

Pterygopalatine fossa

Head and Neck Anatomy

Explaining the location and boundaries of pterygopalatine fossa in addition to demonstrating the foramina and fissures that connecting this fossa to other fossae and cavities of the head, finally explaining the contents of pterygopalatine fossa.

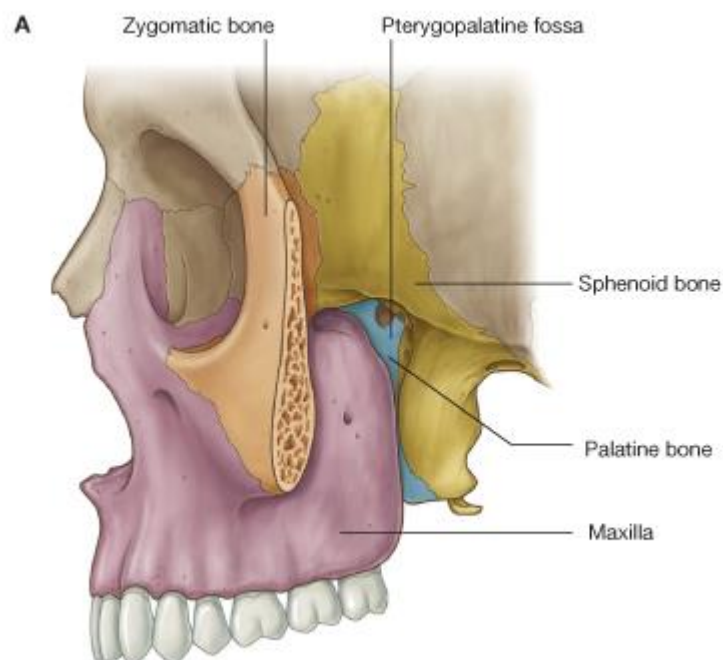
PTERYGOPALATINE FOSSA

Figure 1: The pterygopalatine fossa

The pterygopalatine fossa is an inverted 'tear-drop' shaped space between bones on the lateral side of the skull immediately posterior to the maxilla.

Although small in size, the pterygopalatine fossa communicates via fissures and foramina in its walls with:

- the middle cranial fossa;
- infratemporal fossa;
- floor of the orbit;
- lateral wall of the nasal cavity;
- oropharynx;
- Roof of the oral cavity.

Because of its strategic location, the pterygopalatine fossa is a major site of distribution for the maxillary nerve [V₂] and for the terminal part of the maxillary artery. In addition, parasympathetic fibers from the facial nerve [VII] and sympathetic fibers originating from the T1 spinal cord level join branches of the

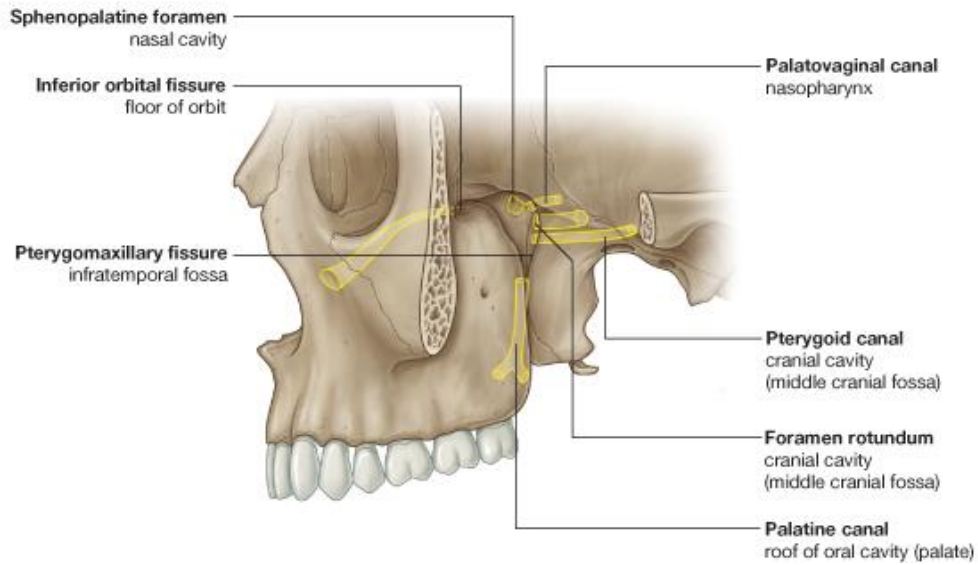


Figure 2. location of foramina and fissures in pterygopalatine fossa

maxillary nerve [V₂] in the pterygopalatine fossa.

The pterygopalatine ganglion, which contains cell bodies for the postganglionic parasympathetic fibers in the greater petrosal branch of the facial nerve [VII] that will synapse with the preganglionic parasympathetic fibers, is formed in association with branches of the maxillary nerve [V₂] in the pterygopalatine fossa.

All the upper teeth receive their innervation and blood supply from the maxillary nerve [V₂] and the terminal part of the maxillary artery, respectively that pass through the pterygopalatine fossa.

Skeletal framework

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

- the anterior wall is formed by the posterior surface of the maxilla;
- the medial wall is formed by the lateral surface of the palatine bone;
- The posterior wall and roof are formed by parts of the sphenoid bone.

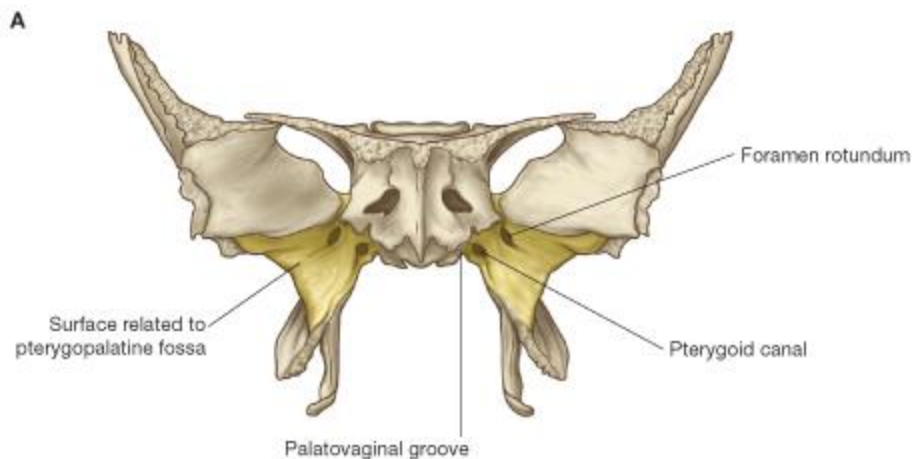


Figure 3. sphenoid bone (boundaries and foramina)

The part of the sphenoid bone that contributes to the formation of the pterygopalatine fossa is the anterosuperior surface of the pterygoid process. Opening onto this surface are two large foramina:

- the maxillary nerve [V₂] passes through the most lateral and superior of these—the foramen rotundum—which communicates posteriorly with the middle cranial fossa
- the greater petrosal nerve from the facial nerve [VII] and sympathetic fibers from the internal carotid plexus join to form the nerve of the pterygoid canal that passes forward into the pterygopalatine fossa through the more medial and inferior foramen—the anterior opening of the pterygoid canal.

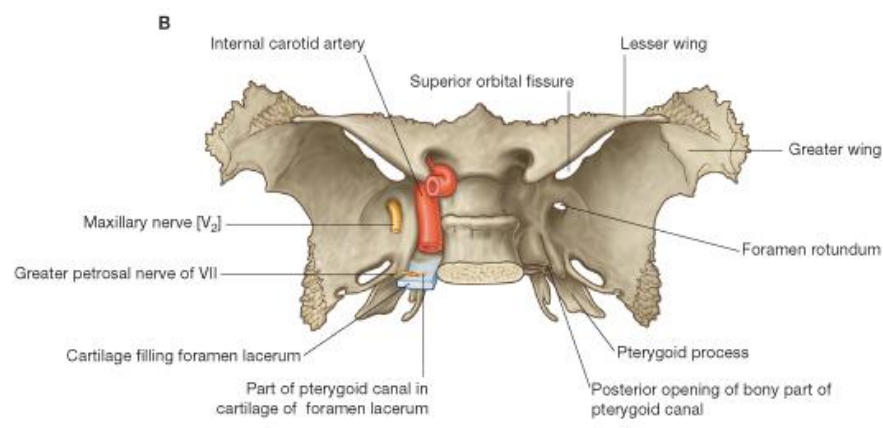


figure4. posterior view of sphenoid bone foramina and its contents

Pterygoid canal

The **pterygoid canal** is a bony canal opening onto the posterior surface of the pterygoid process and then continuing superomedially for a short distance in the cartilage that fills the foramen lacerum and surrounding the posterior opening of the pterygoid canal. The pterygoid canal opens into the middle cranial fossa just anteroinferior to the internal carotid artery as the vessel enters the cranial cavity through the carotid canal.

Gateways

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

- the foramen rotundum and pterygoid canal communicate with the middle cranial fossa and open onto the posterior wall;
- a small **palatovaginal canal** opens onto the posterior wall and leads to the nasopharynx;
- the palatine canal leads to the roof of the oral cavity (hard palate) and opens inferiorly;
- the sphenopalatine foramen opens onto the lateral wall of the nasal cavity and is in the medial wall;
- the lateral aspect of the pterygopalatine fossa is continuous with the infratemporal fossa via a large gap (the **pterygomaxillary fissure**) between the posterior surface of the maxilla and pterygoid process of the sphenoid bone;
- The superior aspect of the anterior wall of the fossa opens into the floor of the orbit via the inferior orbital fissure.

Contents

The maxillary nerve [V₂] and terminal part of the maxillary artery enter and branch within the pterygopalatine fossa. In addition, the nerve of the pterygoid canal enters the fossa carrying:

- preganglionic parasympathetic fibers from the greater petrosal branch of the facial nerve [VII];

- postganglionic sympathetic fibers from the deep petrosal branch of the carotid plexus.

The parasympathetic fibers synapse in the pterygopalatine ganglion associated with branches of the maxillary nerve [V₂], and both the sympathetic and postganglionic parasympathetic fibers pass with branches of the maxillary nerve [V₂] out of the fossa and into adjacent regions.

In addition to these nerves and arteries, veins and lymphatics also pass through the pterygopalatine fossa.

The maxillary nerve [V₂]

The maxillary nerve [V₂] is purely sensory. It originates from the trigeminal ganglion in the cranial cavity, exits the middle cranial fossa, and enters the pterygopalatine fossa through the foramen rotundum. It passes anteriorly through the fossa and exits as the infra-orbital nerve through the inferior orbital fissure.

While passing through the pterygopalatine fossa, the maxillary nerve [V₂] gives rise to the zygomatic nerve, the posterior superior alveolar nerve, and two ganglionic branches. The two ganglionic branches originate from its inferior surface and pass through the pterygopalatine ganglion.

Postganglionic parasympathetic fibers, arising in the pterygopalatine ganglion, join the general sensory branches of the maxillary nerve [V₂] in the pterygopalatine ganglion, as do postganglionic sympathetic fibers from the carotid plexus, and the three types of fibers leave the ganglion as orbital, palatine, nasal, and pharyngeal branches

Branches

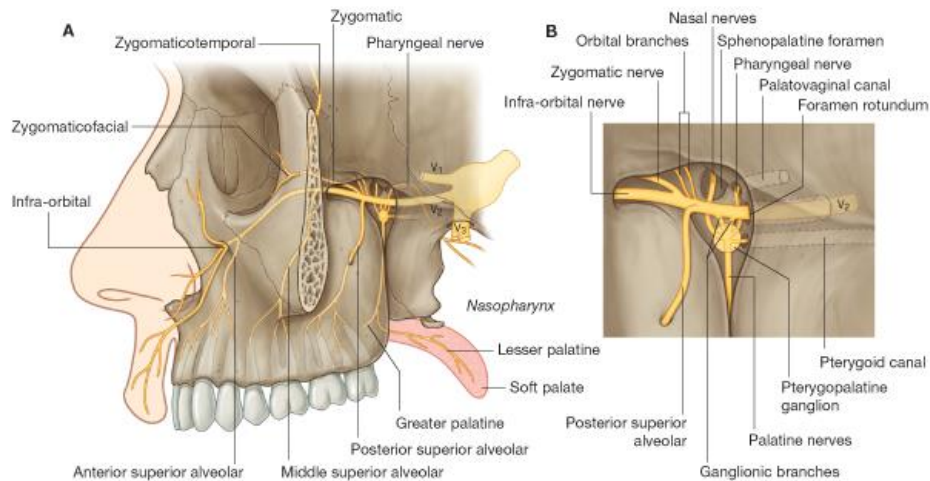


Figure 5. Maxillary nerve and its branches in relation to pterygopalatine fossa

Orbital branches

The **orbital branches** are small and pass through the inferior orbital fissure to contribute to the supply of the orbital wall and of the sphenoidal and ethmoidal sinuses.

Greater and lesser palatine nerves

The **greater** and **lesser palatine nerves** pass inferiorly from the pterygopalatine ganglion, enter and pass through the palatine canal, and enter the oral surface of the palate through the greater and lesser palatine foramina.

The greater palatine nerve passes forward on the roof of the oral cavity to innervate mucosa and glands of the hard palate and the adjacent gingiva, almost as far forward as the incisor teeth.

In the palatine canal, the greater palatine nerve gives origin to **posterior inferior nasal nerves**, which pass medially through small foramina in the perpendicular plate of the palatine bone and contribute to the innervation of the lateral nasal wall.

After passing through the lesser palatine foramen, the lesser palatine nerve passes posteriorly to supply the soft palate.

Nasal nerves

The nasal nerves, approximately seven in number, pass medially through the sphenopalatine foramen to enter the nasal cavity. Most pass anteriorly to supply the

lateral wall of the nasal cavity, while others pass across the roof to supply the medial wall.

One of the nerves passing across the roof to supply the medial wall of the nasal cavity (the **nasopalatine nerve**) is the largest of the nasal nerves and passes anteriorly down the nasal septum, through the incisive canal and fossa in the hard palate to enter the roof of the oral cavity and supply mucosa, gingiva, and glands adjacent to the incisor teeth.

Pharyngeal nerve

The **pharyngeal nerve** passes posteriorly from the pterygopalatine ganglion, and leaves the fossa through the palatovaginal canal, which it then exits to supply the mucosa and glands of the nasopharynx.

Zygomatic nerve

The **zygomatic nerve** originates directly from the maxillary nerve [V₂] in the pterygopalatine fossa, which it leaves to enter the orbit through the inferior orbital fissure. It passes forward on the lateral orbital wall and divides into zygomaticotemporal and zygomaticofacial branches.

- the **zygomaticotemporal branch** continues forward at the base of the lateral orbital wall, passes through a small bony canal in the zygomatic bone to enter the temporal fossa through a small foramen in the lateral orbital margin on the posterior surface of the frontal process of the zygomatic bone, and passes superficially to supply skin over the temple;
- The **zygomaticofacial branch** also passes forward at the base of the lateral orbital wall, leaves through a small bony canal, in the orbital margin, which opens via multiple small foramina on the anterolateral surface of the zygomatic bone, and its branches supply the adjacent skin.

Posterior superior alveolar nerve

The **posterior superior alveolar nerve** originates from the maxillary nerve [V₂] in the pterygopalatine fossa and passes laterally out of the fossa through the pterygomaxillary fissure to enter the infratemporal fossa. It continues laterally and inferiorly to enter the posterior surface of the maxilla through a small alveolar

foramen approximately midway between the last molar tooth and the inferior orbital fissure. It then passes inferiorly just deep to the mucosa of the maxillary sinus to join the **superior dental plexus**.

The posterior superior alveolar nerve supplies the molar teeth and adjacent buccal gingivae, and contributes to the supply of the maxillary sinus.

Infra-orbital nerve

The infra-orbital nerve is the anterior continuation of the maxillary nerve [V₂] that leaves the pterygopalatine fossa through the inferior orbital fissure. It lies first in the infra-orbital groove in the floor of the orbit and then continues forward in the infra-orbital canal.

While in the infra-orbital groove and canal, the infra-orbital nerve gives origin to **middle** and **anterior superior alveolar nerves**, respectively, which ultimately join the **superior alveolar plexus** to supply the upper teeth.

- the middle superior alveolar nerve also supplies the maxillary sinus;
- the anterior superior alveolar nerve also gives origin to a small nasal branch, which passes medially through the lateral wall of the nasal cavity to supply parts of the areas of the nasal floor and walls.

The infra-orbital nerve exits the infra-orbital canal through the infra-orbital foramen inferior to the orbital margin and divides into nasal, palpebral, and superior labial branches.

- nasal branches supply skin over the lateral aspect of the external nose and part of the nasal septum;
- palpebral branches supply skin of the lower eyelid;
- superior labial branches supply skin over the cheek and upper lip, and the related oral mucosa.

Nerve of the pterygoid canal and the pterygopalatine ganglion

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

- the greater petrosal nerve (a branch of the facial nerve [VII]);
- the deep petrosal nerve (a branch of the internal carotid plexus).

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

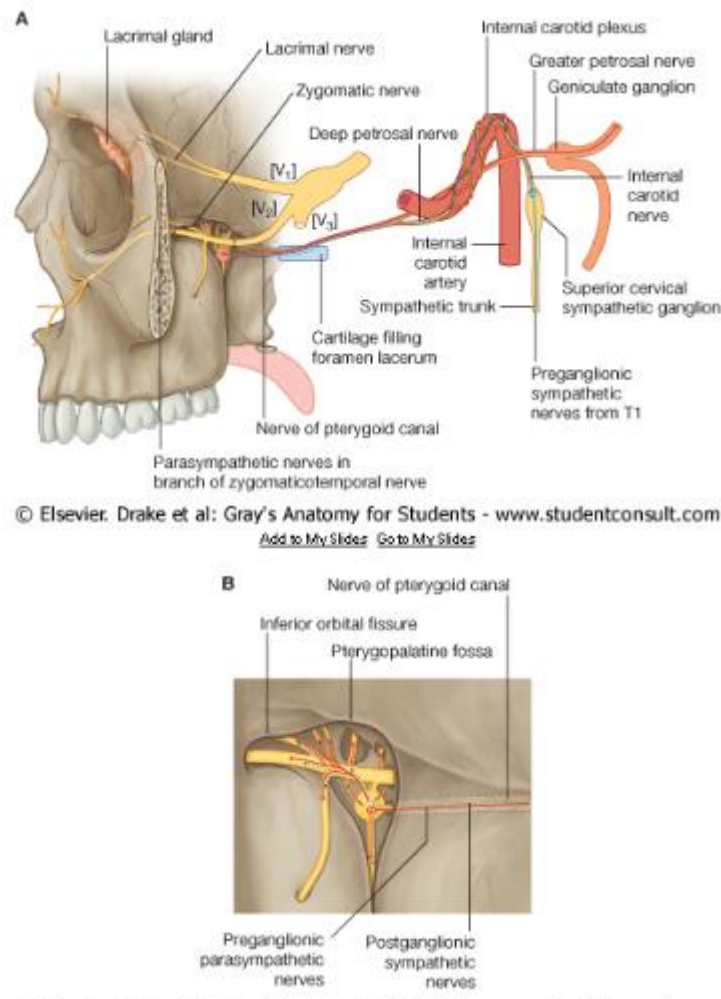


figure 6. Nerve of the pterygoid canal and the pterygopalatine ganglion

Greater petrosal nerve

The greater petrosal nerve, which originates from the geniculate ganglion of the facial nerve [VII] in the temporal bone, exits the temporal bone through a small canal that opens via a fissure onto the anterior surface of the petrous part of the temporal bone. It passes anteromedially along the posterior margin of the middle cranial fossa and then under the internal carotid artery to reach the superior surface

of the cartilage filling the foramen lacerum.

As the greater petrosal nerve passes under the internal carotid artery, it is joined by the deep petrosal nerve to form the nerve of the pterygoid canal.

The greater petrosal nerve carries parasympathetic innervation to all glands above the oral fissure, including:

- mucous glands in the the nasal cavity;
- salivary glands in the upper half of the oral cavity;
- the lacrimal gland in the orbit.

The greater petrosal nerve also carries some taste (SA) fibers from the soft palate in the lesser palatine nerve.

Deep petrosal nerve

The **deep petrosal nerve** is formed by postganglionic sympathetic fibers that originate in the **superior cervical sympathetic ganglion** in the neck and leave the ganglion as the **internal carotid nerve**.

Preganglionic fibers that synapse in the ganglion are from the T1 spinal nerve.

The internal carotid nerve forms the internal carotid plexus around the internal carotid artery as the internal carotid artery passes through the skull and into the cranial cavity. Some of the fibers from the internal carotid plexus converge to form the deep petrosal nerve, which leaves the internal carotid plexus in the middle cranial fossa and joins the greater petrosal branch of the facial nerve [VII].

The deep petrosal nerve carries postganglionic sympathetic fibers destined mainly for blood vessels.

Pterygopalatine ganglion

The nerve of the pterygoid canal enters the superior surface of the cartilage that fills the foramen lacerum and passes anteriorly through the cartilage to enter the pterygoid canal in the root of the pterygoid process of the sphenoid bone. It passes through the canal and into the pterygopalatine fossa where it joins the pterygopalatine ganglion formed around the branches of the maxillary nerve [V₂].

The **pterygopalatine ganglion** is the largest of the four parasympathetic ganglia in

the head and is formed by the cell bodies of the postganglionic neurons associated with preganglionic parasympathetic fibers of the facial nerve [VII] carried by the greater petrosal nerve and the nerve of the pterygoid canal.

The postganglionic fibers that originate in the pterygopalatine ganglion, together with sympathetic fibers, join fibers from the ganglionic branches of the maxillary nerve [V₂] to form orbital, palatine, nasal, and pharyngeal branches, which leave the ganglion.

Other postganglionic parasympathetic fibers and sympathetics pass superiorly through the ganglionic branches of the maxillary nerve [V₂] to enter the main trunk of the maxillary nerve and be distributed with the zygomatic, posterior superior alveolar, and infra-orbital nerves. Of these, the postganglionic parasympathetic and sympathetic fibers that pass into the orbit with the zygomatic nerve are particularly important because they ultimately innervate the lacrimal gland.

Maxillary artery

The maxillary artery is a major branch of the external carotid artery in the neck. It originates adjacent to the neck of mandible, passes forward through the infratemporal fossa, and then enters the pterygopalatine fossa through the pterygomaxillary fissure.

The part of the maxillary artery in the pterygopalatine fossa (the third part) is anterior to the pterygopalatine ganglion and gives origin to branches that accompany branches of the maxillary nerve [V₂] and the pterygopalatine ganglion.

Branches of the maxillary artery include the posterior superior alveolar, infra-orbital, greater palatine, pharyngeal, and sphenopalatine arteries, and the artery of the pterygoid canal. Collectively, these branches supply much of the nasal cavity, the roof of the oral cavity, and all upper teeth. In addition, they contribute to the blood supply of the sinuses, oropharynx, and floor of the orbit.

Branches

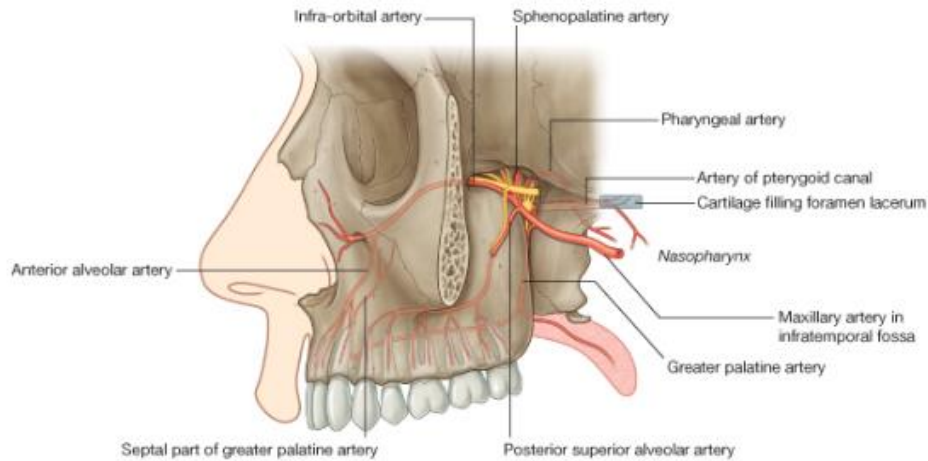


Figure 7: maxillary artery branches

Posterior superior alveolar artery

The **posterior superior alveolar artery** originates from the maxillary artery as it passes through the pterygomaxillary fissure. It meets the posterior superior alveolar nerve, accompanies it through the alveolar foramen on the infratemporal surface of the maxilla, and supplies the molar and premolar teeth, adjacent gingiva, and the maxillary sinus.

Infra-orbital artery

The infra-orbital artery passes forward with the infra-orbital nerve and leaves the pterygopalatine fossa through the inferior orbital fissure. With the infra-orbital nerve, it lies in the infra-orbital groove and infra-orbital canal, and emerges through the infra-orbital foramen to supply parts of the face.

While in the orbital canal, the infra-orbital artery gives origin to:

- branches that contribute to the blood supply of structures near the floor of the orbit—the inferior rectus and inferior oblique muscles, and the lacrimal sac;
- **anterior superior alveolar arteries**, which supply the incisor and canine teeth and the maxillary sinus.

Greater palatine artery

The **greater palatine artery** passes inferiorly with the palatine nerves into the palatine canal. It gives origin to a **lesser palatine branch**, which passes through the lesser palatine foramen to supply the soft palate, and then continues through the

greater palatine foramen to supply the hard palate. The latter vessel passes forward on the inferior surface of the palate to enter the incisive fossa and pass superiorly through the incisive canal to supply the anterior aspect of the septal wall of the nasal cavity.

Pharyngeal branch

The **pharyngeal branch** of the maxillary artery travels posteriorly and leaves the pterygopalatine fossa through the palatovaginal canal with the pharyngeal nerve. It supplies the posterior aspect of the roof of the nasal cavity, the sphenoidal sinus, and the pharyngotympanic tube.

Sphenopalatine artery

The **sphenopalatine artery** is the terminal branch of the maxillary artery. It leaves the pterygopalatine fossa medially through the sphenopalatine foramen and accompanies the nasal nerves, giving off:

- posterior lateral nasal arteries, which supply the lateral wall of the nasal cavity and contribute to supply of the paranasal sinuses;
- posterior septal branches, which travel medially across the roof to supply the nasal septum—the largest of these branches passes anteriorly down the septum to anastomose with the end of the greater palatine artery.

Artery of pterygoid canal

The **artery of pterygoid canal** passes posteriorly into the pterygoid canal. It supplies surrounding tissues and terminates, after passing inferiorly through cartilage filling the foramen lacerum, in the mucosa of the nasopharynx.

Veins

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

The veins coalesce in the pterygopalatine fossa and then pass laterally through the pterygomaxillary fissure to join the **pterygoid plexus** of veins in the infratemporal fossa. **The infra-orbital vein**, which drains the inferior aspect of the orbit, may pass directly into the infratemporal fossa through the lateral aspect of the inferior orbital fissure, so bypassing the pterygopalatine fossa.