

# MBB Lab 7: PowerPoint Handout

## Upper GI and Upper Respiratory Tracts

Review "The Basics" and "The Details" for the following cranial nerves in the Cranial Nerve PowerPoint Handout.

- Glossopharyngeal nerve (CN IX)
- Vagus nerve (CN X)
- Hypoglossal nerve (XII)

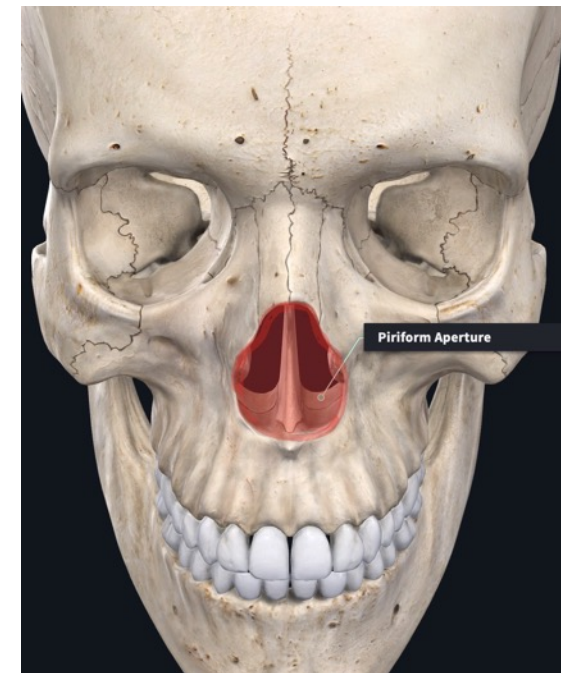
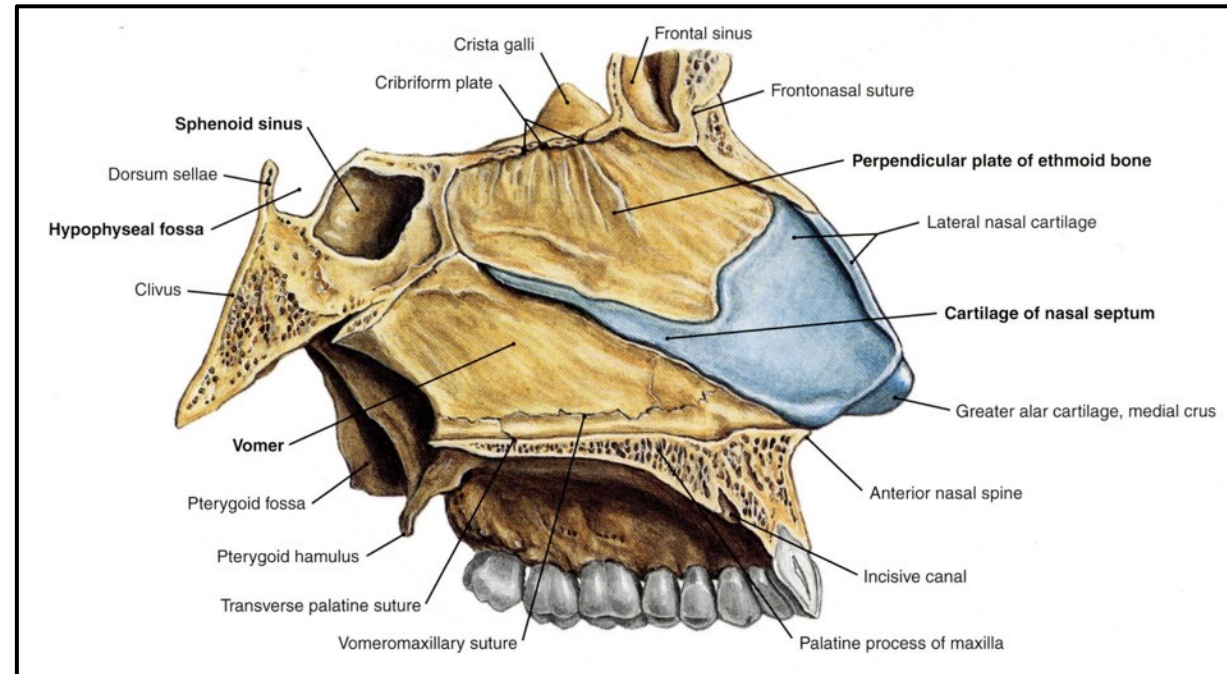
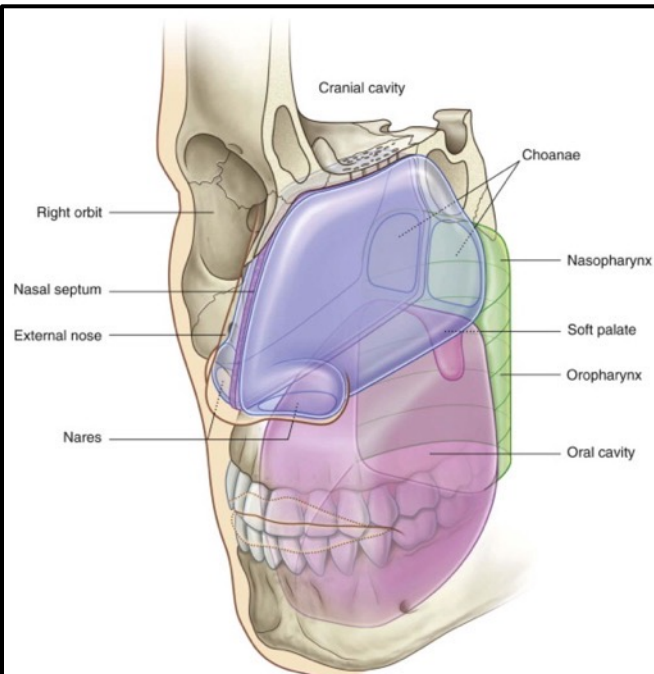
Slide Title	Slide Number
External Nose & Nasal Cavity	<a href="#">Slide 3</a>
Nasal Cavity Proper	<a href="#">Slide 4</a>
Nasal Cavity: Nasal Turbinates	<a href="#">Slide 5</a>
Nasal Cavity: Nasal Meatuses	<a href="#">Slide 6</a>
Nasal Cavity: Paranasal Sinus Drainage and Paranasal Sinus Innervation	<a href="#">Slide 7</a>
Ethmoid Sinus and Infection to Orbit	<a href="#">Slide 8</a>
Nasal Cavity: Spread of Nasal Cavity Infections	<a href="#">Slide 9</a>
Nasal Cavity: Nasal Mucosa Innervation	<a href="#">Slide 10</a>
Nasal Cavity: Nasal Mucosa Blood Supply	<a href="#">Slide 11</a>
Pharynx	<a href="#">Slide 12</a>
Pharyngeal Wall Layers	<a href="#">Slide 13</a>
Pharyngeal Muscles	<a href="#">Slide 14</a>
Sensory Innervation to Pharynx	<a href="#">Slide 15</a>
Sensory Innervation to Pharynx (Continued)	<a href="#">Slide 16</a>
Nasopharynx	<a href="#">Slide 17</a>
Oral Cavity	<a href="#">Slide 18</a>
Oral Cavity/Oropharynx: Palatoglossal and Palatopharyngeal Arches	<a href="#">Slide 19</a>

Slide Title	Slide Number
Oral Cavity/Oropharynx: Soft Palate	<a href="#">Slide 20</a>
Oral Cavity/Oropharynx: Tongue	<a href="#">Slide 21</a>
Oral Cavity/Oropharynx: Tongue Ventral/Inferior Surface	<a href="#">Slide 22</a>
Oral Cavity/Oropharynx: Tongue Dorsal Surface	<a href="#">Slide 23</a>
Oral Cavity/Oropharynx: Tongue Muscles	<a href="#">Slide 24</a>
Oral Cavity/Oropharynx: Tongue Lymph Drainage	<a href="#">Slide 25</a>
Oral Cavity/Oropharynx: Valleculae	<a href="#">Slide 26</a>
Salivary Glands: Submandibular and Sublingual	<a href="#">Slide 27</a>
Salivary Glands: Parotid Gland ( <b>Review</b> )	<a href="#">Slide 28</a>
Anatomical Relationships of Tongue Arteries and Nerves Relative to Hyoglossus m.	<a href="#">Slide 29</a>
Tonsillar Tissue: Waldeyer's Ring	<a href="#">Slide 30</a>
Hypopharynx: Piriform Recess	<a href="#">Slide 31</a>
Larynx: Introduction	<a href="#">Slide 32</a>
Larynx: Ligaments	<a href="#">Slide 33</a>
Larynx: Folds and Spaces	<a href="#">Slide 34</a>
Laryngeal Muscles	<a href="#">Slide 35</a>

# External Nose & Nasal Cavity

The nose consists of the external nose and the nasal cavities.

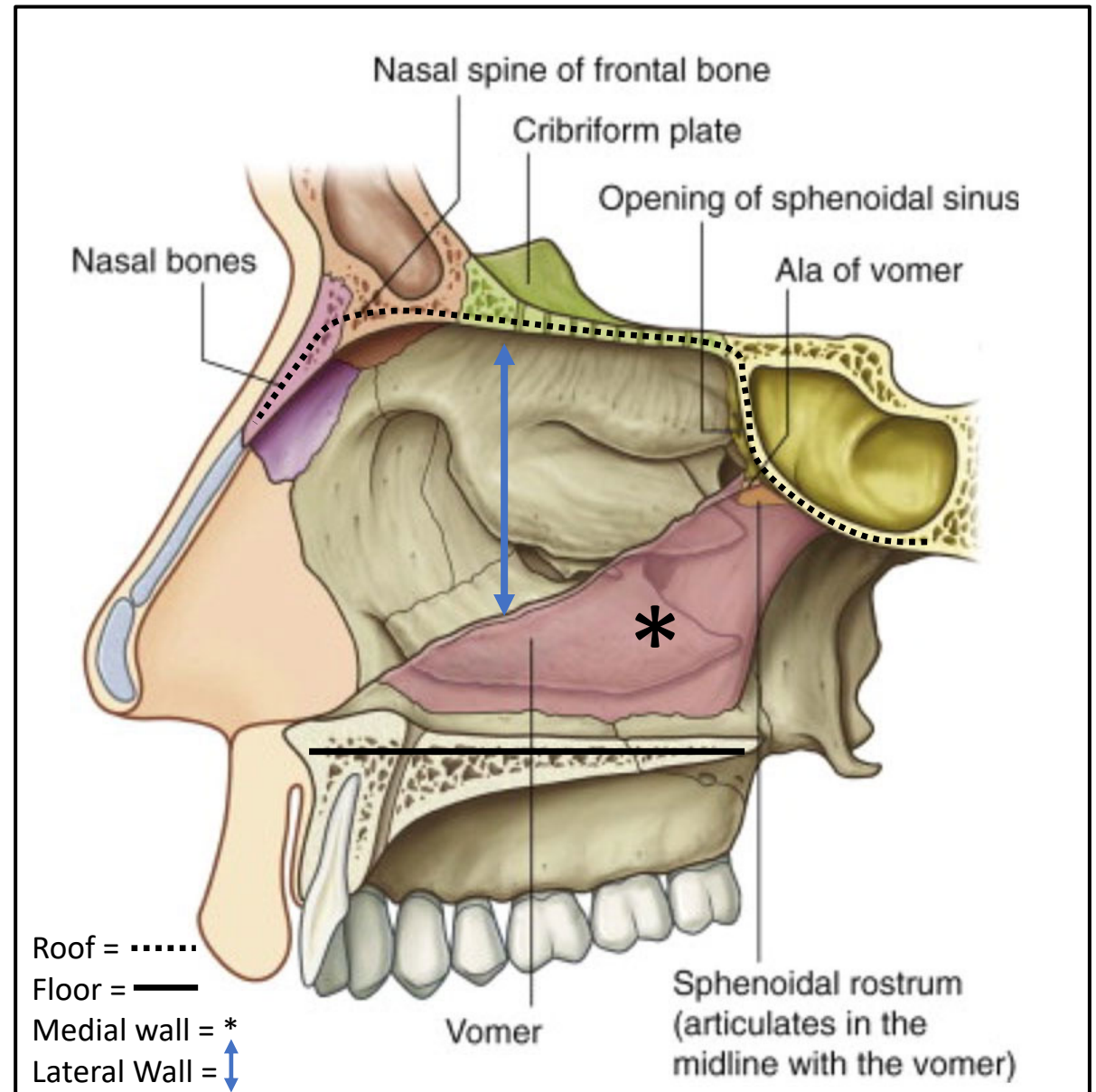
- The **external nose** is the visible pyramidal-shaped anterior protrusion of the face that we commonly refer to as the “nose.” Its size and shape is determined by the cartilage that forms it.
- The **nasal cavity** (nasal fossae) is an air-filled space extending from the nares anteriorly to the choanae posteriorly.
  - The **nares or nostrils** are anterior pear-shaped openings into the nasal cavity through which air flows to enter and exit the respiratory system.
  - The **choanae** form the posterior boundary of the nasal cavity. The choana are osseous openings defining the boundary that separates the nasal cavity from the nasopharynx.
  - The **nasal cavity** can be divided into left and right sides by the nasal septum.
    - The **nasal septum**, which separates the right and left nasal cavities (fossae), is formed by the following structures
      - Posterior and superior: **perpendicular plate of the ethmoid bone**
      - Posterior and inferior: **vomer bone**
      - Anterior: **septal nasal cartilage (hyaline cartilage)**
  - The nasal cavity can be divided into anterior and posterior regions by the portion of the nasal cavity within the skull.
    - The vestibule is the portion of the nasal cavity not within the skull. This region is between the nares and the piriform aperture.
    - The nasal cavity *proper* is the portion of the nasal cavity within the skull (between piriform aperture and choanae).



## Nasal Cavity Proper

The boundaries of the nasal cavity (proper) are as follows.

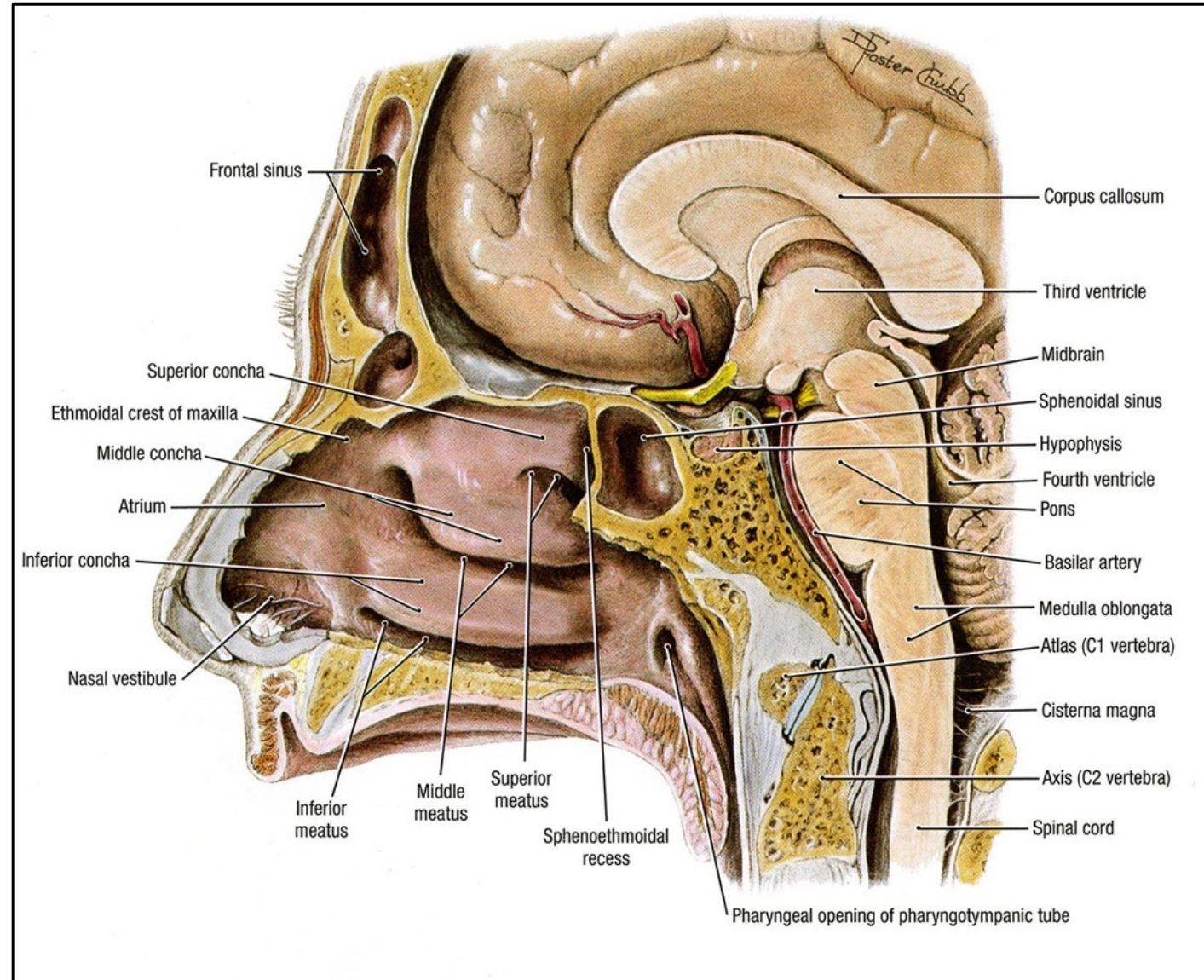
- The roof is formed by the nasal bone, ethmoid bone, frontal bone, and sphenoid bone.
- The floor is formed by the hard palate (palatine processes of the maxilla and horizontal plates of the palatine bones).
- The lateral wall is formed by the nasal conchae and underlying maxilla and (perpendicular plate) palatine bones.
- The medial wall is formed by the nasal septum (vomer, cartilage, perpendicular plate ethmoid bone), which divides the nasal cavity into right and left sides.



## Nasal Cavity: Nasal Turbinates

The **nasal turbinates (conchae)** are three curled bony protrusions of the lateral walls of the nasal cavities. They function to increase the surface area of nasal mucosa that lines the walls of the nasal cavity. Their curled shape causes air to swirl as it flows between the turbinates, which allows the greatest amount of air to be exposed to the mucosa.

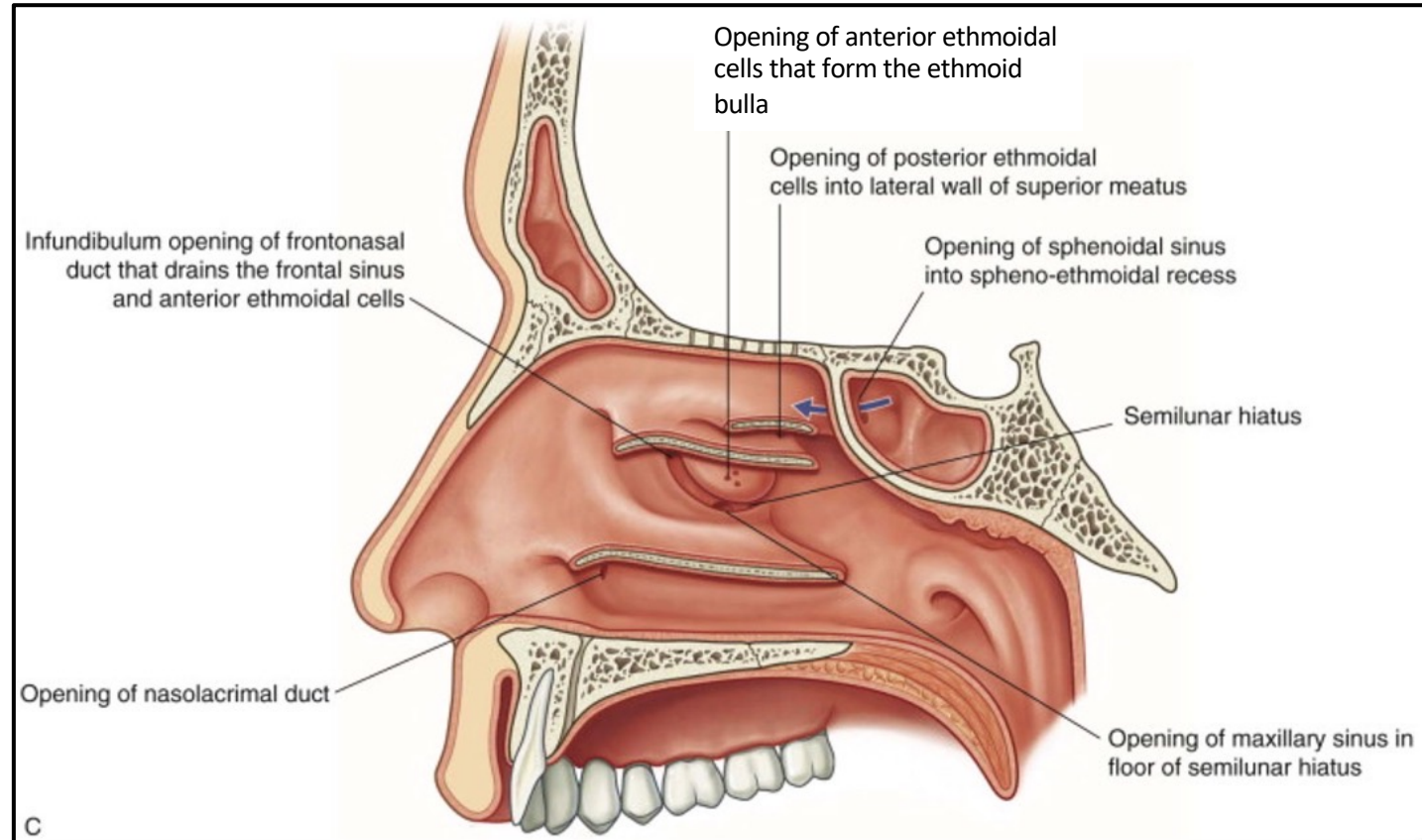
- The **superior nasal turbinates (conchae)** are bony projections of the ethmoid bone that are the most superior of the three turbinates.
- The **middle nasal turbinates (conchae)**, like the superior conchae, are bony projections of the ethmoid bone.
- The **inferior nasal turbinates (concha)** are individual bones of the skull that are the most inferior of the three turbinates.



## Nasal Cavity: Nasal Meatuses

Inferior to each turbinate is a space called a **nasal meatus**.

- The **superior meatus** is directly inferior to the superior turbinate.
  - It receives drainage from the posterior ethmoidal air cells.
- The **middle meatus** is directly inferior to the middle turbinate. The frontal, maxillary, anterior ethmoid, and middle ethmoid sinuses drain into the middle meatus.
  - A crescent-shaped groove called the **semilunar hiatus** is located within the middle meatus.
    - The following sinuses drain into the semilunar hiatus: anterior ethmoidal cells, maxillary, and frontal.
  - Posterior and superior to the semilunar hiatus, the anterior ethmoid air cells protrude toward the nasal cavity to form the ethmoidal bulla. (In some anatomy textbooks, the ethmoid air cells forming the bulla are called middle ethmoid air cells.) The anterior ethmoid air cells forming the bulla drain directly into the middle meatus via small holes.
  - The thin plate of bone (basal lamina) attaching the middle turbinate to the wall of the nasal cavity (lamina papyracea) separates the anterior ethmoidal cells from the posterior ethmoidal air cells.
- The **inferior meatus** is directly inferior to the inferior turbinate.
  - The **nasolacrimal duct** draining tears from the eyes empties into the inferior meatus.

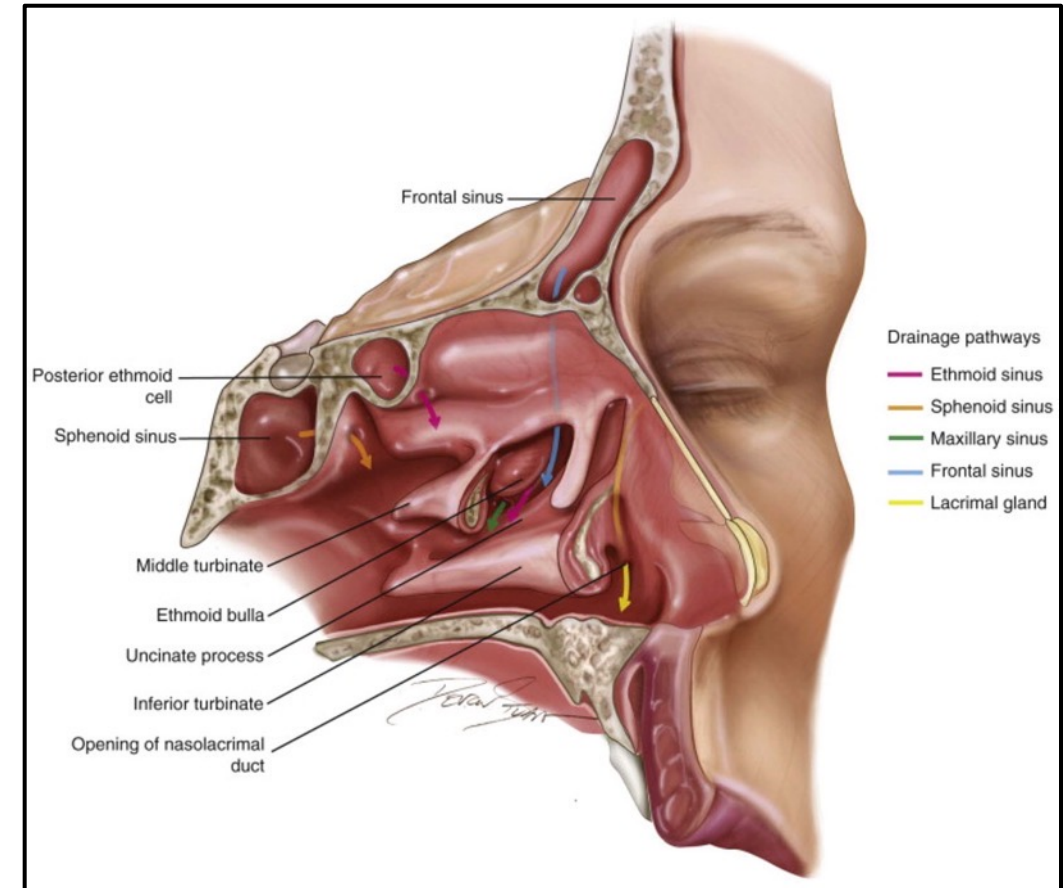
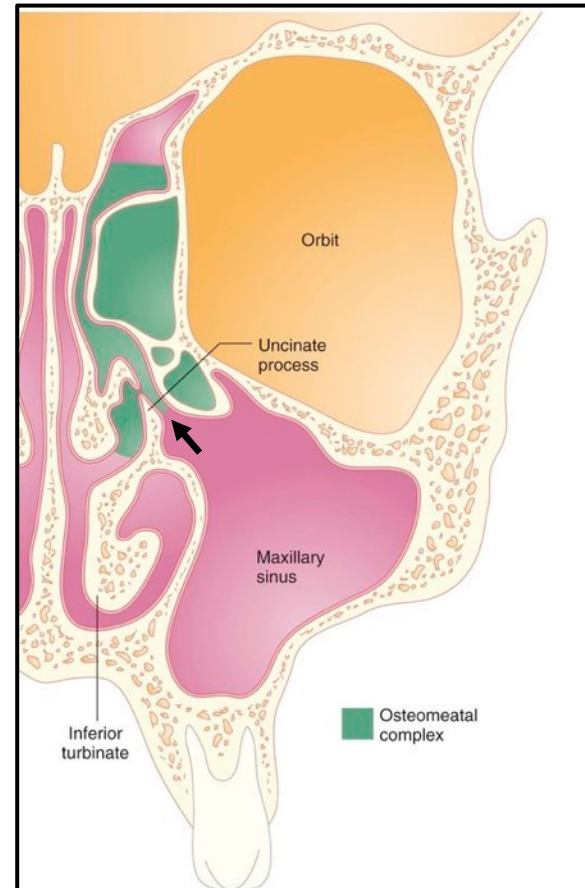


The **sphenoethmoid recess** is a small space located just posterior and superior to the superior turbinate. It receives drainage from the sphenoid sinuses, and in some individuals, the posterior ethmoid sinuses.

# Nasal Cavity: Paranasal Sinus Drainage and Paranasal Sinus Innervation

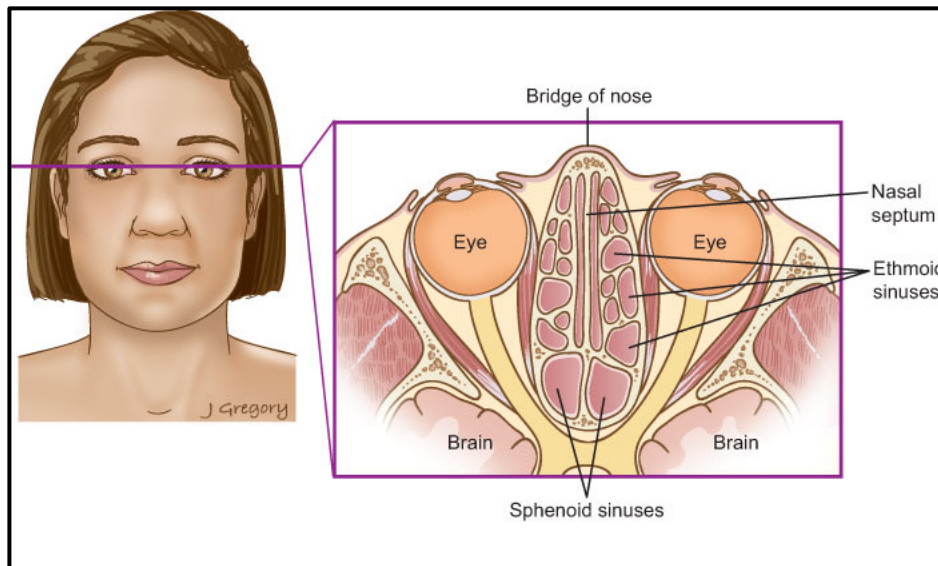
Sinus	Drainage Site	Innervation
Frontal	Middle meatus (semilunar hiatus)	Ophthalmic n. (CN V1)
Anterior ethmoidal cells (includes middle ethmoidal cells described in anatomy textbooks)	Middle meatus (via semilunar hiatus or bulla)	Ophthalmic n. (CN V1)
Posterior ethmoidal cells	Superior meatus (occasionally sphenothmoidal recess)	Ophthalmic n. (CN V1)
Sphenoidal	Sphenothmoidal recess	Ophthalmic n. (CN V1)
Maxillary	Middle meatus (semilunar hiatus)	Maxillary n. (CN V2)

**CLINICAL ANATOMY:** Clinicians often refer to the maxillary sinus as the antrum. Due to the high position of their ostia, drainage of the maxillary air sinuses (antra) is impeded, which likely accounts for the high incidence of infection of these paranasal sinuses.



## Ethmoid Sinus and Infection to Orbit

**CLINICAL ANATOMY:** Infections of the ethmoidal cells may break through the fragile medial wall of the orbit. Spread of infection from these cells could affect the dural sheath of the optic nerve, causing optic neuritis. If severe, infections originating from the ethmoidal air cells can also cause blindness by spreading to the optic nerve in the optic canal.



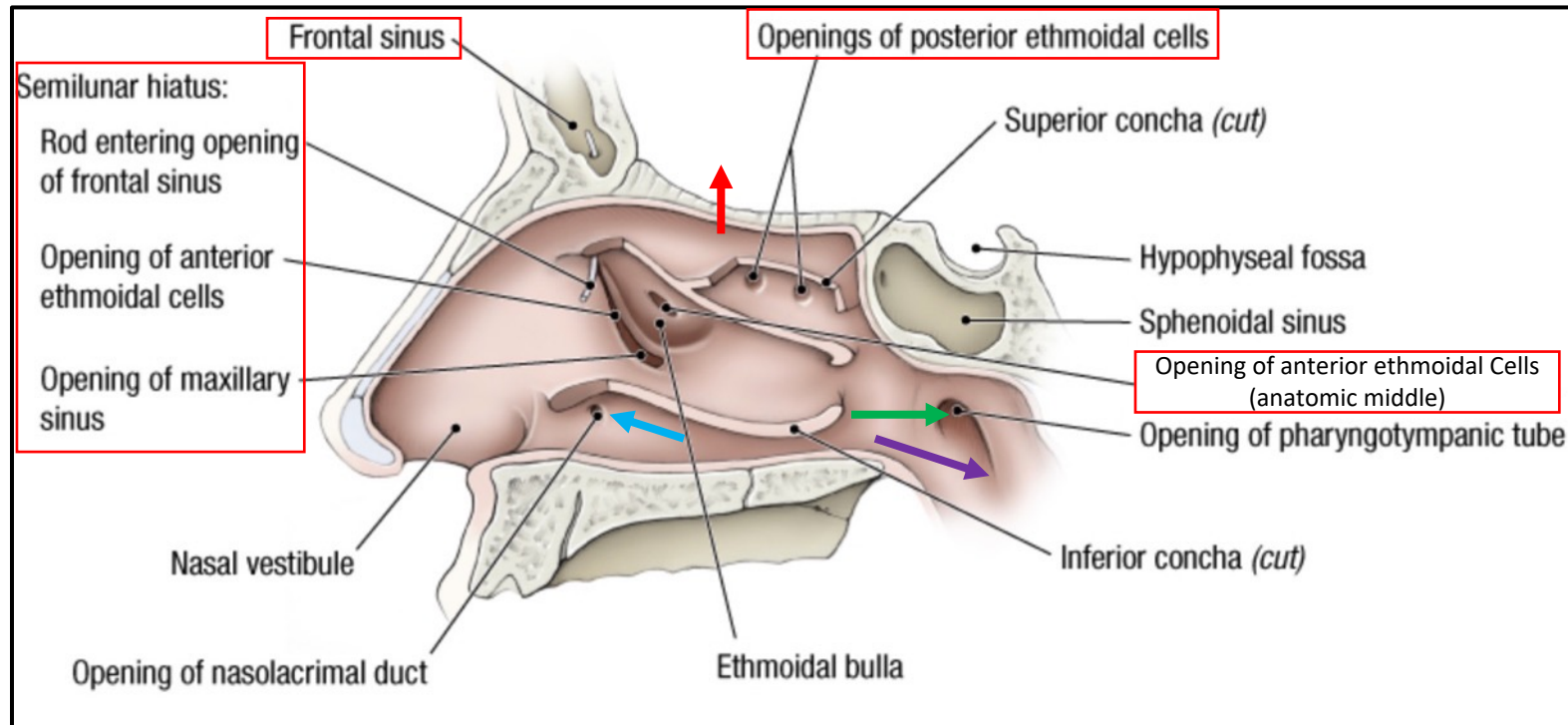
Axial post-contrast image demonstrates ethmoid sinus disease (large arrow) with orbital extension (arrowheads) resulting in cavernous sinus thrombosis (small arrow) and proptosis of left globe. Heterogeneous low-density material within the enlarged cavernous sinus represents thrombus.



## Nasal Cavity: Spread of Nasal Cavity Infections

Due to its rich vascularity and abundant seromucous glands, the nasal mucosa becomes swollen and inflamed (rhinitis) during upper respiratory infections and allergic reactions. Infections of the nasal cavities may spread to the following sites:

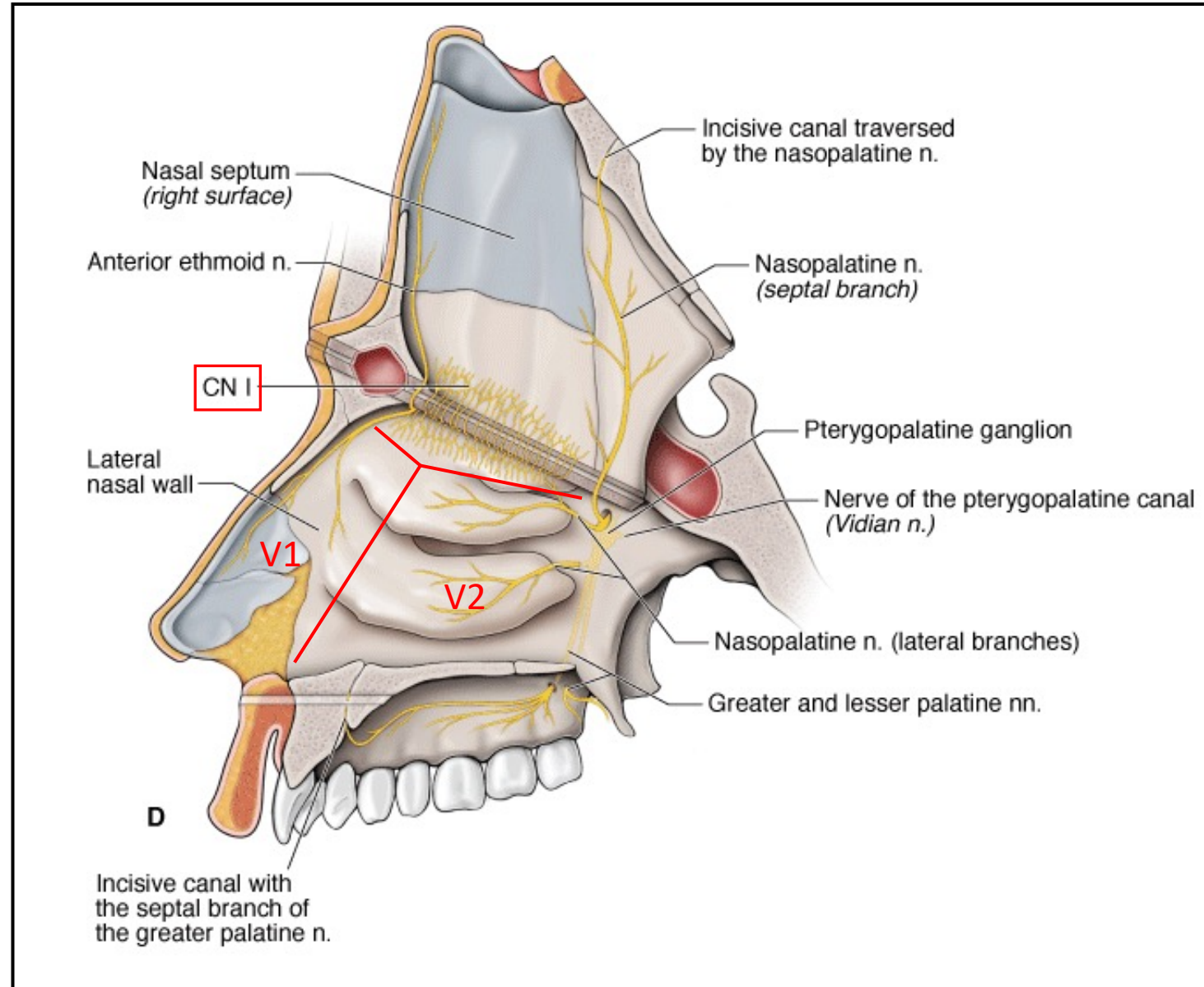
- Anterior cranial fossa via the cribriform foramina ↑
- Nasopharynx via the posterior choanae →
- Middle ear via the auditory tube →
- Paranasal sinuses via sinus ostia (resulting in sinusitis)
- Lacrimal apparatus and conjunctiva via the nasolacrimal duct ←



## Nasal Cavity: Nasal Mucosa Innervation

The innervation of the nasal mucosa can be divided broadly into two areas.

- The olfactory area is the superior  $\frac{1}{3}$  of the nasal cavity innervated by olfactory nerves (CN I)
- The respiratory area is the inferior  $\frac{2}{3}$  of the nasal cavity
  - The anterosuperior region is innervated by the ophthalmic nerve (CN V1) (via the anterior ethmoidal nerve).
  - The posteroinferior region is innervated by the maxillary nerve (CN V2) (via the nasopalatine and greater palatine nerves).

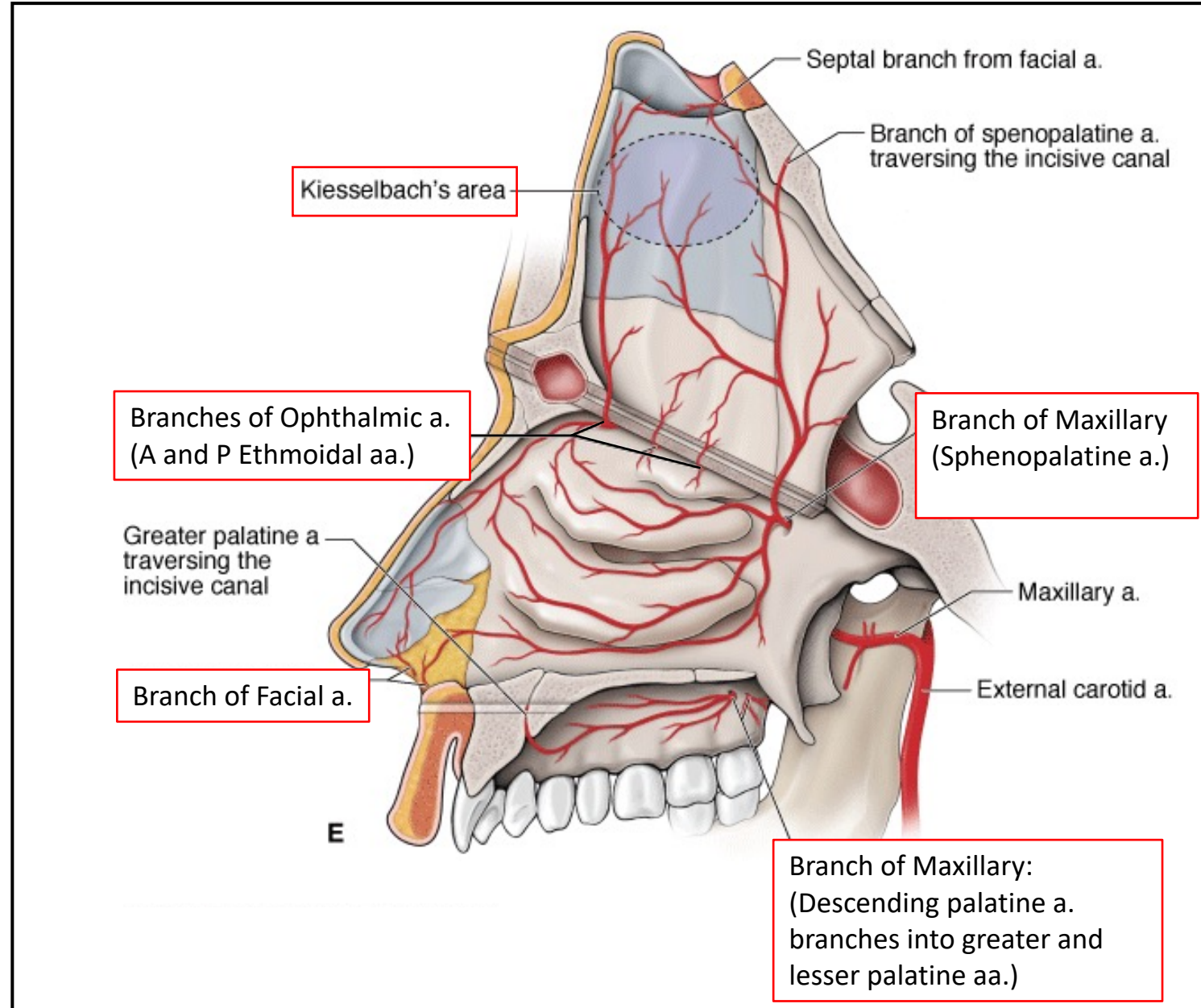


## Nasal Cavity: Nasal Mucosa Blood Supply

The medial and lateral walls of the nasal cavities are supplied by vessels branching from the following larger vessels:

- Ophthalmic artery (via ethmoidal arteries)
- Maxillary artery (note that branches of the maxillary artery that also supply the palate)
- Facial artery.

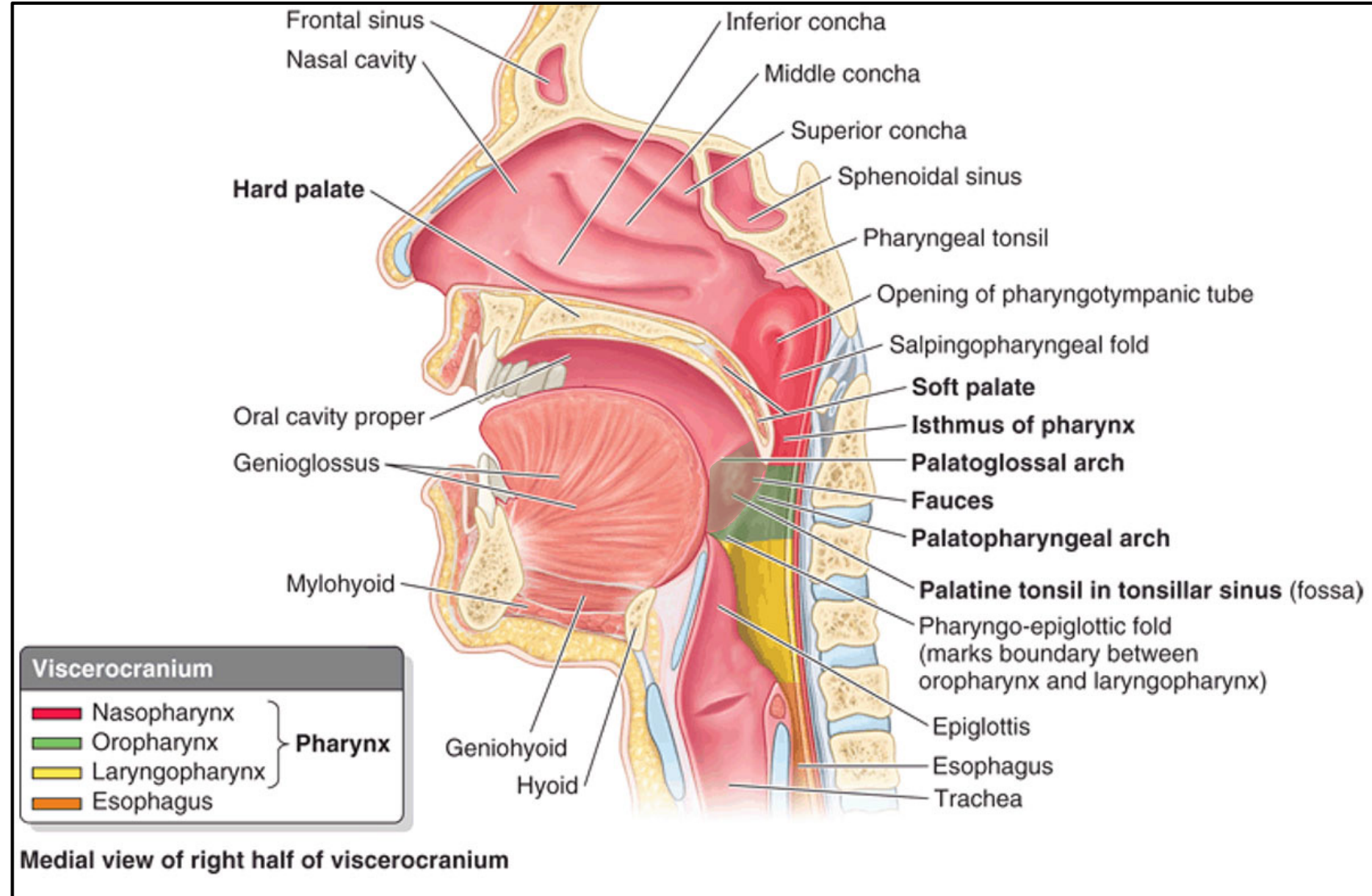
**CLINICAL ANATOMY:** The extensive area of anastomosis between branches of the ophthalmic, maxillary and facial arteries along the anterior aspect of the nasal septum. This area of the nasal septum, known clinically as Kiesselbach's area, which is a site where profuse bleeding from the nose (epistaxis) typically occurs.



# Pharynx

The **pharynx** is a shared passageway for the respiratory system and digestive system. It transports air, liquids, and food, and connects the posterior regions of the oral and nasal cavities with the entrances into the esophagus and larynx. It can be divided into three regions.

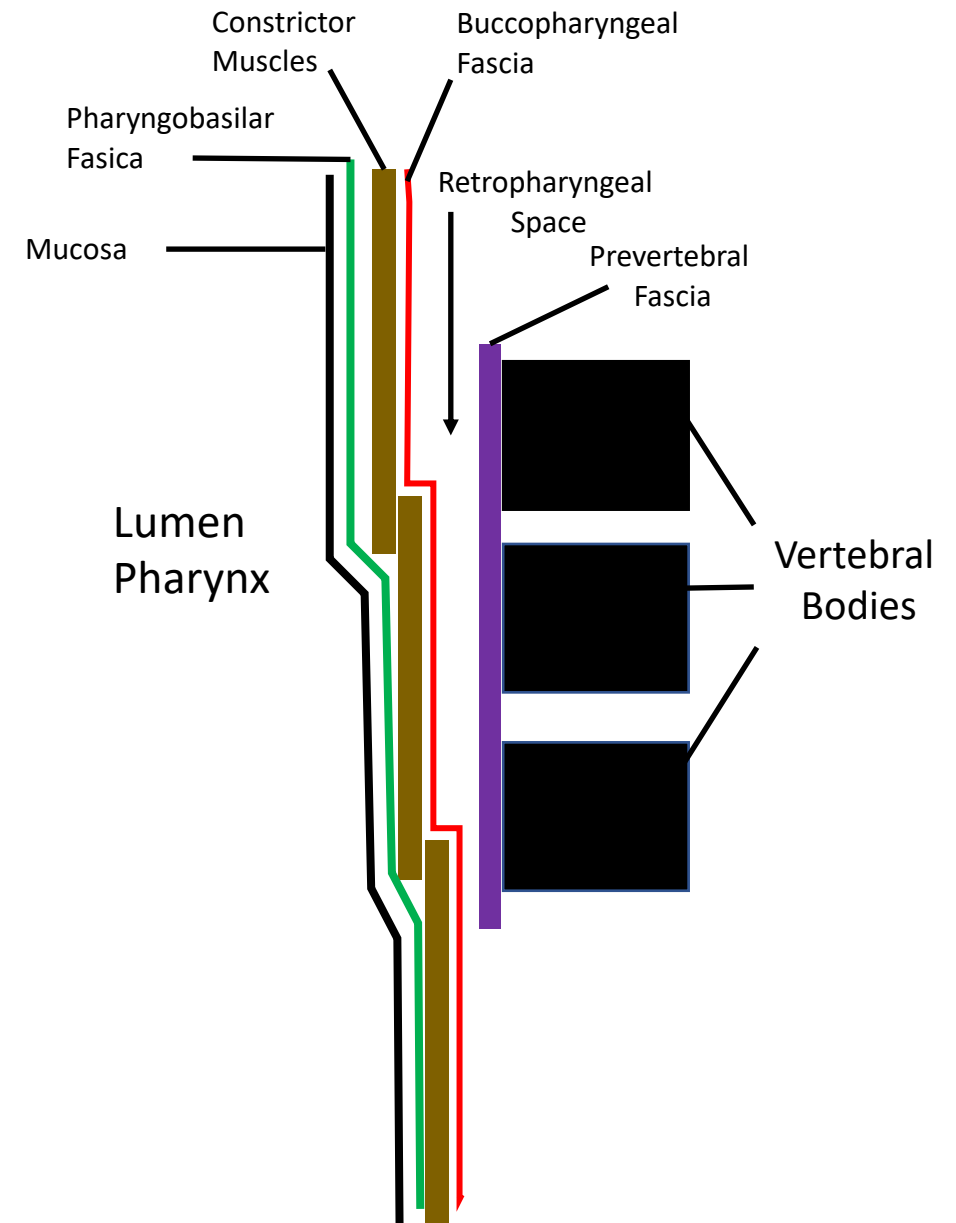
- The **nasopharynx** is located posterior to the nasal cavities and extends to the tip of the soft palate.
- The **oropharynx** is located posterior to the oral cavity and extends from the tip of the soft palate to the upper border of the epiglottis.
- The **laryngopharynx** (**hypopharynx** is often used clinically) extends from the tip of the epiglottis to the inferior border of the cricoid cartilage where it is continuous with the esophagus. It is located posterior and lateral to the larynx.



## Pharyngeal Wall Layers

The pharyngeal wall consists of 3 layers. The layers are listed below from from inside to outside.

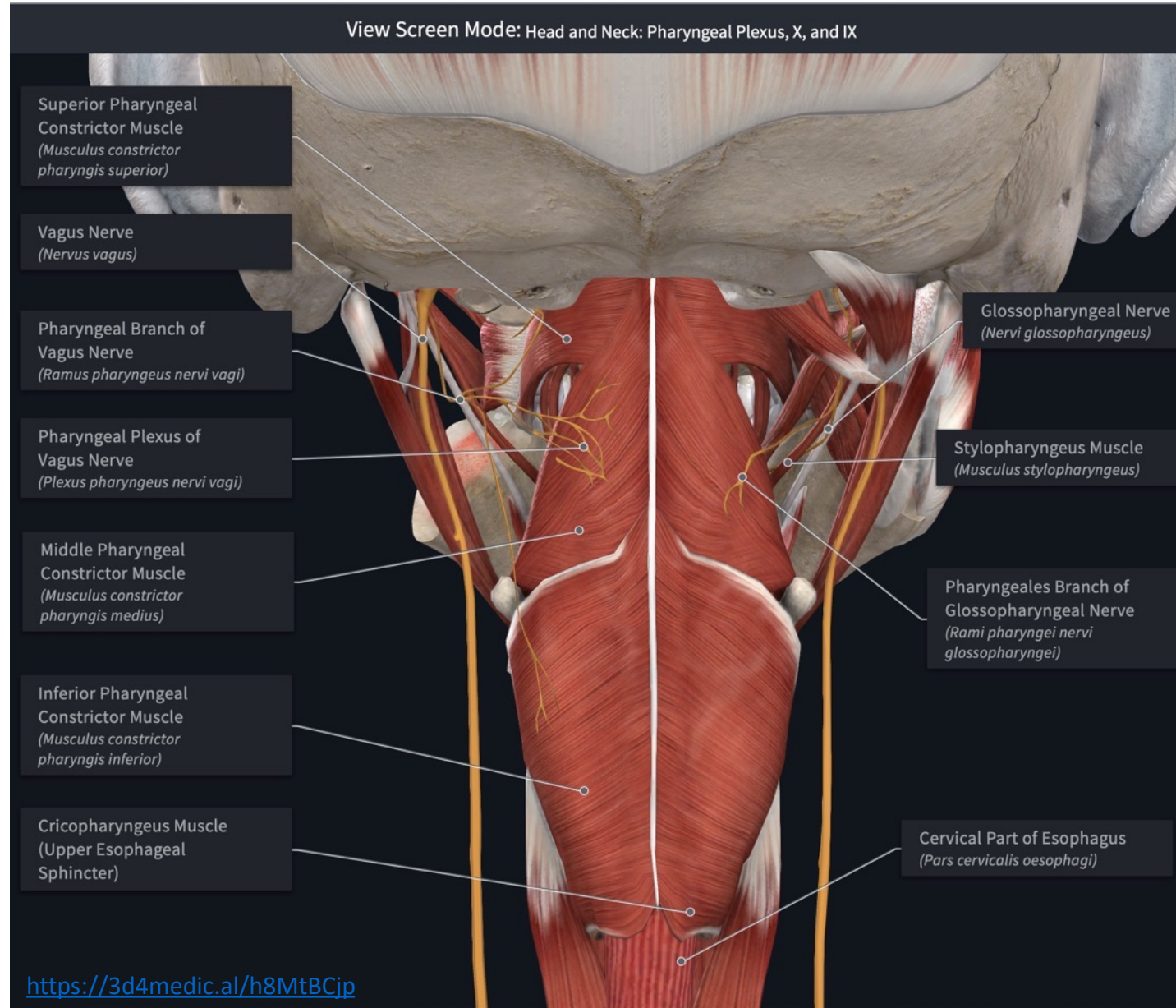
- Mucosa
- Muscular Layer
  - The pharyngobasilar fascia lines the inner aspect of the constrictor muscle and supports the mucosa. Above the superior pharyngeal constrictor muscle, which does not attach to the cranium, this fascia is thickened and attaches to the occipital bone.
  - Three **pharyngeal constrictor muscles** (superior, middle and inferior consist of an outer circular (constrictor) layer and an inner longitudinal muscle layer. These three muscles are composed of skeletal muscle under voluntary control.
- **Buccopharyngeal fascia**, which is the posterior portion of **pretracheal fascia** (Figure 2). Recall that the space between the **buccopharyngeal fascia** and the **prevertebral fascia** covering the anterior region of the cervical vertebral column is called the retropharyngeal space (Figure 2).



Sagittal Cut (Side View of Pharyngeal Layers)

# Pharyngeal Muscles

- The three circular **pharyngeal constrictor muscles** (superior, middle and inferior) overlap each other like a series of overlapping cups or cones.
- The lowest fibers of the inferior constrictor muscle are referred to as the cricopharyngeus muscle because they are attached anteriorly to the cricoid cartilage. These muscle fibers functionally form the important upper esophageal sphincter.
- On either side of the pharynx is the **stylopharyngeus** muscle, which is one of the longitudinal muscles of the pharynx. Note that the glossopharyngeal nerve crosses the posterior and lateral surfaces of this muscle, which it innervates.
- Innervation:
  - Superior, Middle, and Inferior constrictors are innervated by the vagus nerve (CN X).
  - The stylopharyngeus muscle is innervated by the glossopharyngeal nerve. (This is the **ONLY** muscle innervated by the glossopharyngeal nerve.)



# Sensory Innervation to Pharynx

Sensory innervation to the oropharynx can be divided as follows.

- **Nasopharynx:**
  - Maxillary division of Trigeminal (CN V2): proximal to eustachian tube orifice
  - Glossopharyngeal (CN IX) via pharyngeal plexus: Distal to eustachian tube orifice
- **Oropharynx:** Glossopharyngeal nerve (CN IX)
  - Glossopharyngeal via pharyngeal plexus
  - Tonsillar Fossa: Tonsillar branch of glossopharyngeal n. (This nerve then continues toward the tongue as a lingual branch that provides general sensation and taste to the tongue.)
- **Hypopharynx:**
  - Glossopharyngeal nerve (CN IX) via pharyngeal plexus
  - Vagus (CN X) via pharyngeal plexus

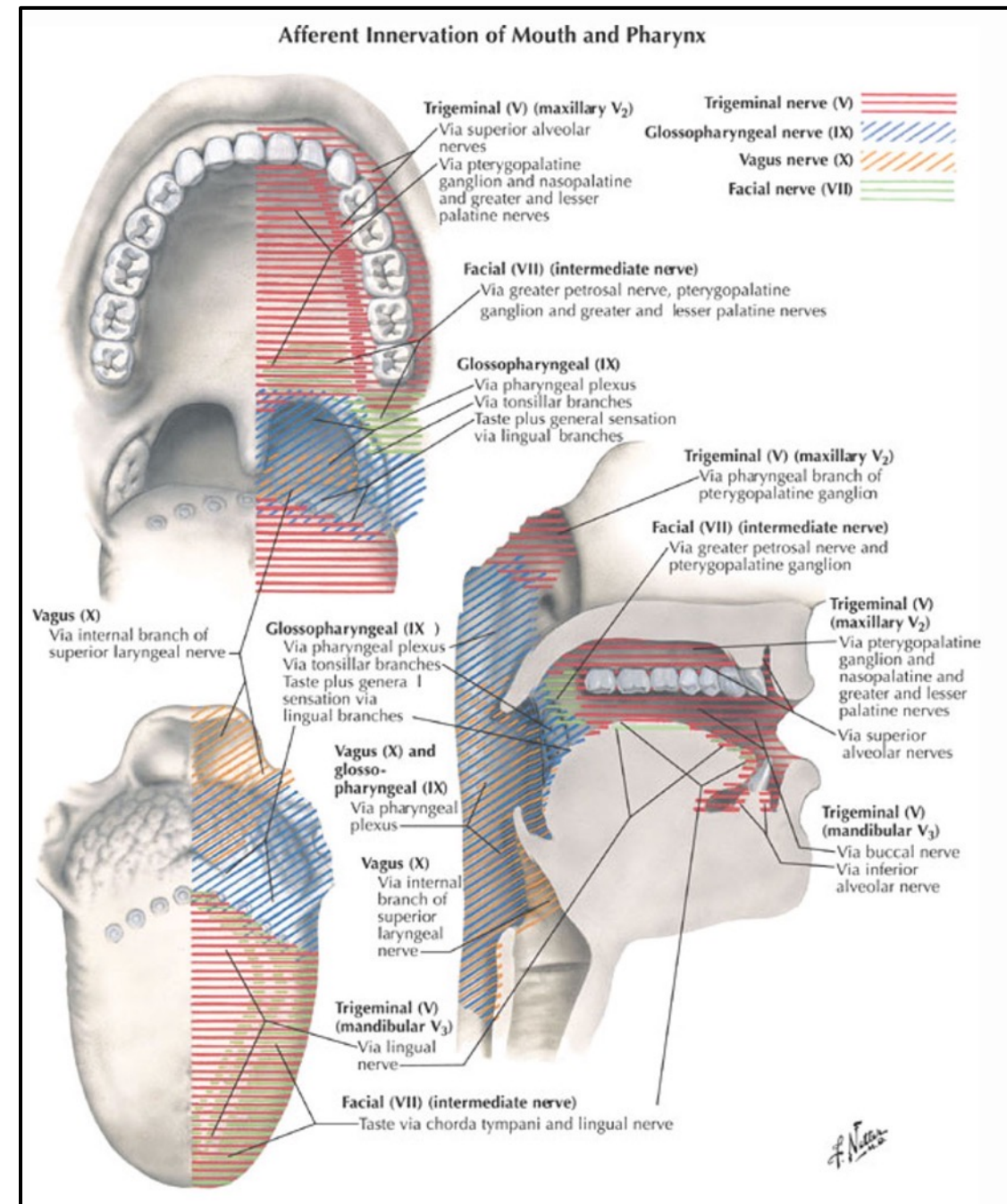
The pharyngeal plexus receives branches from three nerves:

1. Glossopharyngeal nerve (sensory to the pharyngeal mucosa)
2. Vagus nerve (motor to the pharyngeal constrictor muscles)
3. Superior cervical sympathetic ganglion (vasomotor)

NOTE: All muscles of the pharynx and soft palate are supplied by pharyngeal branches of the vagus nerve (CN X) EXCEPT

1. Stylopharyngeus m. (glossopharyngeal, CN IX) and
2. Tensor veli palatini m. (mandibular nerve, CN V3).
3. The inferior constrictor m. also receives innervation from the external and recurrent laryngeal nerves (both derived from branches of the vagus).

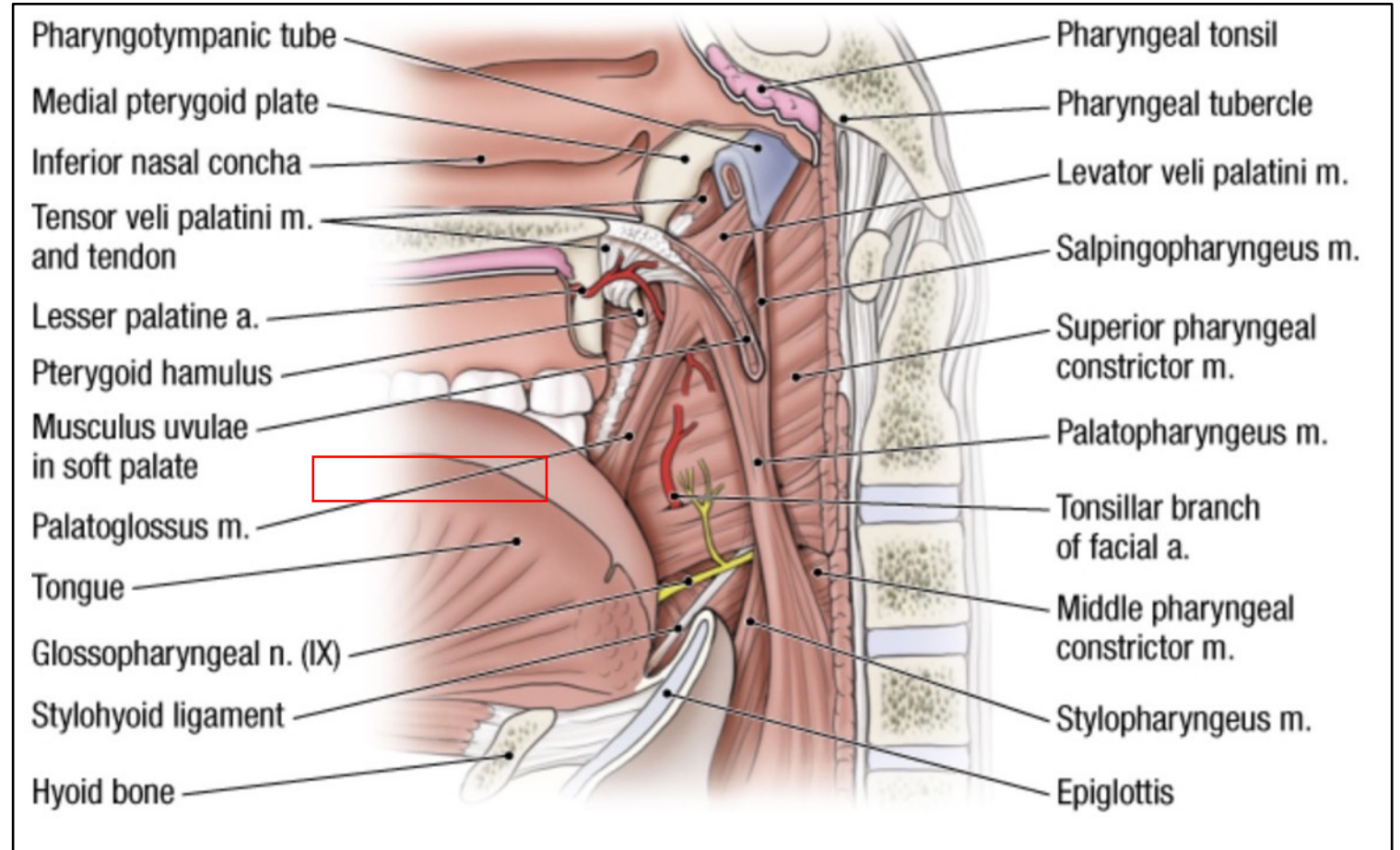
**CLINICAL ANATOMY:** Stimulation of the glossopharyngeal nerve in the region of the oropharynx elicits the gag reflex, which is a reflex contraction of the palatoglossus and palatopharyngeus muscles (both muscles receive motor innervation from the vagus nerve).



## Sensory Innervation to Pharynx (Continued)

The **glossopharyngeal nerve** passes between the superior and middle constrictor muscles to enter the **tonsillar fossa** where it provides sensory innervation to the the mucosa of the tonsillar fossa (tonsillar branch) and continues in an anterior direction to innervate the posterior one-third of the tongue (lingual branch).

**CLINICAL ANATOMY:** Lingual branches of the glossopharyngeal nerve (CN IX) are at risk of injury during tonsillectomy due to their proximity to the muscle layer of the palatine tonsillar bed.





# Nasopharynx

The opening into the **pharyngotympanic tube (Eustachian tube or auditory tube)** is located in the nasopharynx.

- The cartilaginous portion of the eustachian tube is evident as an elevation on the lateral wall of the nasopharynx; this is known as the tubal elevation or torus tubarius.
- The eustachian tube is an air-filled tube that connects the nasopharynx to the middle ear cavity. The primary function of this tube is to equilibrate air pressure on both sides of the tympanic membrane (eardrum), which prevents the tympanic membrane from rupturing.

**CLINIAL ANATOMY:** Infections of the nose and nasal airway can spread to the middle ear through the auditory (pharyngotympanic or Eustachian) tube. Because the orientation of the auditory tube changes during growth (i.e., from a horizontal to oblique orientation), middle ear infections (otitis media) are more common in children than adults.

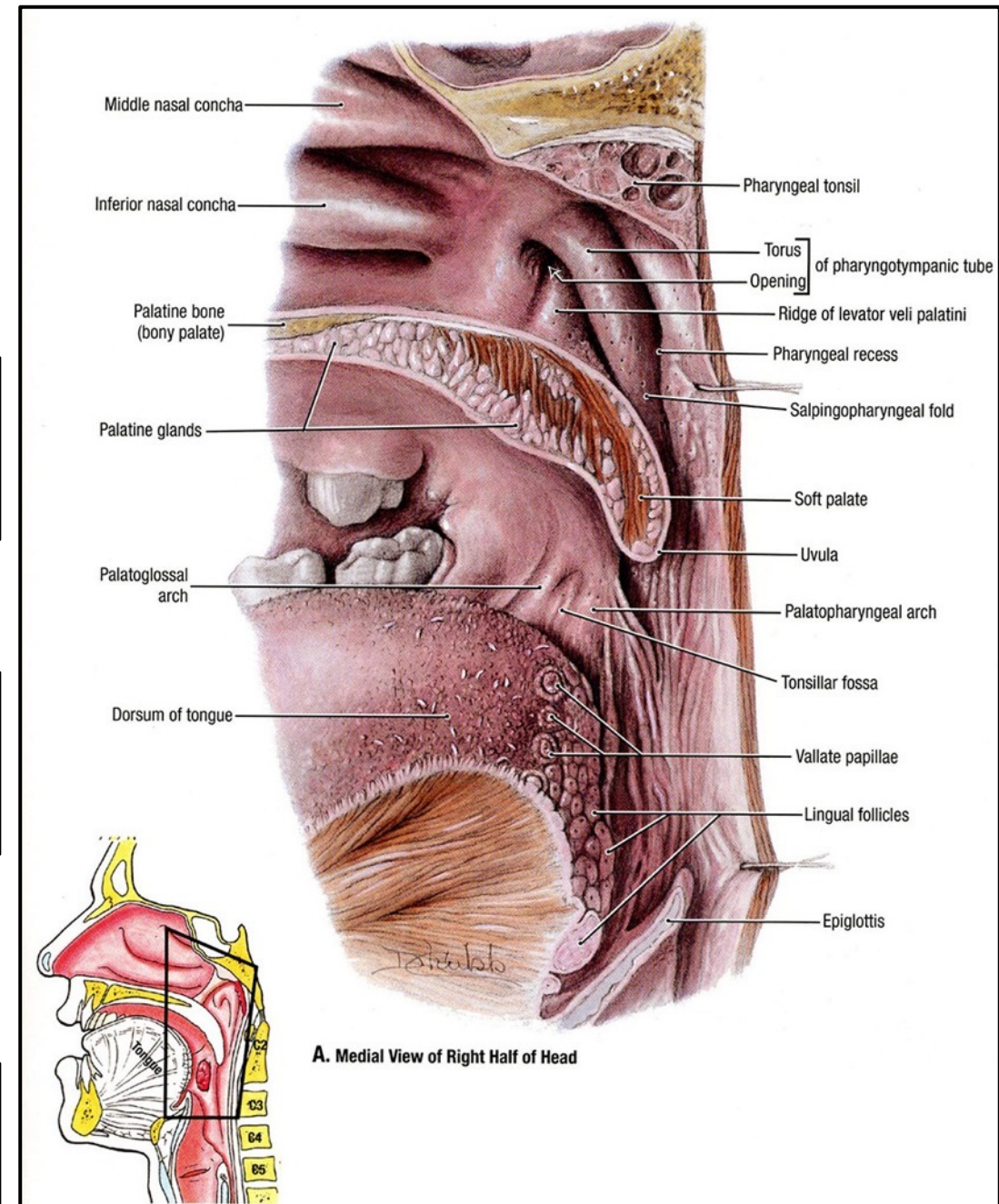
The pharyngeal recess (Rosenmuller's fossa) is a space superior and posterior to the torus tubarius.

**CLINIAL ANATOMY:** The pharyngeal recess (Rosenmuller fossa) is the most common site of nasopharyngeal carcinoma. Carcinoma can lead to a blockage of the Eustachian tube opening. In an adult, a unilateral serous otitis media can be worrisome because it might be due to a carcinoma in the pharyngeal recess.

The nasopharynx contains tonsillar tissue.

- The tubal tonsils are located posterior to the torus tubarius.
- The pharyngeal tonsil (clinically referred to as the adenoid) is located in the roof of the nasopharynx, immediately inferior to the body of the sphenoid bone.

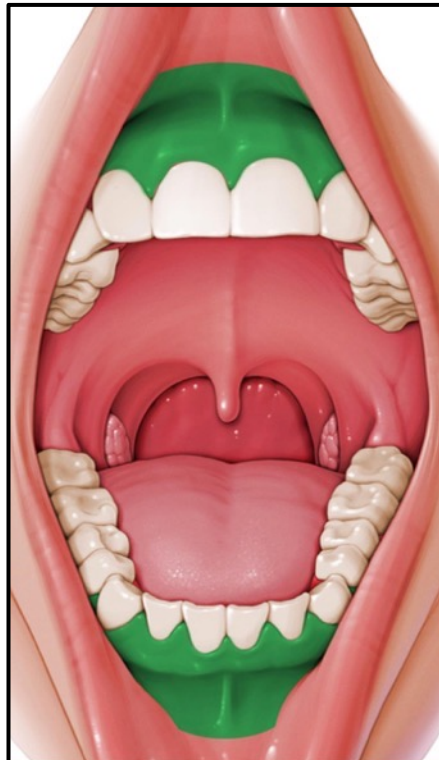
**CLINIAL ANATOMY:** Inflammation of the pharyngeal tonsil (adenoiditis) can obstruct the passage of air from the nasal cavities through the choanae into the nasopharynx, making mouth breathing necessary. Infections of the pharyngeal tonsil can spread to the tubal tonsil (leading to obstruction of the auditory tube) and to the middle ear.



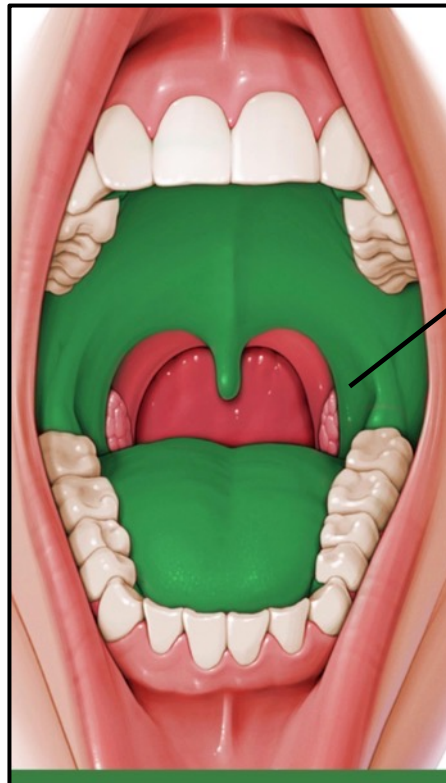
# Oral Cavity

The oral cavity (mouth) can be divided into two parts.

- The **vestibule** is the narrow horseshoe-shaped space between the teeth/gingiva and the lips/cheeks.
- The **oral cavity proper** is separated from the vestibule by the upper and lower teeth. It is bounded by the following structures.
  - The teeth form the anterior and lateral boundaries.
  - The hard and soft palate form the roof.
  - The mylohyoid muscle forms the floor.
  - The palatoglossal arch forms the posterior boundary between the oral cavity and the oropharynx.

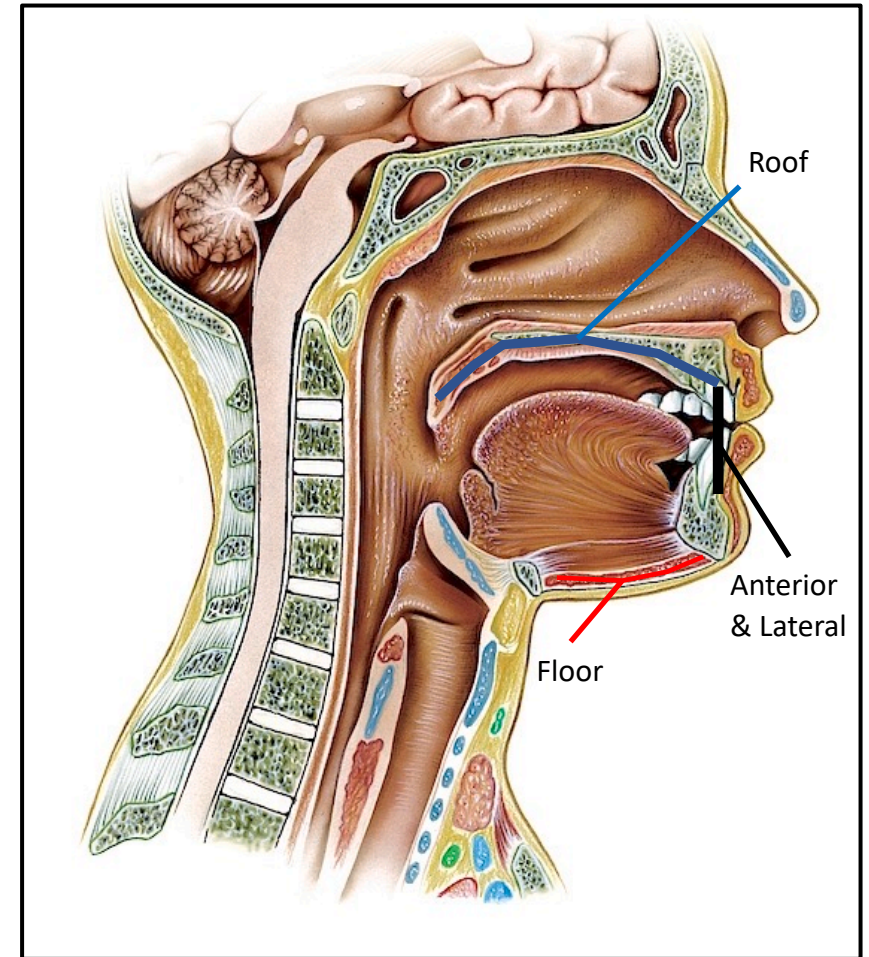


1) Oral cavity vestibule



Posterior

2) Oral cavity proper



Roof

Anterior  
& Lateral

Floor

# Oral Cavity/Oropharynx: Palatoglossal and Palatopharyngeal Arches

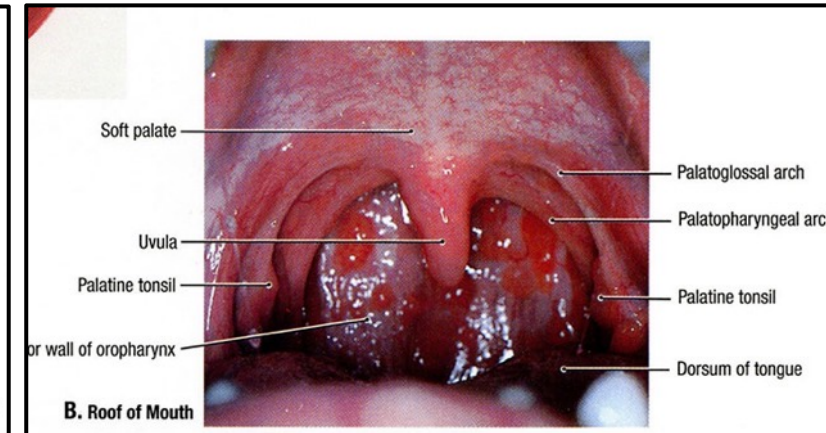
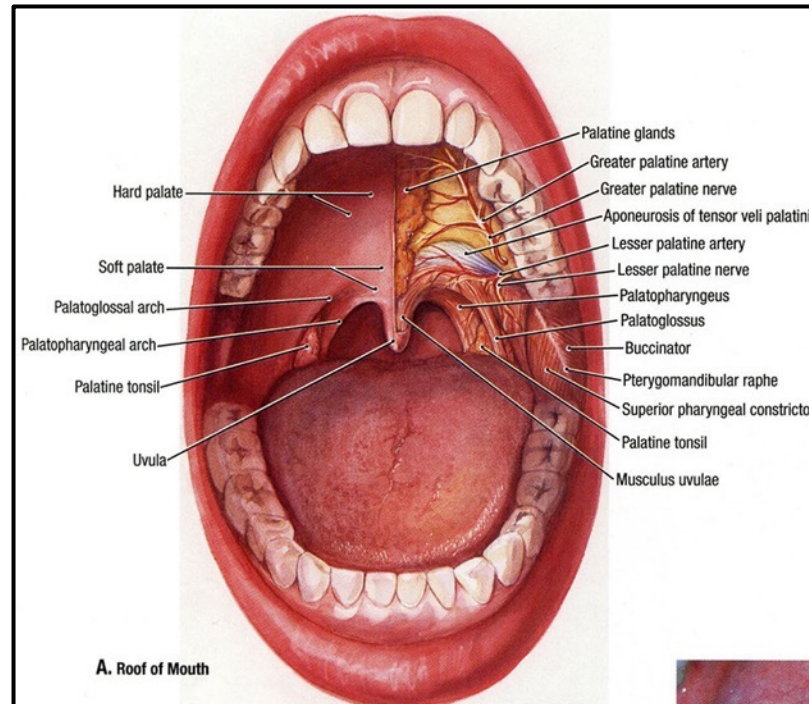
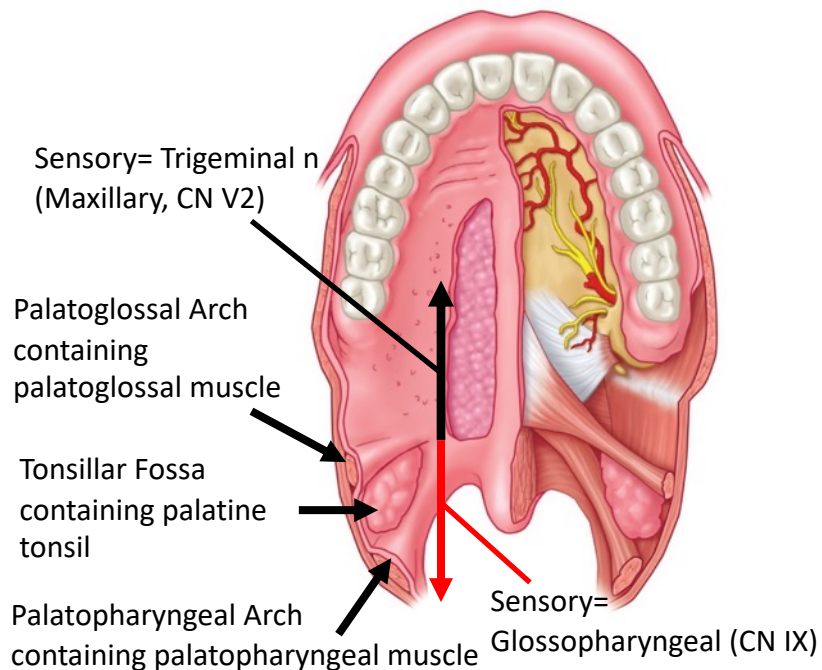
The palatoglossal arch is a columnar “fold” of mucosa connecting the inferior surface of the soft palate to the dorsal surface of the tongue.

- The underlying **palatoglossus muscle** creates the fold in the mucosa.
- The paired **palatoglossal arches** delineate anatomical and innervation boundaries.
  - Anatomically, it delineates the boundary of the **oral cavity** from the **oropharynx**.
  - It delineates the boundary of the mucosa of the oral cavity innervated by the **trigeminal nerve** (derived from ectoderm of the stomodeum) from the mucosa of the pharynx innervated by the **glossopharyngeal nerve** (derived from pharyngeal endoderm).

Posterior to the **palatoglossal arch** is the **palatopharyngeal arch**, which is a broader mucosal fold passing from the edge of the soft palate to the interior of the oropharynx. The underlying **palatopharyngeus muscle** creates this fold.

- The depression located between the palatoglossal and palatopharyngeal arches is called the **tonsillar fossa** (also called the tonsillar sinus or bed), which contains the **palatine tonsils**.
- Because of their role in creating the boundaries of the tonsillar fossa, the palatoglossal and palatopharyngeal arches are also known as the anterior and posterior tonsillar pillar, respectively.

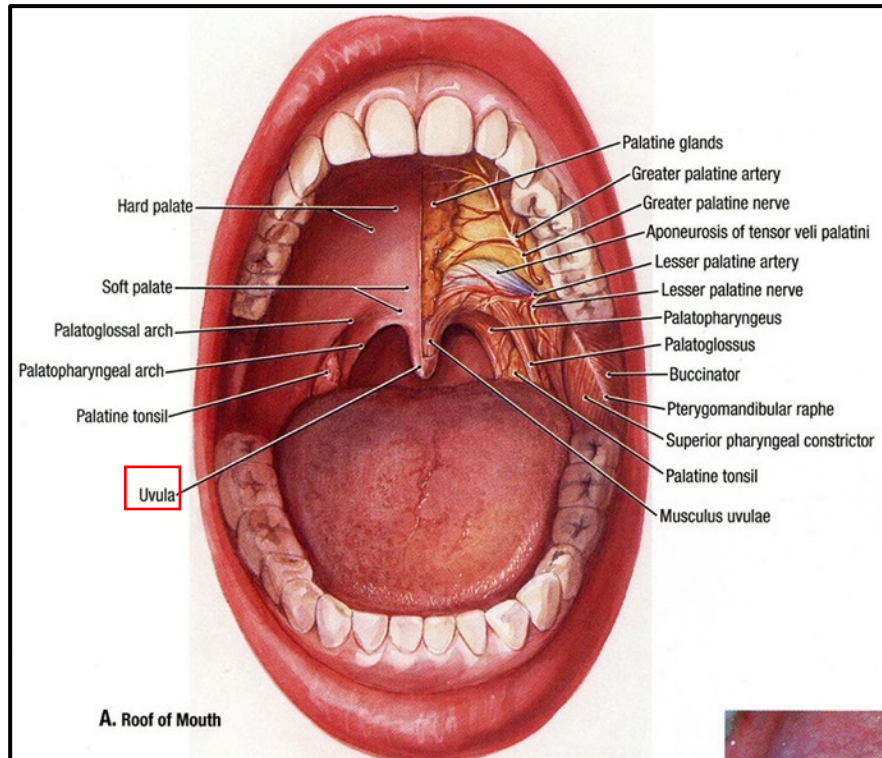
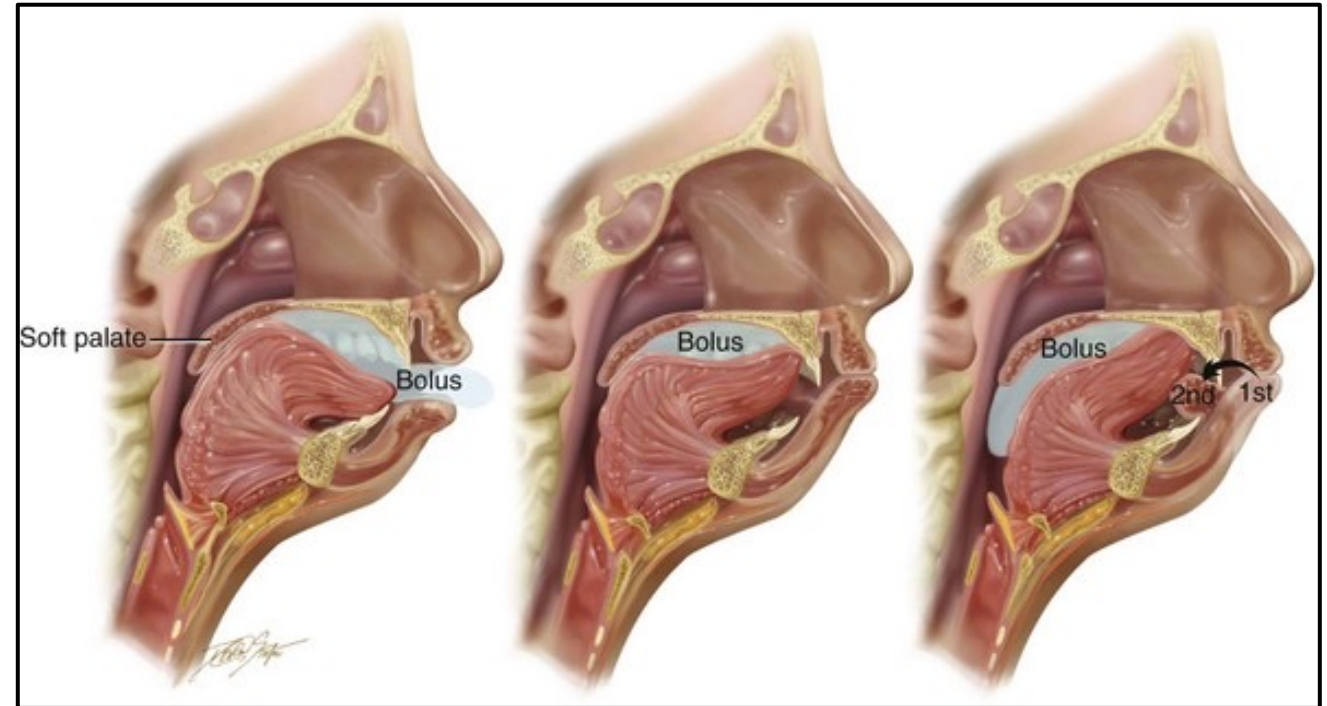
Inferior to Superior View of Hard Palate



## Oral Cavity/Oropharynx: Soft Palate

The soft palate is the movable, posterior  $\frac{1}{3}$  of the palate.

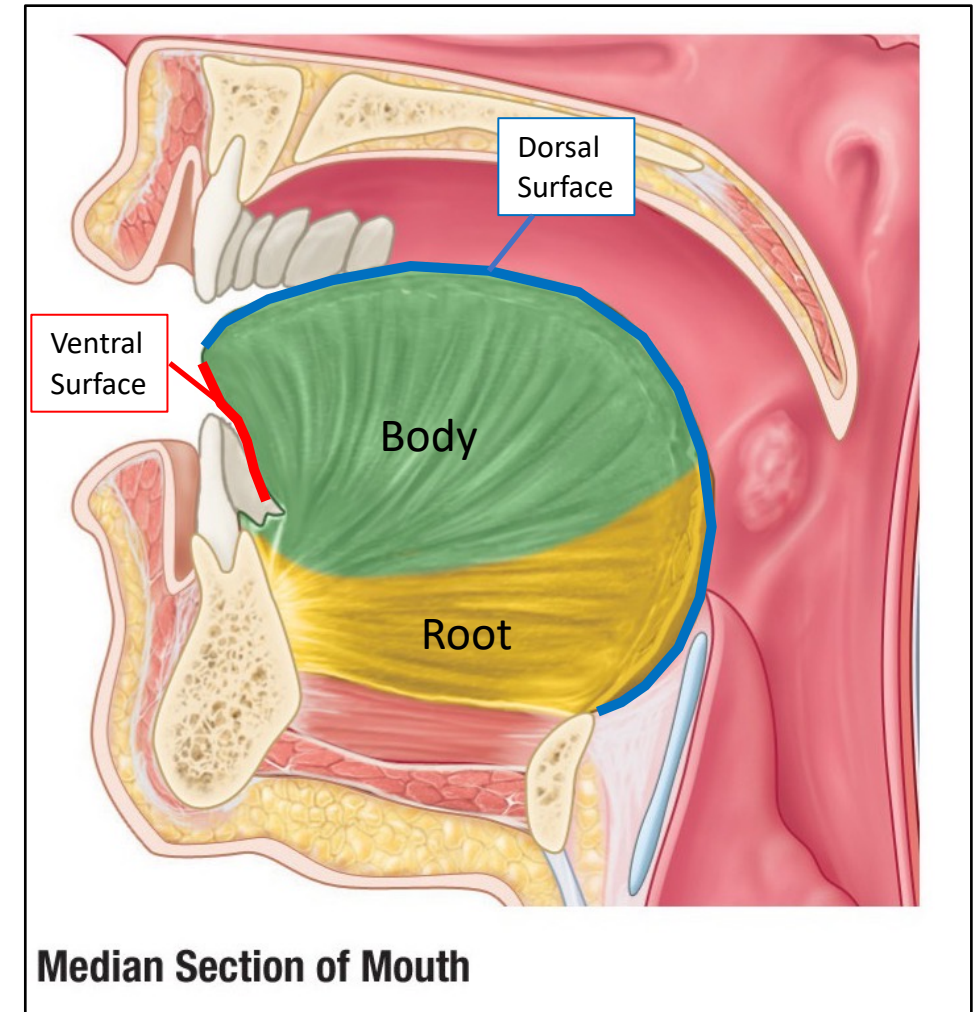
- The conical posterior margin of the soft palate is the uvula
- When elevated against the posterior pharyngeal wall during swallowing, the soft palate and uvula separate the nasopharynx above from the oropharynx below. This separation prevents food and liquid from entering the nasopharynx during swallowing.



## Oral Cavity/Oropharynx: Tongue

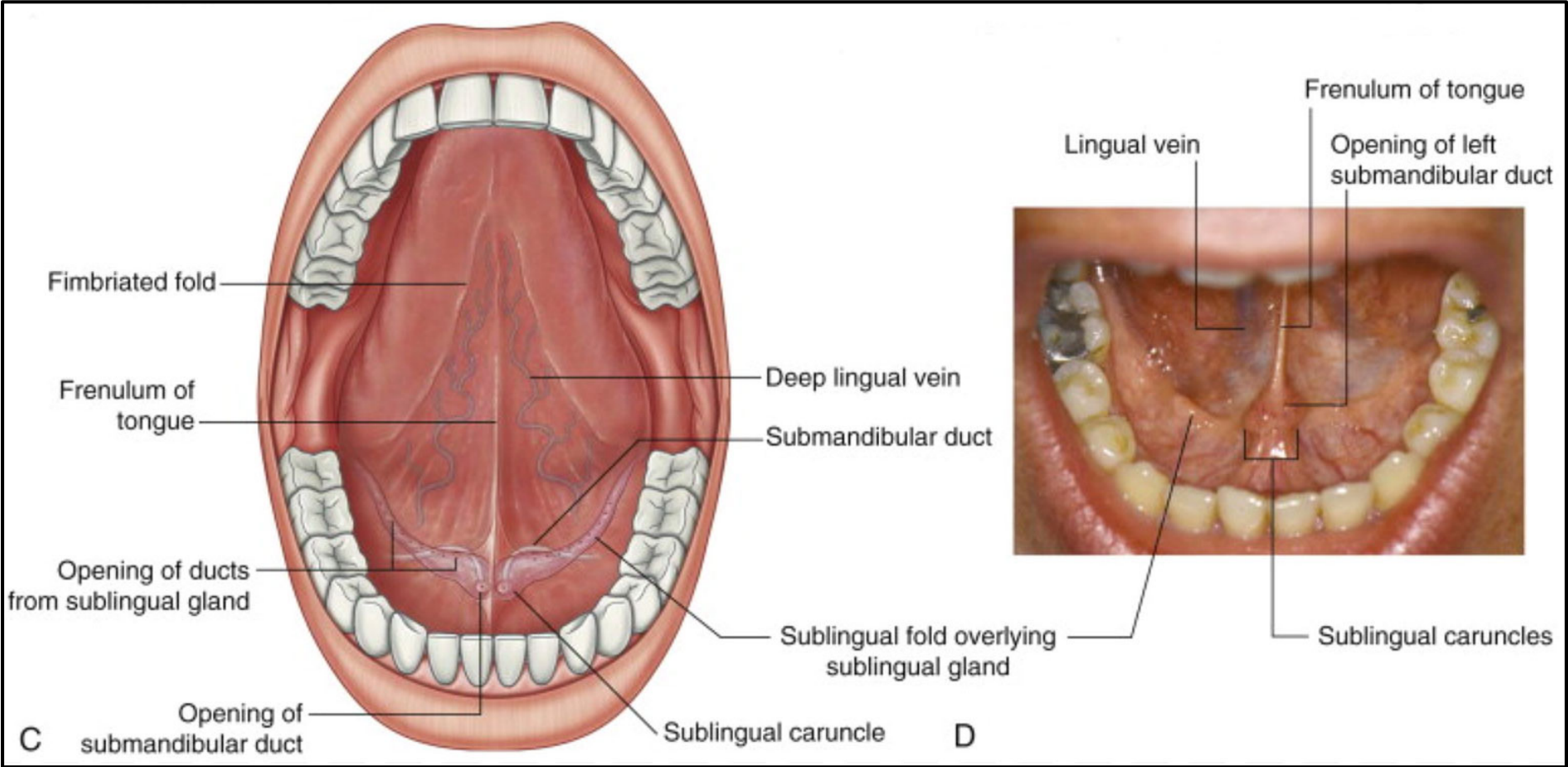
The **tongue** is a muscular organ covered by mucosa that fills the entire oral cavity proper when the mouth is closed and the tongue muscles are relaxed.

- The tongue consists of two main parts
  - **Body:** The body of the tongue is the superior/anterior portion of the tongue.
  - **Root:** The root is the attached posterior/inferior portion of the tongue.
- The tongue consists of two surfaces:
  - **Ventral/Inferior surface** ("underside" of the tongue).
  - **Dorsal surface** ("top" of the tongue):



# Oral Cavity/Oropharynx: Tongue Ventral/Inferior Surface

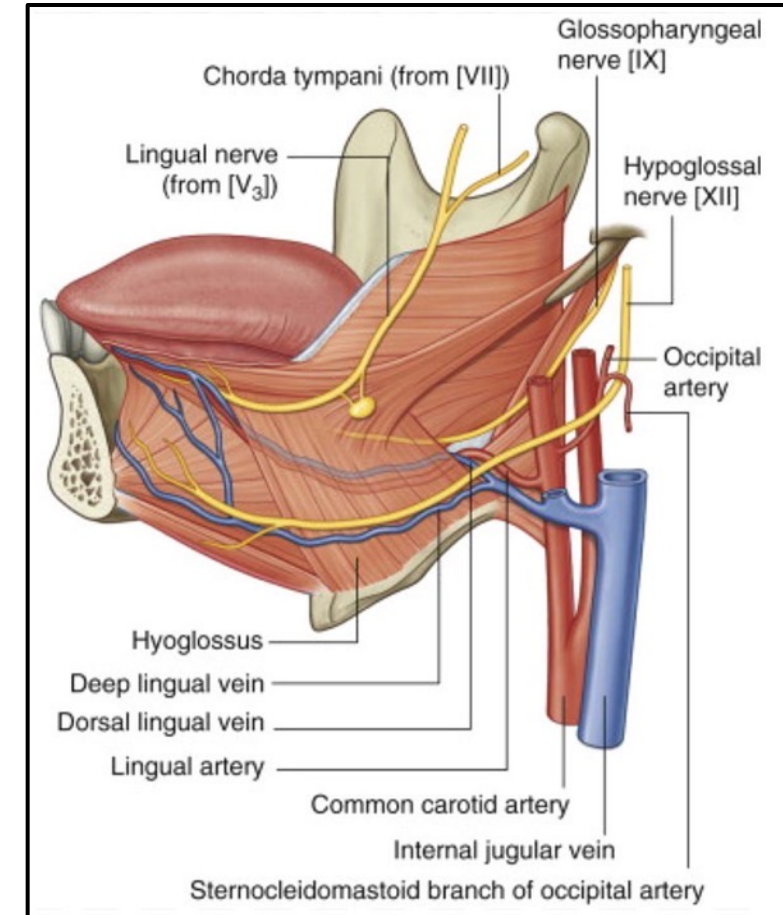
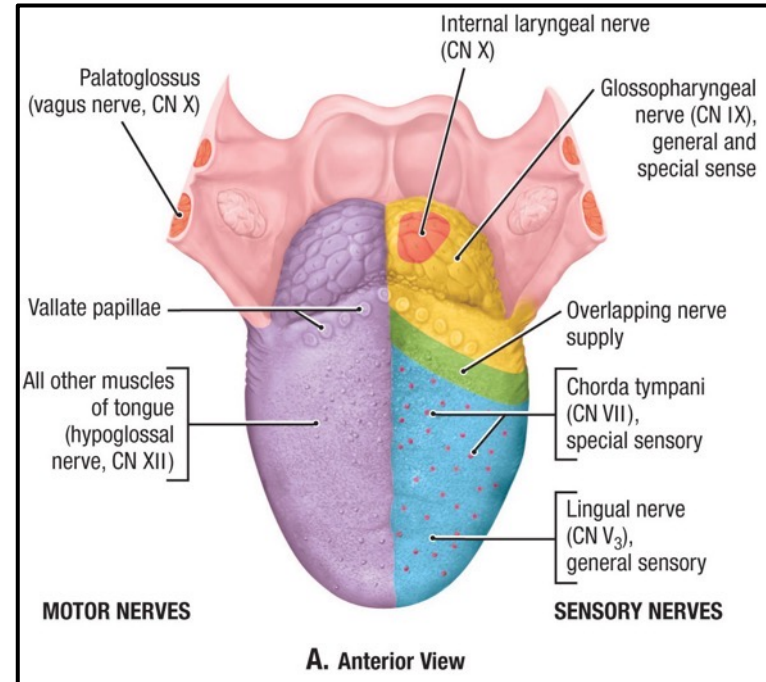
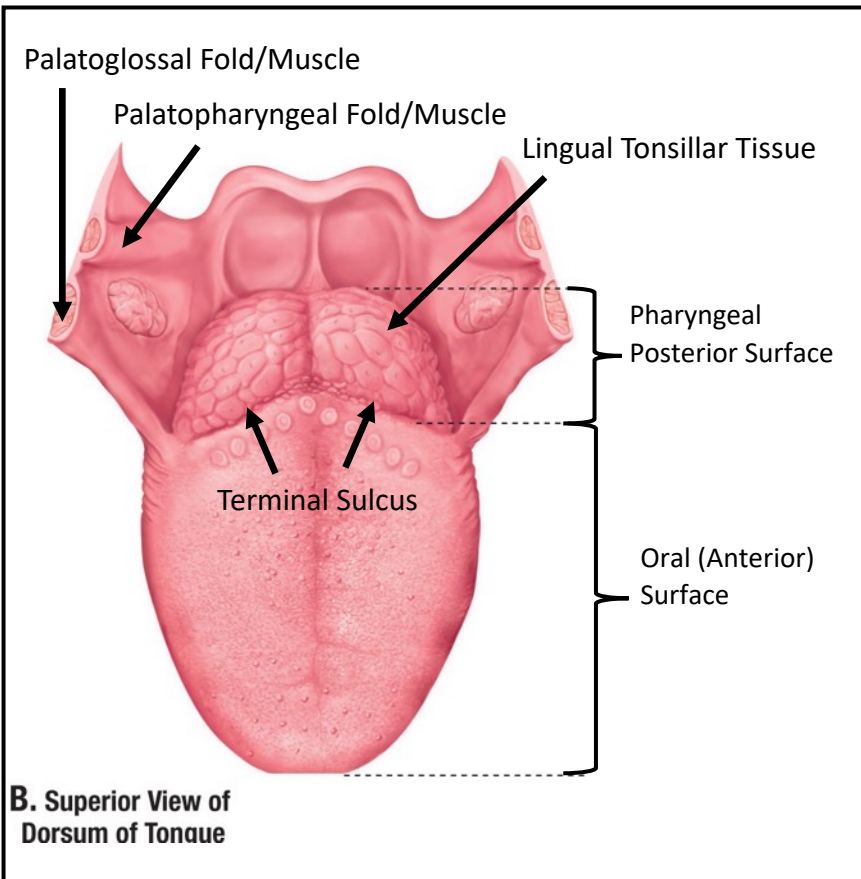
- The inferior surface is covered by a loose mucous membrane.
- The inferior surface of the tongue is loosely attached to the floor of the oral cavity by the (lingual) **frenulum**.



## Oral Cavity/Oropharynx: Tongue Dorsal Surface

The mucosa of the tongue's dorsal surface is separated into two regions by a by a V-shaped groove called the terminal sulcus (terminal groove).

- The **oral (anterior) part** is the **anterior 2/3** of the tongue's surface that faces superiorly toward the hard palate.
  - Sensation for the oral part of the tongue is supplied by the following nerves
  - General sensation: **lingual nerve: branch of mandibular nerve (CN v3)**
  - Taste: **chorda tympani: branch of the facial nerve (CN VII) that courses with the the lingual nerve to reach the tongue.**
- The **pharyngeal (posterior) part** faces posteriorly toward the pharynx and constitutes the **posterior 1/3** of the tongue. Because the palatoglossal fold is the boundary between the oral cavity and the oropharynx, the pharyngeal portion of the tongue is located within the oropharynx.
  - General sensation and taste: **glossopharyngeal nerve (CN IX)**
  - The pharyngeal portion of the tongue's dorsum contains many lingual lymphoid follicles that form the **lingual tonsil**.

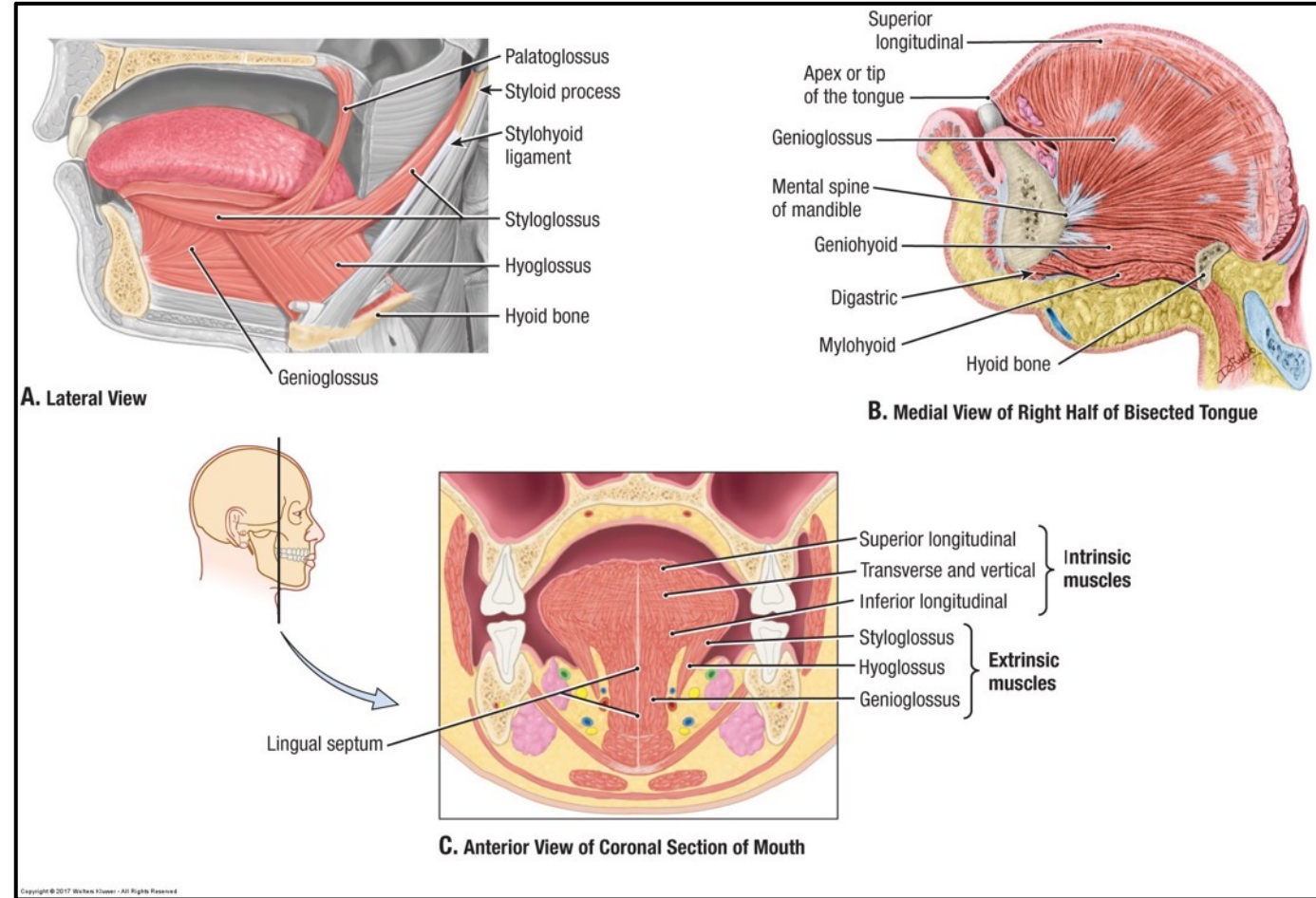


# Oral Cavity/Oropharynx: Tongue Muscles

Extrinsic Muscles	Innervation	Actions: (Alter Position of Tongue)
Genioglossus	CN XII (Hypoglossal n.)	<ul style="list-style-type: none"> <li>Depress</li> <li>Protrude</li> </ul>
Hyoglossus		<ul style="list-style-type: none"> <li>Depress</li> <li>Retract</li> </ul>
Styloglossus		<ul style="list-style-type: none"> <li>Retract</li> </ul>
Palatoglossus	CN X (Vagus n.)	<ul style="list-style-type: none"> <li>Elevate Posterior Tongue</li> <li>Depress Soft Palate</li> </ul>

Intrinsic Muscles	Innervation	Actions
Superior longitudinal, Inferior longitudinal, Transverse, Vertical	CN XII (Hypoglossal n.)	Alter Shape of Tongue (Curl, Elongate, Flatten, Broaden)

**CLINICAL ANATOMY:** Protrusion of the tongue in the exact midline requires contraction of both the right and left genioglossus muscles (that is correct, there are two). Injury to one of these muscles, or its innervation (hypoglossal nerve) in the periphery (i.e., outside of the CNS), results in a deviation of the protruded tongue toward the side of the muscular deficit.

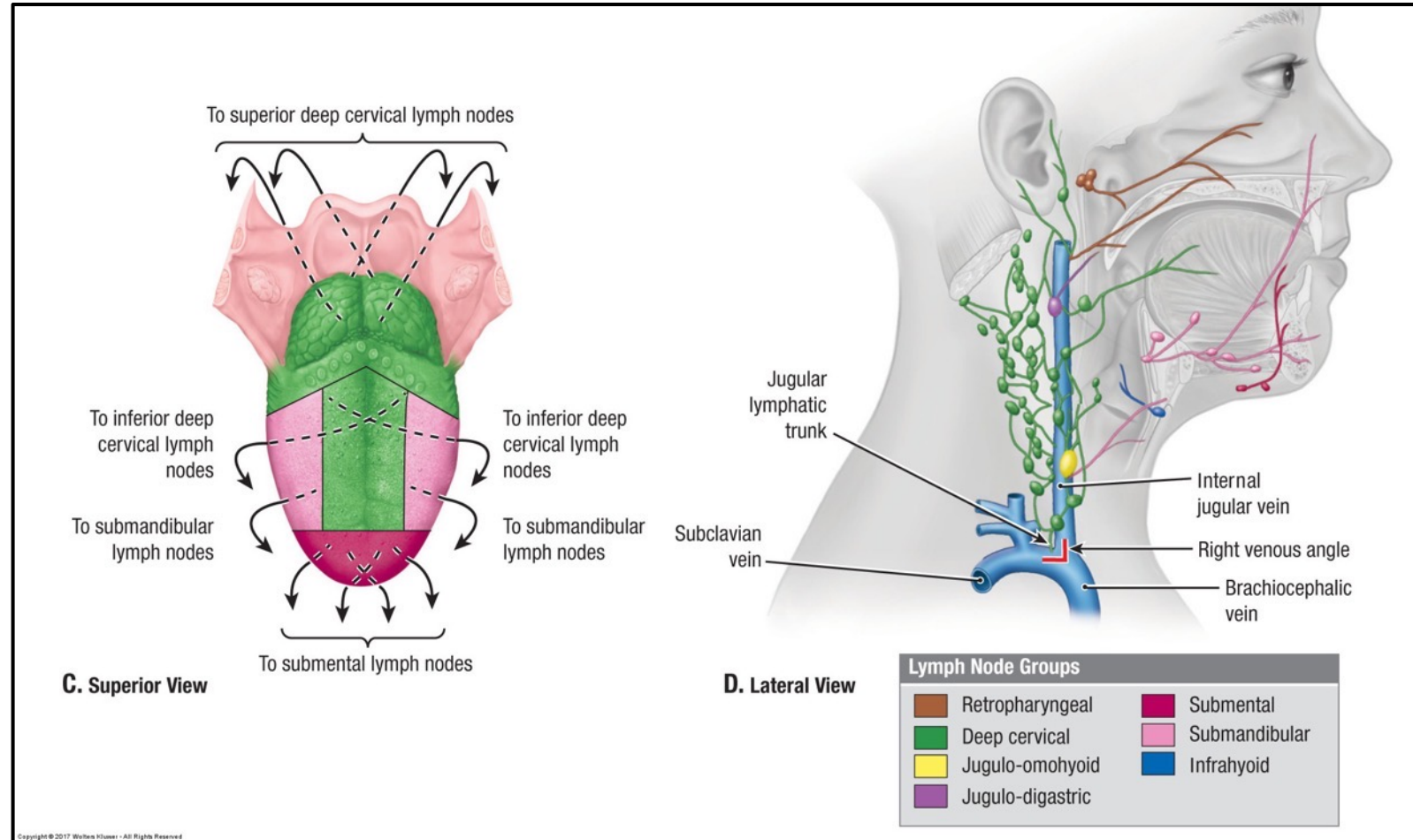




## Oral Cavity/Oropharynx: Tongue Lymph Drainage

Lymph drainage from the tongue drains into the following lymph nodes.

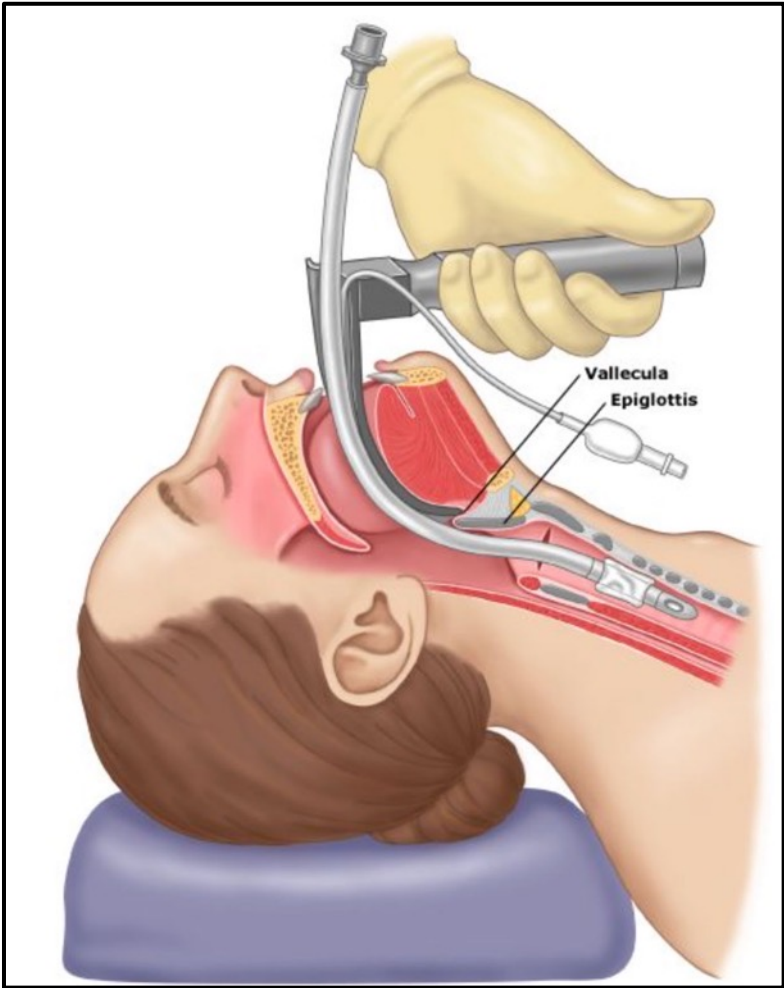
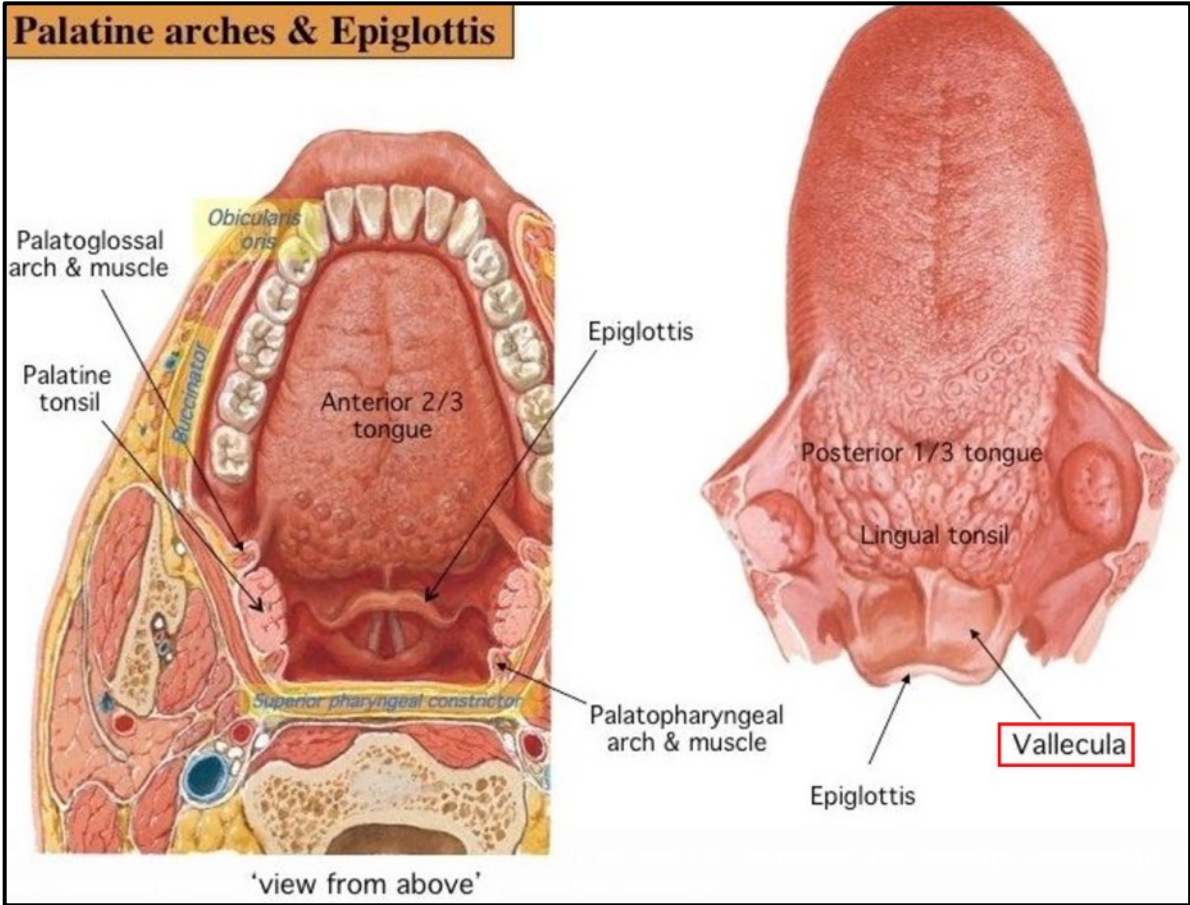
- The lateral margins of the tongue and lateral aspects of the lower lip, drain principally to the submandibular lymph nodes.
- The apex of the tongue, frenulum, and central portion of the lower lip drains to the submental lymph nodes.
- The central and posterior aspects of the tongue's dorsum, drain principally to the jugulodigastric node, which is the largest member of the superior group of the deep cervical chain.



# Oral Cavity/Oropharynx: Valleculae

The (epiglottic) **valleculae** are depressions just posterior to the root of the tongue between the medial and lateral glosso-epiglottic folds in the throat. These depressions serve as locations where saliva is temporarily held to prevent initiation of the swallowing reflex.

**CLINICAL ANATOMY:** The valleculae are important reference landmarks during the placement of an endotracheal tube (intubation). The blade of the laryngoscope should be placed as far as possible into the epiglottic valleculae to allow for visualization of the glottis prior to placing the endotracheal tube through the rima glottidis..

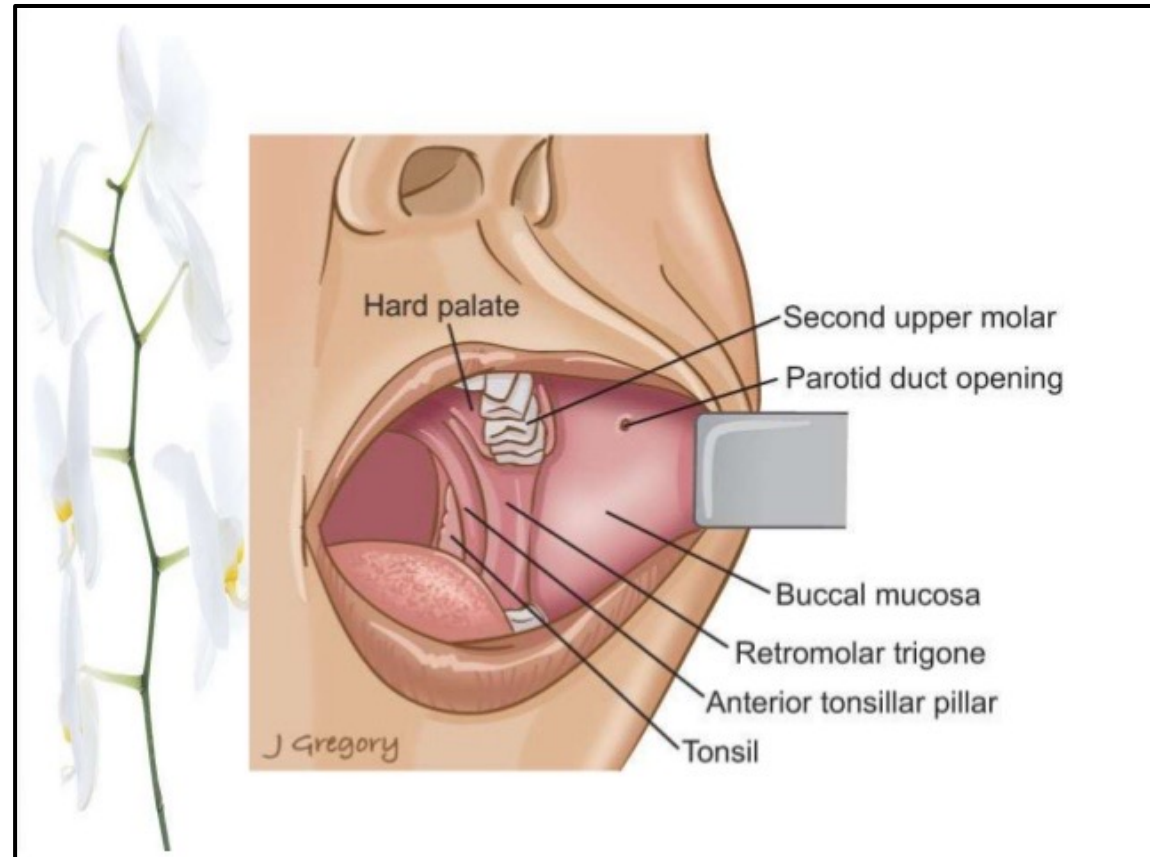
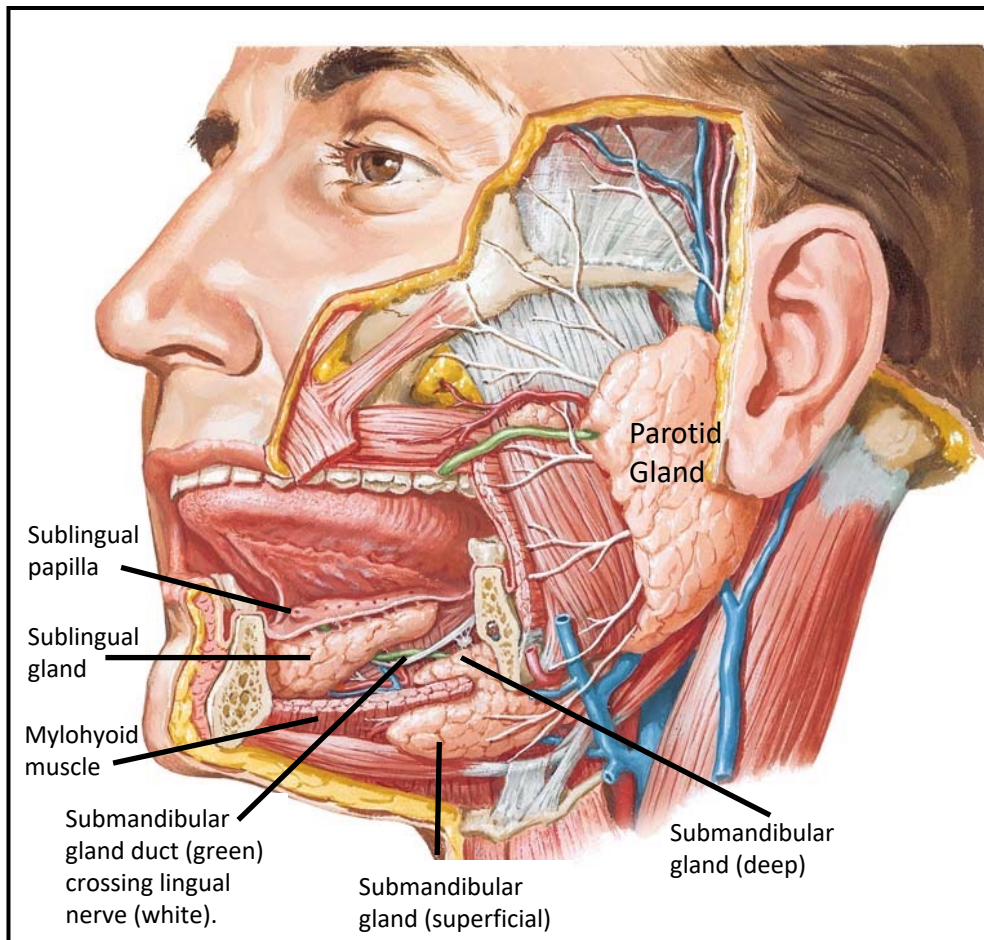




## Salivary Glands: Parotid Gland (Review)

- The paired **parotid glands** are the largest of the salivary glands and are located just anterior and inferior to the pinna (auricle) of the ear.
- The **duct of the parotid gland (Stenson duct)** pierces the **buccinator muscle** and opens into the *oral vestibule* lateral to the maxillary (upper) second molar.

**CLINICAL ANATOMY:** The parotid gland is surrounded by the investing layer of deep cervical fascia that extends from the neck region to the zygomatic arch. This is the most superficial of three deep cervical fascial layers that enclose structures of the neck. The investing layer of deep fascia surrounds the parotid and submandibular glands. Due to the inflexibility of the deep fascia surrounding the parotid gland, parotid infections can lead to severe pain.



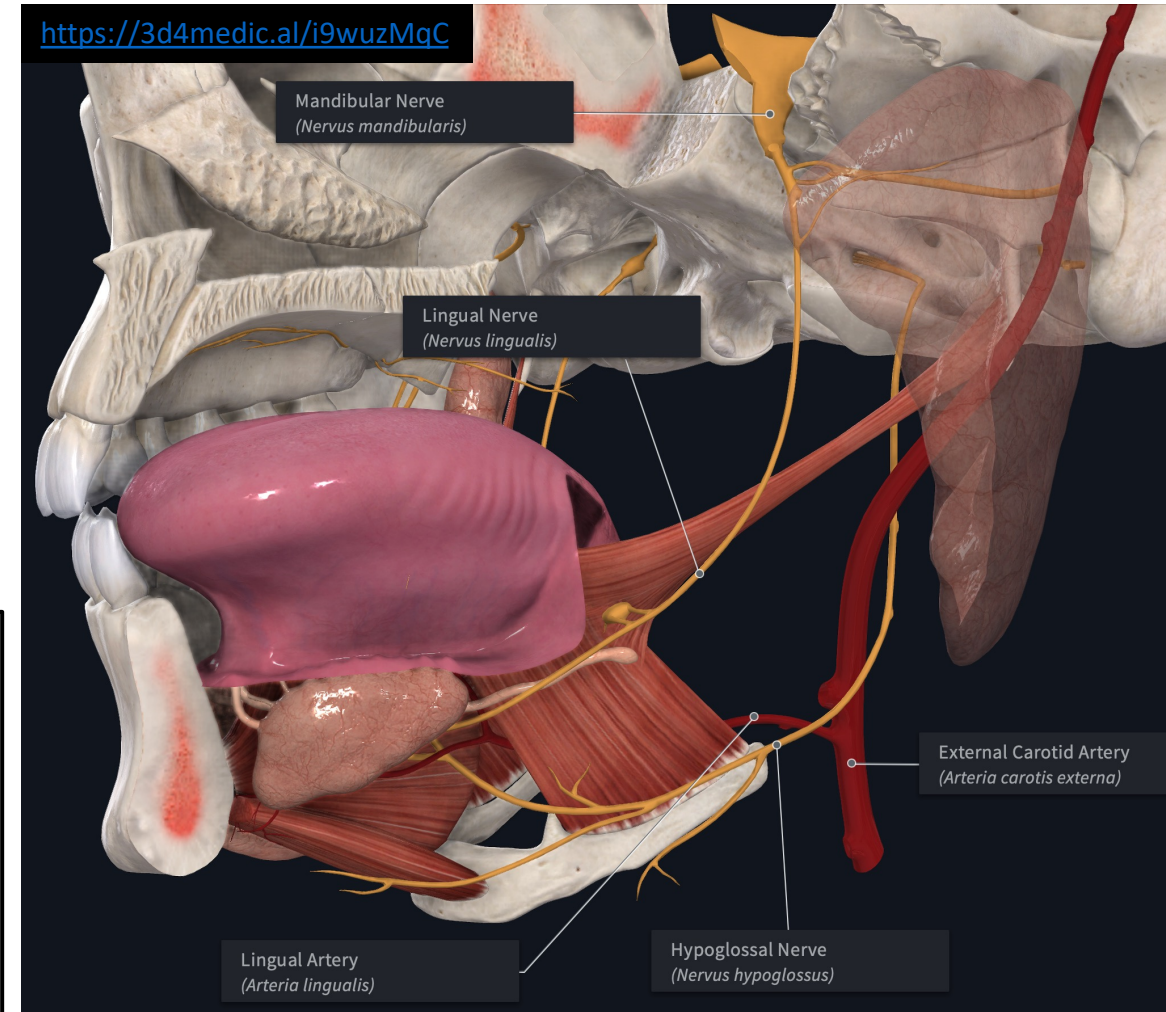
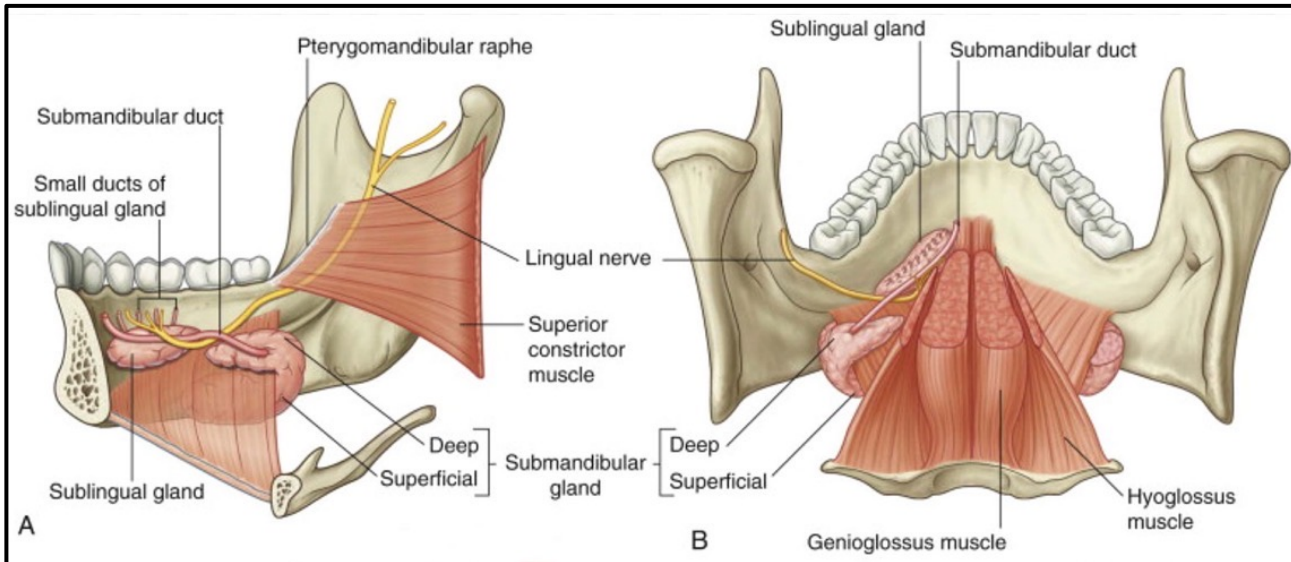
# Anatomical Relationships of Tongue Arteries and Nerves Relative to Hyoglossus m.

Anatomical relationships of nerves and vessels relative to hyoglossus muscle

- Lateral to the hyoglossus muscle
  - Lingual nerve
  - Hypoglossal nerve
- Medial to Hyoglossus
  - Lingual artery

Anatomical Relationship between the lingual nerve (branch of V3) and the submandibular duct

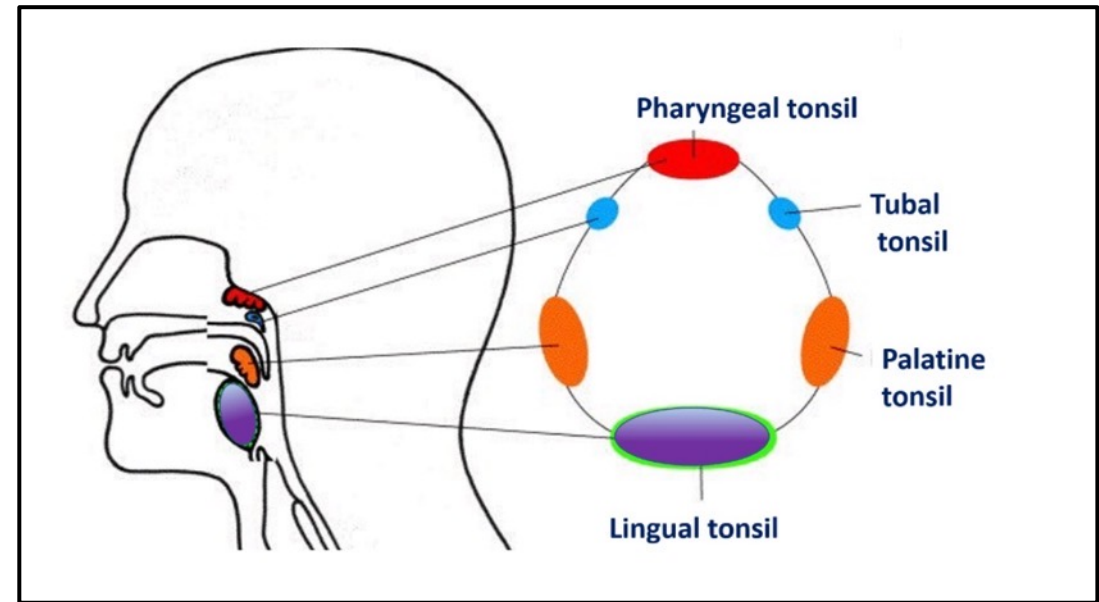
- Note the anatomical relationship between The lingual nerve passes under the submandibular duct (Wharton's duct) as it courses anteriorly toward the tongue. Near the 3<sup>rd</sup> mandibular molar, the submandibular ganglion suspended from the lingual nerve.



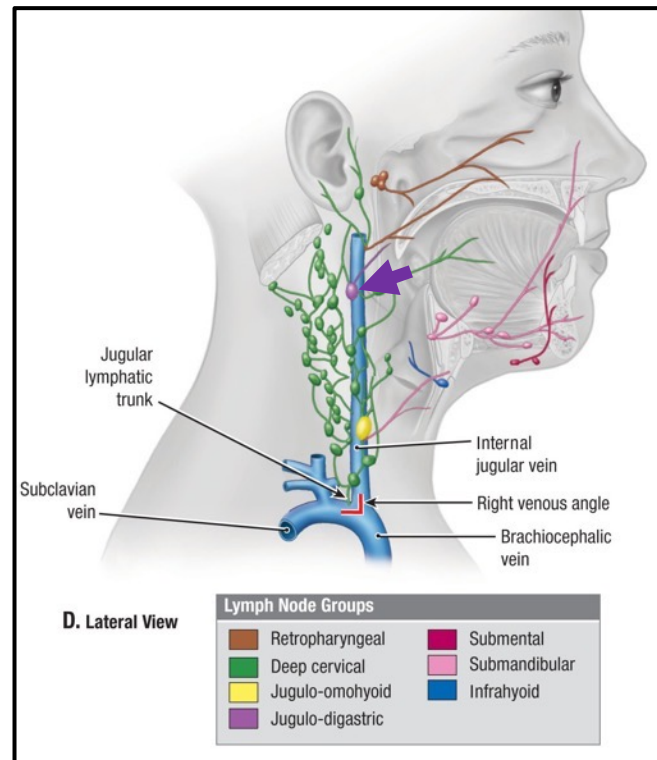
## Tonsillar Tissue: Waldeyer's Ring

The nasopharynx and oropharynx are richly endowed with mucosa-associated lymphoid tissues (MALT). The aggregation of lymphoid tissues "guarding" the openings of the digestive and respiratory tracts is known as Waldeyer's ring and consists of the following tonsillar tissue. Review the locations of the following tonsils.

- The unpaired pharyngeal tonsils (adenoids) located in the roof of the nasopharynx.
- The paired palatine tonsils in the oropharynx.
- The paired tubal tonsils near the openings of the Eustachian tubes.
- The unpaired lingual tonsils located at the base of the tongue.



**CLINICAL ANATOMY:** Lymph from the palatine tonsil drains directly to the jugulodigastric node of the superior group of the deep cervical chain of lymph nodes. Because the jugulodigastric node is frequently enlarged when the palatine tonsil is inflamed (tonsillitis), it is also referred to as the tonsillar node.



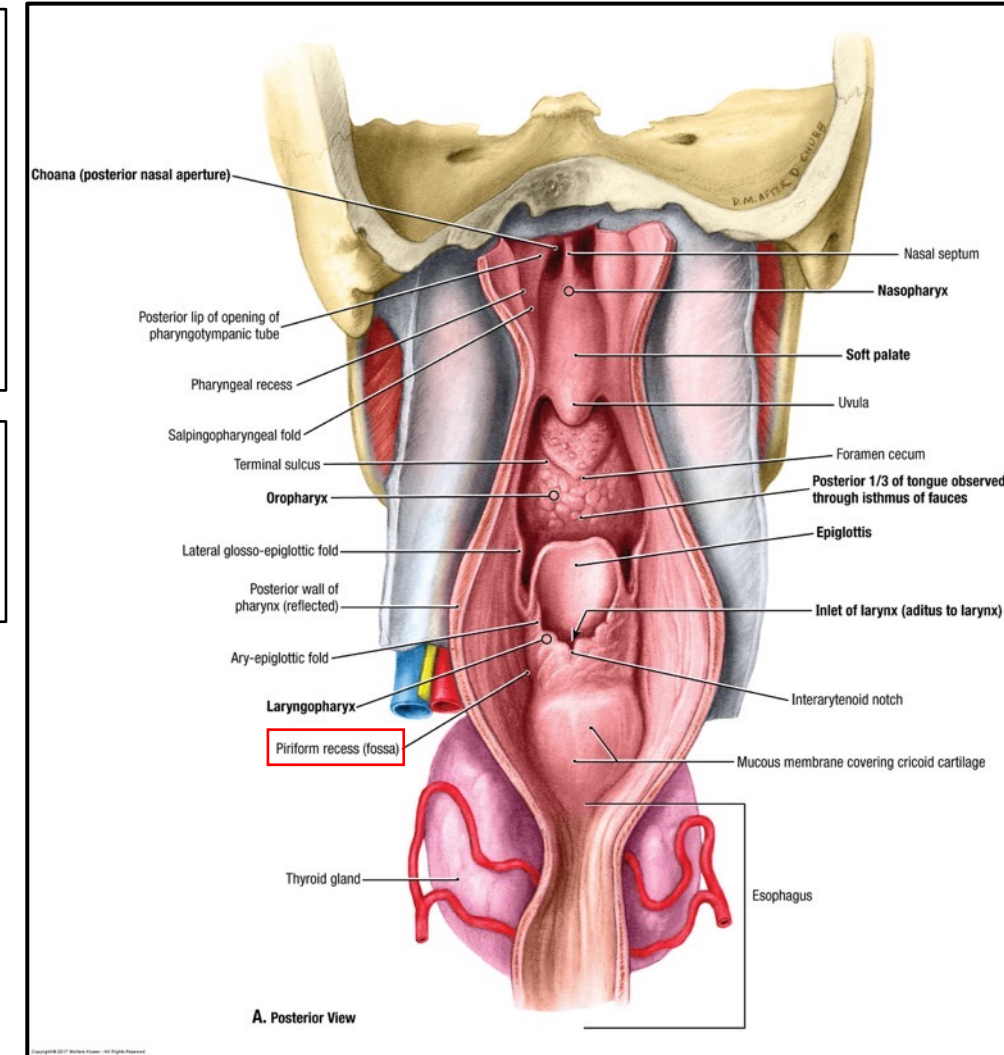
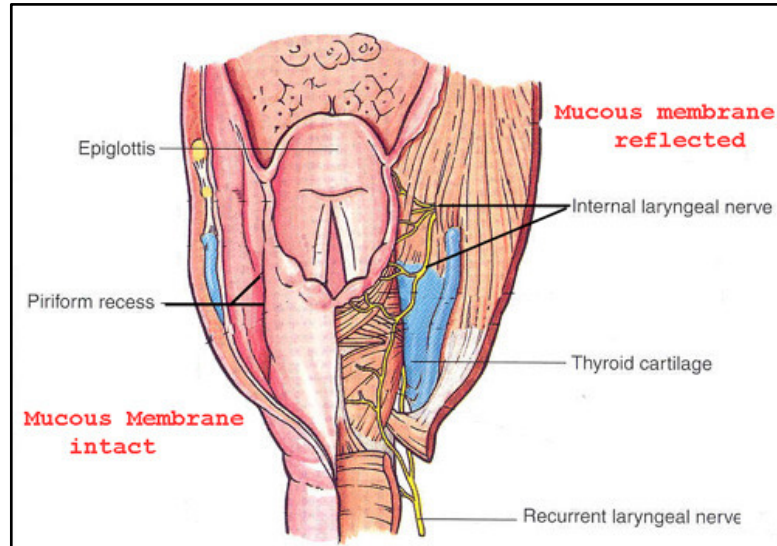
## Hypopharynx: Piriform Recess

In the figure to the right, the posterior wall of the pharynx has been sectioned in the midline and opened to expose the larynx and laryngeal inlet. Observe the **piriform recesses** of the hypopharynx on either side of the larynx.

**FUNCTIONAL ANATOMY:** During swallowing, contraction of the suprahyoid muscles and elevation of the hyoid and larynx elevates the epiglottis against the posterior surface of the tongue and forces the rigid epiglottis to retroflex (i.e., fold posteriorly) over the laryngeal inlet. Passive retroflexion of the epiglottis results in the following functions:

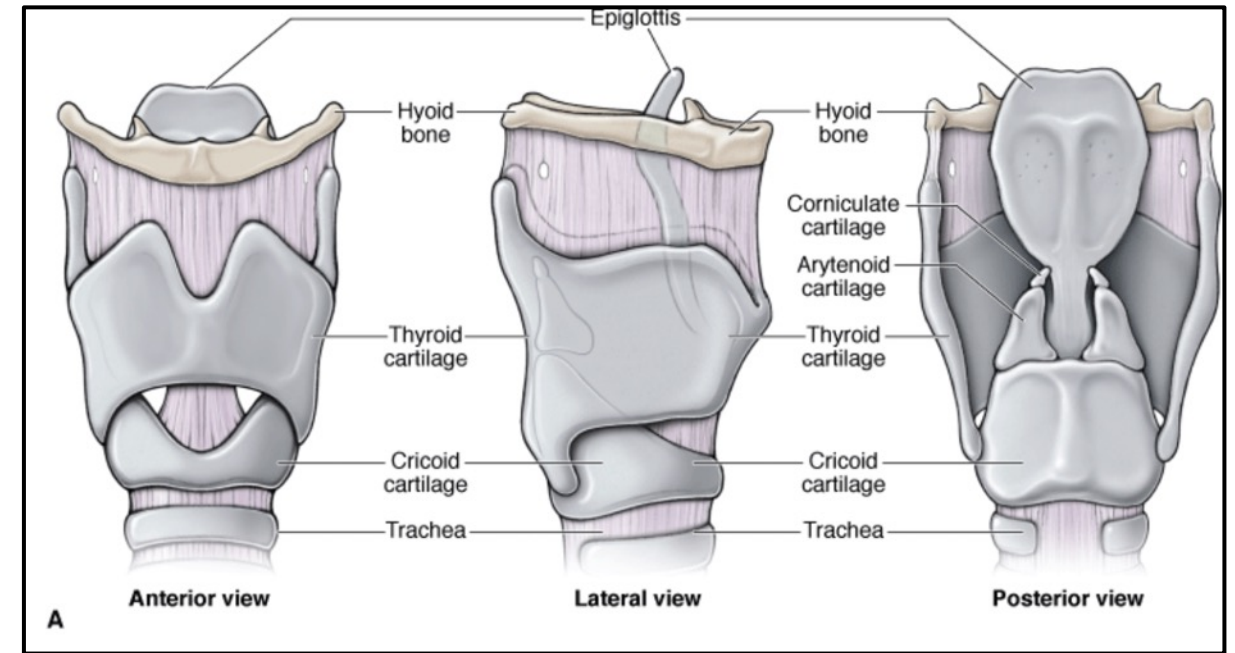
1. It partially covers the laryngeal inlet (it does not cover it completely) to prevent the aspiration of swallowed foods.
2. It directs swallowed food items laterally into the piriform recesses. Food “caught in the throat” lodges in the piriform recess.

**CLINICAL ANATOMY:** As the internal branch of the superior laryngeal nerve courses through the superior larynx, it is located deep to the mucosa of the piriform recess. Sharp objects (e.g., fish or chicken bones) that pass through the piriform recess may pierce the mucous membrane and injure this nerve.

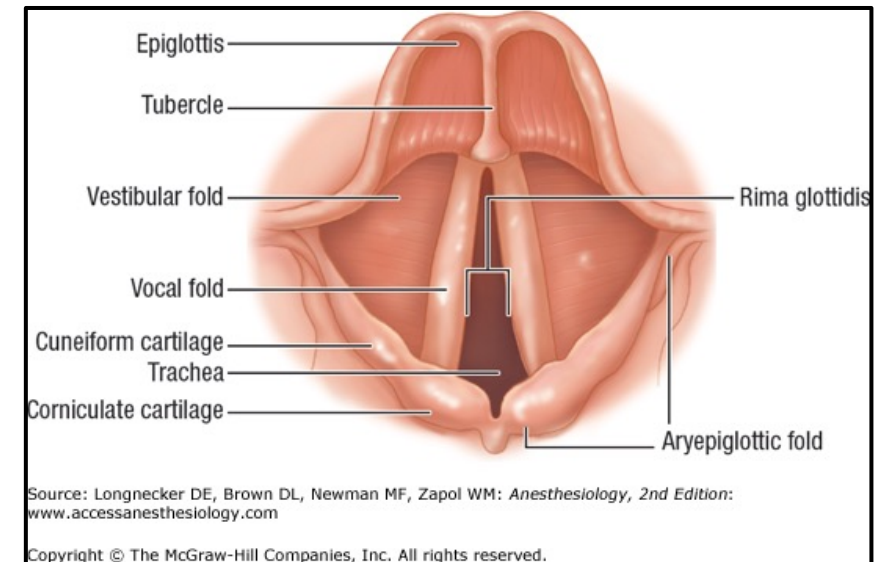


# Larynx: Introduction

- The **larynx** is an air passageway that connects the laryngopharynx to the trachea.
- Its main functions are to maintain a patent airway, phonation, and prevent food from entering the air passageways.
- It is composed of nine cartilages (3 paired and 3 unpaired) connected by ligaments and membranes.
  - The **thyroid cartilage** is the largest cartilage forming the larynx. It is unpaired and is composed of two large plates that are joined anteriorly to form a protrusion called the **laryngeal prominence** (Adam's apple).
  - The **cricoid cartilage** is an unpaired cartilage inferior to thyroid cartilage. It forms a complete ring around the larynx and is connected by ligaments to both the thyroid cartilage and the trachea. It is located at the level of the C6 vertebra. Its inferior edge delineates the boundary between the larynx and the trachea of the respiratory tract, and between the pharynx and the esophagus of the digestive tract.



- The **arytenoid cartilages** are paired pyramidal-shaped cartilages that rest on the superior side of the posterior portion of the cricoid cartilage.
- Attached to the apex of each arytenoid cartilage are the **corniculate cartilages**.
- The cuneiform cartilages are 2 small, club-shaped cartilages that lie anterior to the corniculate cartilages in the aryepiglottic folds. They form small, whitish elevations on the surface of the mucous membrane just anterior of the arytenoid cartilages.
- The **epiglottis** is an unpaired cartilage of the larynx composed of elastic cartilage, which allows it to be flexible. During swallowing, the epiglottis covers the laryngeal inlet. When not actively swallowing, the unattached end projects superiorly from the larynx and extends into the oropharynx.



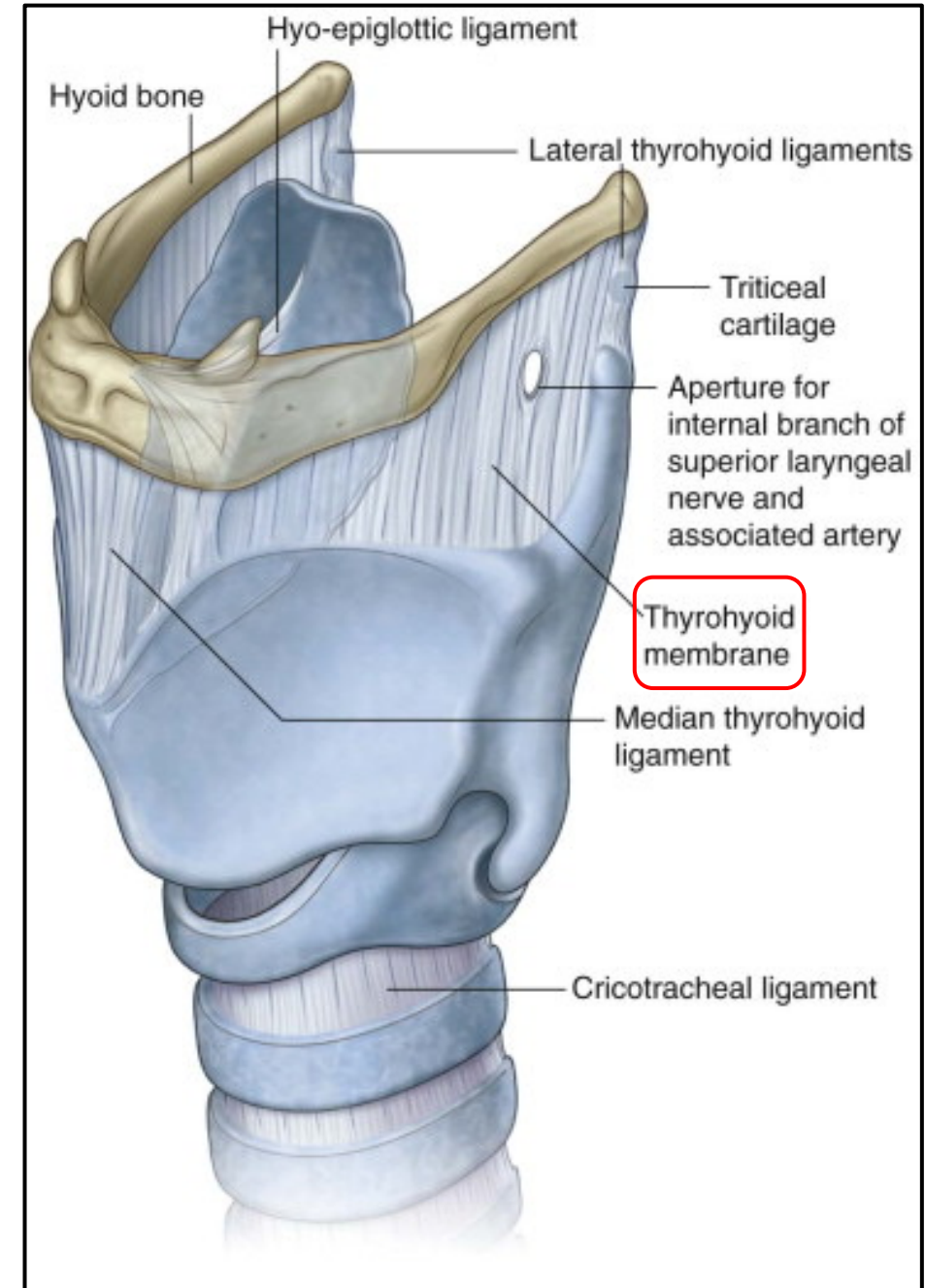
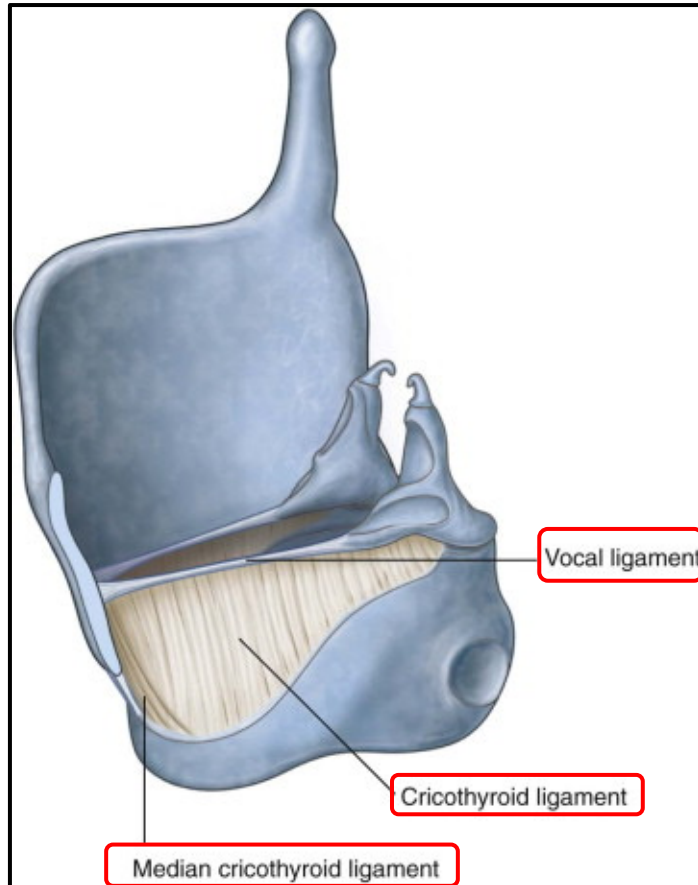
Source: Longnecker DE, Brown DL, Newman MF, Zapol WM: *Anesthesiology*, 2nd Edition: www.accessanesthesiology.com

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## Larynx: Ligaments

- The **cricothyroid ligament (membrane)** is thickened anteriorly in the midline to form the median cricothyroid ligament (Figure 2).
- **Thyrohyoid membrane** spans the space between the thyroid cartilage and hyoid bone
- The **vocal ligaments** extend from the posterior side of the junction between the plates of the thyroid cartilage to the base of the arytenoid cartilages. They are involved in the production of sound. We will explore the muscles involved in phonation in the next PowerPoint Handout.

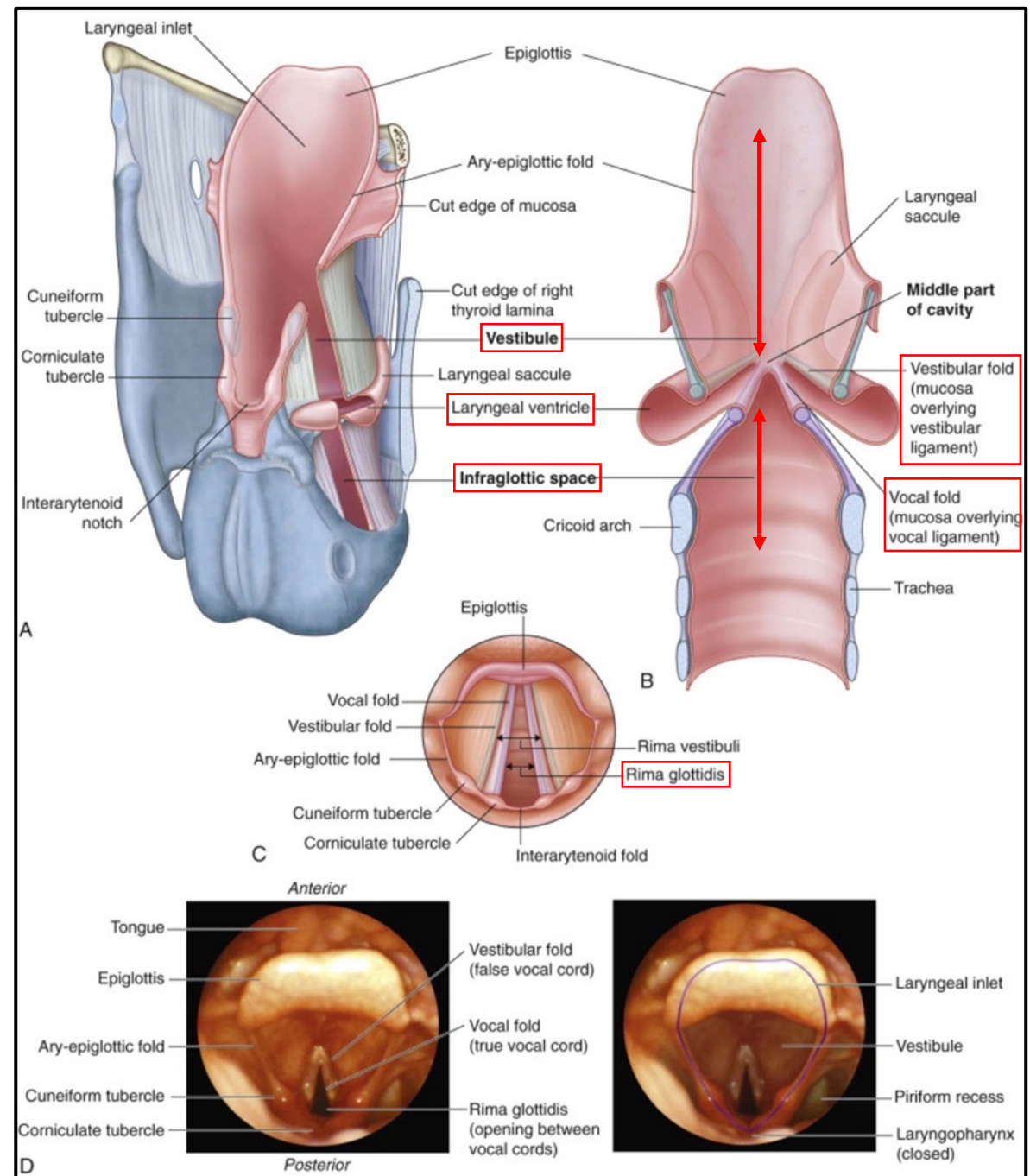


## Larynx: Folds and Spaces

- The **laryngeal inlet** is formed by the following boundaries.
  - The free, curved edge of the epiglottis forms the anterior boundary.
  - The interarytenoid fold (mucous membrane between the arytenoid cartilages) forms the posterior wall.
  - The aryepiglottic fold, spanning between the epiglottis anteriorly and the arytenoid cartilage posteriorly, forms the lateral border.
- The **vocal fold** is a mucosal fold created by the underlying **vocal ligament**.
- The **false vocal fold (vestibular or ventricular fold)** is a fold of tissue superior to the true vocal fold that is not involved in the production of sound.
- The **vestibule** is the space between the laryngeal inlet and the vocal fold.
- The **ventricle** is a recessed region within each lateral wall of the larynx located between the false vocal fold superiorly and the true vocal fold inferiorly.
- The space between the vocal folds is called rima glottidis.
  - The term **glottis** refers to the paired vocal folds (true vocal fold/cord) AND the space between them (rima glottidis) .

### Spaces separated by the ventricle

- The region of the laryngeal cavity between the laryngeal inlet and the ventricle is the **laryngeal vestibule**.
- The region of the larynx inferior to the vocal folds is the **infraglottic space**.



# Laryngeal Muscles

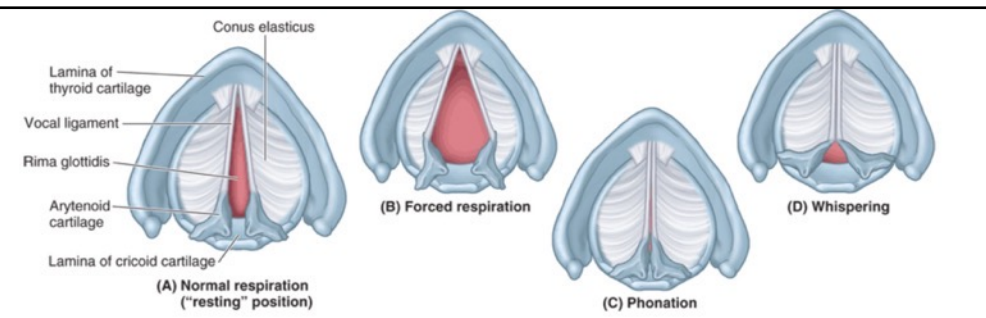
TABLE 8.9		MUSCLES OF LARYNX		
Muscle	Origin	Insertion	Innervation	Main Action(s)
* Cricothyroid	Anterolateral part of cricoid cartilage	Inferior margin and inferior horn of thyroid cartilage	External branch of superior laryngeal nerve (CN X)	Tenses vocal fold
* Posterior crico-arytenoid	Posterior surface of laminae of cricoid cartilage	Muscular process of arytenoid cartilage	Recurrent laryngeal nerve (CN X)	Abducts vocal fold
Lateral crico-arytenoid	Arch of cricoid cartilage	Opposite arytenoid cartilage		Adducts vocal fold
Thyro-arytenoid <sup>a</sup>	Posterior surface of thyroid cartilage			Relaxes vocal fold
Transverse and oblique arytenoids <sup>b</sup>	One arytenoid cartilage	Close inlet of larynx by approximating arytenoid cartilages		
Vocalis <sup>c</sup>	Angle between laminae of thyroid cartilage	Vocal ligament, between origin and vocal process of arytenoid cartilage		Alters vocal fold during phonation

<sup>a</sup>Superior fibers of the thyro-arytenoid muscle pass into the ary-epiglottic fold, and some of them reach the epiglottic cartilage. These fibers constitute the thyro-epiglottic muscle, which widens the inlet of the larynx.  
<sup>b</sup>Some fibers of the oblique arytenoid muscle continue as the ary-epiglottic muscle.  
<sup>c</sup>This slender muscular slip is derived from inferior deeper fibers of the thyro-arytenoid muscle.

Muscles that move the larynx are categorized as extrinsic or intrinsic.

- Extrinsic laryngeal muscles move the entire larynx superiorly or inferiorly (swallowing). Suprahyoid muscles, infrahyoid muscles, and stylopharyngeus are examples of extrinsic laryngeal muscles.
- **Intrinsic laryngeal muscles** move individual components of the larynx, which leads to altering the shape of the rima glottidis, length of vocal ligament, and/or tension on the vocal ligament.
  - Note: All intrinsic laryngeal muscles are innervated by the **recurrent laryngeal nerve** EXCEPT for the **cricothyroid muscle**, which is innervated by the **external branch of the superior laryngeal nerve**.

**FUNCTIONAL ANATOMY:** Variation in the tension and length of the vocal ligaments, in the width of the rima glottidis, and the intensity of the expiratory effort produces changes in the pitch of the voice. The lower range of pitch in postpubescent males results from the greater length of the vocal ligaments.



**CLINICAL ANATOMY:** Bilateral loss of the posterior cricoarytenoid muscles causes adduction of the vocal cords, which results in a risk of asphyxiation.

