricle and meatus-Posterior auricular artery- a branch of external carotid artery; superficial temporal artery-branch of external carotid artery; deep auricular-branch of maxillary artery.
Veins drain into corresponding veins

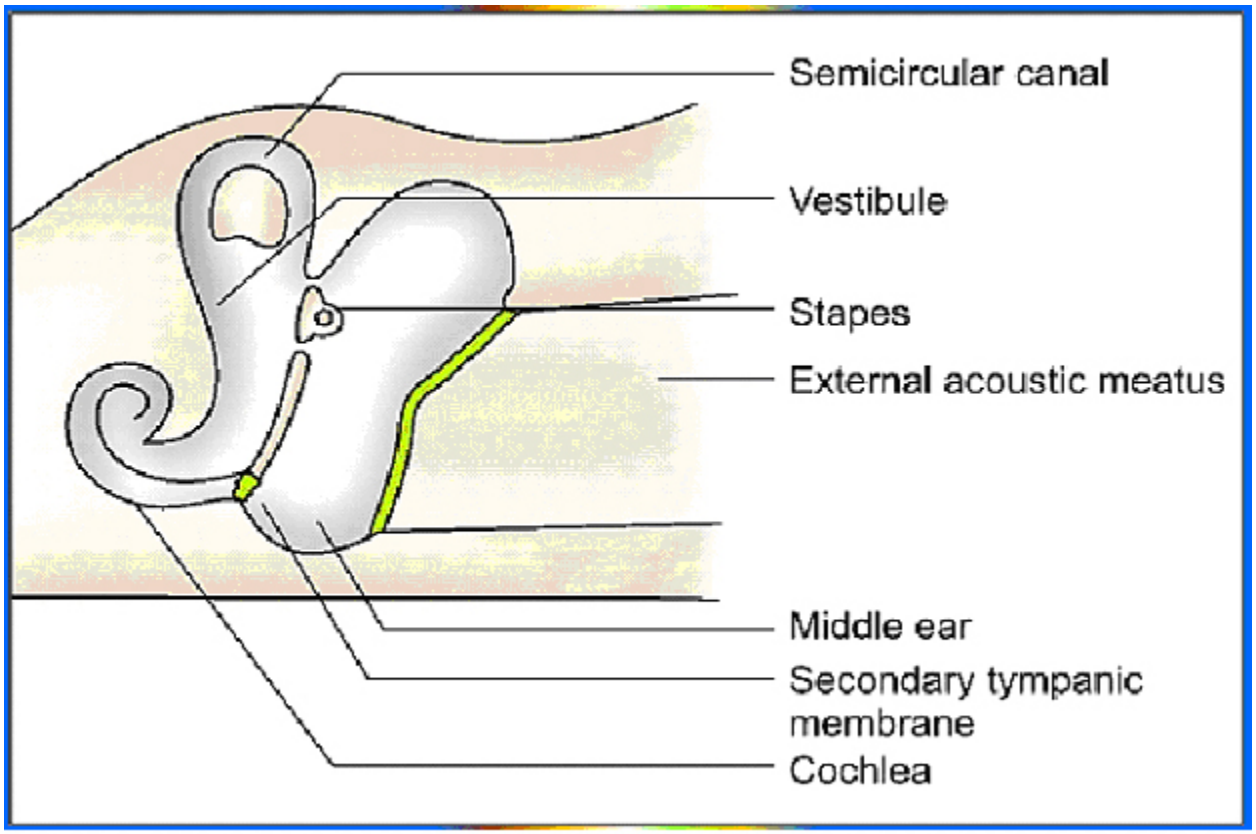
Nerves are derived from:-
Great auricular-Ventral ramus of cervical 2 and C3, auriculotemporal from mandibular nerve, and auricular branch of vagus.
Vagus nerve supplies heart being cardio-inhibitory, It also supplies oesophagus and stomach

being secretomotor to stomach. So over stimulation of vagus during syringing may cause slowing of heart beat and sensation of vomiting and giddiness.



Middle Ear: It is an air space in the temporal bone. It contains 3 ossicles–Malleus, incus and stapes. Auditory tube is in the anterior wall of middle ear and mastoid antrum and mastoid air

cells are in the posterior wall. There are 2 muscles in the cavity.

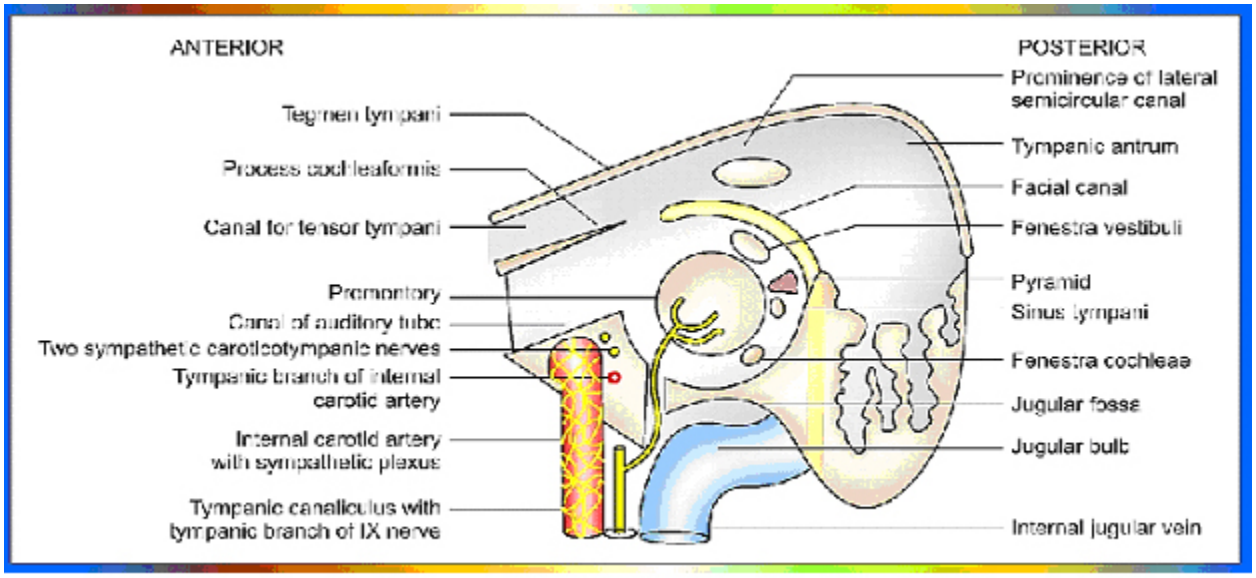


Tympanic cavity-It is only 15 mm in AP and vertical diameters. It is box like cavity with lateral and medial walls bulging towards each other. It consists of roof, floor, lateral, medial, anterior and posterior walls.

Roof- Tegmen tympani, which also forms roof of canal for tensor tympani muscle and mastoid antrum. Above this thin plate of bone lie the meninges and the temporal lobe of brain. Infection in thin plate may cause meningitis and temporal lobe abscess.

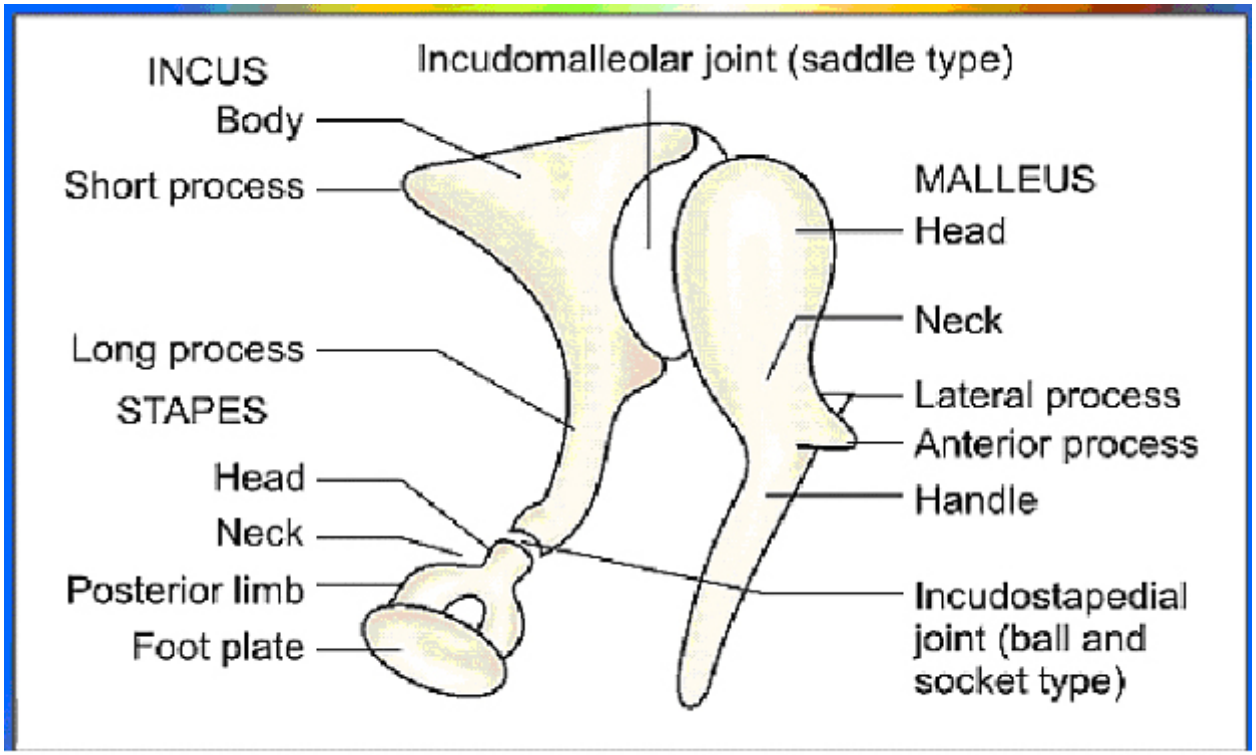
Floor- Thin plate of bone above the jugular fossa containing terminal end of sigmoid sinus. Infection through this plate may cause of thrombosis of sigmoid sinus.

Anterior wall- Is perforated by two canals. Lower and larger is the bony part of auditory tube and upper and smaller is the canal for tensor tympani muscle.
Auditory tube opens into the nasopharynx. Infection from nasopharynx may travel along the tube into tympanic cavity leading to otitis media and further extends into posterior wall resulting in mastoiditis.



Posterior wall- Contains an aditus in the upper part which leads back into the mastoid antrum, Aditus connects the epitympanic recess to the mastoid antrum.
The lateral wall of mastoid antrum corresponds to suprameatal triangle at the posterosuperior margin of external auditory meatus. Lies 15 mm deep to the surface of bone in adults. Groove for facial canal and bulge due to lateral semicircular canal continue backwards along the medial wall of the aditus.

Inferior to aditus is small projection called as pyramid which contains stapedius muscle. The apex of pyramid is pierced by this muscle.
Lateral wall- formed by tympanic membrane, above which is the epitympanic recess.



Tympanic membrane is made up of collagen fibres covered externally by stratified squamous epithelium and internally by low columnar epithelium. It is placed obliquely at 55° with external auditory meatus. It is concave towards the meatus.

The handle of malleus is attached to the internal surface of the membrane. Two thickened folds, the malleolar folds diverge up to the margins of tympanic bone, enclosing the “pars flaccida”. The membrane fits into the groove in the tympanic plate.

Blood Supply-Deep auricular on meatal side and stylomastoid branch on mucosal side. Veins follow the arteries.

Nerve supply-Auriculotemporal and vagus on meatal side, tympanic plexus (of 1X) on mucosal side.

Medial wall-Contains a prominent promontory due to first turn of cochlea. Above the promontory lies a ridge for facial nerve. Still above it is present the bulge due to lateral semicircular canal. The oval window present above and behind promontory is closed by foot plate of stapes.
Below and behind is present the round window closed by the secondary tympanic membrane.

Ossicles: Malleus is laterally placed ossicle. Head is placed in the epitympanic recess. Narrow neck lies against the “pars flaccida” of tympanic membrane.
Handle projects downwards till the umbo.
Incus possesses a large body and two delicate processes. Body also lies in the epitympanic

recess and articulates with head of malleus. Long limb lies parallel to handle of malleus. The tip of long limb articulates with stapes.
Stapes is the smallest ossicle. Its small head articulates with incus. Neck is narrow and is prolonged into two limbs attached to the base. Base articulates with the oval window in the medial wall of middle ear.

Muscles:
Tensor tympani muscle arises in the canal for the muscle present in the anteriorwall of middle ear. The tendon turns its direction and gets inserted into the handle of malleus present in the lateral wall of middle ear.
It is supplied by a branch from nerve to medial pterygoid which in turn is a branch of mandibular nerve. Its contraction makes the tympanic membrane more concave and tense.
Stapedius is a delicate muscle arising from the inside of pyramid. Its tendon perforates the apex of pyramid to be attached to neck of stapes. Being supplied by facial nerve it retracts the neck of stapes. Thus it prevents very high pitched sounds from reaching the delicate internal ear.

Vascular supply
Anterior tympanic from maxillary, stylomastoid from posterior auricular, tympanic branches from internal carotid. Venous drainage into pterygoid venous plexus.
Lymphatics drain into parotid and deep cervical nodes.
Nerve supply- Tympanic plexus formed by tympanic branch of 1X-nerve and sympathetic fibres from internal carotid.

AUDITORY TUBE
Joins nasopharynx and tympanic cavity. It is 3 cm long. Consists of medial cartilaginous part which is 2 cm long and lateral bony part which is 1 cm long.

Cartilaginous part- It is made of elastic cartilage. Its medial end forms tubal elevation in the lateral wall of nasopharynx. During childhood the mucous membrane of tubal elevation contains lymphoid follicles. This is called as tubal tonsil. A fold descends from the posterior end of tubal end. This fold is known a salpingopharyngeal fold. It is covered by the muscle of same name.

Bony part- It is one cm. long and forms the lateral part of the tube. The junction of bony and cartilaginous parts is the isthmus and is narrowest part of the tube.
Levator veli palatini and tensor veli palatini are closely related to auditory tube.
Tensor veli palatini lies lateral to the tube outside the pharynx, while levator palati is situated medial to the tube inside the pharynx. Further the pharyngobasilar fascia is attached to the lower part of the tube. During swallowing this tube is kept patent due to the attached muscles and permits air pressure on two sides of the tympanic membrane to be equalised.

Blood supply- Ascending pharyngeal artery and middle meningeal artery. Veins drain into pharyngeal plexus. Lymph drains into retropharyngeal lymph node.

Nerve Supply- By pharyngeal branch of pterygopalatine ganglion.

Clinical Terms of Head and Neck.

Anaesthetist's arteries: These are the arteries used by the anaesthetist who are sitting at the head end of the patient being operated. The superficial temporal artery as it crosses the root of zygoma in front of ear and facial artery at the anteroinferior angle of masseter muscle are mostly used by the anaesthetist. The common carotid at the anterior border of sternocleidomastoid is also used by the anaesthetist.

Hilton's method of draining parotid gland abscess: The incision given to drain parotid abscess is the horizontal incision. This incision does not endanger the various branches of facial nerve, coursing through the gland.

Frey's syndrome: The sign of Frey's syndrome is the appearance of perspiration on the face while the patient eats food. In certain wounds, the auriculotemporal nerve and great auricular nerves may join with each other. When the person eats food, instead of saliva, sweat appears on the face.

Waldeyer's ring: It is the ring of lymphoid tissue present at the oropharyngeal junction. Its components are lingual tonsil anteriorly, palatine tonsils laterally, tubal tonsils above and laterally and pharyngeal tonsils posteriorly.

Killian's dehiscence: Killian's dehiscence is a potential gap between upper thyropharyngeus and lower cricopharyngeus parts of inferior constrictor muscle.
Thyropharyngeus is the sphincteric part of the muscle, supplied by recurrent laryngeal nerve. If there is incoordination between these two parts, bolus of food is pushed backwards in region of Killian's dehiscence, producing pharyngeal pouch or diverticula.

Safety muscle of larynx: Posterior cricoarytenoid muscle is the only abductor of vocal cords. The paralysis of both these muscles cause unopposed adduction of vocal cords, with severe dyspnoea. So posterior cricoarytenoid is the life saving or safety muscle.

Singer's nodules: These are little swellings on the vocal cords at the junction of anterior and middle thirds of vocal cords. During phonation, the cords come close together, and there is slight friction as well. If friction is more and continuous, there is some inflammation with thickening of vocal cords, leading to singer's or teacher's nodules.
Tongue is pulled out during anesthesia: Genioglossus muscle are responsible for protrusion of tongue. If these muscles are paralysed the tongue falls back upon itself and blocks the airway.

So tongue is pulled out during anaesthesia to keep the air passage clean.

Passavant's ridge: The horizontal fibres of right and left palatopharyngeus muscles form a passavant's fold at the junction of nasopharynx and oropharynx.
During swallowing, palatopharyngeus muscles form a ridge, which closes nasopharynx from oropharynx, so that bolus of food passes, through oropharynx only. In paralysis of this muscle there is nasal regurgitation.

Ludwig's angina: When there is cellulitis of floor of the mouth, due to infected teeth, the condition is known as Ludwig's angina. The tongue is pushed upwards and mylohyoid is pushed downwards. This cellulitis may spread backwards to cause oedema of larynx and asphyxia.

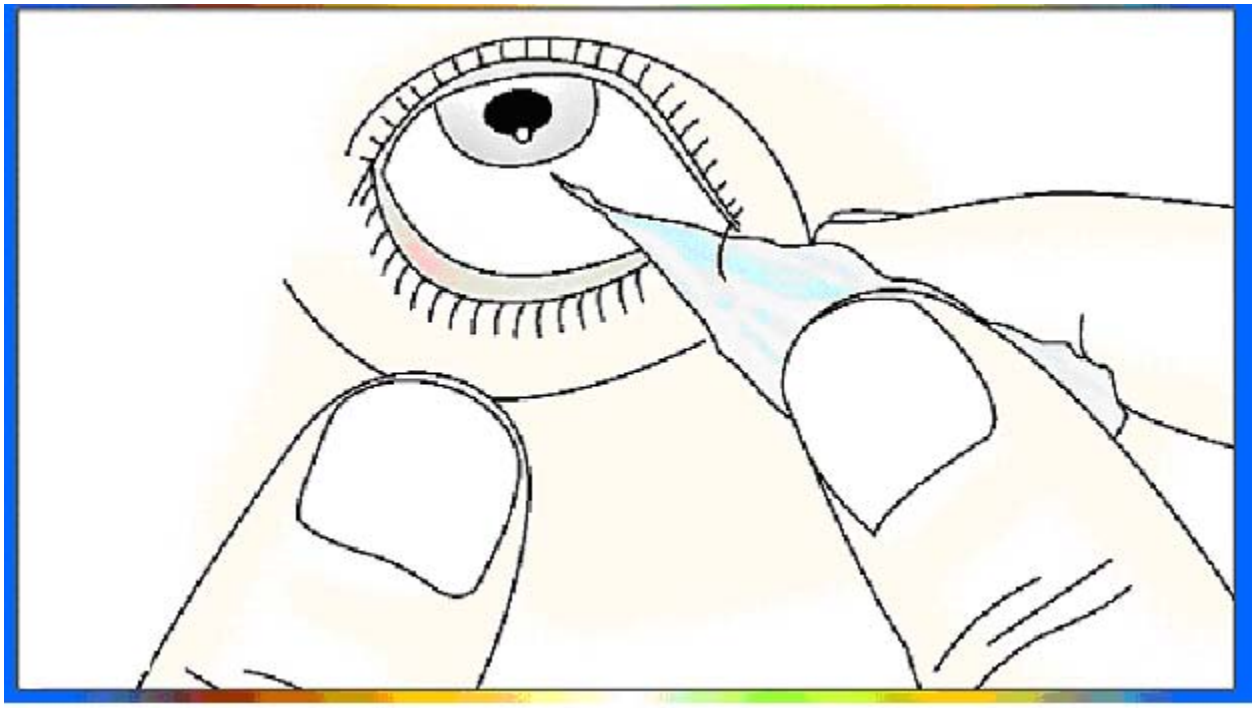
Little's area of nose: This is the area in the anteroinferior part of nasal septum.
Three arteries take part in Kiesselbach's plexus formed by, septal branch of superior labial of facial artery, branch of sphenopalatine artery and branch of anterior ethmoidal artery. Picking of the nose may give rise to nasal bleeding or epistaxis.
Syringing of ear causes decreased heart rate: The external auditory meatus is supplied by auricular branch of vagus. Vagus also supplies the heart with cardio-inhibitory fibres. During syringing of the ear, vagus nerve is stimulated which causes bradycardia. So one must be very careful while syringing the ear.

Nerve of close vision: Oculomotor nerve is the nerve of close vision. It supplies medial rectus, superior and inferior recti, which adduct the eyeball. In addition it also supplies sphincter pupillae and ciliaris muscles used in accommodation. It also supplies levator palpebrae superiors which opens the eye.

Injury to spine of sphenoid: Chorda tympani nerve is related on the medial side of spine of sphenoid, while auriculotemporal nerve is related to the lateral side of spine of sphenoid. Chorda tympani gives secretomotor fibres to submandibular and sublingual salivary glands, whereas auriculotemporal gives secretomotor fibres to the parotid gland. So injury to spine of sphenoid may injure both these nerves affecting the secretion from all three salivary glands.

Extradural haemorrhage: There is collection of blood due to rupture of middle .
meningeal vessels in the space between skull and the endosteum or outer layer of
dura mater. It may press upon the motor area of brain. Blood has to be drained out from the point called 'pterion'.

Loss of corneal blink reflex: In case of injury to ophthalmic nerve, there is loss of corneal blink reflex as the afferent part of reflex arc is damaged.



Loss of sneeze reflex: In injury to maxillary nerve, the sneeze reflex is lost, as afferent loop of the reflex arc is damaged. Afferent limb is by the maxillary nerve.
Loss of jaw jerk reflex: The afferent and efferent limbs of the reflex are is by 5th nerve. Damage to mandibular nerve causes loss of jaw jerk reflex.