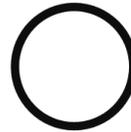


RESPIRATORY SYSTEM

Anatomy



Sheet



Slide

Number:

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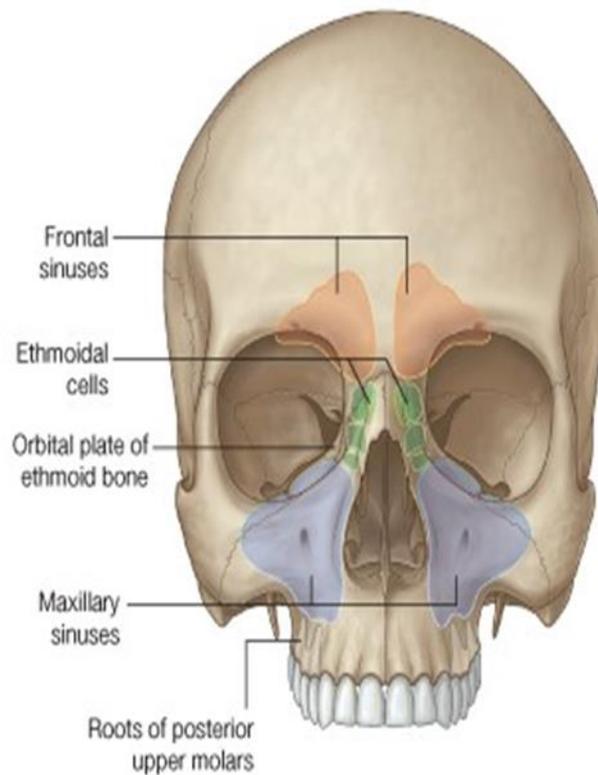
Luma Taweel

Doctor:

Mohammad Almohtaseb

- I didn't include all the photos in this sheet in order to keep it as small as possible so if you need more clarification please refer to slides 😊
- In this lecture we're gonna discuss paranasal sinuses and pterygopalatine fossa.

A



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The paranasal sinuses are spaces inside skull bones. They're all lined with respiratory mucosa which is **pseudostratified ciliated columnar epithelium** but the mucosa here is thin.

- All sinuses open by ducts into lateral wall of the nose.
- The innervation is branches from "CN V" **Trigeminal nerve** (the Trigeminal gives rise to three branches: ophthalmic, maxillary and mandibular). Here in paranasal sinuses we're interested in the first two branches, mandibular nerve don't innervate these sinuses.
- There are 6 ethmoidal sinuses, 2 sphenoid, 2 maxillary, and 2 frontal air sinuses.

Functions:

- 1- resonance of the voice.
- 2- decreased weight of the skull.
- 3- Protection (by moisturizing and modifying of the temperature and reduce intracranial pressure)

Paranasal sinuses:

- 1- The **Frontal** air sinus is present in frontal bone and it is triangular in shape.

At birth it is small and called **rudimental** while in adults it becomes bigger.

Drainage: frontonasal duct into infundibulum (a space in front of the middle meatus especially hiatus semilunaris)

Innervation: it is innervated by the supraorbital nerve, a branch of the ophthalmic nerve that passes through supraorbital foramen.

- 2- The **Ethmoidal** air sinuses/ cells

three pairs of sinuses; anterior, middle and posterior air sinuses (3 on the right and 3 on the left).

each sinus represents one cell that has its own duct. The middle sinus is in the bulla ethmoidalis and opens into it. The anterior sinus opens in the anterior part of hiatus semilunaris and the posterior sinus opens in the superior meatus.

Nerve supply: Innervated by the anterior and posterior ethmoidal branches of nasociliary nerve, a branch of ophthalmic nerve

Ophthalmic nerve → nasociliary nerve → anterior and posterior ethmoidal nerves

3-The **Maxillary** sinus in maxilla. It is the largest sinus. It has a bad drainage (because the duct is located high up) and opens in hiatus semilunaris posteriorly. It has apex and base. The apex is directed laterally, and the base is in the wall of nasal cavity.

It is innervated by the infraorbital and alveolar branches of the maxillary nerve.

Molars and premolars are directly inferior to the maxillary sinus. Extraction of one of the upper molars will form a fistula between

maxillary sinus and oral cavity, and if there is sinusitis, there would be discharge of the sinus content into the oral cavity which is bad.

Relation of maxillary sinus:

above: orbit

Below: upper molars and premolars

Laterally: infratemporal fossa

Medially: nasal cavity

4-The **sphenoid** sinus in the body of sphenoid bone.

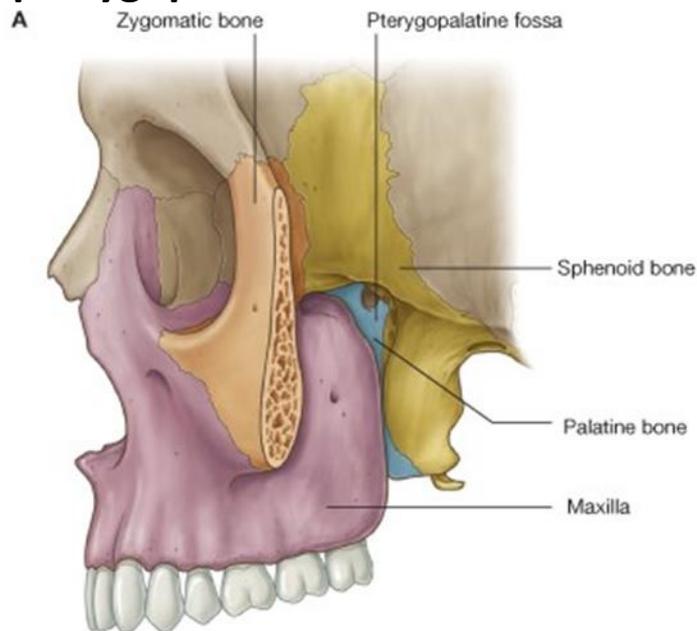
The duct opens in sphenoidal recess

It is innervated by the posterior ethmoidal nerve of the ophthalmic nerve AND the orbital branches of the maxillary nerve.

Relations:

- Above it the pituitary gland in the Sella turcica
If there is an invasive tumor in the pituitary, it causes changes in the underlying bone and compresses the sphenoidal air sinus (these changes can be observed in X-ray)
- Lateral to the sphenoidal sinus there is the cavernous sinuses (located inside the skull at the lateral side of Sella turcica)
 - contents of cavernous sinus : internal carotid artery, sympathetic fibres and abducent nerve
 - contents of the lateral wall of cavernous sinus: ophthalmic, trochlear and oculomotor nerve
- Below and in front of the sphenoidal sinus : the nasal cavity.

The pterygopalatine fossa



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- also called sphenopalatine fossa.

It is very important since all nerve and blood supply of the nose, nasopharynx and the orbit come from the pterygopalatine fossa.

Its shape is Inverted tear-drop and it lies Between bones on the lateral side of the skull.

The walls of the pterygopalatine fossa are formed by:

The **anterior** wall: is formed by the posterior surface of the maxilla.

The **medial** wall: is formed by the lateral surface of the palatine bone (there is a foramen in the palatine bone called Sphenopalatine foramen where sphenopalatine vessels and nerve pass).

The **posterior** wall: pterygoid plate (part of sphenoid bone)

The **roof**: is formed by greater wing of sphenoid bone.

The **Lateral**:formed by infratemporal fossa

Note : The posterior wall and roof are formed by parts of **the sphenoid bone**

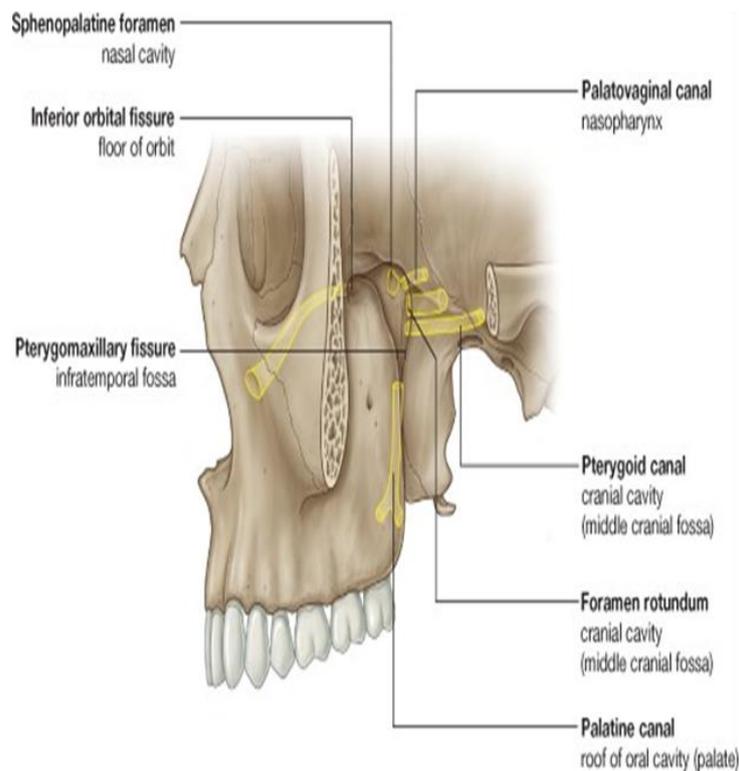
There are two important foramina in sphenoid bone:

- 1- The Foramen Rotundum (for maxillary nerve)
- 2- Pterygoid canal: comes from middle cranial fossa as a groove then goes to the roof of foramen lacerum and make a groove in its cartilage (remember that foramen lacerum is covered by cartilage) to reach pterygopalatine fossa. The nerve of pterygoid canal pass through it and it is composed of two types of fibers; greater petrosal nerve (parasympathetic part) and deep petrosal nerve (the sympathetic part). The difference between the two parts is that parasympathetic is preganglionic and make synapse in pterygopalatine ganglia (part of facial nerve) while the deep petrosal (sympathetic) is postganglionic fiber and pass through ganglia without synapse

These two foramina connect the middle cranial fossa with pterygopalatine fossa

Remember that trigeminal nerve is in the middle cranial fossa and gives us three branches; ophthalmic, maxillary (pure sensory nerve enters pterygopalatine fossa through foramen rotundum and then give branches to the nose, orbit, the nasopharynx, and the oral cavity) and mandibular.

Gateways between pterygopalatine fossa and the surrounding areas (very important in clinical):



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

1. **Foramen rotundum** and **pterygoid canal** communicate with the middle cranial fossa. (explained above).
2. **Palatovaginal canal**: opens onto the posterior wall and leads to the nasopharynx to give blood and nerve supply.
3. **Palatine canal**: small canal leads to the roof of the oral cavity (hard palate) and opens inferiorly through greater and lesser palatine foramina. Pass through it palatine artery and nerve. Palatine nerve divide into two branches: greater and lesser palatine nerves. Greater palatine nerve pass through greater palatine foramina (located on the hard palate) to reach the hard palate and then to the nose by passing

through incisive foramina. The lesser palatine nerve pass through lesser foramina to reach the soft palate.

4. **Sphenopalatine** foramen on the medial wall and opens into the lateral wall of the nasal cavity. Gives blood supply and innervation to the nose.

5. **Pterygomaxillary** fissure between lateral aspect of the pterygopalatine fossa and the infratemporal fossa. The maxillary artery (branch from the external carotid) starts from the parotid gland then enter the pterygopalatine fossa through this fissure (pterygomaxillary fissure). The direction of the artery is opposite to the direction of the branch of maxillary nerve (middle cranial fossa > pterygopalatine fossa>infratemporal fossa)

6. **Inferior orbital fissure** between the superior aspect of the fossa into the floor of the orbital cavity. For maxillary nerve and vessels they pass from the pterygoid fossa into orbital cavity and then In the floor of the orbit then groove then canal and then exit through infraorbital foramen. Some books name them (maxillary N and V) the infraorbital nerve and vessels after the entry of the orbit and others called them infraorbital N and V when the exit the foramen the nomenclature is not important but what you have to know is that what they exit from infraorbital foramen they're called infraorbital N and V.

The content of pterygopalatine fossa:

1. The maxillary nerve: a branch of trigeminal nerve, reach the pterygoid fossa through foramen rotundum.

2. Terminal part of the maxillary artery (lateral pterygoid muscle divides it into three parts. The first is before the muscle the second is behind or anterior to muscle and the third in the pterygopalatine fossa).

Terminal branch of maxillary artery :infratemporal fossa → pterygomaxillary fissure → pterygopalatine fossa

3. Nerve of the pterygoid canal

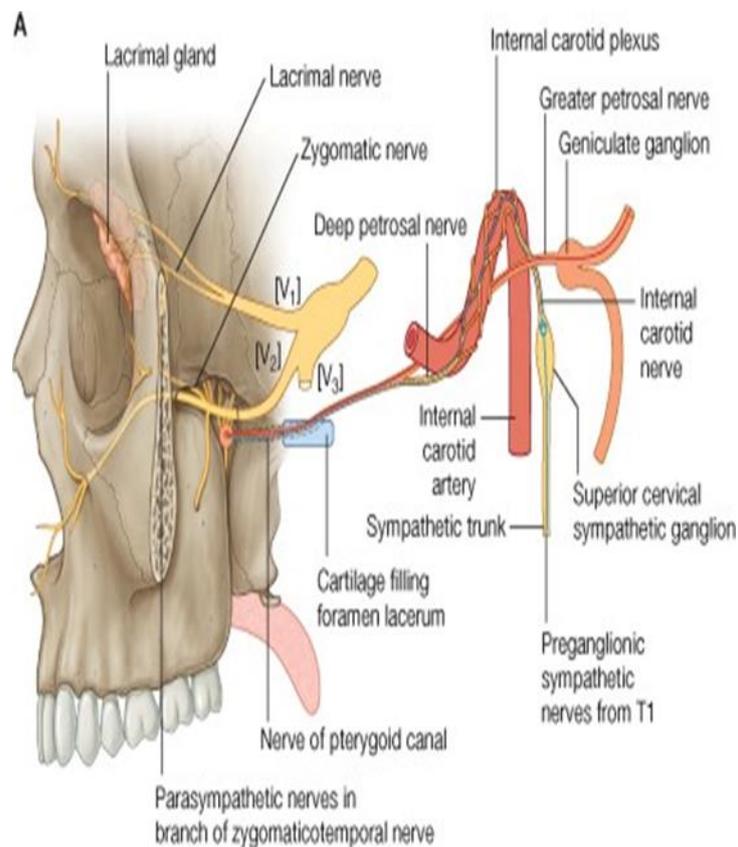
4. The pterygopalatine ganglion (parasympathetic ganglia in which parasympathetic fibers make synapse) gives fibers (parasympathetic and the associated sympathetic (without synapse) to the glands in the nose, nasopharynx, orbit and the oral cavity.

5. Veins and lymphatics also pass through the pterygopalatine fossa.

The Pterygopalatine ganglia:

In the head in neck we have 4 parasympathetic ganglia. In the GI system we took otic ganglia, submandibular ganglia and ciliary ganglia in the eye and here in RS we have pterygopalatine ganglia. The sympathetic is already post ganglionic so it passes without synapsing and both end up in the glands.

Let's go deeper....



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Here we have geniculate ganglia (part of the facial nerve). It exclusive for parasympathetic so it gives us greater petrosal (preganglionic and make synapse) while sympathetic fibers come from superior cervical sympathetic ganglia and passes around internal carotid artery then it gives us deep petrosal nerve. The two fibers when they are in pterygoid canal collectively called nerve of pterygoid canal. They reach the ganglia and as we said only the parasympathetic make a synapse and sympathetic just pass through. After that they distribute with maxillary nerve into different organs so when the maxillary nerve is present in the

pterygopalatine fosse it is accompanied with sympathetic and parasympathetic fibers.

Maxillary nerve gives sensory fibers and two branches to the ganglia (twigs)So, if there is an inflammation in the ganglia the sensation is carried by maxillary nerve. The ganglia give sympathetic, parasympathetic and sensory to the head.

Examples of branches of the maxillary nerve:

- 1- Zygomatic branch: zygomaticofacial and zygomaticotemporal.
- 2- Posterior superior alveolar to the molars of the upper jaw.
- 3- Middle superior alveolar
- 4- Anterior superior alveolar

3 & 4 are branches of the maxillary when it is in the orbital cavity, the groove and the canal and we said that some books called it infraorbital (the end of maxillary nerve)

Lacrimal gland receives secretomotor by zygomaticotemporal nerve (parasympathetic and sympathetic by lacrimal nerve)

Orbital branches:

Enter the inferior orbital fissure then directed to the periostium of the orbit and ethmoidal and sphenoidal air sinuses

Pharyngeal branches:

Pterygopalatine ganglia through palatovaginal canal to the nasopharynx (gland and mucosa)

Nasal nerves :

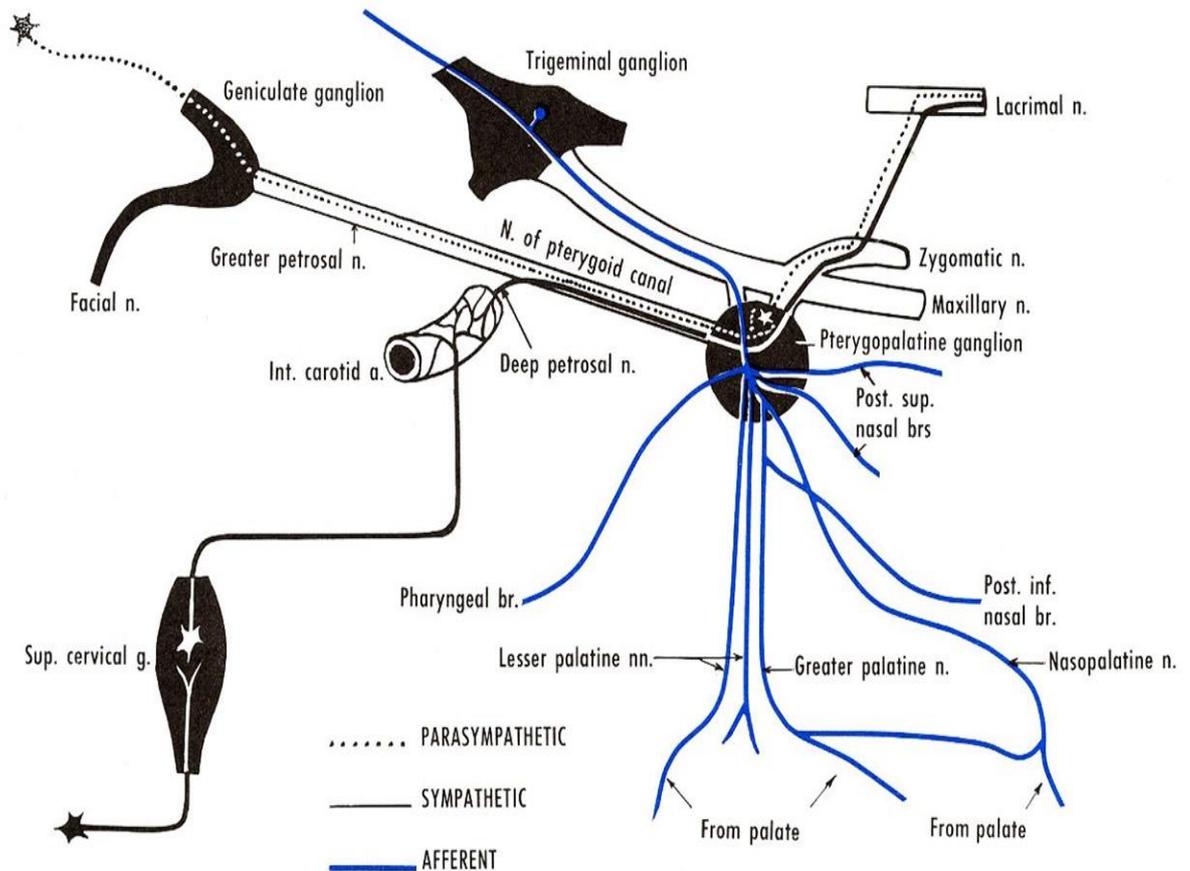
Greater platine nerve pass through greater palatine foramen to the hard palate and then to the nose through incisive foramina.

The most important is sphenopalatine. The branches are long (mainly to the septum “nasopalatine nerve”) and short (to the lateral wall>> upper posterior quadrant of the lateral wall).

Maxillary nerve after reaching the ganglia, by pterygomaxillary fissure it passes to the infratemporal fossa to give posterior superior alveolar nerve (sensory to the molars and the surrounding gingiva and maxillary air sinuses) then return to the inferior orbital fissure and continues as

infraorbital nerve (the end of maxillary nerve) and as we said above it gives zygomatic (there is zygomaticofacial and zygomatico temporal 'carries postganglionic parasympathetic and sympathetic through the lacrimal nerve to the lacrimal gland' to the temporal) they are sensory.

The infraorbital nerve gives three sensory branches: palpiral, nasal and labial. The infraorbital nerve inside the orbital cavity may give anterior and superior alveolar.



Maxillary artery:

The terminal branch of external carotid artery in the parotid gland. The origin in parotid then passes through infratemporal fossa then enters the pterygopalatine fossa through pterygomaxillary fissure.

it is divided into three parts by lateral pterygoid muscle:

1st part:

Before lateral pterygoid muscle and gives 5 branches (each one enters either a foramen or fissure). For example inferior alveolar which enter the mandible through mandibular foramen. There are also middle meningeal and accessory middle meningeal which penetrate the base of the skull through foramen spinosum and foramen ovale to the cranial fossa.

The last two branches are deep auricular and anterior tympanic arteries to the external ear.

Relations of the first part:

Medially: sphenomandibular ligament

Above: auriculotemporal nerve

Below: maxillary vein

2nd part:

Related to the lateral pterygoid muscle and gives muscles of mastication (masseter, temporalis, medial pterygoid and lateral pterygoid) that's why it's called muscular artery

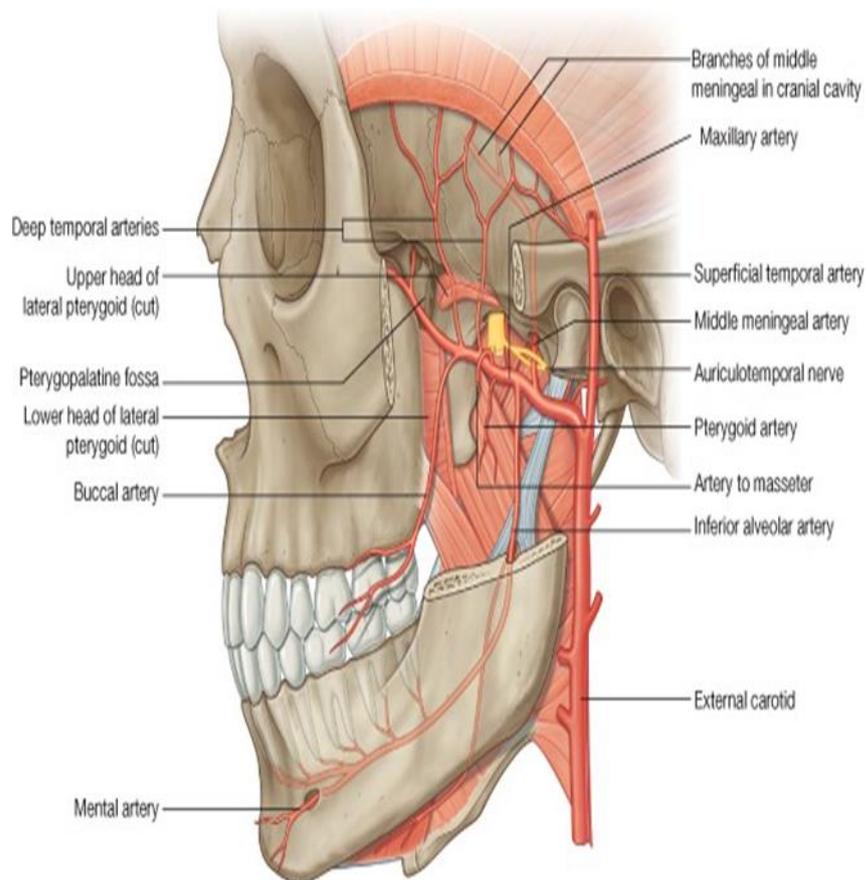
3rd part:

In the pterygopalatine fossa and gives branches same to branches of the nerve so it gives orbital, palatine and nasal. The maxillary artery ends by infraorbital artery and enters to the infraorbital foramen with the nerve. Infraorbital artery also gives palpebral, labial and nasal branches as well as anterior, middle (premolars) and superior alveolar in the orbit and gives posterior superior alveolar artery (to the molars) in the infratemporal fossa. Also gives palatine, greater palatine and occasionally lesser palatine. It gives sphenopalatine (short and long (to the septum)). It gives pharyngeal to the nasopharynx and a branch to the pterygoid canal

Long sphenopalatine with facial (superior labial branch) are responsible for epistaxis.

Artery of pterygoid canal to the mucosa of pterygoid canal and nasopharynx.

The veins are opposite to the arteries and most veins form as pterygoid plexus of nerve and pterygoid plexus makes maxillary vein which goes to the parotid and make retromandibular vein. Anteriorly there is infraorbital vein to the inferior aspect of the orbit and sometimes it goes directly through infratemporal fossa to the pterygopalatine fossa.



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