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Medicine and Surgery

A.

### **Anatomy of the Tongue**

The tongue is a mass of muscle that is almost completely covered by a mucous membrane. It occupies most of the oral cavity and oropharynx. It is known for its role in taste, but it also assists with mastication (chewing), deglutition (swallowing), articulation (speech), and oral cleansing.

#### **Embryonic Development**

The embryologic origins of the tongue first appear at 4 weeks' gestation. The body of the tongue forms from derivatives of the first branchial arch. This gives rise to 2 lateral lingual swellings and 1 median swelling (known as the tuberculum impar). The lateral lingual swellings slowly grow over the tuberculum impar and merge, forming the anterior two thirds of the tongue. Parts of the second, third, and fourth branchial arches give rise to the base of the tongue. Occipital somites give rise to myoblasts, which form the intrinsic tongue musculature

#### **Parts and Surfaces of the tongue**

From anterior to posterior, the tongue has 3 surfaces: tip(apex), body, and base(root). The tip is the highly mobile, pointed anterior portion of the tongue which rests against the incisor teeth. Posterior to the tip lies the body of the tongue, which has superior (posterior surface regarded as the dorsum of the tongue) and inferior (commonly referred to as 'underside') surfaces. The median sulcus of the tongue separates the body into left and right halves. The terminal sulcus or groove, located on the dorsum of the tongue, is a V-shaped furrow that separates the body from the base of the tongue. At the tip of this sulcus is the foramen cecum, a nonfunctional remnant of the proximal thyroglossal duct from which the thyroid gland developed. The base of the tongue is the attached posterior portion, extending between the mandible, hyoid, and nearly vertical posterior surface of the tongue. The mucosa of the anterior part of the tongue is relatively thin and closely attached to the underlying muscle. It has a rough texture because of the numerous small lingual papillae which are projections of lamina propria covered with epithelium. The 4 types of lingual papillae are as follows:

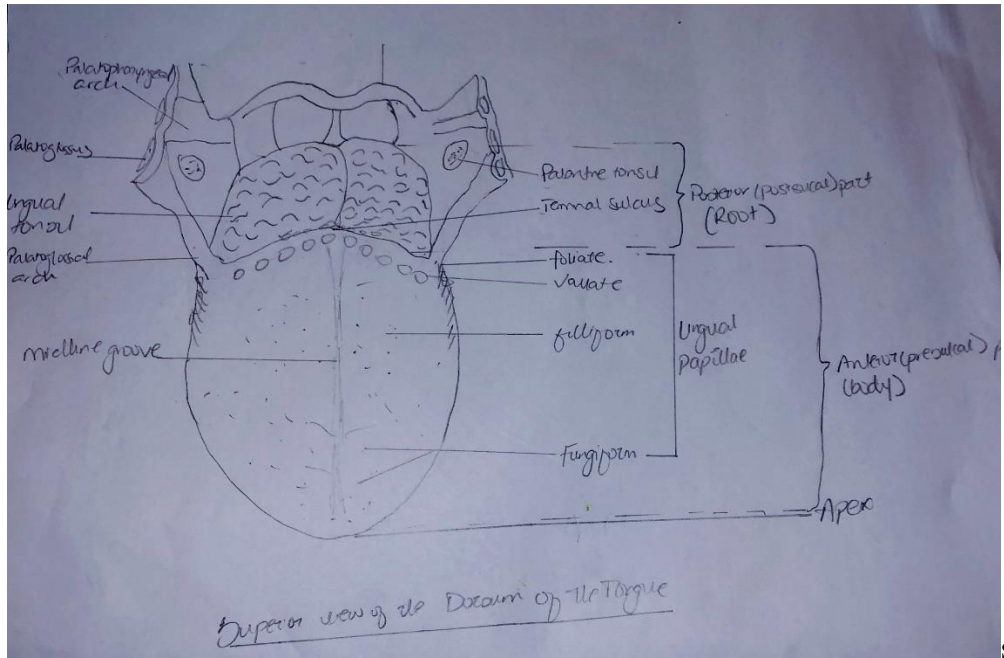
- **The vallate papillae:** are flat, prominent papillae that are surrounded by troughs, the walls of which are studded with taste buds. In humans, there are 8-12 vallate papillae, located directly anterior to the terminal sulcus and arranged in a v shaped row. The ducts of the lingual glands of von Ebner secrete lingual lipase into the surrounding troughs to begin the process of lipolysis.
- **The foliate papillae:** are small folds of mucosa located along the lateral surface of the tongue. They are poorly developed in humans.
- **The filiform papillae:** are thin and long; they are the most numerous papillae and are located along the entire dorsum of the tongue, but they are not involved in taste sensation. They contain afferent nerve endings that are sensitive to touch. They are pinkish grey and are arranged in v shaped rows that are parallel to the terminal sulcus, except at the apex where they tend to be transversely arranged.
- **The fungiform papillae:** are mushroom shaped, pink or red spots and are dispersed most densely along the tip and lateral surfaces of the tongue; humans have approximately 200-300 fungiform papillae.

Each vallate, foliate, and fungiform papilla contains taste buds (250, 1000, and 1600 taste buds, respectively). Each taste bud is innervated by several nerve fibers. In humans, all taste buds can perceive the 5 different taste qualities: salt, sweet, bitter, acid, and umami.

The mucosa of the posterior part of the tongue is thick and freely movable. It has no lingual papillae but the underlying lymph nodules gives this part a cobblestone appearance. The lymph nodules are known collectively as lingual tonsil.

The inferior surface of the tongue is covered with a thin, transparent mucous membrane. 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 mucous membrane.

A sublingual caruncle is present on each side of the base of the frenulum that includes the opening of the submandibular duct from the submandibular salivary gland.



### Muscles of the Tongue

The tongue has 4 intrinsic and 4 extrinsic muscles. Extrinsic muscles are so named because they originate outside the tongue and insert within it; intrinsic muscles are within the substance of the organ and do not insert on bone. Although the muscles do not act in isolation, intrinsic muscles generally alter the shape of the tongue, whereas extrinsic muscles alter its position. The muscles on each side of the tongue are separated by a fibrous lingual septum which emerges posteriorly with the lingual aponeurosis.

The intrinsic muscles include : Superior and inferior longitudinal muscles and the transverse and vertical muscles.

The extrinsic muscles include: Genioglossus, hyoglossus, styloglossus and palatoglossus.

Muscle	Type	Origin	Insertion	Action
<b>Superior longitudinal</b>	Intrinsic	Lingual septum and submucous fibrous layer	Margins of tongue	Elevates tip and sides of tongue; shortens tongue
<b>Inferior longitudinal</b>	Intrinsic	Body of hyoid and base of tongue	Apex of tongue	Curles tip inferiorly; shortens tongue
<b>Transverse</b>	Intrinsic	Lingual septum	Submucous fibrous layer	Narrows and lengthens tongue
<b>Vertical</b>	Intrinsic	Superior surface of tongue	Inferior surface of tongue	Flattens and broadens tongue
<b>Genioglossus</b>	Extrinsic	Mental spine of mandible	Lateral and inferior tongue	Depresses and protrudes tongue

<b>Hyoglossus</b>	Extrinsic	Body and greater horn of hyoid	Lateral and inferior tongue	Depresses and retracts tongue
<b>Styloglossus</b>	Extrinsic	Styloid and stylohyoid ligament	Lateral and inferior tongue	Retracts tongue
<b>Palatoglossus</b>	Extrinsic	Palatine aponeurosis	Lateral tongue	Elevates posterior tongue

### **Vasculature of the Tongue**

Similar to most of the head and neck region, the tongue derives its arterial blood supply from the lingual artery a branch of the external carotid artery. The lingual artery branches off the external carotid artery deep to the stylohyoid muscle. At first, it travels superomedially; after a short distance, it changes direction and moves anteroinferiorly. The hypoglossal nerve (CN XII) crosses over it laterally before it enters the tongue deep in the hyoglossus muscle.

Within the tongue, the lingual artery gives rise to its 3 main branches: the dorsal lingual, deep lingual, and sublingual arteries. The dorsal lingual artery supplies the base of the tongue. The deep lingual artery travels on the lower surface of the tongue to the apex. A branch to the sublingual gland and the floor of the mouth is known as the sublingual artery.

The veins of the tongue run parallel the lingual artery branches. The deep lingual vein begins at the tip of the tongue and travels posteriorly to join the sublingual vein. This drains into the dorsal lingual vein, which accompanies the lingual artery. Directly or indirectly, this vein empties into the internal jugular vein. The Sublingual vein in elderly people are often very varicose (enlarged and tortuous).

### **Nerve Supply of the Tongue**

Motor innervation for all of the muscles of the tongue comes from the hypoglossal nerve--with the exception of the palatoglossus, which is supplied by the pharyngeal plexus (fibers from the cranial root of the spinal accessory nerve carried by the vagus nerve).

General sensation (touch and temperature) of the anterior two thirds of the tongue is supplied by the lingual nerve, a terminal branch of the third division of the trigeminal nerve. Taste sensation for this portion of the tongue (except the vallate papillae) is carried by the chorda tympani, a branch of the facial nerve. The chorda tympani joins the lingual nerve in the infratemporal fossa and runs anteriorly in its sheath. The mucosa of the posterior third of the tongue and the vallate papillae relays general and sensation via the lingual-tonsillar branch of the glossopharyngeal nerve. Some general and taste sensation from the base of tongue anterior to the epiglottis is carried by the internal laryngeal branch of the vagus nerve (CN X). These mostly sensory nerves also carry parasympathetic secretomotor fibers to serous glands in the tongue.

### **Lymphatic drainage**

The lymphatic drainage of the tongue is complex. Lymphatics from the tip of the tongue and frenulum travel to the submental lymph nodes. This can be ipsilateral or bilateral depending on

the site of the lesion. Lymph from the medial anterior two thirds of the tongue travels to the inferior deep cervical lymph nodes, and lymph from the lateral anterior tongue goes to the submandibular nodes on the ipsilateral side. The tongue-base lymphatics drain bilaterally into the superior deep cervical lymph nodes.

### **Pathophysiologic Variants**

1. Ankyloglossia is caused by an abnormally short lingual frenulum. A frenum of the tongue extending farther anteriorly towards the apex (tongue-tie) interferes with tongue movements and may affect speech. In unusual case, a frenectomy is required in infants to free the tongue for normal movements.
2. Macroglossia is a congenital enlargement of the tongue. Microglossia is a small tongue, and aglossia is the absence of the tongue. These are rare and are usually associated with other limb abnormalities.
3. Geographic tongue (migratory glossitis) is characterized by a benign, asymptomatic bright red patch (or patches) with a gray or white margin on an otherwise normal tongue.
4. Fissured tongue (scrotal tongue) is characterized by numerous small furrows or grooves on the dorsal surface of the tongue.
5. Lingual carcinoma in the posterior part of the tongue metastasizes to the superior deep cervical lymph nodes on both sides. However, a tumor in the anterior part usually does not metastasize to the inferior deep cervical lymph nodes until late in the disease. Due to the closeness of the lymph nodes to the internal jugular vein, metastasis from the tongue may be distributed through the submental and submandibular regions and along the internal jugular veins in the neck.
6. In black hairy tongue, hyperplasia of filiform papillae leads to bacterial trapping; entrapped pigments and desquamation may lead to the dark discoloration of the tongue.
7. Injury to the hypoglossal nerve (CNXII) results in deviation of the tongue toward the paralyzed side during protrusion because of the action of the unaffected genioglossus muscle on the other side. The tongue also atrophies over time on the paralyzed side.

## **B.**

### **Paranasal Sinuses( 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. The sinuses are named according to the bones in which they are located in. Four sets of paired sinuses are recognized: maxillary, frontal, sphenoid, and ethmoid.

#### **Maxillary sinus**

The maxillary sinus is the largest paranasal sinus and lies inferior to the eyes in the maxillary bone. It is the first sinus to develop and is filled with fluid at birth. It grows

according to a biphasic pattern, in which the first phase occurs during years 0-3 and the second during years 6-12. The earliest phase of pneumatization is directed horizontally and posteriorly, whereas the later phase proceeds inferiorly toward the maxillary teeth. This development places the floor of the sinus well below the floor of the nasal cavity. The shape of the sinus is a pyramid, with the base along the nasal wall and the apex pointing laterally toward the zygoma. The natural ostium of the maxillary sinus is located in the superior portion of the medial wall.

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.

The roof of the maxillary sinus is the floor of the orbit. Behind the posteromedial wall of the maxillary 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.

The maxillary sinus is supplied by branches of the internal maxillary artery, which include the infraorbital, alveolar, greater palatine, and sphenopalatine arteries. It is innervated by branches of the second division of the trigeminal nerve, the infraorbital nerve, and the greater palatine nerves.

### **Frontal sinus**

The left and right frontal sinuses are between the outer and inner tables of the frontal bone superior to the eyes in the forehead, posterior to the super ciliary arches and the root of the nose. It is formed by the upward movement of anterior ethmoid cells after the age of 2. Developmentally, this is the last sinus to pneumatize. Growth increases at age 6 years and continues until the late teenage years. They vary from size to size from approximately 5mm to large spaces. The frontal sinuses are funnel-shaped structures with their ostia located in the most dependent portion of the cavities.

The left and right sinuses drain through the frontonasal duct into the ethmoidal infundibulum, which opens into the semilunar hiatus of the middle nasal hiatus. The posterior wall of the frontal sinus, which separates the sinus from the anterior cranial fossa, is much thinner than its anterior wall.

Often, a frontal sinus has two parts; a vertical part in the squamous part of the frontal bone and a horizontal part in the orbit of the frontal bone.

The frontal sinus is supplied by the supraorbital and supratrochlear arteries of the ophthalmic artery. It is innervated by the supraorbital and supratrochlear nerves of the first division of the trigeminal nerve.

### **Sphenoid sinus**

The sphenoid sinus originates in the sphenoid bone at the center of the head and may extend into the wings of this bone. It arises not from an outpouching of the nasal cavity

but from the nasal embryonic lining. The sinus reaches its full size by the late teenage years. The sphenoid sinus is variably pneumatized and may extend as far as the foramen magnum in some patients.

The thickness of the walls of the sphenoid sinus is variable, with the anterosuperior wall and the roof of the sphenoid sinus (the planum sphenoidale) being the thinnest bones. The sphenoid sinus ostium is located on the anterosuperior surface of the sphenoid face, usually medial to the superior turbinate.

The sphenoid sinus is supplied by the sphenopalatine artery, except for the planum sphenoidale, which is supplied by the posterior ethmoidal artery. Innervation of the sphenoid sinus comes from branches of the first and second divisions of the trigeminal nerve.

### **Ethmoid sinus cells**

The ethmoid sinuses arise in the ethmoid bone, forming several distinct air cells between the eyes. They are a collection of fluid-filled cells at birth that grow and pneumatize until the age of 12. The ethmoid cells are shaped like pyramids and are divided by thin septa. They are bordered by the middle turbinate medially and the medial orbital wall laterally. 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.

The ethmoid sinuses are supplied by the anterior and posterior ethmoidal arteries from the ophthalmic artery (internal carotid system), as well as by the sphenopalatine artery from the terminal branches of the internal maxillary artery (external carotid system). The anterior ethmoidal cells drain directly or indirectly into the middle nasal meatus through the ethmoidal infundibulum. The middle ethmoidal cells open directly into the middle meatus and are sometimes called bulla cells because they form the ethmoidal bulla, a swelling on the superior border of the semilunar hiatus. The posterior ethmoidal cells open directly into the superior meatus.

