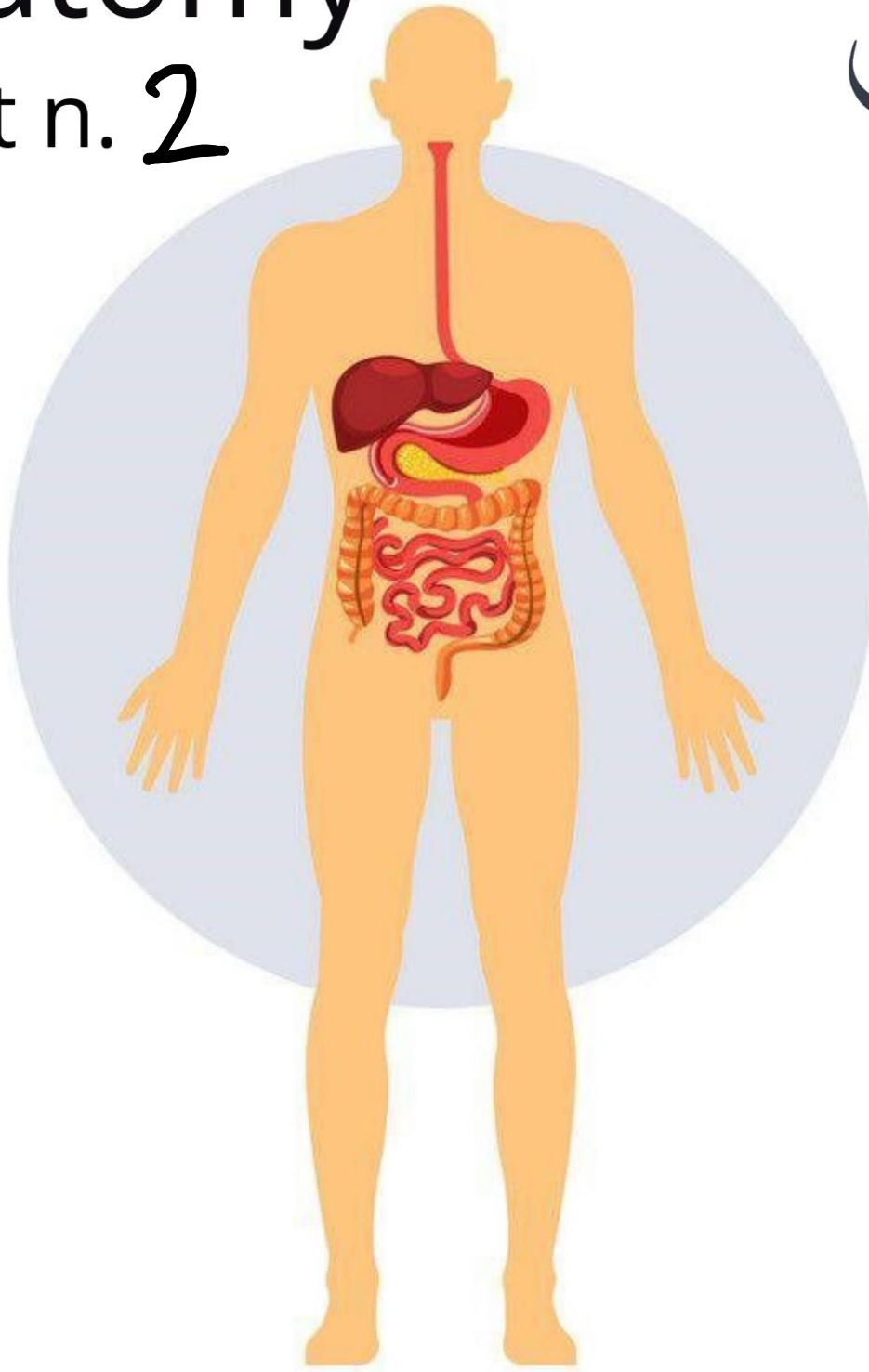


Anatomy

Sheet n. 2



DIGESTIVE SYSTEM

Writer: Dr 021

Corrector: *Farah Khatzneh*



THIS FONT WAS USED FOR SUBTITLES

This font was used for paragraphs from slides.

This font was used for paragraphs that Dr read from slides

This font is for very important info.

This font was used for Dr's explanation away from slides:

This font was used for info from other sources.

Many photos were added for better understanding

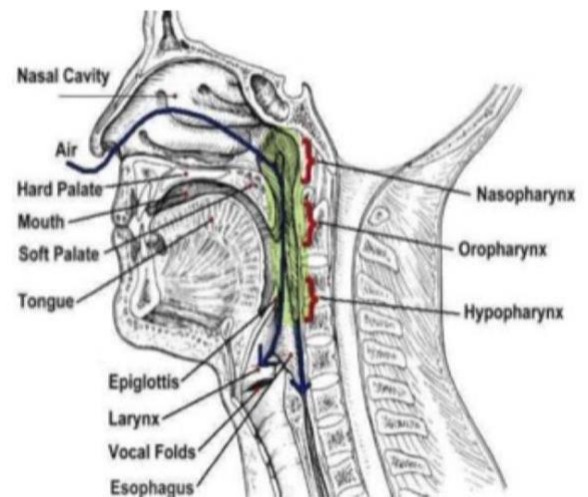
The Pharynx, Tonsils and Palate

THE PHARYNX

It begins at the base of the skull and ends at the 6th cervical vertebra and continues as the esophagus.

It's situated behind the nasal cavities, the mouth, and the larynx and may be divided into: nasal, oral and laryngeal parts.

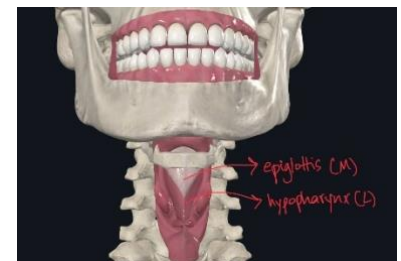
On the inside, it is covered with mucosa (stratified squamous non-keratinized) just like that of the esophagus. Then areolar CT, layer of constrictor muscles, CT. Thereby, we describe the pharynx and its wall to be Musculo-membranous.



The Pharynx is funnel shaped (upper part is wide, low part is narrow). **Its upper wider end lying under the skull and its lower, narrow end becoming continuous with the esophagus opposite the sixth cervical vertebra.**

The pharynx has a Musculo-membranous wall which is deficient (open) anteriorly. Here it is replaced by:

- 1) The posterior openings into the nose (choanae) into the nasopharynx**
- 2) The opening into the mouth (oropharyngeal isthmus) into the oropharynx**
- 3) The inlet of the larynx into the laryngopharynx (or hypopharynx), bounded by the epiglottis (check additional pic on the right)**



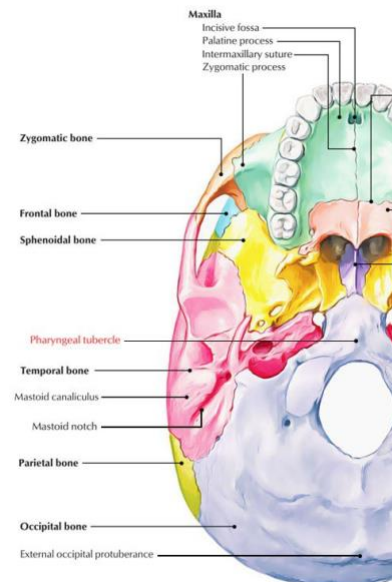
*Each part of the pharynx takes its name from the cavity it's behind.

By means of the auditory tube, the mucous membrane is also continuous with that of the tympanic cavity.

MUSCLES OF THE PHARYNX

The muscles in the wall of the pharynx consist of the superior, middle, and inferior constrictor. Their fibers run in a somewhat circular direction, and the stylopharyngeus and salpingopharyngeus muscles, whose fibers run more obliquely in a somewhat longitudinal direction. (5 muscles in total: 3 circular constrictors & 2 oblique muscles)

The three constrictor muscles contract to help the peristaltic movement in descending the bolus. They extend around the pharyngeal wall to be inserted into a fibrous band or raphe (pharyngeal raphe) that extends from the pharyngeal tubercle on the basilar part of the occipital bone of the skull down to esophagus. (Check additional pic on the right)

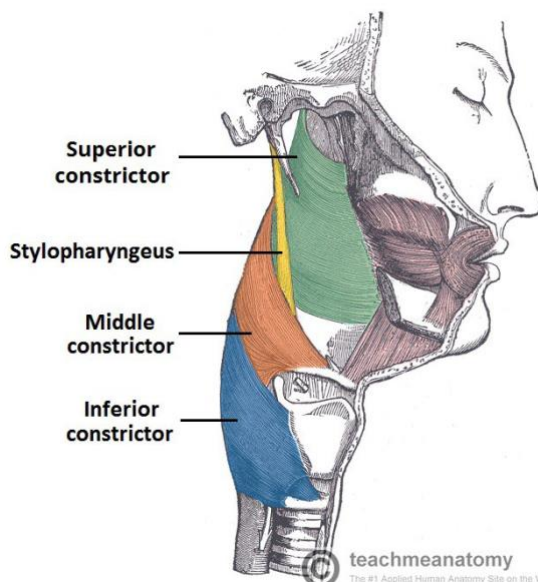


The three constrictor muscles overlap each other so that the middle constrictor lies on the outside of the lower part of the superior constrictor and the inferior constrictor lies outside the lower part of the middle constrictor.

There are three constrictor muscles whose fibers are circular:

- 1) superior constrictor of the pharynx
- 2) middle constrictor of the pharynx
- 3) inferior constrictor of the pharynx

(Superior constrictor of the pharynx ~~inside~~ ^{outside} the middle, and the middle ~~inside~~ ^{outside} the inferior)
 (Check additional pic on the right) → outside



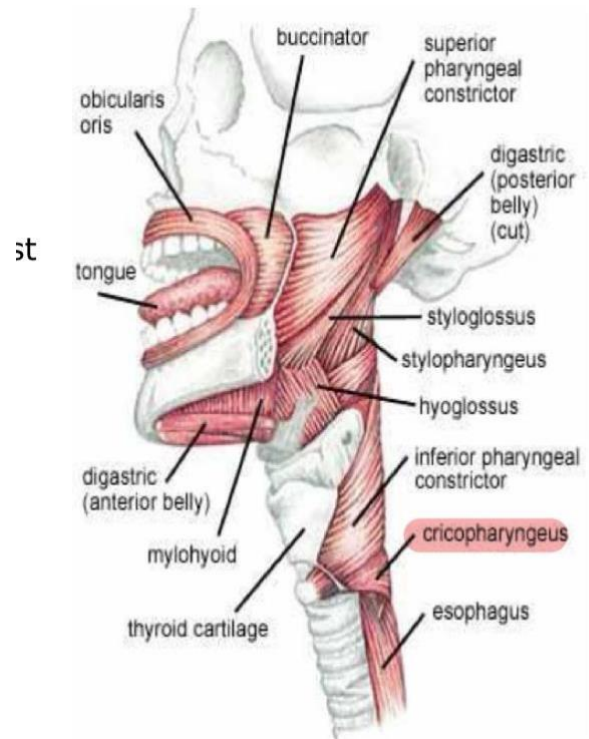
You need to know the origin, insertion, nerve supply and action of each muscle.

- The insertion for all the constrictor muscles (3) is Pharyngeal raphe.
- You can tell the origin of each muscle from its name.
- Nerve supply: all of them are supplied by the pharyngeal plexus except one.
 *Reminder: pharyngeal plexus is made of 3 nerves (vagus, accessory, glossopharyngeal nerves) on the posterior wall of the pharynx
- Action: helping in the peristaltic movements and thereby helping the bolus to descend downwards to the esophagus.

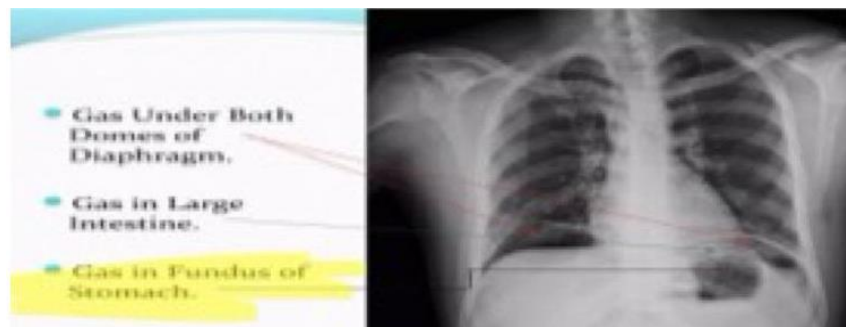
Muscle	Origin	Insertion	Innervation	Action
Superior constrictor	Medial pterygoid plate, pterygoid hamulus, pterygomandibular ligament, mylohyoid line of mandible	Pharyngeal tubercle of occipital bone, raphe in midline posteriorly	Pharyngeal plexus	Aids soft palate in closing off nasal pharynx, propels bolus downward
Middle constrictor	Lower part of stylohyoid ligament, lesser and greater cornu of hyoid bone	Pharyngeal raphe	Pharyngeal plexus	Propels bolus downward
Inferior constrictor	Lamina of thyroid cartilage, cricoid cartilage	Pharyngeal raphe	Pharyngeal plexus	Propels bolus downward
Cricopharyngeus (lowest fibers of inferior constrictor muscle)	Sphincter at lower end of pharynx			
Stylopharyngeus	Styloid process of temporal bone	Posterior border of thyroid cartilage	Glossopharyngeal nerve	Elevates larynx & pharynx during swallowing
Salpingopharyngeus	Auditory tube	Blends with palatopharyngeus	Pharyngeal plexus	Elevates pharynx
Palatopharyngeus	Palatine aponeurosis	Posterior border of thyroid cartilage	Pharyngeal plexus	Elevates wall of pharynx, pulls palatopharyngeal arch medially

Notes regarding the previous table:

- Palatopharyngeal fold is formed by palatopharyngeus muscle and its mucous membrane, it helps separate the oral cavity from oropharynx (will be discussed later in detail) .
- **The fibers of the lower part of the inferior constrictor, the cricopharyngeus muscle pass horizontally around the lowest and narrowest part of the pharynx and act as a sphincter.** -to constrict the lower portion of the pharynx, preventing passage of air. This means that it is always contracting (closed) unless (1) a bolus reaches it, stimulates it, causes it to relax and open OR (2) when vomiting, the intra-abdominal pressure causes it to open.
- Some air can still enter despite the presence of the cricopharyngeus to the pharynx -> esophagus -> stomach -> goes upwards to the upper portion of the stomach called Fundus.

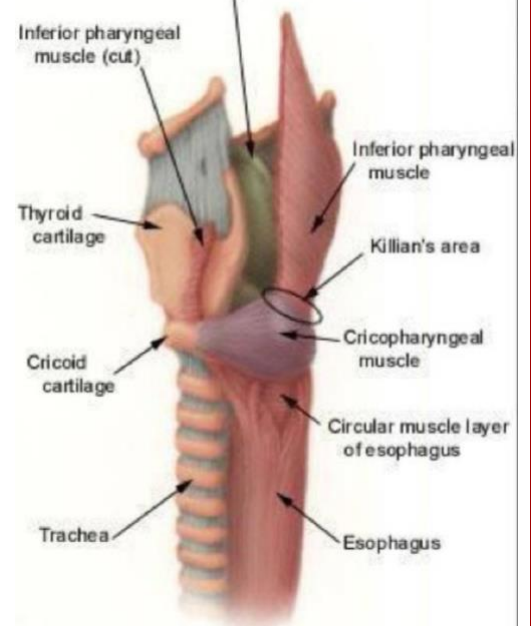


Dr mentioned the presence of gas in the fundus of the stomach displayed as black dots in X - ray imaging of the abdomen ([check additional pic below](#))



- **Killian's dehiscence is the area on the posterior pharyngeal wall between the upper propulsive part of the inferior constrictor and the lower sphincteric part, the cricopharyngeus.**

It is very sensitive, so any stimulation causes the muscles to contract -> make us cough/vomit



INTERIOR OF THE PHARYNX

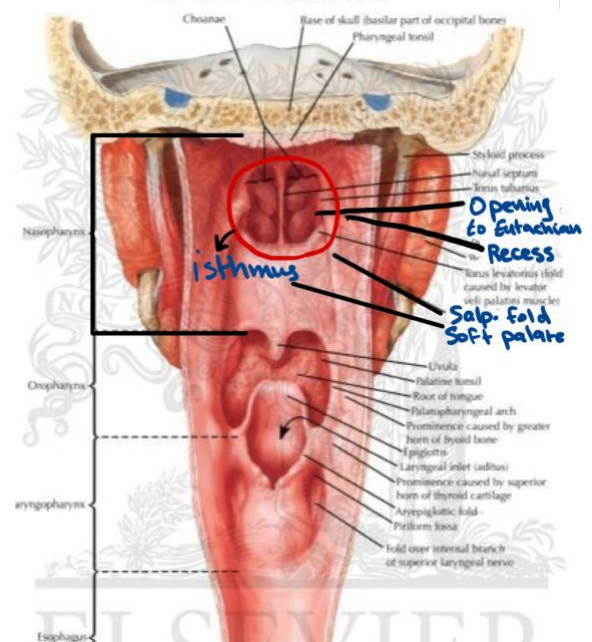
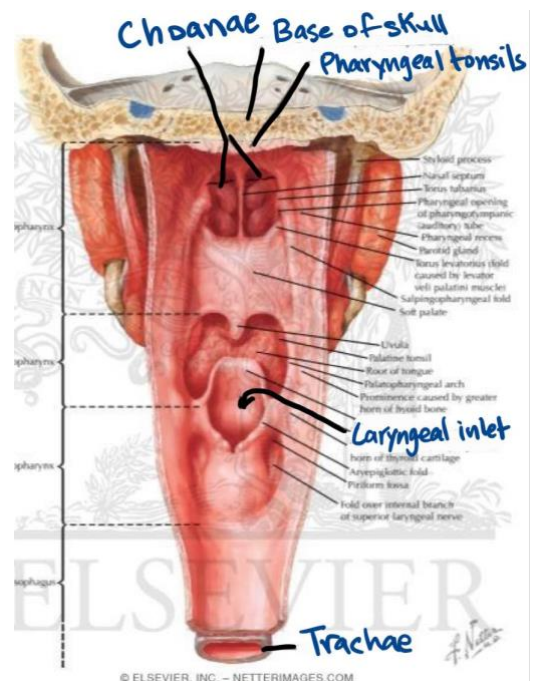
Pics below show a coronal section Posteriorly.

- The pharynx (function: passage of air: it enters from the choanae to inlet and then from the larynx to trachea, bronchi, and fills the lungs) **is divided into three parts: the nasal pharynx, the oral pharynx, and the laryngeal pharynx**

1. Nasal Pharynx (Choanae)

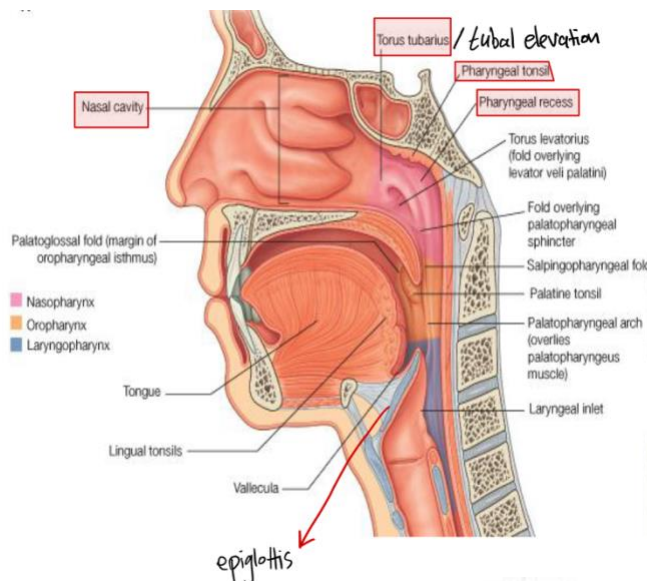
- This lies between base of the skull and the soft palate, behind the nasal cavities
- In the submucosa of the roof is a collection of lymphoid tissue called the pharyngeal tonsils
- Very important clinically: Pharyngeal tonsil (adenoid) enlargement causes block to nasopharynx, so child starts breathing via mouth rather than nose, needs removal by surgery

- The pharyngeal isthmus (function is swallowing the bolus, we'll discuss later how) **It is the opening in the floor between the soft palate and the posterior pharyngeal wall**
- On the lateral wall is the opening of the auditory tube, the elevated ridge of which is called the tubal elevation
- The pharyngeal recess is a depression in the pharyngeal wall behind the tubal elevation
- The salpingopharyngeal fold is a vertical fold of mucous membrane covering the salpingopharyngeus muscle.



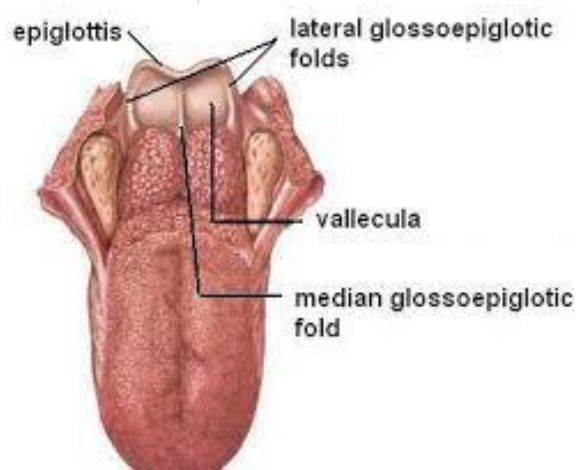
- Clinical note: On the lateral wall of nasopharynx is the opening of the auditory tube (Eustachian) it delivers air to the middle ear and balance pressure to tympanic membrane. The disadvantage is that it can spread infection from the nasal cavity to the middle ear and cause otitis media... that is especially the case when a child vomits in supine position

Dr focused on the following structures in this Sagittal section.

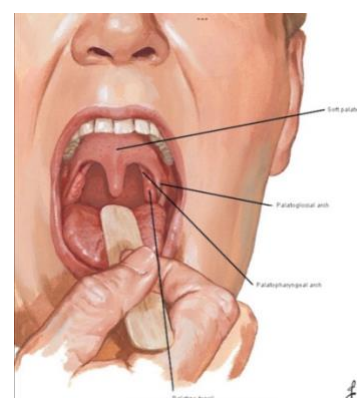
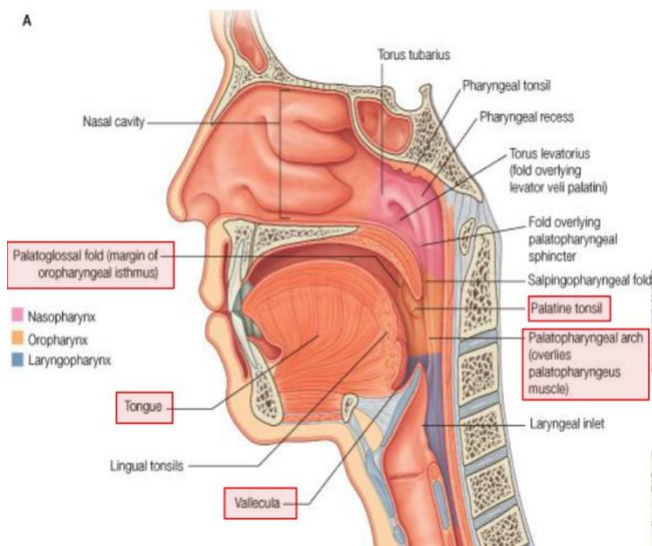


2. Oropharynx

- This lies behind the oral cavity
- The floor is formed by the posterior one third of the tongue and the interval (connection) between the tongue and epiglottis (recall previous lecture from the pic on the right)



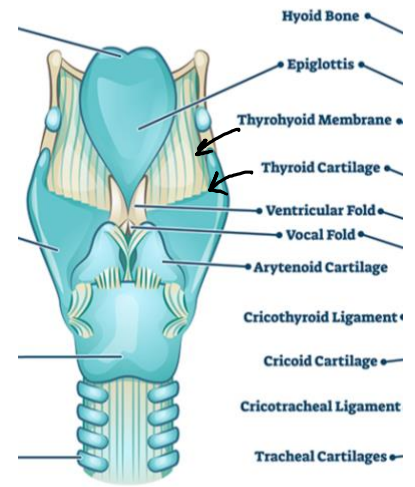
- In the midline is the median glossoepiglottic fold and on each side the lateral glossoepiglottic fold (also called aryepiglottic folds)
- The depression on each side of the median glossoepiglottic fold is called the vallecula (a space filled with saliva)
- On the lateral wall on each side are the palatoglossal and the palatopharyngeal arches or folds (formed by palatoglossus & palatopharyngeus respectively) and the palatine tonsils between them
- interval between the two palatoglossal arches is called the oropharyngeal isthmus and marks the boundary between the mouth and pharynx.



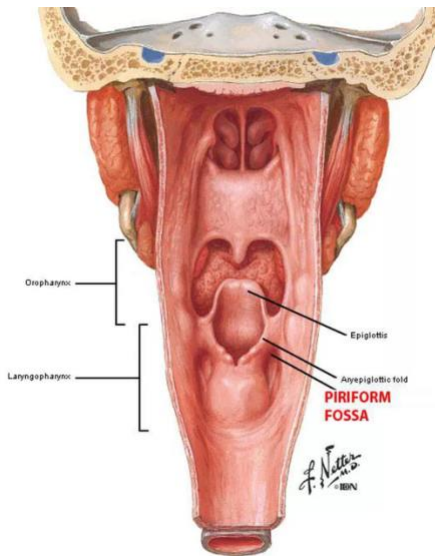
3. Laryngeal Pharynx

- **This lies behind the opening into the larynx**
- **The lateral wall is formed by the thyroid cartilage and the thyrohyoid membrane (see pic on the right)**
This is the posterior view of the larynx.. so the laryngeopharynx is right behind the shown structure. Try to imagine how the lateral walls of the pharynx are continuous with the thyroid cartilage and thyrohyoid membrane of the larynx
- **The piriform fossa is a depression in the mucous membrane on each side of the laryngeal inlet.** So It is
- in between the pharynx and the larynx.
(see pic below)

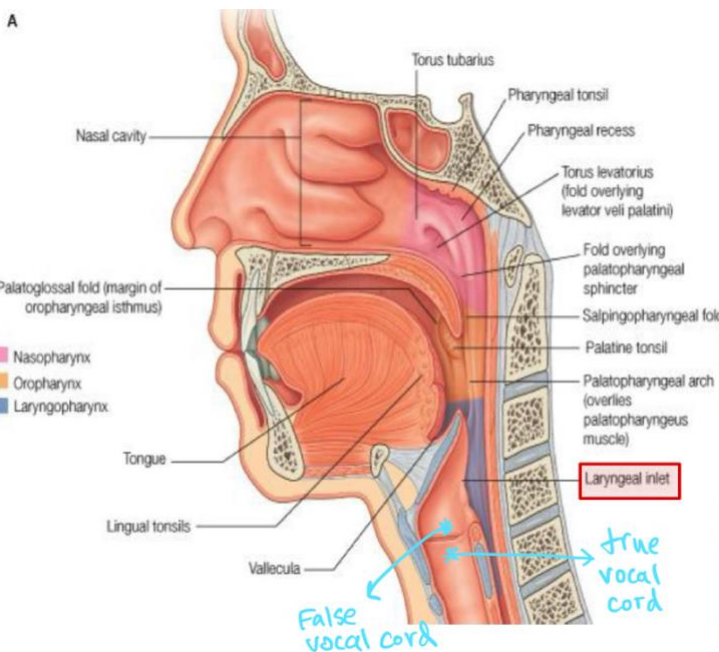
Larynx



POSTERIOR VIEW



Piriform fossa, a depression, antero-lateral to laryngopharynx. It is a common site for the lodge of foreign bodies such as fish bones.

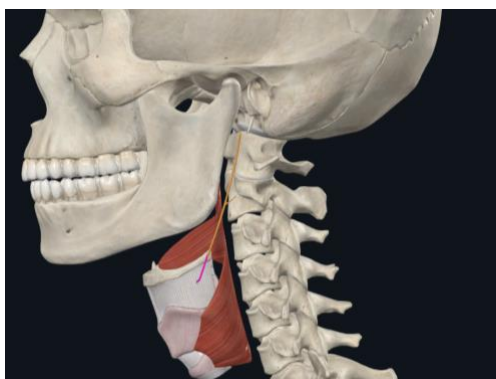
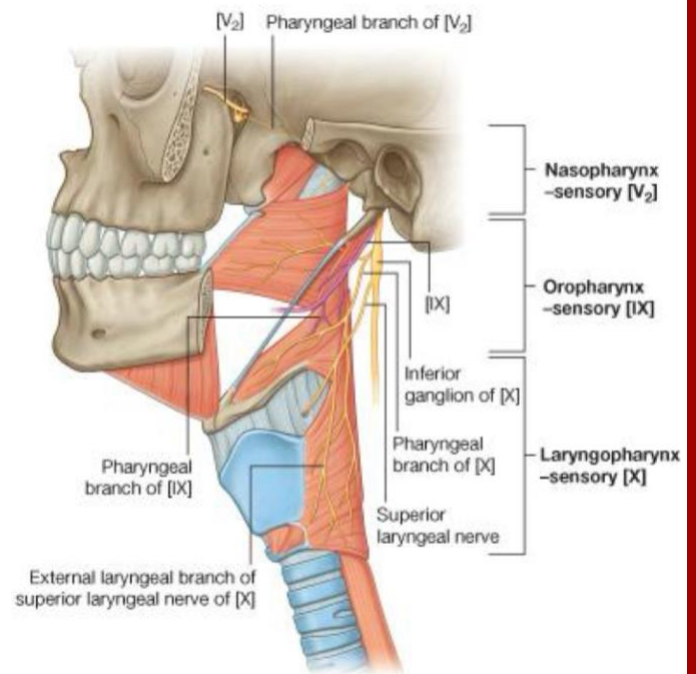


Vocal cords are not within our scope, so this is supposed to be extra info... but the doctor mentioned them and pointed at the true and false cords. He said true cords are always below, and they are the ones responsible for speech.

SENSORY NERVE SUPPLY OF THE PHARYNGEAL MUCOUS MEMBRANE

- Nasal pharynx: The maxillary nerve (V₂)
- Oral pharynx: The glossopharyngeal nerve (IX)
- Laryngeal pharynx (around the entrance into the larynx): The internal laryngeal branch of the vagus nerve (X)

Note: the internal laryngeal nerve pierces the thyrohyoid membrane and passes between the middle and inferior constrictor muscles.

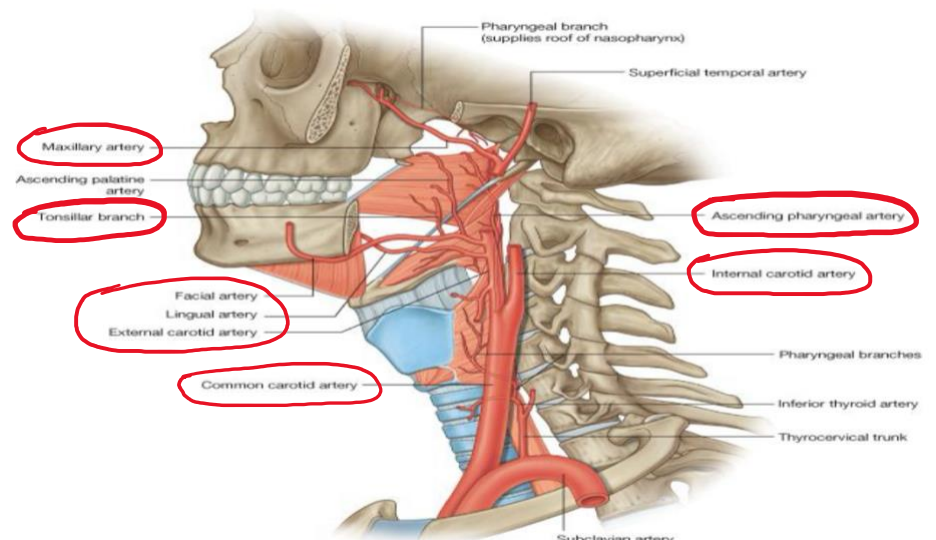


Internal Laryngeal Nerve shown in pink

BLOOD SUPPLY OF THE PHARYNX

- Arterial supply: **Ascending pharyngeal tonsillar branches of facial arteries, and branches of maxillary and lingual arteries** (all are branches of ECA)

Venous Drainage: Pharyngeal Venous Plexus formed by the branches of: Ascending pharyngeal vein, maxillary and lingual veins (all drain into IJV)

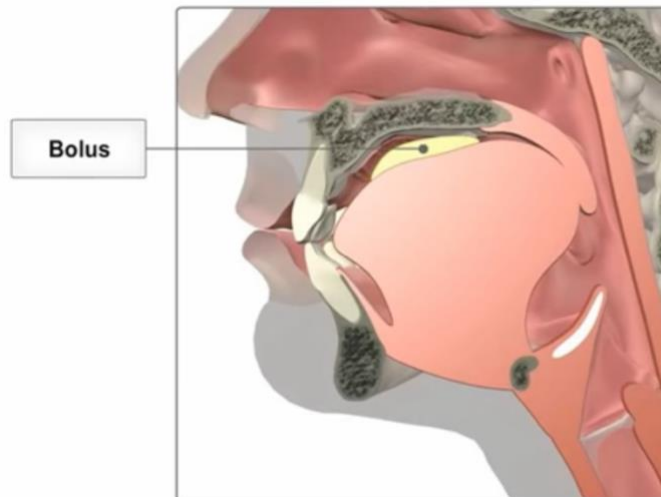


- Lymphatic drainage: Directly into the **deep cervical lymph nodes** or indirectly via the retropharyngeal or paratracheal nodes into the deep cervical nodes

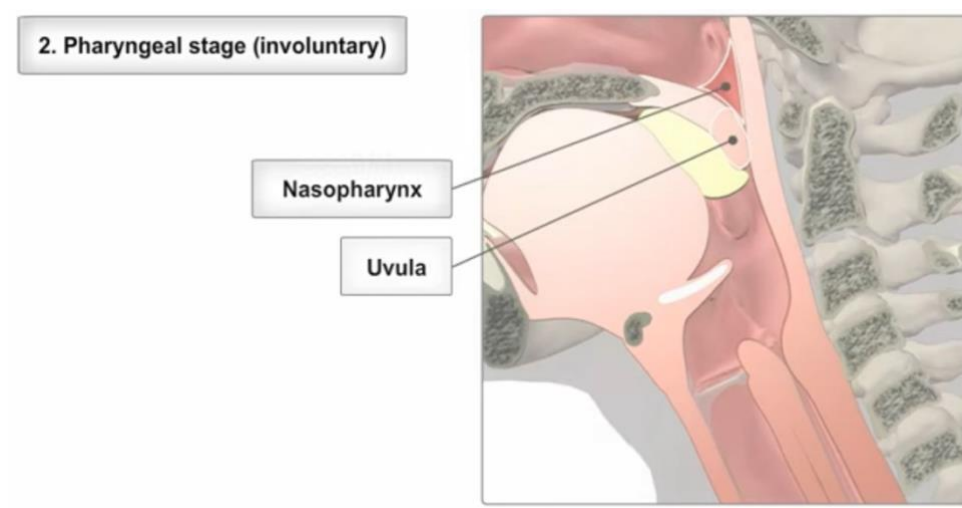
THE PROCESS OF SWALLOWING (DEGLUTITION)

Pics are additional

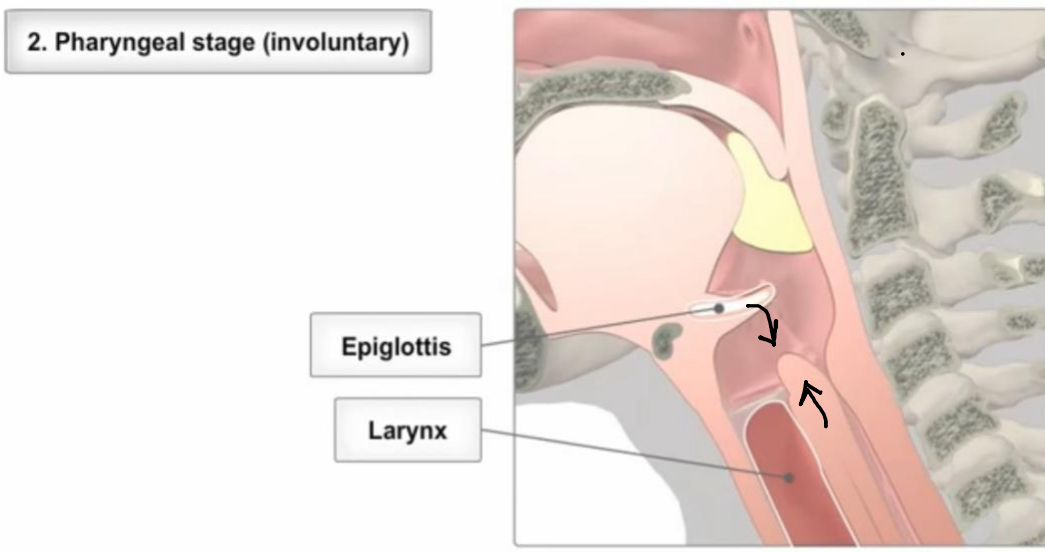
- Masticated food is formed into a ball or bolus on the dorsum of the tongue and voluntarily pushed upward and backward against the undersurface of the hard palate
- This is brought about by the contraction of the styloglossus muscles on both sides, which pull the root of the tongue upward and backward. Also, the soft palate is pushed downward and forward closing the oral cavity (as long as the bolus is still on the dorsum of the tongue)



- The palatoglossus muscles then squeeze the bolus backward into the pharynx. From this point onward the process of swallowing becomes an involuntary act.
- The nasal part of the pharynx is now shut off from the oral part of the pharynx by the elevation of the soft palate, and the pulling forward of the posterior wall of the pharynx by the upper fibers of the superior constrictor muscle, and the contraction of the palatopharyngeus muscles. This prevents the passage of food and drink into the nasal cavities

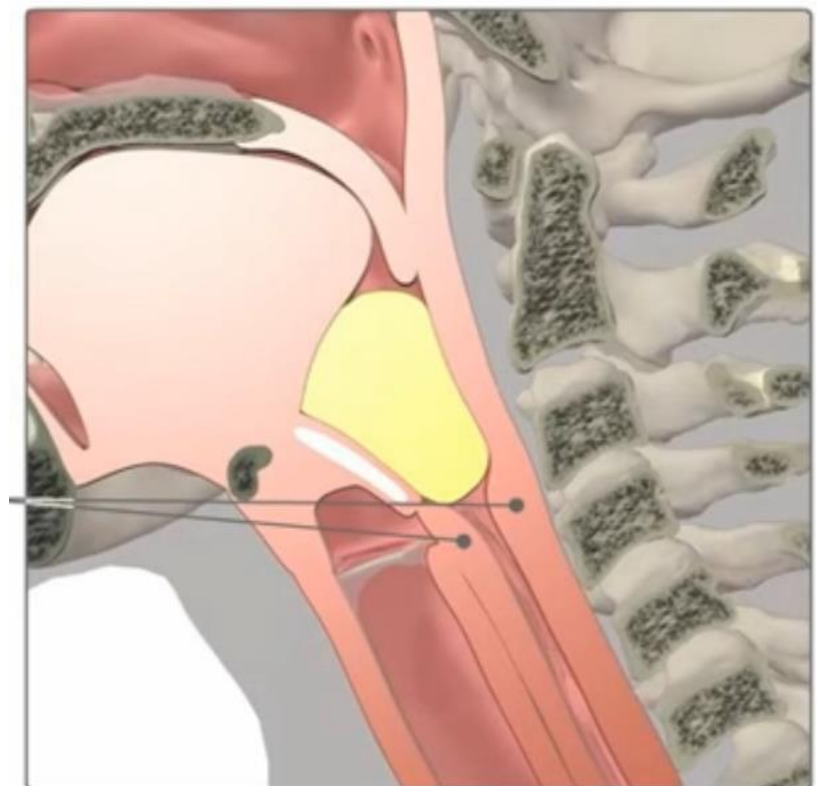


- The larynx and the laryngeal part of the pharynx are pulled upward by the contraction of the stylopharyngeus, salpingopharyngeus, thyrohyoid, and palatopharyngeus muscles
- The main part of the larynx is thus elevated to the posterior surface of the epiglottis, and the entrance into the larynx is closed
- The laryngeal entrance is made smaller by the approximation of the aryepiglottic folds, and the arytenoid cartilages are pulled forward by the contraction of the aryepiglottic, oblique arytenoid, and thyroarytenoid muscles.



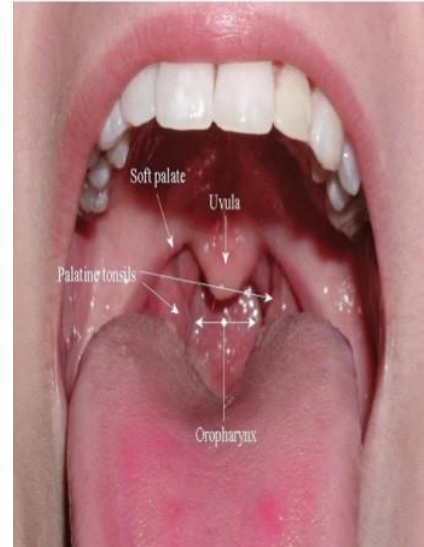
The bolus moves downward over the epiglottis, the closed entrance into the larynx, and reaches the lower part of the pharynx as the result of the successive contraction of the superior, middle, and inferior constrictor muscles

- Some of the food slides down the groove on either side of the entrance into the larynx, that is, down through the piriform fossae —> which causes coughing to get bolus out
- Finally, the lower part of the pharyngeal wall (the cricopharyngeus muscle, the sphincter) relaxes and the bolus enters the esophagus.



PALATINE TONSILS

- ❖ **The palatine tonsils are two masses of lymphoid tissue**, each located in the depression on the lateral wall of the oral part of the pharynx between the palatoglossal and palatopharyngeal arches
- ❖ Each tonsil is covered by mucous membrane, and its free medial surface projects into the pharynx
- ❖ The surface is **pitted** medially by numerous small openings that lead into the tonsillar crypts. (Those crypts initiate the first step of adaptive immune response)
- ❖ The tonsil is covered on its lateral surface by a fibrous capsule (loose CT)
- ❖ The capsule is separated from the superior constrictor muscle by loose areolar tissue and the external palatine vein descends from the soft palate in this tissue to join the pharyngeal venous plexus
It is not supplied by the plexus, rather by the tonsillar branch of facial artery, which is close to the Common Carotid Artery.
- ❖ **Lateral to the superior constrictor muscle lie the styloglossus muscle, the loop of the facial artery, and the internal carotid artery.**

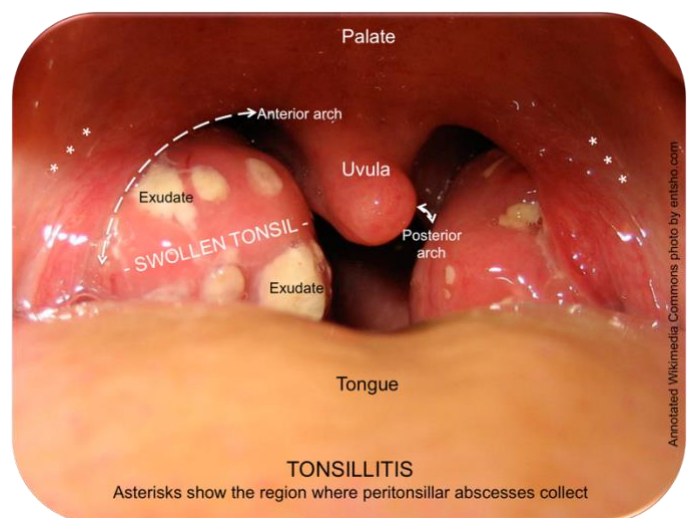


Tonsils are very important for immunity. Palatine tonsils are responsible for filtration of foreign bodies and pathogens (especially in children). Why children? Because **The tonsil reaches its maximum size during early childhood, but after puberty it diminishes considerably in size.**

Tonsillitis: (see pic on the right) occurs occasionally in children due to putting foreign objects inside their mouth, causing bacterial and viral infections

If the infection happened more than 4 times a year, we need to remove the tonsils surgically (Tonsillectomy) as a precaution to prevent streptococcus (main pathogen in tonsillitis) from spreading to the heart, kidney, and joints, causing severe complications.

Tonsillectomy doesn't cause any harm because we have plenty of lymph nodes.



Typically, tonsillectomy is done through the oral cavity by extending an index to the lateral surface. Using the scalpel, the surgeon opens the lateral capsules to have better access to the tonsils and removes them. Cutting then ligating both the tonsillar artery and vein are done to prevent any postoperative bleeding.

**bear in mind that the Dr only related bleeding to the vein... so if you were asked to choose between them, it's the ~~tonsillar vein~~, although both are correct in real life.

External Palatine vein

After tonsillectomy we enroll the patient for 24 hours in the hospital for further supervision. If any bleeding took place, it would probably be caused by the previously mentioned vessels, why? because they pierce the constrictor muscle, and the contraction of this muscle can cause the release of the ligation of the vessel, causing bleeding.

Remember:

- Enlargement in pharyngeal tonsil can cause blockage in the nasopharynx
- Enlargement in palatine tonsils leads to difficulty in swallowing

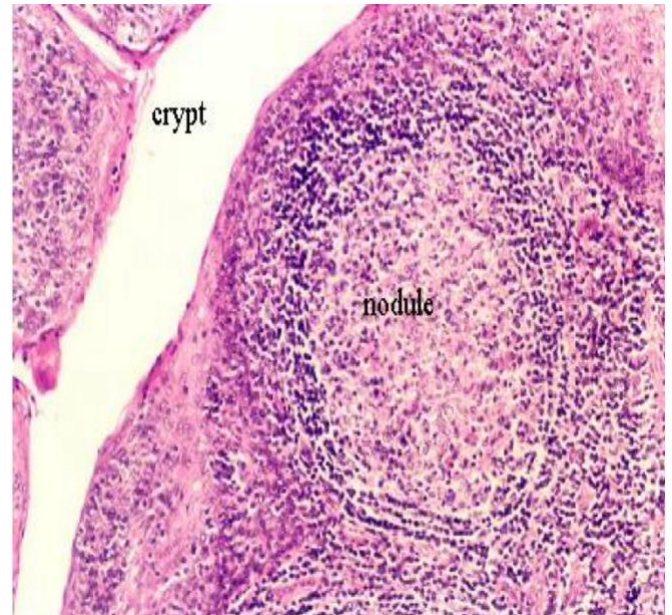
Blood Supply

- The tonsillar branch of the facial artery. The veins pierce the superior constrictor muscle and join the external palatine, the pharyngeal, or the facial veins.

Lymph Drainage of the Tonsil

- The upper deep cervical lymph nodes, just below and behind the angle of the mandible

Dr didn't add any comment regarding the pic above

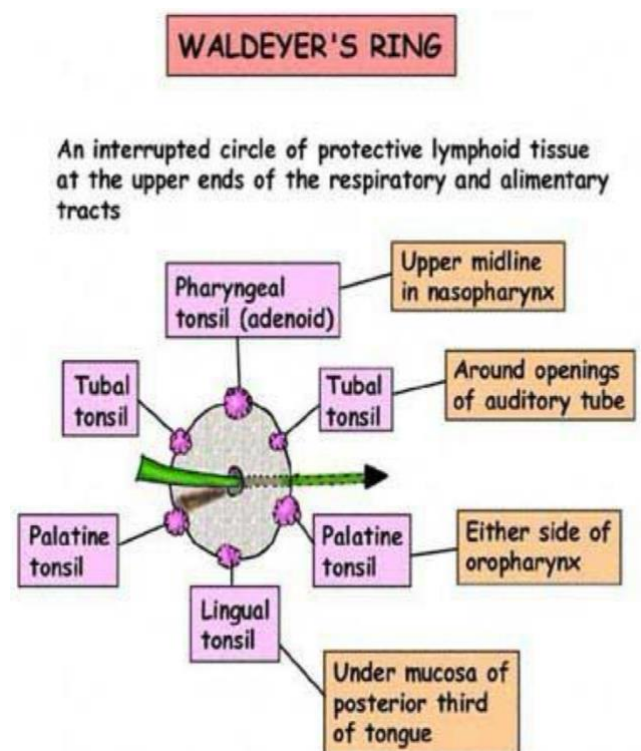


WALDEYER'S RING OF LYMPHOID TISSUE

(function: filtration of bacteria and viruses)

- The lymphoid tissue that surrounds the opening into the respiratory and digestive systems forms a ring
- **The lateral part of the ring is formed by the palatine tonsils and tubal tonsils (lymphoid tissue around the opening of the auditory tube in the lateral wall of the nasopharynx)**

The pharyngeal tonsil in the roof of the nasopharynx forms the upper part, and the lingual tonsil on the posterior third of the tongue forms the lower part.



INNERVATION, BLOOD SUPPLY AND LYMPHATIC DRAINAGE OF THE TONGUE

The innervation is divided into motor and sensory. (Sensations are general or special)
notice the motor innervation from the picture on the right.

➤ Sensory Innervation

Anterior two thirds:

Lingual nerve branch of mandibular division of trigeminal nerve (general sensation) and chorda tympani branch of the facial nerve (taste)

Posterior third:

Glossopharyngeal nerve general sensation and taste)

How does the posterior third have taste innervation although it has no taste buds?!

Via the circumvallate papillae, although they are found in the anterior two thirds but they originated from the posterior third and follow its innervation. سؤال امتحان

➤ Blood Supply

The lingual artery (a branch from ECA external carotid artery), **the tonsillar branch of the facial artery** (the facial artery is also a branch from ECA), **and the ascending pharyngeal artery supply the tongue.**

*Remember: the lingual artery has a tonsillar branch for palatine tonsils

The veins drain into the internal jugular vein opposite to the arteries.

➤ Lymph Drainage

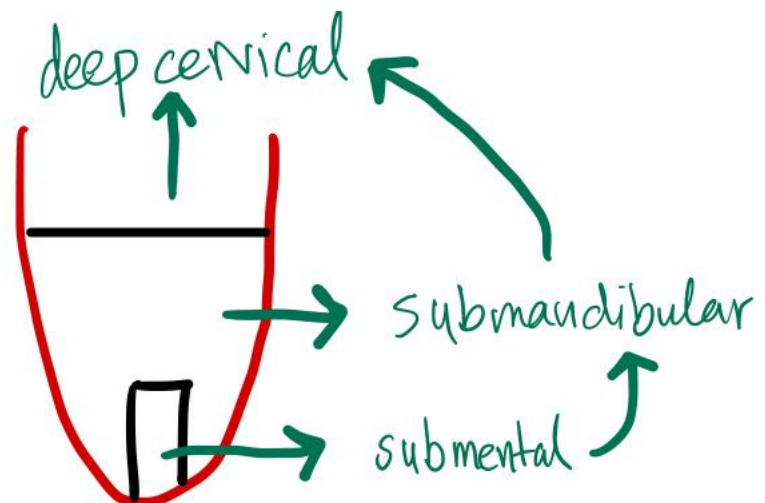
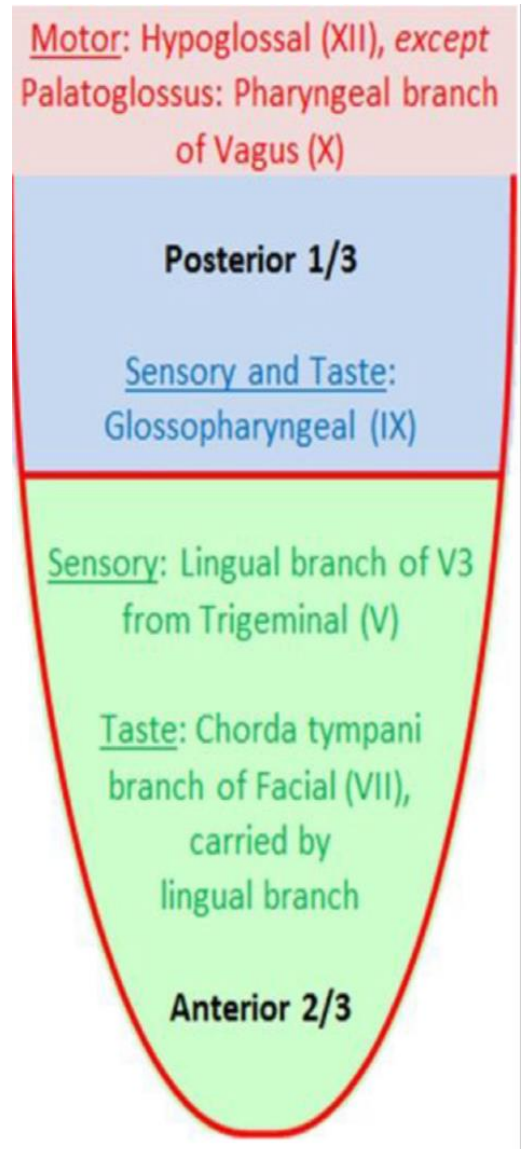
Tip: Submental lymph nodes

Sides of the anterior two thirds:

Submandibular and deep cervical lymph nodes

Posterior third: Deep cervical lymph nodes directly

*Structures in the midline drain into the submental lymph nodes like the tip of the tongue , the philtrum , the mid of the lower lip and the tip of the nose



THE PALATE

- ❖ The palate forms the roof of the mouth and the floor of the nasal cavity.
- ❖ It is divided into two parts: the hard palate in front and the soft palate behind.

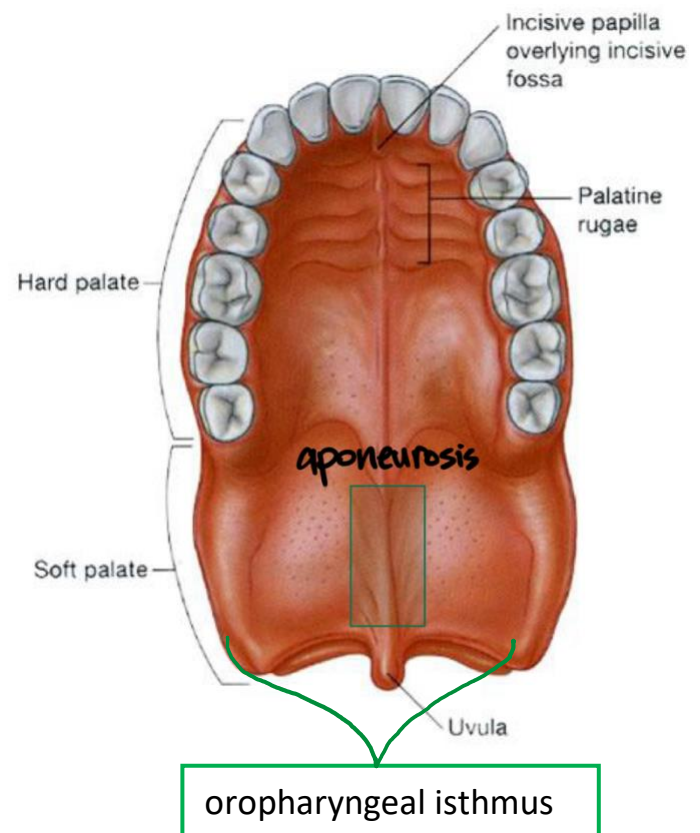
❖ Hard Palate

- The hard palate is formed by the palatine processes of the maxillae and the horizontal plates of the palatine bones

*remember greater and lesser palatine foramina (for the passage of greater and lesser palatine nerves and vessels)

- The hard palate has dense CT adhered tightly to periosteum (لازق في العظم)
- It is continuous behind with the soft palate.
- It has a foramen anteriorly: the incisive foramen that connects the hard palate with the nasal cavity. Nerves & arteries pass through this foramen.

At the posterior border of the hard palate there is a spine where the aponeurosis is attached forming the soft palate



❖ Soft Palate

It has loose CT

- Formed by **Palatine aponeurosis** which is the meeting point of the Tensor villi palatini muscles on the right & left side (we'll discuss the muscle soon)
- The soft palate is a mobile fold attached to the posterior border of the hard palate.
- Its free posterior border presents in the midline a conical projection called the uvula. That's seen on the roof of the oropharynx.
- The soft palate is continuous at the sides with the lateral wall of the pharynx
- It is a muscular structure .
By moving upward and backward it closes the nasopharynx , it moves downward during mastication to increase the pressure inside oral cavity, then upwards again during swallowing.

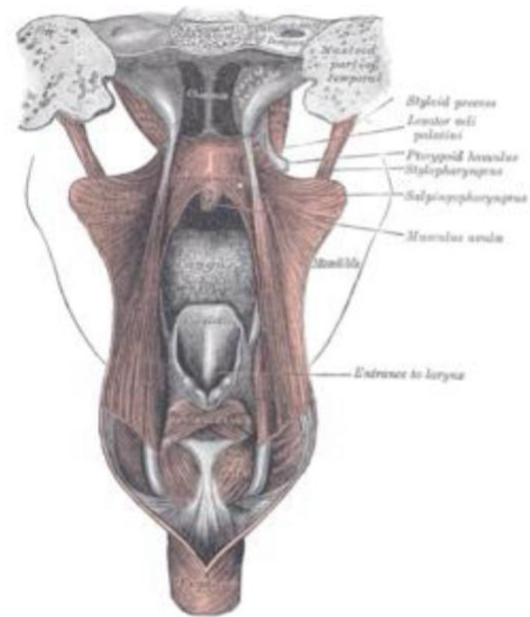
The soft palate is composed of :

1. mucous membrane: covers the upper and lower surfaces of the soft palate.
2. palatine aponeurosis: a fibrous sheet attached to the posterior border of the hard palatine. It is the expanded tendon of the tensor veli palatini muscle. (tensor: tenses)
3. muscles

MUSCLES OF THE SOFT PALATE

• The muscles of the soft palate are:

- 1) tensor veli palatine (tenses increasing the pressure)
- 2) levator veli palatine (elevates)
- 3) palatoglossus (around the palatine tonsils)
- 4) palatopharyngeus (around the palatine tonsils)
- 5) musculus uvulae (the uvula itself)



Now that we know the tensor veli palatini, it's time to understand how that palatine aponeurosis is formed exactly.

- The muscle fibers of the tensor veli palatini converge as they descend from their origin to form a narrow tendon, which turns medially around the pterygoid hamulus
- The tendon, together with the tendon of the opposite side, expands to form the palatine aponeurosis
- When the muscles of the two sides contract, the soft palate is tightened so that the soft palate may be moved upward or downward as a tense sheet.

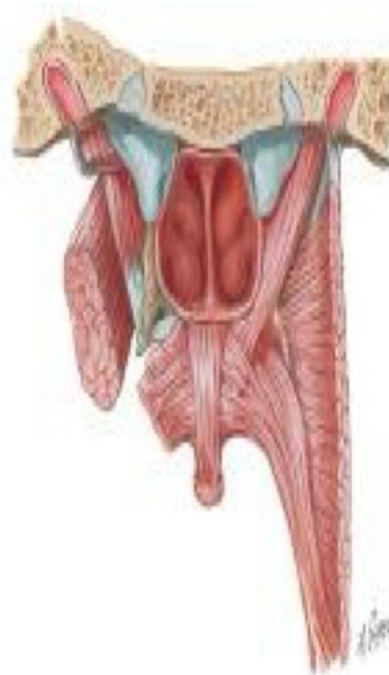
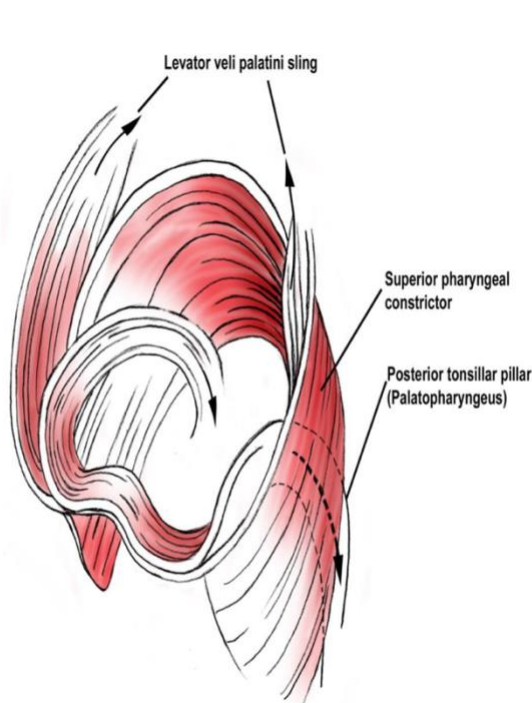
Muscle	Origin	Insertion	Action	Nerve supply
Levator veli palatini	Petrous part of temporal bone, auditory tube	Palatine aponeurosis	Raises soft palate	Pharyngeal plexus
Tensor veli palatini	Spine of sphenoid, auditory tube	With muscle of other side, forms palatine aponeurosis	Tenses soft palate	**Nerve to medial pterygoid from mandibular nerve
Palatopharyngeus	Palatine aponeurosis	Posterior border of thyroid cartilage	Elevates wall of pharynx, pulls palatopharyngeal folds medially	Pharyngeal plexus
Musculus uvulae	Posterior border of hard palate	Mucous membrane of uvula	Elevates uvula	Pharyngeal plexus

*All the muscles of the soft palate mentioned in the slides and their details have been written in this table.

*All of these muscles are innervated by pharyngeal plexus except Tensor Veli Palatini muscle

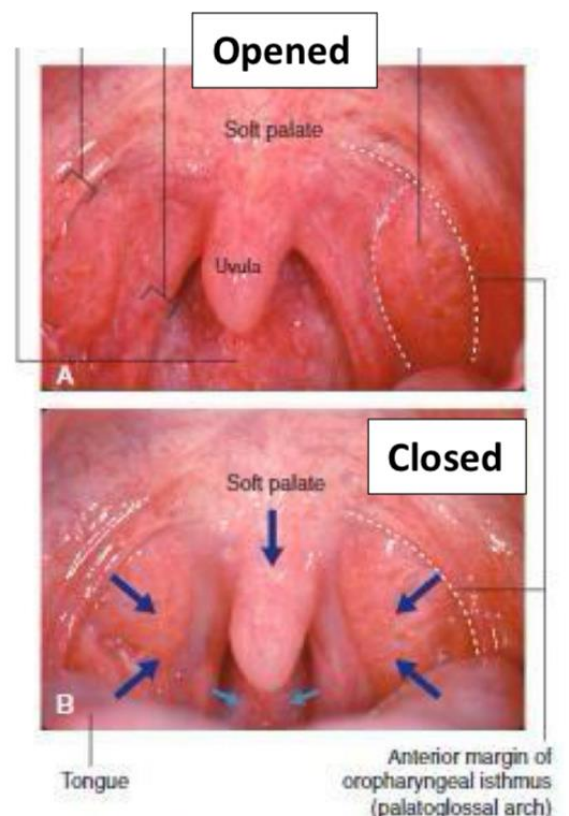
*The pharyngeal plexus is formed by : glossopharyngeal nerve and the vagus nerve with the cranial accessory nerve

*Recall from MSS embryo that cleft in the uvula can occur during embryonic development if the fusion of the maxillary processes fails forming a bifid uvula



MOVEMENTS OF THE SOFT PALATE

- Normally the soft palate is relaxed to maintain the space between the oropharynx & nasopharynx opened for air inhalation and articulation of vowels.
- The pharyngeal isthmus (the communicating channel between the nasal and oral parts of the pharynx) is closed by raising the soft palate.
- Closure of the oral cavity occurs during the production of explosive consonants in speech (Like the voice /k/ in cat) and during mastication (pressure inside the oral cavity is needed)

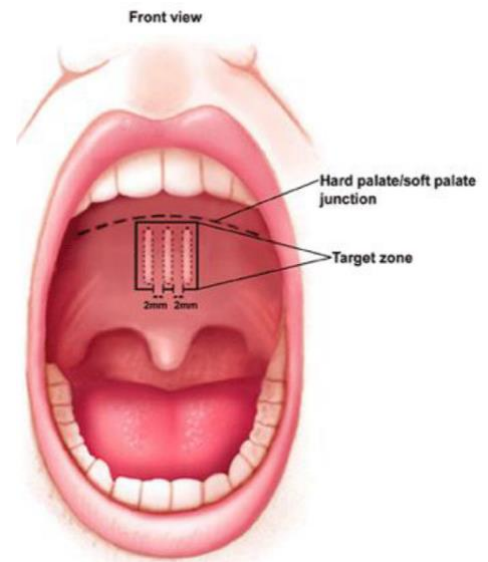


Closure of oropharyngeal isthmus

- Medial and downward movement of palatoglossal arches
- Medial and downward movement of palatopharyngeal arches
- Upward movement of tongue

- Closure of the nasal cavity is **important during vomiting** to prevent the vomit from going out of the nasal cavity and restrict its exit via the oral cavity.

- The soft palate is raised by the contraction of the levator veli palatini on each side.
- At the same time, the upper fibers of the superior constrictor muscle contract and pull the posterior pharyngeal wall forward
- The palatopharyngeus muscles on both sides also contract so that the palatopharyngeal arches are pulled medially, like side curtains
- By this means the nasal part of the pharynx is closed off from the oral part.



NERVE SUPPLY OF THE PALATE

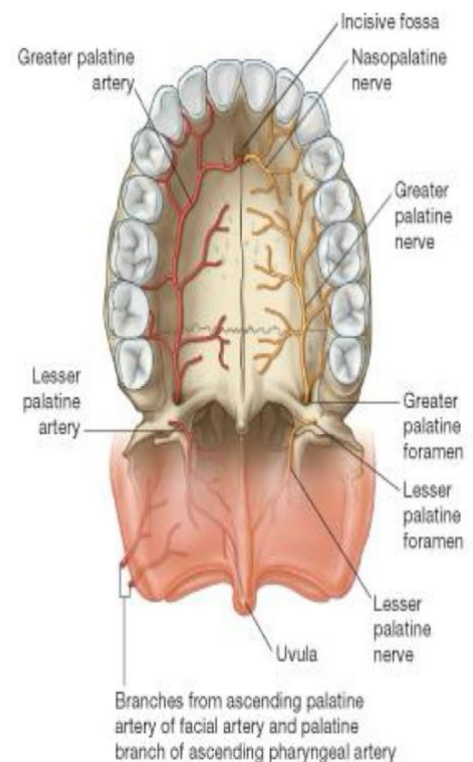
- The greater and lesser palatine nerves from the maxillary division of the trigeminal nerve enter the palate through the greater and lesser palatine foramina
- The nasopalatine nerve, also a branch of the maxillary nerve, enters the front of the hard palate through the incisive foramen.
- The glossopharyngeal nerve also supplies the soft palate

• BLOOD SUPPLY OF THE PALATE

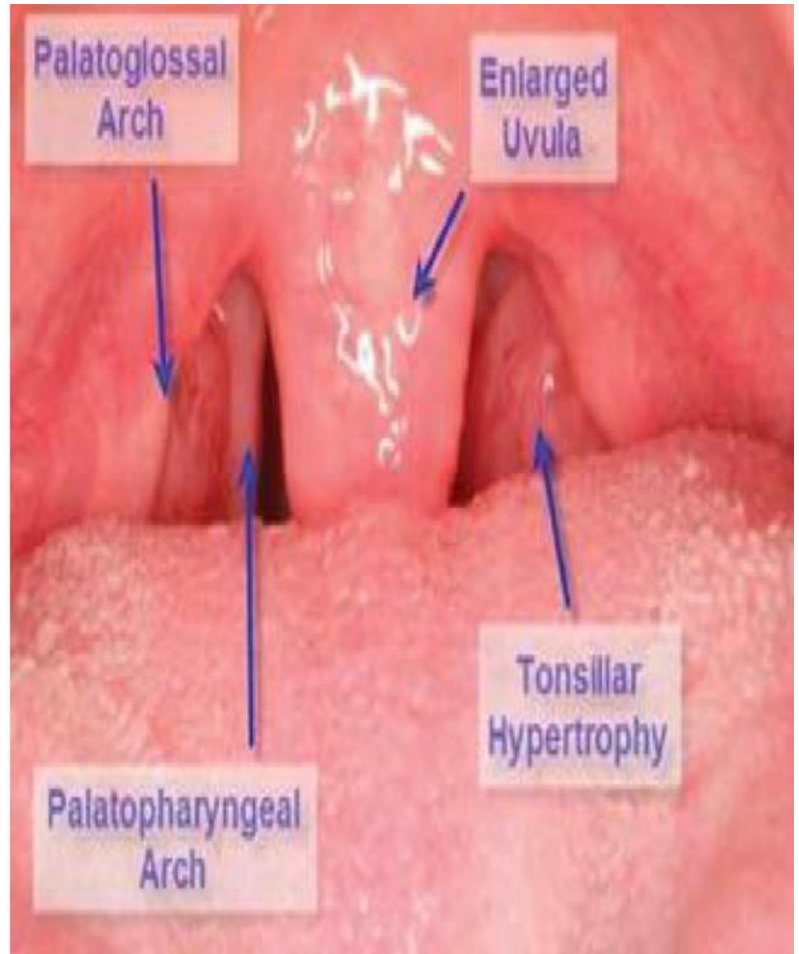
- The greater palatine branch of the maxillary artery, the ascending palatine branch of the facial artery, and the ascending pharyngeal artery

• LYMPH DRAINAGE OF THE PALATE

- Deep Cervical Lymph Nodes



- The palatoglossal arch is a fold of mucous membrane containing the palatoglossus muscle, which extends from the soft palate to the side of the tongue
- The palatoglossal arch marks where the mouth becomes the pharynx.
- The palatopharyngeal arch is a fold of mucous membrane behind the palatoglossal arch
- runs downward and laterally to join the pharyngeal wall.
- The muscle contained within the fold is the palatopharyngeus muscle.
- The palatine tonsils, which are masses of lymphoid tissue, are located between the palatoglossal and palatopharyngeal arches



There are 5 structures between the mylohyoid and hypoglossus muscles: deep part of submandibular gland, submandibular duct, submandibular ganglia, lingual nerve, and hypoglossal nerve.

V2

Page 4:

wrong statement about overlapping muscles was reformed.

Font-related modifications:

Page 15:

Underlined the innervation of circumvallate papillae (very important)

Page 17:

The upmost sentence was colored in black although it is directly from the slides

Page 18:

Additional info was colored dark blue mistakenly.

Page 20:

Corrected some spelling errors

V3:

Page 4: outside instead of inside

Page 14: external palatine vein instead of tonsillar vein