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1. Discuss the anatomy of the tongue and comment on its applied anatomy

The tongue is a mobile muscular organ that can assume a variety of shapes and positions. It is partly in the **oral cavity** and partly in the **oropharynx**. The tongue is involved with mastication, taste, swallowing, articulation, and oral cleansing; however, its main functions are forming words during speaking and squeezing food into the oropharynx when swallowing.

Parts and Surfaces of the Tongue

**The root of the tongue:**

* is the part of the tongue that rests on the floor of the mouth
* It is usually defined as the posterior third of the tongue

**The body of the tongue:**

* is the anterior two thirds of the tongue

**The apex (tip) of the tongue:**

* is the anterior end of the body, which rests against the incisor teeth

**The dorsum (dorsal surface) of the tongue :**

* is the posterosuperior surface, which is located partly in the oral cavity and partly in the oropharynx
* The dorsum is characterized by a V-shaped groove called the **terminal sulcus** or **groove (sulcus terminalis)**
* posterior to this groove is  **foramen cecum**.
* This small pit, frequently absent, is the non-functional remnant of the proximal part of the embryonic thyroglossal duct from which the thyroid gland developed
* The terminal sulcus divides the dorsum of the tongue into the:
* **anterior (oral) part** in the **oral cavity proper**
* **posterior (pharyngeal)** part in the **oropharynx**

The margin of the tongue is related on each side to the lingual gingivae and lateral teeth. The mucous membrane on the anterior part of the tongue is rough because of the **presence of numerous small lingual papillae(small nipple like process)**:

**Vallate papillae**: Large and flat topped, they lie directly anterior to the terminal sulcus and are arranged in a V-shaped row

**Foliate papillae**: Small lateral folds of the lingual mucosa. They are poorly developed in humans

**Filiform papillae**: Long and numerous, they contain afferent nerve endings that are sensitive to touch

**Fungiform papillae**: Mushroom shaped pink or red spots, they are scattered among the filiform papillae but are most numerous at the apex and margins of the tongue

The vallate, foliate, and most of the fungiform papillae contain taste receptors in the taste buds.The mucous membrane over the anterior part of the dorsum of the tongue is thin and closely attached to the underlying muscle. A shallow midline groove of the tongue divides the tongue into right and left halves called the **median sulcus.** The mucous membrane of the posterior part of the tongue is thick and freely movable. It has no lingual papillae, but the underlying lymphoid nodules give this part of the tongue an irregular, cobblestone appearance. The lymphoid nodules are known collectively as the **lingual** **tonsil**. The pharyngeal part of the tongue constitutes the anterior wall of the oropharynx. The inferior surface of the tongue is covered with a thin, transparent mucous membrane through which one can see the underlying veins. This surface is connected to the floor of the mouth by a midline fold called the **frenulum of the tongue**. The frenulum allows the anterior part of the tongue to move freely. On each side of the frenulum, a deep lingual vein is visible through the thin mucous membrane**.** There are four basic taste sensations: sweet, salty, sour, and bitter

**Sweetness** is detected at the apex

**Saltiness** at the anterolateral margins

**Sourness** at the posterolateral margins

**Bitterness** at the posterior part of the tongue

Muscles of the Tongue

The tongue is essentially a mass of muscles that is mostly covered by mucous membrane. Extrinsic muscles alter the position of the tongue while intrinsic muscles alter its shape. The four intrinsic and four extrinsic muscles in each half of the tongue are separated by a median fibrous lingual septum, which merges posteriorly with the lingual aponeurosis. The extrinsic muscles are; genioglossus, hyoglossus, styloglossus, palatoglossus. And the intrinsic muscles are; superior longitudinal muscle, inferior longitudinal muscle, transverse muscle, vertical muscles

Arterial supply

* The arteries of the tongue are derived from the lingual artery, which arises from the external carotid artery

On entering the tongue, the lingual artery passes deep to the hyoglossus muscle and give rise to the:

* The dorsal lingual arteries supply the posterior part (root);
* the deep lingual arteries supply the anterior part.
* The deep lingual arteries communicate with each other near the apex of the tongue.
* The dorsal lingual arteries are prevented from communicating by the lingual septum

Venous drainage

* The veins of the tongue are the dorsal lingual veins, which accompany the lingual artery;
* the deep lingual veins, which begin at the apex of the tongue, run posteriorly beside the lingual frenulum to join the sublingual vein
* The sublingual veins in elderly people are often varicose (enlarged and tortuous)
* All these lingual veins terminate, directly or indirectly, in the IJV

The lymphatic drainage of the tongue

Lymph from the tongue takes four routes

* Lymph from the posterior third drains into the **superior deep cervical lymph nodes**
* Lymph from the medial part of the anterior two thirds drains directly to the **inferior deep cervical lymph nodes**
* Lymph from the lateral parts of the anterior two thirds drains to the **submandibular lymph nodes**
* The apex and frenulum drain to the **submental lymph nodes**
* The posterior third and the medial part of the anterior two thirds drain bilaterally

Innervation of the Tongue

**Motor innervation**

All muscles of the tongue, except the palatoglossus (actually a palatine muscle supplied by the vagus nerve(X) of the pharyngeal plexus), receive motor innervation from the hypoglossal nerve (CN XII)

**Sensory innervation**

The anterior two thirds of the tongue are supplied by:

* the lingual nerve (CN V3) for general sensation
* the chorda tympani, a branch of the facial nerve (CN VII) transferring nerve fibers to the lingual nerve, for taste

The posterior third of the tongue and the vallate papillae are supplied by:

* the lingual branch of the glossopharyngeal nerve (CN IX) for both general sensation and taste
* Another contribution is made by the internal laryngeal branch of the vagus (CN X) for general sensation and taste
* Hence CN VII, CN IX, and CN X provide nerve fibers for taste; those from CN VII are ultimately conveyed by CN V3

Clinical anatomy

1. **Lingual Carcinoma**: A lingual carcinoma in the posterior part of the tongue metastasizes to the superior deep cervical lymph nodes on both sides, whereas a tumor in the anterior part usually does not metastasize to the inferior deep cervical lymph nodes until late in the disease. Because these nodes are closely related to the IJV, metastases from the tongue may be widely distributed through the submental and submandibular regions and along the IJVs in the neck.

2. **Frenectomy:** An overly large lingual frenulum (tongue-tie/ ankyloglossa) interferes with tongue movements and may affect speech. In unusual cases, a frenectomy (cutting the frenulum) in infants may be necessary to free the tongue for normal movement and speech

3. **Thyroglossal Duct Cyst**: A cystic remnant of the thyroglossal duct, associated with development of the thyroid gland, may be found in the root of the tongue and be connected to a sinus that opens at the foramen cecum. Surgical excision of the cyst may be necessary. Most thyroglossal duct cysts are in the neck, close or just inferior to the body of the hyoid bone.

2. Write an essay on the air sinuses

The air sinuses are also known as the Paranasal Sinuses. They are air-filled extensions of the respiratory part of the nasal cavity, located within 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. There are four paired sinuses, named according to the bone in which they are located. They are the maxillary, frontal, sphenoid and ethmoid sinuses.

1. **Maxillary Sinuses**: The maxillary sinuses are the largest of the all the paranasal sinuses and lie inferior to the eyes in the maxillary bone. It is the first sinus to develop and is filled with fluid at birth. They have the shape of a pyramid, with the base along the nasal wall and the apex pointing laterally towards the zygomatic bone. 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.

The maxillary sinuses have thin walls which are often penetrated by the long roots of the posterior maxillary teeth. The anterior maxillary sinus wall houses the infraorbital nerve, which runs through the infraorbital canal along the roof of the sinus and sends branches to the soft tissues of the cheek. The thinnest portion of the anterior wall is above the canine tooth, called the canine fossa, which is an ideal entry site for addressing various disease processes of the maxillary sinus. Behind the posteromedial wall of the sinus lies the pterygopalatine fossa, a small inverted space that houses several important neurovascular structures and communicates with several skull base foramina. The infratemporal fossa lies behind the posterolateral wall of the maxillary sinus.

 Arterial Supply: The maxillary sinus is supplied by branches of the internal maxillary artery, which include the infraorbital, alveolar, greater palatine, and sphenopalatine arteries.

 Innervation: It is innervated by the maxillary division of the trigeminal nerve, the infraorbital nerve, and the greater palatine nerves.

 Lymphatic Drainage: The submandibular lymph nodes are the main destination during lymphatic drainage.

2. **Frontal Sinuses**: The frontal sinuses are housed in the frontal bone superior to the eyes in the forehead. 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.

 Arterial Supply: The frontal sinuses are supplied by the anterior ethmoidal artery and supraorbital and supratrochlear arteries of the ophthalmic artery.

 Innervation: They are innervated by the supraorbital and supratrochlear branches of the ophthalmic division of the trigeminal nerve.

 Lymphatic Drainage: They drain primarily into the ethmoidal infundibulum and the corresponding lymph drainage occurs via the submandibular lymph nodes.

3**. 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. The sphenoidal sinus originates in the sphenoid bone at the center of the head. Laterally, a cavernous sinus exists which is part of the middle cranial fossa and also the carotid artery and cranial nerves III (Oculomotor nerve), IV (Trochlear nerve), V1 (Ophthalmic division of Trigeminal nerve), V2 (Maxillary division of Trigeminal nerve) and VI (Abducens nerve) 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.

 Arterial Supply: The sphenoidal sinus is supplied by the posterior ethmoidal artery and posterior lateral nasal branches.

 Innervation: Innervation of the sphenoidal sinuses is provided by the posterior ethmoidal branch of the ophthalmic division of the trigeminal nerve and the maxillary division of the trigeminal nerve via orbital branches from the pterygopalatine ganglion.

 Lymphatic Drainage: The lymphatic drainage occurs in the same way as the posterior ethmoid sinus, to the retropharyngeal lymph nodes.

4. **Ethmoidal Sinuses**: The ethmoid sinuses are unique because they are the only paranasal sinuses that are more complex than just a single cavity. The ethmoidal sinuses arise in the ethmoid bone, forming several distinct air cells between the eyes. The ethmoid cells are shaped like pyramids and are divided by thin septa. On each side of the midline, anywhere from 3-18 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. They are bordered by the middle turbinate medially and the medial orbital wall laterally. Superior to the ethmoidal sinus is the anterior cranial fossa and the frontal bone. The ethmoid labyrinth may extend above the orbit, lateral and superior to the sphenoid, above the frontal sinus, and into the roof of the maxillary sinus.

 Arterial Supply: The ethmoid sinuses are supplied by branches of the anterior and posterior ethmoidal arteries from the ophthalmic artery (internal carotid system) as well as the sphenopalatine artery from the terminal branches of the internal maxillary artery (external carotid system).

 Innervation: The ethmoidal cells are innervated by the anterior and posterior ethmoidal branches of the nasociliary nerve from the ophthalmic division of the trigeminal nerve and the maxillary division of the trigeminal nerve via orbital branches from the pterygopalatine ganglion.

 Lymphatic Drainage: 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.