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**THE GROSS ANATOMY OF THE TONGUE**

 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’s main functions are articulation (forming words during speaking) and squeezing food into the oropharynx as part of deglutition (swallowing). The tongue is also involved with mastication, taste, and oral cleansing.

 The tongue comprises root, a body, and an apex.

* The root of the tongue is the attached posterior potion extending between the mandible, hyoid, and the nearly vertical posterior surface of the tongue.
* The body of the tongue is the anterior, approximately two thirds of the tongue between root and apex.
* The apex (tip) of the tongue is the anterior end of the body, which rests against the incisor teeth.

The body and apex of the tongue are extremely mobile.

The tongue has two surfaces:

* The more extensive, superior and posterior surface which is the dorsum of the tongue (referred to in lay terms as the “top” of the tongue).
* The inferior surface of the tongue (commonly referred to as its “underside”) which usually rests against the floor of the mouth.

The margin of the tongue separating the two surfaces is related on each side to the lingual gingivae and lateral teeth. The dorsum of the tongue is characterized by a V-shaped groove, the terminal sulcus, the angle of which points posteriorly to the 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 transversely into a presulcal anterior part in the oral cavity proper and a postsulcal posterior part in the oropharynx.

A midline groove divides the anterior part of the tongue into right and left parts. The mucous membrane on the anterior part of the tongue is relatively thin and closely attached to the underlying muscle. It has a rough texture because of the presence of numerous small lingual papillae:

• Vallate papillae: large and flat topped, lie directly anterior to the terminal sulcus and are arranged in a V-shaped row. They are surrounded by deep circular trenches, the walls of which are studded with taste buds. The ducts of the serous glands of the tongue open into the trenches.

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

• Filiform papillae: long and numerous, contain afferent nerve endings that are sensitive to touch. These scaly, conical projections are pinkish gray and are arranged in V-shaped rows that are parallel to the terminal sulcus, except at the apex, where they tend to be arranged transversely.

• Fungiform papillae: mushroom shaped pink or red spots 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 of the posterior part of the tongue is thicker 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 and can be inspected only with a mirror or downward pressure on the tongue with a tongue depressor. 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 thin mucous membrane. A sublingual caruncle (papilla) is present on each side of the base of the lingual frenulum that includes the opening of the submandibular duct from the submandibular salivary gland.

MUSCLES OF THE TONGUE

 The tongue is essentially a mass of muscles covered mostly by muscous membrane. They are four extrinsic and four intrinsic muscles in each half of the tongue separated by a median fibrous lingual septum, which merges posteriorly with the lingual aponeurosis.

The extrinsic muscles alter the position of the tongue, and intrinsic muscles alter its shape.

EXTRINSIC MUSCLES OF THE TONGUE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Muscle** | **Shape and position** | **Proximal attachment**  | **Distal attachment** | **Main functions** |
| Genioglossus | Fan-shaped muscle;constitutes bulk of tongue | Body and greater hornof hyoid bone | Body and greater hornof hyoid bone | Bilateral activity depresses tongue,especially central part, creating alongitudinal furrow; posterior partpulls tongue anteriorly for protrusion;a most anterior part retractsapex of protruded tongue; unilateralcontraction deviates (“wags”)tongue to contralateral side |
| Hyoglossus | Thin, quadrilateral muscle | Body and greater hornof hyoid bone | Inferior aspects of lateralpart of tongue | Depresses tongue, especiallypulling its sides inferiorly; helpsshorten (retrude) tongue |
| Styloglossus | Small, short triangularmuscle | Anterior border of distalstyloid process;stylohyoid ligament | Sides of tongue posteriorly,interdigitating withhyoglossus | Retrudes tongue and curls (elevates)its sides, working withgenioglossus to form a centraltrough during swallowing |
| Palatoglossus | Narrow crescent-shapedpalatine muscle; formsposterior column of isthmus of fauces | Palatine aponeurosisof soft palate | Enters posterolateraltongue transversely,blending with intrinsictransverse muscles | Capable of elevating posteriortongue or depressing soft palate;most commonly acts to constrictisthmus of fauces |

INTRINSIC MUSCLES OF THE TONGUE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Muscle** | **Shape and position** | **Proximal attachment**  | **Distal attachment** | **Main functions** |
| Superiorlongitudinal | Thin layer deep tomucous membrane ofdorsum | Submucosal fibrous layerand median fibrousseptum | Margins of tongue andmucous membrane | Curls tongue longitudinally upward,elevating apex and sides of tongue;shortens (retrudes) tongue |
| Inferiorlongitudinal | Narrow band close toinferior surface | Root of tongue and bodyof hyoid bone | Apex of tongue | Curls tongue longitudinally downward,depressing apex; shortens(retrudes) tongue |
| Transverse | Deep to superior longitudinalmuscle | Median fibrous septum | Fibrous tissue at laterallingual margins | Narrows and elongates (protrudes)tonguec |
| Vertical | Fibers intersect transversemuscle | Submucosal fibrous layerof dorsum of tongue | Inferior surface of bordersof tongue | Flattens and broadens tongue |

INNERVATION OF THE TONGUE

All muscles of the tongue, except the palatoglossus receive motor innervation from CN XII, the hypoglossal nerve. Palatoglossus is a palatine muscle supplied by the pharyngeal plexus. For general sensation (touch and temperature), the mucosa of the anterior two thirds of the tongue is supplied by the lingual nerve, a branch of CN V3 For special sensation (taste), this part of the tongue, except for the vallate papillae, is supplied through the chorda tympani nerve, a branch of CN VII. The chorda tympani joins the lingual nerve in the infratemporal fossa and runs anteriorly in its sheath. The mucous membrane of 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 and special sensation. Twigs of the internal laryngeal nerve, a branch of the vagus nerve (CN X), supply mostly general but some special sensation to a small area of the tongue just anterior to the epiglottis. These mostly sensory nerves also carry parasympathetic secretomotor fibers to serous glands in the tongue.

There are four basic taste sensations: sweet, salty, sour, and bitter. Sweetness is detected at the apex, saltiness at the lateral margins, and sourness and bitterness at the posterior part of the tongue. All other “tastes” expressed by gourmets are olfactory (smell and aroma).

VASCULATURE OF TONGUE

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. The dorsal lingual arteries supply the root of the tongue; the deep lingual arteries supply the body. 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. 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 sub-lingual veins in elderly people are often varicose (enlarged and tortuous). Some or all of these veins may drain directly into the IJV, or they may do so indirectly, joining first to form a lingual vein that accompanies the initial part of the lingual artery. The lymphatic drainage of the tongue is exceptional. Most of the lymphatic drainage converges toward and follows the venous drainage; however, lymph from the tip of the tongue, frenulum, and central lower lip runs an independent course. Lymph from the tongue takes four routes:

1. Lymph from the root drains bilaterally into the superior deep cervical lymph nodes.

2. Lymph from the medial part of the body drains bilaterally and directly to the inferior deep cervical lymph nodes.

3. Lymph from the right and left lateral parts of body drains to the submandibular lymph nodes on the ipsilateral side.

4. The apex and frenulum drain to the submental lymph nodes, the medial portion draining bilaterally.

All lymph from the tongue ultimately drains to the deep cervical nodes, and passes via the jugular venous trunks into the venous system at the right and left venous angles.



DIAGRAM OF THE TONGUE

**APPLIED ANATOMY**

GAG REFLEX

It is possible to touch the anterior part of the tongue without feeling discomfort; however, when the posterior part is touched, the individual gags. CN IX and CN X are responsible for the muscular contraction of each side of the pharynx. Glossopharyngeal branches provide the afferent limb of the gag reflex.

PARALYSIS OF GENIOGLOSSUS

When the genioglossus muscle is paralyzed, the tongue has a tendency to fall posteriorly, obstructing the airway and presenting the risk of suffocation. Total relaxation of the genioglossus muscles occurs during general anesthesia; therefore, an airway is inserted in an anesthetized person to prevent the tongue from relapsing.

INJURY TO HYPOGLOSSAL NERVE

Trauma, such as a fractured mandible, may injure the hypoglossal nerve (CN XII), resulting in paralysis and eventual atrophy of one side of the tongue. The tongue deviates to the paralyzed side during protrusion because of the action of the unaffected genioglossus muscle on the other side.

2. **THE AIR SINUSES**

PARANASAL SINUSES

The paranasal sinuses are air-filled extensions of the respiratory part of the nasal cavity into the following cranial bones: frontal, ethmoid, sphenoid, and maxilla. They are named according to the bones in which they are located. The sinuses continue to invade the surrounding bone, and marked extensions are common in the crania of older individuals.

FRONTAL SINUSES

The right and left frontal sinuses are between the outer and the inner tables of the frontal bone, posterior to the superciliary arches and the root of the nose. Frontal sinuses are usually detectable in children by 7 years of age. The right and left sinuses each drain through a frontonasal duct into the ethmoidal infundibulum, which opens into the semilunar hiatus of the middle nasal meatus. The frontal sinuses are innervated by branches of the supraorbital nerves (CN V1). The right and left frontal sinuses are rarely of equal size, and the septum between them is not usually situated entirely in the median plane. The frontal sinuses vary in size from approximately 5 mm to large spaces extending laterally into the greater wings of the sphenoid. Often a frontal sinus has two parts: a vertical part in the squamous part of the frontal bone and a horizontal part in the orbital part of the frontal bone. One or both parts may be large or small. When the supra-orbital part is large, its roof forms the floor of the anterior cranial fossa and its floor forms the roof of the orbit.

ETHMOIDAL CELLS

The ethmoidal cells (sinuses) are small invaginations of the mucous membrane of the middle and superior nasal meatus into the ethmoid bone between the nasal cavity and the orbit. The ethmoidal cells usually are not visible in plain radiographs before 2 years of age but are recognizable in CT scans. 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 “bullar cells” because they form the ethmoidal bulla, a swellingon the superior border of the semilunar hiatus. The posterior ethmoidal cells open directly into the superior meatus. The ethmoidal cells are supplied by the anterior and posterior ethmoidal branches of the nasociliary nerves (CN V1).

SPHENOIDAL SINUSES

The sphenoidal sinuses are located in the body of the sphenoid and may extend into the wings of this bone. They are unevenly divided and separated by a bony septum. Because of this extensive pneumatization (formation of air cells), the body of the sphenoid is fragile. Only thin plates of bone separate the sinuses from several importantstructures: the optic nerves and optic chiasm, the pituitary gland, the internal carotid arteries, and the cavernous sinuses. The sphenoidal sinuses are derived from a posterior ethmoidal cell that begins to invade the sphenoid at approximately 2 years of age. In some people, several posterior ethmoidal cells invade the sphenoid, giving rise to multiple sphenoidal sinuses that open separately into the sphenoethmoidal recess. The posterior ethmoidal arteries and the posterior ethmoidal nerves that accompany the arteries supply the sphenoidal sinuses.

MAXILLARY SINUSES

The maxillary sinuses are the largest of the paranasal sinuses. They occupy the bodies of the maxillae and communicate with the middle nasal meatus.

• The apex of the maxillary sinus extends toward and often into the zygomatic bone.

• The base of the maxillary sinus forms the inferior part of the lateral wall of the nasal cavity.

• The roof of the maxillary sinus is formed by the floor of the orbit.

• The floor of the maxillary sinus is formed by the alveolar part of the maxilla. The roots of the maxillary teeth, particularly the first two molars, often produce conical elevations in the floor of the sinus.

Each maxillary sinus drains by one or more openings, the maxillary ostium (ostia), into the middle nasal meatus of the nasal cavity by way of the semilunar hiatus. The arterial supply of the maxillary sinus is mainly from superior alveolar branches of the maxillary artery; however, branches of the descending and greater palatine arteries supply the floor of the sinus.

Innervation of the maxillary sinus is from the anterior, middle, and posterior superior alveolar nerves, which are branches of the maxillary nerve.

