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*GROSS ANATOMY ASSIGNMENT*

**QUESTION 1**

Discuss the anatomy of the tongue and comment on it’s applied anatomy.

The tongue is a pink, muscular organ located within the oral cavity proper. It is kept moist by the products of the major and minor salivary glands, which aids the organ as it facilitates deglutition, speech, and gustatory perception. While there is significant variability in the length of the tongue among individuals, on average, the organ is roughly 10 cm long. It has three main parts: the tip, the body and the base.

The tip or apex of the tongue is the most anterior, and most mobile aspect of the organ.

The tip is followed by the body of the tongue. It has a rough dorsal (superior) surface that abuts the palate and is populated with taste buds and lingual papillae, and a smooth ventral (inferior) surface that is attached to the floor of the oral cavity by the lingual frenulum.

The base of the tongue is the most posterior part of the organ. It is populated by numerous lymphoid aggregates known as the lingual tonsils along with foliate papillae along the posterolateral surface.

There are numerous important structures surrounding the tongue. It is limited anteriorly and laterally by the upper and lower rows of teeth. Superiorly, it is bordered by the hard (anterior part) and soft (posterior part) palates. Inferiorly, the root of the tongue is continuous with the mucosa of the floor of the oral cavity; with the sublingual salivary glands and vascular bundles being located below the mucosa of the floor of the oral cavity.

Anterior two thirds

The presulcal tongue includes the apex and body of the organ. It terminates at the sulcus terminalis; which can be seen extending laterally in an oblique direction from the foramen cecum towards the palatoglossal arch. The mucosa of the dorsal surface of the oral tongue is made up of circumvallate, filiform, and fungiform papillae. There is also a longitudinal midline groove running in an anteroposterior direction from the tip of the tongue to the foramen cecum. This marks the embryological point of fusion of the lateral lingual swellings that formed the oral tongue. It also represents the location of the median lingual (fibrous) septum of the tongue that inserts in the body of the hyoid bone.

Terminal sulcus of tongue

On the lateral surface of the oral tongue are foliate papillae arranged as a series of vertical folds. The ventral mucosa of the oral tongue is comparatively unremarkable. It is smooth and continuous with the mucosa of the floor of the mouth and the inferior gingiva. The lingual veins are relatively superficial and can be appreciated on either side of the lingual frenulum. Lateral to the lingual veins are pleated folds of mucosa known as the plica fimbriata. They are angled anteromedially toward the apex of the tongue.

Posterior third

The remainder of the tongue that lies posterior to the sulcus terminalis is made up by the base of the organ. It lies behind the palatoglossal folds and functions as the anterior wall of the oropharynx. Unlike the oral tongue, the pharyngeal tongue does not have any lingual papillae. Instead, its mucosa is populated by aggregates of lymphatic tissue known as the lingual tonsils. The mucosa is also continuous with the mucosa of the laterally located palatine tonsils, the lateral oropharyngeal walls, and the posterior epiglottis and glossoepiglottic folds.

Muscles

The tongue is chiefly a muscular organ with some amount of fatty and fibrous tissue distributed throughout its substance. All the muscles of the tongue are paired structures, with each copy being found on either side of the median fibrous septum. There are muscles that extend outside of the organ to anchor it to surrounding bony structures, known as extrinsic muscles. The other set of muscles are confined to each half of the organ and contribute to altering the shape of the organ; these are the intrinsic muscles.

 Intrinsic tongue muscles

The intrinsic tongue muscles are responsible for adjusting the shape and orientation of the organ. It is made up of four paired muscles, which are discussed below in a dorsoventral manner.

The **superior longitudinal muscles:** are made up of a thin layer of muscle fibers traveling in a mixture of oblique and longitudinal axes just deep to the superior mucosal surface of the organ. These fibers arise from the median fibrous septum as well as the fibrous layer of submucosa from the level of the epiglottis. They eventually insert along the lateral and apical margins of the organ. These muscles are responsible for retracting and broadening the tongue, as well as elevating the tip of the tongue. The net effect of these muscles results in shortening of the organ.

The **vertical muscles**: arise from the root of the organ and genioglossus muscle and insert into the median fibrous septum, along the entire length of the organ. These muscles facilitate flattening and widening of the tongue.

The **transverse muscles**: they take a lateral route, extending from either side of the medial lingual septum (origin) to the fibrous submucosa along the lateral margins of the tongue (insertion). As these muscles contract, they cause the tongue to narrow and elongate.

The **inferior longitudinal muscles:** travel above the ventral submucosa of the tongue. These fibers travel between hyoglossus and genioglossus as it arises from the base of the tongue and body of the hyoid bone. The fibers end in the apex of the tongue; allowing the muscle to pull the tip of the tongue inferiorly and also shortening the organ.

The intrinsic tongue muscles can operate independently, or in combination with each other to give rise to numerous shapes. This is an important feature of the tongue as it facilitates molding of the food particles into a bolus in preparation for deglutition and speech.

Summary

Superior longitudinal

Origin - submucosa of posterior tongue, lingual septum

Insertion - apex/anterolateral margins of tongue

Innervation - hypoglossal nerve (CN XII)

Blood supply - lingual branch of external carotid artery

Action - retracts and broadens tongue, elevates apex of tongue

Inferior longitudinal

Origin - root of tongue, body of hyoid bone

Insertion - apex of tongue

Innervation - hypoglossal nerve (CN XII)

Blood supply - lingual branch of external carotid artery

Action - retracts and broadens tongue, lowers apex of tongue

Transverse muscle

Origin - lingual septum

Insertion - lateral margin of tongue

Innervation - hypoglossal nerve (CN XII)

Blood supply - lingual branch of external carotid artery

Action - narrows and elongates tongue

Vertical muscle

Origin - root of tongue, genioglossus muscle

Insertion - lingual aponeurosis

Innervation - hypoglossal nerve (CN XII)

Blood supply - lingual branch of external carotid artery

Action - broadens and elongates tongue

Extrinsic tongue muscles

While the shape of the tongue is determined by the intrinsic muscles of the tongue, movement of the organ within (and out of) the oral cavity is dependent on the extrinsic tongue muscles. There are four pairs of extrinsic muscles, which can be viewed as those arising from above the tongue, and those that originate from below the tongue.

* Palatoglossus is anatomically a part of the pharyngeal group of muscles. However, its attachments to the tongue mean that it is also an extrinsic tongue muscle. It originates from the oral part of the aponeurosis of the soft palate. Here, and also at its insertion in the lateral margins of tongue, the muscle is wider than along its middle section. Its role as an extrinsic tongue muscle is to elevate the dorsal surface of the tongue, and (while working synergistically with the contralateral palatoglossus) to act as a sphincter at the oropharyngeal isthmus.
* Styloglossus originates from the anterolateral surface of the styloid process. Not only does it contribute to the stylomandibular ligament, but it also assists in retraction of the tongue (moving it posterosuperiorly). It is the smallest and shortest of the three styloid muscles. At the lateral margin of the tongue, the muscle bifurcates into longitudinal and oblique components. The former pierces the tongue on the dorsolateral aspect and integrates with the inferior longitudinal muscle; while the latter crosses over and decussates with hyoglossus.
* Genioglossus originates from a slender tendon that is attached to the superior genial tubercle found on the inner surface of the symphysis menti. This attachment prevents the tongue from falling backward and obstructing the airway when an individual is supine. The lower fibers of the muscle also have indirect attachments to the anterior part of the body of the hyoid bone via its slender aponeurosis. It is a triangular, midline structure that travels posterosuperiorly at which point the upper fibers of the muscle interdigitate with the intrinsic muscles, before attaching along the length of the inferior surface of the tongue (extending from the root to the tip).
* Hyoglossus originates from the entire greater cornu of the hyoid bone as a slender, quadrilateral muscle. It is often accompanied by chondroglossus (may be considered as part of the hyoglossus), which arises from the base of the lesser cornu of the hyoid bone. Hyoglossus takes a vertical course cranially, where it pierces the inferolateral margins of the tongue and subsequently blends between the inferior longitudinal muscles and the styloglossus.

Genioglossus muscle

The extrinsic muscles play an important role in pressing and molding the food bolus in preparation for the initial phase of swallowing. Additionally, they are used to move the bolus posteriorly into the oropharyngeal inlet. Furthermore, the action of palatoglossus closes off the oropharyngeal isthmus in order to prevent food from moving cranially during swallowing. Although some of these muscles are able to act in isolation, it is the combined effect of all the intrinsic and extrinsic muscles that allows the tongue to have significant flexibility.

Summary

 Genioglossus

Origin - Superior mental spine of mandible

Insertion - entire length of dorsum of tongue, lingual aponeurosis, body of hyoid bone

Innervation - hypoglossal nerve (CN XII)

Blood supply - sublingual branch of lingual artery, submental branch of facial artery

Action - depresses and protrudes tongue (bilateral contraction); deviates tongue contralaterally (unilateral contraction)

Hyoglossus

Origin - body and greater horn of hyoid bone

Insertion - inferior/ventral parts of lateral tongue

Innervation - hypoglossal nerve (CN XII)

Blood supply - sublingual branch of lingual artery, submental branch of facial artery

Action - depresses and retracts tongue

Styloglossus

Origin - anterolateral aspect of styloid process (of temporal bone), stylomandibular ligament

Insertion - blends with inferior longitudinal muscle (longitudinal part); blends with hyoglossus muscle (oblique part)

Innervation - hypoglossal nerve (CN XII)

Blood supply - sublingual branch of lingual artery

Action - retracts and elevates lateral aspects of tongue

Palatoglossus

Origin - palatine aponeurosis of soft palate

Insertion - lateral margins of tongue, blends with intrinsic muscles of tongue

Innervation - vagus nerve (CN X) (via branches of pharyngeal plexus)

Blood supply - ascending palatine branch of facial artery, ascending pharyngeal artery

Action - elevates root of tongue, constricts isthmus of fauces



 **OVERVIEW OF THE STRUCTURE OF THE TONGUE (SUPERIOR VIEW) (Image above)**

 **OVERVIEW OF TONGUE MUSCLES (ANTERIOR VIEW) (Image below)**



**QUESTION 2**

The paranasal sinuses are air cavities that help circulate the air that is breathed in and out of the respiratory system. They are situated around the nasal cavity and they are all paired and sometimes symmetrical, while always being bilateral. There are four different pairs of sinuses and they are called the:

* maxillary sinuses
* frontal sinuses
* sphenoidal sinuses
* ethmoidal sinuses

**Maxillary sinus**

The maxillary sinuses are the largest of the all the paranasal sinuses. They have thin walls which are often penetrated by the long roots of the posterior maxillary teeth. The superior border of this sinus is the bony orbit, the inferior is the maxillary alveolar bone and corresponding tooth roots, the medial border is made up of the nasal cavity and the lateral and anterior border are limited by the cheekbones. Posteriorly, two anatomical spaces known as the pterygopalatine fossa and the infratemporal fossa exist.

Vascularization, innervation and lymphatics

Submandibular lymph nodes

The submandibular lymph nodes are the main destination during lymphatic drainage. The blood supply includes a contribution from the:

* anterior superior alveolar artery
* middle superior artery
* posterior superior alveolar artery

Innervation occurs through nerves of the same names as the arteries.

**Frontal sinuses**

Frontal sinus

Anteriorly, the frontal sinuses are contained by the forehead and the superciliary arches, superiorly and posteriorly by the anterior cranial fossa and inferiorly by the bony orbit, the anterior ethmoidal sinuses and the nasal cavity. Medially the sinuses face one another, separated by the midline.

This pair of sinuses are irregular in shape when compared to one another and is underdeveloped at birth. They reach their full size and shape around seven to eight years of age.

Vascularization, innervation and lymphatics

Anterior ethmoidal artery (Arteria ethmoidalis anterior); Image: Yousun Koh

Anterior ethmoidal artery

They drain primarily into the ethmoidal infundibulum and the corresponding lymph drainage occurs via the submandibular lymph nodes. It is innervated by the ophthalmic nerve, including the supraorbital and supratrochlear branches.

The frontal sinuses are supplied by the:

* anterior ethmoidal artery
* supraorbital artery
* supratrochlear artery

 **Sphenoidal sinuses**

Sphenoidal sinus

The most posterior of all the sinuses in the head, the sphenoidal sinuses are large and irregular, just like their septum, which is made by the sphenoid bone. Laterally, a cavernous sinus exists which is part of the middle cranial fossa and also the carotid artery and cranial nerves III, IV, V/I, V/II and VI can be found.

The anterior wall separates this pair of sinuses from the nasal cavity, as does the hypophyseal fossa, the pituitary gland and the optic chiasm superiorly and the nasopharynx and pterygoid canal inferiorly.

Vascularization, innervation and lymphatics

The lymphatic drainage occurs in the same way as the posterior ethmoid sinus. The posterior ethmoidal artery and the posterior lateral nasal branches supply the sphenoidal sinuses.

The posterior ethmoidal nerve and the orbital branch of the pterygopalatine ganglion innervate them.

**Ethmoidal sinuses**

Ethmoidal cells

Superior to the ethmoidal sinus is the anterior cranial fossa and the frontal bone, laterally the orbit can be found, while the nasal cavity is situated medially. The ethmoid sinuses are unique because they are the only paranasal sinuses that are more complex than just a single cavity.

On each side of the midline, anywhere from three to eighteen ethmoidal air cells may be grouped together. These air cells are smaller individual sinuses grouped together to form one large one which encompass the anterior, middle and posterior nasal meatuses.

Vascularization, innervation and lymphatics

The anterior and middle ethmoid sinuses send their lymphatic drainage to the submandibular lymph nodes while the posterior ethmoid sinus sends its own to the retropharyngeal lymph nodes.

The anterior and posterior ethmoidal arteries, as well as the posterior lateral nasal branches provide an ample blood supply to this region. Meanwhile the anterior and posterior ethmoidal nerves and the posterior lateral superior and inferior nasal nerves help innervate it.

**Summary**

Maxillary sinuses

Superior wall - bony orbit

Inferior wall - alveolar bone of the maxilla

Medial wall - nasal cavity

Lateral and anterior walls - cheekbones

Posterior wall - pterygopalatine fossa, infratemporal fossa

Innervation - anterior superior alveolar, middle superior, posterior superior nerves (branches of the maxillary nerve)

Blood supply- anterior superior alveolar, middle superior alveolar, posterior superior alveolar arteries (branches of the maxillary artery)

Frontal sinuses

Anterior wall - forehead and superciliary arches

Superior and posterior walls - anterior cranial fossa

Inferior wall - bony orbit

Medial wall - contralateral sinus

Innervation - supraorbital nerve, supratrochlear nerve (branches of the ophthalmic nerve)

Blood supply- anterior ethmoidal, supraorbital, supratrocheal arteries (branches of the ophthalmic artery)

Sphenoidal sinuses

Anterior wall - nasal cavity

Superior wall - hypophyseal fossa

Inferior wall - nasopharynx and pterygoid canal

Innervation - posterior ethmoidal nerve (branch of the nasociliary nerve)

Blood supply - posterior ethmoidal, posterior lateral nasal arteries (branches of the ophthalmic artery)

Ethmoidal sinuses

Superior wall - anterior cranial fossa, frontal bone

Lateral wall - bony orbit

Medial wall - nasal cavity

Innervation - anterior and posterior ethmoidal nerves (branches of the nasociliary nerve)

Vascularization - anterior and posterior ethmoidal arteries (branches of the ophthalmic artery)

Clinical Anatomy

Sinusitis