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1. The anatomy of the tongue

It is located in the oral cavity that not only facilitates perception of taste but also plays important roles in mastication and deglutition. Additionally, it aids in the speech pathway and aids articulation. The prefixes (gloss-) and the suffix (-glossus) are used for reference to the tongue. Therefore, the name **glossopharyngeal** refers to the “Muscle arising from the tongue and inserting in the pharynx”.

Similarly, the name **hyoglossus** speaks of a “muscle originating at the hyoid bone and inserting in the tongue”.



**Its anatomy**

The tongue is normally a pink, muscular organ located within the oral cavity proper which is kept moist by the products of the major and minor salivary glands that aids it as it facilitates deglutition, speech, and taste. There are significant variability in its length among individuals but on average, it is roughly 10 cm long and divided into three main parts:

* The **tip or apex** of the tongue is the most anterior and most mobile aspect
* The **body** has a **rough dorsal (superior) surface** that lies adjacent to the palate and surrounded by 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 populated by numerous lymphoid aggregates the (lingual tonsils) along with foliate papillae at the poster lateral surface
* **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 (oral tongue)**

This includes the apex and body of the organ (it can also be called the presulcal part). It terminates at the sulcus terminals which can be seen extending laterally in an oblique direction from the foramen cecum towards the palatoglossal arch.

 The mucosa of the **dorsal (anterior) surface** 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**.

On the **lateral surface** 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 (plica fimbriata) which are angled anteromedially toward the apex of the tongue.

**Posterior one** **third (Pharyngeal tongue)**

The remainder of the tongue that lies posterior to the sulcus terminalis is made up by its base. It lies behind the palatoglossal folds and functions as the anterior wall of the oropharynx, this tongue does not have any lingual papillae. Instead, its mucosa is populated by aggregates of lymphatic tissue (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 has some amount of fatty and fibrous tissue distributed throughout its body. All the muscles are paired structures (with each copy being found on either side of the median fibrous septum). They extend outside of the organ to anchor it to their surrounding bony structures (extrinsic muscles) while the other set are confined to each half of the organ and contribute to altering its shape (intrinsic muscles).

**Intrinsic muscles**

They are responsible for adjusting its shape and orientation, it is made up of four paired muscles 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 deep to its superior mucosal surface. These fibers arise from the median fibrous septum as well as the fibrous layer of submucosa from the epiglottis level. They eventually insert along the lateral and apical margins. They are responsible for retracting and broadening, as well as elevating its tip also the effect of these muscles results in its shortening.
* The **dorsoventral** plane (deep to the superior longitudinal muscles) are the vertical muscles that arise from its root and genioglossus muscle and insert into the median fibrous septum (along its entire length). These muscles facilitate flattening and widening.

**Extrinsic muscles**

While its shape is determined by the intrinsic muscles, its movement within (and out) of the oral cavity is dependent on these muscles. There are four pairs of them, which can classified as those originating from above and below the tongue:

1. **Styloglossus and palatoglossal** (arising from above)
* ***Palatoglossus*** is a part of the pharyngeal group of muscle but its attached to the tongue makes it an extrinsic muscle. It originates from the oral part of the aponeurosis of the soft palate and at its insertion in the lateral margin where the muscle is wider than in its middle section. Its role is to elevate the dorsal surface and) 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, it assists in retracting (posterosuperior movement) and is the smallest and shortest of the three styloid muscles. At the lateral margin, it bifurcates into longitudinal and oblique components. The former pierces on the dorsolateral aspect and fuses with the inferior longitudinal muscle while the latter crosses over and crosses with the hyoglossus.
1. **Genioglossus and hyoglossus** (arise from below)
* ***Genioglossus*** originates from a slender tendon that is attached to the superior genial tubercle (on the inner surface of the symphysis menti), it prevents the tongue from falling backward and obstructing the airway when an individual is supine. The lower fibers also have indirect attachments to the anterior part of the hyoid bone by its slender aponeurosis. It is a triangular, midline structure that travels posterosuperiorly at which point the upper fibers folds with the intrinsic muscles, before attaching along the inferior surface length (extending from the root to the tip).
* ***Hyoglossus*** originates from the entire greater cornu (at hyoid bone) as a slender, quadrilateral muscle that is often accompanied by **chondroglossus** which arises from the base of the lesser cornu (hyoid bone). This takes a vertical course (cranially), where it pierces the inferolateral margins of the tongue and blends between the inferior longitudinal muscles and the styloglossus.

These muscles aids in pressing and molding if food bolus for swallowing. They are used to move the bolus posteriorly into the oropharyngeal inlet then the action of palatoglossus closes off the oropharyngeal isthmus in order to prevent food from moving (cranially) during swallowing. Although some are able to act on their own, it is the combined effect of all the muscles that allows the tongue to have flexibility.

**Blood supply and lymphatic drainage**

**Arteries**

It is provided by derivatives of the **lingual artery** which is a branch of the **external carotid artery** that lies across the region between the middle pharyngeal constrictor and hyoglossus to the floor of the mouth. It takes a superior turn at the hyoglossus (anterior border) as it travels alongside ***CN IX***. It has good supply as the lingual artery also anastomosis with the **contralateral vessel**. The branches of the lingual artery are:

* The **dorsal lingual arteries** are small derivatives of the main artery that arise medial to hyoglossus. It supplies the dorsal mucosa and also gives branches to the palatoglossus, soft palate, palatine tonsils, and epiglottis.
* The **sublingual arteries** (Emerging at the anterior limit of the hyoglossus) course between the mylohyoid and genioglossus as it travels towards the sublingual glands in the floor of the oral cavity. One of its branches will anatomies with the **submental branches** of the **facial artery**, while another traverses the gingiva of the mandible to anastomose with the **analogous contralateral vessel**.

As the lingual artery terminates near the lingual frenulum on the ventral surface, it is called the **deep lingual artery**. The main artery is supported by other branches of the **external carotid artery** while the facial artery gives off the **ascending palatine and tonsillar arteries** that also supply the tongue with the ascending **pharyngeal branch of the external carotid artery**

**Veins**

They are named similarly to the arteries that they accompany, as the **deep lingual vein** forms adjacent to the tongue’s apex, it goes along its ventral surface (deep to the mucosa). As the main vein anastomosis with the **sublingual vein**, they become the **vena comitans of CN XII**, This network drains to the **lingual vein** that later join the facial (anterior) part of the **retromandibular veins**. They form the **common facial vein** which is a part to **the internal jugular vein** and the venae comitantes may drain directly into it.

The **dorsal lingual veins** are responsible for draining the lateral and dorsal surface of the tongue and travel alongside their similarly artery as they drain into the **internal jugular vein.**

**Lymphatic drainage**

The **marginal and central** groups drain the anterior parts while the **dorsal** group drains from the posterior third of the organ (it is not rare to see the central area of the tongue draining to both marginal and dorsal groups)

* The **marginal** lymph vessels will carry lymph to the submandibular or jugulo-omohyoid nodes (it is not rare to see lymph vessels crossing to drain to contralateral lymph nodes).
* The **central** region may go to the deep cervical nodes, for either the jugulo-omohyoid or jugulodigastric nodes.
* The **dorsal** group passes laterally on either side and joins the **marginal** vessels to the jugulo-omohyoid and jugulodigastric vessels.

**Innervation**

It is grouped based on its embryological origins, efferent fibers (carry motor impulses), general sensory (conveys touch and proprioception) and special afferent (conveys gustatory impulses).

**Motor innervation**

The muscles arise from **occipital myotomes** that migrated to the floor of the pharyngeal apparatus during development. These primitive myocytes took the fibers of **CN XII** during their journey which lead to CN XII providing motor innervation to all muscles (except palatoglossus). As CN XII pierces the ventrolateral part of the **pharyngeal** part, it gives a branch to the **geniohyoid** muscle which bifurcates into medial and lateral branches.

The **medial branch** innervates the posterior part of the transverse and vertical muscles with the medial part of the inferior longitudinal muscle and the entire genioglossus.

 The **lateral branch** of CN XII innervates the lateral part of the inferior and superior longitudinal, hyoglossus and styloglossus muscles.

The pharyngeal plexus may bring motor fibers to the muscle but there’s some doubt about the component of the pharyngeal plexus (i.e. cranial part of accessory nerve [CN XI] or vagus nerve [CN X]) that the fibers arise from. Some say that CN XI piggybacks on CN X to supply palatoglossus while others are confident that there is no sharing and the CN X supplies the palatoglossus but one thing is certain, the nucleus ambiguus provides efferent fibers to the skeletal muscles of the soft palate.

**Tactile sensory innervation**

The **lingual nerve** is a branch of CN V3 which is responsible for conveying general somatic afferent impulses from the anterior two-thirds of the tongue and also carries sensory information from the oral mucosa beneath its ventral surface and gingival mucosa of the lingual side of the mandible. General afferent impulses from the circumvallate papillae, along with the posterior third of the tongue are carried by fibers of CN IX.

**Taste innervation**

There are three cranial nerves responsible for this (CN VII, CN IX, and (to a lesser extent) CN X). The region of the tongue covered by each nerve is dependent on the proximity of the taste bud (and lingual papilla) to the free nerve ending. CN VII reduces special sensory signals from the anterior two-thirds and the inferior part of the soft palate of the tongue.

Fibers of the chorda tympani travel by the lingual nerve to detect impulses from the sulcal tongue. The postsulcal tongue, circumvallate papillae, palatoglossal arches, and oropharynx are governed by CN IX. CN X only provides supply to taste buds in the extreme areas of the pharyngeal tongue. These impulses are conveyed by the internal laryngeal branch of the vagus nerve.

**Clinical correlates**

* A pharyngeal arch defect (**Pierre Robin Syndrome**) causes glossoptosis with other symptoms. It causes the tongue to be displaced posteriorly and may cause airway obstruction (apnea).
* Aglossia - complete absence of the tongue at birth
* Hypoglossia - congenitally short tongue
* Macroglossia - an abnormally large tongue).

2) Air (paranasal) sinuses

They are sinuses (air cavities) that help circulate the air that is breathed in and out of the respiratory system situated around the nasal cavity. They are all paired (sometimes symmetrical) while being bilateral, there are four different pairs of sinuses:

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

**The maxillary sinuses**

They are the largest with thin walls which are often penetrated by the long roots of the posterior maxillary teeth.

* **The superior border** 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
* **The** **lateral and anterior** border are limited by the cheekbones.

**The frontal sinuses**

* **Anteriorly** is the forehead and the superciliary arches,
* **Superiorly and posteriorly** by the anterior cranial fossa and
* **Inferiorly** (by the bony orbit) is the anterior ethmoidal sinuses and the nasal cavity.
* **Medially** the sinuses face one another (separated by the midline)

**The sphenoidal sinuses**

The most posterior in the head, they are large and irregular (just like their septum) which is made by the sphenoid bone.

* **Laterally**, a cavernous sinus exists at the middle cranial fossa and the carotid artery and cranial nerves III, IV, V/I, V/II and VI can be found.
* The **anterior** wall separates its pairs from the nasal cavity, as does the hypophyseal fossa, the pituitary gland and the optic chiasm superiorly and the nasopharynx and pterygoid canal inferiorly.

**The ethmoidal sinuses**

* **Superiorly** is the anterior cranial fossa and the frontal bone,
* **Laterally** the orbit can be found
* **Medially** the nasal cavity is situated.

 They are unique because they are the only paranasal sinuses that are more complex than just a single cavity.