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**Course Title:** Gross Anatomy of Head and Neck.

**Course Code:** ANA 301.

**Question:**

1. Discuss the anatomy of the tongue and comment on its applied anatomy.
2. Write an essay on the air sinuses.

**Question 1:**

The tongue is a mass of muscle that is almost completely covered by a mucous membrane. It forms part of the floor of the oral cavity and part of the anterior wall of the oropharynx. Under normal circumstances, the tongue is pink and kept moist by the products of the major and minor salivary glands. It is known for its role in taste, but it also assists with mastication(chewing), deglutition(swallowing), articulation(speech) and oral cleansing.

This organ is roughly 10cm long and is somewhat triangular in shape, having 3 main parts:

* The apex/tip
* The body
* The root/base

The apex/tip is the highly mobile, pointed anterior portion of the tongue. Posterior to the apex is the body, which has 2 surfaces: a rough dorsal(superior) surface and a smooth ventral(inferior) surface. The dorsal surface abuts the palate and is populated with taste buds and lingual papillae while the ventral surface 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 and is populated by numerous lymphoid aggregates known as the **lingual tonsils** along with foliate papillae along the posterolateral surface.

The anterior two-thirds of the tongue (the apex and the body) forms the **Oral surface of the tongue** while the posterior one-third (the base) forms the **Pharyngeal surface of the tongue**. The oral and pharyngeal surfaces are separated by a V-shaped furrow known as the **terminal sulcus**. At the tip of this sulcus is the **foramen cecum**. The median sulcus of the tongue separates the body into left and right halves.

**Lingual Papillae:**

The superior surface of the body of the tongue derives its characteristic appearance from the presence of lingual papillae, which are projections of lamina propria covered with epithelium. The 4 types of lingual papillae are: vallate, foliate, filiform and fungiform.

1. **Vallate Papillae:** They are the largest out of all the papillae. They are flat, blunt-ended, cylindrical, prominent papillae invaginations in the tongue’s surface that are surrounded by troughs. In human, there are only about 8-12 vallate papillae in a single V-shaped line located directly anterior to the terminal sulcus. The ducts of the lingual glands of von Ebner secrete lingual lipase into the surrounding troughs to begin the process of lipolysis.
2. **Foliate Papillae:** They are small linear folds of mucosa located along the lateral surface of the tongue near the terminal sulcus.
3. **Filiform Papillae:** 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.
4. **Fungiform Papillae:** They are mushroom-shaped and tend to be concentrated along the margins of the tongue. Humans have approximately 200-300 fungiform papillae.

Each vallate, foliate, and fungiform papillae contain taste buds. Vallate papillae contain about 250 taste buds each, foliate papillae contain about 1000 taste buds each and fungiform papillae contain about 1600 taste buds each. Each taste bud is innervated by several nerve fibers.

**Muscles of The Tongue:**

The tongue is chiefly a muscular organ with some amount of fatty and fibrous tissue distributed throughout it. All the muscles of the tongue are paired structures, with each copy on either side of the median fibrous lingual septum made up of connective tissue. The tongue has 4 extrinsic and 4 intrinsic muscles. Extrinsic muscles originate from structures outside the tongue and insert within it while intrinsic muscles originate and insert within the substance of the tongue. Intrinsic muscles generally alter the shape of the tongue, whereas extrinsic muscles alter its position.

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| --- | --- | --- | --- |
| **Muscle** | **Origin** | **Insertion** | **Action** |
| **Intrinsic** | | | |
| Superior longitudinal | Median lingual septum and submucous fibrous layer at the back of the tongue | Margins of tongue | Shortens tongue; curls apex and sides of tongue |
| Inferior longitudinal | Body of hyoid and base of tongue | Apex of tongue | Shortens tongue; uncurls apex and turns it downward |
| Transverse | Median lingual septum | Submucous fibrous layer on lateral margins of the tongue | Narrows and elongates tongue |
| Vertical | Submucous fibrous layer on dorsum of tongue | Ventral surface of the tongue | Flattens and widens tongue |

|  |  |  |  |
| --- | --- | --- | --- |
| **Muscle** | **Origin** | **Insertion** | **Action** |
| **Extrinsic** | | | |
| Genioglossus | Superior mental spines of mandible | Body of hyoid; entire length of tongue | Protrudes tongue; depresses center of tongue |
| Hyoglossus | Body and greater horn of hyoid | Lateral surface of tongue | Depresses tongue |
| Styloglossus | Styloid process  (anterolateral surface) | Lateral surface of tongue | Elevates and retracts tongue |
| Palatoglossus | Inferior surface of palatine aponeurosis | Lateral surface of tongue |  |

**Vasculature:**

* **Arterial Supply:**

The major artery of the tongue is the lingual artery. On each side, the lingual artery originates from the external carotid artery in the neck adjacent to the tip of the greater horn of the hyoid bone. It forms an upward bend and then loops downward and forward to pass deep to the hyoglossus muscle, and accompanies the muscle through the aperture (oropharyngeal triangle) formed by the margins of the mylohyoid, superior constrictor, and middle constrictor muscles, and enters the floor of the oral cavity. The lingual artery then travels forward in the plane between the hyoglossus and genioglossus muscles to the apex of the tongue.

Within the tongue, the lingual artery gives rise to 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 tip. A branch to the sublingual gland and the floor of the mouth is known as the sublingual artery.

* **Venous Drainage:**

The veins of the tongue are named similarly to the arteries they accompany. They are formed from numerous venous tributaries that eventually coalesce.

The **deep lingual veins** are visible through the mucosa on the undersurface of the tongue. Although they accompany the lingual arteries in anterior parts of the tongue, they become separated from the arteries posteriorly by the hyoglossus muscles. On each side, the deep lingual vein travels with the hypoglossal nerve on the external surface of the hyoglossus muscle and passes out of the floor of the oral cavity through the aperture formed by the margins of the mylohyoid, superior constrictor, and middle constrictor muscles. It anastomoses with the sublingual vein and joins the internal jugular vein in the neck.

The **dorsal lingual vein** follows the lingual artery between the hyoglossus and genioglossus muscles, and like the deep lingual vein, drains into the internal jugular vein. The dorsal lingual veins are responsible for draining the lateral margins and dorsal surface of the tongue.

**Innervation:**

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

General sensation 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 is carried by the **chorda tympani branch of the facial nerve**. The posterior one-third of the tongue relays general and taste sensation via the **lingual-tonsillar branch of the glossopharyngeal nerve**. Some general and taste sensation from the base of the tongue anterior to the epiglottis is carried by the **internal laryngeal branch of the superior laryngeal nerve**.

**Lymphatic Drainage:**

All lymphatic vessels from the tongue ultimately drain into the deep cervical chain of nodes along the internal jugular vein.

* Lymphatics from the tip of the tongue travel to the submental lymph nodes and then drain mainly into the jugulo-omohyoid node of the deep cervical chain.
* Lymph from the medial anterior two-thirds of the tongue travels to the deep cervical lymph nodes.
* Lymph from the lateral anterior two-thirds of the tongue drains into the submandibular nodes.
* The pharyngeal part of the tongue (the base) drains through the pharyngeal wall directly into mainly the jugulodigastric node of the deep cervical chain.

**Applied Anatomy:**

1. **Thrush (Candidiasis):** *Candida albicans* (a yeast) grows over the surface of the moth 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.
2. **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.
3. **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.
4. **Geographic Tongue:** Ridges and colored spots migrate over the surface of the tongue, periodically changing its appearance. Geographic tongue is a harmless condition.
5. **Burning Mouth/Burning Tongue syndrome:** This is a relatively common problem. The tongue feels burned or scalded, or strange tastes or sensations develop. Apparently harmless, burning tongue syndrome may be caused by a mild nerve problem.
6. **Atrophic Glossitis (Bald Tongue):** The tongue loses its bumpy texture, becoming smooth. Sometimes this is due to anemia or a B vitamin deficiency.
7. **Hairy Tongue:** Papillae can overgrow the surface of the tongue, giving it a white or black appearance. 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.
8. **Ankyloglossia (Tongue-tie):** This condition is caused by an abnormally short lingual frenulum, which can inhibit tongue movement.

**Question 2:**

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](http://emedicine.medscape.com/article/1284288-overview). 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**](https://www.kenhub.com/en/library/anatomy/bones-of-the-orbit), the **inferior** is the **maxillary alveolar bone and corresponding tooth roots**, the **medial border** is made up of the [**nasal cavity**](https://www.kenhub.com/en/library/anatomy/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](https://www.kenhub.com/en/library/anatomy/the-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.

1. **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**.

1. **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](https://www.kenhub.com/en/library/anatomy/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**](https://www.kenhub.com/en/library/anatomy/the-oculomotor-nerve) **(Oculomotor nerve)**,[**IV**](https://www.kenhub.com/en/library/anatomy/the-trochlear-nerve-and-the-abducent-nerve) **(Trochlear nerve)**, **V1 (Ophthalmic division of Trigeminal nerve)**,[**V2 (Maxillary division of Trigeminal nerve)**](https://www.kenhub.com/en/library/anatomy/the-maxillary-branch-of-the-trigeminal-nerve) and[**VI**](https://www.kenhub.com/en/library/anatomy/the-trochlear-nerve-and-the-abducent-nerve) **(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**](https://www.kenhub.com/en/library/anatomy/pituitary-gland) and the [**optic chiasm**](https://www.kenhub.com/en/library/anatomy/the-optic-nerve) **superiorly** and **the** [**nasopharynx**](https://www.kenhub.com/en/library/anatomy/the-pharynx) 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**.

1. **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**](https://www.kenhub.com/en/library/anatomy/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**.