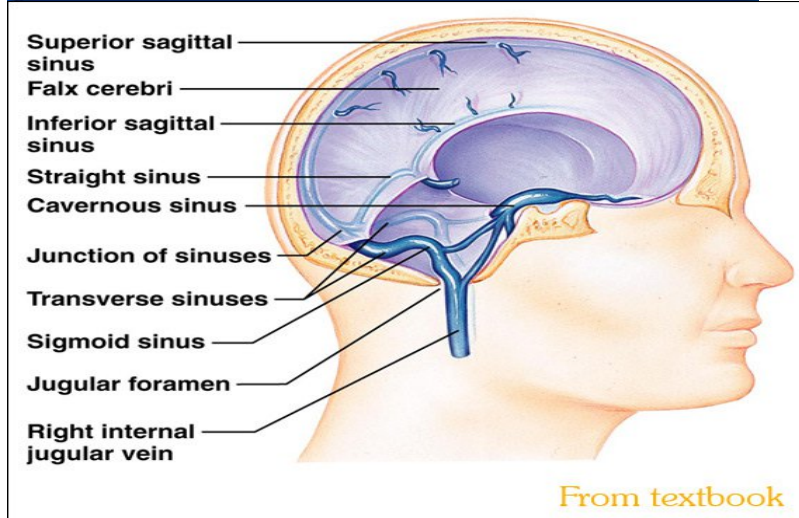
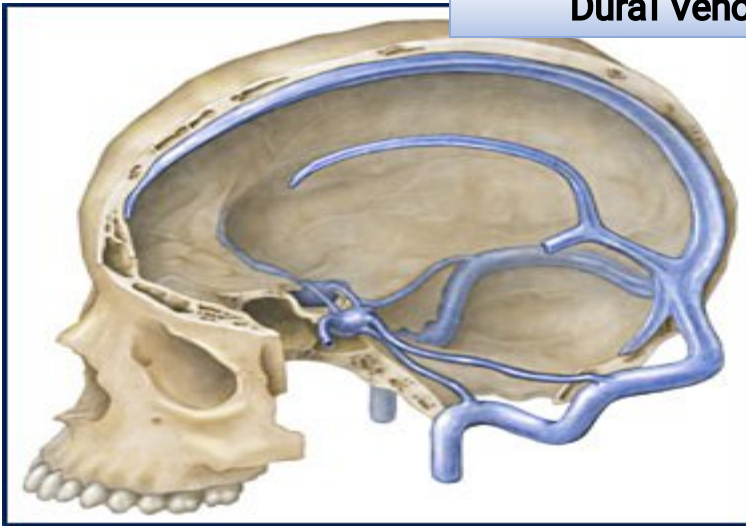
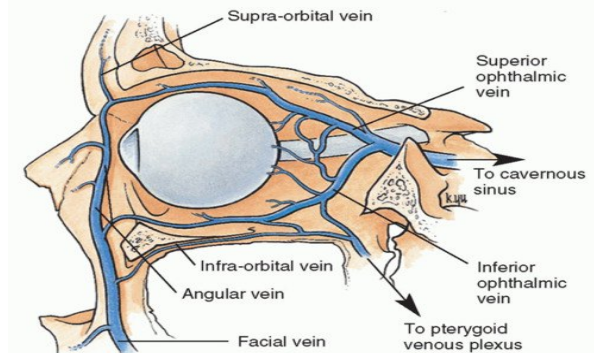


Dural Venous sinus



Superior sagittal sinus

occupies the attached convex margin of falx cerebri
it becomes the **right** transverse venous sinus



there is venous communication between the nasal mucosa and superior sagittal sinus via **emissary** vein that goes through the **foramen cecum** which lies in front of crista galli

Straight sinus:

it becomes the **left** transverse sinus
receives greater cerebral vein

Transverse sinus: becomes sigmoidal sinus

superior +inferior ophthalmic veins: drain into the cavernous sinus

cavernous sinus: drain into superior +inferior petrosal sinuses

superior petrosal: drain into the transverse sinus

inferior petrosal vein: drain into the internal jugular vein

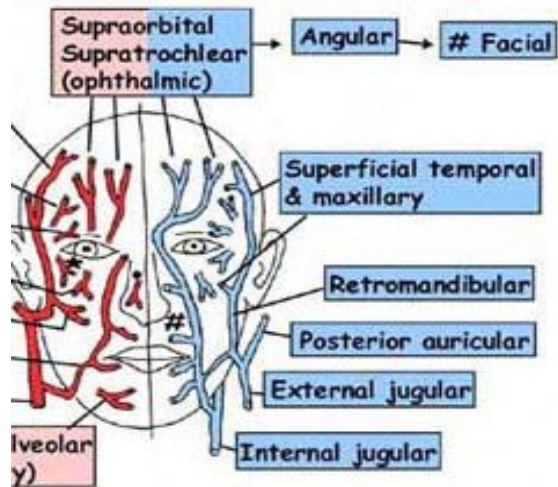
Note: the **sigmoid sinus** is **posteriomedial** to the **mastoid**, so ear infection may lead to sinus thrombophlebitis, otitic hydrocephalus

Venous drainage and connection:

Inferior orbital vein has several connections

- 1- drain with the superior ophthalmic vein through the superior orbital fissure into the **cavernous sinus**

2-



orbital fissure

send branch to **pterygoid plexus** through the inferior

3- communicates with the **facial vein**

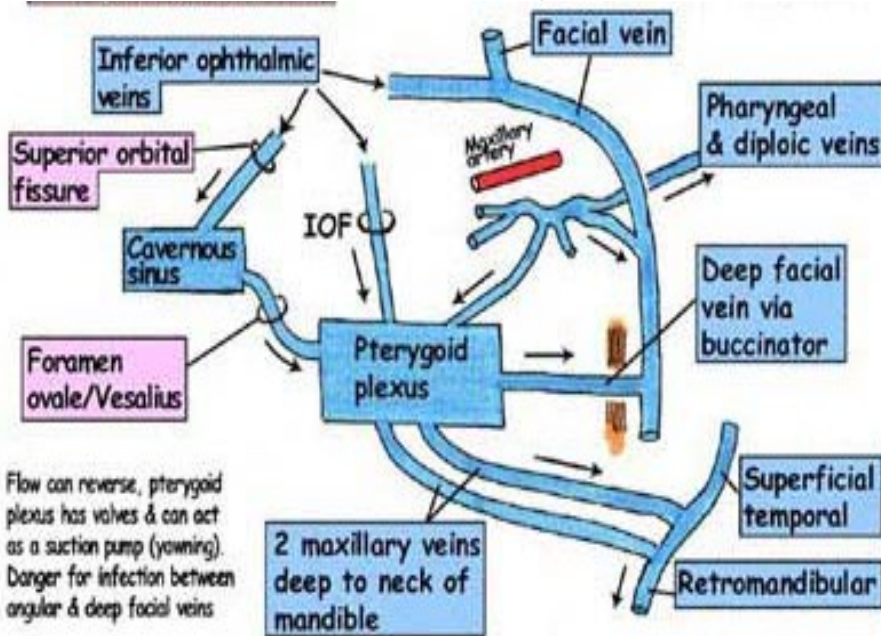
cavernous sinus has connection with pterygoid plexus by **emissary vein** via foramen **ovale**

Pterygoid plexus drain through 2 maxillary veins

Superficial temporal vein + maxillary veins = **retromandibular vein**

Retromandibular vein + posterior auricular vein = **external jugular**

Supraorbital + subratrochlear vein = **angular facial vein**



Flow can reverse, pterygoid plexus has valves & can act as a suction pump (yawning). Danger for infection between angular & deep facial veins

Facial vein drain into **internal**

jugular vein

Cavernous sinus Syndrome

The most common cause is **ethmoiditis**

The most common microorganism: **coagulase +ve staph aureus**

80 % fatal

Nerves that are involved: II, III,IV,V1

The ophthalmic vein & artery are also involved

Symptoms:

Fever

Venous congestion of lid ,retina, conjunctiva

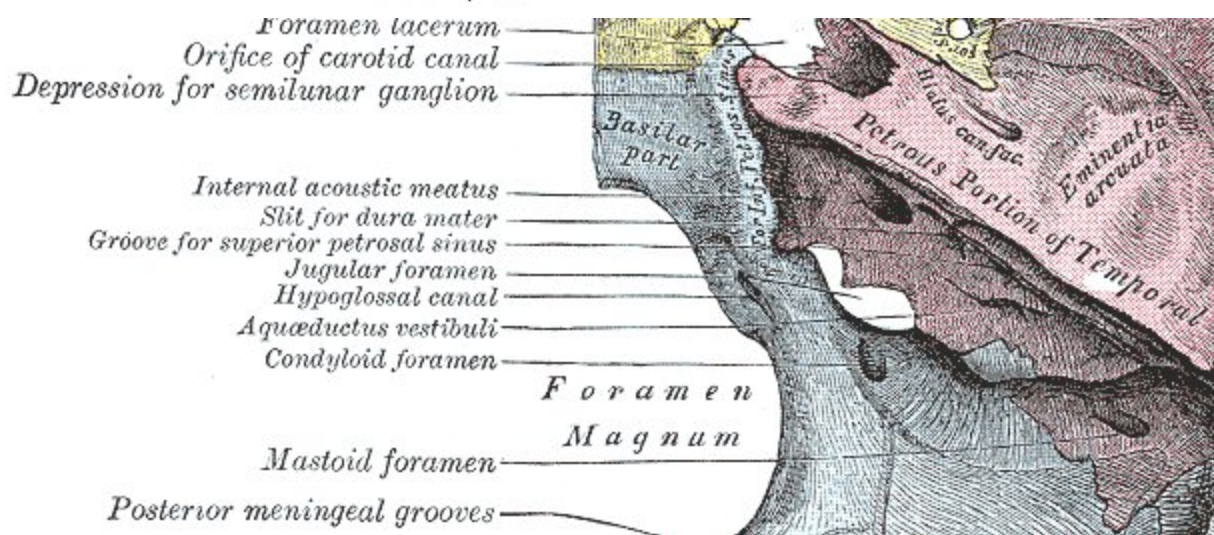
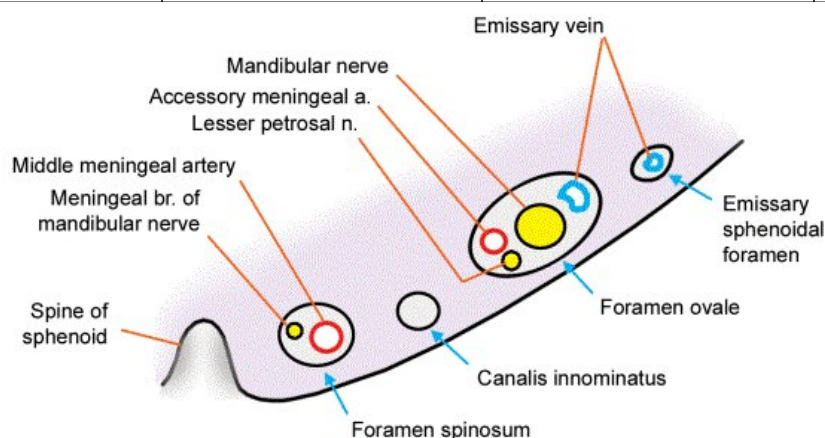
Exophthalmus

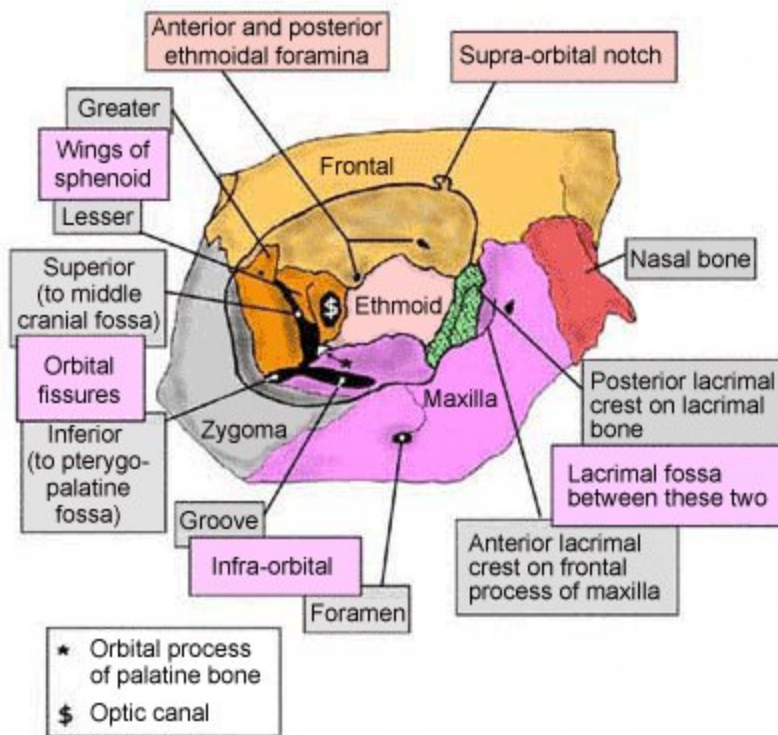
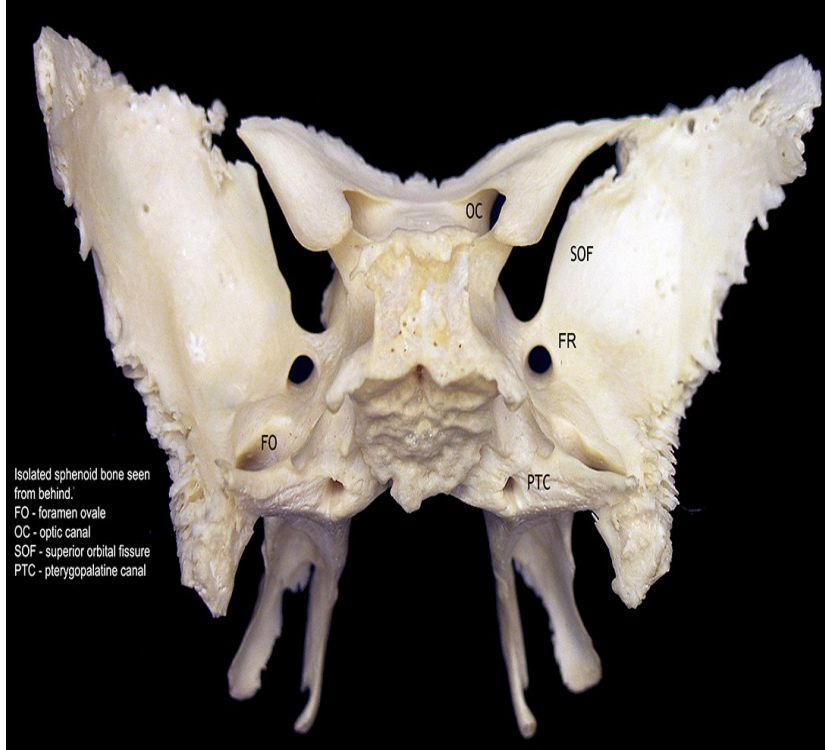
Photophobia

Ophthalmoplegia

Foramen	Location	Nerve	Artery	Vein
Foramen cecum (allows communication between the nasal cavity & the sphenoid sinus)	In front of crista galli			Emissary vein between the nose & sup sagittal vein
Foramen ethmoidale	Ethmoid bone	Olfactory nerve I		
Optic canal	Curvilinear portion of the lesser wing	Optic nerve II	Ophthalmic artery	
Superior orbital fissure	Between the greater & lesser wings Medially lies the sphenoid body	Nerve III,IV,VI Ophthalmic division of trigeminal nerve (V1)	Orbital branch of middle Meningeal artery Recurrent branch of lacrimal artery	Superior Ophthalmic vein Superior orbital vein
Inferior orbital fissure	Between the greater wings & orbital surface of the maxilla & orbital process of the palatine bone	Infraorbital nerve Zygomatic nerve Small branches from sphenopalatine ganglion to the lacrimal gland	Infra-orbital vessels	Branch of inferior Ophthalmic vein that drain into pterygoid plexus
Foramen rotundum		Terminal branch of V2		
Foramen ovale	Greater wing of sphenoid	Maxillary division of trigeminal nerve (V2)		
Foramen spinosum	Greater wing of sphenoid	Mandibular division of Trigeminal nerve (V3) Lesser petrosal nerve (IX) Otic ganglion : is situated directly under the foramen in pterygopalatine fossa, but is also transmitted through the foramen ovale	Accessory Meningeal artery	Emissary veins : from the cavernous sinus to the pterygoid plexus
Foramen spinosum	Greater wings of sphenoid	Meningeal branch of Mandibular division	Middle Meningeal artery	middle meningeal vein

Foramen lacerum	Greater wings of sphenoid	(V3)		
Foramen lacerum	Between greater wings of Sphenoid bone Petrous tip basilar part of occipital bone		Internal carotid artery	
Foramen acoustic	Petrous part of temporal bone	Facial nerve Vestibulochochlear N	Labyrinthine artery	
Foramen foramen	Between the occipital & temporal bone	IX,X,XI	Meningeal artery	Inferior & transverse petrosal vein Jugular vein
Foramen glossal canal	Entrance: Medial aspect of the occipital bone Exit: lateral to occipital condyle	Hypoglossal nerve	Meningeal artery	
Foramen magnum	Occipital & sphenoid bone	Spinal root of Accessory nerve		
Foramen opalatine			Sphenoplatine artery	





Note: Foramen rotundum: pterygoid fossa: inferior orbital fissure

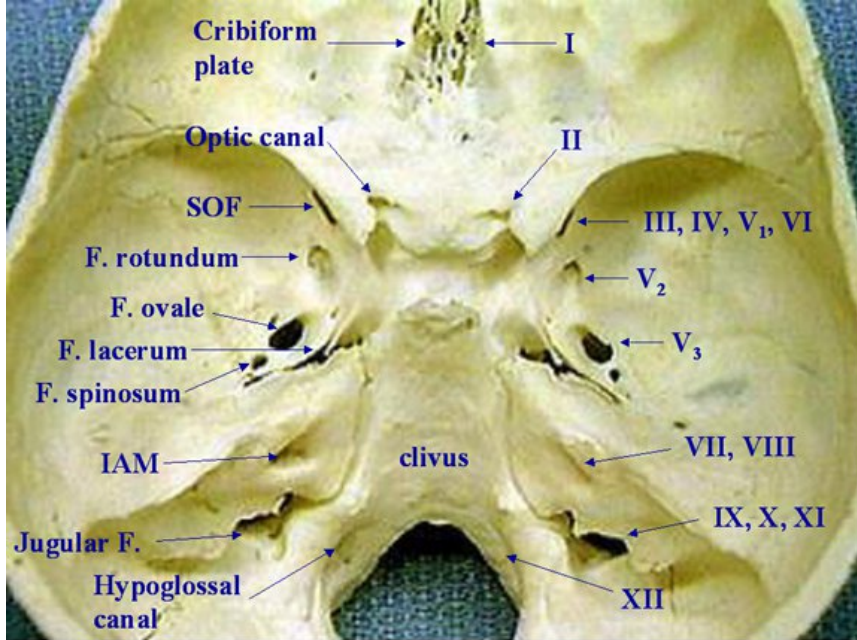
V2 goes through **foramen rotundum**

Terminal branch of V2 (**infra-orbital branch**) goes through the **infra-orbital foramen**

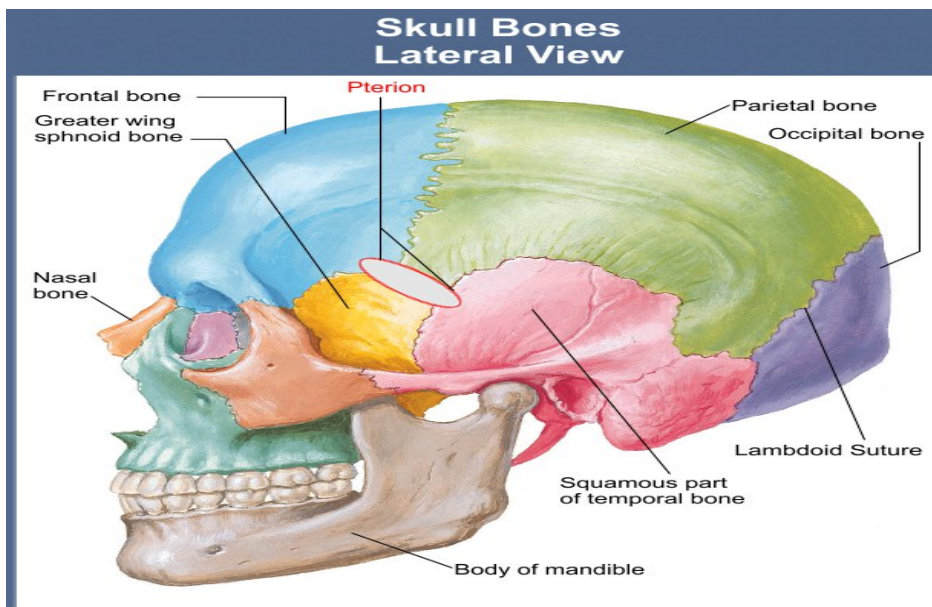
Note: in 40% an emissary venous sphenoid foramen is found, related to foramen ovale

note: the lesser superficial petrosal nerve sometimes passes through a special canal (canaliculus innominatus of Arnold), situated **medial** to the foramen spinosum)

The contents of this foramen neatly form the mnemonic '**OVALE**' (otic ganglion, V₃, accessory meningeal artery, lesser petrosal nerve, emissary veins).



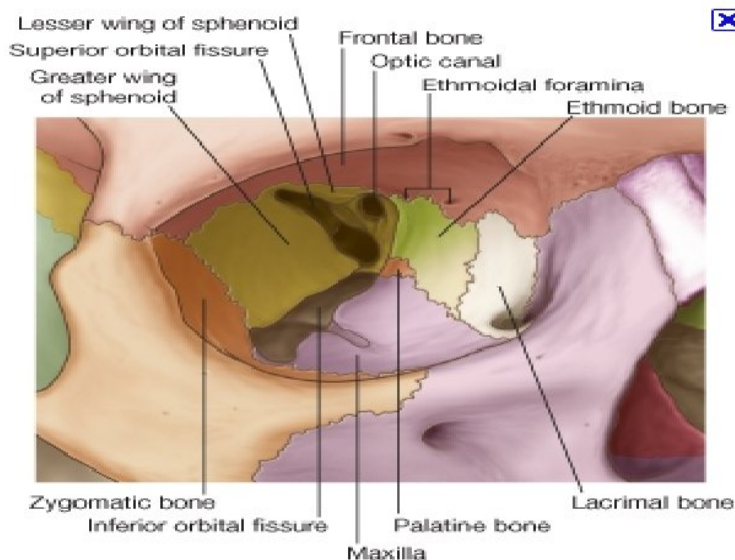
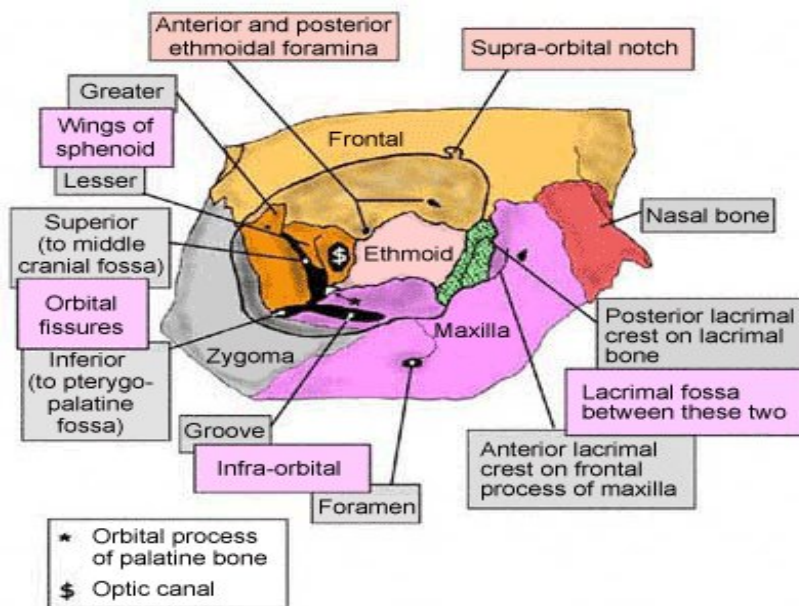
Pterion



Pterion is the point where all of the following bones meet:

1. Frontal bone
2. Parietal bone
3. Greater wings of the sphenoid bone
4. Squamous part of the temporal bone

Related ophthalmology



Roof: orbital process of the frontal bone; Lesser wing of sphenoid

Medial wall: orbital process of Maxillary bone; Lacrimal bone; Lamina papyracea; Sphenoid bone to optic nerve foramen (lesser wing)

floor: orbital plate of maxillary bone (**main component**); orbital surface of zygoma; orbital process of the palatine bone



lateral wall: zygoma; **greater** wings

Communications:

Middle cranial fossa via: optic canal + superior orbital fissure

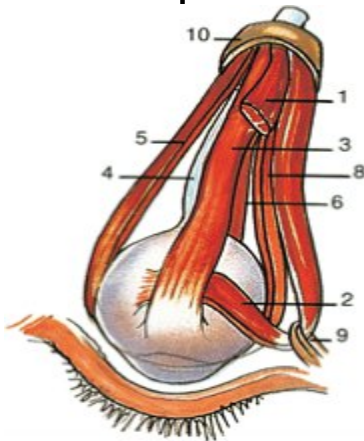
Pterygopalatine fossa & infratemporal fossa via infraorbital fissure

Nose via nasolacrimal duct

Eye movements:

Lateral rectus: lateral

Medial rectus: medial
 Superior rectus: upper medial
 Inferior rectus: lower medial
 Superior oblique: outer inferior
 Inferior oblique: outer superior



Note:

in oblique muscles :the insertion is medial + opposite direction

All muscles are innervated by the III N (oculomotor) except

superior oblique: IV trochlear

lateral rectus: VI abducent Nerve

Superior division of the **oculomotor** nerve innervates:

superior rectus

levator palpebrae superioris muscle

Inferior division of the **oculomotor** nerve innervates:

inferior oblique muscle

inferior rectus

medial rectus

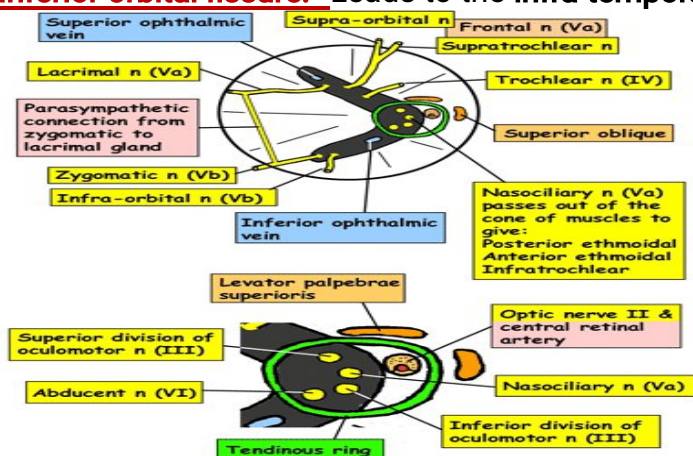
Note:

division of the **superior cervical sympathetic** nerve fibers result in **ptosis** due to paralysis of levator palpebrae superioris muscle

Optic nerve tubercle: bony protuberance on the **medial** surface of the optic foramen

Superior orbital fissure: Leads to **middle** cranial fossa

Inferior orbital fissure: Leads to the **infra-temporal fossa** , pterygopalatine fossa



The following structures lie **outside the muscle core**:

lacrimal nerve (V1)

frontal nerve(V1)

trochlear nerve(IV)

ophthalmic vein

see tendon of zinn

lacrimal system:

made of:

1. lacrimal gland

Located in the antero-lateral aspect of the orbit in a fossa in the zygomatic process of the frontal bone

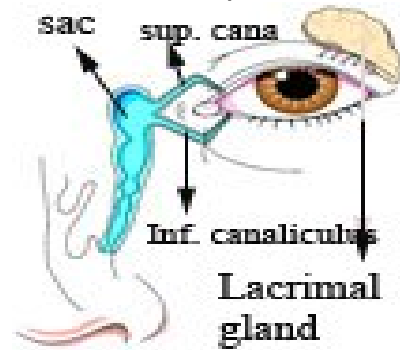
Separated into 2 parts by the lateral tendon of **levator palpebrae superioris**

Mainly **serous** secretions

1. lacrimal canaliculus (superior+inferior)

Has vertical part **2mm** long

Has horizontal part **8mm** long



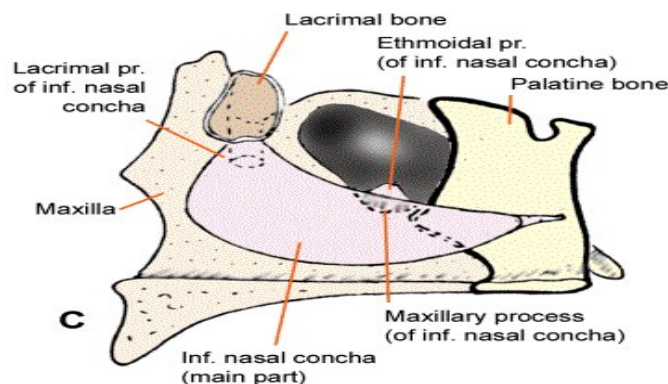
Superior +inferior canaliculi join into common canaliculi

1. common canaliculus
of variable length (3-5mm)

Common canaliculus angled forwards before entering the **posterior-lateral** aspect of the lacrimal sac.

1. lacrimal sac
12 mm long

1.



lacrimal duct

Runs within lacrimal bony canal which is made of:

Anterio-Medially : maxilla

Posterio-Laterally : Lacrimal bone, Lacrimal process of the inferior turbinate

17 mm long

continues in an inferior direction with for 12 mm before entering the nose

Empty into the **inferior** meatus just **anterior** to its **highest** point (junction of the **anterior** and **middle** third) 10-15 mm behind the anterior end of the inferior turbinate and 16 mm above the floor of the nasal cavity high in the inferior meatus.

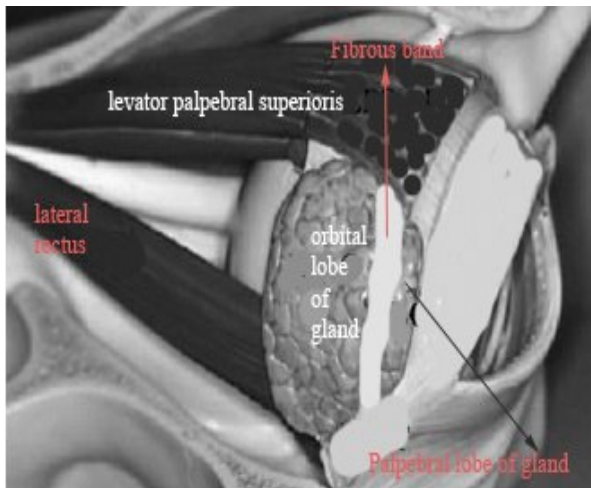
It is guarded at this point by **Hasner's valve**.

Distance between the **nasolacrimal duct** & the **ostium of the maxillary** sinus is **3-6 mm**

Note:

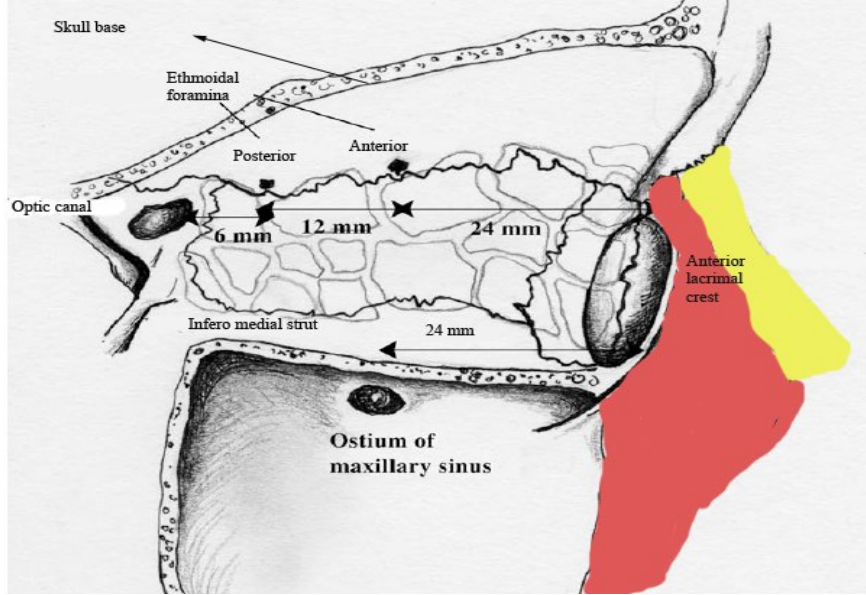
The name of the **fleshy pink mound** of tissue which is located at the **medial canthus** is called:

Lacrimal carbuncle



Distances of important structures from anterior lacrimal

crest:



What is the average volume of the orbit? 30 cm³.

What is the average depth of the orbit? 40-50 mm.

What are the layers of the eyelid from superficial to deep?

Skin, subcutaneous tissue, voluntary muscle, orbital septum, tarsal plate, smooth muscle, and conjunctiva.

What is unique about the anatomy of the Asian eyelid?

Levator muscle lacks attachment to the pretarsal skin, resulting in an absent pretarsal fold.

What structure divides the lacrimal gland into two lobes? Levator aponeurosis.

What provides static support to the lower lid?

Tarsal plate and its associated medial and lateral canthal tendons.

What provides dynamic support to the lower lid?

Adhesion of the pretarsal portion of the orbicularis to the tarsal plate.

What structure in the lower lid is analogous to the levator aponeurosis of the upper lid?

Capsulopalpebral fascia.

What are the lower eyelid retractors?

Capsulopalpebral fascia and the inferior tarsal muscle.

What lines the posterior surface of the eyelid? Palpebral conjunctiva.

What creates the gray line in the lid margin?

The muscle of Riolan.

What does the gray line divide? The anterior and posterior lamella.

What structures make up the anterior lamella of the lid?

Pretarsal orbicularis oculi muscle and the eyelid skin.

What structures make up the posterior lamella of the lid?

Conjunctiva and the tarsal plate.

Periosteum and periorbita meet at the orbital margin and continue into the eyelids as what? Orbital septum.

What is the origin of the superior tarsal muscle (of Muller)?

Deep side of the levator palpebrae superioris.

What structure forms the medial canthal tendon?

The superficial head of the pretarsal fibers of the orbicularis oculi muscle.

What are the three limbs of the medial canthal tendon?

Anterior, superior, and posterior limbs.

Which of these covers the lacrimal fossa? Superior limb.

What is Whitnall's tubercle?

Insertion site of the lateral canthal tendon.

Which part of the lacrimal system is most vulnerable to injury?

The inferior canaliculus near the medial canthal tendon.

Where are the anterior and posterior ethmoid arteries and optic canal in relation to the anterior lacrimal crest?

24-12-6 rule: Anterior ethmoid artery is approximately 24 mm posterior to the lacrimal crest; the posterior ethmoid artery is 12 mm posterior to the anterior ethmoid artery; the optic canal is 6 mm posterior to the posterior ethmoid artery.

What does the medial epicanthal fold cover?

Lacrimal lake.

What is the function of the deep head of the orbicularis oculi?

Inserts on the posterior lacrimal crest and provides structural support to the lid.

What happens with disruption of the deep head?

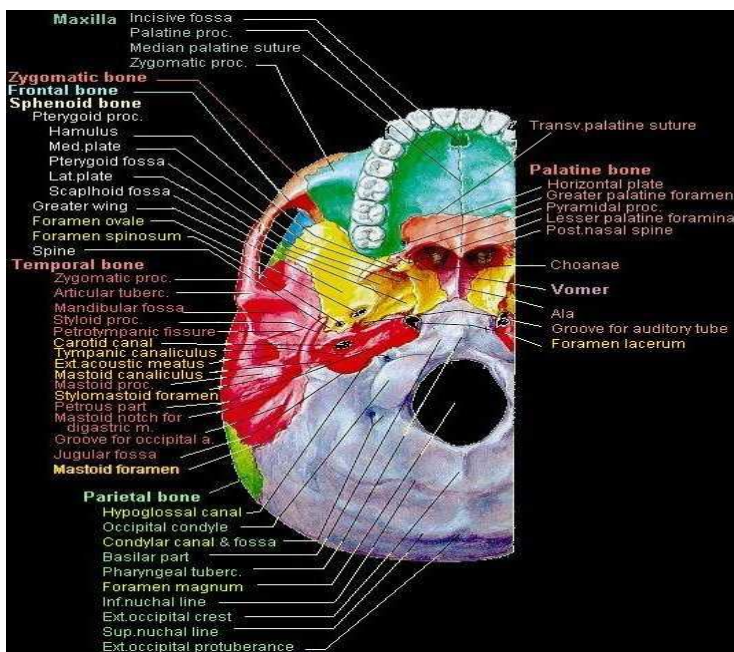
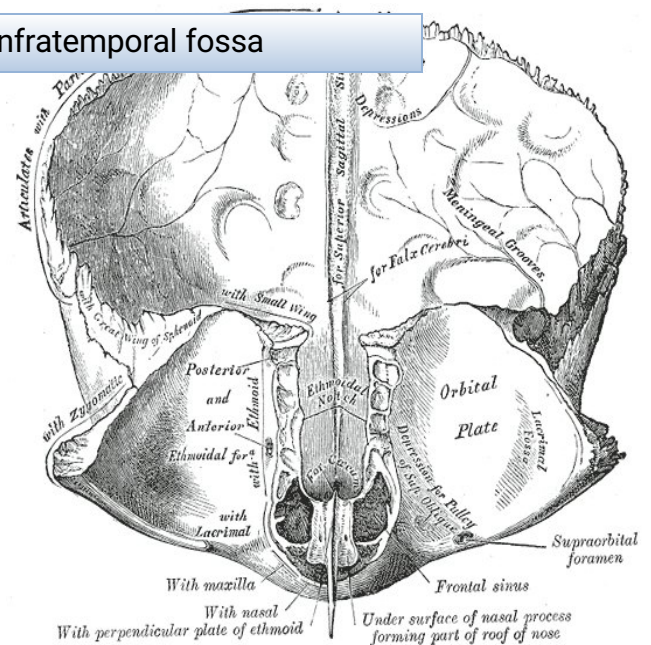
Lateral and anterior displacement of the medial canthal angle.

Where does the lateral canthal tendon insert?

Orbital tubercle located 5 mm posterior to the lateral orbital rim.

- **What glands are contained within the tarsal plates?** Tarsal glands (Meibomian)
- What is trichiasis?**
 - Abnormal direction of the eyelashes.
- **What is Argyll Robertson pupil?**
 - Pupil reacts to accommodation but not light; often associated with syphilis.
- **What test may elicit a Marcus Gunn pupil?**
 - Swinging flashlight test.
- **What is the term for gross asymmetry of eye movement?**
 - Heterotropia.

Anatomy of the skull base & infratemporal fossa



Definition of skull base: The floor of the cranial cavity

Overall topography of the skull base:

Anatomically, the **Inferior** aspect of the **skull base** is bounded:

Anteriorly: upper incisor teeth

Posteriorly: superior nuchal line of the occipital bone

Laterally: by the remaining upper teeth, zygomatic arch and the mastoid process

Anterior skull base:

Anatomically:

part of the **maxillofacial** structure

laying at a **lower** level than the rest of the skull base

formed by: hard palate + alveolar process

Surgically:

Formed by

- o orbital part of the frontal bone
- o cribriform plate of the ethmoid bone

Provides the roof for orbit + ethmoid air system (sinuses)

Surgical components of the anterior skull base :

1- orbital part of the frontal bone:

The **inferior** surface of the orbital plate of the frontal bone extends from the **supra-orbital rim** anteriorly to its articulation with the **lesser wing** posteriorly

the **lateral** part of the inferior surface of the frontal bone forms the orbital plate, demarcating the bony limit of the orbital plate superiorly

The **Medial** part of the inferior surface of the frontal bone articulates with the nasal bone, nasal process of maxillary bone, lacrimal bone, ethmoidal bone

1- ethmoid bone:

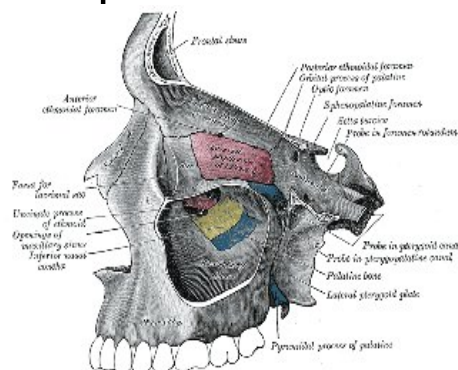
Components:

- **perpendicular plate**

- o Upper part forms crista gali; Lower part forms part of posterior aspect of the nasal septum

- **cribriform plate:**

o



Lies on either side of the crista gali; Transmits the olfactory nerves; Forms the roof of nasal cavity

- **the paired labyrinths:**

- o Thin walled structure containing numerous air cells
- o Forms part of: Orbital plate (lamina papyracea); Lateral nasal wall

The medial surface of the ethmoid is of surgical importance to the sinus

- 1- The anterior & posterior ethmoidal arteries pass through **anterior & posterior ethmoidal foramen** at the frontoethmoidal suture over the medial wall of the orbit
 - o **24 & 36 mm posterior to the lacrimal crest**

1- **Sphenopalatine process:**

- o The processes of the superior border of the **palatine bone** are separated by the sphenopalatine notch, which is converted into the sphenopalatine foramen by the under surface of the body of the **sphenoid**.
- o leads from the **pterygopalatine fossa** into the **posterior part of the superior meatus of the nose**
- o located 18mm from the horizontal plate of palatine bone, 13mm from the inferior turbinate
- o Transmits the **sphenopalatine artery** (largest artery in pterygoid fossa) and vein and the **superior nasal** and **nasopalatine nerves** (passage of neurovascular structures into nasal passages)

PTERYGOPALATINE FOSSA 3

Diagrammatic view of right fossa looking down on it from above to show entry and exit of nerves. The roof (removed) is greater wing of sphenoid

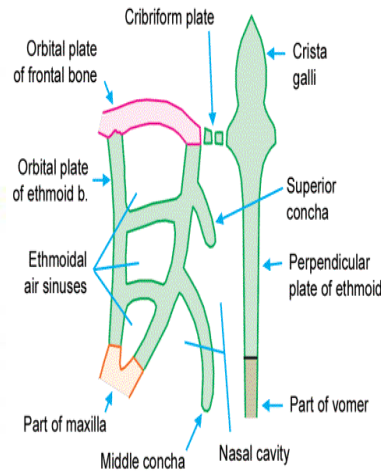
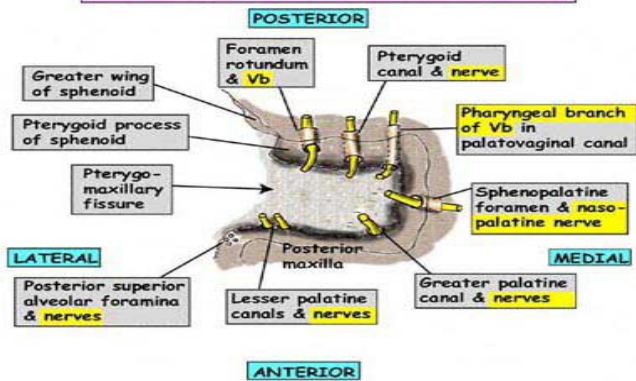
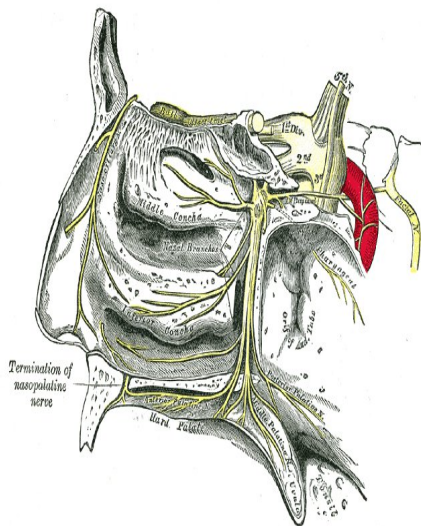
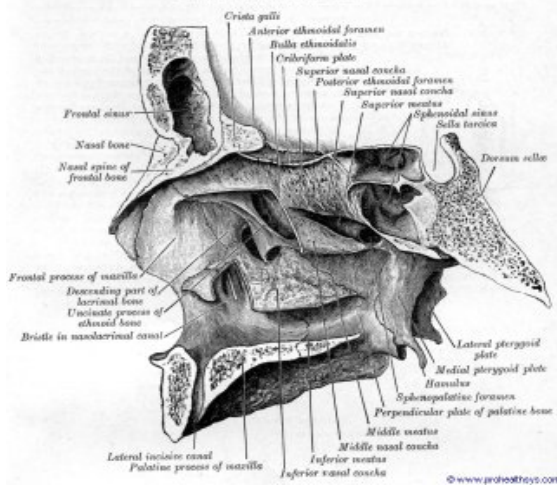


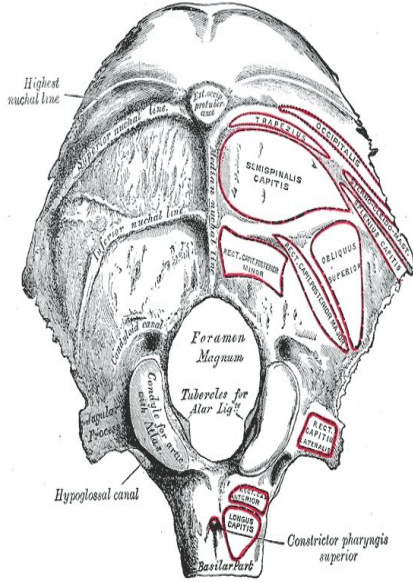
FIG. 371.—The lateral wall of the right nasal cavity, after removal of parts of the middle and inferior nasal conchae.



Surgical approaches via anterior cranial fossa can be used to reach

- Superior nasal cavity
- Cribriform plate
- Ethmoidal sinuses
- Frontal sinuses
- Sphenoid sinus
- Pituitary fossa
- Basisphenoid
- Frontal lobes of the brain
- Orbits
- Optic cavity

Posterior skull base



Made of the **Inferior** surface of the occipital bone

The occipital bone encloses the foramen magnum through which the cranial cavity communicates with the vertebral canal

Occipital bone parts:

squamous part; broad curved plate posterior & superior to the foramen magnum

foramen magnum

lateral part: from which occipital condyle arise

basioccipit: thick square piece ant to the foramen magnum

Lateral/middle skull Base

The name reflects the direction of the surgical approaches to this area, however a number of structures in the midline anterior to foramen magnum can be approached via anterior/ anteriolateral approach

Bounded:

Anteriorly: anterior border of sphenoid bone + zygomatic arch

Posteriorly: occipital bone

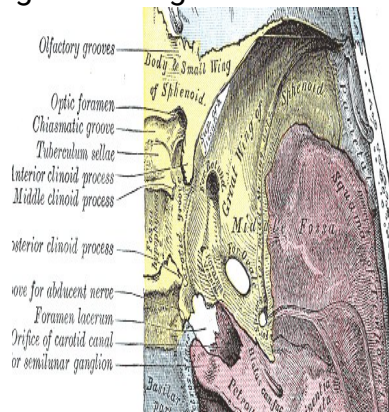
Components are the **undersurface** of:

1- Sphenoid bone

Components of sphenoid bone that contributes to the skull base:

1. Greater wings:

- o Medially the greater wing is wedge with the petrous bone
- o perforated by:
 - Anteriorly: Foramen ovale
 - Posteriorly: Foramen spinosum
- o Articulates with the squamous part of temporal bone to form the roof of the infratemporal fossa
- o Anteriorly this infratemporal surface ends with inferior orbital fissure behind the maxilla
- o the greater wing end:



Anteriorly: pterygoid plate

Posteriorly: spine of sphenoid (which is an important surgical land mark)

- o Occasionally 2 smaller foramina also exist:
 - Foramen of Vesalius (medial to foramen ovale)
 - Foramen innominate (posterior to foramen ovale)

1. Medial pterygoid plate:

Projects back from the lateral wall of choanal opening where it articulates with the vertical plate of the palatine bone

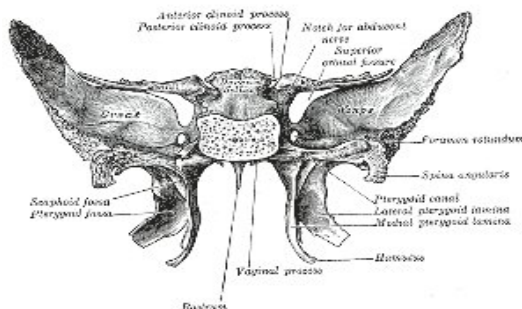
Ends:

Inferiorly: pterygoid hamulus

Superiorly: pterygoid tubercle which projects to foramen lacerum

Superior to this pterygoid tubercle lies the pterygoid canal

Halfway up the posterior surface of the medial pterygoid plate is a spur



Spur: ridge which runs upward and laterally toward the opening of the bony auditory tube enclosing the concave scaphoid fossa lateral to the pterygoid tubercle

1. Lateral pterygoid plate:

Extends back & laterally into infratemporal fossa.

The plate gives attachment to the pterygoid muscles

1- Temporal Bone:

Consists of 4 parts that ossify separately and later fuse

1. Squamous part:

Contributes to the articular area to the skull base, but most of it is in the infratemporal fossa on the side of the skull

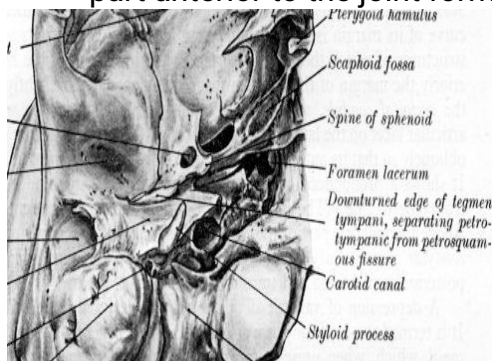
Contains:

glenoid fossa

Articular tubercle (eminentia articularis) joined laterally to the zygomatic process

This area lies almost totally in the temporomandibular joint with only small triangular part anterior to the joint forming part of the infratemporal fossa

1.



Petromastoid part:

Projects forward and medially at 45 degree

Wedge between basiocciput and the greater wings of the sphenoid

At the apex of the wedge of the 3 bones do not quite meet, leaving foramen lacerum which is closed by dense fibrocartilage and transmit only minute blood vessels.

1. Tympanic plate:

Lies below the squamous and petrous bone

Lateral to the carotid canal and jugular foramen

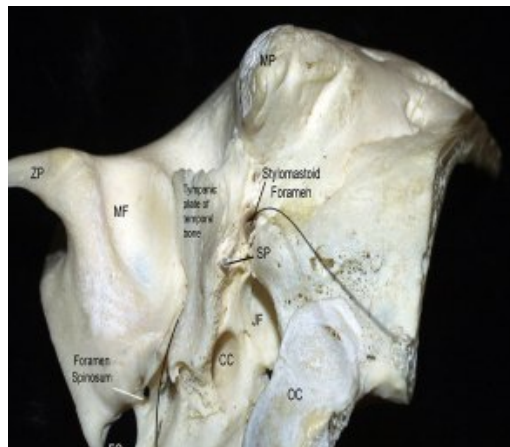
Rolled like a tube open at the top

Laterally:

Forms the bony part of the external auditory canal

Contributes to formation of 2 fissures

1-



squamotympanic fissure: tympanic plate

Articulates anteriorly with squamous bone of the glenoid fossa

The medial part of the squamotympanic fissure is divided by a thin flag of petrous bone (the projecting margin of the tegmen tympani)

So creating:

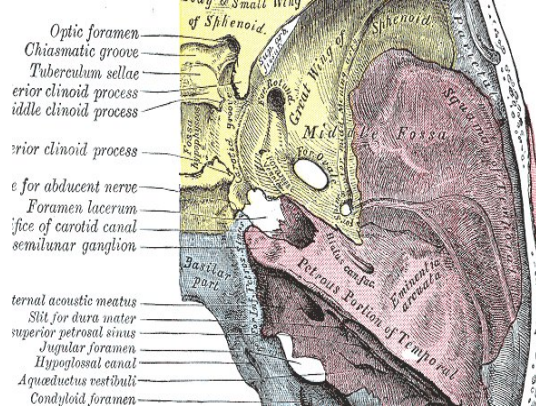
- o petrosquamous fissure anteriorly

- o Petrotympanic fissure posteriorly

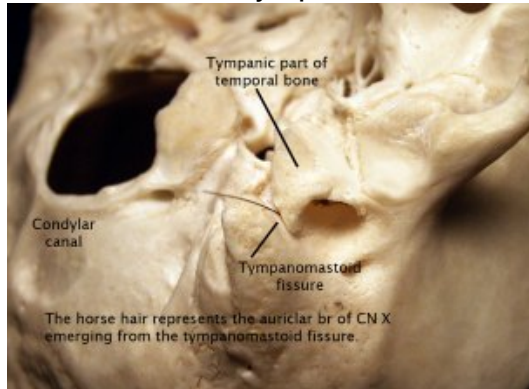
1- Tympanomastoid fissure: tympanic plate articulating posteriorly with mastoid process

Medially: Forms the **floor** of **hypotympanum**

1. Styloid process:



Located Lateral to the jugular foramen and tucked in close behind the tympanic bone; Of variable length



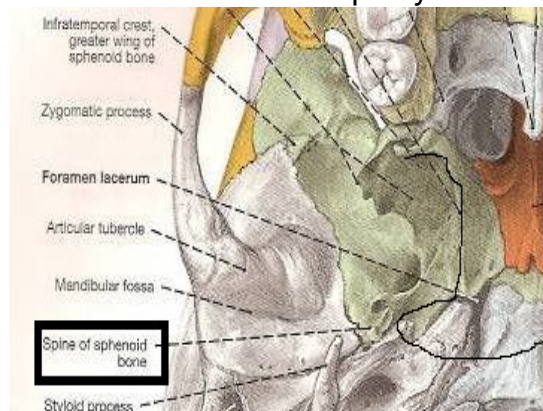
Behind its base lies the **stylomastoid foramen**
Further posteriorly the mastoid bone is indented medially by the **digastrics notch**, medial to which lie the groove for **occipital artery**

Subdivisions of the the lateral skull base:

The **lateral** skull base subdivisions correspond to compartments that **underneath (it forms the roof of the following structures)** : Pharyngeal, Tubal, Neurovascular, Auditory, Articular, Infratemporal fossa

1-Pharyngeal Area:

It is the **roof** of the Nasopharynx



Situated **centrally** in the skull base
Boundaries of the pharyngeal area are formed by the **line** of attachment of the pharyngeal wall

The pharyngeal wall is made of **pharyngobasilar fascia** (because the pharyngeal constrictor muscles do not extend to the skull base but are attached to it by pharyngobasilar fascia)

2- Tubal Area:

Lies **lateral** to pharyngeal area

Comprises the region occupied by the **Eustachian Tube**

Anteriorly it includes **Scaphoid fossa**

Scaphoid fossa:

Located at the **base** of medial pterygoid plate

Slit between the petrous bone & The greater wing of the sphenoid bone

The cartilaginous Eustachian tube runs posteriolaterally in this fossa until it reaches the bony Eustachian tube anterior to the carotid canal

3-Neurovascular Area:

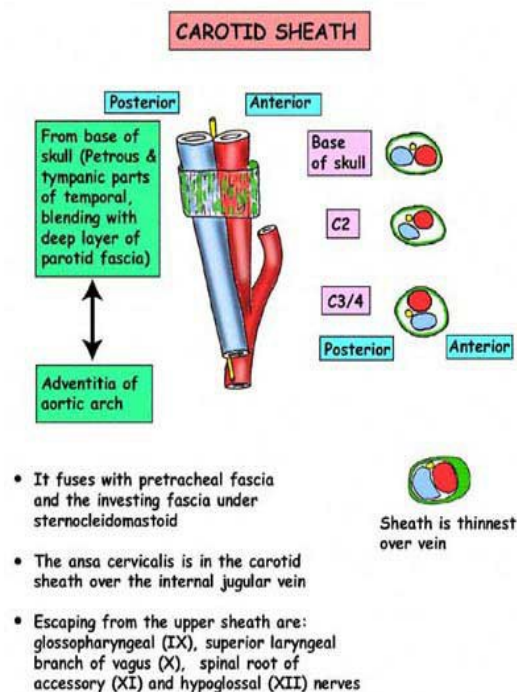
Located **posterior** to the tubal area, containing the:

1. Carotid sheath

2. Styloid apparatus

Tubal area	Pharyngeal area
Carotid sheath	Retropharyngeal area

3. Facial Nerve



1- Carotid Sheath:

It is part of the **Deep** cervical fascia

Not a membranous fascia, It is a dense network of **areolar** tissue

Located :

1. posterior to the tubal area
2. lateral to the retropharyngeal area
3. deep to the sternocleidomastoid
4. at the level of the oropharynx

Upper Border: skull base around the **carotid foramen**

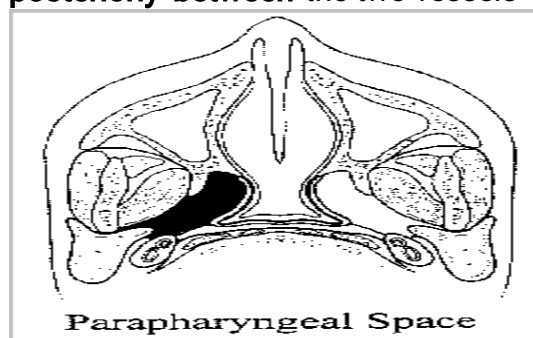
Lower Border: downwards as far as the **aortic arch**.

Contents: carotid artery (common, internal, external), IX, X, XI, XII, ans cervicalis

Tubal area	Pharyngeal area
Carotid sheath	Retropharyngeal area

It is virtually absent over the **internal jugular vein**, so it is able to expand greatly during periods of increased blood flow

The carotid artery lies **medial** to the internal jugular vein, and the vagus nerve is situated **posteriorly between** the two vessels



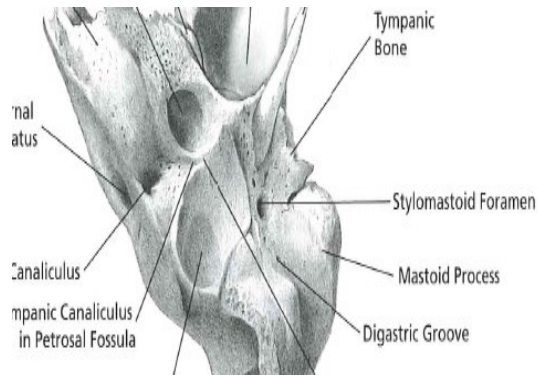
The carotid sheath, together with the pretracheal fascia is firmly attached anteriorly to the deep surface of the SCM

Posteriorly it is not attached to the prevertebral fascia, but it is free to slide over it

This means abscess tracing **laterally** from the **parapharyngeal abscess** passes behind the sheath & the sternocleidomastoid, to point in the **posterior** triangle.

The Internal carotid artery:

Pass vertically upwards from the carotid bifurcation in the neck to enter the carotid foramen.

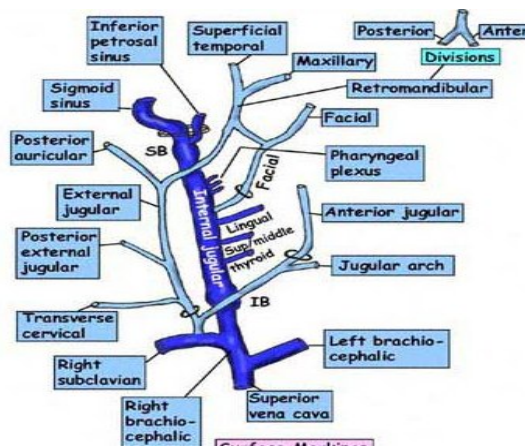


It has **no** branches, but carries with it the **carotid plexus** of the sympathetic nerves from the superior cervical ganglion

Nerve Supply Of The carotid Artery: Glossopharyngeal Nerve

Jugular Foramen: is divided by 2 transverse septa of fibrous **dura** (which may **ossify**) into **3** compartments.

Anterior compartment	Middle compartment	Posterior compartment
Glossopharyngeal Inferior Petrosal sinus	Vagus Nerve Accessory Nerve	Internal Jugular vein



Internal jugular vein :

formed when The **Inferior petrosal sinus** Join the **Sigmoid sinus**.

At Its origin, it is dilated, and this dilatation is called the **superior bulb**.

It is located **posterior** to the internal carotid artery on the lateral mass of **atlas**

As it descends, it passes across on to the **lateral** side of the internal carotid artery, receiving pharyngeal venous plexus

It is crossed on its lateral side by **accessory nerve**

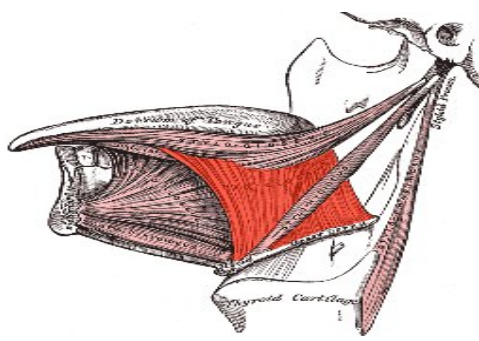
On the lateral side of the Vein Lie the **deep Cervical Lymph node**

Glossopharyngeal Nerve:

Lies **between** the internal & external carotid artery (lateral to the internal & medial to the external)

Lies lateral to the **Inferior** Petrosal Sinus

Then it gently curves forward around the **lateral** side of the **stylopharyngeus**, medial to the tongue.



Vagus Nerve:

Emerges from its superior ganglion in the middle compartment of Jugular foramen

Just below the skull base, it is dilated into its **inferior ganglion**, where it receives a connection from the **accessory** nerve carrying fibers from nucleus ambiguus

descends between the jugular vein & the internal and common carotid arteries

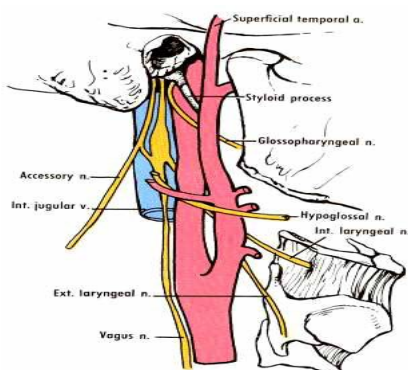
Accessory Nerve:

Lies **lateral** to the Vagus Nerve

Runs in the back of the carotid sheath between the carotid artery & Jugular vein

Immediately **curves** away posteriorly across the lateral surface of the Internal Jugular

Medial to the Styloid Process & **posterior** to belly of the digastric muscle



Giving a branch to **sternocleidomastoid** before piercing the muscle to gain the posterior triangle

Hypoglossal Nerve:

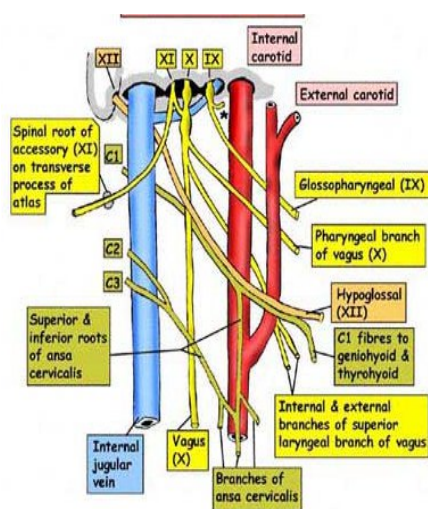
superficial to the great vessels, winds around the origin of the occipital artery. The maxillary artery disappears deep to the neck of the mandible

Cervical sympathetic Trunk:

Lies **behind** the carotid sheath

Medial to the vagus nerve

Ends superiorly at the superior cervical ganglion



The deep petrosal nerve arises from this ganglion & passes superiorly to join the greater petrosal nerve to form the vidian nerve

	Styloglossus	Stylohyoid	Stylopharyngeus
Origin	The front of the Styloid process + upper part of the Stylohyoid ligament	Back of the base of the Styloid process	medial aspect of the base of the Styloid process
Direction	Slopes downward & forward	Downward & forward	Down ward
Insertion	The sides of the tongue	Inserted into the base of the greater cornu of the hyoid bone*	The thyroid cartilage and side walls of the pharynx
Innervation	Hypoglossus Nerve	Facial Nerve	Glossopharyngeal Nerve
Action	Retract the tongue	Retracts + elevate the tongue & hyoid bone	Elevates the pharynx & the larynx
Relation	Crosses lateral to the internal carotid Anterior & Medial to the lingual nerve	Passes lateral to the external carotid artery	Lateral to the internal carotid artery

1- Styloid apparatus:

Stylohyoid Ligament:

Arise from the Styloid process

Passes downward and forward

Attached to the **lesser** Cornu of the Hyoid Bone

Land mark for the main trunk of the Facial Nerve
which is located superior & lateral to it

Stylomandibular Ligament:

Not a distinct structure

It is a **condensation** of the deep layer of the parotid fascia between the **base** of the Styloid process & the angle of the mandible

Styloid muscles:

Note: Stylohyoid **ligament** attaches to the **lesser** cornu of the hyoid

Muscle: attaches to the **greater** cornu of the hyoid bone

External Carotid artery relation to the styloid muscles:

It is **medial** to the Stylohyoid muscle & digastric muscle

Lateral to the styloglossal & stylopharyngeus in its way to enter the parotid gland
Retromandibular vein is superficial to all elements of Styloid apparatus

1- Facial Nerve:

Emerges from the **Stylomastoid foramen** along with the Stylomastoid artery

The Immediate branches of the Facial Nerve after it emerges from the Stylomastoid foramen are:

- 1- **posterior auricular nerve** : supplies the occipital belly of the occipitofrontalis muscle
- 2- **muscular branch** : supplies the posterior belly of the digastric & Stylohyoid muscles
it then swings forward into the **parotid** gland dividing into upper & lower divisions which then divide further within the substance of the gland

4- Auditory Area:

it is made of steeply sloping surface of the **tympanic bone**

small area **anteriolateral** to the neurovascular area

at the **anteriomedial** edge of the area lies the **petrotympanic fissure of Glaser**

the petrotympanic fissure transmits:

1. Chord tympani Nerve
2. Anterior tympanic artery (branch of the maxillary artery)
3. Anterior tympanic vein that drains into the pterygoid plexus



Chord tympani on its existing from the petrotympanic fissure travels in a **groove** in the spine of the sphenoid bone and joins the lingual nerve **2 cm** below the skull

5- Articular Area:

Immediately in **front** of the auditory area

It is the surface on which the **head** of the mandible articulates (by way of intervening fibrocartilaginous disc)

The joint capsule attaches to the **border** of articular area:

1. Anteriorly: articular eminence (articular tubercle)
2. Posteriorly: squamotympanic fissure
3. Lateral + medial: borders of the mandibular fossa

6- Infratemporal Fossa:

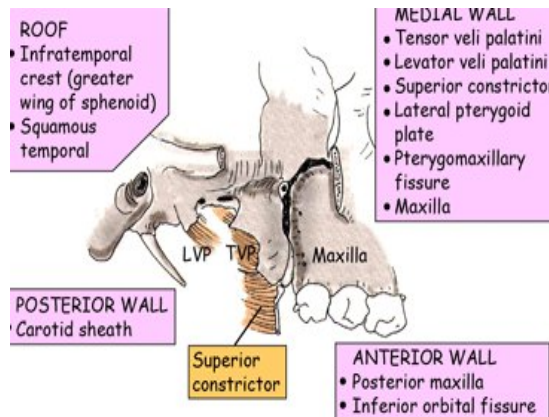
lies **below** the middle cranial fossa

Between the **lateral** walls of the pharynx & the **ramus** of the mandible

Borders:

Anteriorly: posterior wall of maxilla with the inferior orbital fissure + pterygomandibular fissure

Posteriorly: carotid sheath & styloid apparatus



fascia

Medially: medial pterygoid muscle & interpterygoid

Laterally: mandible

Roof: Greater wing of the sphenoid with a small triangular contribution posteriorly from the squamous temporal bone (the roof contains **foramen ovale & spinosum**)

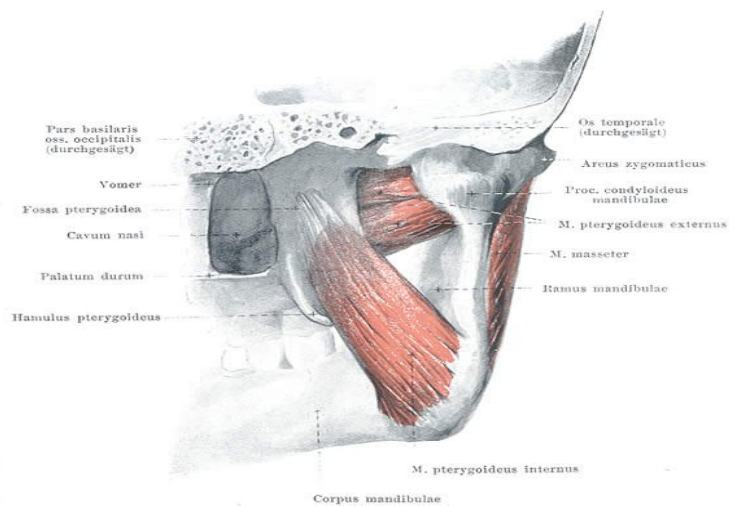
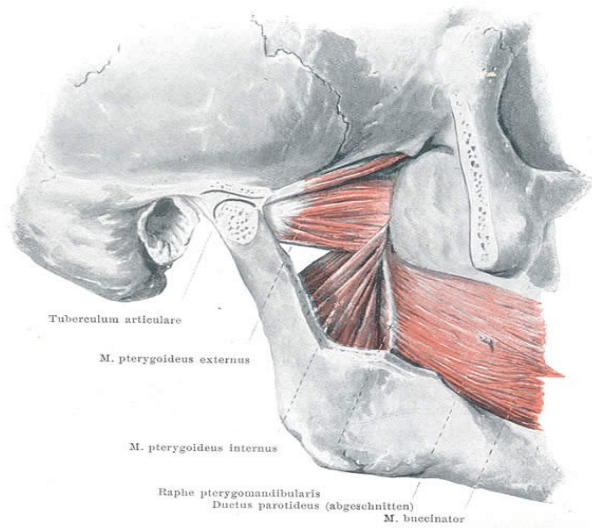
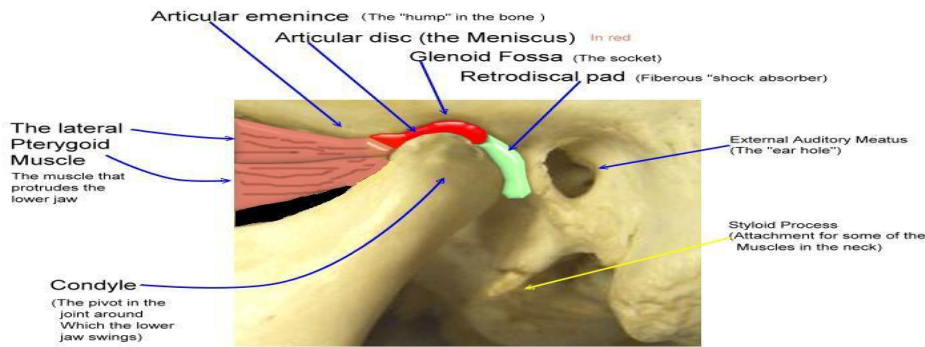
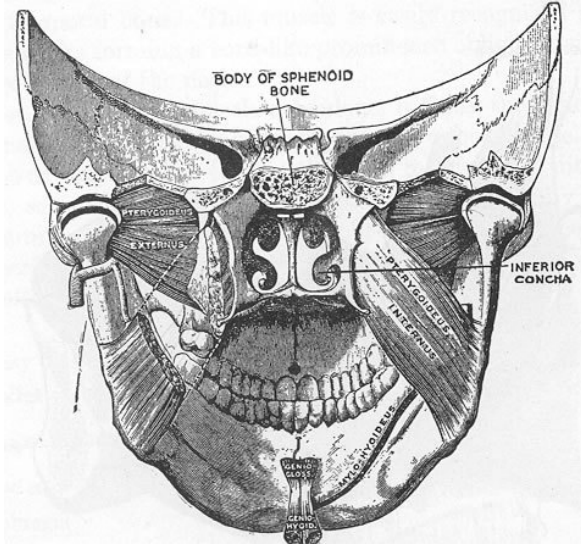
Floor: no anatomical floor, but opens inferiorly to the Neck & **superior mediastinum**

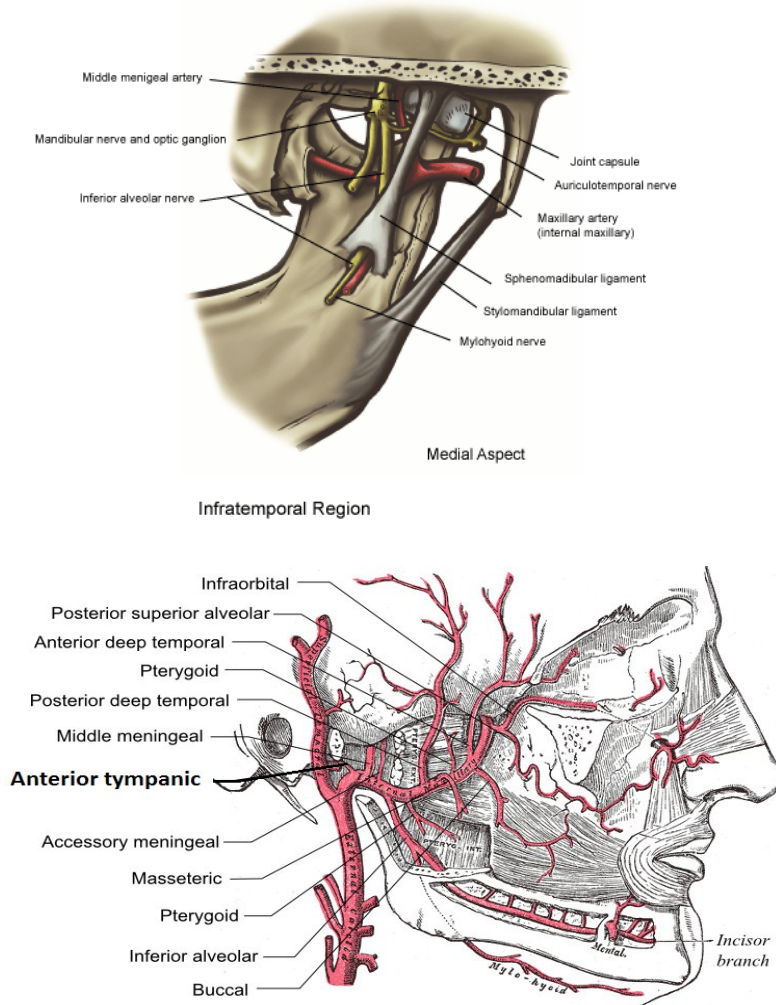
Contents of the Infratemporal Fossa:

A-muscles:

	Lateral pterygoid muscle	Medial pterygoid muscle
Origin	2 heads: 1-Upper head : the Infratemporal surface of the greater wing 2-Lower head : lateral surface of the lateral pterygoid plate	1-Medial surface of the lateral pterygoid plate Fossa between 2 plates 2-Small slip joins from the tuberosity of the maxilla & tubercle of the palatine bone
Insertion	The 2 heads converge posteriorly into a tendon: 1. Neck of the mandible 2. Intra-articular disc 3. Capsule	It passes laterally, inferiorly & posteriorly at 45° to be inserted into the medial surface Angle of the mandible
Action	Opening the mouth by pulling the condyle forward into the articular tubercle	Close the mouth and move the mandible towards the opposite side in chewing
Innervation	Lateral pterygoid N: Mandibular branch of the trigeminal Nerve	Medial pterygoid nerve

Both **medial** & **lateral** pterygoid originates from **lateral** pterygoid plate but from **different surfaces**.





b- Blood vessels:

1-Maxillary artery:

The **external** carotid artery has **2 terminal** branches:

1. **Internal** maxillary artery

It passes forward either lateral **or** medial to the pterygoid muscles

If it takes the medial course, the artery then turns laterally again to emerge between the 2 heads of the muscle

It leaves the Infratemporal fossa through the **Pterygomaxillary fissure** to enter the **Pterygopalatine fossa**

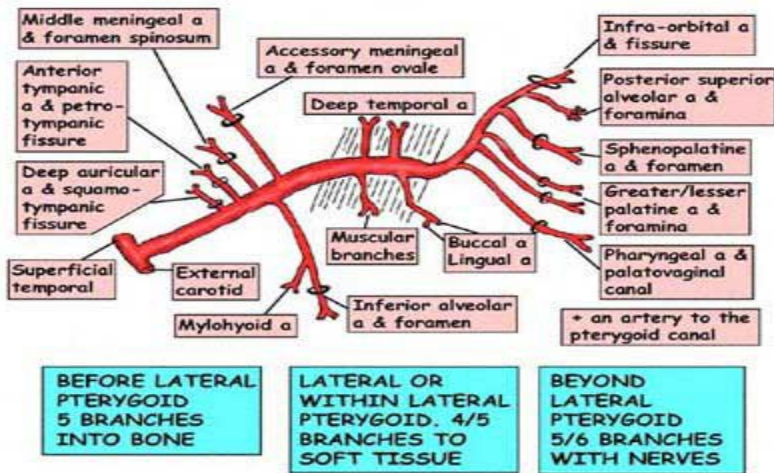
3 divisions by the **lateral pterygoid muscle** w

The **maxillary artery** enters the Infratemporal fossa **between** the **sphenomandibular*** ligament & the **neck** of mandible

***Sphenomandibular ligament**: extends from the sphenoid spine to the **angle** of the mandible

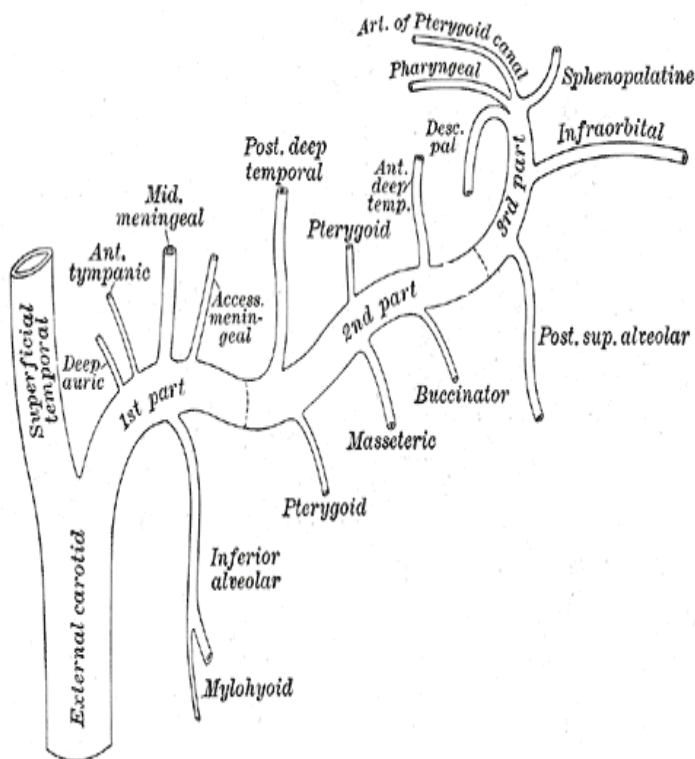
MAXILLARY ARTERY

In infratemporal fossa, either within or lateral to the superficial head of lateral pterygoid muscle. This muscle is shown below



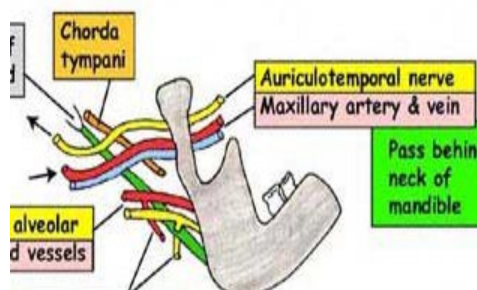
Note the roof is made of the greater wings of the sphenoid bone which contains foramen ovale through which pass the mandibular branch of trigeminal nerve + accessory artery branch of maxillary artery

So maxillary artery + mandibular division are content of infratemporal fossa



The 1st part of the maxillary artery gives off 5 branches to **bones**: (See the above diagram 4 foramen)
Deep auricular: supply the external auditory canal
Anterior tympanic: supply the middle ear cavity
Inferior alveolar artery: passes down to join the inferior alveolar nerve to enter the Mandibular foramen

The 2nd part of the maxillary artery gives off 5 branches to the **soft tissue**:



Temporalis muscle

Lateral & medial pterygoid muscles

Long buccal nerve & lingual nerves

Masseteric supply masseter muscles

The 3rd part of the artery divides in the Pterygopalatine fossa

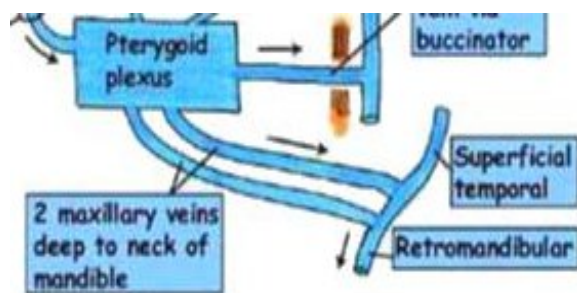
b- Blood vessels:

2- pterygoid plexus & 3-maxillary vein:

Lie **within & on the lateral** surface of the **lateral** pterygoid muscle

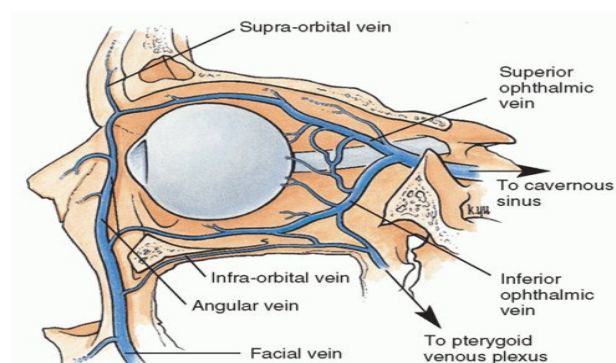
Receives tributaries corresponding to the branches of the maxillary artery

The plexus drains into **2 short, large** maxillary veins which pass **horizontally** backwards deep to the **neck** of the mandible to join the superficial temporal vein & form the **retromandibular vein**



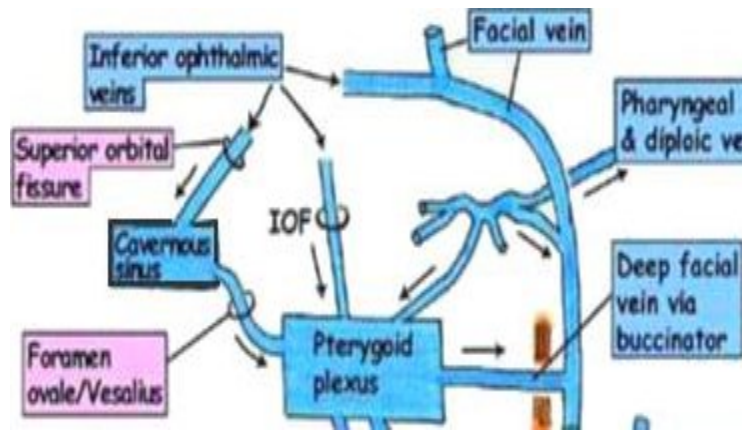
Pterygoid plexus has **3** communicating veins:

1. **Inferior ophthalmic vein** via inferior orbital fissure
2. **Connecting vein** directed vertically down from the cavernous sinus via foramen ovale or when present, foramen Vesalius
3. **Deep facial vein** runs forward beneath the zygoma to join the anterior facial vein



There are **NO VALVES** in these veins or the plexus, and blood can flow in **several** directions depending on pressure conditions. The clinical significance of this, then, is that bacteria from an infection of **dental/oral origin** or **danger area** of the face can be carried from the infratemporal fossa to the cavernous sinus.

3-Mandibular Nerve:



foramen **ovale**

Mandibular nerve passes through

The **main** trunk gives off:

1. **sensory nervus spinosum** (which reenters the middle fossa through foramen **spinosum**)
2. **motor nerves to medial pterygoid** which also supply the **tensor tympani** & **palate**

Muscle	Medial pterygoid muscle	Tensor tympani muscle
Origin	medial surface of the lateral pterygoid plate and the fossa between them	Scaphoid fossa Lateral cartilaginous lamina of ET Sphenoid spine
Direction	Posteriorly with 45 degree angle	Vertical

So the sequence would be **medial** pterygoid plate: tensor tympani muscle **medial** pterygoid muscle: lateral pterygoid **plate**: lateral pterygoid **muscle**

After a short course just **deep** to the **upper** head of the **lateral** pterygoid muscles, the **main** trunk divides into

Divisions	Anterior division	Posterior division
Size	Smaller	Larger
Branches	1. Anterior & posterior deep temporal 2. massenteric (through mandibular notch) 3. Lateral pterygoid (between 2 heads of lateral pterygoid piercing buccinators to supply mucous membrane of the cheek) 4. Buccal	1) Lingual 2) Inferior alveolar (passes between the sphenomandibular ligament and the neck of the mandible mandibular foramen) 3) mylohyoid 4) Auriculotemporal (parallels the superficial temporal vessels) 1. Sensation from the scalp, tragus, crus of helix, helix, anterior 1/2 of the EUC & T.M, T.M.J 2. Secretory fibers of the parotid gland
Motor Vs sensory	Mainly motor except buccal	Mainly sensory except mylohyoid

Note:
the division of the mandibular nerve into its main divisions occurs below the foramen ovale in the interval between the skull base & superior constrictor muscle

Lingual nerve:

Lie **anterior** to the **inferior** alveolar nerve

joined by the chorda tympani **2 cm** below the base of the skull

passes downward and forward on the **medial** pterygoid muscle & lateral to the lateral pterygoid muscle

grooving the mandible before entering the mouth

it enters the mouth below the inferior border of the superior constrictor muscle

then it courses above the mylohyoid muscle & lateral to the hyoglossus

between the deep lobe of the submandibular & sublingual gland

under the submandibular duct

Sphenomandibular ligament

Fibrous band Joining the spine of the sphenoid to the lingual of the mandible

It is derived from the 1st brachial arch (meckel's cartilage)

Anteriorly it blends into interpterygoid fascia (which separates the medial from lateral pterygoid muscle)

Stretching forward as a sheet to be attached to the posterior edge of the lateral pterygoid plate

Pterygoid fossa Vs infratemporal fossa

Pterygomaxillary fissure leads from the **infratemporal fossa** into the **pterygopalatine fossa**

Contents:

Pterygopalatine fossa	Infratemporal fossa	
3 rd part of the maxillary artery	2 nd part of the maxillary artery Pterygoid plexus	Artery
Maxillary N (V2)	Mandibular N (V3) Chorda tympani	Nerve
Pterygopalatine ganglion	Otic ganglion	Ganglion
	Insertion of the temporalis muscle to the coroid process Medial & lateral pterygoid muscle	Other

Pterygopalatine /pterygomaxillary

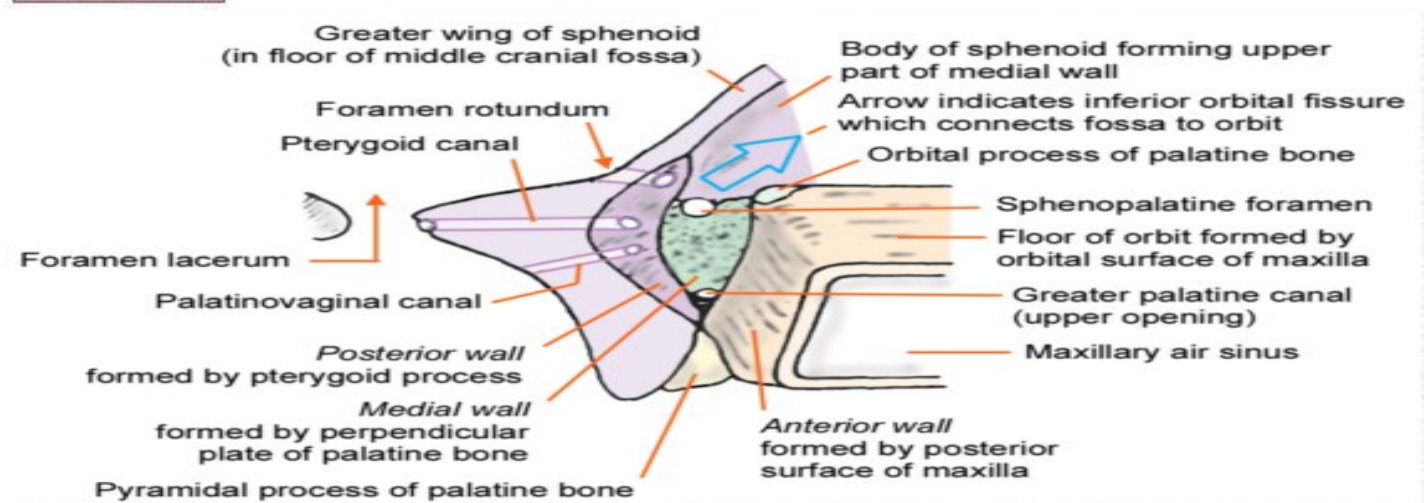
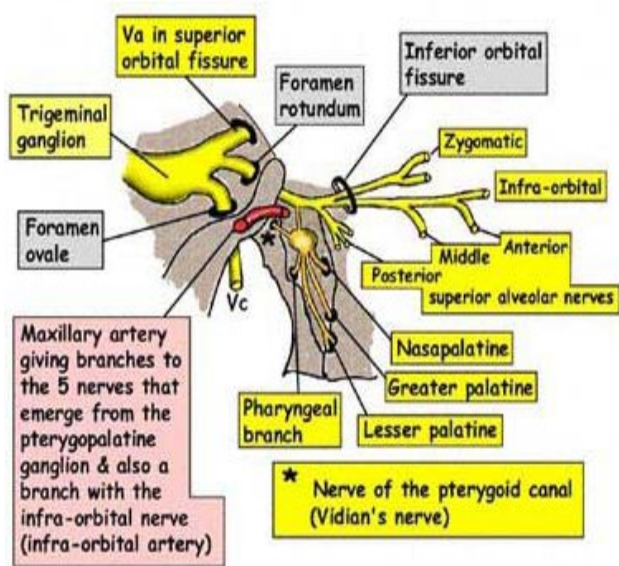
Small Fat filled **triangular** space

directed **laterally** and slightly **upwards**

located on the lateral aspect of the skull between the maxilla's infratemporal surface and the pterygoid process of the sphenoid bone

Borders:

Border	Structure
Anteriolateral wall	Posterior part of the Infratemporal surface of the maxilla (maxillary antrum)
Posteriolateral wall	Lateral pterygoid plate of the sphenoid bone
Medial wall	Perpendicular plate of the palatine bone
Lateral wall	None (opened into the Pterygomaxillary fissure)
Superior wall	Inferior surface of the greater wings of the sphenoid & orbital process of the palatine bone
Inferior wall	Pyramidal process of the palatine bone



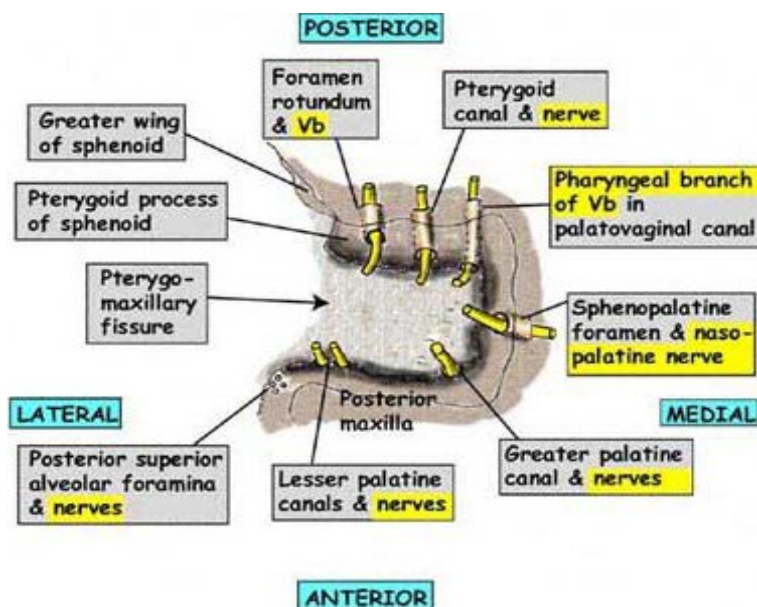
Contents of the Pterygopalatine Fossa:

- 3rd part of the maxillary artery

Note that the sphenopalatine artery is the largest artery in the pterygopalatine fossa

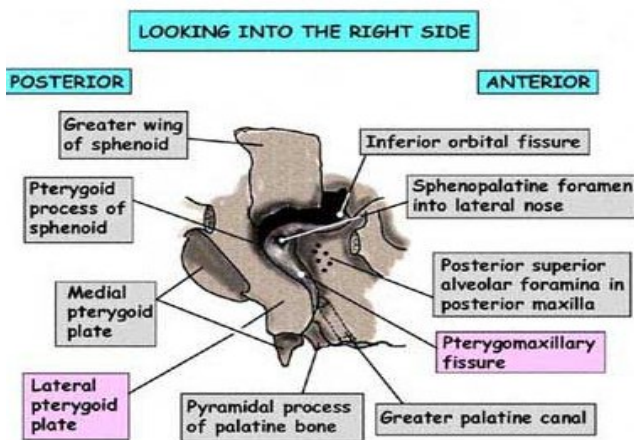
- Maxillary branch of the trigeminal nerve

c.



meckel's ganglion

Pterygopalatine/sphenopalatine/



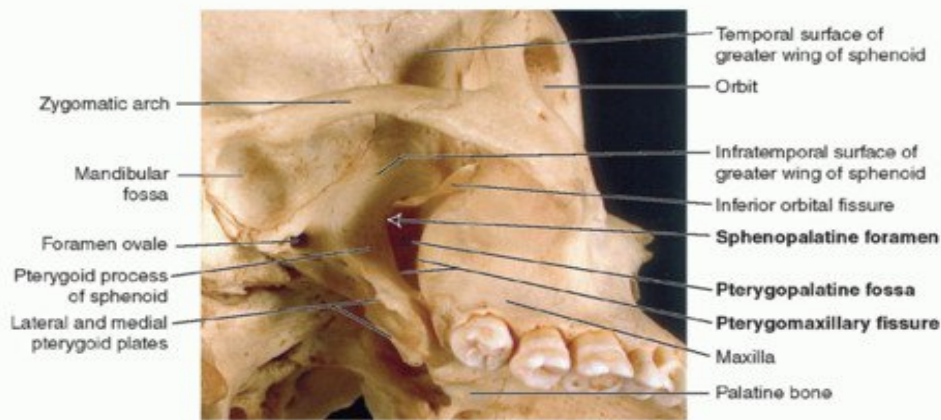
Foramens:

Note: Superior posterior alveolar foramen is located in the Infratemporal fossa not in the Pterygopalatine fossa

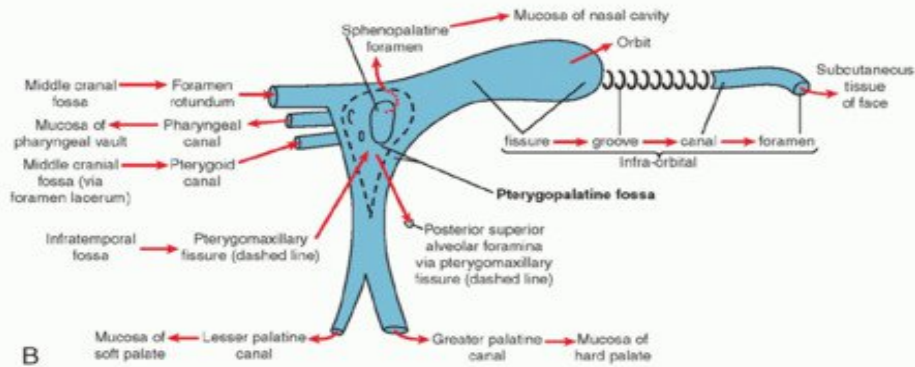
Surface	Foramen	Passing structures	Connections
Lateral	Pterygopalatine fissure	Into : 3 rd part of the maxillary artery Out of: post superior alveolar nerve	Infratemporal fossa
Medial	Sphenopalatine foramen	Sphenopalatine artery Nasopalatine nerve Posterior superior nasal nerve	Nasal cavity
Superior	Infra-orbital fissure	Infraorbital artery Infra-orbital Nerve Zygomatic nerve	Orbital cavity
Inferior	Palatine/pterygoplatine canal	Descending palatine artery Greater + lesser palatine nerve	Oral connection
Posterior	Foramen rotundum Vidian/pterygoid canal Palatovaginal canal	Maxillary branch of trigeminal N (V3) Vidian A+N Pharyngeal A+N	Cranial Cranial Nasopharynx

So the pterygoid fossa has connections with

1-



A Infralateral and slightly posterior view, looking into infratemporal and pterygopalatine fossae

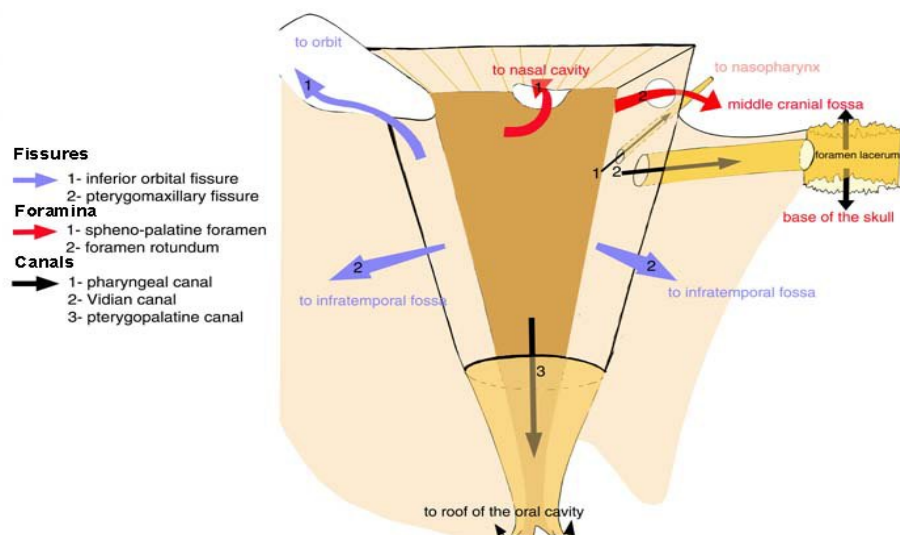


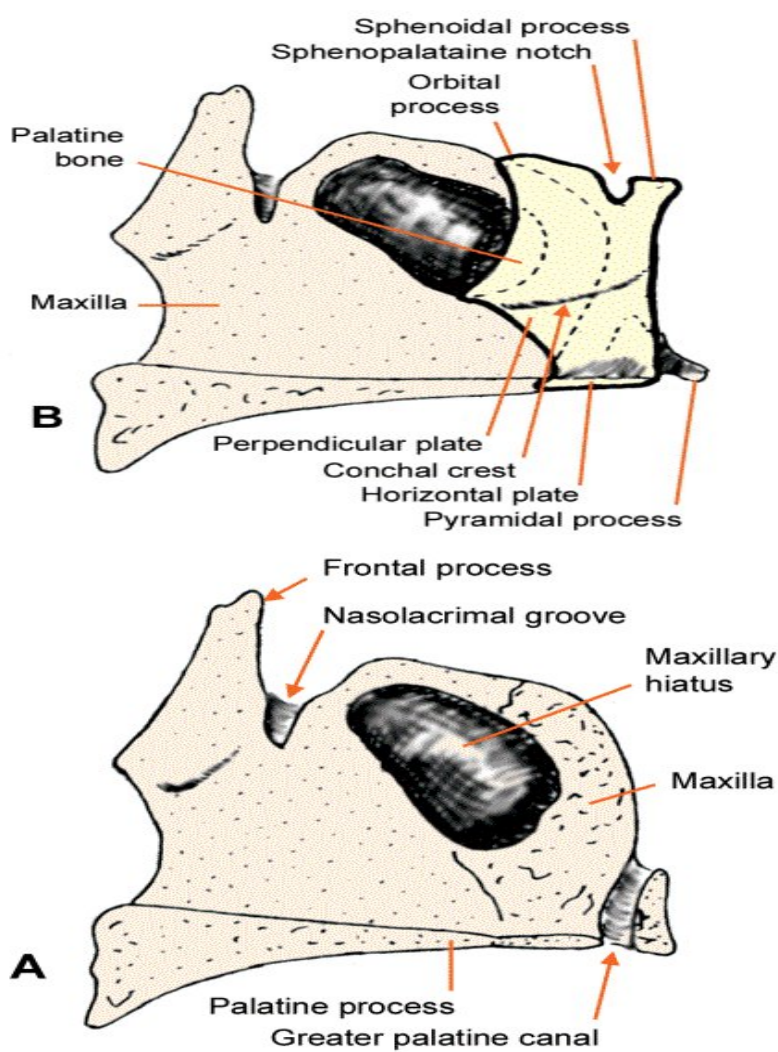
B

Middle Cranial

fossa

- 2- Nasopharynx/choana
- 3- Orbital
- 4- Nasal cavity
- 5- Hard Palate
- 6- scaphoid fossa





palatine canal):

Pterygopalatine canal (Greater

Starts on the **inferior** aspect of the [pterygopalatine fossa](#).

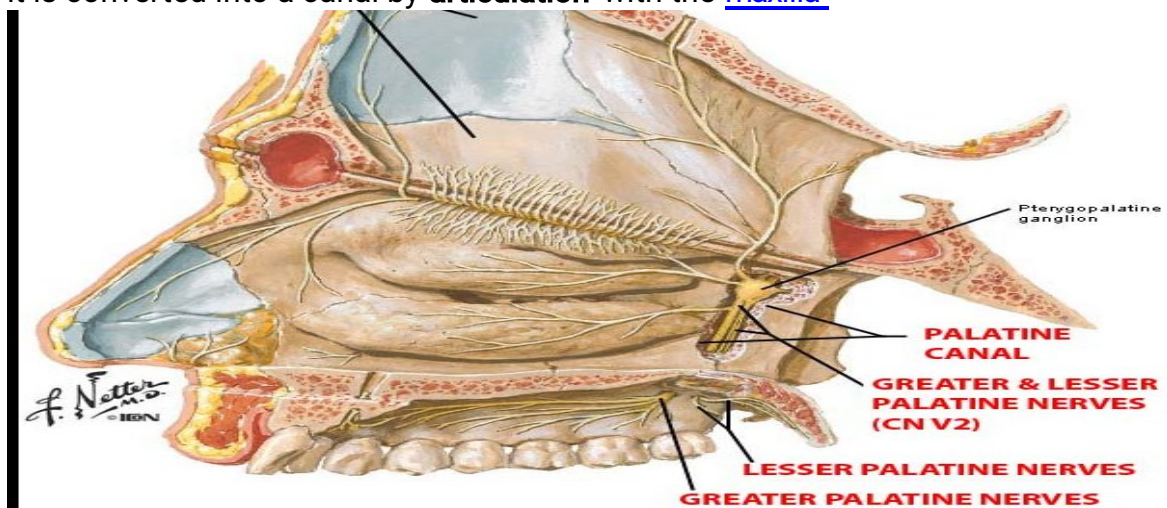
End at the greater palatine foramen.

Foramen rotundum is located lateral to it.

connects the pterygopalatine fossa & oral cavity

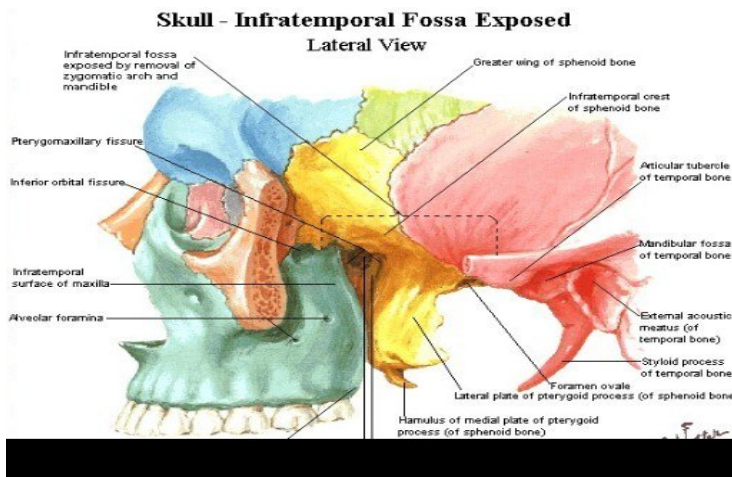
formed by a **vertical** groove on the **posterior** part of the **maxillary surface** of the [palatine bone](#);

it is converted into a canal by **articulation** with the [maxilla](#)

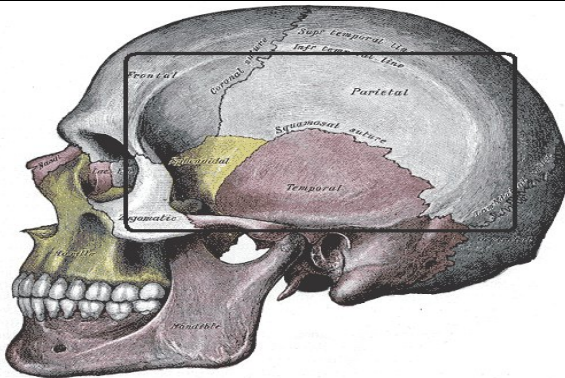


the greater & lesser palatine nerve, lesser palatine artery

contains



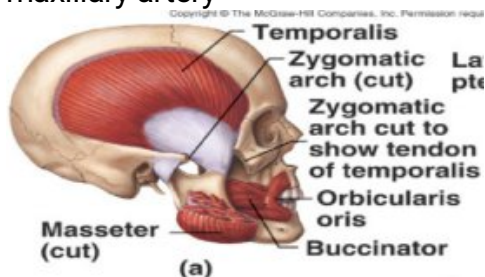
Temporal vs infratemporal fossa



Superior Border	Pair of Temporal lines	Inferior surface Greater wings & small contribution of the squamous part of the temporal bone
Inferior border	Laterally zygomatic arch Medially sphenoid infratemporal crest	No floor
Medial	Frontal, parietal, sphenoid, squamous part of temporal & occipital	Medial pterygoid & interpterygoid fascia
Lateral	Temporal fascia	Mandible
Anterior	Posterior surface of the zygomatic process of the frontal bone Posterior surface of the frontal process of the zygomatic bone	Inferior orbital fissure Pterygomandibular fissure Posterior surface of the maxillary bone
Posterior	Temporal lines	Carotid sheath
Content	Temporal muscle Deep temporal artery (maxillary artery) Deep temporal nerve (mandibular Nerve) Superficial temporal artery (External carotid artery branch) Zygomaticotemporal nerve	Medial & lateral pterygoid muscle maxillary artery (external carotid) Maxillary Vein Pterygoid venous plexus Mandibular nerve (trigeminal nerve)

So what separates the temporal fossa from the infratemporal fossa is **zygomatic arch**

Note the roof is made of the greater wings of the sphenoid bone which contains foramen ovale through which pass the mandibular branch of trigeminal nerve + accessory artery branch of maxillary artery



So maxillary artery + mandibular division are content of

infratemporal fossa

Temporalis muscle:

Origin: fan shaped; temporal fossa (mainly squamous part of temporal bone) & deep part of temporal fascia.

Course: It passes medial to the zygomatic arch

Insertion: coronoid process of the mandible.

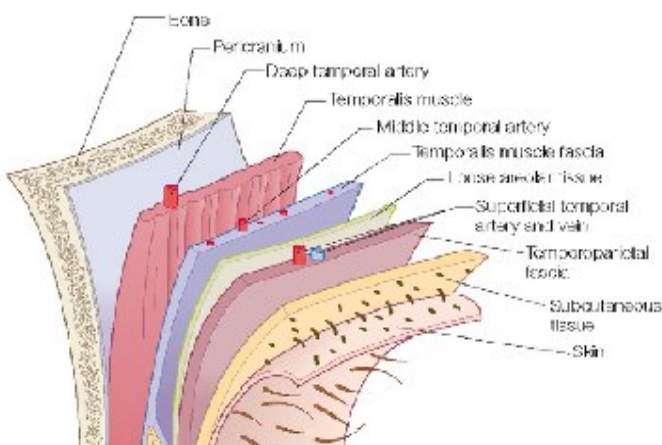
Action: closes jaw; Posterior fibers retract the mandible

Blood supply: external carotid internal maxillary deep temporal artery

Nerve supply: trigeminal nerve mandibular nerve deep temporal nerve

Note:

Deep temporal nerve enters the Temporalis muscle Anteriorly



The most important blood supply to the Temporalis muscle flap is the deep temporal artery
Hence the muscle can be mobilized Posteriorly and used to obliterate the middle ear &

mastoid

The temporal muscle is covered by the temporal fascia, also known as the temporal aponeurosis. Superficial temporal vessels & nerves, auriculotemporal nerve cross below the Temporalis fascia

Layers of the scalp

1. Skin: It has abundance of **sebaceous** gland
2. Subcutaneous tissue: It has the blood vessels of the scalp; The scalp has the richest cutaneous blood supply in the body
3. Galea (aponeurosis)
4. Loose connective tissue
5. Pericranium (periosteal): Adheres to the **suture lines** of the skull; Thus collection of blood/pus beneath this layer **outlines** the affected bone

Note:

the **venous drainage** of the scalp is **not** entirely to **superficial** veins; There are numerous **emissary veins** piercing the skull

General notes:

craniofacial ratio: at birth (8:1), adult (2:1) so orbital roof and temporal bone fractures are more common in children

foramen of morgagni: between superior constructor muscle and the skull base; might be a potential route for spread of nasopharyngeal tumors to skull base and brain

weakest area of the mandible is the area around 3rd molar, socket of the canine tooth, condyle

Why is the midface inherently prone to deficient projection?

It lacks good sagittal buttresses.

What are the three paired vertical buttresses of the midface?

Nasomaxillary, zygomaticomaxillary, and pterygomaxillary.

What are the horizontal buttresses of the midface?

Frontal bar and cranial base, zygomatic arch and temporal process of the zygoma, maxillary palate and alveolus, and the greater wing and pterygoid plates of the sphenoid.

What are the horizontal buttresses of the nasoethmoidal region?

Superiorly, the frontal bone and bilateral superior orbital rims; inferiorly, the bilateral inferior orbital rims.

What are the vertical buttresses of the nasoethmoidal region?

The paired "central fragments" arising from the frontal process of the maxilla and internal angular process of the frontal bone.

What is the most prominent portion of the zygomaticomaxillary complex (ZMC)?

Malar eminence.

What are the four bony attachments to the skull radiating from the malar eminence?

Superior attachment to the frontal bone (frontozygomatic suture); medial attachment to the maxilla (zygomaticomaxillary suture); lateral attachment to the temporal bone (zygomaticotemporal suture); and a deep attachment to the greater wing of the sphenoid (zygomaticosphenoidal suture).

Which of these is strongest?

Zygomaticofrontal buttress.

What is the weakest part of the entire ZMC complex?

Orbital floor.

What is the normal inclination of the orbital floor?

Inclines superiorly at a 30-degree angle from anterior to posterior and at a 45-degree angle from lateral to medial.

What determines the projection of the upper face?

The frontal bar (supraorbital rims and frontal sinuses).