**NAME: AHAMEFULE JONAS IKENNA**

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Question one: Discuss the anatomy of the tongue and comment on its applied anatomy.

Under normal circumstances, the tongue is a pink, muscular organ located within the oral cavity proper.The tongue is covered with moist, pink tissue called mucosa. Tiny bumps called papillae give the tongue its rough texture. Thousands of taste buds cover the surfaces of the papillae. Taste buds are collections of nerve-like cells that connect to nerves running into the brain.

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 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.

The palatoglossal and palatopharyngeal arches (along with the palatine tonsils) have lateral relations to the posterior third of the tongue. Posterior to the base of the tongue is the dorsal surface of the epiglottis and laryngeal inlet, and the posterior wall of the oropharynx.

The tongue has a presulcal and postsulcal part, the presulcal and postsulcal parts of the tongue differ not only by anatomical location, but also based on embryological origin, innervation, and the type of mucosa found on its surface.

**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.

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 of the tongue**

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.

Another set of muscles occupy the dorsoventral plane of the tongue deep to the superior longitudinal muscles. These are the vertical muscles that 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.

Deep to the ventral muscles is the layer of transverse muscles of the tongue. 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.

Finally, 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.

**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.

Styloglossus and palatoglossus are the two muscles arising from above. 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 and hyoglossus arise from below. 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.

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.

**Innervation**

In the anterior 2/3, general sensation is supplied by the trigeminal nerve (CNV). Specifically the lingual nerve, a branch of the mandibular nerve (CN V3).

On the other hand, taste in the anterior 2/3 is supplied from the facial nerve (CNVII). In the petrous part of the temporal bone, the facial nerve gives off three branches, one of which is chorda tympani. This travels through the middle ear, and continues on to the tongue.

The posterior 1/3 of the tongue is slightly easier. Both touch and taste are supplied by the glossopharyngeal nerve (CNIX).

**Vasculature**

The lingual artery (branch of the external carotid) does most of the supply, but there is a branch from the facial artery, called the tonsillar artery, which can provide some collateral circulation. Drainage is by the lingual vein.

**Lymphatic Drainage**

The lymphatic drainage of the tongue is as follows:

**Anterior two thirds** – initially into the submental and submandibular nodes, which empty into the deep cervical lymph nodes

**Posterior third** – directly into the deep cervical lymph nodes

**Clinical Anatomy**

Thrush (candidiasis): *Candida albicans* (a yeast) grows over the surface of the mouth and tongue. Thrush can occur in almost anyone, but it occurs more often in people taking steroids or with suppressed immune systems, the very young, and the elderly.

Oral cancer: A growth or ulcer appears on the tongue and grows steadily. Oral cancer is more common in people who smoke and/or drink alcohol heavily.

Macroglossia (big tongue): This can be broken down into various categories based on the cause. These include congenital, inflammatory, traumatic, cancerous, and metabolic causes. Thyroid disease, lymphangiomas, and congenital abnormalities are among some of the causes of an enlarged tongue.

Canker sores (aphthous ulcers): Small, painful ulcers appear periodically on the tongue or mouth. A relatively common condition, the cause of canker sores is unknown; they are unrelated to the cold sores caused by herpes viruses. Canker sores are not contagious.

Oral leukoplakia: White patches appear on the tongue that can’t be scraped off. Leukoplakia may be benign, or it can progress to oral cancer.

Biopsy: A small sample of tissue is taken from a suspicious-looking area on the tongue. This is most often done to check for oral cancer.

Tongue surgery: Surgery may be required to remove oral cancer or leukoplakia.

Question two: write an essay on the air sinuses.

The paranasal sinuses are air-filled spaces located within the bones of the skull and facial bones. They are centered on the nasal cavity and have various functions, including lightening the weight of the head, humidifying and heating inhaled air, increasing the resonance of speech, and serving as a crumple zone to protect vital structures in the event of facial trauma.

They help circulate the air that is breathed in and out of the respiratory system and they are all paired and sometimes symmetrical, while always being bilateral.

Four sets of paired sinuses are recognized: maxillary, frontal, sphenoid, and ethmoid sinuses.

**Maxillary sinuses**

The maxillary sinuses are the largest of 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.

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**

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.

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**

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 chains superiorly and the nasopharynx and pterygoid canal inferiorly.

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**

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.

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.