

The digestive system in the head and neck

The gastrointestinal (GI) system is divided into three main parts

1. Head and Neck Region

This includes: Mouth, Salivary glands, Pharynx, Palate and Tongue

2. Abdominal Part (Alimentary Canal)

The alimentary canal is a continuous muscular tube that begins at the oral cavity and ends at the anal canal. It includes: Oral cavity, Pharynx, Esophagus, Stomach, Small intestine, Large intestine, ending at the rectum and anal canal

3. Accessory Organs

These organs assist in digestion and include: Salivary glands, Liver, Gallbladder, Pancreas and Spleen. These organs are called accessory digestive organs, and they secrete substances (like enzymes and bile) that open into the alimentary canal to aid in digestion.

Functions of the GI System

1. **Digestion:** The process of breaking down complex food substances into simpler absorbable forms.
2. **Absorption:** The absorption of nutrients occurs primarily in the intestines. These nutrients are then transported via the portal circulation to the liver.

The **liver** is one of the most vital abdominal organs and performs multiple essential functions:

- Metabolizes absorbed nutrients
- Synthesizes:
 - Bile and bile salts
 - Enzymes and hormones, including those involved in coagulation
- Detoxifies harmful substances
- Stores glycogen for energy

The **portal vein** carries nutrient-rich blood from the GI tract directly to the liver for initial processing.

After metabolism, waste materials are transported via the **hepatic vein** to the inferior vena cava, and then to the heart, where they are circulated for oxidation and further processing.

Oral Cavity (Mouth)

The oral cavity is the first organ of the gastrointestinal (GI) system. It has two openings:

A. Anterior Opening (Oral Fissure)

- Located between the upper and lower lips.
- The lips are formed by a circular muscle called the **orbicularis oris**, a striated muscle that acts as a sphincter to close the mouth.
- This muscle is innervated by the facial nerve.
 - Functions:
 - Closes the mouth
 - Important in speech, particularly for producing labial sounds (b, m)
 - Responsible for whistling (تصفير)

Clinical Correlation:

- Facial nerve palsy (Bell's palsy):
 - Leads to paralysis of half the mouth and weakness of the buccinator muscle.
 - The patient cannot whistle, and saliva may dribble from the angle of the mouth on the affected side.

Development of the Upper Lip:

- Formed from:
 - Maxillary prominences (from the 1st pharyngeal arch)
 - Medial nasal prominences
- These fuse at a junction between the lateral two-thirds and medial one-third of the upper lip.
- Failure of fusion results in harelip (الشفة الأرنبية). Can be unilateral or bilateral

Philtrum: A vertical midline depression on the upper lip. Represents the fusion line of the right and left medial nasal prominences

Structure of the Lips

The upper and lower lips are divided into three zones:

1. Outer Zone (Cutaneous (skin) Zone):

- Covered by keratinized stratified squamous epithelium
- Contains: Hair follicles, Sebaceous glands and Sweat glands

2. Inner Zone (Oral Mucosa):

- Covered by non-keratinized stratified squamous epithelium
- Contains labial glands (secrete mucus)

3. Transitional Zone (Vermilion Zone):

- The red area of the lips. Covered by modified skin stratified squamous epithelium (Not clearly keratinized or non-keratinized)
- Lacks Hair follicles, Sebaceous glands and Sweat glands. Rich in:
 - Blood vessels (gives it a red color)
 - Sensory nerve terminals (high sensitivity)

Labial Frenulum: Thin mucosal folds that connect the lips to the gums: Superior labial frenulum (upper lip to gum) **and** Inferior labial frenulum (lower lip to gum)

B. Posterior Opening of the Oral Cavity (Oropharyngeal Isthmus/Fauces)

This is the passage from the oral cavity to the oropharynx.

Boundaries:

- Roof (Superiorly): Formed by the soft palate. Contains the uvula (اللهاة)
- Floor (Inferiorly): Formed by the posterior third of the tongue. Contains lingual tonsils (lymphoid tissue)
- Lateral Walls:
 - Two mucosal folds:
 - Palatoglossal fold (anterior): covers the palatoglossus muscle
 - Palatopharyngeal fold (posterior): covers the palatopharyngeus muscle
 - Between these folds lies the palatine tonsil (to be discussed)

Divisions of the Oral Cavity

The oral cavity is anatomically divided into two main parts:

1. Oral Vestibule

- The vestibule is the space between the inner surface of the lips and cheeks and the outer surfaces of the teeth and gums.
- When the teeth are closed, the vestibule is the space outside the dental arches—it's where you would place a toothbrush.
- Boundaries:
 - Medially (internally): Closed teeth and gums
 - Laterally: Cheeks
 - Anteriorly: Lips
- Clinical Importance:
 - The parotid gland—one of the major salivary glands—opens into the vestibule via the parotid duct, usually opposite the second upper molar. It's secretions pass behind last molar from the vestibule to the mouth proper.

2. Mouth Proper (Oral Cavity Proper)

- The mouth proper is the space inside the closed teeth.
- Boundaries:
 - Roof: Formed by the hard palate (anteriorly) and the soft palate (posteriorly)
 - Floor: Formed mainly by the anterior two-thirds of the tongue
 - Laterally and Anteriorly: Bounded by the teeth and gums, separating it from the vestibule

Mucous Membrane of the Oral Cavity

The oral mucosa (lining of the mouth) is classified into two main types based on the type of underlying connective tissue:

1. Soft and Elastic Oral Mucosa (Lining Mucosa)

- Supported by loose and elastic connective tissue.
- Locations:
 - Inner lining of the cheeks
 - Floor of the mouth (under the tongue)
 - Inner aspect of the lips
 - Soft palate

2. Tough or Dense Oral Mucosa (Masticatory Mucosa)

- Supported by dense, fibrous connective tissue for durability.
- Locations:
 - Gums (gingiva)
 - Hard palate (roof of the mouth)
 - Areas around the teeth

Innervation of the Mouth

1. Roof of the Mouth (Palate)

- Supplied by branches of the maxillary nerve:
 - Greater palatine nerve **and** Nasopalatine nerve

2. Floor of the Mouth

- Supplied by the lingual nerve, a branch of the mandibular nerve:
 - Provides general sensation (touch, pain, temperature)

3. Cheeks

Muscle Layer (Buccinator Muscle) Innervated by the buccal branch of the facial nerve – motor function

Mucosa (Inner lining of the cheek) Supplied by the buccal nerve, a branch of the mandibular nerve – sensory function

Skin (Outer cheek) Sensory innervation by branches of the trigeminal nerve

Teeth

Teeth are embedded in the gums (gingiva) and surrounded by dense connective tissue. Humans have two sets of teeth over a lifetime:

Deciduous Teeth (Milk Teeth / الأسنان اللبنية)

- Total: 20 teeth
 - 10 in the upper jaw **and** 10 in the lower jaw
- Types per jaw:

- 4 Incisors (قواطع)
- 2 Canines (أنياب)
- 4 Molars (طواحين)
- Eruption Timeline: Begin to erupt around 6 months of age. First to appear: Lower central incisors. Followed by: Upper incisors → Lateral incisors → Canines → Molars
 - All deciduous teeth are typically erupted by 2 years

2. Permanent Teeth (الأسنان الدائمة)

- Total: 32 teeth
 - 16 in the upper jaw **and** 16 in the lower jaw
- Types per jaw:
 - 4 Incisors (قواطع)
 - 2 Canines (أنياب)
 - 4 Premolars (ضواحك) – only present in permanent teeth
 - 6 Molars (طواحين) – including the third molars (wisdom teeth)
- Eruption Timeline:
 - Replacement of milk teeth begins around 6 years of age
 - Permanent dentition is usually complete by 12 years, excluding wisdom teeth
 - Third molars (wisdom teeth / ضرس العقل):
 - Erupt between 17 to 30 years of age
 - May be absent, impacted, or cause complications

Tongue: Mucous Membrane, Papillae, Tonsils, and Muscles

The tongue is a muscular organ (not bony) located in the oral cavity.

Tongue Anatomy and Innervation

The muscles of the tongue are divided into two main groups:

- **Intrinsic Muscles:** These are located entirely within the tongue. They are arranged in bundles of longitudinal, transverse, and oblique muscle fibers. These muscles are responsible for changing the shape of the tongue. Supplied by the **hypoglossal nerve**
- 1. **Extrinsic Muscles:** These originate from surrounding bones and structures and insert into the tongue. They are responsible for changing the position of the tongue.
 - Styloglossus: from the styloid process of the skull to the base of the tongue posteriorly
 - Genioglossus: from the superior genial tubercle of the mandible to base and posterior (why? See next topic)
 - Hyoglossus: from the hyoid bone to the base of the tongue
 - Palatoglossus: from the palate to the tongue

All muscles of the tongue are innervated by the **Hypoglossal nerve**, except for the Palatoglossus muscle, which is innervated by the Pharyngeal branch of the Vagus nerve with Accessory nerve (cranial).

Protrusion of the Tongue and Hypoglossal Nerve Function

- The muscle primarily responsible for protruding the tongue out of the mouth is the genioglossus.

- When functioning normally, both right and left genioglossus muscles contract equally, causing the tongue to protrude straight out of the mouth.

Hypoglossal Nerve Injury

- If the right hypoglossal nerve is damaged:
 - The right genioglossus muscle is paralyzed
 - The left genioglossus pulls the tongue forward and toward the weaker (right) side
 - As a result, the tongue deviates to the right upon protrusion

This deviation occurs toward the side of the lesion, because the functioning side (left) overpowers the paralyzed side (right), pulling the tongue toward the weaker side.

Symmetry of the Tongue

The tongue is divided into two symmetrical halves, both in terms of muscle and nerve supply, with the right and left sides being mirror images of each other.

Developmental and Structural Division

The tongue is anatomically and developmentally divided into:

- Anterior Two-Thirds:
 - Derived from the first pharyngeal arch
 - Innervated (sensory) by the lingual nerve (branch of mandibular nerve)
 - Contains taste buds on its dorsal surface, especially on:
 - Fungiform papillae
 - Filiform papillae (numerous)
 - Circumvallate papillae (located near the sulcus terminalis)
 - Taste sensation carried by the chorda tympani (branch of facial nerve) except for circumvallate by glossopharyngeal (related to the posterior third in development)
- Posterior One-Third:
 - Derived from the third pharyngeal arch
 - Innervated by the glossopharyngeal nerve for both general and taste sensation
 - Contains lingual tonsils, which are part of the lymphatic system

The boundary between the anterior and posterior parts is marked by the foramen cecum and the sulcus terminalis, which is inverted V-shaped.

Taste Regions of the Tongue

The dorsal surface of the tongue has specific areas associated with the perception of different tastes:

- Tip (anterior): Sweet
- Edges: Sour and salty
- Circumvallate region (posterior dorsum): Bitter (anterior to the sulcus terminalis)

Clinical Note: A common mistake in elderly patients is placing medication near the circumvallate papillae at the back of the tongue. This often causes a bitter taste. To avoid this, medications should be placed on the anterior part of the tongue where bitter receptors are less concentrated.

Mucous Membrane of the Tongue

1. Dorsal Surface (Upper Surface)

- Covered by stratified squamous parakeratinized epithelium
 - Originally keratinized, but due to constant exposure to saliva, digestion, and mechanical stress, it becomes parakeratinized.
 - Contains lingual papillae, which house taste buds on the anterior two-thirds of the tongue.
 - The posterior third lacks taste buds (that's what the prof said) and is instead composed of lymphoid tissue, referred to as the lingual tonsil or lymphoid follicles.
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2. Ventral Surface (Lower Surface)

- Covered by stratified squamous non-keratinized epithelium
 - Lacks papillae and taste buds
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Sensation and Innervation of the Tongue

1. Posterior Third of the Tongue

- Sensory and Taste Innervation:
 - General Sensation: Supplied by the **Glossopharyngeal nerve**.
 - Taste Sensation: Taste for the posterior third includes circumvallate papillae (though they are located in the anterior part), is also provided also by the **Glossopharyngeal nerve**.

2. Anterior Two-Thirds of the Tongue

- Sensory Innervation:
 - General Sensation (touch, temperature, pain): Provided by the **Lingual nerve**, a branch of the Mandibular nerve.
 - Taste Sensation: Taste is carried by the **Corda tympani**, a branch of the Facial nerve.
- Motor Innervation: All muscles of the tongue are innervated by the **Hypoglossal nerve**, except for the Palatoglossus muscle, which is innervated by the pharyngeal branch of the **Vagus** nerve with Accessory nerve (cranial).

Blood Supply to the Tongue

- Arterial Supply: The tongue receives blood from:
 - Lingual artery: A branch of the External carotid artery (to the tongue).
 - Tonsillar branch of the Facial artery: Also from the External carotid artery.
 - Ascending pharyngeal artery: Another branch from the External carotid artery.
- Venous Drainage: The venous blood from the tongue drains into the Internal jugular vein.

Lymphatic Drainage

- Tip of the Tongue, Philtrum, Center of the Lower Lip, and Tip of the Nose:
 - Lymph from these midline structures drains into the **Submental** lymph nodes.
 - Other Parts of the Tongue:
 - Lymph from the remaining areas of the tongue drains into the **Submandibular** lymph nodes and at the end to the **Deep cervical lymph nodes**.
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Palate

The palate forms the roof of the oral cavity and is divided into two parts: the hard palate and the soft palate.

1. Hard Palate

- The hard palate is the anterior bony part of the palate.
- It is covered by dense mucosa that is tightly adherent to the underlying periosteum.
- The surface shows rugae and grooves.
- It is formed by two bones:
 - Palatine process of the maxilla
 - Horizontal plate of the palatine bone
- At the posterior part of the hard palate there is a projection (spine) where **the palatine** tendon attaches. This tendon serves as the base for the soft palate.
- It contains two openings:
 - Greater palatine foramen
 - Lesser palatine foramen
- These foramina transmit:
 - Greater and lesser palatine nerves
 - Greater and lesser palatine arteries and veins

2. Soft Palate

- The soft palate is the posterior muscular part of the palate.
 - It is covered by loose connective tissue and mucosa.
 - In the midline, it contains the uvula.
 - It consists of five muscles and functions as a muscular structure, similar to the tongue.
 - The palatine aponeurosis, a fibrous sheath, attaches to the posterior edge of the hard palate, specifically at the posterior nasal spine.
 - This aponeurosis is formed by the tensor veli palatini muscle (right and left), which meet at the midline and help tense the soft palate.
 - The extension of this muscles also contributes to the formation of the uvula.
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Functions of the Soft Palate

- Elevation upward and backward to close off the nasopharynx (as seen in vomiting).
- Movement downward and forward to increase pressure in the oral cavity and close the oropharyngeal isthmus during mastication.
- During swallowing, it temporarily opens to allow the bolus to pass into the oropharynx.

Muscles of the Soft Palate

The soft palate is composed of five paired muscles, which function to elevate, tense, and shape the palate during speech and swallowing. These muscles include:

1. Tensor Veli Palatini

- Action: Tenses the soft palate.
 - Innervation: Mandibular nerve via the medial pterygoid nerve — the only soft palate muscle not supplied by the pharyngeal plexus.
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2. Levator Veli Palatini

- Origin: Petrous part of the temporal bone, auditory tube.
 - Insertion: Palatine aponeurosis
 - Action: Elevates the soft palate
 - Innervation: Pharyngeal plexus.
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3&4. Palatoglossus & Palatopharyngeus

- Around palatine tonsils
- Innervation: Pharyngeal plexus

5. Musculus Uvulae (Musculus Uvuli)

- Location: midline within the uvula.
 - Action: Elevates the soft palate.
 - Innervation: Pharyngeal plexus
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Pharyngeal Plexus (Innervation Overview)

- Located in the posterior pharyngeal wall, it is formed by:
 - Cranial part of the **accessory** nerve via the **vagus** nerve
 - **Glossopharyngeal** nerve
 - All muscles of the soft palate are innervated by the pharyngeal plexus, except the tensor veli palatini, which is supplied by the mandibular nerve.
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Movements and Functions of the Soft Palate

The soft palate plays a key role in:

1. Swallowing and Vomiting:

- The soft palate elevates and moves backward to close the nasopharyngeal isthmus, preventing food or vomit from entering the nasal cavity.
 - 2. Mastication (Chewing):
 - It moves downward and forward to close the oropharyngeal isthmus, helping build intraoral pressure during chewing.
 - 3. Speech (Articulation):
 - In normal speech, the soft palate adjusts to control airflow:
 - When pronouncing nasal sounds like “n”, the soft palate stays lowered, allowing air to pass into the nasal cavity.
 - For non-nasal sounds, it elevates to direct air through the oral cavity via the oropharyngeal isthmus.
 - 4. Respiration:
 - During breathing, the nasal and oral cavities remain open, allowing air to pass through either route depending on the situation.
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Nerve Supply of the Palate

Nerve Supply of the Palate:

- The greater palatine foramen transmits the greater palatine nerve.
- The lesser palatine foramen transmits the lesser palatine nerve.
- The incisive foramen transmits the **nasopalatine** nerve (IMPORTANT), a branch of the maxillary nerve. This nerve travels through the nasal cavity and passes through the incisive foramen to reach the hard palate.

In contrast, the greater palatine artery supplies the nasal cavity then passes through the incisive foramen into the nasal cavity.

- The soft palate is mainly supplied by the glossopharyngeal nerve, especially through the pharyngeal plexus.

Blood Supply of the Palate

- Greater Palatine Artery
 - Lesser Palatine Artery
 - Ascending Palatine Artery (branch of facial artery)
 - Ascending Pharyngeal Artery (branch of external carotid artery)
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Lymphatic Drainage

- Drains to the deep cervical lymph nodes.
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Clinical Note

- Uvula Enlargement: Conditions such as **diphtheria** can cause uvular swelling.

Salivary Glands

Minor Salivary Glands

Numerous minor salivary glands, primarily mucous in nature, are distributed throughout the oral cavity:

- Labial Glands: Located within the lips.
- Palatal Glands: Situated in the palate.
- Lingual Glands: Found in the tongue.

Major Salivary Glands

There are three pairs of major salivary glands:

1. Parotid Gland: The largest salivary gland, primarily producing serous secretions.
2. Submandibular Gland: Produces mixed secretions, containing both serous and mucous components.
3. Sublingual Gland: Predominantly secretes mucous, with some serous output.

Salivary Gland Structure

- Each salivary gland is encapsulated by fibrous connective tissue, which extends septa dividing the gland into lobes and lobules.
- These lobules contain small ducts that converge into major ducts.
- The parotid gland is unique in its capsule.

Innervation

- Parasympathetic Innervation: Acts as a secretomotor, directly stimulating saliva secretion.
- Sympathetic Innervation: Does not directly stimulate secretion but can indirectly influence it by causing vasoconstriction, reducing blood flow to the glands, and potentially altering secretion.
- Sensory

Parotid Gland

Location: Situated anterior to the ear, the parotid gland overlies the masseter muscle sternocleidomastoid muscle.

Secretion: Primarily produces serous (watery) saliva

Anatomical Orientation: The base of the parotid gland lies beneath the skin, while its apex is directed towards the pharynx.

Parotid Bed and Anatomical Relations

The parotid gland resides within the parotid bed, within styloid process and the surrounding structures:

Muscles

- Posterior belly of the digastric muscle
- Stylohyoid muscle

Nerves

- Last four cranial nerves in addition to the facial nerve (traverses the gland)

Blood Vessels

- Common carotid artery: which gives rise to the external and internal carotid arteries.
 - Internal Jugular vein
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Anatomical Relations

Facial Nerve

- Enters the parotid gland and divides it into superficial and deep lobes.
- Within the gland, it branches into five terminal branches:
 - Temporal: Innervates muscles like the orbicularis oculi.
 - Zygomatic: Supplies the zygomatic region.
 - Buccal: Innervates the buccinator muscle.
 - Mandibular.
 - Cervical: Innervates the platysma muscle.
- While the facial nerve doesn't contribute to salivary secretion, its preservation is crucial during parotid surgeries as it lies superficially (cut leads to facial paralysis) .

Retromandibular Vein

- Formed by the union of the superficial temporal and maxillary veins within the parotid gland.
- It runs through the gland, typically superficial to the external carotid artery and deep to the facial nerve .

External Carotid Artery

- Enters the parotid gland and bifurcates into its terminal branches:
 - Superficial Temporal Artery
 - Maxillary Artery
- The deepest structure.

Auriculotemporal Nerve

- A branch of the mandibular nerve, it carries:
 - Sensory fibers.
 - Parasympathetic fibers (to be discussed)
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Lymphatic Drainage: The parotid gland contains intraparotid lymph nodes

Capsules

- Outer Capsule: tough fibrous sheath around the gland derived from deep fascia.
- Inner Capsule (True Capsule): extends septa into the gland, dividing it into lobules .

Clinical Note: Mumps (مرض النكاف)

- Mumps is a viral infection that leads to inflammation and swelling of the parotid gland.
- Due to the rigidity of the gland's fibrous capsules (two capsules), swelling can result in significant pain.

Parotid Duct

- Approximately 4 cm in length .
- Opens into the oral cavity opposite the second upper molar tooth (vestibule).
- Surface anatomy: Located about one fingerbreadth below the zygomatic arch.

Innervation of the Parotid Gland

1. Parasympathetic Innervation (Secretomotor)

- Origin: Inferior salivatory nucleus in the medulla oblongata.
- Pathway:
 - Glossopharyngeal nerve
 - Gives a tympanic branch at the tympanic membrane.
 - Then gives rise to the **lesser petrosal nerve**.
 - The lesser petrosal nerve exits the skull via the foramen ovale and synapses in the otic ganglion.
 - Postganglionic fibers travel with the **auriculotemporal nerve** to reach the parotid gland.

2. Sympathetic Innervation

- Origin: Superior cervical sympathetic ganglion in the neck through blood vessels.
- Pathway: Postganglionic fibers travel along the external carotid artery to reach the gland.

3. Sensory Innervation

- Provided by the auriculotemporal nerve (branch of mandibular nerve).

Submandibular Gland

Location

- Located in the submandibular (digastric) triangle, between the anterior and posterior bellies of the digastric muscle.
- It has superficial and deep parts, separated by the mylohyoid muscle.

Capsule

- Enclosed by one capsule of connective tissue.

Secretion

- Produces mixed saliva, containing both serous and mucous components.

Duct

- Originates from the anterior part of the deep portion of the gland.
- Opens into the floor of the mouth at the **submandibular papilla**, near the base of the tongue.

Structures Between the Mylohyoid and Hyoglossus Muscles

Five structures lie in this region:

- Deep part of the **submandibular** gland
 - **Submandibular** ganglion
 - **Submandibular** duct
 - Lingual **nerve**
 - Hypoglossal **nerve**.
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Sublingual Gland

- Location: Situated below the tongue.
- Capsule: Enclosed by a single capsule.
- Secretion: Primarily mucous.
- Ducts: Comprises 8–20 minor sublingual ducts that open either directly beneath the tongue or into the submandibular duct.
- Medial Relations: Lingual nerve, submandibular duct, and genioglossus muscle.

Innervation of the Submandibular and Sublingual Glands

1. Parasympathetic Innervation (Secretomotor)

- Origin: Superior salivatory nucleus in the medulla oblongata.
- Pathway:
 - Facial nerve gives rise to the **chorda tympani nerve**.
 - Chorda tympani carries preganglionic parasympathetic fibers and taste fibers from the anterior two-thirds of the tongue.
 - Joins the lingual nerve.
 - Fibers synapse in the submandibular ganglion, located in the submandibular triangle between the mylohyoid and hyoglossus muscles.
 - Postganglionic fibers either:
 - Travel **directly** to the gland, or
 - Rejoin the **lingual nerve** to reach the gland

2. Sympathetic Innervation

- Origin: Superior cervical sympathetic ganglion.
- Pathway: Postganglionic fibers travel with the **lingual artery**.

3. Sensory Innervation

- Provided by the **lingual nerve**.

Relations and notes regarding the Oral Cavity

- A fold of mucosa between the upper lip and the gum is called the superior labial **Frenulum**.
- The tongue has a mucosal fold called the frenulum of the tongue.
- The floor of the mouth contains the lingual vein (artery, and nerve located medially).
- The submandibular duct opens into the oral cavity at the submandibular papilla.

Submandibular Duct

- Arises from the anterior part of the deep portion of the submandibular gland.
- Has a triple relationship with the lingual nerve:
 1. Initially, the lingual nerve lies lateral to the duct.
 2. Then it passes below the duct.
 3. Finally, it lies medial to the duct.

Chorda Tympani Nerve

- In the infratemporal fossa, the chorda tympani joins the lingual nerve.
- Their fibers do not mix:
 - The lingual nerve provides general sensory fibers.
 - It also carries parasympathetic fibers from the chorda tympani to the submandibular gland.

The Pharynx: Structure, Divisions, and Function

The pharynx is a muscular tube that extends from the base of the skull to the lower border of the sixth cervical vertebra (C6), where it continues as the esophagus. It is open anteriorly, forming a U-shape, which results in the division into three main regions based on the openings it communicates with:

1. Nasopharynx – opens anteriorly to the nasal cavity
2. Oropharynx – opens anteriorly to the oral cavity
3. Laryngopharynx (Hypopharynx) – opens into the inlet of the larynx

Anterior Openings of the Pharynx

1. Choanae
 - These are the posterior openings of the nasal cavity.
 - They connect the nasal cavity to the nasopharynx.
2. Oropharyngeal isthmus
 - This is the opening between the oral cavity and the oropharynx.
3. Laryngeal inlet (Aditus of the larynx)
 - This is the opening from the laryngopharynx into the larynx.
 - It is bordered superiorly by the epiglottis.
 - Opening from the pharynx to the larynx, allowing air to enter the trachea, which lies anterior to the pharynx and esophagus

Pharyngeal Openings

- Choanae: Posterior nasal apertures that connect the nasal cavity to the nasopharynx

- Oropharyngeal isthmus: Connects the oral cavity to the oropharynx
 - Laryngeal inlet: Connects the pharynx to the larynx and is bordered superiorly by the epiglottis
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Musculature of the Pharynx

Constrictor Muscles (Circular fibers)

These are responsible for the peristaltic movement of the bolus during swallowing, pushing it downward into the esophagus (contraction):

- Superior constrictor
- Middle constrictor
- Inferior constrictor

Longitudinal Muscles (Oblique fibers)

These muscles elevate the pharynx during swallowing:

- Stylopharyngeus – originates from the styloid process
- Salpingopharyngeus – located within the nasopharynx, associated with the auditory (Eustachian) tube

Cricopharyngeus (Part of Inferior Constrictor)

- The cricopharyngeus muscle originates from the cricoid cartilage and inserts into the pharyngeal wall.
- It acts as a sphincter (has circular horizontal fibres) at the pharyngoesophageal junction.
- Normally remains tonically contracted to prevent air from entering the esophagus.
- Opens reflexively when the bolus stimulates the mucosa, allowing food to pass into the esophagus.

Clinical Note: When air mistakenly enters the esophagus (due to improper closure), it may pass into the stomach. Because the fundus is the highest part of the stomach, air collects there and appears as a black shadow on abdominal X-rays.

Constrictor Muscles of the Pharynx

The three pharyngeal constrictor muscles—superior, middle, and inferior—are arranged circularly and function to propel the food bolus downward into the esophagus during swallowing.

All three muscles insert into a common fibrous midline structure at the posterior pharyngeal wall called the **pharyngeal raphe**, which extends from the pharyngeal tubercle (on the base of the skull anterior to the foramen magnum) downwards.

Killian's Dehiscence

- A small weak area located above the upper border of the cricopharyngeus muscle
 - This area is highly sensitive, and stimulation here can trigger reflex contraction and vomiting.
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1. Superior Constrictor Muscle

- Origin:
 - Medial pterygoid plate
 - Pterygoid hamulus
 - Pterygomandibular raphe
 - Mylohyoid line of the mandible
- Insertion: Pharyngeal raphe
- Innervation: Pharyngeal plexus, formed by:
 - Vagus nerve
 - Accessory nerve
 - Glossopharyngeal nerve
- Function: Contracts to push the bolus downward from the oropharynx toward the esophagus.

2. Middle Constrictor Muscle

- Origin:
 - Lower part of the stylohyoid ligament
 - Greater and lesser horns of the hyoid bone
- Insertion: Pharyngeal raphe
- Innervation: Pharyngeal plexus (Vagus, Accessory, and Glossopharyngeal nerves)
- Function: Propels the bolus further down.

Inferior Constrictor Muscle

The inferior constrictor is the most caudal of the constrictors and has two parts:

1. Thyropharyngeus
 - Origin: Lamina of the thyroid cartilage
 - Function: Contracts to propel the bolus downward
 2. Cricopharyngeus
 - Origin: Cricoid cartilage
 - Function: Acts as a sphincter
- Insertion: Pharyngeal raphe
 - Innervation: Pharyngeal plexus
 - Function: Moves the food bolus downwards

Stylopharyngeus Muscle

- Origin: Styloid process
- Insertion: Pharyngeal raphe
- Innervation: Glossopharyngeal nerve — the only pharyngeal muscle not innervated by the pharyngeal plexus
- Function: Elevates the pharynx during swallowing and speaking

Salpingopharyngeus Muscle

- located within the nasopharynx, associated with the auditory (Eustachian) tube

Clinical Relevance – Eustachian Tube & Middle Ear Infection

- The auditory (Eustachian) tube opens into the lateral wall of the nasopharynx.
- It functions to equalize air pressure on both sides of the tympanic membrane (eardrum).
- In infants who lie flat on their backs, vomitus may pass from the nasopharynx through the Eustachian tube into the middle ear, potentially leading to otitis media.
- This is why physicians commonly examine the tympanic membrane in young children during emergency visits or checkups..

Regions of the Pharynx

1. Nasopharynx

- Location: Extends from the base of the skull to the soft palate
 - Structures:
 - Auditory (Eustachian) tube
 - Tubal elevation
 - Salpingopharyngeal fold
 - Pharyngeal tonsil: Located on the roof of the nasopharynx
 - Clinical Relevance:
 - Enlargement or infection of the pharyngeal tonsil (adenoids) in children can block the nasopharynx, causing snoring and mouth breathing during sleep.
-

2. Oropharynx

- Structures:
 - Palatine tonsils: Located laterally at the oropharyngeal isthmus; frequently infected (tonsillitis)
- 2. Glossoepiglottic folds (Aryepiglottic Fold) that's what the prof said : Mucosal folds connecting the tongue to the epiglottis

Valleculae: Depressions between the glossoepiglottic folds; a site where saliva may collect

Vocal Folds

- True Vocal Folds:
 - Lower pair of mucosal folds in the larynx
 - Responsible for sound production (phonation)
 - False Vocal Folds (Vestibular Folds):
 - Upper pair
 - Do not participate in sound production
 - Play a role in protecting the true vocal cords
-

3. Laryngopharynx (Hypopharynx)

- Structure:

- Piriform fossa (recess): A depression on either side of the laryngeal inlet
 - Clinical Relevance: A common site where foreign bodies (fish bones) can become lodged. Doctors often inspect this area to locate and safely remove the object.
-

Innervation of the Pharyngeal Mucosa (Sensory)

1. Nasopharynx:
 - Supplied by the maxillary nerve
2. Oropharynx:
 - Supplied by the glossopharyngeal nerve
3. Laryngopharynx:
 - Supplied by the internal laryngeal nerve, a branch of the vagus nerve
 - This nerve enters the pharynx between the middle and inferior constrictor muscles

Blood Supply of the Pharynx

The pharynx receives arterial blood from multiple branches:

- Ascending pharyngeal artery (a branch of the external carotid)
 - Tonsillar branch of the facial artery
 - Branches of the maxillary artery
 - Branches of the lingual artery
-

Lymphatic Drainage of the Pharynx

- Primary drainage:
 - Deep cervical lymph nodes
- Secondary/indirect pathways:
 - Retropharyngeal lymph nodes
 - Paratracheal lymph nodes

These eventually drain into the deep cervical nodes

Process of Swallowing (Deglutition)

1. Oral

- Food is chewed and mixed with saliva to form a bolus.
- The tongue pushes the bolus against the hard palate and then onto the dorsum of the tongue.
- The soft palate moves downward and the base of the tongue moves upward to close the oropharyngeal isthmus, preventing premature entry of the bolus into the oropharynx.
- This phase ends as the bolus is voluntarily pushed into the oropharynx.

2. Pharyngeal

- As the bolus enters the oropharynx, the soft palate moves upwards and backward to close off the nasopharynx.
- At the same time, the posterior pharyngeal wall moves forward (due to contraction of the constrictor muscles), helping seal off the nasopharynx to prevent food from regurgitating upward.
- The larynx elevates, and the epiglottis bends downward and backward, covering the inlet of the larynx to prevent food from entering the airway.
- If any material attempts to enter the larynx, a protective cough reflex is triggered to expel it.
- The pharyngeal constrictor muscles sequentially contract to propel the bolus downward through the pharynx.

Palatine Tonsils

Anatomical Location

- Located in the lateral wall of the oropharynx.
- Positioned between two mucosal arches:
 - Palatoglossal arch (anterior)
 - Palatopharyngeal arch (posterior)
- These arches are formed by the palatoglossus and palatopharyngeus muscles, respectively.

Structure and Surfaces

- The palatine tonsils are masses of lymphoid tissue.
- Medial surface:
 - Covered by mucous membrane
 - Contains crypts (deep invaginations), which trap bacteria and debris.
 - These crypts are common sites for recurrent infections, especially in children.
- Lateral surface:
 - Surrounded by a fibrous capsule, which separates the tonsil from the superior constrictor muscle.
 - Composed of loose connective tissue, allowing the entry of blood vessels, nerves, and lymphatics.
 - Lies close to the tonsillar branch of the facial artery, and is in proximity to the external (the prof said common) carotid artery, making surgery delicate in this area.

Clinical Relevance

In Children

- Tonsils play a significant role in filtration of bacteria, viruses, and foreign particles.
- Prone to hypertrophy and recurrent infections, due to frequent exposure to pathogens.

In Adults

- The tonsils often undergo involution (shrinkage) with age.
- Tonsillitis is less common and generally less severe.

Tonsillectomy

- Indicated in cases of recurrent tonsillitis (typically 4–5+ infections/year).
- Infection may extend from the tonsils to systemic organs, potentially causing:
 - affecting joints and heart
 - Glomerulonephritis (affecting the kidneys)
- Post-operative bleeding is a critical risk:
 - Mainly due to injury to or rupture of the external palatine vein.
 - This vein pierces the superior constrictor muscle, and bleeding can be severe if not properly managed.
 - Surgeons typically perform double ligation of this vein before cutting, to prevent post-op hemorrhage.
 - Observation for at least 24 hours post-op is standard.

Palatine Tonsils: Vascular and Lymphatic Supply

Blood Supply

- Arterial supply is primarily from the tonsillar branch of the facial artery.

Venous Drainage

- External palatine vein is the most clinically important vein.
 - It pierces the superior constrictor muscle.
 - Drains into the pharyngeal venous plexus.
 - This vein is a common source of post-tonsillectomy hemorrhage.

Lymphatic Drainage

- Drains primarily to the upper deep cervical lymph nodes, located just below and behind the angle of the mandible.

Waldeyer's Ring of Lymphoid Tissue

Waldeyer's ring is a ring of lymphoid tissue surrounding the openings of the digestive and respiratory tracts at the level of the oropharynx and nasopharynx. It plays a crucial role in the first line of immune defense.

Components of Waldeyer's Ring

1. Pharyngeal tonsil:
 - Located in the roof of the nasopharynx
 - Enlarges in children and is known as adenoids when infected
2. Palatine tonsils:
 - Located in the tonsillar fossa between the palatoglossal and palatopharyngeal arches
3. Lingual tonsil:
 - tongue, near the midline
4. Tubal tonsils:
 - Located near the opening of the auditory (Eustachian) tube in the lateral wall of the nasopharynx

Function

- These lymphoid structures act as a filter system to trap and respond to bacteria, viruses, and foreign particles entering through the oral and nasal cavities.
- Especially important in children, whose immune systems are still developing.

For any feedback, please click [HERE](#)

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