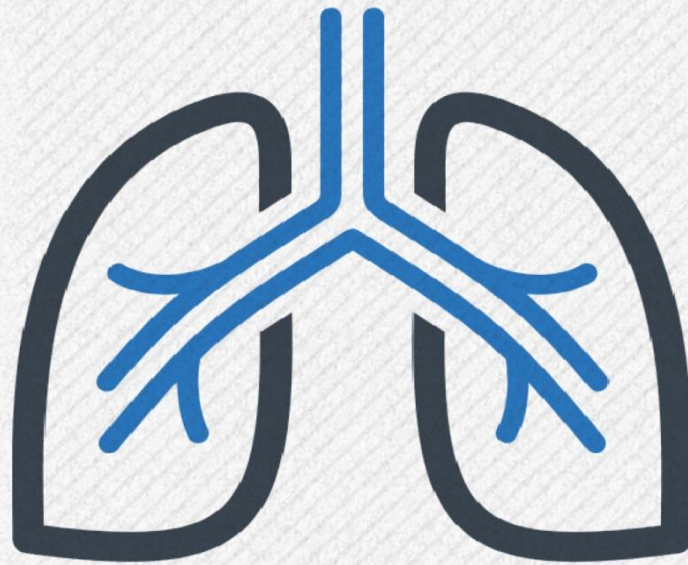




Respiratory system Anatomy



sheet



handout



slides

Number

2

Doctor

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Done by

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corrected by

Reyad Jabiri

This is only correction for the last year sheet according to our record.
If you already studied this sheet just read the yellow notes which contains extra information or clarifications mentioned by the doctor.

The Pterygopalatine fossa: is a space between skull bones. Also called sphenopalatine fossa.

General features

Shape : inverted tear-drop shape , small in size

Location: Immediately posterior to the maxilla.

Its content is distributed to the nasal cavity , oral cavity , orbital cavity , naso-pharynx . (Lies between the sphenoid bone and the maxilla, best viewed from the lateral aspect of the skull)

The most important two contents of the Pterygopalatine fossa are the maxillary artery and nerve.

Boundaries

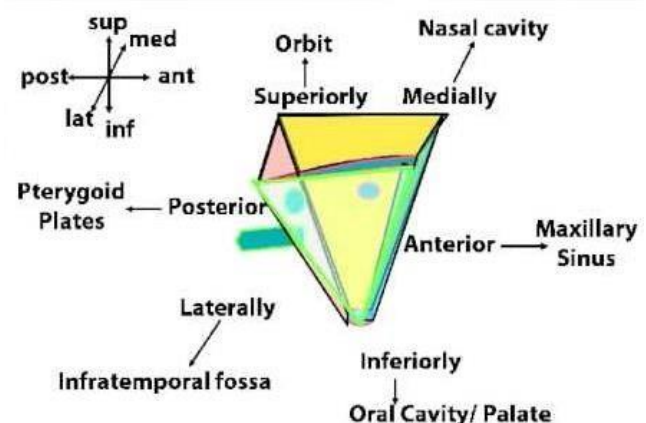
Refer to fig1
the boundaries are bony structures
(Skeletal framework) :

- ✓ Anteriorly : posterior wall of Maxilla
- ✓ Superiorly : greater wing of Sphenoid
- ✓ Posteriorly : lateral Pterygoid plate of Sphenoid bone
- ✓ Laterally : Pterygomaxillary fissure which opens into the inferior temporal fossa.
- ✓ Medially : lateral surface of palatine bone (contain Sphenopalatine foramen “which is a gateway to the *nasal cavity*”)

Note: nerve and blood supply of the nose pass through sphenopalatine **foramen**.(at the medial wall)

At the Pterygoid plate (sphenoid bone), there are two important foramen (figure2)

1. Foramen Rotundum (the Maxillary “V2” n. pass through it)



2. Pterygoid canal (nerve to Pterygoid canal (pterygoid n.) pass through this, **present at the roof of foramen lacerum**)

These two are present at the middle cranial fossa and they serve as a passage for their nerves to pass from the middle cranial fossa into the sphenopalatine fossa.

Note : recall foramina of skull from figure3 also Dr. Amjad 2nd year slides [here](#) for an excellent review .

Remember, the maxillary n. is a branch of the trigeminal n. (V) , it's a pure sensory n. that supply the upper teeth , the skin over maxilla and the external nose (other details later)

U can notice in figure2 the internal carotid artery,

Internal carotid artery

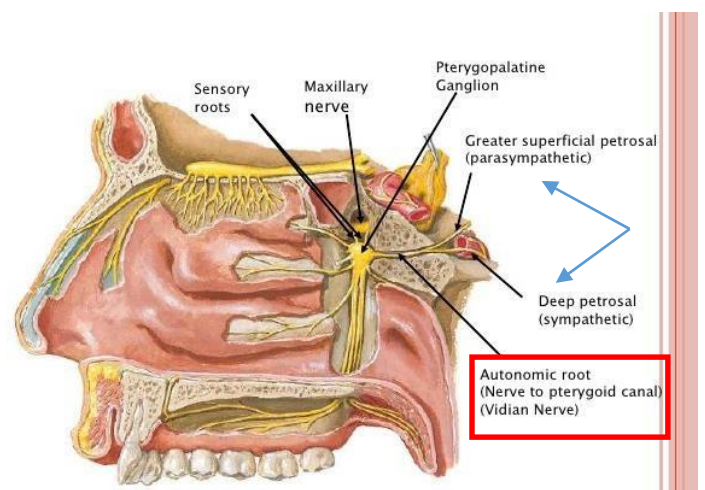
- ✓ Passes to foramen lacerum (to its roof) , then it enters the cavernous sinus
- ✓ Branches : ophthalmic artery (which accompanied the optic nerve through the optic canal)

Note : the foramen lacerum is covered by a cartilage (and its roof we find the internal carotid artery)

Nerve to Pterygoid canal

nerve to pterygoid canal is a mixed nerve of sympathetic and parasympathetic fibers

- ✓ It obtains its parasympathetic fibers from greater petrosal nerve (branch of facial nerve VII) , this will supply the pterygopalatine ganglia with parasympathetic fibers. "*preganglionic*"
- ✓ Once the nerve to pterygoid canal (parasympathetic portion) reaches the pterygopalatine ganglia it will synapse in the ganglia.
- ✓ It obtains its sympathetic fibers from deep petrosal nerves plexus which surround the internal carotid artery. "*postganglionic*"



-Important question for the exam:

-what are the contents of the pterygoid canal? And which one is preganglionic and postganglionic.

Notes:

- ✓ Every nerve fibers has to synapse in ganglia, before the synapse the nerve is preganglionic while after the synapse the nerve is postganglionic.
- ✓ The sympathetic fibers tend to synapse right after its origin (near the cranium or the spines) >> this implies that any sympathetic fiber will be "postganglionic" while the parasympathetic tends to synapse near organs
- ✓ The main role of sympathetic fibers is vasomotor for blood vessels.
>> thus the parasympathetic fibers will be preganglionic –generally speaking-
- ✓ When a post ganglionic fiber reach another ganglia it will pass through the ganglia without synapsis
- ✓ We have 4 ganglia in the head and neck, all are parasympathetic
- ✓ Parasympathetic role in glands is = secretomotor where are these glands?
-at mucosa of the respiratory system (or submucosa), also independent glands like the lacrimal gland also need parasympathetic fibers.
- ✓ The pterygopalatine ganglia is one of the head ganglia >> a parasympathetic ganglia. (it is one of the contents of the fossa)

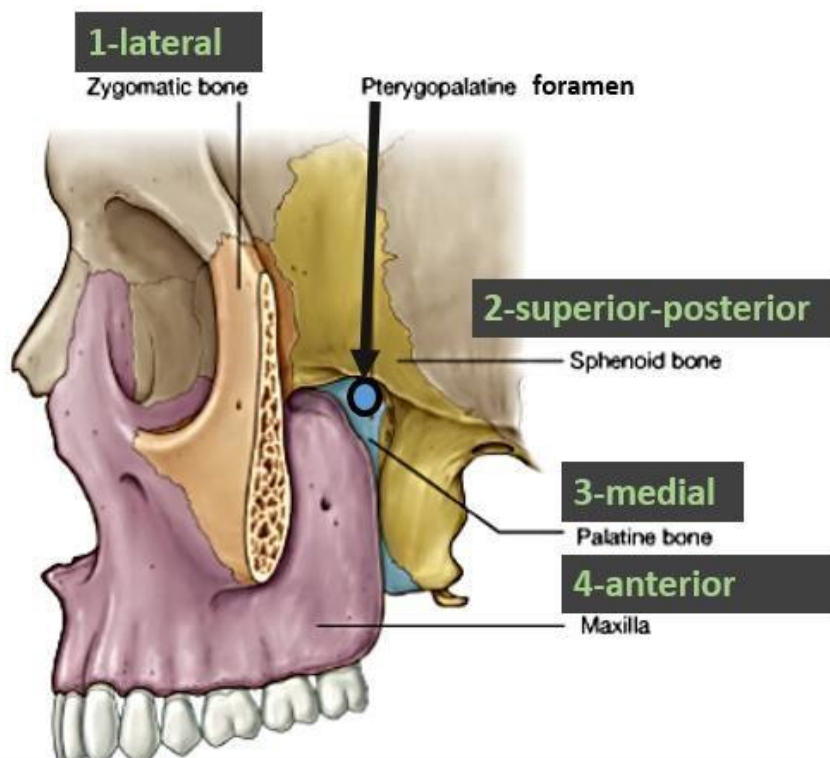


Figure1: skeletal frame of pterygopalatine fossa

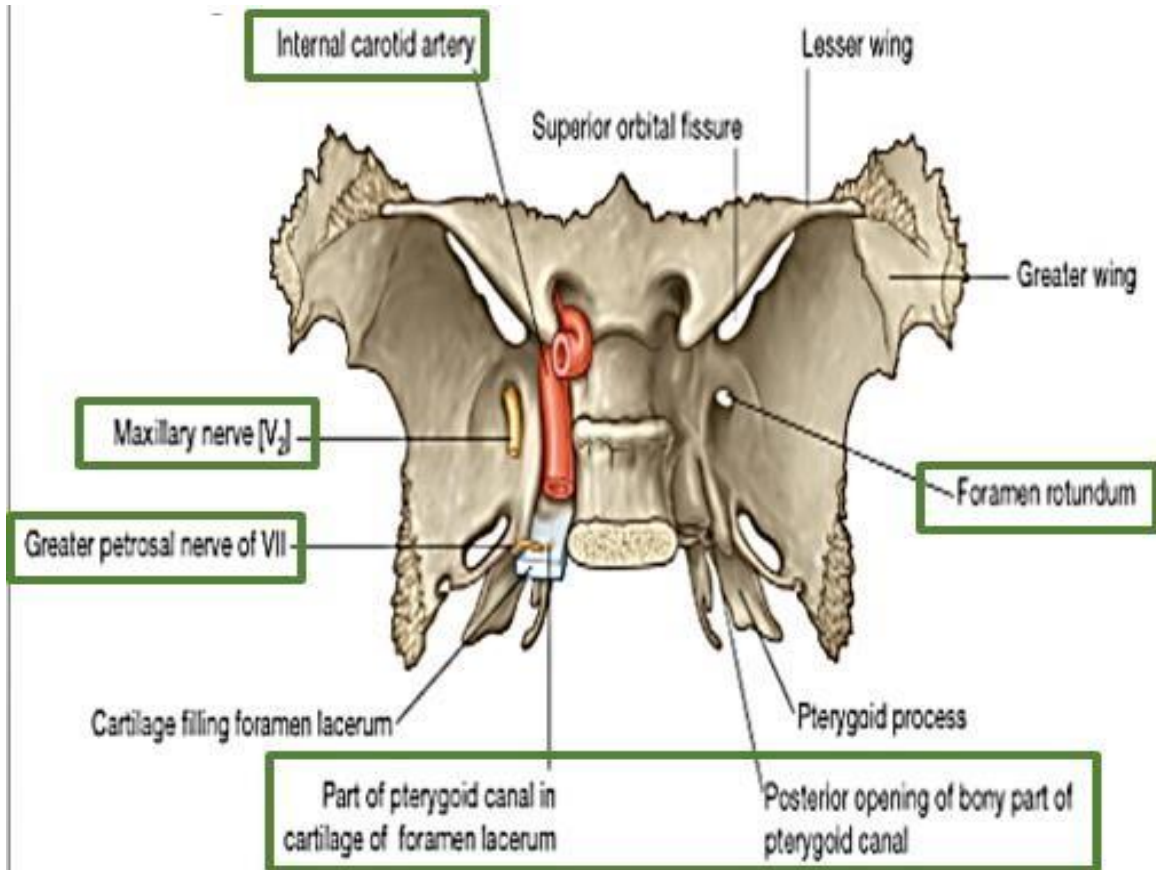
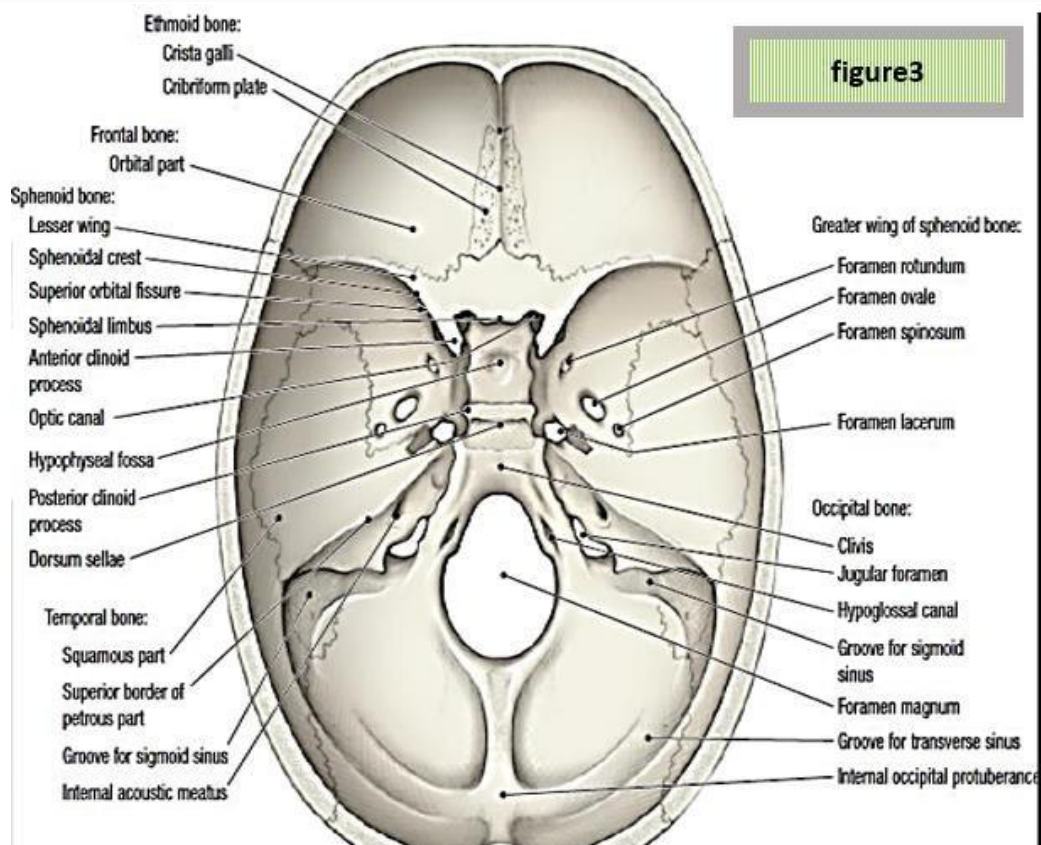


Figure2 : related foramens in sphenoid bone



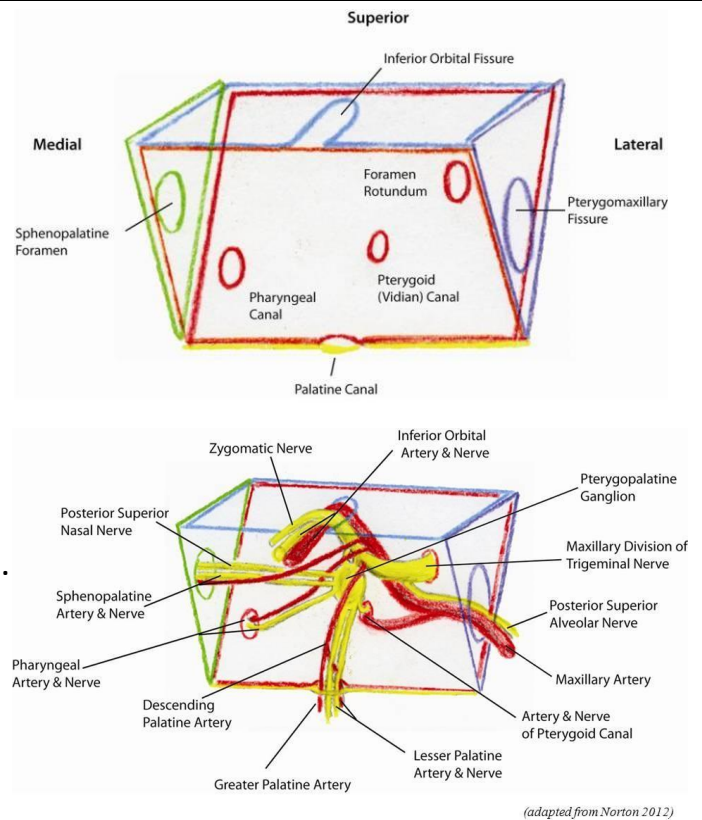
Gateways

Figure4 (indicated from 1- 6)

These gateways are simply the communications between different spaces through the fossa, these

are: -no.1+2 u already know-

1. **Foramen rotundum and pterygoid canal** communicate with the middle cranial fossa.
2. **Sphenopalatine foramen** opens into the lateral wall of the nasal cavity and is in the medial wall of the fossa (all nerves and vessels of lec1 have passed through this foramen)
3. **Palatine canal** , opens into the roof oropharynx, pass through this canal palatine vessels and nerves. "Palatines" split into greater and lesser palatines "*greater & lesser palatine foramen+nerve +vessels*", greater to hard palate and lesser to the soft palate. These ends at the oral cavity.
note : the hard palate innervation and blood supply , also aids in nose supplement.
4. **Palatovaginal canal** opens onto the posterior wall and leads to the nasopharynx, pass through this canal blood supply and nerves to nasopharynx.
5. **Pterygomaxillary fissure** between lateral aspect of the pterygopalatine fossa and the infratemporal fossa
note: this fissure is a space between pterygoid plate and the maxilla hence. The name .
passes through this fissure : the maxillary artery (it reaches the pterygopalatine fossa through the fissure , in the fossa it will give branches
—discussed in details later-
6. **Inferior orbital fissure** , communicate with the orbital cavity.
the maxillary n. and artery enter the cavity >> then exit through the infraorbital foramen as infraorbital nerves and vessels.



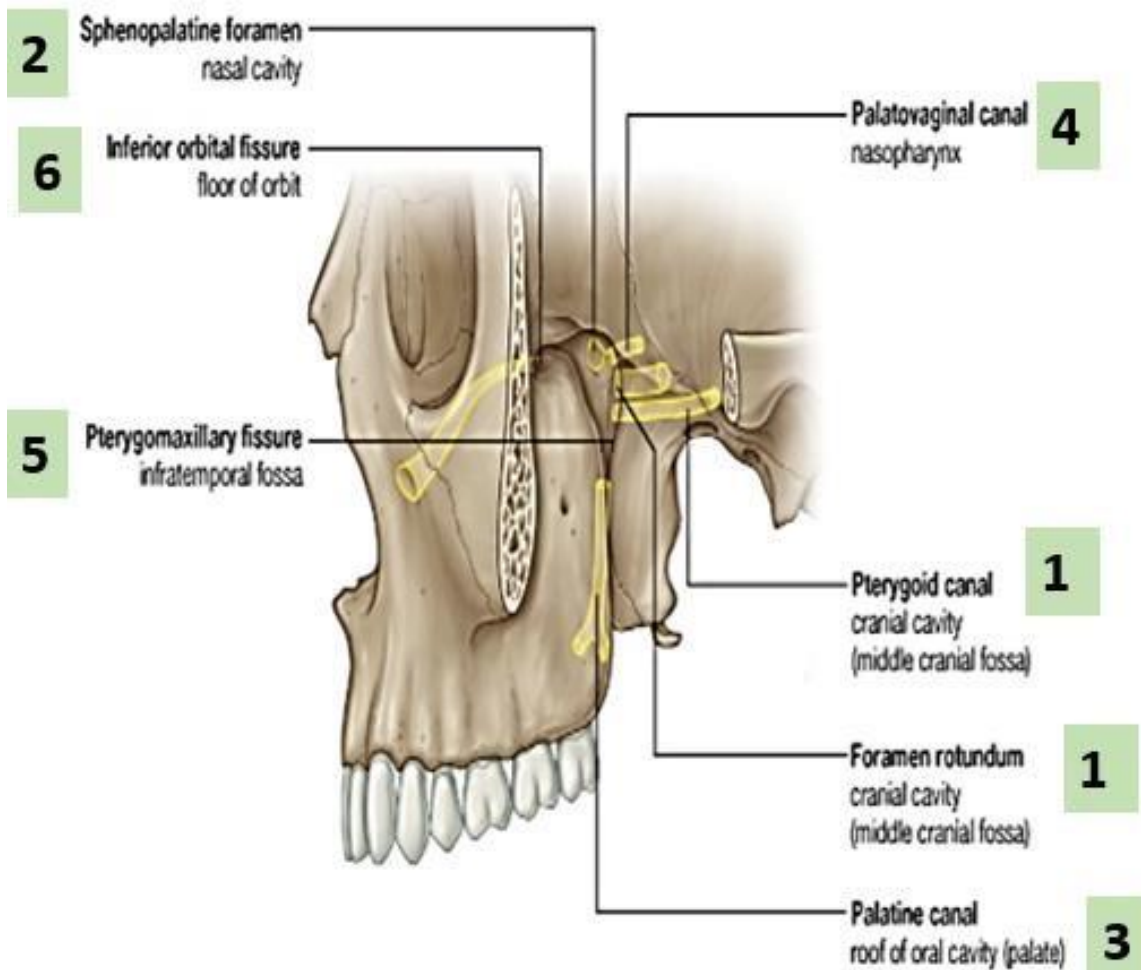


Figure3: gateways through the fossa

Contents of the fossa

We will talk in details about each content of the fossa –except the lymphatics - let us first list them :

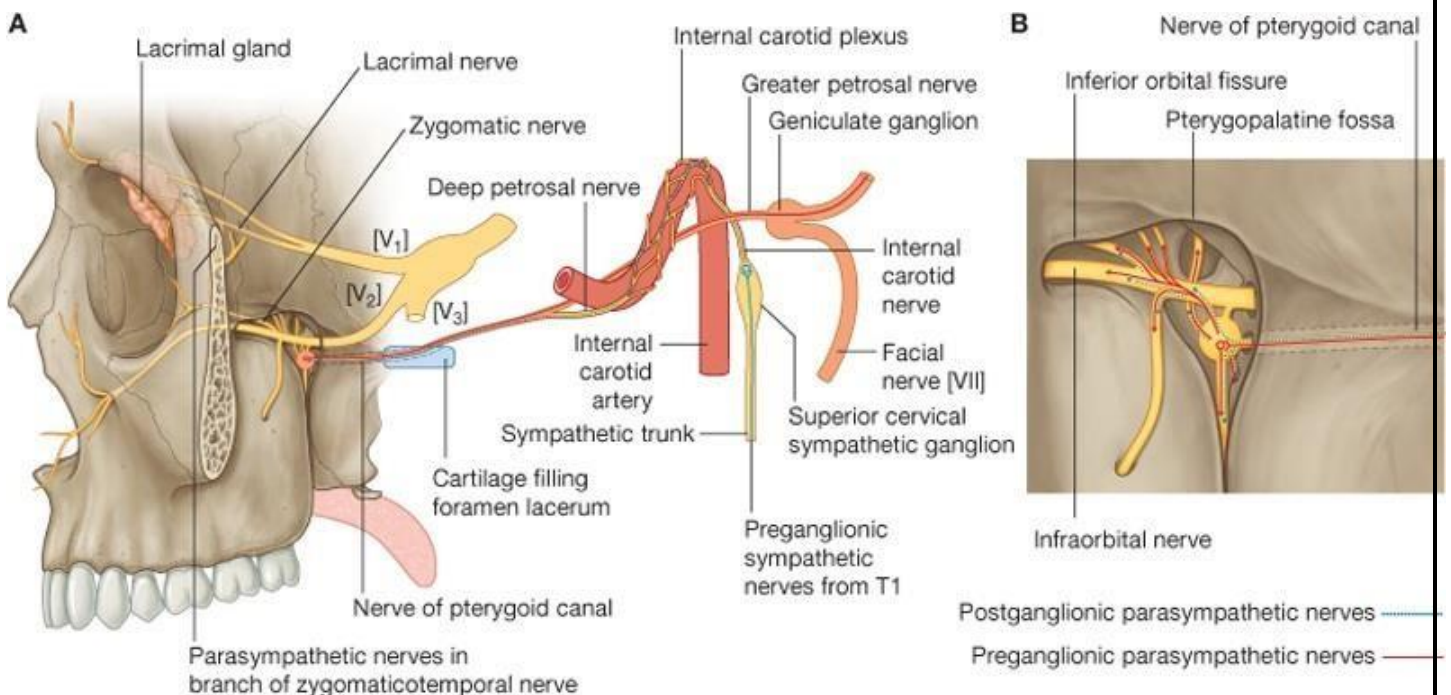
1. The maxillary nerve [V2]
2. Terminal part of the maxillary artery
3. Nerve of the pterygoid canal
4. The pterygopalatine ganglion
5. Veins and lymphatics also pass through the pterygopalatine fossa.

-1-

Nerve of pterygoid canal

- ✓ as said before , this nerve is composed of sympathetic and parasympathetic fibers
- ✓ also called “Vidian” nerve
- ✓ the parasympathetic comes from great petrosal N. (branch of facial VII) these fibers are preganglionic and will become postganglionic after passing the pterygopalatine ganglion
- ✓ The sympathetic comes from deep petrosal plexus (around the internal carotid artery. These fibers are postganglionic (already have synapse superior cervical sympathetic ganglia **at the level of T1 spinal segment**)
- ✓ **Great petrosal fibers + deep petrosal fibers= nerve to pterygoid canal** these will enter the pterygoid canal and then reach the pterygopalatine fossa to synapse at the pterygopalatine ganglion.

Refer to Figure5



Drake: Gray's Anatomy for Students, 2nd Edition.

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-2-

Pterygopalatine ganglion

- ✓ Present at the pterygopalatine fossa ☺ -refer to figure6
- ✓ Is considered as parasympathetic ganglia (because only the parasympathetic. Synapse inside it "the great petrosal")
- ✓ The source of parasympathetic fibers in PPG is the great petrosal nerve (preganglionic) that originates from the geniculate ganglion (also a parasympathetic ganglia mainly for the parasympathetic branches of the facial nerve).
- ✓ As any ganglion this ganglion has to have 3 types of fibers and will distribute them to other tissue after synapsis :
 - Sensory branches (from the maxillary n.>> twigs of nerves (two nerves) descends to the ganglion "twigs من twig :P"(those sensory branches from the maxillary nerve are responsible for transmitting sensation from the ganglia in cases of infection or pain)
 - Parasympathetic fibers obtained from pterygoid n. and distributed – postganglionically- with branches of the maxillary n.
 - Sympathetic fibers obtained from pterygoid n. and also distributed after passing the ganglion with branches of maxillary n.
- ✓ Distributions of the postganglionic fibers (through the gateways) :
 - To the orbit: through the inferior orbital fissure.
 - To the palatine through the palatine canal
 - Pharyngeal branches to the nasopharynx through the Palatovaginal canal
 - Branches to nasal cavity through the sphenopalatine foramen , the maxillary give branch here (sphenopalatine nerve ; which further give long and short sphenopalatine)

Now we will talk about the distributing branches in further details :

1st :

Orbital branches

- Pass through the inferior orbital fissure
- Supply of the orbital wall (periosteum) and lacrimal gland
- Supply the sphenoidal and ethmoidal sinuses.

Notice the lacrimal gland receive parasympathetic fibers (secretomotor) , HOW ?



refer to figure 7 (from Dr Amjad slides)

- 1- Through the Zygomatico-temporal branch of max. nerve
- 2- Lacrimal nerve receive parasympathetic and sympathetic fibers from the former

2nd :

Pharyngeal nerve

- Passes posteriorly from the pterygopalatine ganglion
- Leaves the fossa through the palatovaginal canal
- Supply the mucosa and glands of the nasopharynx

Refer to figure 8

3rd: Greater and lesser palatine nerves

- Pass through the palatine canal
- Enter the oral surface of the palate through the greater and lesser palatine foramina.
- **Lesser palatine (Middle, Post, palatine) nerve** passes posteriorly to supply the soft palate.
- **The Greater palatine (Ant.palatine) nerve** passes forward on the roof of the oral cavity

Refer to figure 8

4th :

Nasal nerves

- Seven in number
- Pass medially through the sphenopalatine foramen to enter the nasal cavity
- **Short sphenopalatine** (Post.Sup. Lateral nasal) supply the mucosa of the Post,Sup. quadrant of the nasal cavity.
- The **Nasopalatine nerve (long Sphenopalatine)** is the largest of the nasal nerves
- Passes anteriorly grooving down the nasal septum
- Through the incisive canal and fossa in the hard palate
- Supply mucosa, gingiva, and glands adjacent to the incisor teeth.
- Join the greater palatine nerve.

Refer to figure 8

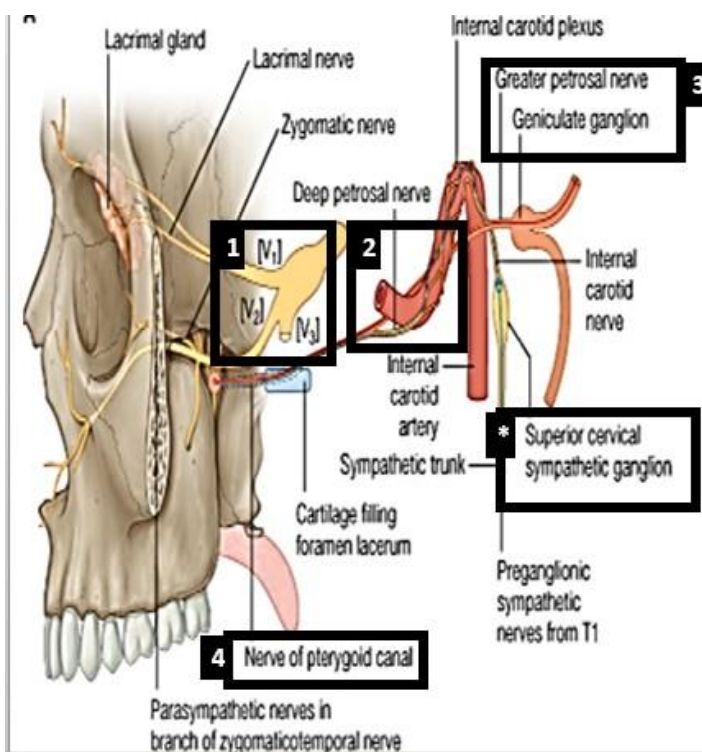


Figure5: nerve to pterygoid canal

1 : the trigeminal n gives 3 branches :
V1 ophthalmic
V2 maxillary (through foramen rotundum) go to upper teeth
V3 mandibular (through the foramen ovale) supplies the lower teeth.

2 the internal carotid artery surrounded by sympathetic nerve plexus >> deep petrosal n.

3 the greater petrosal n branch of fascial n. (notice the geniculate ganglion of the fascial n.)

4 nerve to pterygoid canal passing to the fossa and the ganglia

notice in (*) this is the superior cervical ganglion at which the sympathetic fibers synapse first

Figure6: pterygopalatine ganglion

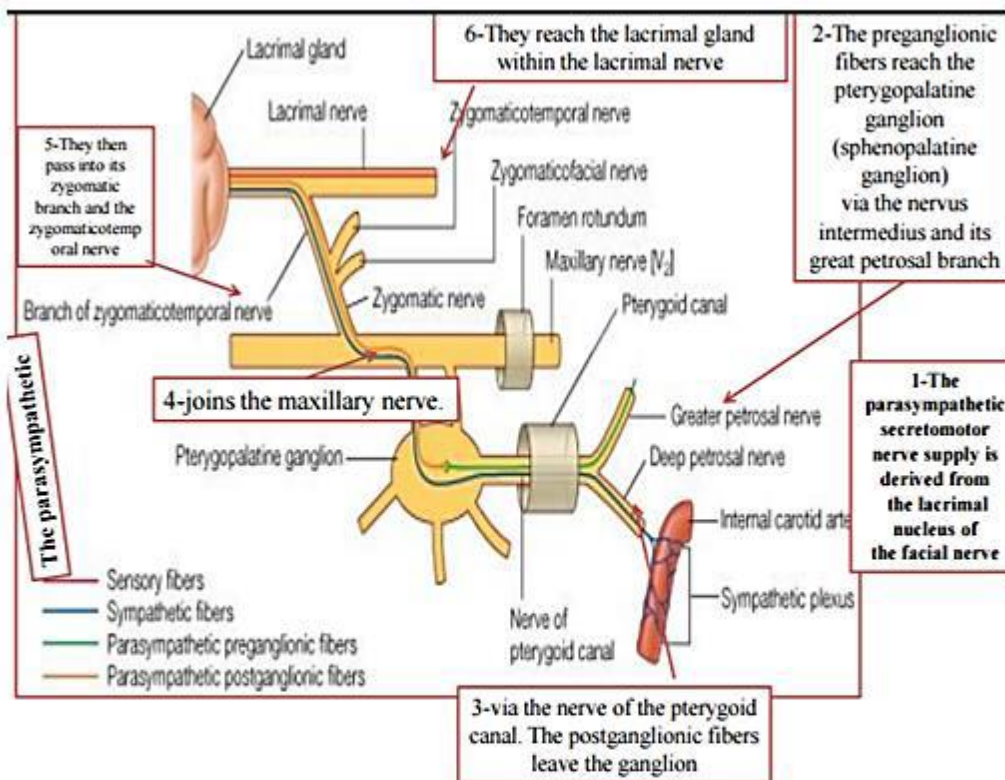
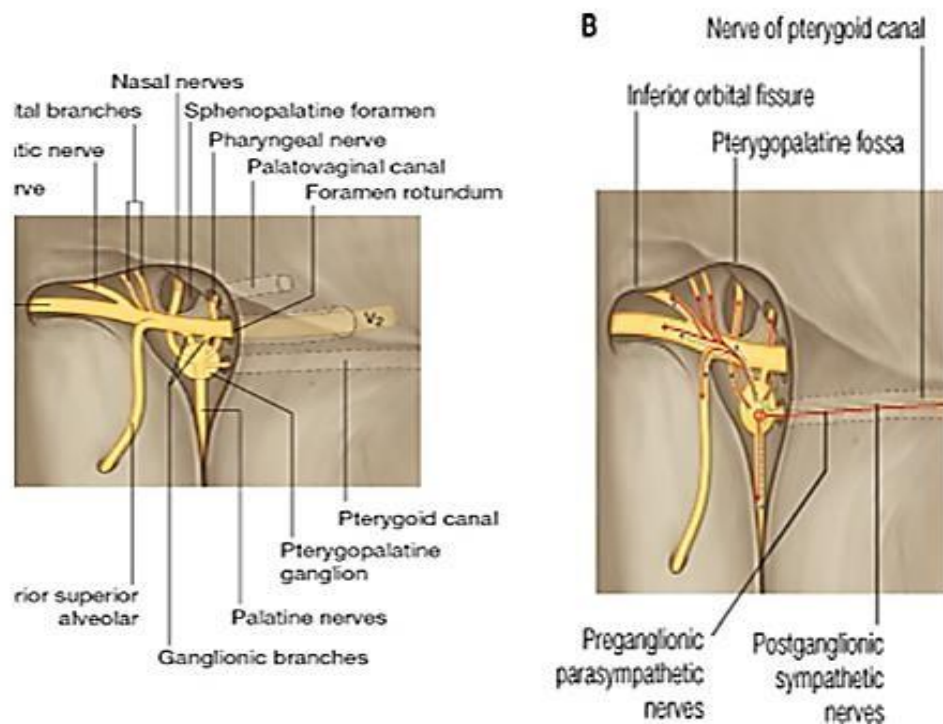
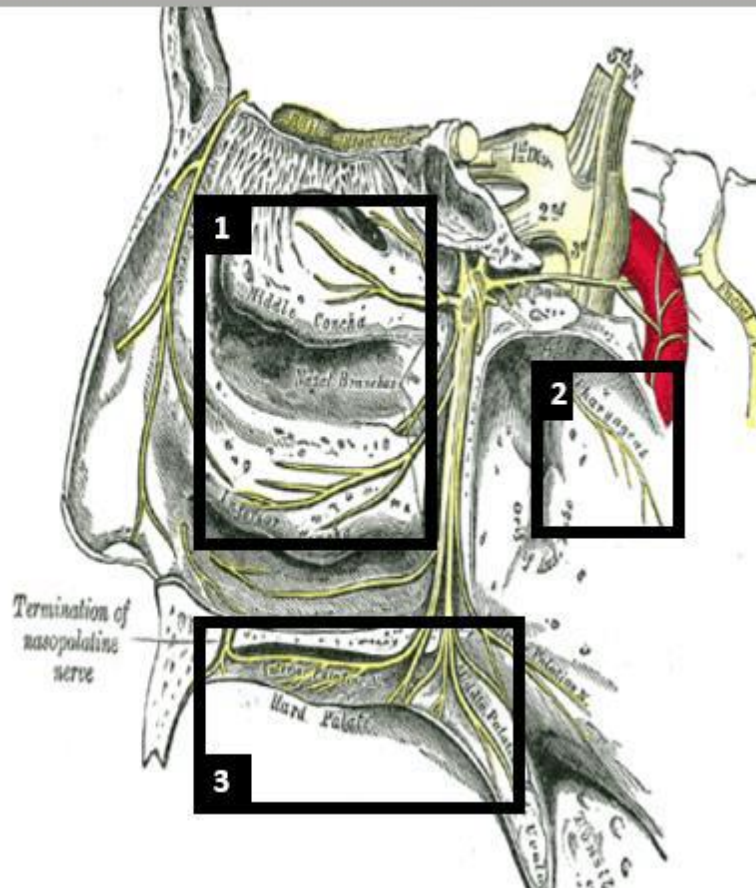


Figure7 : parasympathetic of lacrimal gland
 (just recall ur-self if u want to ☺)

Figure8: distribution of post ganglionic branches

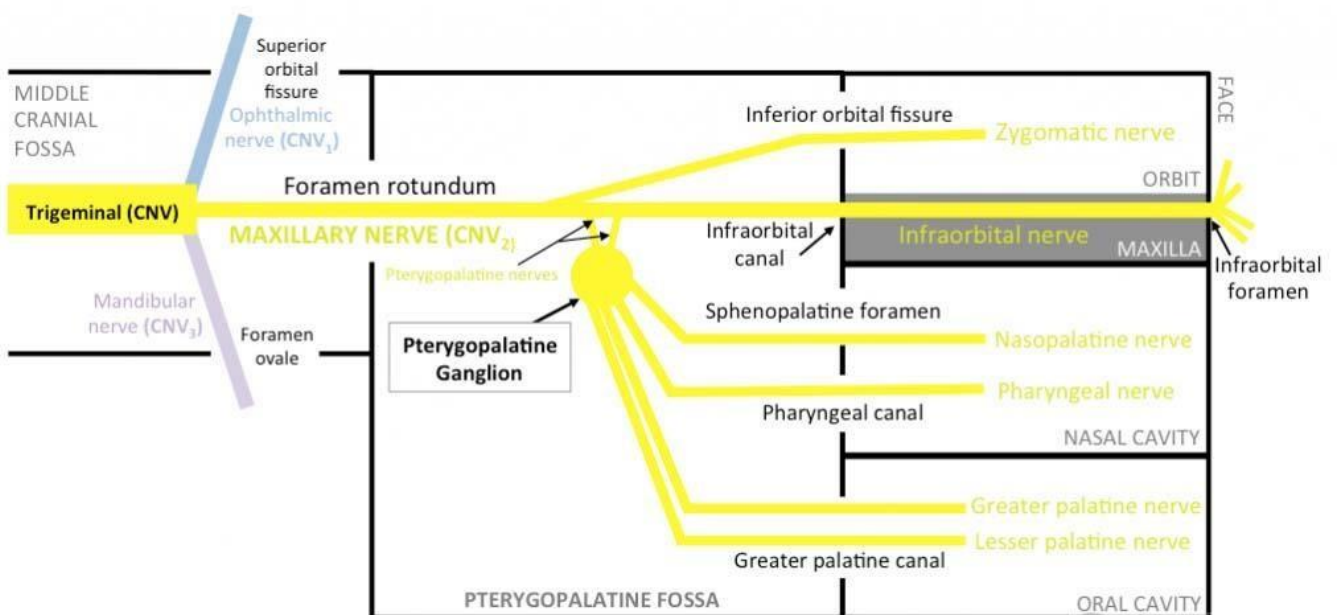


- 1: nasal branches
(this is the lateral wall of the nasal cavity)
- 2: pharyngeal branches
- 3: palatine branches

u suppose to know these branches from lec.1

-3-

Maxillary nerve



- ✓ Pure sensory
- ✓ Originate from trigeminal nerve in the middle cranial fossa
- ✓ Pass through foramen rotundum reaching the pterygopalatine fossa
- ✓ From there it reaches the infratemporal fossa through the pterygomaxillary fissure -here it gives superior posterior alveolar nerve which innervates the last three molars of the upper jaw.
- ✓ Then through the inferior orbital fissure >> it reaches the orbital cavity here it is called infraorbital nerve.

in the orbital cavity it gives branches to the periosteum of the orbit (sensory) and (anterior- and middle-) superior alveolar nerves.

when exiting through infraorbital foramen it gives sensory to the lower eyelid “palpebral” & to the skin over the external nose “nasal” and the upper lip “labial” .

-figure 9

Always remember that the max. nerve is mainly for the upper teeth while the mandibular nerve to the lower teeth.

So , The maxillary n. ends as infraorbital n. which itself gives rise to

- ✓ superior alveolar n. , which separate into anterior and middle >> these supply teeth “incisors, Canines”from anterior” & Premolars teeth”from middle””. (most of the upper jaw)
- ✓ Note :The posterior superior alveolar (arise from the maxillary n directly in the infratemporal fossa) >> supply last 3 molar teeth.
- ✓ These branches (superior alveolars) arise from the infraorbital n. right before exiting the orbital cavity through infraorbital foramen.

-FOCUS-

some books say that right after the max n. enter the orbital cavity it turns into infraorbital n (this nerve will pass through the cavity by passing through a groove or canal) then it terminate after passing out of the orbital cavity through the infraorbital foramen.

other resources do not consider the nerve inside the orbital cavity as infraorbital n. but rather a max. nerve.

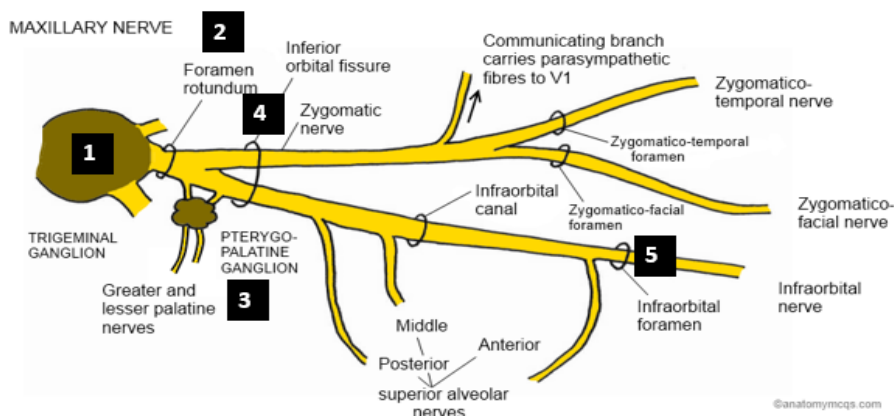
Note , blood vessels correspond and accompanied nerves here.

These branches are very clear at **figure10 Other branches of maxillary nerve:**

- 1- Meningeal branches, before reaching the fossa.
- 2- Postganglionic parasympathetic fibers, these fibers accompanied with the original sensory fibers of the maxillary nerve, after it synapse in the PP ganglion.
- 3- Zygomatic nerve, at the inferior orbital fissure.

the zygomatic nerve divides into zygomaticotemporal and zygomaticofacial

rem. Zygomaticotemporal is the nerve that carry parasympathetic (postganglionic) fibers to lacrimal nerve >> to lacrimal gland . while zygomaticofacial n. supplies skin of the face over the zygome.



Excellent figure :

- 1: the maxillary is a branch of trigeminal nerve
- 2: exit the cranium through foramen rotundum
- 3: synapse at the PP ganglion
- 4: pass through the gateways of the fossa
- 5: terminate as infraorbital nerve after passing through the infraorbital foramen.

The branches are well identified

Figure9: course of max nerve

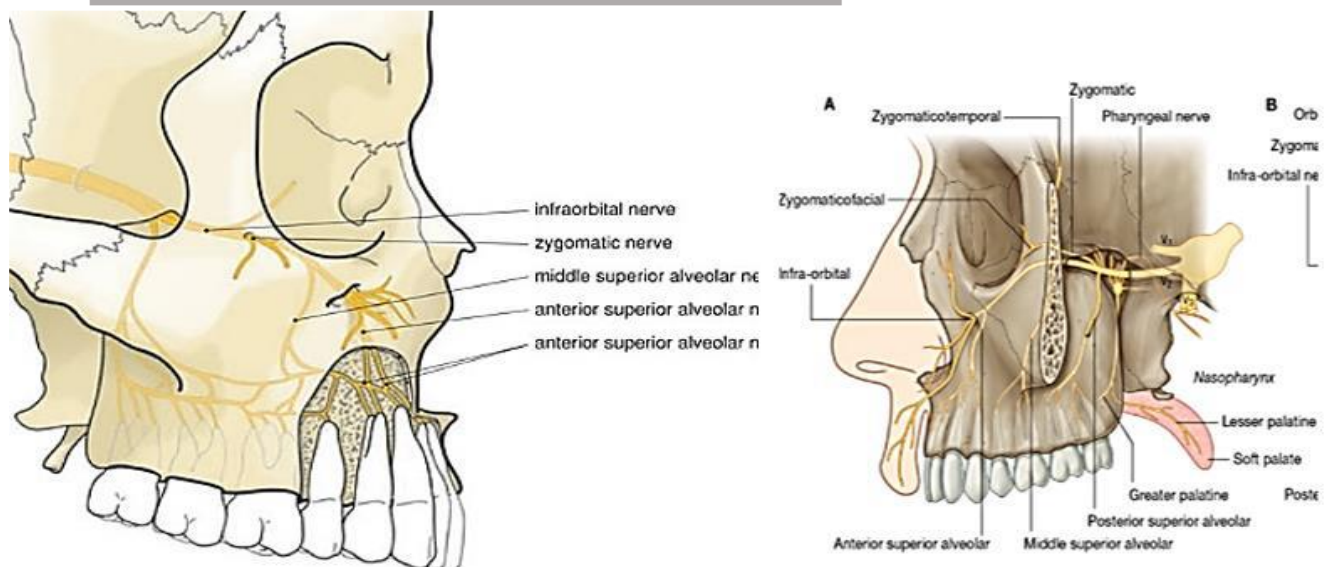


Figure10 : some branches of the max nerve

Maxillary artery

- ✓ Correspond to maxillary nerve branches (same names)
- ✓ branch of the external carotid , this branching occur within the substance of the parotid gland , here the external carotid terminate giving two terminal branches superficial temporal artery and the maxillary artery
- ✓ The maxillary artery is divided by **lateral pterygoid** muscle into 3 parts:
-figure 11
 - 1st part: before the muscle.
 - 2nd part: related to the muscle (either superficial or deep –as it branches)
 - 3rd part after the muscle. This part is what reach the pterygopalatine fossa. Note: lateral pterygoid is one of muscles of mastication which are masseter, temporalis, lateral and medial pterygoid.

Relations:

1st part:

1st part gives 5 branches,

- We can notice that all branches of this part enter foramina or canals
 - Also notice that deep auricular and ant. Tympanic reach the ear through external auditory meatus
 - Accessory middle meningeal artery goes back to the skull through foramen ovale, while middle meningeal goes to foramen spinosum
- The first part of the maxillary artery is the part between the neck of mandible (Lat.) and the sphenomandibular ligament (Med.)
 - Also related to the auriculo.temporal nerve (above) and the maxillary vein (below).
 - Gives origin to two major branches (the middle meningeal and inferior alveolar arteries)
 - Smaller branches (deep auricular, anterior tympanic, and accessory meningeal);
- Inferior Alveolar artery which goes downward to the mandibular canal, supplies the lower teeth

Note: notice that the maxillary artery supplies both upper and lower teeth unlike the nerve which supplies only the upper teeth

1. deep auricular artery (enters squamotympanic fissure)
 2. anterior tympanic artery (enters squamotympanic fissure)
 3. middle meningeal artery (enters foramen spinosum)
 4. accessory meningeal artery (enters foramen ovale)
 5. inferior alveolar artery (enters mandibular foramen)

2nd part:

2nd part also gives 5 branches but most of them are muscular so it is mainly muscular (supplies muscle of mastication and buccal region)

- The second part of the maxillary artery the part related to the lateral pterygoid muscle
- Gives origin to deep temporal, masseteric, buccal, and pterygoid branches (muscles of mastication)
- Course with branches of the mandibular nerve

1. anterior [deep temporal branches](#)
2. posterior deep temporal branches
3. pterygoid branches
4. [masseteric artery](#)
5. [buccinator artery](#)

3rd part

3rd part gives 5 +1 branches (the +1 is the terminal branch)

- In the pterygopalatine fossa
- Anterior to the pterygopalatine ganglion
- Gives origin to branches that accompany branches of the maxillary nerve [V2] and the pterygopalatine ganglion.
- These branches supply much of the nasal cavity, the roof of the oral cavity, and all upper teeth.
- In addition, they contribute to the blood supply of the sinuses, oropharynx, and floor of the orbit.

Branches of the maxillary artery

1- post. Superior alveolar (to molar teeth)

2- infraorbital , which gives arise to

3- anterior and middle superior alveolar

4- lesser and greater palatine (the greater enters through the incisive foramen and supplies the nose)

5- pharyngeal for naso-pharynx

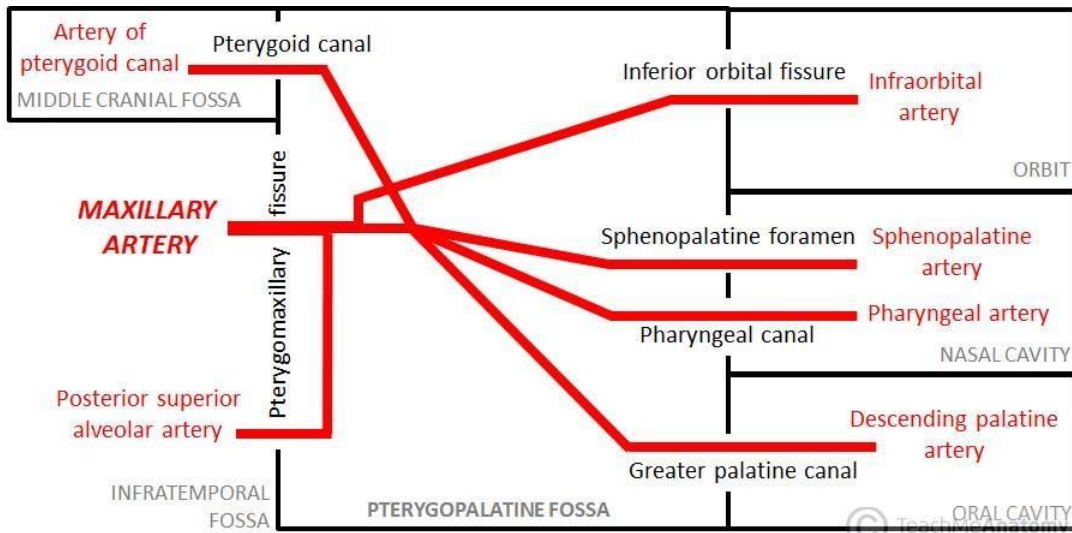
6- sphenopalatine (long and short)

long sphenopalatine= nasopalatine supplies the septum (one of the

causes of epistaxies –along with facial)

7- artery to pterygoid canal accompanies the corresponding nerve.

“the doctor said something which I think is wrong, he said that the artery (similar to the nerve) ends as infra orbital artery! While in textbooks the terminal branch is the sphenopalatine artery



Notice the maxillary artery course is inverse to the nerve as the artery ASCEND from the infratemporal to PP fossa .

while the nerve DESCEND from the middle cranial fossa then to PP fossa then to infratemporal fossa

Where does the artery and nerve meet?

At the pterygomaxillary fissure and the pterygopalatine fossa.

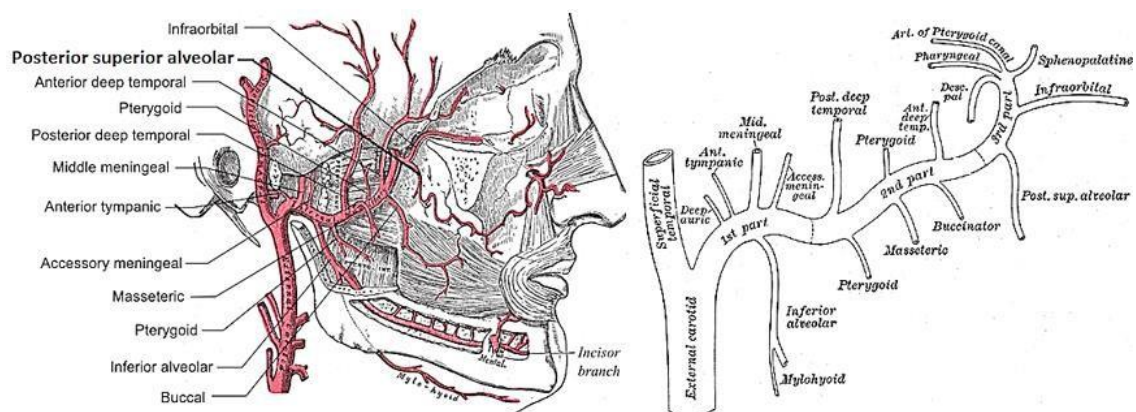


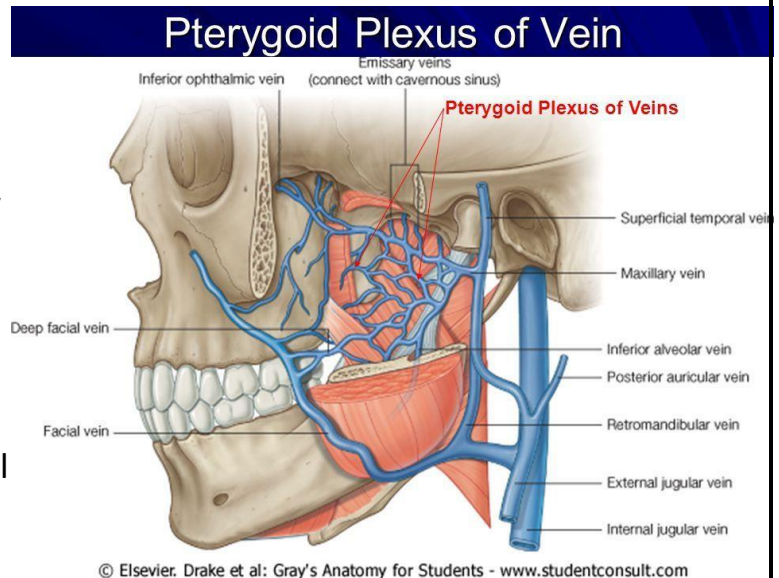
Figure11 : max artery branches and parts

-5- Veins

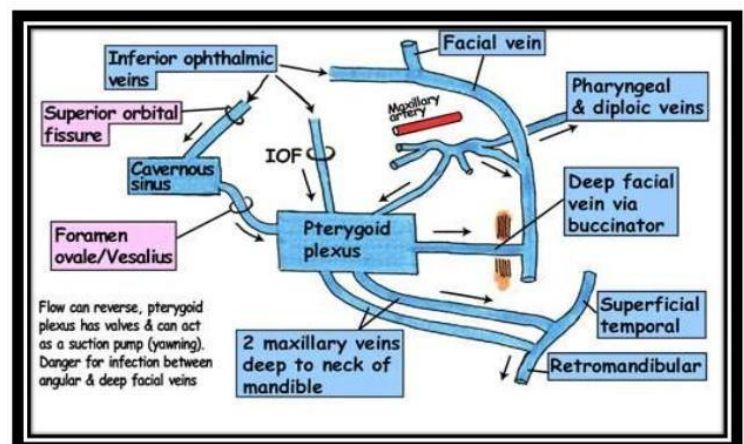
- ✓ Inverse to the artery
Descend to the infratemporal fossa to **pterygoid plexus of veins** (around lateral pterygoid muscle) and posteriorly it forms the maxillary vein.
- ✓ anteriorly there is a communication between pterygoid plexus of veins with the facial vein
- ✓ anterior part may go through the orbital fissure and ophthalmic vein to cavernous sinus "rare"

Dangerous area of the face:

- ✓ Emissary veins connect the pterygoid plexus of veins with the cavernous sinus (through foramen ovale) >> if there's an Infection "*pus*" around the nose, it can be conducted to the cavernous sinus through emissary veins because they are valve less >> this might cause thrombosis and death. (this make squeezing an acne in the dangerous area , dangerous!)

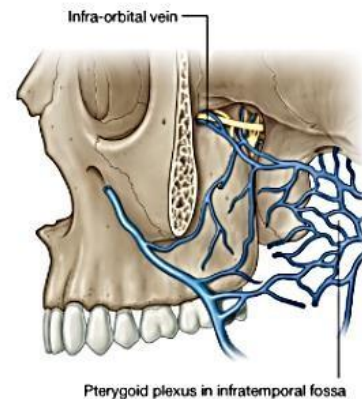


Venous connections of cavernous sinus



now read this slide

- Drain areas supplied by branches of the terminal part of the maxillary artery
- Generally travel with these branches back into the pterygopalatine fossa.
- The veins coalesce in the fossa and then pass laterally through the pterygomaxillary fissure to join the pterygoid plexus of veins in the infratemporal fossa
- The infra-orbital vein, drains the inferior aspect of the orbit,
- May pass directly into the infratemporal fossa, so bypassing the pterygopalatine fossa



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-Infra-orbital vein (usually accompanied with the infra-orbital artery and nerve) may drain into the fascial vein which drains into the common fascial then to the internal jugular vein.