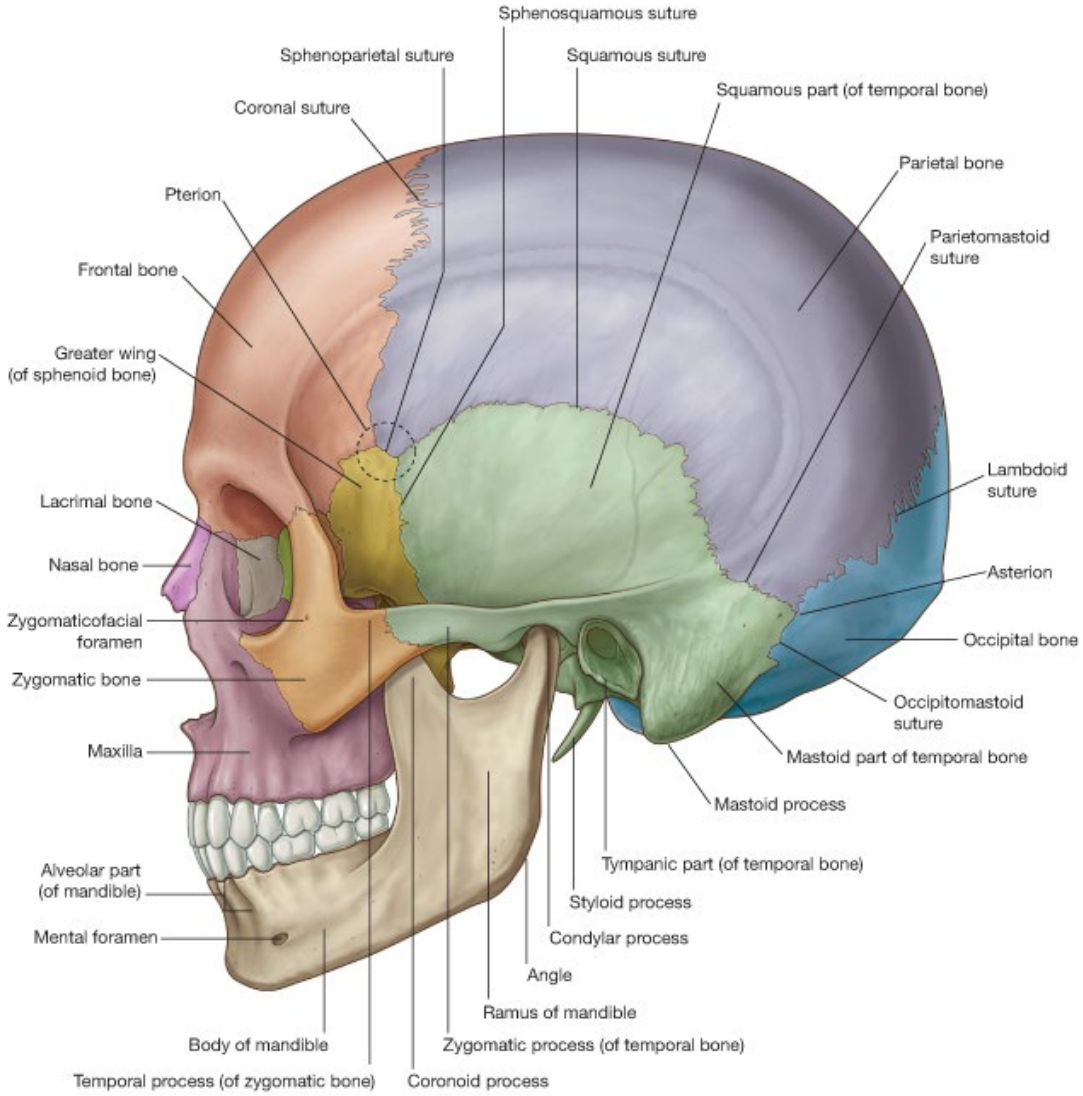
THE NOSE AND PARANASAL AIR SINUSES

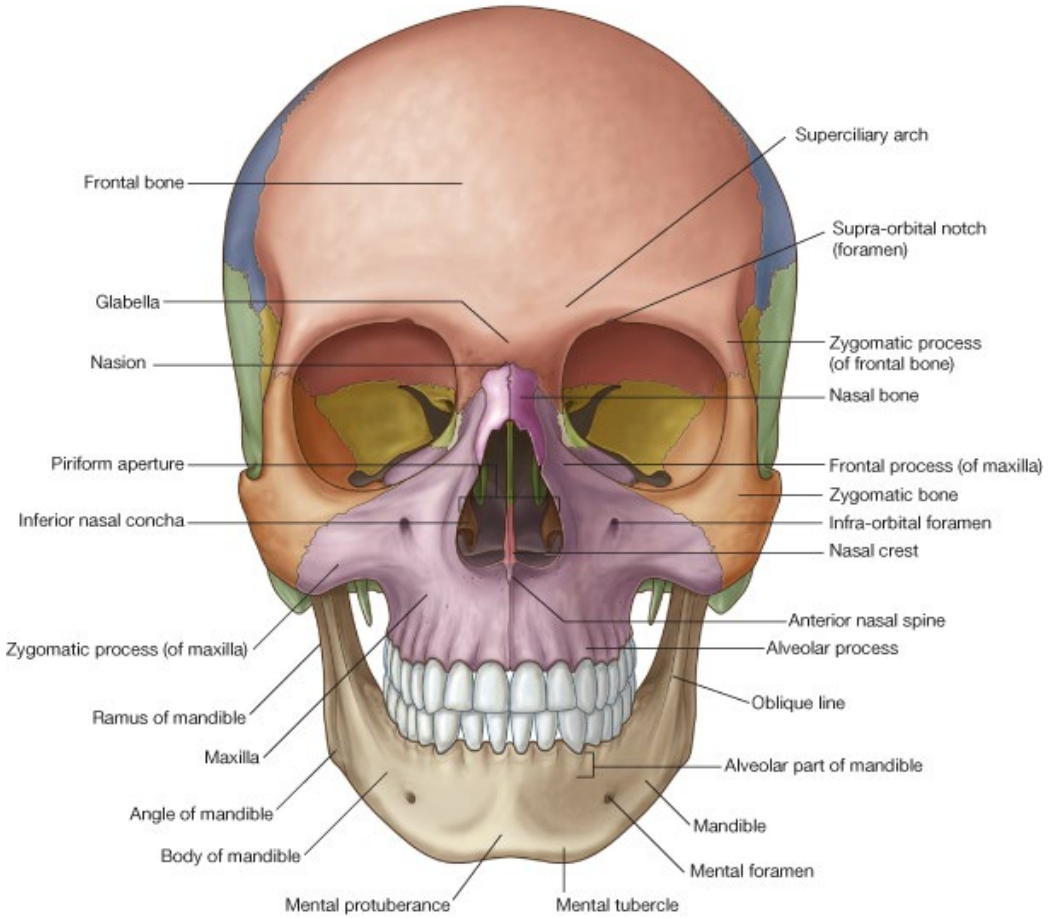
- **Maxilla** occupies a large region of the skull in the angle between the orbit and the nose.
- Frail bone, as its inside is excavated into a large air sinus – the **maxillary air sinus / antrum**
- Maxilla forms most of the floor of the orbit and lateral wall of the nose
- **Infraorbital canal** is a boney tunnel which runs through the floor of the orbit – opens onto the face at the **infraorbital foramen**.

- Both the zygomatic bone and sphenoid bone communicate with the maxilla

- **Zygomatic bone** is easily palpated – it forms the 'cheek bone' of the cheek
- Contributes to lateral wall of the boney orbit
- Forms the <u>zygomatic arch</u>

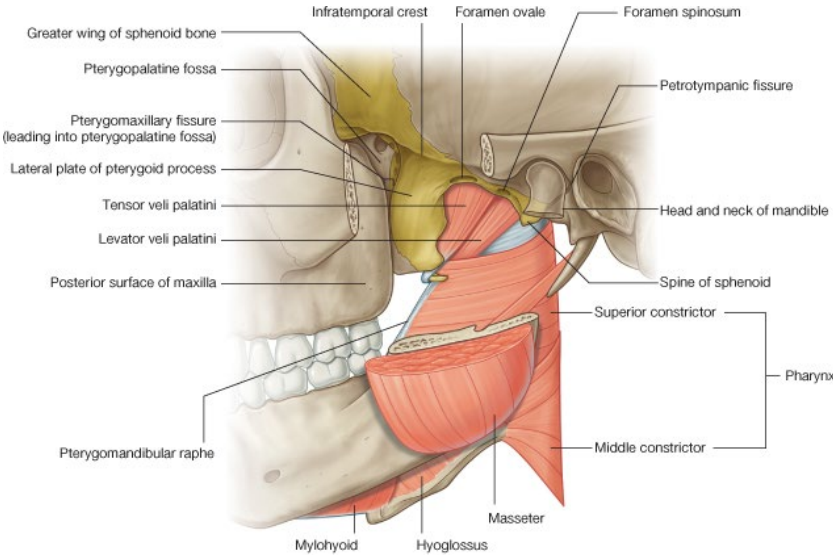
- Greater and lesser wings of the **sphenoid** are visible at the back of the orbit
- Greater wing contributes to side of the cranium (vault)
- Undersurface of the sphenoid contributes to the sides of the soft palate as 2 plates: **lateral** & **medial <u>pterygoid plates</u>.**

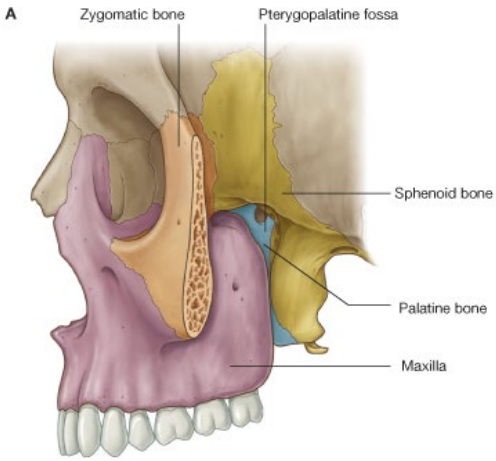


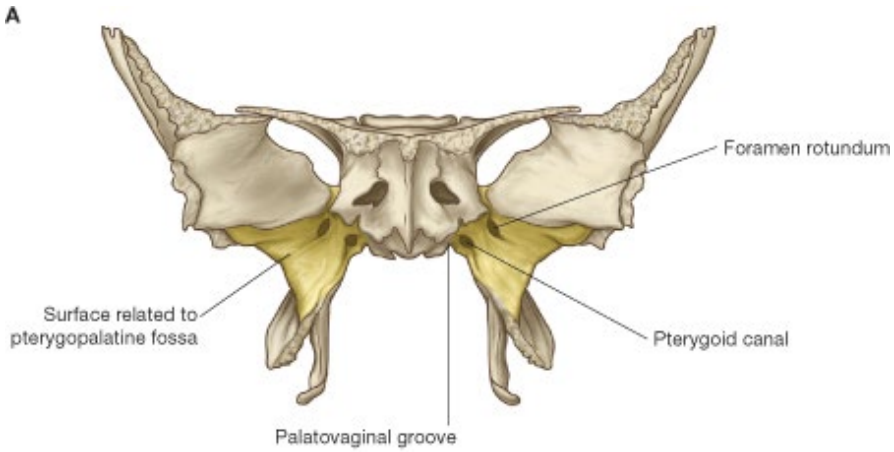


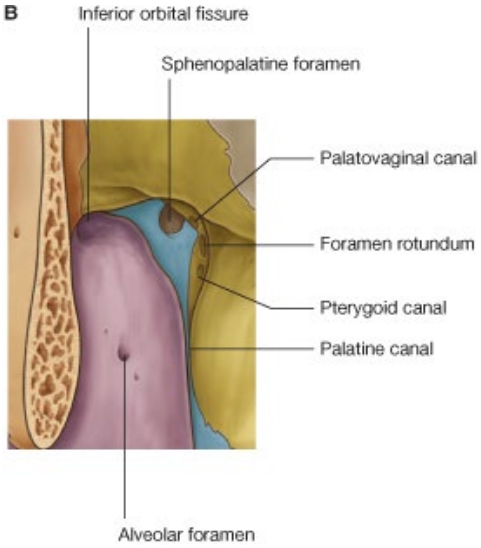
- Between the <u>sphenoid</u> & the <u>maxilla</u> there is a slit where the bones don't meet – the **pterygomaxillary <u>fissure</u>**.
- Deeper within this fissure is another bone which lies opposite the pterygoid plates – the **palatine bone**.
- Δ deepest part of the fissure is the **<u>pterygopalatine fossa</u>**
- Several boney tunnels run into the deepest part of the pterygopalatine fossa
- 2 entrances from the middle cranial fossa into the pterygopalatine fossa.

- **<u>Foramen rotundum</u>** is a hole in the sphenoid bone, below the superior orbital fissure
- **<u>Pterygoid canal</u>** opens below the level of the foramen rotundum in the sphenoid bone (hidden from view in an articulated skull).
- Both the foramen rotundum and pterygoid canal pass anteriorly right through the sphenoid bone to open into the pterygopalatine fossa.



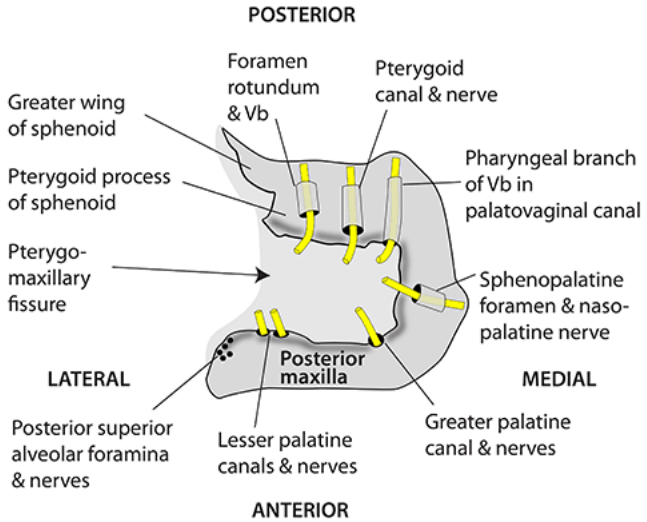






PTERYGOPALATINE FOSSA 3

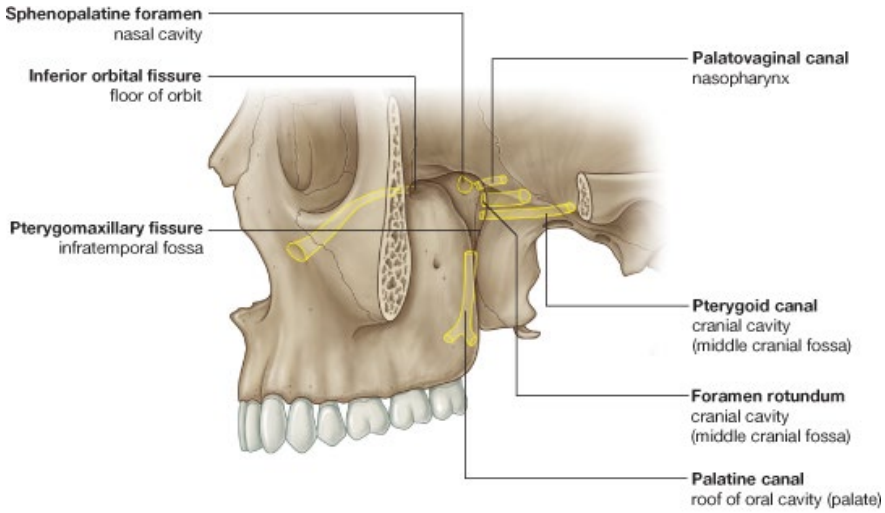
Diagrammatic view of right fossa looking down on it from above to show entry and exit of nerves. The roof (removed) is greater wing of sphenoid



- **Sphenopalatine foramen** is a round foramen deep within the palatine fossa leading to the lateral wall and roof of nose
- The foramen is composed of part of the sphenoid and part of the palatine bone.

- **Palatine canal** runs from pterygopalatine fossa → side of hard palate
- Divides to open as 2 foramina in the hard palate where the palatine bone sutures with the maxilla – greater & lesser palatine foramina

- **Infraorbital fissure & canal** continue onwards to the infraorbital foramen on the front of the maxilla.



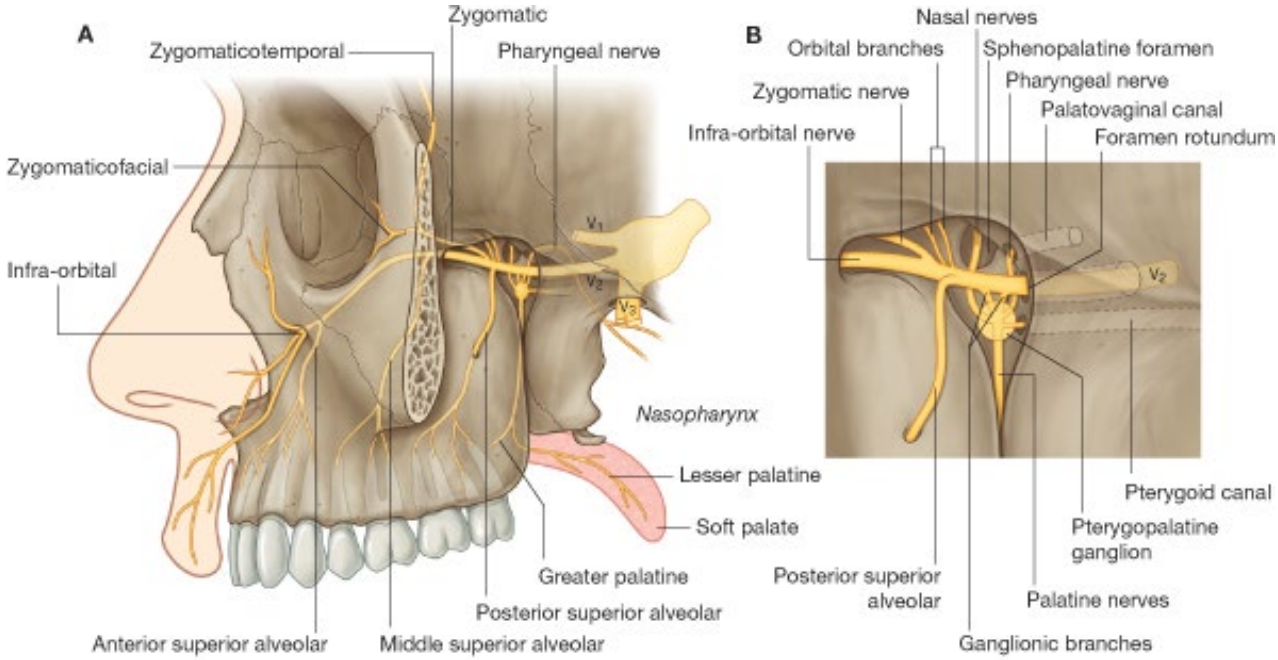
Nerves travelling through these canals:

- **Maxillary division (V_{ii})** of trigeminal leaves the skull through the **foramen rotundum** → enters the infraorbital canal → emerge at infraorbital foramen

- Whilst in the pterygopalatine fossa, several branches are given off the maxillary division:
    A. Move medially through the sphenopalatine fossa into the nasal cavity (as **nasopalatine nerve**)
    B. Downwards towards palate through the palatine canal **(greater palatine nerve)**

- Nerve of the pterygoid canal runs into the pterygopalatine ganglion.

- Pterygopalatine fossa contains many nerves & BVs



BONES OF THE NASAL CAVITY

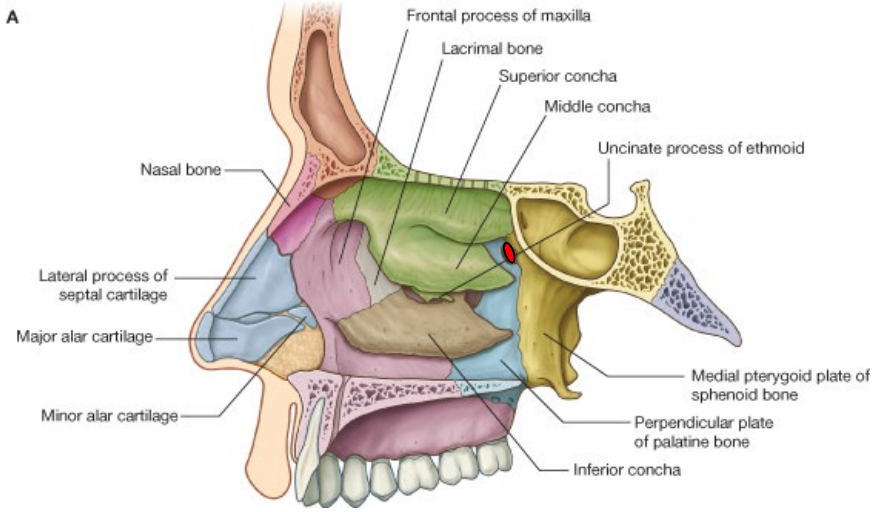
- The **nasal bones** lie in front of the maxilla – form the <u>bridge of the nose</u>
- The **ethmoid bone** lies between the orbital cavities

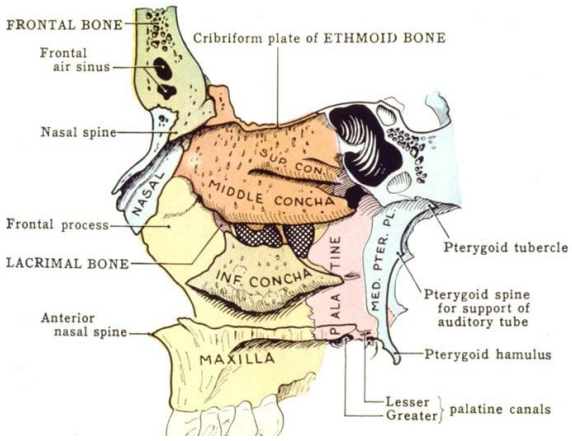
- **Lacrimal bone** makes up part of medial wall of orbital cavity
- **Nasolacrimal canal** lies within the <u>lacrimal bone</u> – contains the **nasolacrimal duct** which carries lacrminal secretions from the orbit to the floor of the nose

The nasal cavity:

- <u>Roof</u>:
    - Cribiform plate of ethmoid bone in front
    - Sphenoid bone behind
- Body of sphenoid contains sphenoidal air sinus

- <u>Floor & lateral wall:</u>
    - Maxilla in front
    - Palatine bone behind
- Palatine bone is shaped like and 'L' when viewed from the front
- The vertical part of the palatine bone is forked at the top- making up the lower part of the sphenopalatine foramen.





- The **maxillary air sinus** lies in front of the pteryogopalatine fossa.

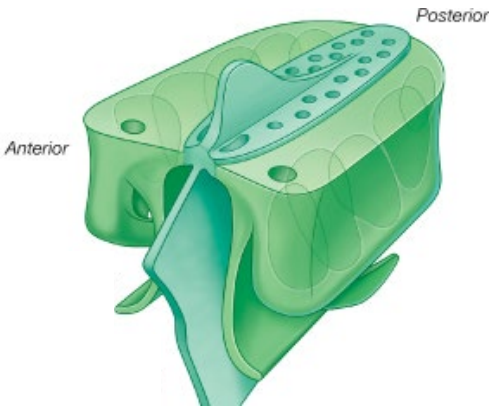
- The **Sphenopalatine fossa** opens into the nasal cavity from the pterygopalatine fossa (red circle)
- Sphenopalatine fossa passes through the fork in the palatine bone.

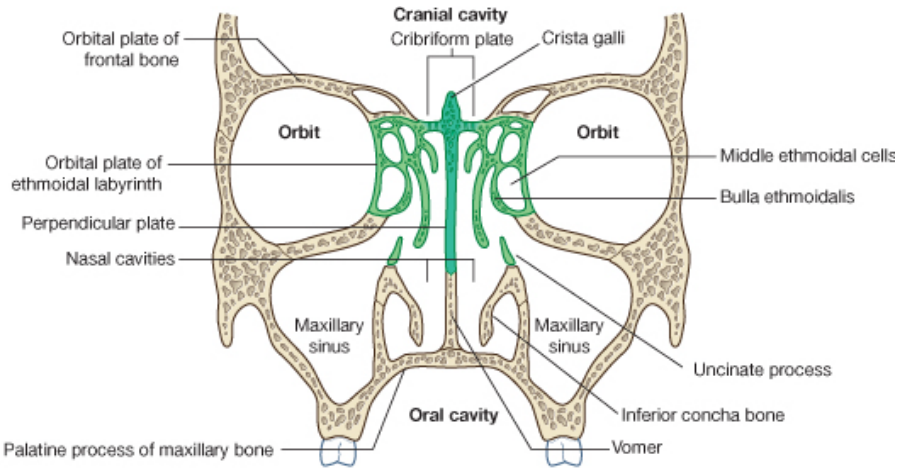
- The maxilla forms large part of the lateral wall of the nasal cavity.
- Within the maxilla is an opening into the maxillary air sinus
- Above the opening into the maxillary air sinus, the ethmoid bone forms the lateral wall of the nasal cavity (as the superior and medial concha).

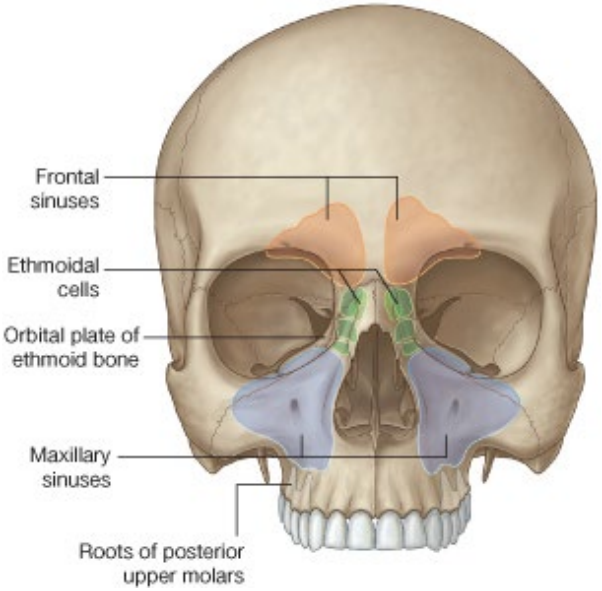
Ethmoid bone:

- Cribiform plate forms roof of nose and floor of anterior cranial fossa
- Midline projection – crista galli
- Downwards extension of the crista galli – the **perpendicular plate** – forms the midline nasal septum.
- Either side of the perpendicular plate, the lateral walls of the ethmoid bone are expanded by numerous air cells.
- The lateral walls of these air cells form the medial walls of the orbital cavity.
- Ethmoid air cells expand into the top of the nasal cavity to form the **<u>anterior, middle</u>** & **<u>posterior</u>** groups of **ethmoidal air cells / sinuses**.

- Boney processes of the lateral wall of the nasal cavity which curl over the ethmoidal air sinuses are the **conchae**
- **Superior and middle conchae** are part of the ethmoid bone
- **Inferior conchae** is a separate bone.
- Beneath each concha is a **meatus** (pocket).

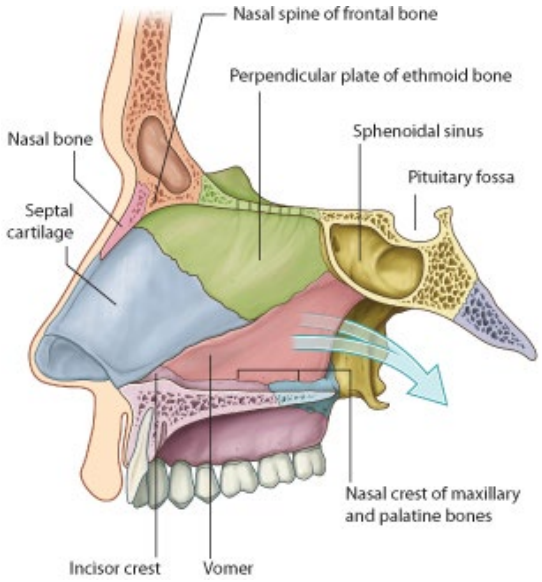


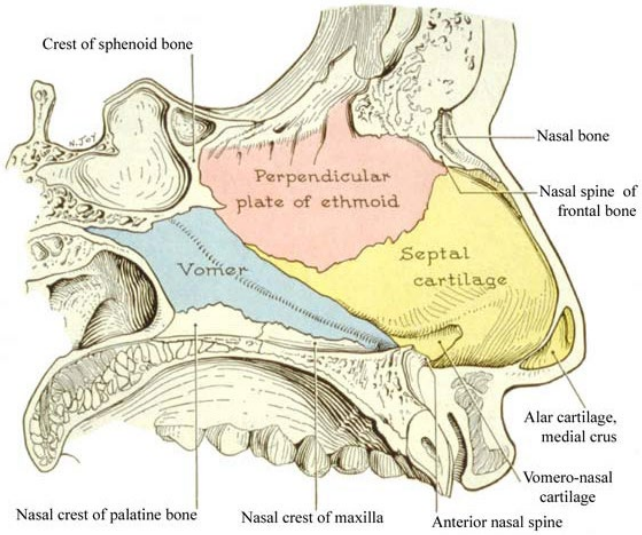




<u>Medial wall</u> of nasal cavity:

- *Above*: perpendicular plate of ethmoid
- *Below*: thin flat bone – **vomer** (wedge-shaped between floor of nose and cranial base)
- *Anteriorly*: continous as **septal cartilage**





PARANASAL AIR SINUSES:

- All the paranasal air sinuses are lined with respiratory mucous membrane (psedostratified columnar)
- Have sensory nerve supply and rich blood supply

- Each sinus opens onto the cavity of the nose

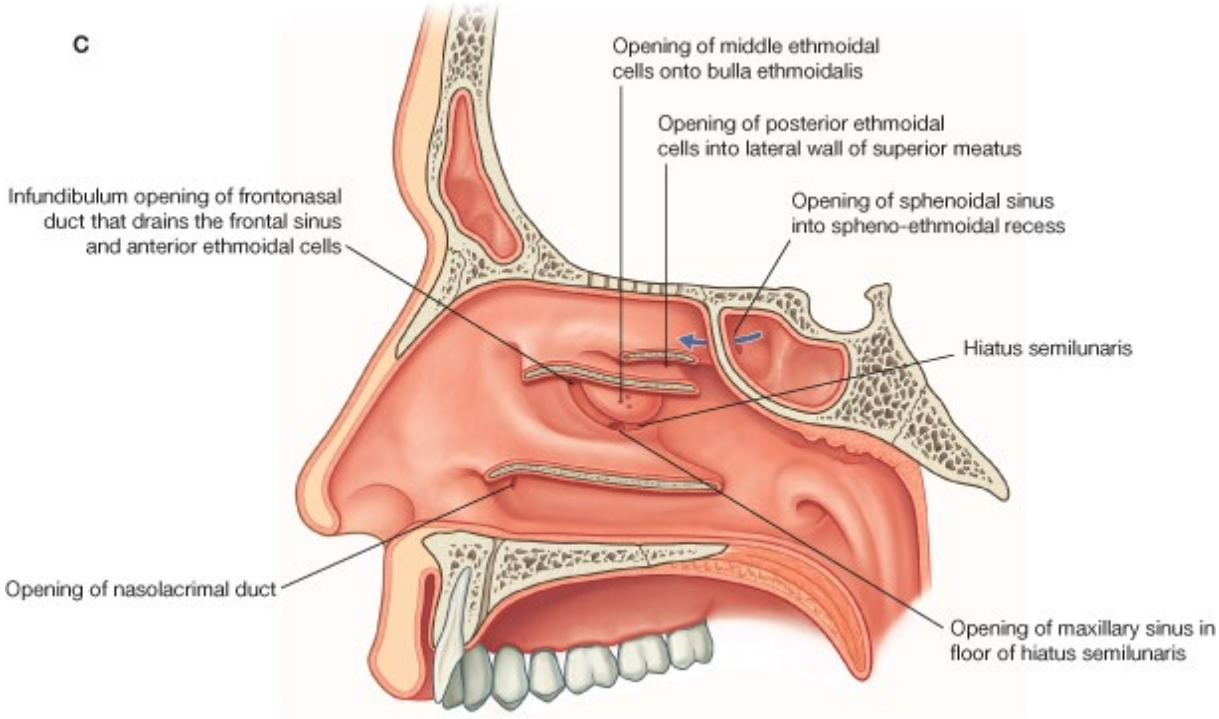
Maxillary air sinus:

- Pyramidal in shape
- Base of pyramid is lateral wall of the nose
- Apex lies close to zygomatic bone
- Roof of maxillary sinus is the floor of the orbit - in which the infraorbital canal lies.
- Anterior wall lies behind the cheek
- Behind the posterior wall lies the pterygomaxillary fissure and pterygopalatine fossa.

- In the floor of the maxillary sinus, the tips of the roots of the teeth create bumps.
- These teeth roots are embedded in the **alveolar bone** of the maxilla.

- Maxillary sinuses can become infected
- Mucous membrane swells and fluid collects in the cavity
- Can be painful – esp. when bending forwards.

- The **ostium** (hole) through which the maxillary sinus drains is on the lateral wall of the nose beneath the **middle concha** at the front of a groove called the **hiatus semilunaris**.
- Hiatus semilunaris runs around the base of a swelling – the **bulla ethmoidalis** – formed by a bulging of some of the ethmoidal air cells into the nasal cavity.



Ethmoidal air sinuses:

- Ethmoidal air sinuses open into the cavity of the nose through holes which open under the superior and middle meati.

Sphenoidal air sinuses:

- Drain into the nose through 2 openings high in the roof of the nose at the back
- This region is called the **sphenoethmoidal recess**

Frontal sinuses:

- Each frontal bone also has an air sinus lateral to the midline
- Occasionally there is a common sinus, or one of the sinuses may be absent.
- The frontal sinuses drain into the nose either side via the **infundibulum**
- Infundibulum empties into the front of the hiatus semilunaris **in the middle meatus**

- The only structure to empty into the inferior meatus is the **nasolacrimal duct**

- The opening of the **auditory tube** is at the level of the floor of the nose.

NERVES IN THE NOSE AND MIDFACE:

- **Trigeminal nerve (V)** is a mixed cranial nerve
- Largest of the cranial nerves
- Has a large ganglion containing the cell bodies of its sensory neurons.
- Ganglion lies just within the medial cranial fossa – in depression on the apex of petrous temporal bone.
- During development the trigeminal nerve pushes underneath the dura mater of the middle cranial fossa, drawing arachnoid mater with it.
- Δ first part of nerve and ganglion lie in CSF of subarachnoid space beneath the dura of the middle cranial fossa – this is **Meckel's cave**.
- Nerve then divides into 3 great divisions on the floor of the middle cranial fossa:

➢ **Opthalmic division (V_i):** passes through superior orbital fissure → orbit

➢ **Maxillary nerve (V_{ii}):** passes forwards through the foramen rotundum → pterygopalatine fossa

➢ **Mandibular division (V_{iii}):**
  - Only division with motor fibres
  - Immediately passes directly downwards through foramen ovale into the infratemporal fossa.

Maxillary division:

- Leaves skull through the foramen rotundum → pterygopalatine fossa
- In the fossa it divides into several branches:

❖ **Infraorbital nerve:**
  - Runs forwards through the infraorbital fissure → infraorbital canal → infraorbital foramen
  - Supplies sensation to:
    - Lower eyelid & conjunctiva
    - Skin of mid-face
    - Upper lip

❖ **Zygomatic nerve:**

- Passes along the lateral wall of the orbital cavity
- Runs through the zygomatic bone to supply the skin overlying this bone and skin over the temple.

❖ **Nasopalatine**:
- Passes medially through the **sphenopalatine foramen** → roof and lateral wall of nose.
- **Lateral nasal branches** come from nasopalatine
- Nasopalatine passes through incisive foramen into hard palate

❖ **Palatine nerve** runs through the **palatine canal** to supply the palate through the **greater and lesser palatine foramina.**

Superior alveolar nerves:

❖ **Posterior superior alveolar nerve** is a branch from maxillary nerve in the pterygopalatine fossa
- Through **alveolar foramen** in pterygopalatine fossa → through the bone to form a plexus over the tips of the roots of the upper molar teeth.

❖ **Middle superior alveolar nerves** are banches from the infraorbital nerve
- Runs into the plexus above the teeth roots

❖ **Anterior superior alveolar nerves** are another branch of the infraorbital nerve
- Also gives sensation to part of the **front, lateral wall, floor and medial septum of the nose**.

- In this way, **all the upper teeth are supplied by branches of the maxillary nerve**

ADDITIONAL NERVES SUPPLYING THE NOSE:

❖ **Anterior ethmoidal:**
- Branches of **nasocillary nerve in the orbit (from V1)**
- Leave though the medial wall of the orbit → anterior cranial fossa
- → enter nose through sides of cribiform plate of ethmoid bone.
  - Sensory to upper anterior segment of nasal walls
  - **Sensory to skin on bridge of nose**

❖ **Olfactory (cranial nerve I)**
- Carry special smell sensations from special smell receptors in upper part of nose.
- Olfactory nerves pass through the cribiform plate of ethmoid bone → olfactory bulb above the cribiform plate.

AUTONOMIC NERVES IN THE NOSE AND MIDFACE:

- **Parasympathetic ganglia are always found near the terminal branches of the trigeminal nerve.**

- **Ciliary ganglion** in **orbit** lies close to the nasocillary branch of opthalmic division (V_i)
  - Pregang PS (CNIII) → ciliary ganglion → postgang PS (short cilliary nerve) → eye

- **Pterygopalatine ganglion** lies in the **pterygopalatine fossa.**

- Here it is connected to the maxillary division (V_{ii}) of the trigeminal nerve

- **Otic ganglion**
  - lies close to mandibular division (V_{iii}) in infratemporal fossa

V1	**Ciliary ganglion**	Orbit
V2	**Pterygopalatine ganglion**	Pterygopalatine fossa
V3	**Otic ganglion**	Infratemporal fossa

Pterygopalatine ganglion (V2)

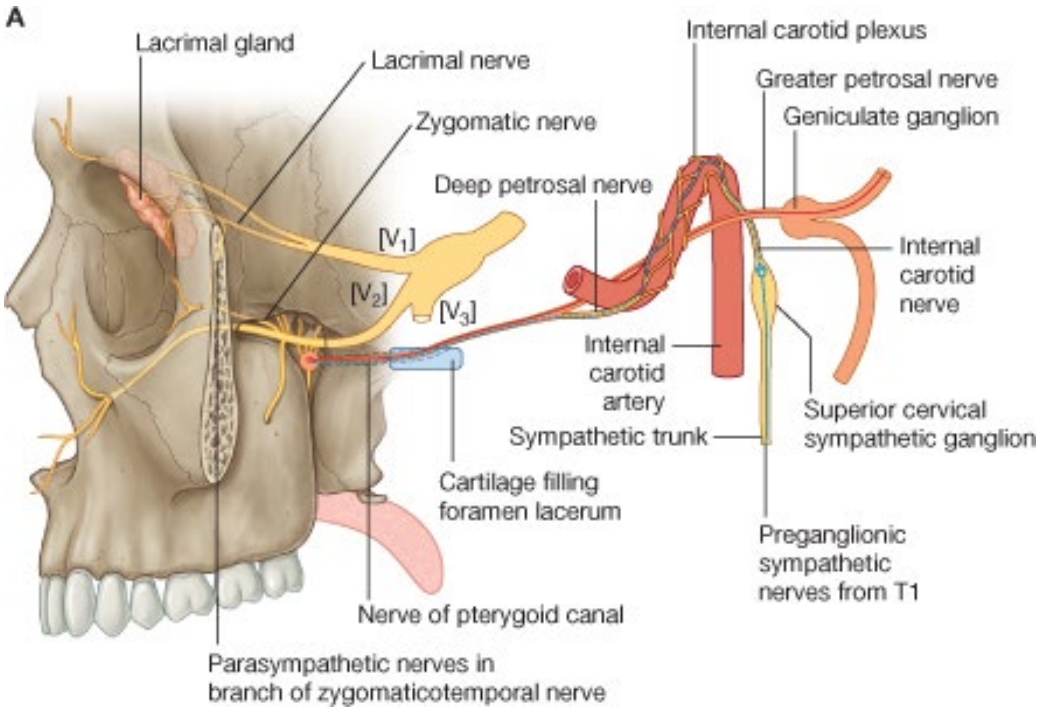
Parasympathetic

- The preganglionic parasympathetic neurons to this ganglion come from the facial nerve (VII)
- The branch of the facial nerve carrying the parasympathetic fibres is the **greater superficial petrosal nerve**.
- Petrosal nerve travels in **pterygoid canal** of sphenoid bone.
- Enters the pterygopalatine fossa, and the parasympathetic fibres enter the pterygopalatine ganglion.
- Synapse in ganglion
- Postganglionic parasympathetic fibres are distributed with all the sensory branches of the maxillary division (V_{ii})
- Actions mimic the effects of hay-fever (tears from lacrimal gland, secretion from nose, palate & sinuses).
- Some postganglionic parasympathetics pass directly to the lacrimal gland via the inferior orbital fissure.
- **Lacrimal gland supplied with parasymps from facial nerve:**
  - **Facial nerve → greater superficial petrosal nerve → pterygopalatine ganglion → Vii**
  - **Lacrimal gland also supplied by parasymps carried on Vi**

Sympathetic:

- Arise from the internal carotid as the **deep petrosal nerve**
- Travel through **pterygoid canal** along with parasympathetics
- Pass straight through the pterygopalatine ganglion without synapsing
- Pass to the glands

- **Sympathetic & parasympathetic** fibres in the pterygoid canal are collectively known as the **nerve of the pterygoid canal**.



BLOOD SUPPLY TO THE NOSE:

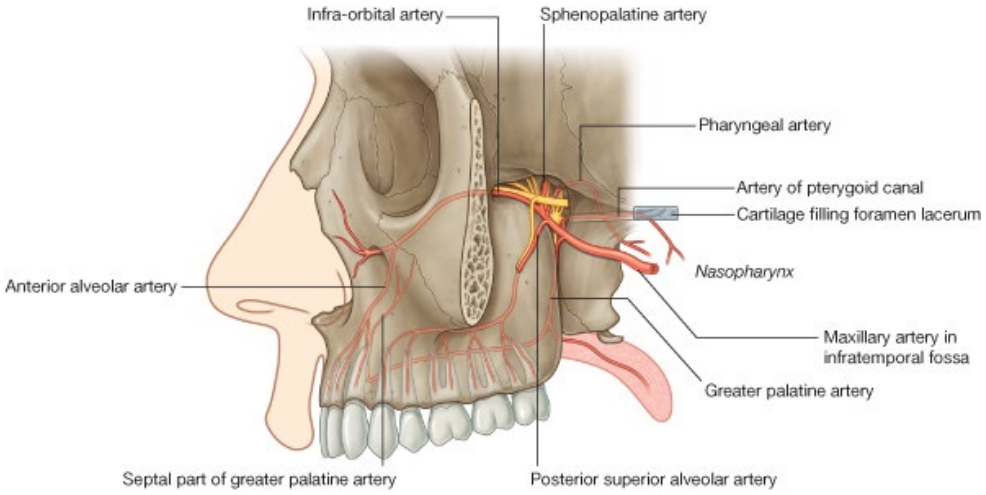
- Each of the nerves that pass into the nose is accompanied by an artery.
- Many of these arteries are banches of the **maxillary artery (external carotid artery)**
- In the pterygopalatine fossa the maxillary artery gives off branches through the sphenopalatine fossa which become the **sphenopalatine artery → lateral nasal arteries**

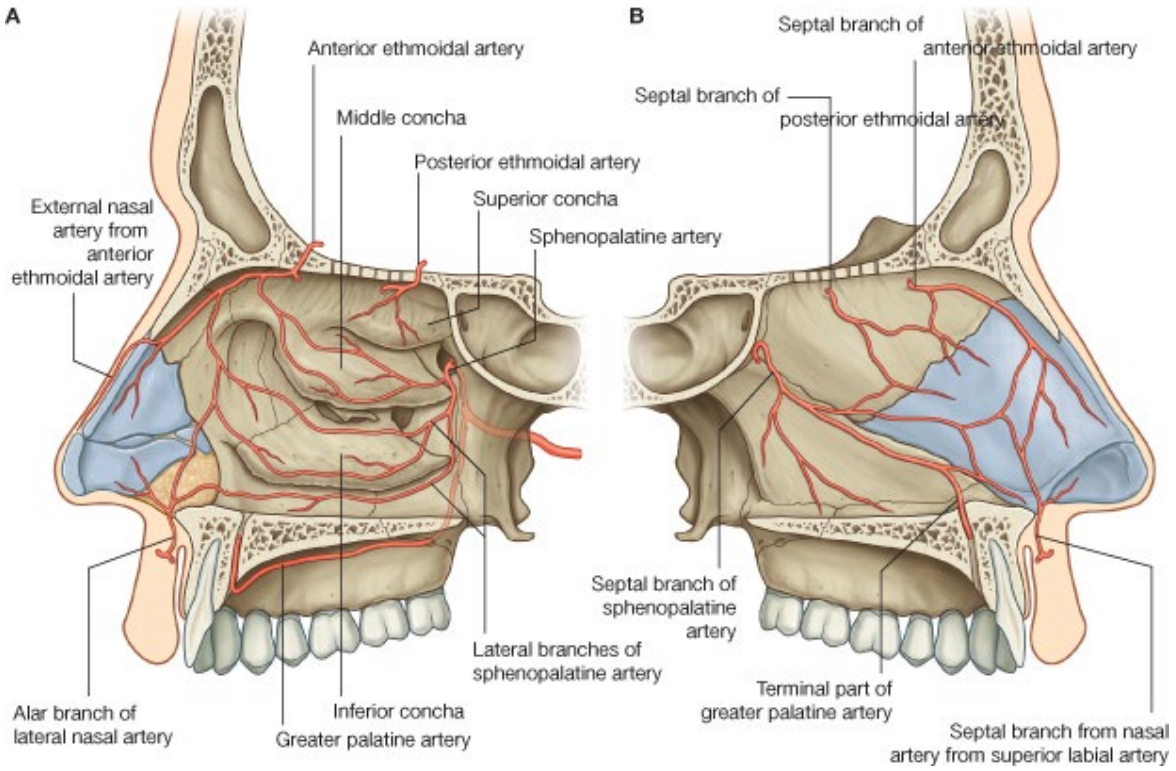
- **Facial artery** also gives off **nasal arteries**

- Mucous membrane of the lateral wall gets important contributions from:
    - *Superiorly:* **anterior ethmoidal artery (ophthalmic artery)**
    - *Inferiorly:* **anterior superior alveolar artery (infraorbital artery from maxillary artery)**

- **Greater palatine artery** (itself a branch of the maxillary artery) also gives a significant branch to the nasal septum through the **incisive canal** at the front of the hard palate.

- There is a rich vascular plexus at the front of the midline septum of the nose – **Little's area**.



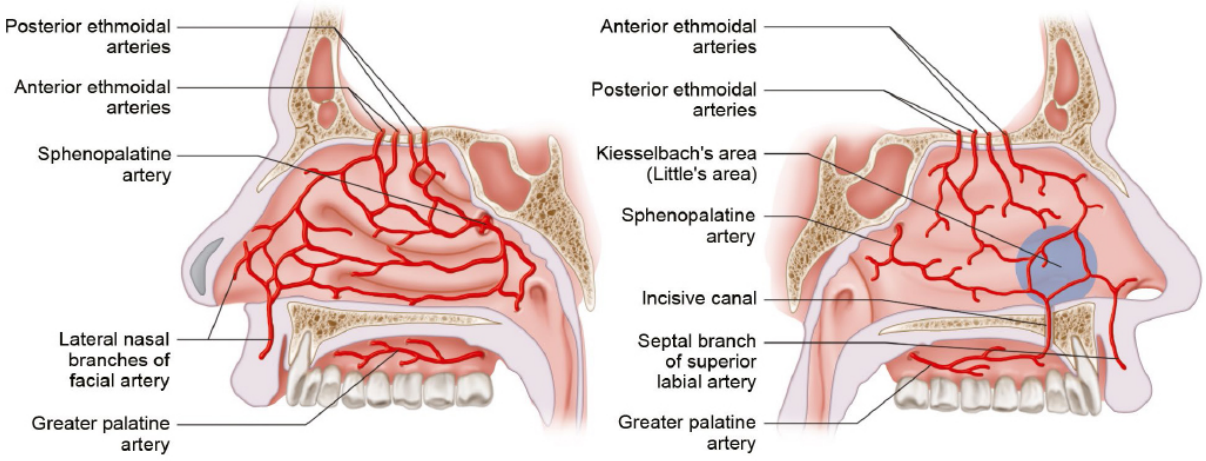


Lateral wall

Medial wall

Blood supply to nose:

- **Maxillary artery (from ECA)**
    - **Sphenopalatine artery → lateral nasal arteries**
    - **Infraorbital artery → anterior superior alveolar artery**
    - **Greater palatine artery** (through incisive canal)
- **Ophthalmic artery (from ICA)**
    - **Anterior ethmoidal atery**
    - **Posterior ethmoidal artery**
- **Facial artery (from ECA):**
    - **Lateral nasal branches**
    - **Superior labial artery**



APPLIED ANATOMY OF THE NOSE:

- **<u>Sinusitis</u>** is a complication which often follows common cold / URTI
- Cilia of the respiratory epithelium within the sinuses cease to function effectively
- Mucous membrane becomes engourged and inflamed
- Drainage though the ostium of each sinus slows and is ineffective → fluid accumilates within the cavity of the sinus.
- Maxillary sinusitis & frontal sinusitis are common and present with pain on bending the head forwards.
- Mucosa around the ostium is the most sensitive area of each sinus.

- Maxillary sinus begins to form after birth
- As the face grows the epithelium is drawn into the body of the maxilla from the nose from a point that represents the opening of the ostium.
- The ostium remains in the same position, even as the face grows in height and the sinus extends inferiorly.
- This is a disadvantage in adults, as the drainage of the sinus is high on the medial wall.
- It does, however, ensure that secretions of the nasolacrimal duct, which open into inferior meatus, cannot run into the maxillary sinus.

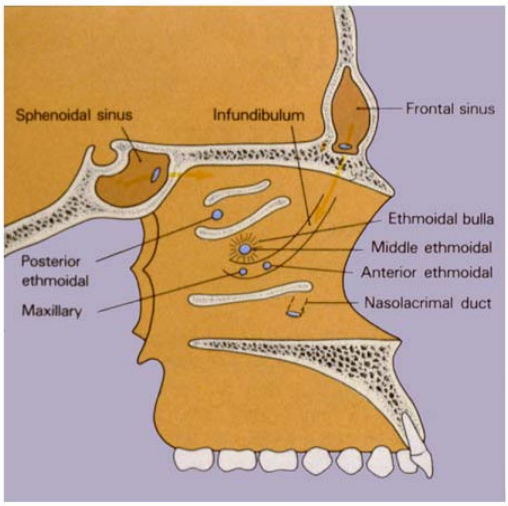
<u>Epistaxis</u> (nosebleeds)

- The nasal mucous membrane has a rich blood supply and is erectile in nature:
    - Alternating vasodilation and vasoconstriction of one side of the nose means that we ofen breathe through one side of the nose only for periods of time.
    - It is a function of the nose to warm and humidify inspired air in this way
    - Nasal mucous membrane is also involved in heat loss when core temperature rises above 37^{o}c

- Nose bleeds may originate from vascular plexus on either side of the nasal septum, 1.5cm from the opening of the nostril.
- This is **Little's area**.
- It is in Little's area that many arteries anastomose on the septum:
    - Superior labial artery
    - Anterior ethmoid artery

- Sphenopalatine artery
- Anterior superior alveolar artery

- Nose bleeds which arise higher and further back in the nose can be serious and difficult to stop.
- They are more common in older people with hypertension.



Lateral wall of nasal cavity with turbinate bones removed to show ostia of sinuses.

- Summary of the **glossopharyngeal nerve (IX)**:
  - Sensory to oropharynx
  - Sensory to posterior 1/3 of tongue
  - Sensory to middle ear (tympanic membrane)
  - Branch to carotid body & carotid sinus