RS

ANATOMY

MODIFIED NO. 1

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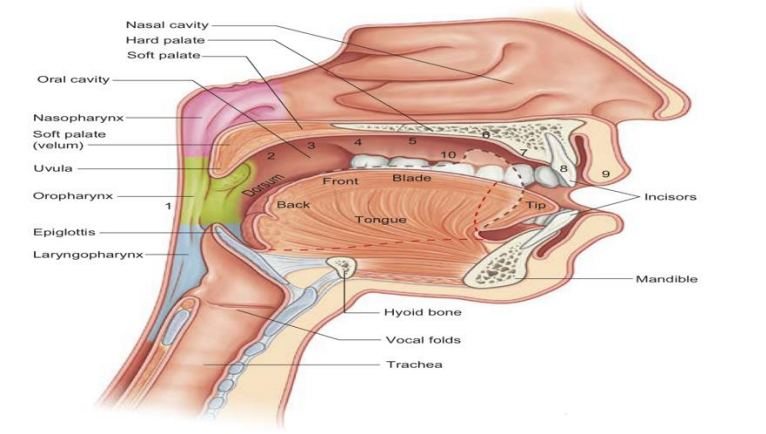
First things first

Let’s meet the awesome organs that team up to create your respiratory system!

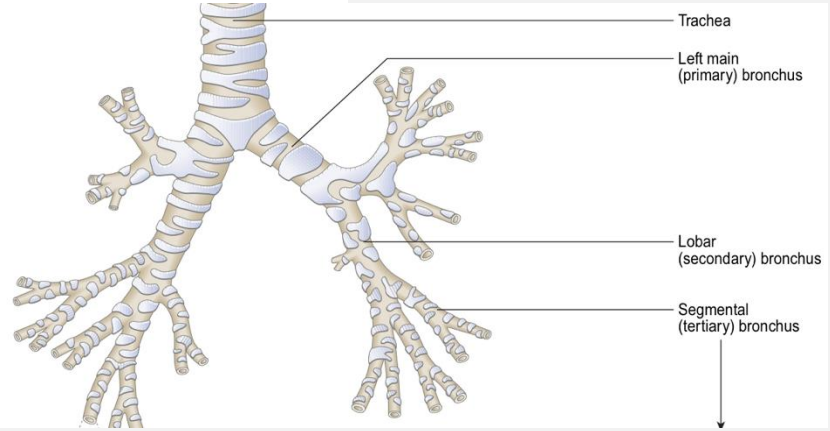
The **respiratory system** consists of multiple organs, beginning with the **nose** and progressing through the **pharynx**. The pharynx is divided into three parts:

1. **Nasopharynx**
2. **Oropharynx**
3. **Laryngopharynx**



Following the pharynx, the **larynx** and **trachea** continue the pathway. When the trachea reaches the lung, it divides into **two main bronchi**:

- The **right main (primary, principal) bronchus**
- The **left main (primary, principal) bronchus**



Each **primary bronchus** further subdivides into **secondary (lobar) bronchi**, then these secondary bronchi further subdivide into **tertiary (segmental) bronchi**. So by that, we have **primary, secondary and tertiary bronchi.**

The **bronchi** are composed of **cartilaginous tissue**, which provides structural support. “Bronchi” is the plural form of **bronchus**.

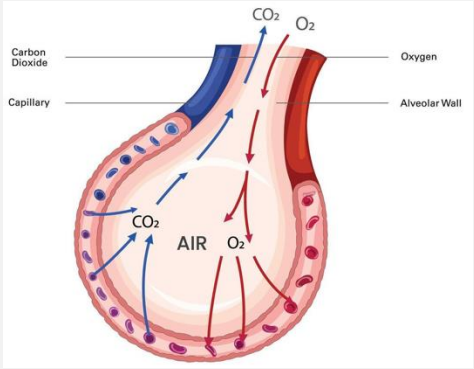
After the bronchi, the pathway continues into **bronchioles**. Unlike bronchi, bronchioles **do not contain cartilage**. Instead, they consist of **smooth muscle**. This structural difference is significant in conditions such as **asthma**, where the smooth muscles in bronchioles constrict and narrow the passage of air. By contrast, the bronchi—due to their cartilage—cannot undergo such narrowing or obstruction. Within the lungs, each bronchiole will eventually terminate in alveoli.

Now we will dive into the lungs, each lung is composed of **bronchopulmonary segments**. **A segmental, tertiary bronchus supplies a structurally separate and functionally independent unit of lung tissue called a bronchopulmonary segment.**

The lungs contain **millions of alveoli**, which are the primary sites for **gas exchange**. This can be compared to: A **bag filled with tennis balls** (where each tennis ball represents an alveolus and the bag is one of the two lungs).

• Each **alveolus** is **spherical** and surrounded by a wall. When **two alveoli meet** (like two tennis balls), a **septum** forms between them. Surrounding each alveolus is a dense **network of capillaries**. This network is critical for:
• Gas exchange between **alveoli** and **capillaries**.

This gas exchange is the **primary function** of the lungs.

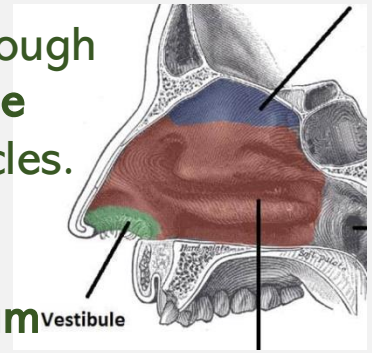


Functions of the respiratory system:

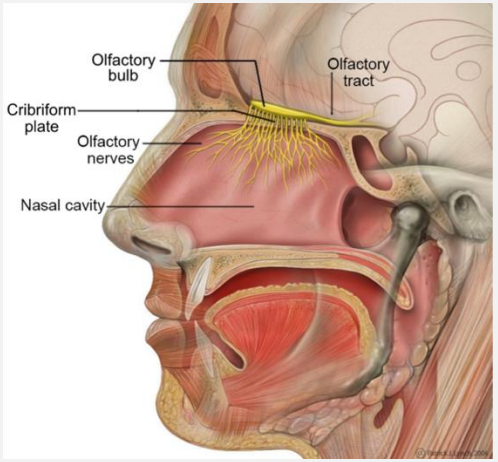
- 1. **Gas exchange**: which was described in the previous slide.

- 2. **Regulation of blood's pH** : which relies on the **concentration of oxygen (O_2) and carbon dioxide (CO_2) gases**. For this reason, when a patient presents with **pulmonary problems**, it is a standard practice to obtain a **sample of arterial blood**. This sample allows doctors to measure the concentrations of:
- **Oxygen (O_2)**, **Carbon dioxide (CO_2)** and the **blood's pH level**

- **3. Filtration of Inspired Air**: The **respiratory system** filters the air as it enters the **nasal cavity** through the first entrance, known as the **anterior nares** (nostrils). Beyond the nostrils, there is a **vestibule** lined with both **thick and short hairs** that play a key role in **air filtration** by trapping large particles.
- The **epithelial lining** of the respiratory tract varies based on location:
- The **nose, larynx, trachea, and bronchi** are lined with **pseudostratified ciliated columnar epithelium** containing **goblet cells**.
- In the **bronchioles**, the epithelium transitions to **simple ciliated columnar** or **cuboidal ciliated epithelium**.
- As the airways continue distally, the **thickness of the epithelial cells decreases**. The cells transition from **columnar to cuboidal**, and then from **ciliated to non-ciliated epithelium** (**Clara cells** (non-ciliated cells))
- The final part of the respiratory tract features **simple squamous epithelium**, which consists of specialized cells crucial for **gas exchange**. So, the **filtration of inspired air** primarily depends on the **epithelium**. The **ciliated epithelium** has: **Cilia**: Tiny hair-like structures that move trapped dust and foreign bodies in a **unidirectional manner**, pushing them **out of the body**.



- **4. Smell Sensation and Phonation**: The **sense of smell** is facilitated by the **epithelium** lining the **roof of the nasal cavity**. This **olfactory epithelium** contains **bipolar cells** (olfactory receptor neurons) responsible for detecting airborne odorant molecules and converting them into **nerve impulses**.
- These impulses travel through the **olfactory nerve (CN 1)** to the **brain**, where they are processed and stored as inputs in specific centers. The brain then interprets these signals, enabling the individual to recognize and identify different smells.



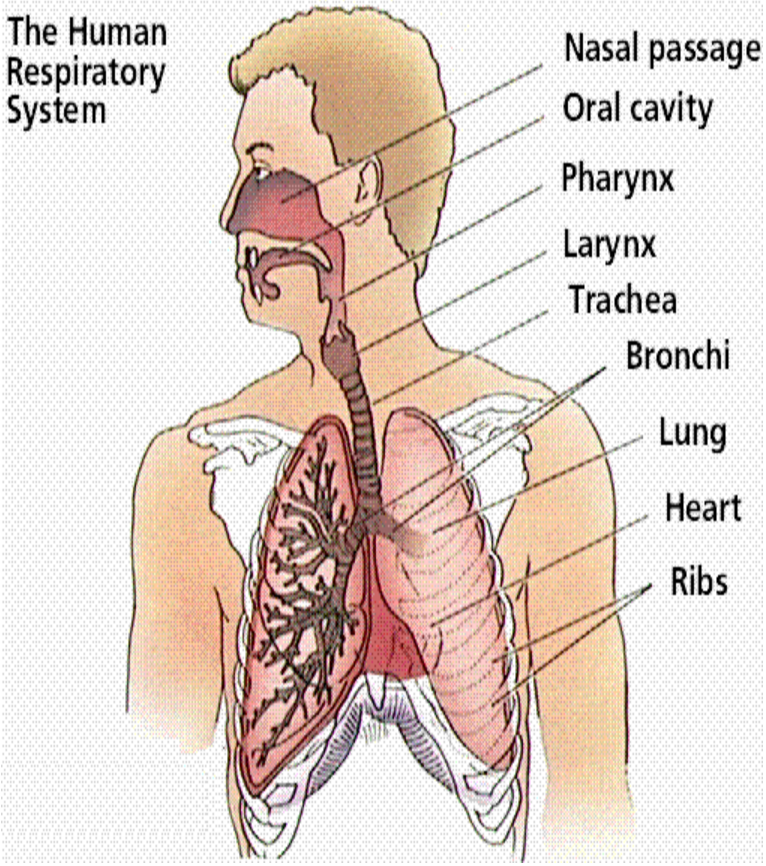
- Additionally, the **larynx** contains both **false vocal cords** and **true vocal cords**. The **true vocal cords** are primarily responsible for **articulation** and **phonation** (the production of sound).

- **5. Air Warming and Moisturization** : The **mucosal secretions** of the respiratory system play a key role in **warming and moisturizing** inspired air. Cold air that enters the nasal cavity is **warmed** to a more suitable temperature, protecting sensitive **brain cells** from potential damage caused by exposure to cold air.
- Furthermore, the **moisture** air helps trap **bacteria** and **dust particles** more effectively.

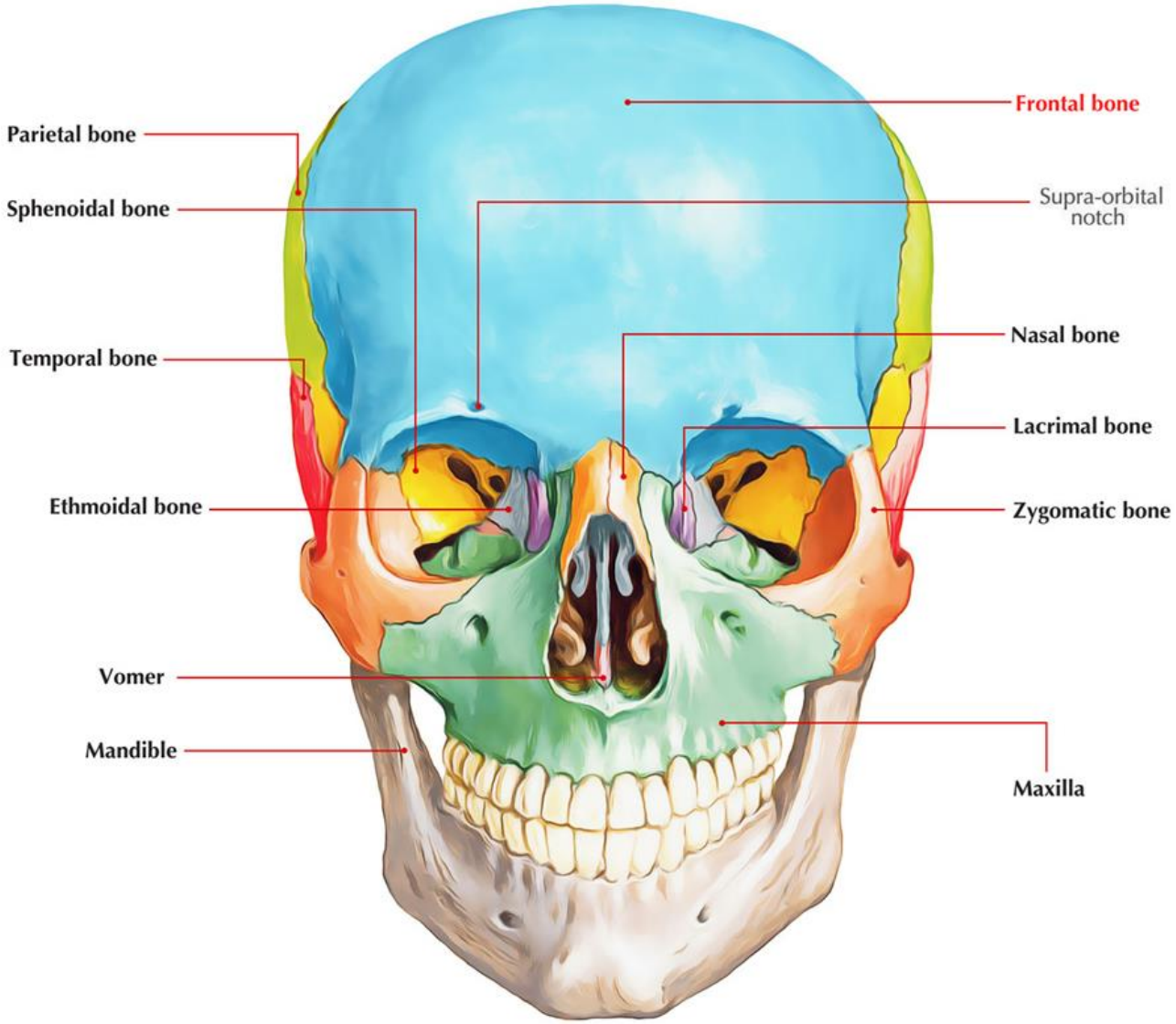
Everything was explained in the previous slides.

The Nasal Cavity

- The first part of the respiratory tract
- **Functions of the respiratory system:**
- 1. Provides for gas exchange
- 2. Regulates blood ph
- 3. Filters the inspired air
- 4. Contains receptors for smell, and produce vocal sounds (phonation)
- 5. Excretes small amounts of water and heat



Recall the bones of the skull:



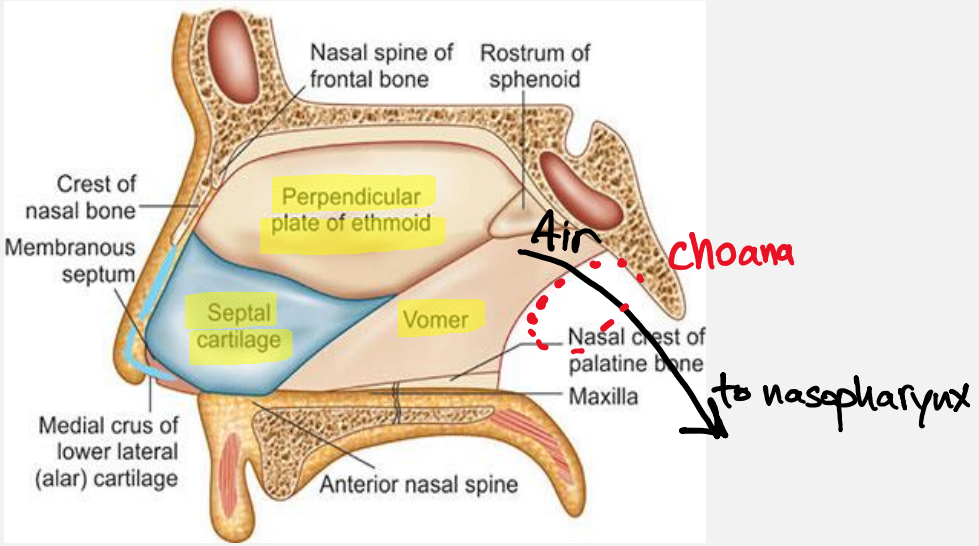
Nose

- Devided into :
- External nose
- Nasal Cavity

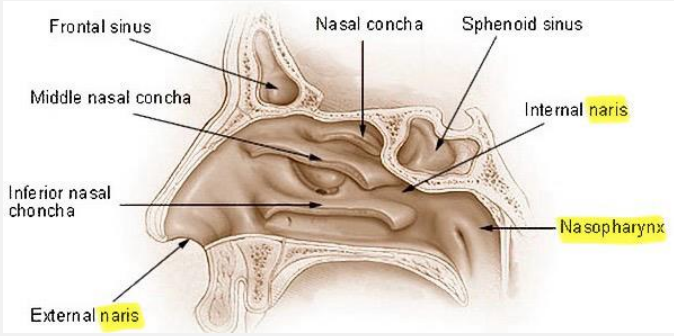
Starting with the first organ of our respiratory system, the NOSE.

The nose is divided into the **external nose** and 2 **nasal cavities**. The 2 nasal cavities are separated by a **septum**. Each cavity has **4 boundaries:**

- **Roof**
- **Floor**
- **Lateral wall**
- **Medial wall, which corresponds to the nasal septum, is composed of 3 parts:**
  - **Anterior part: cartilage**
  - **Superior part : vertical plate of ethmoidal bone**
  - **Posterior part: vomer bone**



- **Each nasal cavity** has **2 openings:**
- **Anterior opening: Nares or Nostrils**
- **Posterior opening: Choana, that leads to the nasopharynx**



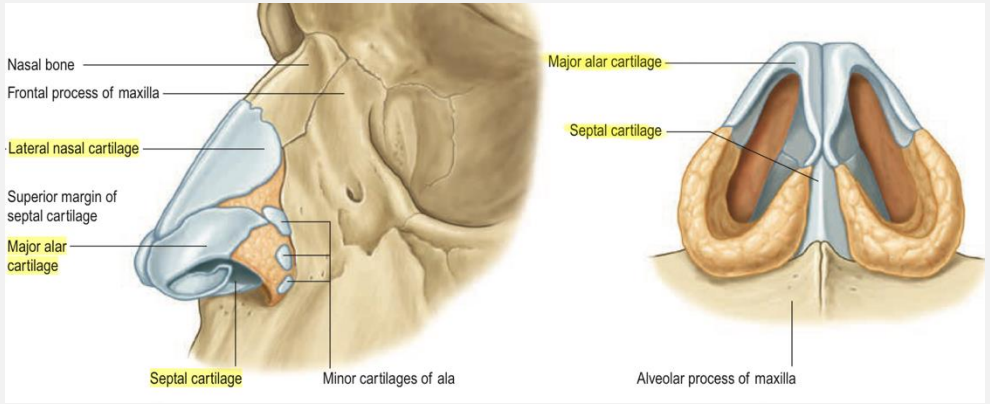
The **external nose** comprises **two structural components** :

1. **Anterior cartilaginous part**, which projects **inferiorly**, and consists of three **hyaline cartilages**:

- **Septal cartilage**
- **Lateral nasal cartilage** (divided into upper and lower parts)
- **Alar cartilage**, which forms the **lateral bulge**

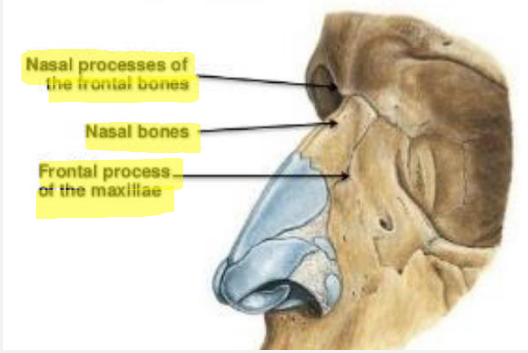
and is associated with two muscles:

- **Constrictor muscles**
- **Dilator muscles**



2. **Superior bony part**, composed of **two nasal bones** along with adjoining bones of the skull:

- **Frontal process of the maxilla**
- **Nasal process of the frontal bone**

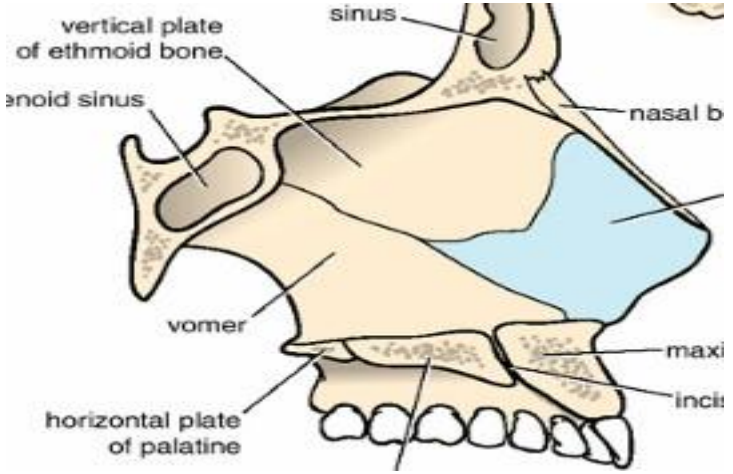


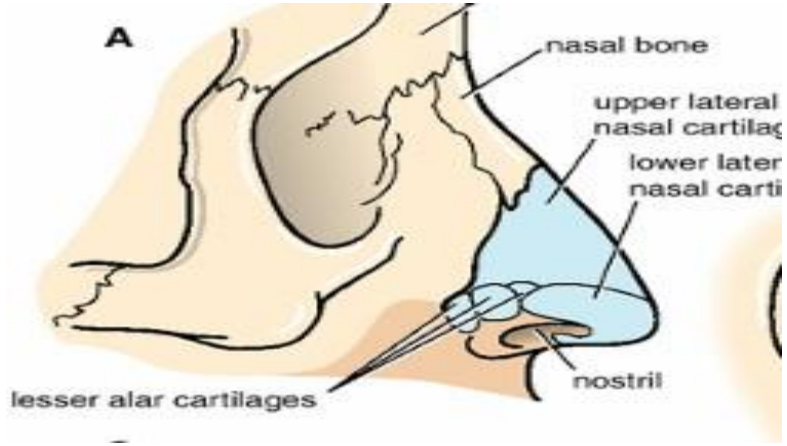
Collectively, these components unite to form the **superior bony framework** of the nose.

Everything was explained in the previous slides.

External nose

- Cartilaginous framework:
- **1. Septal cartilage**
- **2. Lateral nasal cartilage**
- **3. Alar cartilage**
- All are plates of **hyaline cartilage**

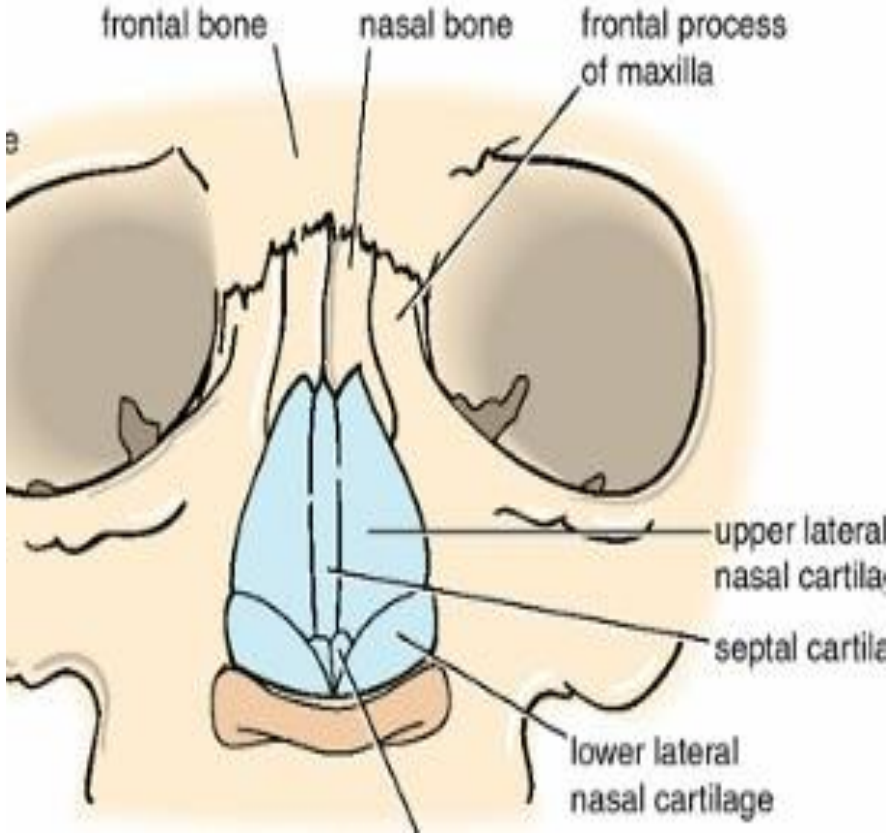




Everything was explained in the previous slides.

External nose

- Bony framework
- 1. The **nasal bones**
- 2. Frontal processes of **the maxillae**
- 3. Nasal part of the **frontal bone**



External Nose

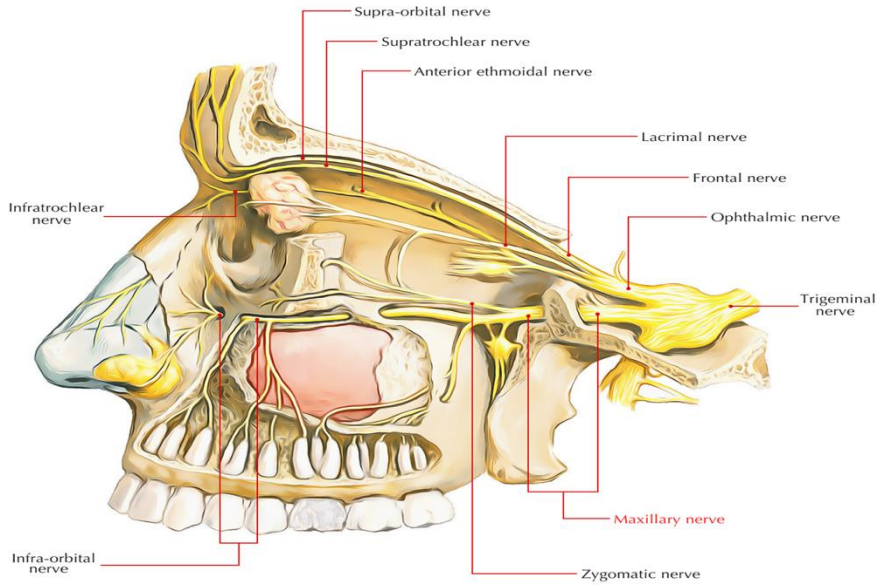
- **Blood Supply**
- Branches of the **ophthalmic** (a branch of the internal carotid artery) **and the maxillary arteries** (branches of the external carotid arteries)
- Ala and the lower part of the septum by branches from the **facial artery,** which itself is a branch of the external carotid artery. Facial artery branches to superior and inferior labial arteries upon entering the face, the superior labial artery then branches to give rise to the nasal branch that supplies the lower septum

External Nose

- **Nerve Supply**
- **Infratrochlear and external nasal branches of the ophthalmic nerve , it also has an supraorbital branch**
- **infraorbital branch of the maxillary nerve.**

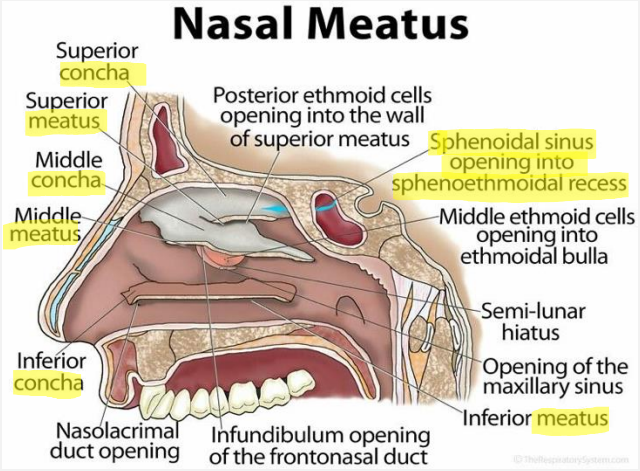
- The **maxillary artery** and **maxillary nerve** terminate at the **infraorbital foramen**, where they continue as the **infraorbital artery** and **infraorbital nerve**, respectively. The **infraorbital nerve** subsequently divides into three branches:

- **Palpebral nerve**
- **Nasal nerve**
- **Labial nerve**



Each nasal cavity is bounded by a roof, floor, lateral wall, and medial wall:

1. Lateral wall: This is the external part of the nose, palpable on the face.
2. Medial wall: This is the nasal septum, which separates the two nasal cavities.



The nasal cavity has two openings:

- Anterior opening: The nostril (nares).
- Posterior opening: The choana, which connects the nasal cavity to the nasopharynx.

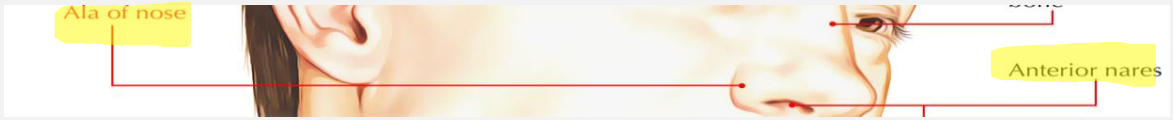
Features of the Lateral Wall

- The vestibule is the initial part, containing both thick and thin hairs that filter air. It is lined by keratinized squamous skin epithelium.
- Beyond the vestibule lies the atrium.
- Further along, there are three conchae and three meatuses and a sphenoethmoidal recess, which drains the sphenoid sinus into the nasal cavity.

Each concha is a bony projection extending from the lateral wall, forming a shelf-like structure that increases the surface area of the lateral wall.

Features of the Vestibule

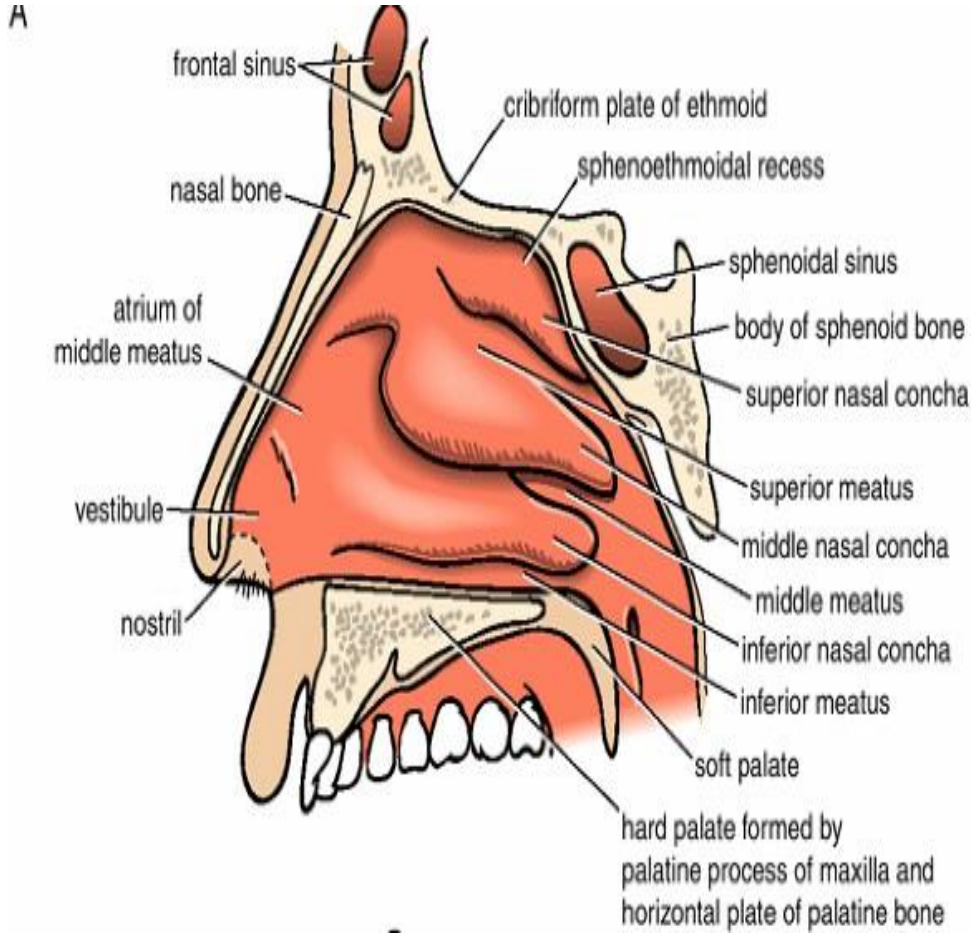
1. Dilatation
2. The ala, located on the lateral side of the vestibule.



Nasal Cavity

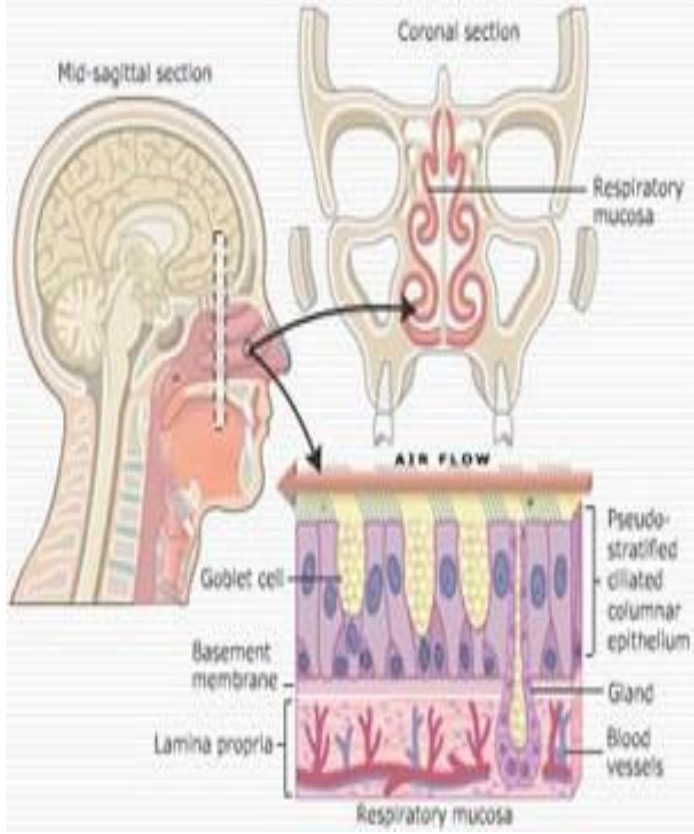
Everything was explained in the previous slides.

- Extends from the nostrils in front to the posterior nasal apertures **(choana)**
- Opens into the nasopharynx
- **Vestibule** is the area of the nasal cavity lying just inside the nostril
- Divided into right and left halves by the **nasal septum**
- **Septum** is made up of the **septal cartilage**, the vertical plate of the **ethmoid**, and the **vomer.**



Nasal Cavity

- Functions :
- 1. **Respiratory, air passage**
- 2. **Olfactory, smell sensation**
- 3. **Resonance of voice, will be explained in the upcoming slide**
- 4. **drains lacrimal fluid, will be explained in the upcoming slide**
- 5. **Protective :**
- Sneezing
- Filtration
- Proteolytic enzymes produced by glands
- Warming and moistering the air



3. Resonance of Voice

The **resonance of the voice** (نغمة الصوت) varies among individuals due to the presence of the **12 paranasal sinuses, named after the bones that contain them**. These include **2 frontal, 2 maxillary, 2 sphenoidal**, and a pair of **3 ethmoidal sinuses** (anterior, middle, and posterior). The paranasal sinuses are air-filled cavities that connect to the nasal cavity via ducts that open into the **lateral wall of the nose**. These sinuses contribute to voice resonance by acting as sound resonating chambers.

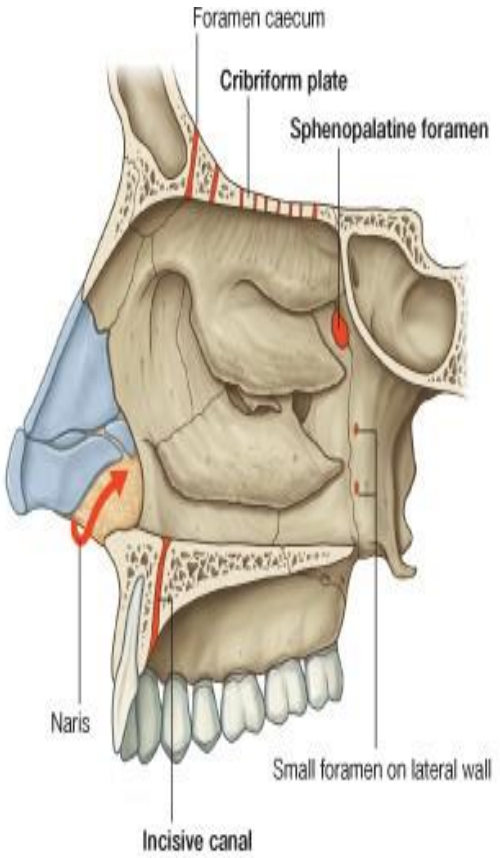
4. Drainage of Lacrimal Fluid

Lacrimal fluid (tears) is produced by the **lacrimal gland**, which is located on the **lateral aspect of the roof of the orbit**. The tears serve to clean and maintain the transparency of the cornea. A portion of this fluid travels beneath the skin at the **medial angle of the eye**, while the majority is collected in the **lacrimal sac**, located medially to the eye. The sac drains into the **nasolacrimal duct**, which opens into the **inferior meatus** of the nasal cavity.

A common pathological condition arises when the nasolacrimal duct becomes obstructed, leading to **stagnation of tears** in the lacrimal sac. This can result in an infection, a condition known as **dacryocystitis**. Treatment involves relieving the obstruction by surgically creating an opening into the lacrimal duct, restoring proper tear drainage.

Nares

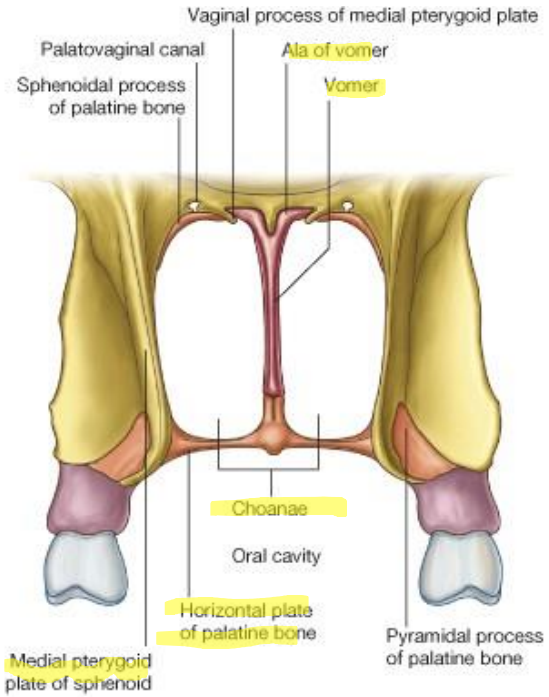
- <u>The anterior openings of the nasal cavities.</u>
- Held open by the surrounding alar cartilages and septal cartilage
- Nares are continuously open
- Can be widened further by the action of the related muscles of facial expression



Choanae

- Openings between the nasal cavities and the nasopharynx
- These are the posterior nares.
- Rigid openings completely surrounded by bone

Vomer forms part of the the septum, medial wall.
It has an upper part, ala of vomer.
The base of the nasal cavity is formed by the horizontal plates of palatine bone.
Laterally, medial pterygoid plate of sphenoid bone is present.
The roof has also the medial pterygoid plate of sphenoid, palatine bone, foreman (foreman of cribriform plate, in the ethmoid bone) and the ala of vomer.



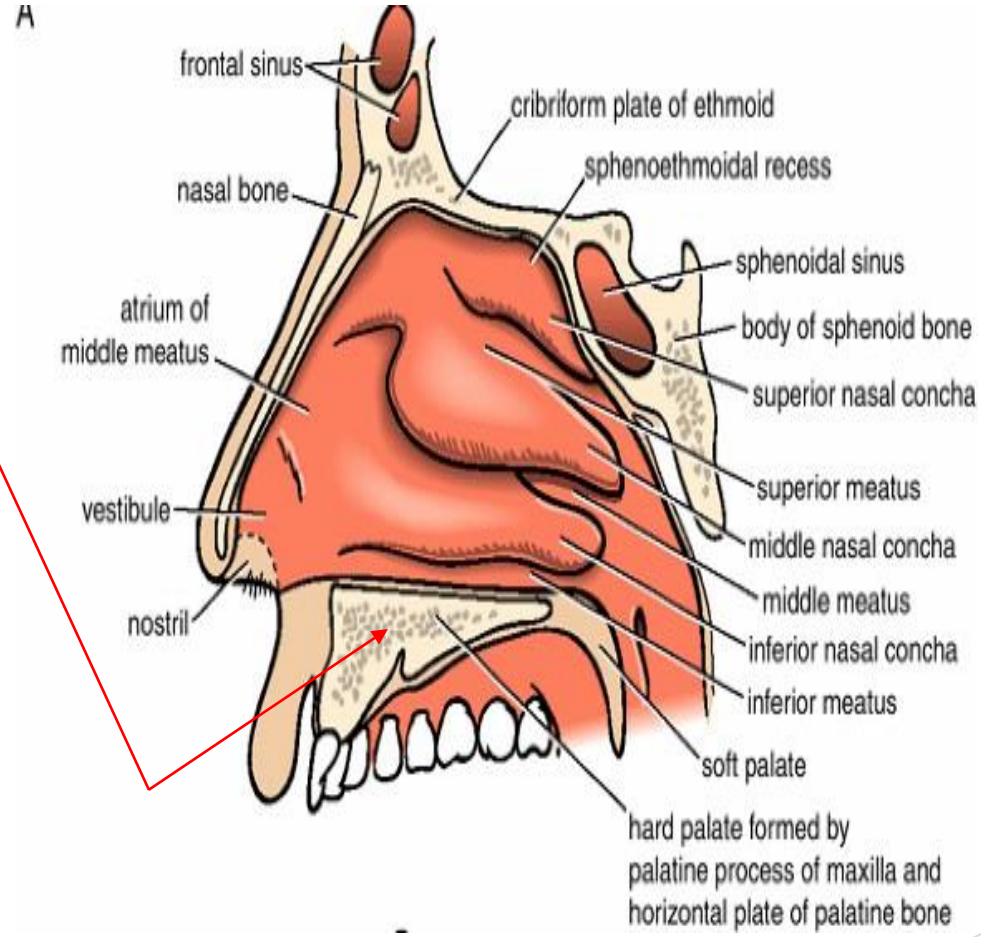
The next slides break these down, and the doctor has *seriously* focused on them – don't be surprised if they pop out in the exam !

Nasal Cavity

- Boundaries of the cavity :
- **Floor**
- **Roof**
- **lateral wall**
- **Medial or septal wall.**

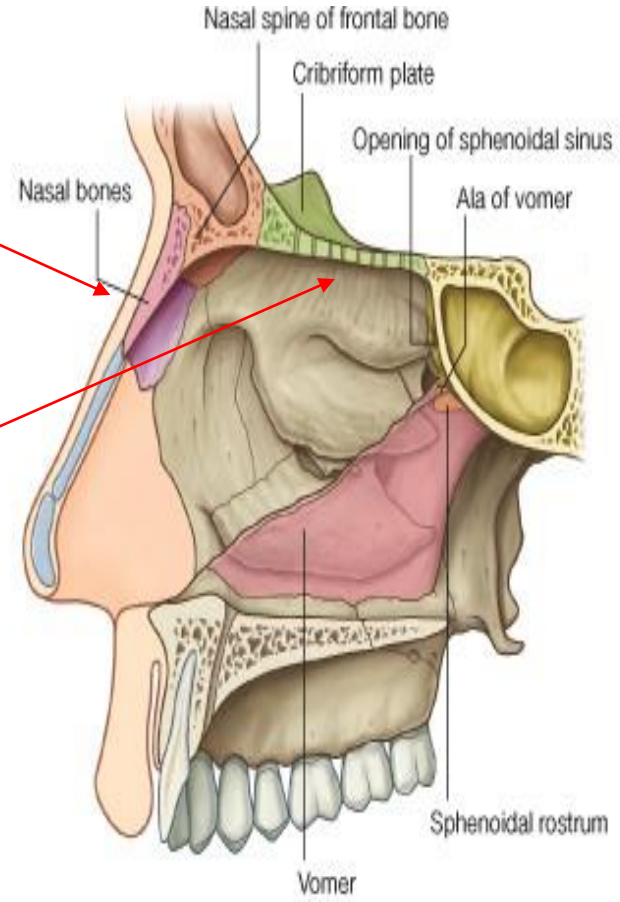
Floor

- **The upper surface of the hard palate , it separates the nasal cavity from the oral cavity.**
- Which consist of:
- 1. Palatine process of the **maxilla**
- 2. Horizontal plate of the **palatine bone**



Roof

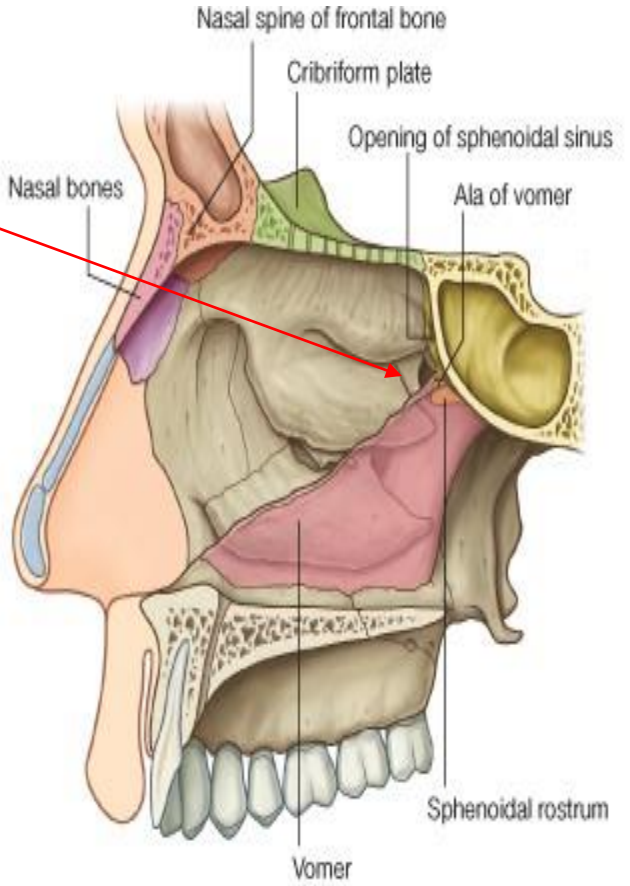
- 1. **Sloping anterior part:**
- Nasal spine of the frontal bone and the nasal bones
- **2.Horizintal middle part, this area is called the 'olfactory area':**
- The cribriform plate of the ethmoid bone, beneath of it is the olfactory area, which has bipolar cells for smell sensations



Roof

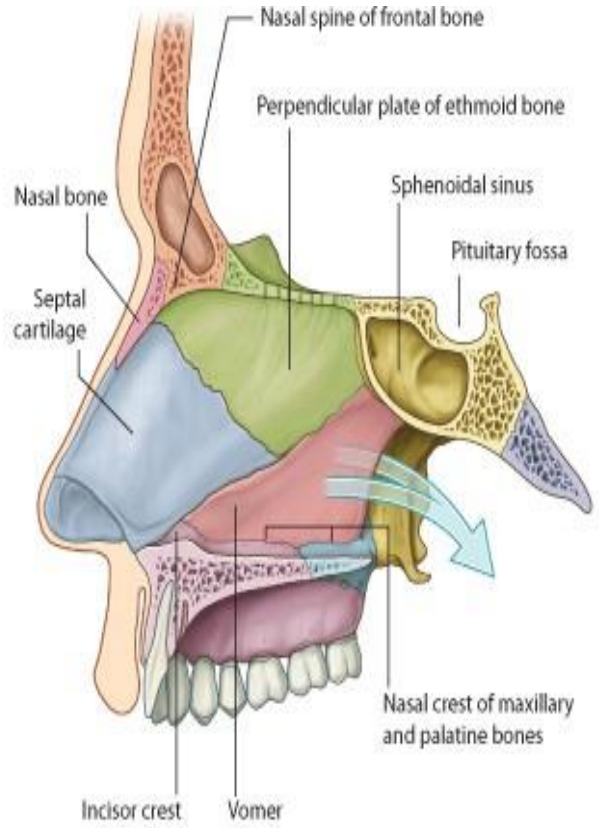
So, the roof of the nasal cavity consists of three main parts:
1. **Anterior part**: Formed by the **frontal bone** and nasal bone.
2. **Middle part**: Formed by the **cribriform plate of the ethmoid bone**.
3. **Posterior part**: Formed mainly by the **body of the sphenoid bone**.

- 3. Sloping posterior part:
- Anterior surface of the **sphenoid bone (body)**
- Ala of the **vomer**
- **Vaginal process** of the palatine bone



Medial wall

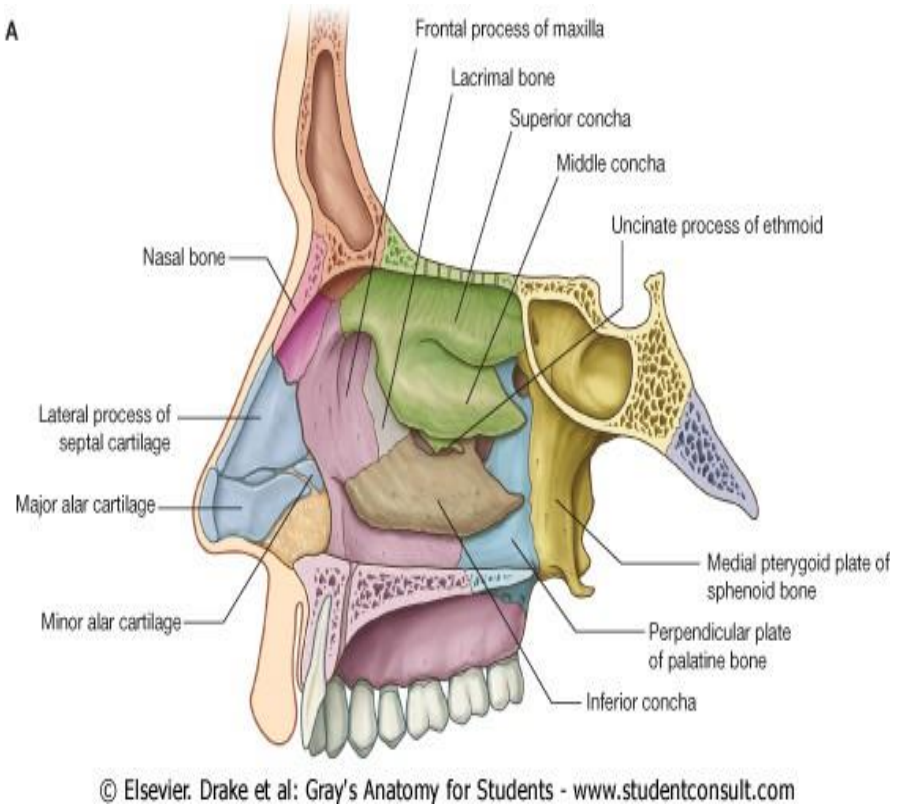
- **Septal nasal cartilage** anteriorly
- **Posteriorly vomer** and the **perpendicular plate of ethmoid** bone



Lateral Wall

Superior and middle chonchae are extensions from the cribriform plate of **ethmoidal** bone. While the inferior chonca is an extension from the **maxilla**, also it can be seen from the anterior nostril as a **separate** bone.

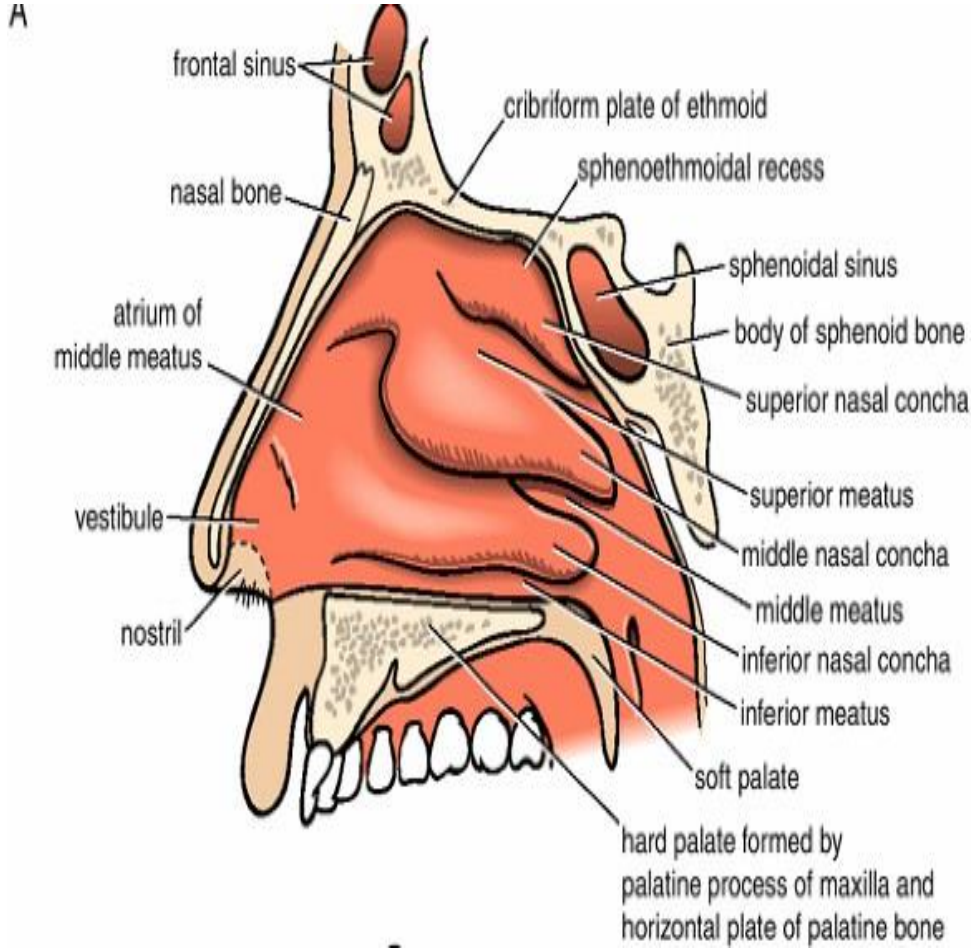
- Complex and formed by bone, cartilage, and soft tissues
- **Bony support :**
- **Ethmoidal labyrinth** and **uncinate process**
- Perpendicular plate of the **palatine bone**
- Medial plate of the **pterygoid process**
- Medial surfaces of the **lacrimal bones and maxillae (frontal process)**
- **Inferior concha**



Conchae form shelf-like structures

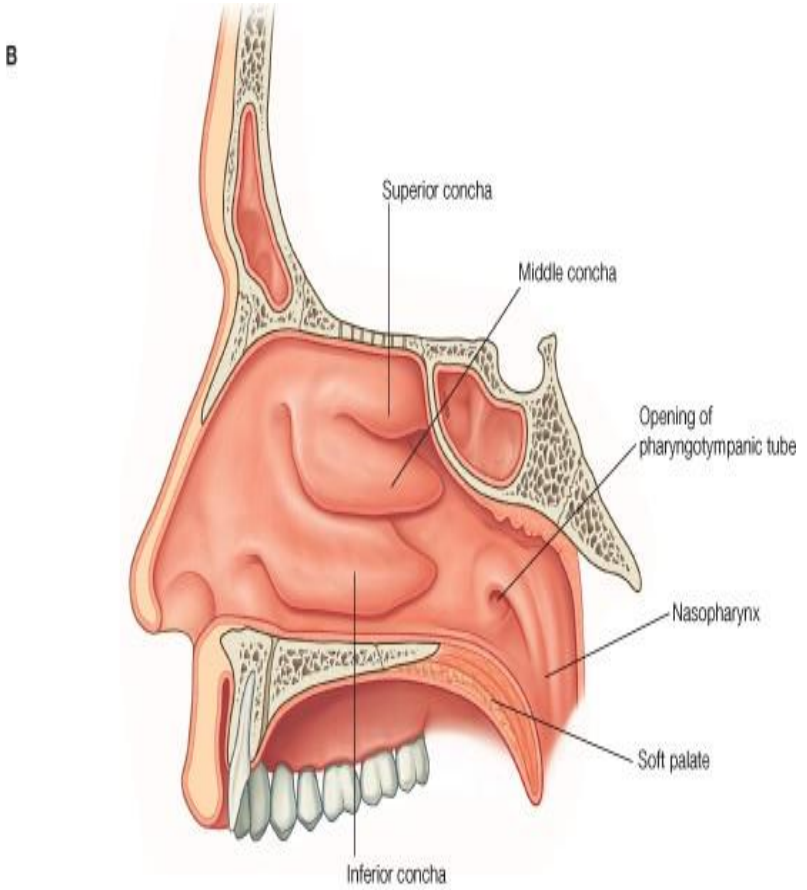
Lateral Wall

- Parts:
- **1. Vestibule** is the area of the nasal cavity lying just inside the nostril
- Covered with skin and contains thick hairs **(vibrissae)**
- **2. Antrum (atrium)**
- 3. Posterior part contain **3 conchae**, **3 meatuses**, and **one recess.**



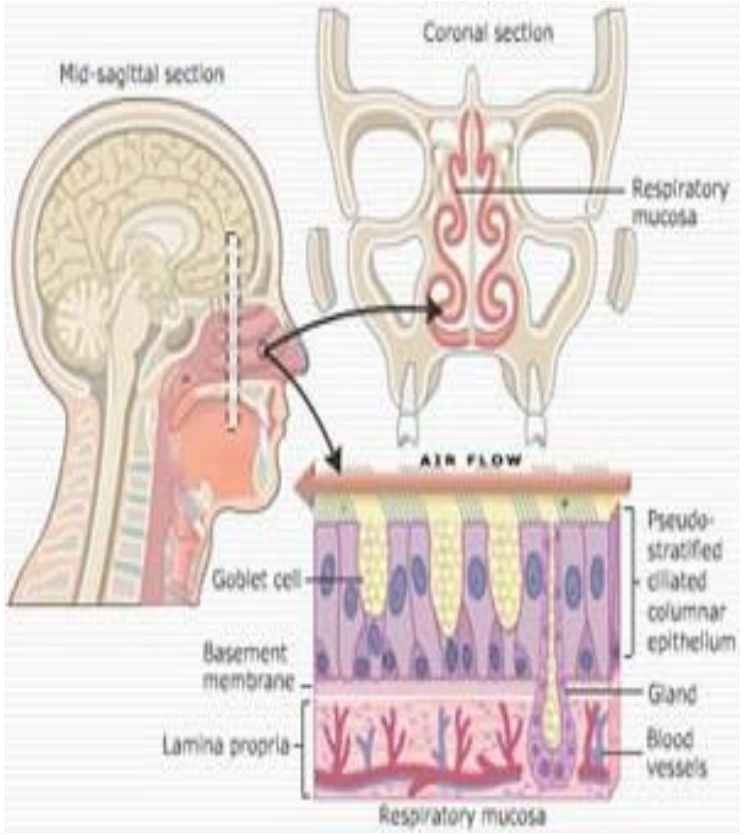
Mucosa

- lined with respiratory mucous membrane
- Except :
- 1. **The vestibule** is lined with modified skin and has coarse hairs
- 2. **Above the superior concha** is lined with **olfactory** mucous membrane and contains **nerve endings**

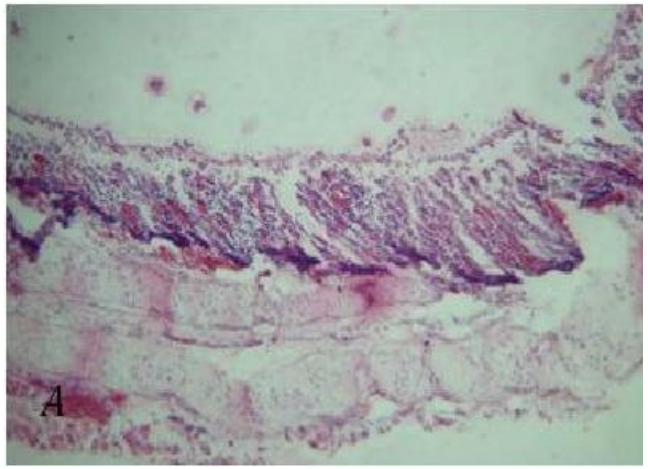


Function of Mucous Membrane

- large plexus of veins in the submucous connective tissue is present in the respiratory region.
- Warm blood in the venous plexuses serves to heat up the inspired air as it enters the respiratory system
- Mucous traps foreign particles and organisms in the inspired air

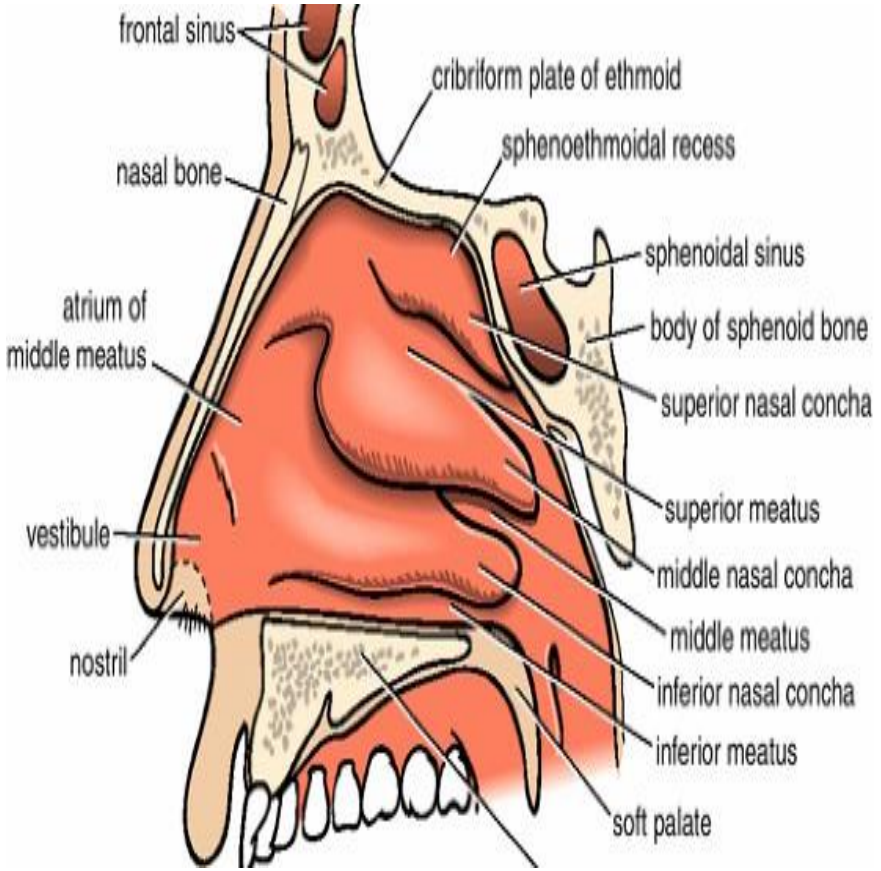


- The lateral wall of the nasal cavity shares structural similarities with the rest of the respiratory tract, being composed of mucosa, submucosa, a supportive layer (cartilage), and connective tissue. However, it is uniquely characterized by a **thick** submucosal layer containing a **venous plexus**, which becomes engorged with blood during normal inflammatory processes. This increased blood flow contributes to nasal congestion (block) when the nose is inflamed, as seen in conditions such as rhinitis (الزكام) where airflow is obstructed, compromising breathing. The lining epithelium of the lateral wall is pseudostratified ciliated columnar epithelium, **except** in the vestibule and olfactory regions, where specialized bipolar cells are present.



Choncae

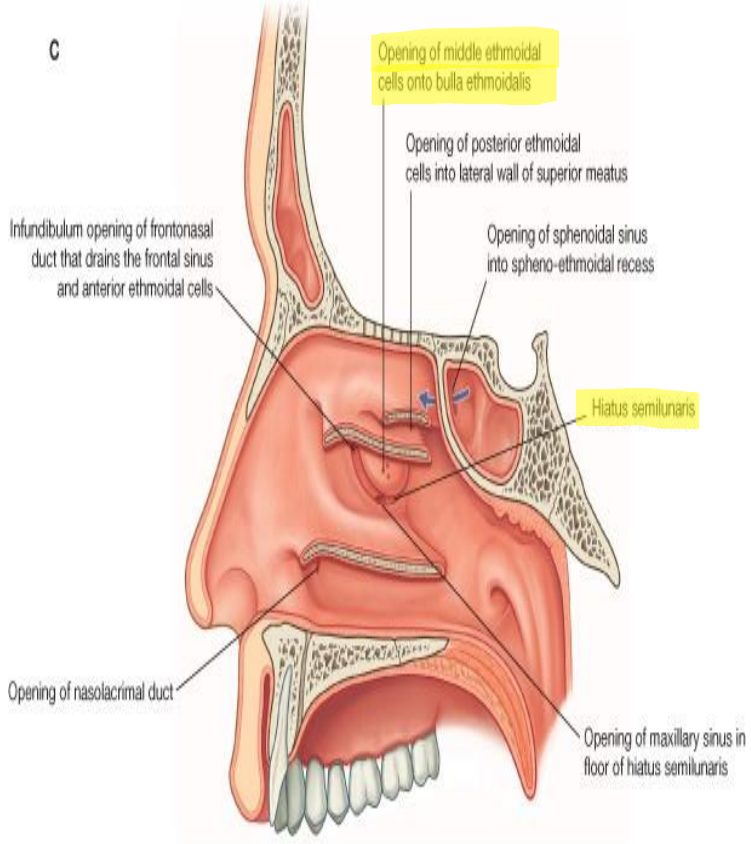
- All Choncae extend medially across the nasal cavity, separating it into four air channels:
- **Inferior**, **Middle**, and **Superior meatus**, and a **Spheno-ethmoidal recess, paranasal sinuses' ducts open into the meatuses of the lateral wall of the nose.**
- Anterior end of each concha curves inferiorly to form a lip that overlies the end of the related meatus



Choncae

- lateral wall of the middle meatus elevates to form the dome-shaped **Ethmoidal bulla**
- Formed by the underlying middle ethmoidal cells, which expand the medial wall of the ethmoidal labyrinth.
- Inferior to the ethmoidal bulla is a curved gutter (the **Hiatus semilunaris, groove-like semicircular structure, which the maxillary air sinus open into and anteriorly, the anterior ethmoidal air sinus opens into it)**
- Formed by the mucosa covering the lateral wall
- Defect in the bony wall between the ethmoidal bulla above and the uncinate process below.

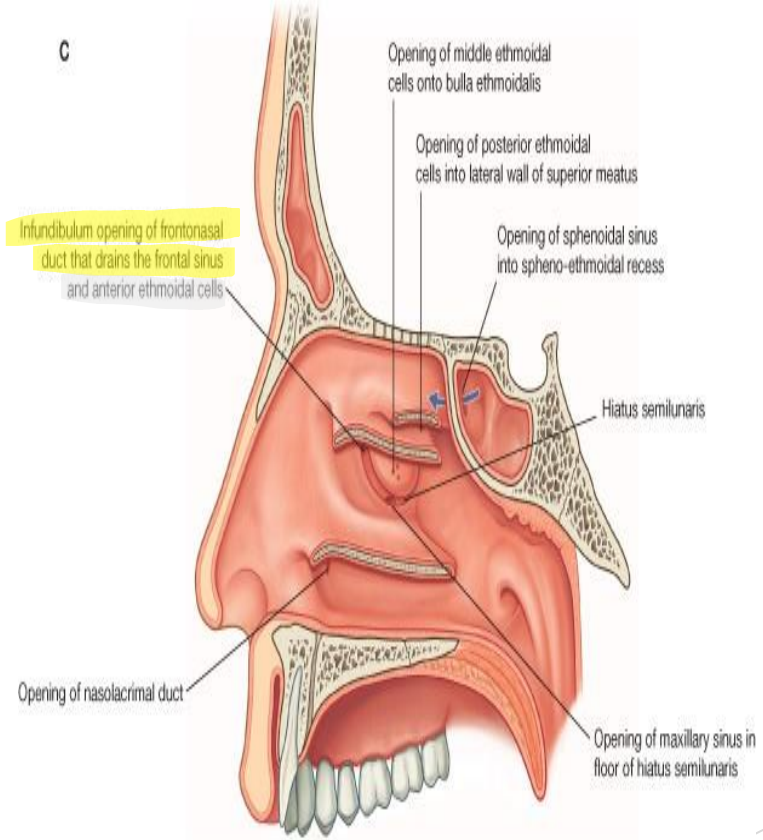
The middle meatus is distinguished by the presence of two anatomical structures. The first is the bulla ethmoidalis, a bulge formed by the ethmoidal bone. The bulla houses the middle ethmoidal sinus, which drains directly into it. Thus, the bulla ethmoidalis both contains the middle ethmoidal sinus and serves as its drainage pathway.



Choncae

- Anterior end of the hiatus semilunaris forms a channel (the **Ethmoidal infundibulum.**
  The anterior end of the hiatus semilunaris forms a channel known as the **Ethmoidal infundibulum**. This small area is located in the middle meatus, anterior to the opening of the anterior ethmoidal air sinus, and serves as the site where the **frontal air sinus opens into it**.

- Curves upwards and continues as the **Frontonasal duct** through the anterior part of the ethmoidal labyrinth to open into the frontal sinus. So, the frontal air sinus sends a frontonasal duct that opens into the infundibulum



Paranasal Sinuses and Their Site of Drainage Into the Nose

- The nasolacrimal duct and most of the paranasal sinuses open onto the lateral wall of the nasal cavity

- **1. Maxillary sinus**
- Middle meatus through hiatus semilunaris

- **2.Frontal sinuses**
- Middle meatus via infundibulum and frontonasal duct

- **3. Sphenoidal sinuses**
- Sphenoethmoidal recess

Paranasal Sinuses and Their Site of Drainage Into the Nose

- **Ethmoidal sinuses**

- 1. Anterior group
- Infundibulum and into middle meatus

- 2. Middle group
- Middle meatus on or above bulla ethmoidalis

- 3.Posterior group
- Superior meatus

- Nasolacrimal duct opens onto the lateral wall of the inferior nasal meatus

- The paranasal sinuses, totaling 12, play a crucial role in the resonance of the nose. The ducts of these sinuses are typically directed downward, facilitating easy drainage. However, the **maxillary sinus** is an exception, as its duct is directed upward. This anatomical feature can lead to poor drainage, causing infections to persist in the sinus.

- When the maxillary sinus becomes infected, complications may arise due to its proximity to the oral cavity, particularly above the last molar. Such complications include the formation of a **fistula (oral-antral fistula)** between the sinus and the oral cavity, which can result in pus draining into the mouth, producing a foul odor. Additionally, aggressive extraction of the last molar by a dentist may inadvertently create a fistula that opens into the maxillary air sinus. These complications are primarily attributed to the poor drainage of the maxillary sinus.

Blood & Nerve Supply of The Nose

- The nose is divided into a **lateral wall** and a **medial wall (septum)**, with distinct blood and nerve supplies for each.
- **2 main sources: Maxillary and Ophthalmic arteries. (Other sources: branches of facial artery)**

- 1. **Maxillary artery** (a branch of the **external carotid artery**, ECA):

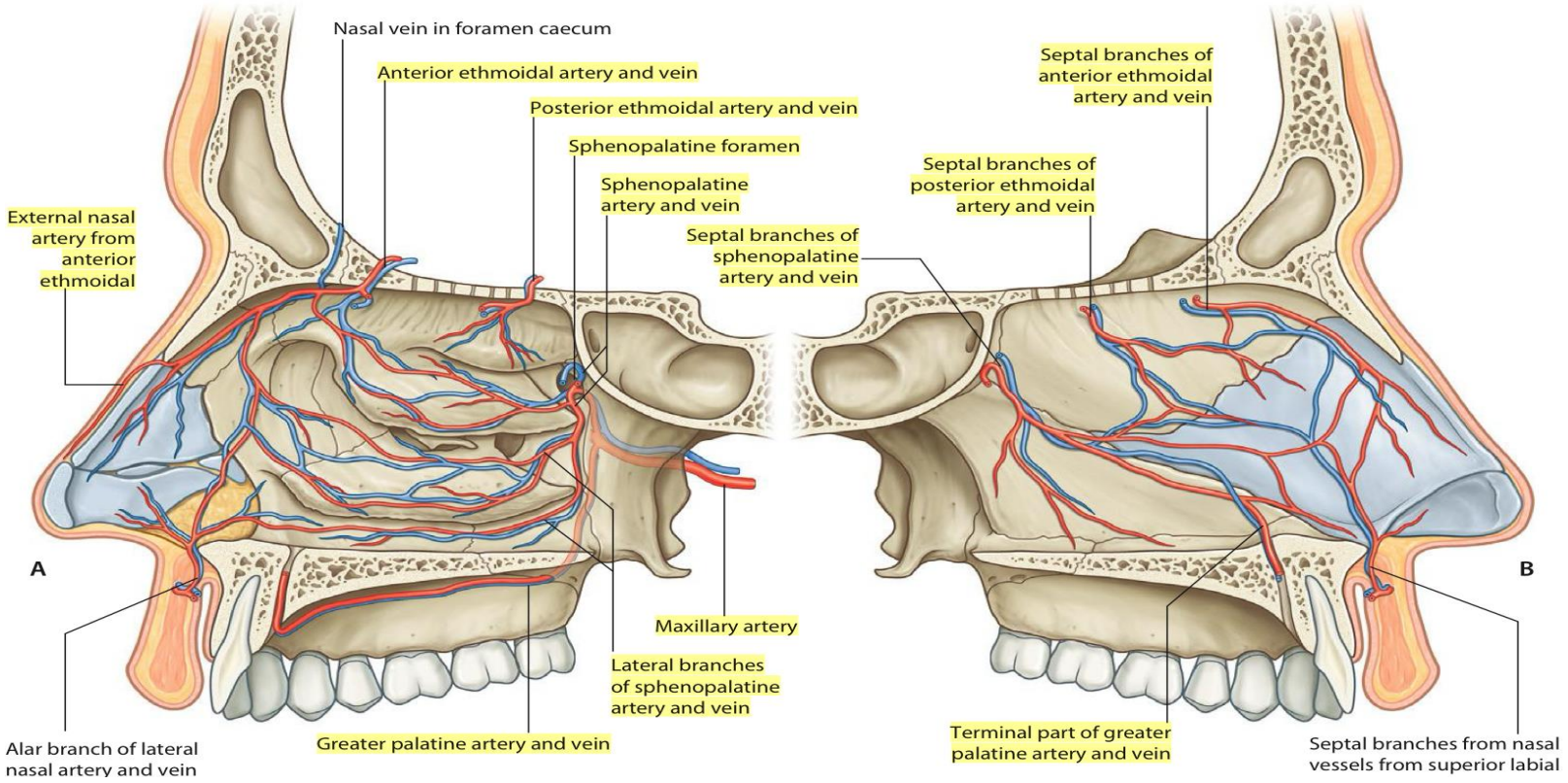
❖ The **sphenopalatine artery** (the largest branch) enters through the **sphenopalatine foramen** and divides into:

- **Long sphenopalatine artery**: Supplies the **septum**.
- **Short sphenopalatine artery**: Supplies the **lateral wall**.

❖ The **palatine artery** (another branch of the maxillary artery) travels through the **palatine canal, reaches the roof of the oral cavity** and divides into:

- **Greater palatine artery**: Supplies the **hard palate** and passes through the **incisive foramen** to reach the **inferior part of the lateral wall**.
- **Lesser palatine arteries**: Supply the **soft palate**.

- 2. **Ophthalmic artery** (a branch of the **internal carotid artery**, ICA):
  - **Anterior ethmoidal artery**: Supplies the lateral wall and septum anteriorly and ends as the **external nasal artery**.
  - **Posterior ethmoidal artery**: Supplies the **posterior part of the lateral wall** and air sinuses.



- The **superior labial artery** (a branch of the **facial artery**) provides nasal branches to the **septum** and contributes to the blood supply of the nasal cavity, along with the **lateral nasal artery**.

- **Epistaxis** refers to bleeding from the nose, commonly seen in children, especially following trauma. Bleeding often originates from the **septum** at **Kiesselbach's area**, a vascular region where 3 or 4 arteries anastomose. This area lies between the **upper two-thirds** and **lower one-third** of the nasal septum.

- The main arteries responsible for bleeding in this region are:

1. **Nasopalatine artery** (a septal branch of the **long sphenopalatine artery**, a branch of the **maxillary artery**).

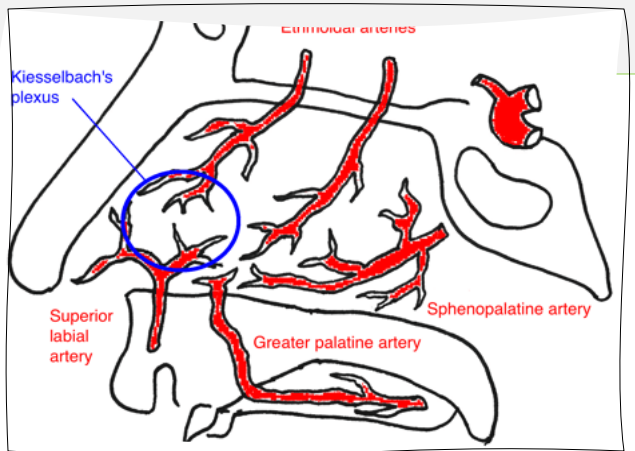
2. **Superior labial artery** (a branch of the **facial artery**), which provides a **septal branch**.

- **Management of Epistaxis**

• The patient should **not** be placed in a **supine position**; instead, they should sit upright.

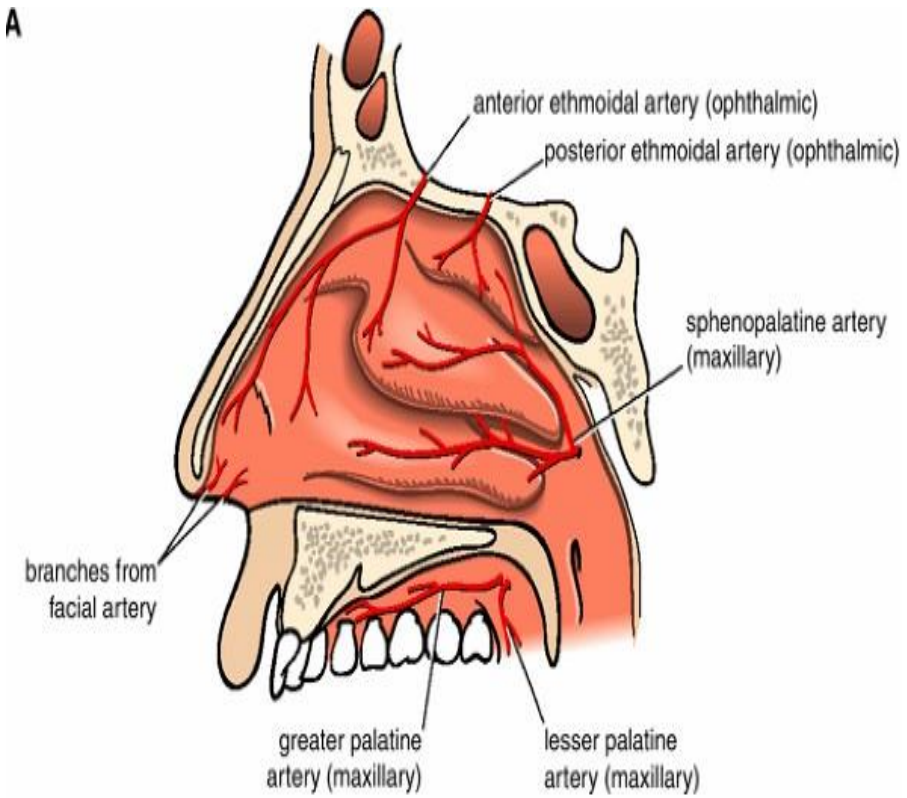
• Initial treatment involves inserting a material into the **vestibule** of the nose to block the bleeding artery.

• If this approach fails, **cauterization "كي"** (using electrical or chemical methods such as **silver nitrate**) may be performed to stop the bleeding.



Blood Supply

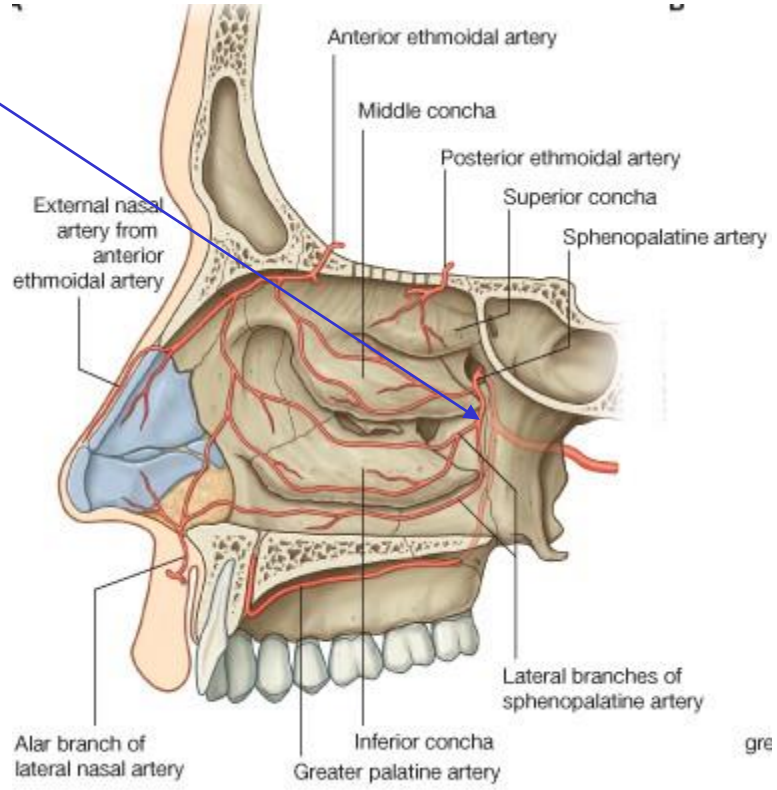
- **Sphenopalatine artery**
- largest vessel supplying the nasal cavity
- Terminal branch of the maxillary artery in the pterygopalatine fossa
- Enters the nasal cavity by passing medially through the sphenopalatine foramen



Branches

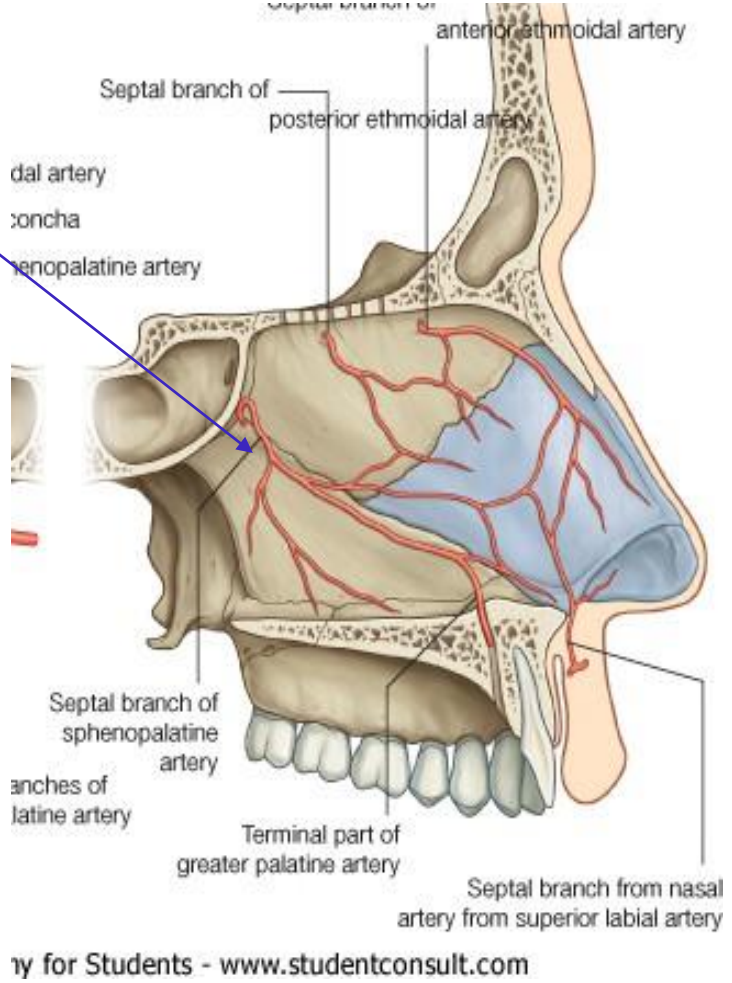
- **1. Posterior lateral nasal branches**
- Short sphenopalatine artery

- supply a large part of the lateral wall (post.superior quadrant)



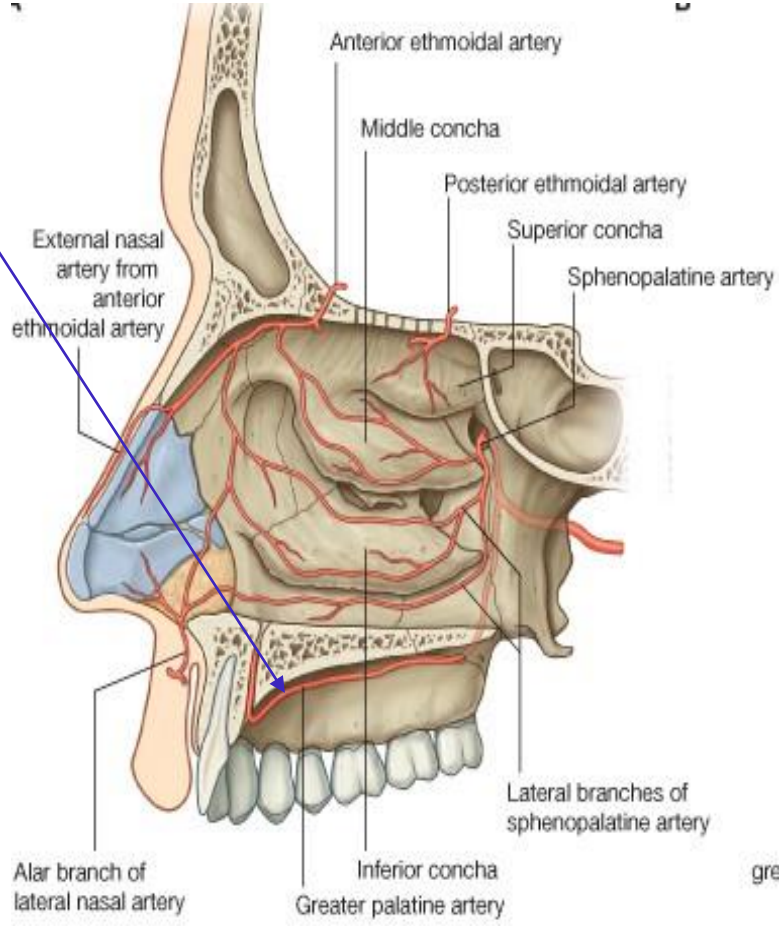
Branches

- **2.. Posterior septal branches**
- Long sphenopalatine
- pass over the roof of the cavity and onto the nasal septum
- contribute to the blood supply of the medial wall



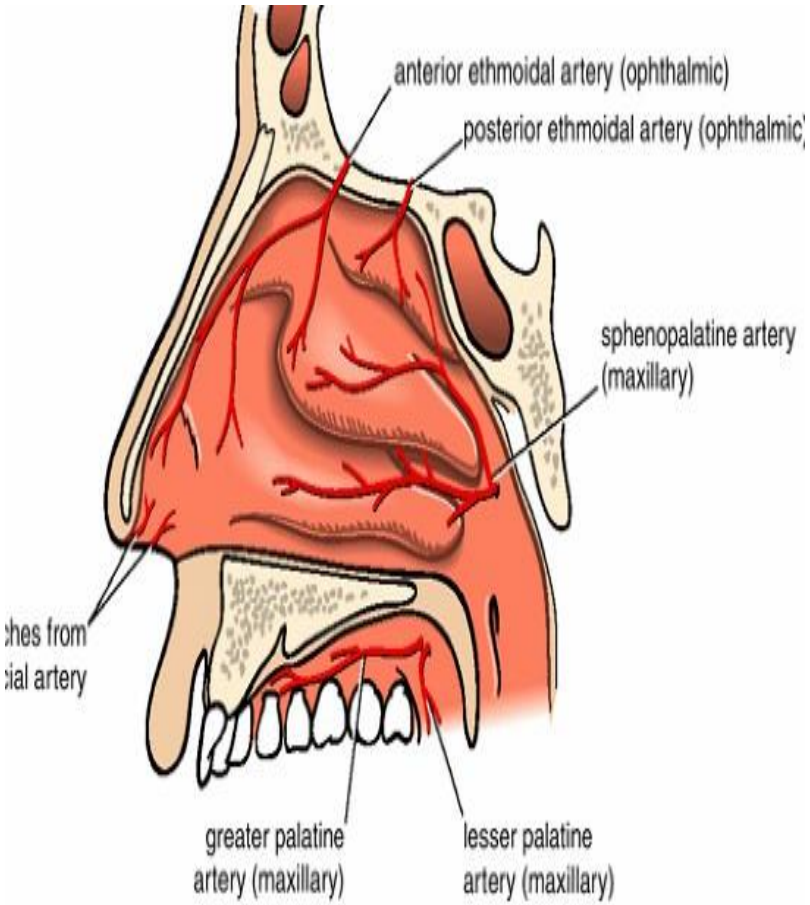
Greater palatine artery

- **Greater palatine artery**
- Arises in the pterygopalatine fossa as a branch of the maxillary artery
- Enters the nasal cavity by passing up through the **incisive canal**
- Supplies the anterior regions of the medial wall and adjacent floor **(posterio and anterio-inferior quadrant)**



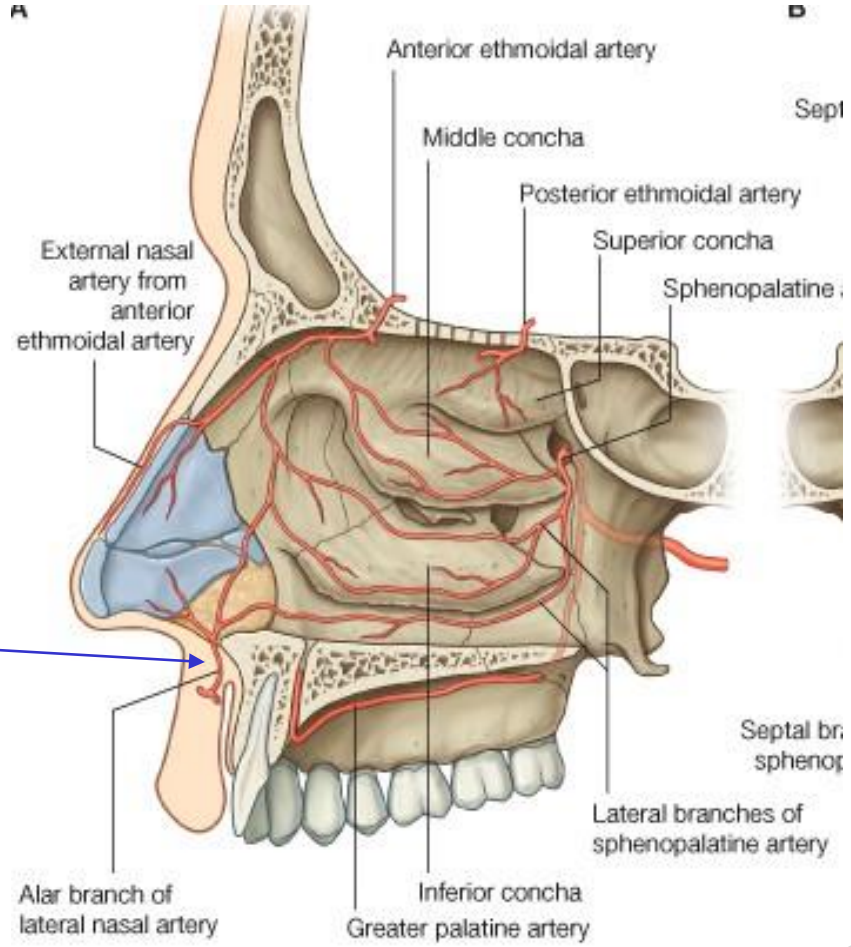
Anterior and posterior ethmoidal arteries

- Originate in the orbit from the ophthalmic artery
- The **anterior ethmoidal artery** accompanies the anterior ethmoidal nerve
- Descending through a slit-like foramen lateral to the crista galli
- Supply the medial (septal) and lateral wall of the nasal cavity **(anterior- superior quadrant)**
- The **posterior ethmoidal artery** descends into the nasal cavity through the **cribriform plate** and has branches to the upper parts of the medial and lateral walls.



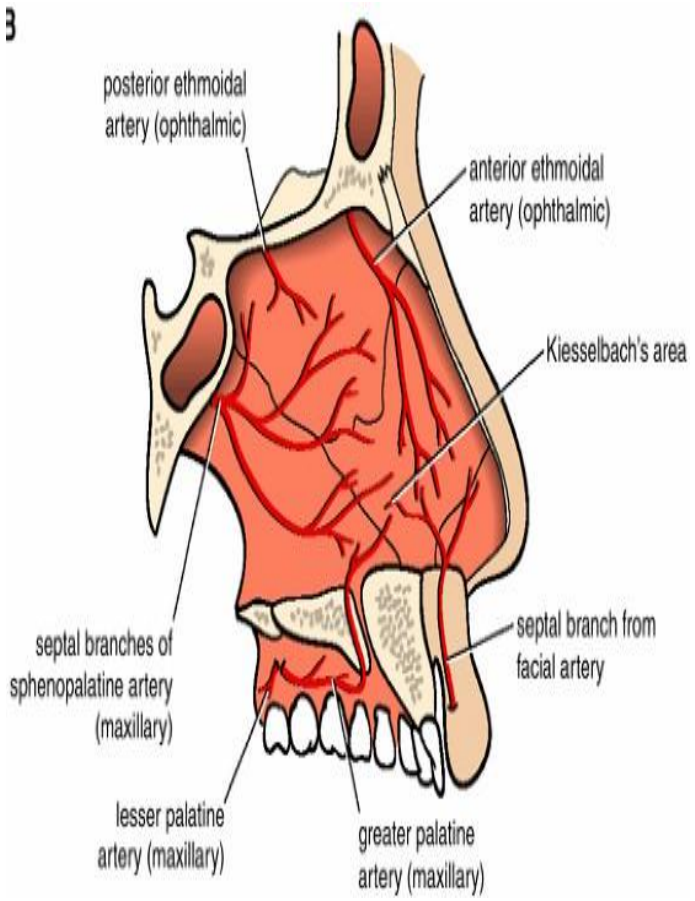
Superior labial and lateral nasal arteries

- Originate from the facial artery on the front of the face
- **Superior labial** gives an **alar** branch supplies the region around the naris and a **septal** branch supplies anterior regions of the nasal septum.
- **lateral nasal** arteries supply blood of the external nose
- **Alar** branches pass around the lateral margin of the naris and supply the nasal vestibule.

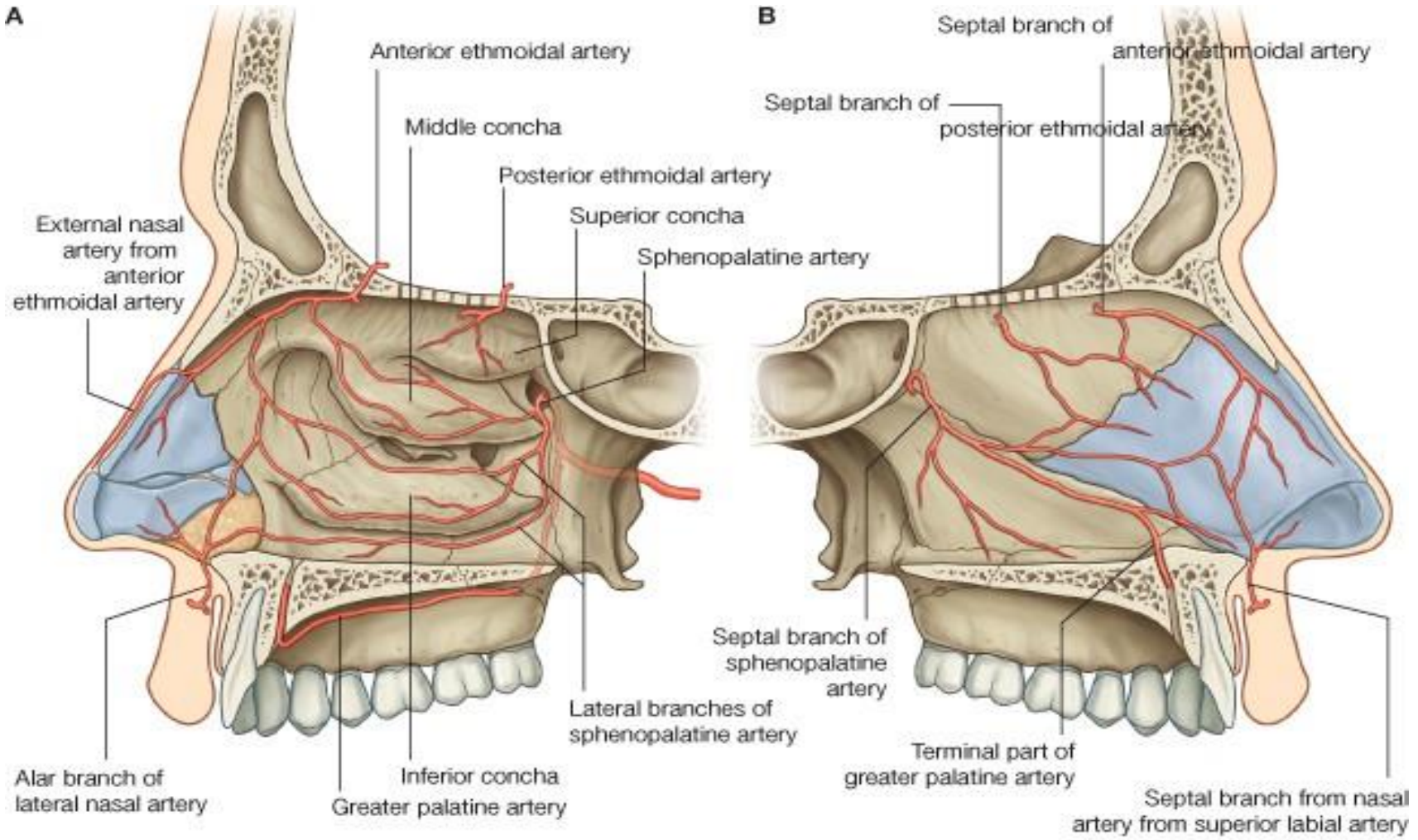


Epistaxis

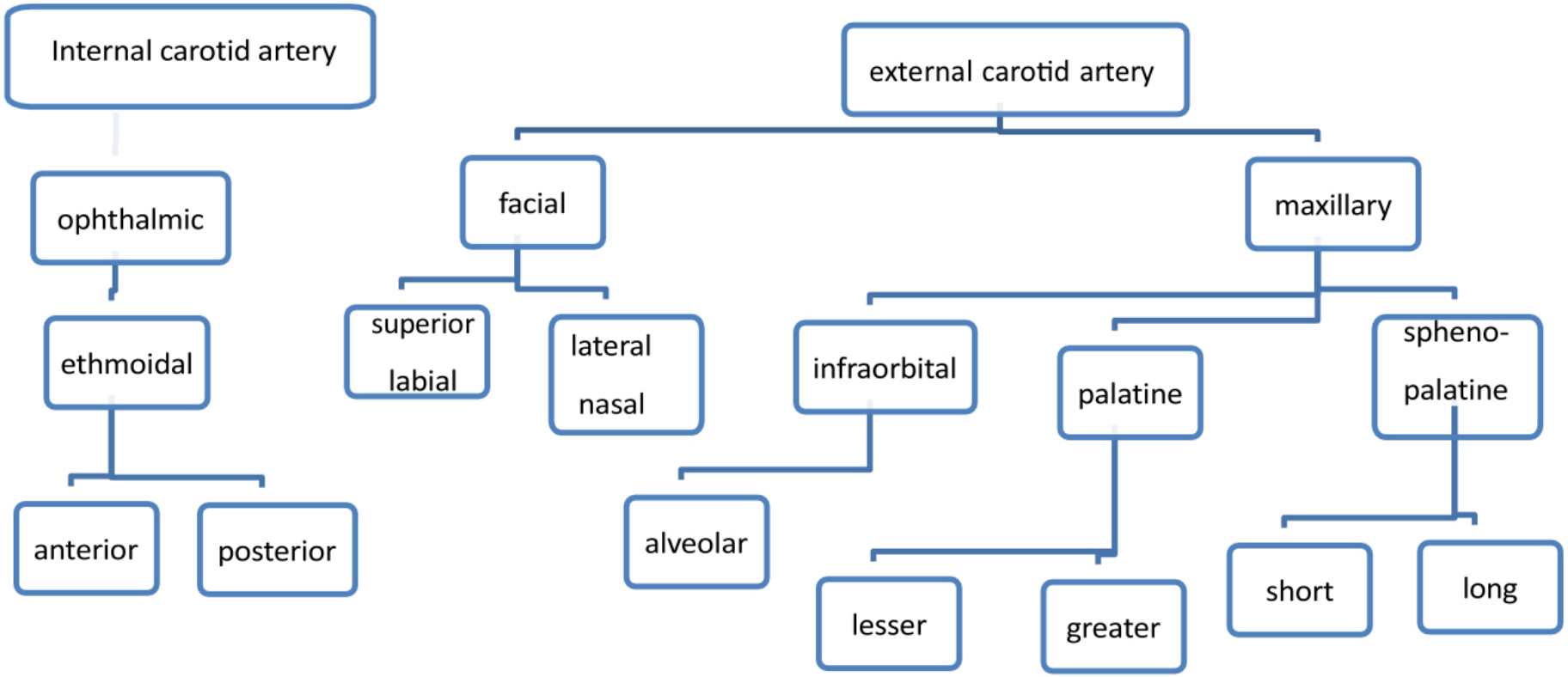
- Vessels that supply the nasal cavities form extensive anastomoses with each other
- in the anterior region of the medial wall there are anastomoses relatively close to the surface **(Kiesselbach's area)**
- This area is the major site of 'nose bleeds' or epistasxis.



Blood Supply



Mindmap by Dr020

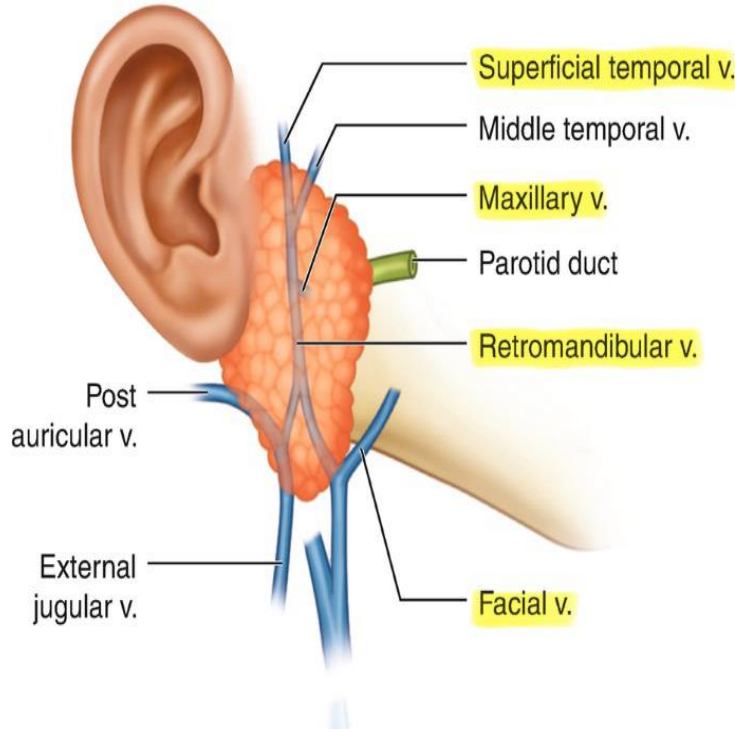


Venous Drainage of the Nose

1. **Anterior Drainage**:
• The **facial vein** receives blood from the anterior part of the nose.
• It subsequently drains into the **internal jugular vein**.

2. **Posterior and Upper Drainage**:
• Blood from the posterior and upper parts of the nose drains into the **pterygoid venous plexus**, which is located around the **lateral pterygoid muscle**.
• From the pterygoid plexus, the blood flows into the **maxillary vein**.

3. **Pathway of the Maxillary Vein**:
• The **maxillary vein** travels toward the **parotid gland**, where it joins with the **superficial temporal vein** to form the **retromandibular vein**.

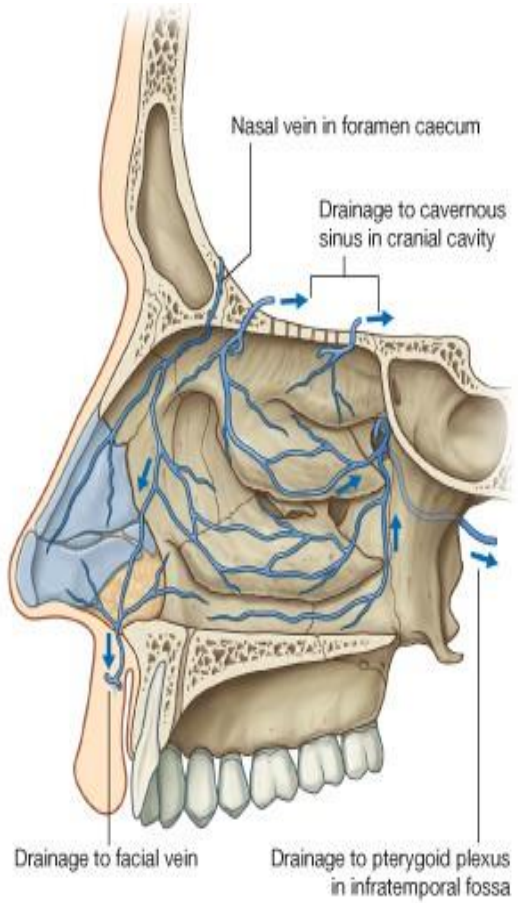


Summary

• **Anteriorly**: Facial vein → Internal jugular vein.
• **Posteriorly/Upper parts**: Pterygoid venous plexus → Maxillary vein → Parotid gland → Superficial temporal vein → Retromandibular vein.

Veins

- Veins draining the nasal cavities generally follow the arteries
- veins that pass with branches originate from the maxillary artery drain into the pterygoid plexus
- veins from anterior regions of the nasal cavities join the facial vein.



Lymphatics

- Lymph from anterior regions drains onto the face by passing around the margins of the nares

- These lymphatics connect with the **submandibular nodes**

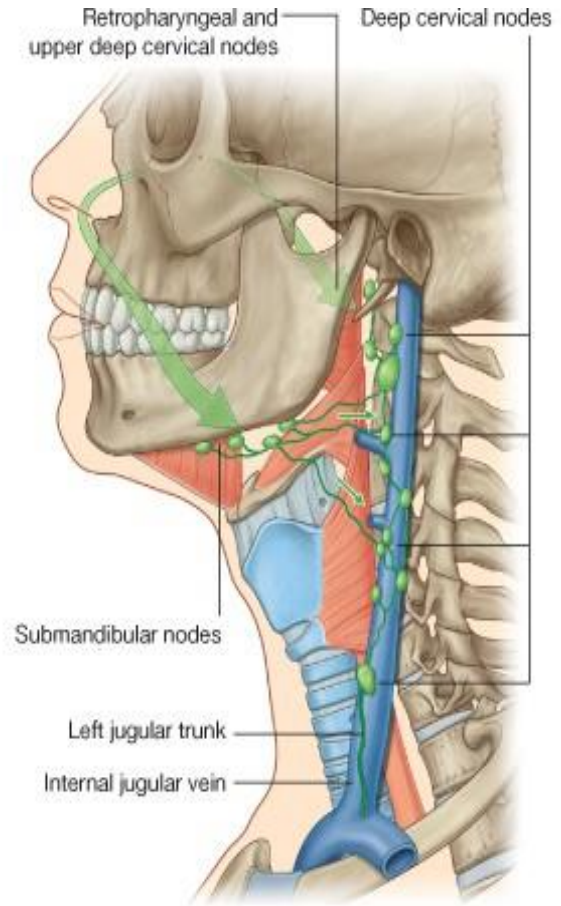
▶ The **lymphatic drainage** of the nose is divided based on anatomical location:

▶ 1. **Midline structures** (e.g., the **tip of the nose**):

• These drain into the **submental lymph nodes**.

▶ 2. **Other parts** of the nose:

• These drain into the **submandibular lymph nodes**.



The **nerve supply of the nose** can be categorized into three types:

1. Special Sensation (Smell)

- The **olfactory region** contains **bipolar cells** that give rise to filaments of the **olfactory nerve (CN I)**.
- These nerve filaments pass to reach the **olfactory bulb**.
- From the olfactory bulb, signals are transmitted through the olfactory tract to the **olfactory center** in the brain, where all smell sensations are processed.

2. General Sensation (Pain, Inflammation)

- General sensory innervation to the nose is provided by branches of the **ophthalmic nerve (V1)** and the **maxillary nerve (V2)**:
- **Ophthalmic nerve (V1)** and **Maxillary nerve (V2)**: through the **nasopalatine nerve that supplies the septum**
- The distribution of sensory nerves corresponds closely to the blood supply, with the **nasopalatine nerve** aligning with the long sphenopalatine artery.

3. Parasympathetic (Secretomotor) Supply

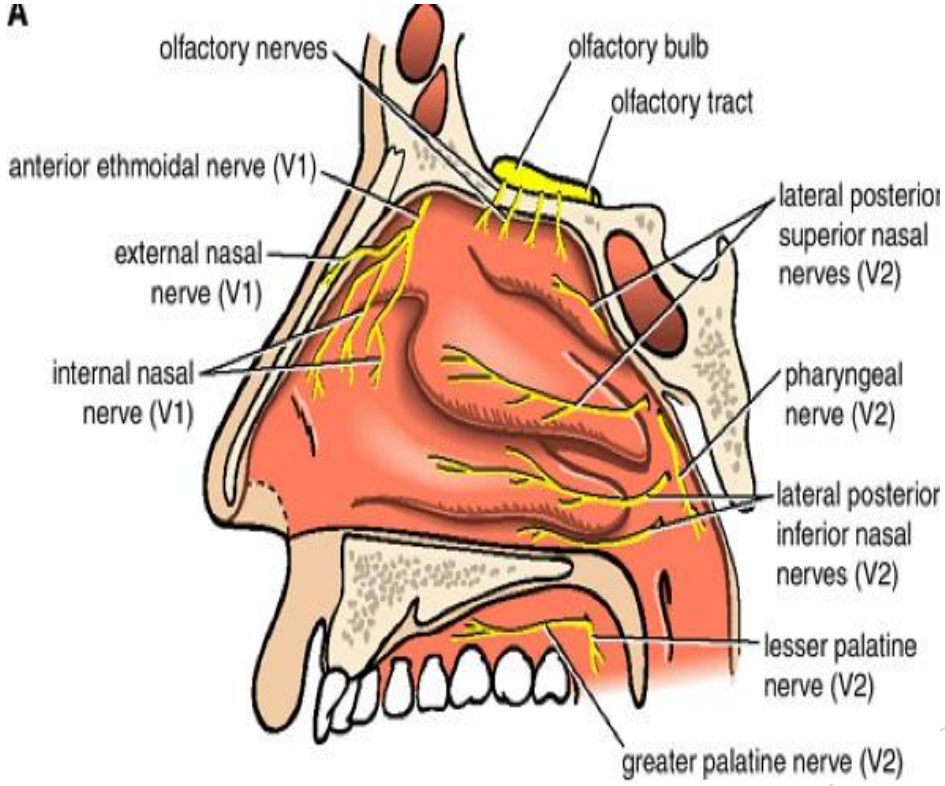
- The **parasympathetic innervation** to the **submucosal glands** of the nasal cavity comes from the **facial nerve (CN VII)**.
- The pathway involves the **greater petrosal nerve**, a branch of the facial nerve, which provides secretomotor control to the submucosal glands.

Innervation

- 1. The olfactory nerve [I] for olfaction
- 2. Branches of the ophthalmic [V1] and maxillary [V2] nerves for general sensation
- 3. Parasympathetic fibers from the facial nerve [VII], Secretomotor innervations of mucous glands

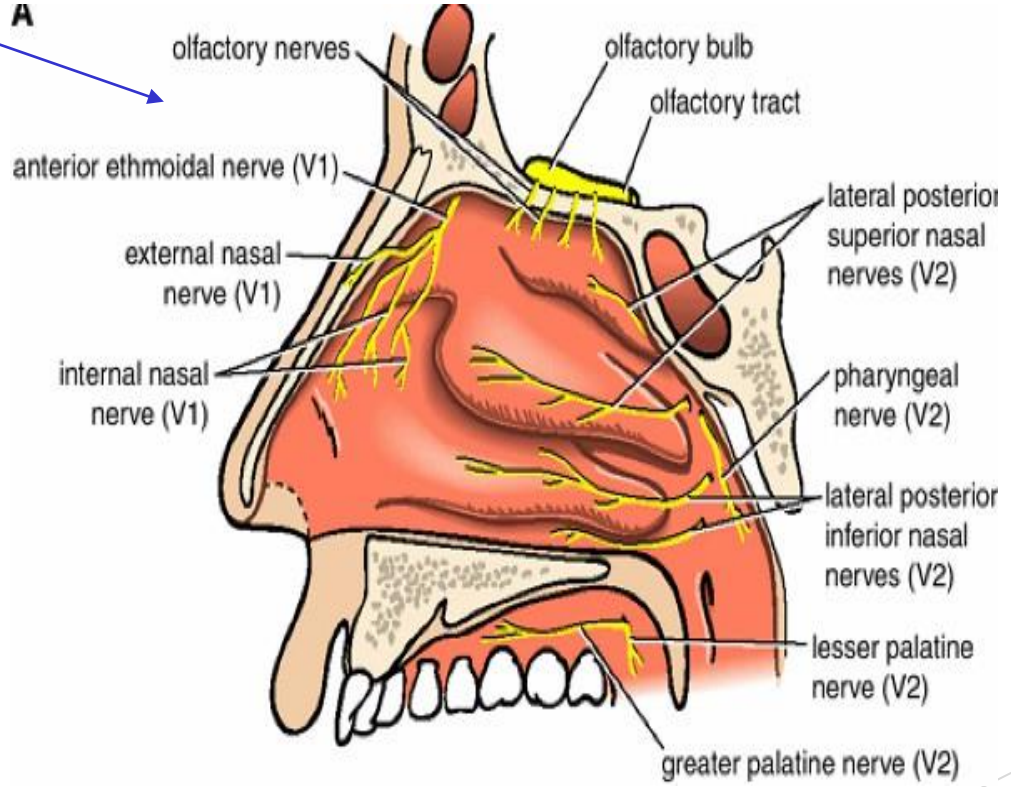
Olfactory nerve [I]

- Composed of axons from receptors in the olfactory epithelium at the top of each nasal cavity
- Pass superiorly through the cribriform plate to synapse with the olfactory bulb of the brain.
- Branches that innervate the nasal cavity:
- **anterior and posterior ethmoidal nerves**, which originate from the nasociliary nerve in the orbit.



Anterior and Posterior ethmoidal nerves

- The **anterior ethmoidal nerve** travels with the anterior ethmoidal artery (the correspondence mentioned earlier)
- It has branches to the medial and lateral wall of the nasal cavity and continues forward on the undersurface of the nasal bone
- onto the external surface of the nose by traveling between the nasal bone and lateral nasal cartilage, terminates as the **external nasal nerve**



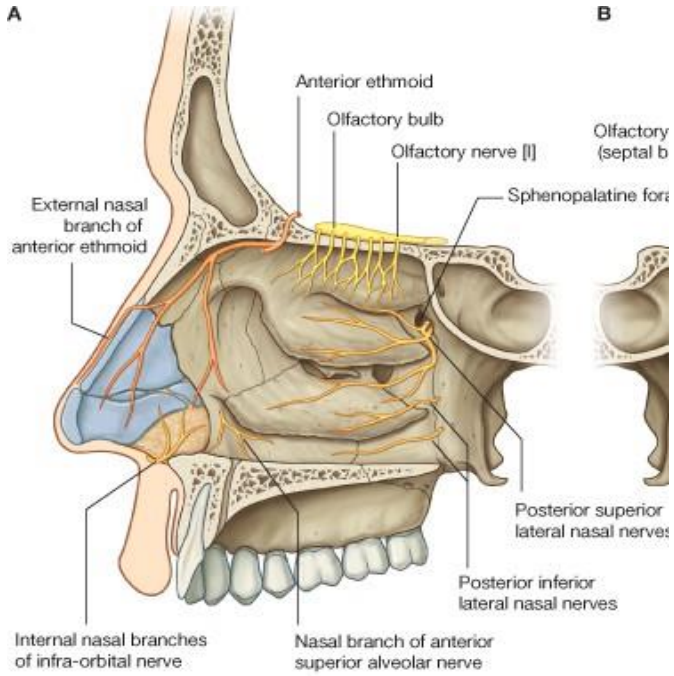
- **Posterior ethmoidal nerve (mainly to the air sinuses)**
- leaves the orbit through a similar canal in the medial wall of the orbit
- Terminates by supplying the mucosa of the ethmoidal cells and sphenoidal sinus
- Normally does not extend into the nasal cavity itself.

Branches from the maxillary nerve [V2]

The same as the arterial organization

Sphenopalatine nerve divides into: 1. long sphenopalatine (nasopalatine) nerve
2. short sphenopalatine nerve

- originate in the pterygopalatine fossa just lateral to the lateral wall of the nasal cavity
- leave the fossa to enter the nasal cavity by passing medially through the **sphenopalatine foramen**
- **1. Posterior superior lateral nasal nerves** pass forward on and supply the lateral wall of the nasal cavity;
- **2. Posterior inferior nasal nerves** originate from the greater palatine nerve, innervate the lateral wall of the nasal cavity
- 3. **Anterior superior alveolar** branch of the infra-orbital nerve supply the lateral wall near the anterior end of the inferior concha.

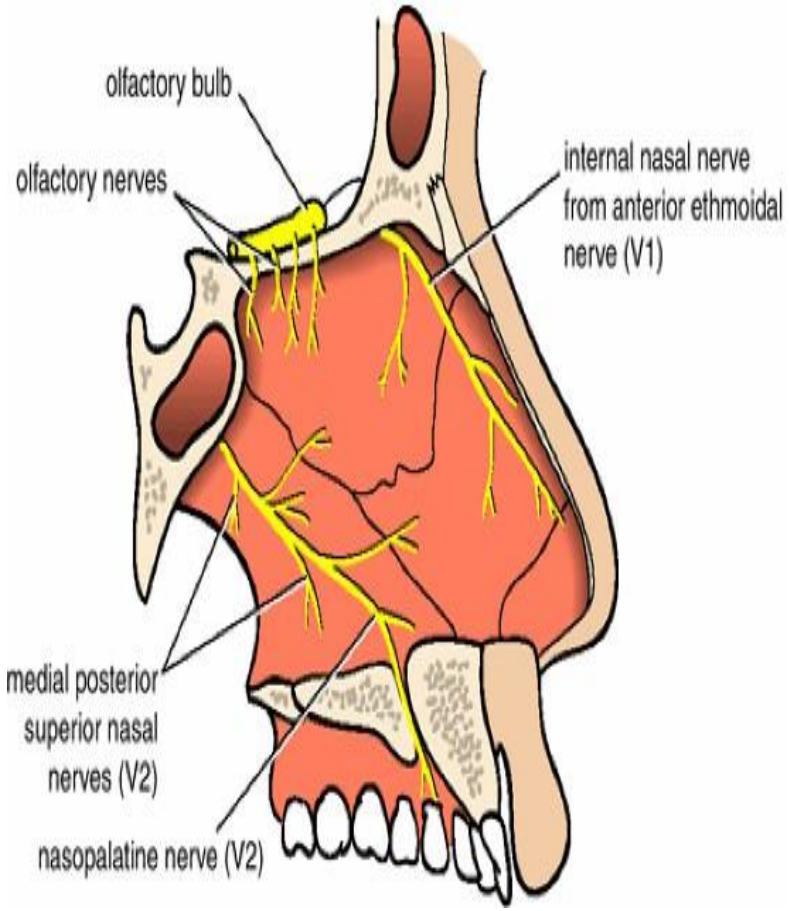


Both the greater and lesser palatine nerves originate from the **pterygopalatine ganglion**, receiving sensory fibers from the **maxillary nerve (V2)**

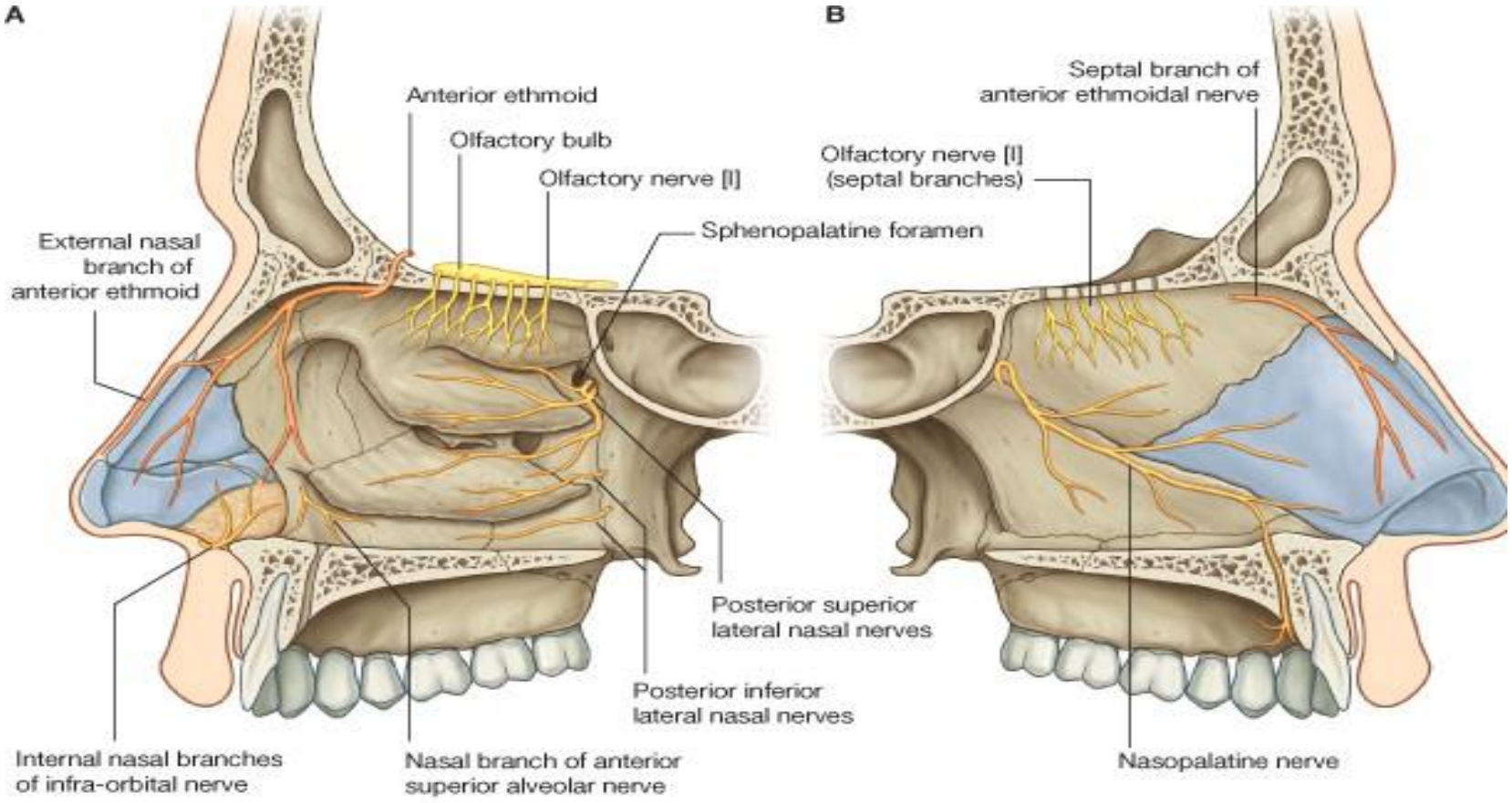
Branches from the maxillary nerve [V2]

- 4. Largest of these nerves is the **nasopalatine nerve,** pass through the incisive canal onto the roof of the oral cavity, and terminates by supplying the oral mucosa posterior to the incisor teeth

- **5. Posterior superior medial** nasal nerves cross the roof to the nasal septum and supply both these regions



Innervation



Summary for blood supply and innervations

- **1. Postero-superior quadrant:**
- Posterior-superior lateral nerve and vessels (short spheno palatine)

- **2. Postero-inferior quadrant**:
- Greater palatine nerve and vessels

- **3. Antero-superior quadrant :**
- Ant. Ethmoidal nerve (internal and external nerve) and artery

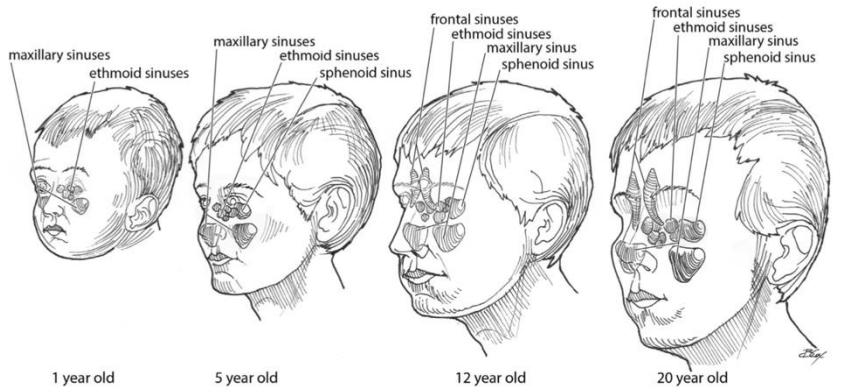
- **4. Antero-inferior quadrant :**
- Ant. Superior alveolar nerve and branches from the facial and greater palatine artery

- **5. Nasal septum:**
- Lower posterior part by the long sphenopalatine nerve
- Upper anterior part by the septal branch of the anterior ethmoidal nerve.
- Blood supply by the long sphenopalatine artery.

Paranasal sinuses

As we mentioned, paranasal sinuses are air-filled cavities inside specific bones of the skull, which include the frontal, maxillary, ethmoidal and sphenoidal bones

All of them are rudimentary at birth. However, with the growth of the bones of the skull, they progressively enlarge.

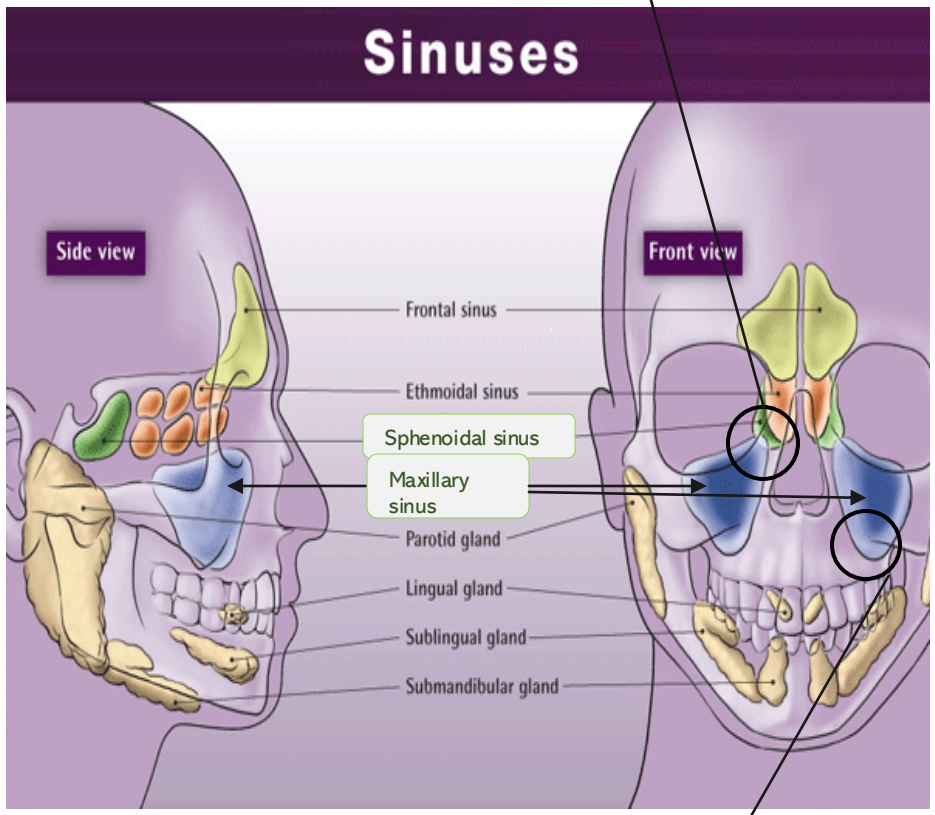


Paranasal sinuses

- There are four paranasal air sinuses-the **ethmoidal cells, and the sphenoidal, maxillary, and frontal sinuses**

- All are:
- lined by respiratory mucosa, which is ciliated and mucus secreting;
- open into the nasal cavities;
- innervated by branches of the trigeminal nerve [V].

The duct opens here, upward at the apex on the lateral wall, that's why it has a bad drainage



The base

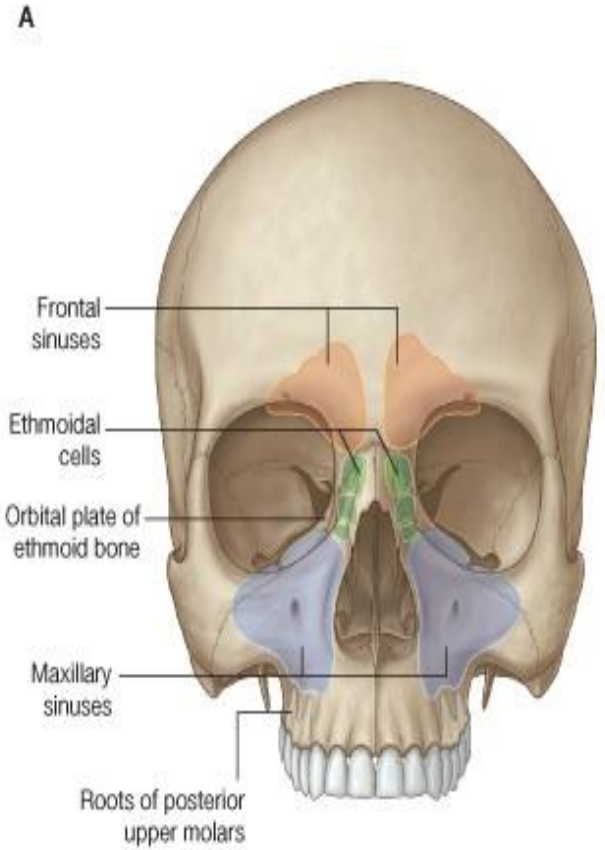
Paranasal sinuses

- Functions:
- 1. Resnonance of the voice
- 2. Decrease the weight of the skull
- 3. Protection

Frontal sinuses

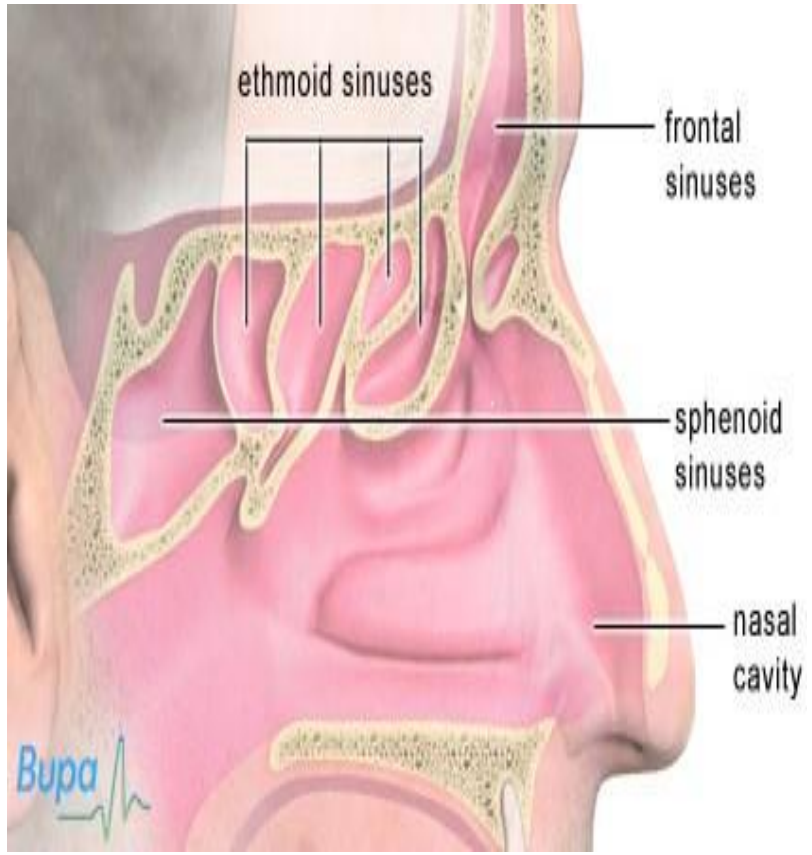
Located upwards, medial to the orbit.

- One on each side, seperated by a septum
- Triangular (or pyramidal) in shape and is in the part of the frontal bone under the forehead
- Drains onto the lateral wall of the middle meatus via the frontonasal duct, which continues as the ethmoidal infundibulum (good drainage, from upward it drains downwards, opens into the infundibulum of middle meatus)
- Innervated by branches of the supra-orbital nerve from the ophthalmic nerve



Ethmoidal cells

- Each cluster of cells is separated from the orbit by the thin orbital plate of the ethmoidal labyrinth
- Divided into **anterior, middle, and posterior** ethmoidal cells
- The anterior ethmoidal cells open into the ethmoidal infundibulum or the frontonasal duct;
- The middle ethmoidal cells open onto the ethmoidal bulla
- The posterior ethmoidal cells open onto the lateral wall of the superior nasal meatus.
- Iinnervated by the **anterior** and **posterior ethmoidal branches** of the nasociliary nerve from the ophthalmic nerve

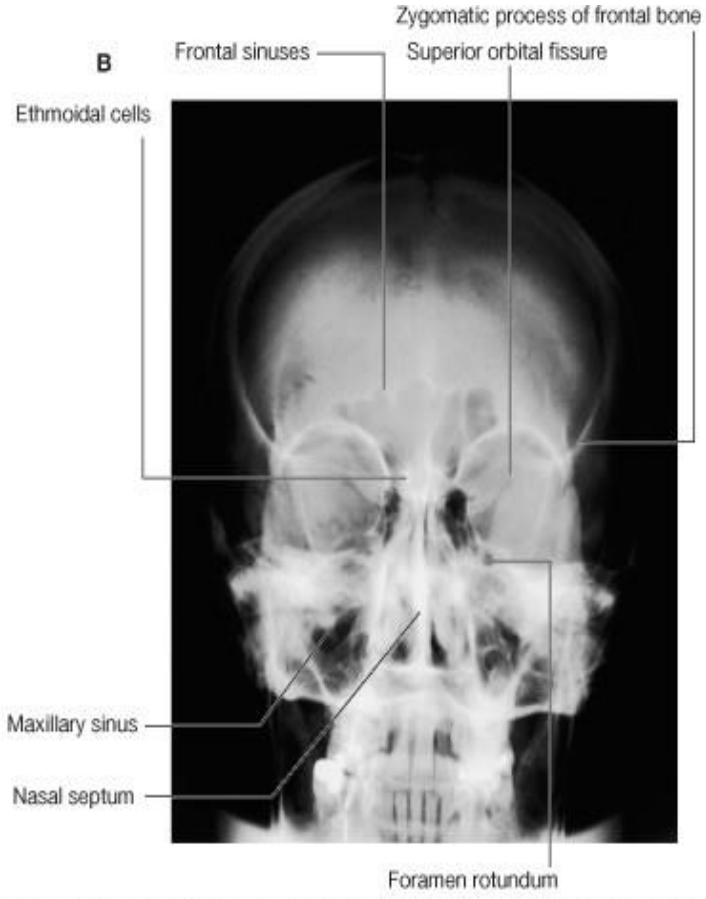


The **6 ethmoidal sinuses** resemble small air cells and are categorized as follows:

1. **2 Anterior Ethmoidal Sinuses**:
   - Located in the **hiatus semilunaris**.
   - They open into the **anterior part of the hiatus semilunaris**.
2. **2 Middle Ethmoidal Sinuses**:
   - Located in the **bulla ethmoidalis**.
   - They open into the **bulla** within the **middle meatus**.

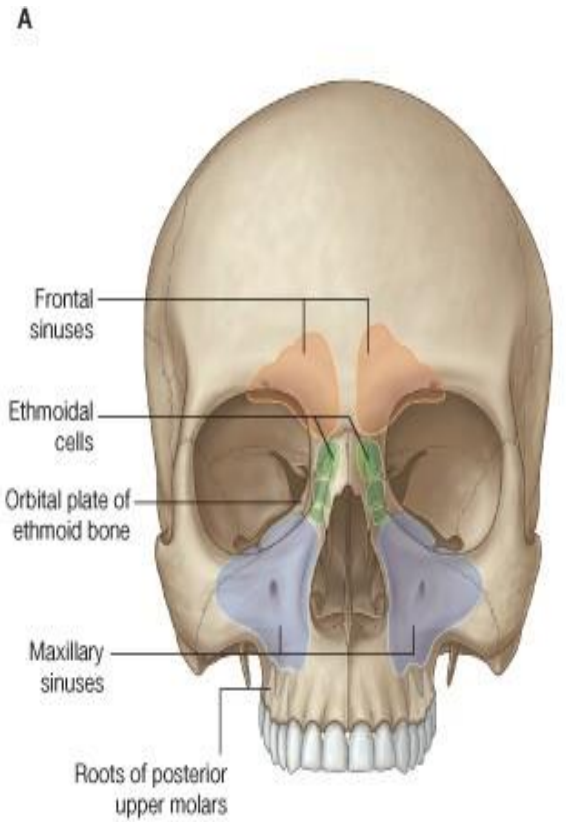
Maxillary sinuses

- The largest of the paranasal sinuses and completely fill the bodies of the maxillae
- Pyramidal in shape
- Apex directed laterally
- Base deep to the lateral wall of the adjacent nasal cavity
- Innervated by infra-orbital and alveolar branches of the maxillary nerve
- Drains in Middle meatus through hiatus semilunaris (Bad drainage)
- **Clinical note** : Extraction of upper teeth might lead to **fistula** formation (related to the last 3 molars) and sinusitis



Maxillary sinuses

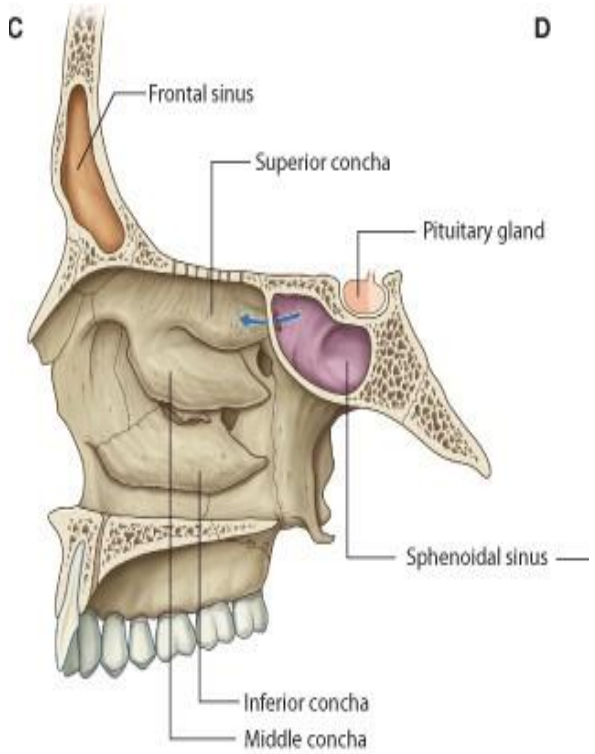
- Relationships of the maxillary sinus :
- Related above to the orbit
- Related below to the roots of the upper molar and premolar teeth
- Related behind to the infratemporal fossa
- Related medially to the lower part of the nasal cavity



Sphenoidal sinuses

- Within the body of the sphenoid
- Open into the roof of the nasal cavity on the wall of the spheno-ethmoidal recess
- Innervation :
- the posterior ethmoidal branch of the ophthalmic nerve [V1];
- the maxillary nerve [V2] via orbital branches
- Relations:
- Above to the pituitary gland and to the optic chiasm (the pituitary gland can be surgically approached)
- Laterally to the cavernous sinuses;
- Below and in front, to the nasal cavities.

Dr advised to revise the Contents of cavernous sinus: ICA, abducens nerve. On the lateral wall: occulomotor, trochlear, ophthalmic and maxillary nerves.



- Within the body of the sphenoid bone, the **sphenoidal sinus** is located. Superior to this sinus lies the **sella turcica**, which houses the **pituitary gland**.
- If an **invasive tumor** originates in the pituitary gland and grows downward, it can erode the body of the sphenoid bone, causing **enlargement** of the sphenoidal sinus. On **X-ray imaging**, this would appear as the **sella turcica invading the air sinuses**.

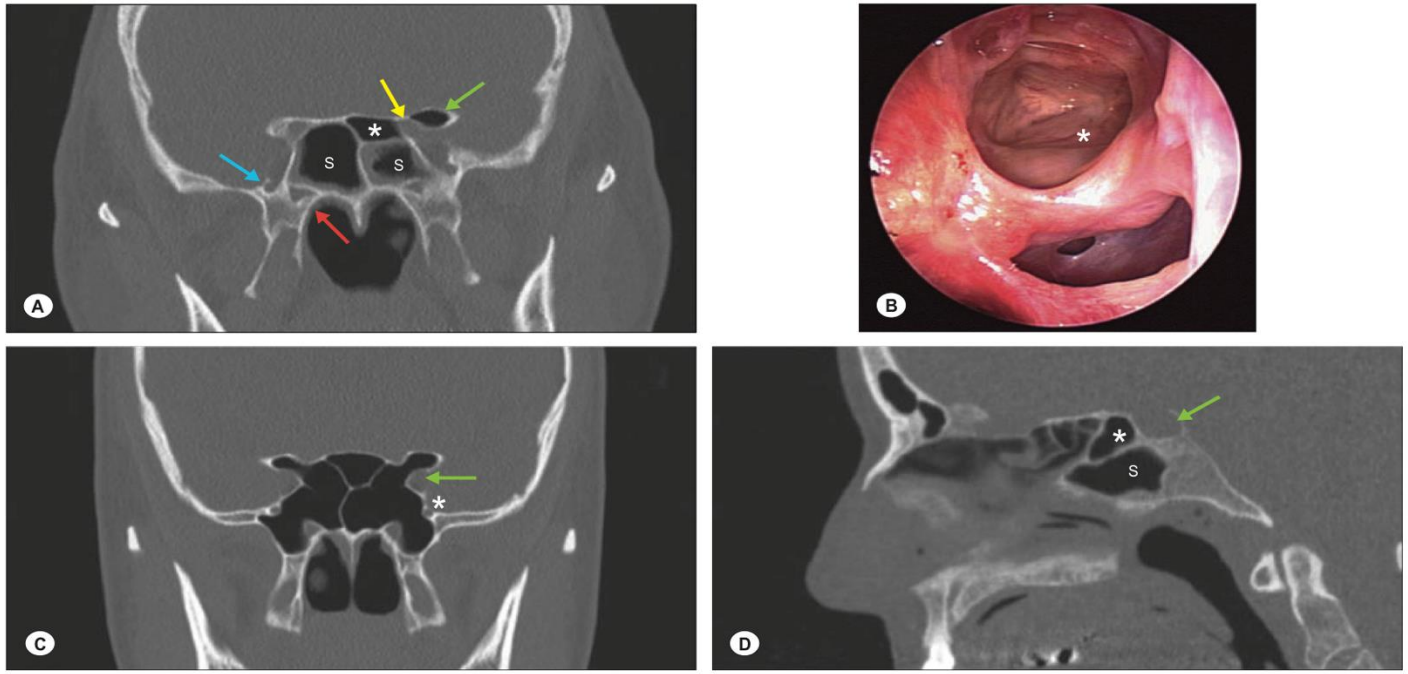


Fig. 39.20 **A**, A coronal CT demonstrating a normal right-sided sphenoidal sinus and a small left-sided sphenoidal sinus (S). The left sphenoethmoidal cell is also shown (asterisk). Pneumatization of the left anterior clinoid process (green arrow) means that the optic nerve (yellow arrow) lies exposed within the sphenoethmoidal cell. The foramen rotundum (blue arrow) and pterygoid (Vidian) canal (red arrow) can also be seen. **B**, An endoscopic view of a right Onodi cell; the optic nerve is visible in the posterolateral wall of the cell (asterisk). **C**, A coronal CT demonstrating well-pneumatized sphenoidal sinuses. The foramen rotundum (asterisk) and internal carotid artery (arrow) are also shown. **D**, A sagittal CT demonstrating the sphenoidal sinus (S), pituitary fossa (arrow) and posterior sphenoethmoidal cell (asterisk).

Additional, in case you are interested

Additional sources

1. Gray's atlas of anatomy
2. High-Yield gross anatomy

We highly recommend Mohamed Nour's (vagus) youtube playlists on nasal cavity blood supply and nasal nerve supply.

VERSIONS	SLIDE #	BEFORE CORRECTION	AFTER CORRECTION
V1→ V2	39	Inferior part of nasal septum	inferior part of the lateral wall
V2→V3	6	thin	short

امسح الرمز و شاركنا بأفكارك لتحسين أدائنا !!