

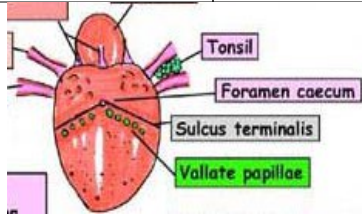
Boundaries:**Anteriorly** : the vermillion border**Posteriorly** :**Superiorly** : the junction of the hard palate & soft palate**Inferiorly** : circumvallate papillae (lina terminalis)

Subunits: Lips; Buccal mucosa; Upper & lower alveolar ridge; Retromolar triangle; Oral tongue (anterior 2/3 which is anterior to circumvallate papillae); Hard palate; Floor of the mouth

Topography:**Papillae:**Cover the **anterior 2/3** of the tongue

Includes:

Type of papille	Presence of taste bud	number	location	innervation
Filiform	No taste bud		Most numerous	
Fungiform	Yes	400	Dorsum & tip(more)	Chorda tympani
Folate	Yes	1300	Lateral aspect	Glossopharyngeal (IX)
Circumvalate	Yes	2400	Anterior to sulcus terminalis	Glossopharyngeal (IX)

**Distribution of the taste buds in the tongue:**

Sweet: at the tip

Salty: at the dorsum of the tongue anteriorly

Sour: along the edges

Bitter: back of the tongue

Acid taste sour and sourness generally proportionate to [H]

Although **most** text book shows taste map there is **no** taste map**General information about the Gustatory Structures :****7900** gustatory receptors in the human mouth are grouped into distinct subpopulationsGustatory subpopulations differ in **sensitivity** to chemical stimulihowever, the overall morphology of the taste bud structures within each subpopulation is very **similar**Receptor cells die and are replaced over a **10- to 14- day period (200-300 hour)**Fungiform papillae Concentrated along the **tip** of tongue, **No** fungiform papillae are found along the midline.When you section chorda tympani nerve there will be decrease in the **salty** stimulus**most** of the taste buds in the tongue are innervated by the **glossopharyngeal** nerve: 2400 circumvulate + 1300 folatetaste buds in the pharynx, larynx & soft palate are **not** associated with distinct papillae

The specific pattern of innervation of the fungiform papillae:



Single fibers of the chorda tympani nerve synapse on multiple receptor cells within a single taste bud and on receptor cells in adjacent taste buds. Likewise, each receptor cell is innervated by more than one fiber of the chorda tympani nerve. Each fiber of the chorda tympani thus receives input from multiple receptor cells. Each bud is innervated by more than one fiber. This pattern of **convergence** of multiple receptor cells from adjacent taste buds into a single afferent fiber provides an anatomic substrate for **spatial** interactions between adjacent taste buds.

Sulcus terminalis: Groove at the posterior margin of circumvallate papillae

Foramen cecum: A pit at the junction of sulcus terminalis from which the embryologic thyroid begins its descent, **boundary between anterior 2/3 and posterior 1/3**

Frenulum:

Anterior mucosal fold

Attaches the anterior inferior aspect of the tongue to the floor of the mouth and gingiva

Lateral to it:

- 1- Wharton's duct orifice
- 2- deep lingual artery & vein

The floor of the mouth: It consists mainly by the mylohyoid

Muscles of the tongue

The muscles of the tongue comprise:

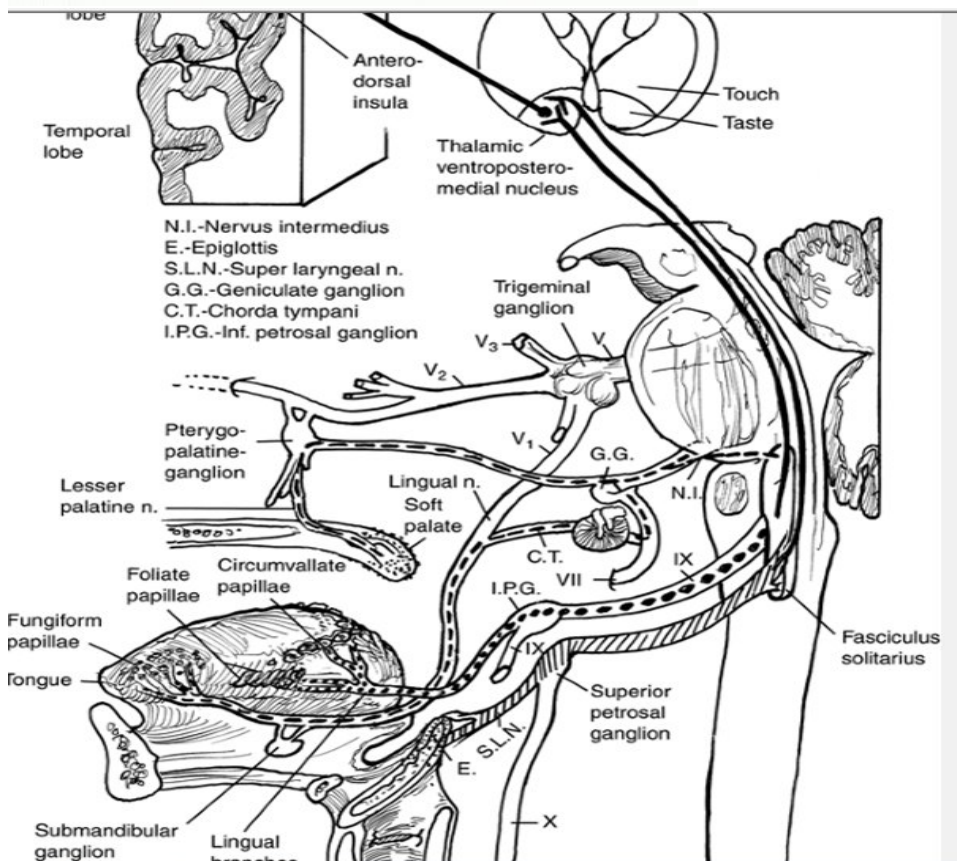
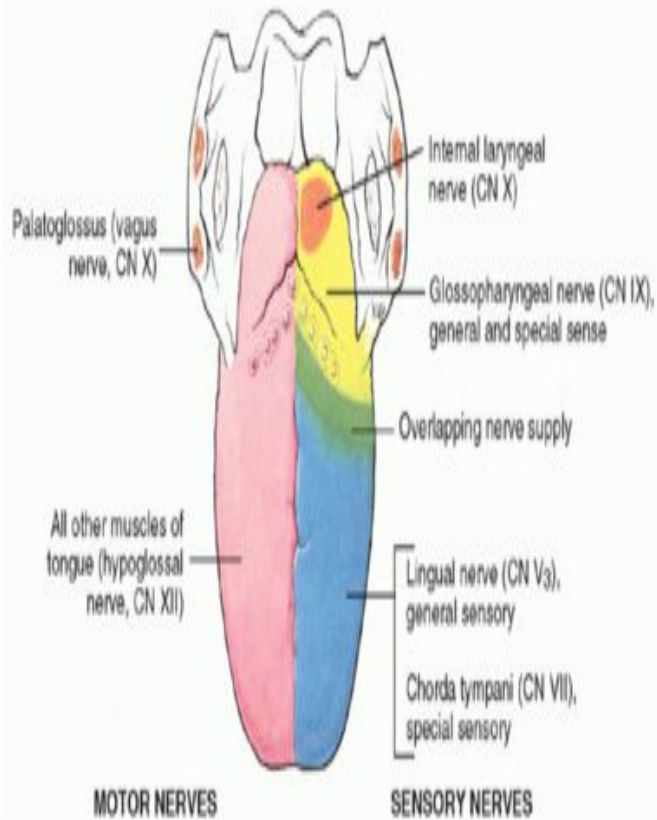
Muscle	Origin	Insertion	Action	Nerve	Blood supply
Genio-glossus	superior genial tubercle (mental spine) behind the mandibular symphysis (above the origin of the geniohyoid muscle)	inferior fibers : attached to the upper anterior surface of the hyoid body (near the midline) Intermediate fibers: pass backwards into the posterior part of the tongue superior fibers : ascend forwards to enter the whole length of the	1- forward traction of the tongue to protrude its apex from the Mouth. 2-Acting bilaterally : depress the central part of the tongue (concave) 3-Acting unilaterally move the Tongue to the	Hypo-glossus nerve	1- lingual artery (sublingual branch) 2- facial artery (submental branch)

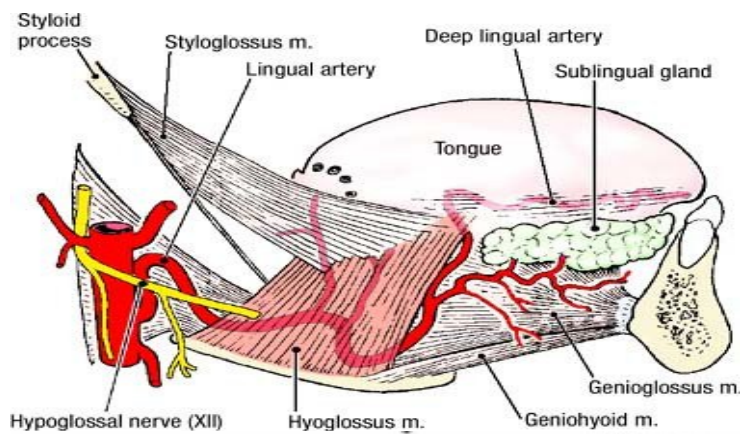
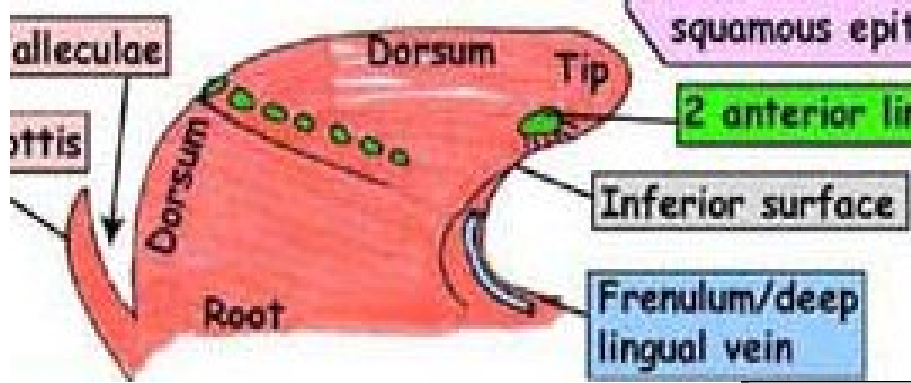
		ventral surface of the tongue from root to apex, intermingling with the intrinsic muscles.	opposite side.		
Hyo-glossus	greater cornu & the front of the body of the hyoid bone	The side of the tongue between the inferior longitudinal muscle medially and styloglossus laterally.	depresses the tongue		1- lingual artery (sublingual branch) 2- facial artery (submental branch)
Stylo-glossus	1- anterolateral aspect of the apex of the styloid process 2- styloid end of The stylomandibular ligament (a fibrous cord extending from the tip of the styloid process to the lesser cornu of the hyoid bone)	downwards and forwards to enter the substance of the tongue , decussating with fibres of hyoglossus	pull the tongue upwards and backwards		lingual artery (sublingual branch)
Palate-glossus	arises from the palatine aponeurosis	passes to the side of the tongue within the palatoglossal arch	Acting bilaterally , the muscles narrow the oropharyngeal isthmus and can also help raise the sides of the tongue (brings tongue superiorly and posteriorly)	cranial portion of the accessory nerve through the pharyngeal plexus	1- ascending pharyngeal 2- Facial (ascending palatine) arteries

extrinsic muscles: extending outside the tongue and moving it **bodily** (change the position)

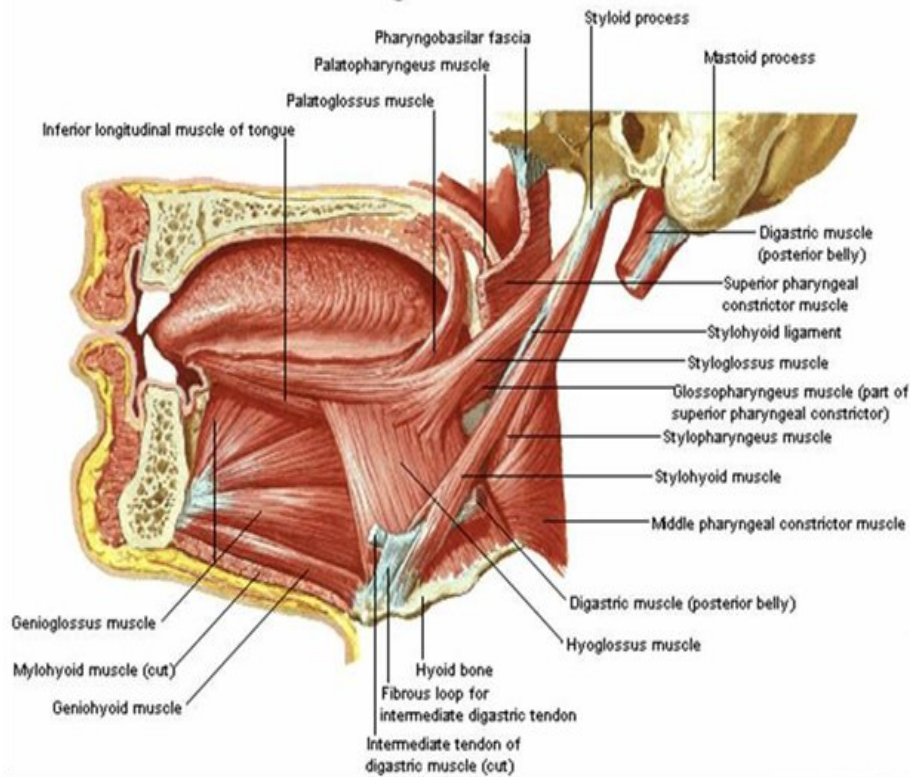
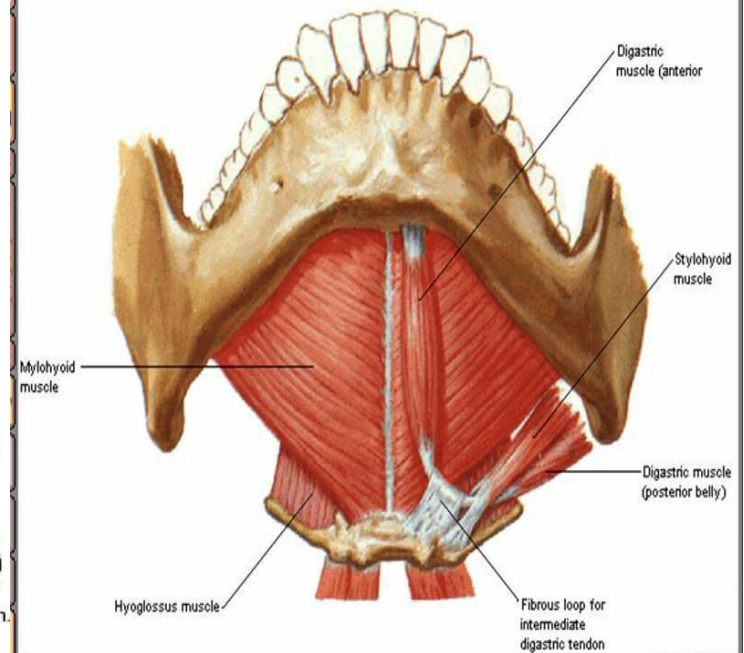
intrinsic muscles: lying wholly within it and altering its **shape**.

The **extrinsic** musculature is composed of 4 pairs of muscles:





Floor of Mouth - Musculature Anteroinferior View



Innervation of the tongue:

1. Motor supply:

- Intrinsic muscles: Superior longitudinal; Inferior longitudinal; Transverse
- Extrinsic muscles: Genioglossus; Hypoglossus; Styloglossus; Palatoglossus

Part of the tongue	General sensation (pain, temp, touch)	Taste sensation
Anterior 2/3	Lingual N mandibular branch trigeminal nerve	Papillae except (Circumvalate) afferent fibers lingual chordi tympani geniculate ganglion intermediate nerve nucleus solitarius
Posterior 1/3	Lingual branch glossopharyngeal nerve nucleus solitarius	Circumvalate (which is anterior to sulcus terminalis) + Tongue base + Vallecula [lingual nerve]
lingual surface of the epiglottis, pharynx, larynx	Internal laryngeal nerve superior laryngeal nerve vagus nerve	Internal laryngeal nerve superior laryngeal nerve vagus nerve
palate		Superficial petrosal (VII)

All muscle of the tongue are innervated by the hypoglossal nerve except the palatoglossal nerve is innervated by pharyngeal plexus (accessory nerve via vagus nerve)

all tongue muscles are striated

Fibrous septae (septum linguae)

Contains a triangular fat pad that is visualized on axial CT scan

Defines midline

1. Sensory:

Note all of fibers end in nucleus solitarius

Glossopharyngeal nerve carries afferent fibers of the gag reflex

Taste buds degenerate in case of de-nervation

Some drugs may decrease taste sensation like penicillamine & captopril because it contains sulfhydryl group

Location of taste buds: lingual surface of soft palate, tongue, epiglottis, oropharynx, hypopharynx

So we have 3 nerves that carry the afferent taste fibers to solitarius nucleus

1- **facial nerve:**

a) **Lesser palatine** nerve pterygopalatine ganglion Superficial Greater petrosal nerve **oral** surface of the soft palate at the junction with the hard palate

b) Chorda tympani anterior 2/3 of the tongue except circumvillate taste bud

1- lingual branch of glossopharyngeal nerve: Circumvillate taste bud, vallecula

2- **Vagus nerve internal** branch of **superior** laryngeal nerve lingual surface of the tongue

Note:

Unlike olfactory receptor cells, the taste receptors are **not** neurons.

They receive a **button** from a **sensory** dendrites

Ganglia:

Facial nerve: geniculate ganglion

Glossopharyngeal nerve: **inferior** petrosal nerve

Vagus: **superior** petrosal ganglion/ jugular ganglion

Innervation of the palate:

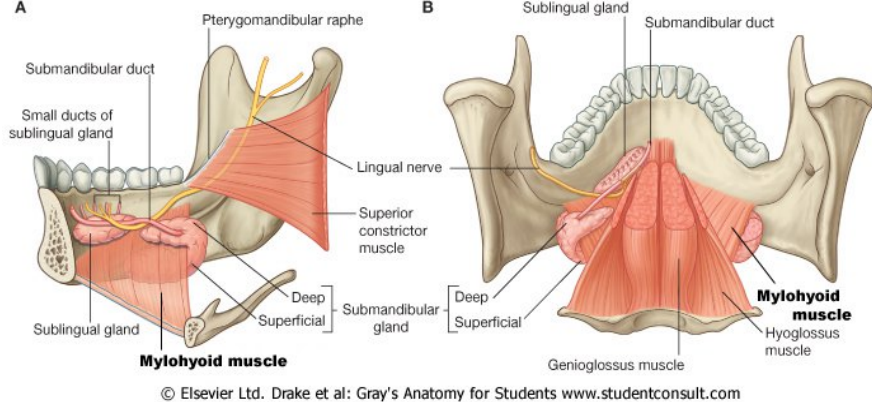
Hard palate:

primary palate (anterior to incisive foramen): nasopalatine nerve; sphenopalatine artery

2nd palate: greater palatine nerve; greater palatine artery

Soft palate (part of the oropharynx): lesser palatine nerve

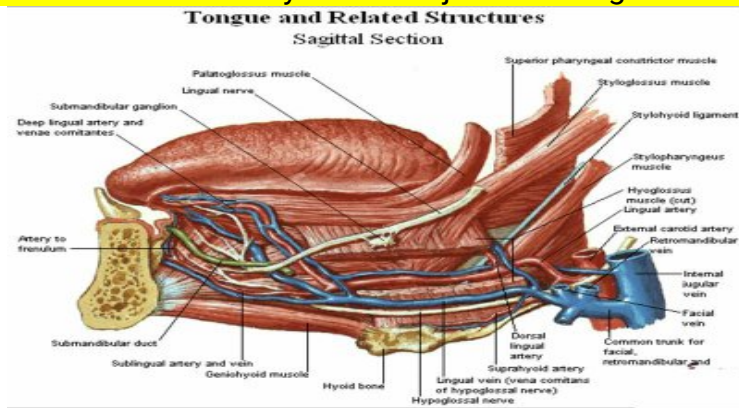
Incisive foramen contains: nasopalatine nerve; greater palatine artery



Tongue related structures:

Note the intimate relationship between the lingual nerve and submandibular duct

So if a patient developed Ipsilateral numbness of the tongue after removal of submandibular gland stone it means that you have injured the lingual nerve



Both lingual vein & artery can be seen through the mucus membrane lateral to the frenulum linguae

Note: relation of lingual nerve, artery, vein & submandibular duct

Vascular supply:

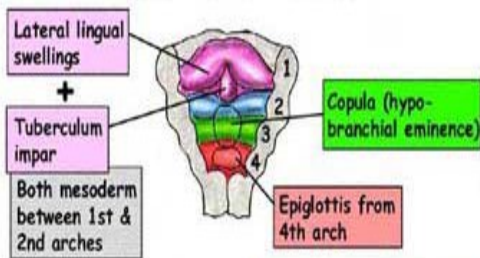
Lingual artery: a branch of external carotid artery

Deep Lingual vein

Embryology:

4th week:

- median lingual swelling (tuberculum impar): This swelling is the first indication of tongue development.
- Soon, 2 lateral lingual swellings (distal tongue buds) develop on each side of the median tongue bud.



The 3 lingual swellings result from:

Proliferation of mesenchyme of the 1st pair of pharyngeal arches

swelling in ventromedial part of the arch in the floor of the pharynx

Arise rostral to the foramen cecum

The lateral lingual swellings rapidly increase in size, merge with each other, and overgrow the median lingual swelling.

The merged lateral lingual swellings form the anterior two thirds (oral part) of the tongue

The median lingual swellings do not form a recognizable part of the adult tongue.

Formation of the posterior third (pharyngeal part) of the tongue is indicated in the fetus by two elevations that develop caudal to the foramen cecum:

The **copula** (Latin, bond, tie) forms by fusion of the ventromedial parts of the 2nd pair of pharyngeal arches.

The **hypopharyngeal eminence** develops caudal to the copula from mesenchyme in the ventromedial parts of the 3rd and 4th pairs of arches.

As the tongue develops, the **copula** is gradually **overgrown** by the hypopharyngeal eminence and disappears.

As a result, the posterior third of the tongue develops from the rostral part of the hypopharyngeal eminence.

3rd arch part: Posterior 1/3 of the tongue

4th arch part: Base of the tongue

7th week:

Occipital somites migrates anteriorly with hypoglossal nerve to give all **extrinsic and intrinsic muscles except palatoglossus**

8-20th week:

Develop **circumvallate** papillae which is innervated by glossopharyngeal nerve although it is situated in the anterior 2/3 of the tongue

It is believed that arch 3 mucosa extend to the anterior 2/3 of the tongue

11th week :

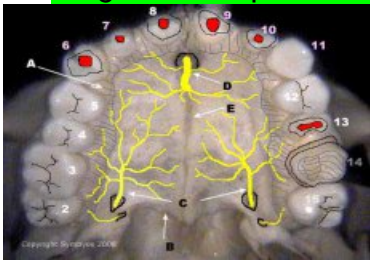
Filiform + fungiform papillae develop

The mandible forms from the 1st arch between the 5th & 8th week

Note: the anterior 2/3 derived from ectoderm + posterior 1/3 from the endoderm

Both the anterior and posterior portions of the tongue are located within the oral cavity at birth; the posterior third descends into the oropharynx by 4 years of age.

The anterior 2/3 of the tongue develops from the 1st branchial arch and the posterior 1/3 of the tongue develops from the 3rd and 4th branchial arches



Embryology of the mouth:

The mouth is subdivided into :

1. vestibule (**external** to the teeth)
2. Oral cavity **proper** (**internal** to the teeth).

Borders:

Anteriorly: lips and cheeks

Posteriorly: anterior pillars of the fauces (**palatoglossal** arches) where it continues into the oropharynx

Roof: the palate which separates the oral and nasal cavities.

Floor: the mylohyoid muscles and is occupied mainly by the tongue.

Lateral: the cheeks and retromolar region

Opening into the mouth are:

Three pairs of major salivary glands (parotid, submandibular and sublingual)

Numerous minor salivary glands (labial, buccal, palatal, lingual).

Hard Palate:

Formed by the palatine processes of the maxillae+ the horizontal plates of the palatine bones

The oral mucosa is bound **tightly** to the underlying periosteum.

In its more **lateral** regions it also possesses a **submucosa** where the main neurovascular bundles lie .

Gingiva : The periphery of the hard palate surrounding the necks of the teeth

palatine raphe : zone similarly lacking submucosa runs anteroposteriorly in the midline as a narrow, low ridge.

incisive papilla : small prominence At the anterior extremity of the raphe behind the incisor teeth that covers the incisive **fossa** at the oral opening of the **incisive canal**.

Rugae: transverse ridges Radiating outwards from the palatine raphe in the anterior 1/2 of the hard palate .The pattern of rugae is unique for the individual.

The submucosa in the **posterior 1/2** of the hard palate contains minor mucous salivary glands.

These secrete through numerous small ducts although bilaterally larger ducts collecting from many of these glands often open at the paired palatine foveae.

These are 2 sagittally elongated depressions sometimes a few millimetres deep which flank the midline raphe at the posterior border of the hard palate.



The upper nasal surface of the hard palate is the floor of the nasal cavity and is covered by **ciliated respiratory epithelium** .

The lower oral masticatory surface is covered by **keratinized epithelium**

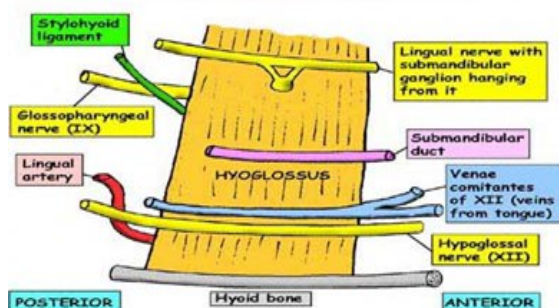
Note:

hard palate separates the nasal cavity from the oral cavity

Soft palate separates the oropharynx from the nasopharynx

Soft Palate:

The boundary between the hard and soft palate may be distinguished by a change in Colour : The soft palate being a darker red with a yellowish tint



Just behind and medial to each upper alveolar process in the

lateral region of the anterior part of the soft palate a small bony prominence can be felt. This is produced by the pterygoid hamulus) an extension of the medial pterygoid plate of the sphenoid bone.

Nerve supply of the mouth

Hypoglossal muscle:

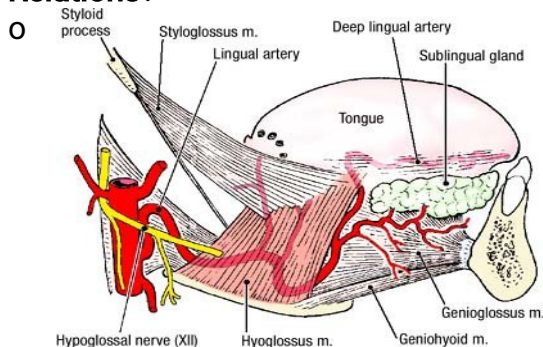
Origin: greater + lesser horns of the hyoid bone

Insertion: the lateral side of the tongue

Innervations: hypoglossal nerve

Action: depress the tongue

Relations:



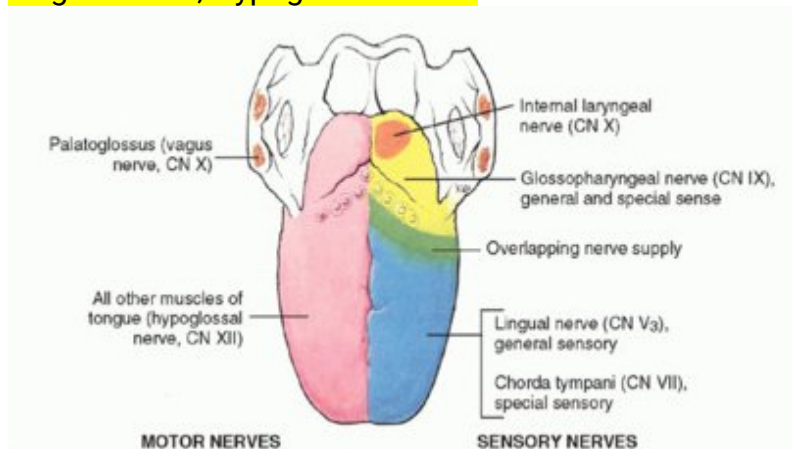
- o **Medial surface:** lingual artery + glossopharyngeal nerve
- o **Lateral surface:** lingual nerve, hypoglossal nerve, submandibular duct

Submandibular gland:

During resection the following structures may be injured

Marginal branch of facial artery;

Lingual nerve; Hypoglossal nerve

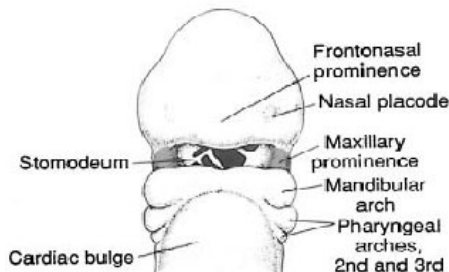


Palate embryology

At the end of the 4th embryonic week:

5 facial primordial appear around the **stomodeum** (primitive mouth) lined by ectoderm:

1. The **frontonasal prominences**: proliferation of **mesenchyme** ventral to the **forebrain**, form the upper border of the stomodeum.
- 2.



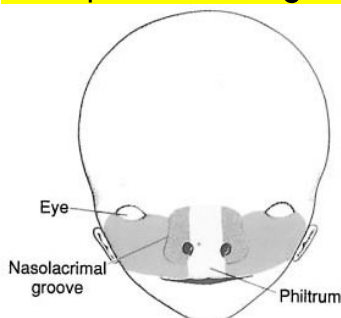
Paired **maxillary prominence**: 1st brachial arch structures forming sides

3. Paired **mandibular prominence**: 1st brachial arch structures forming caudal boundary

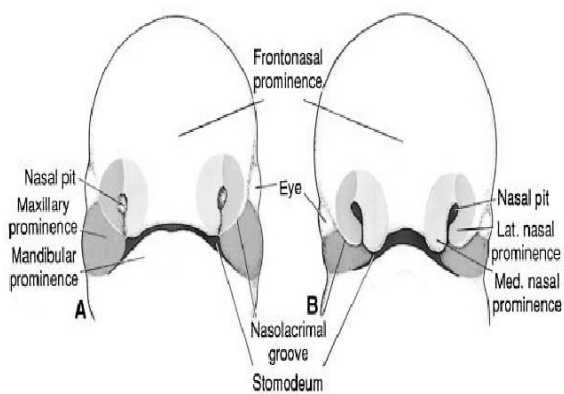
On either side of the frontonasal prominences are local thickenings of surface **ectoderm** that form the **nasal placodes**

During the 5th week of embryonic development:

nasal placodes invaginate to form the **nasal pits**.



This invagination process creates a **ridge** of tissue around the pit called the **lateral** nasal prominences laterally and the **medial** nasal prominences medially



Over the next **2 weeks**, the paired maxillary prominences grow **medially** and approximate the paired **medial** nasal prominences.

fusion of the paired **medial nasal** prominences and **paired maxillary** prominences occurs, thereby forming the **upper lip**.

The **medial nasal prominences** fuse to form:

1. nasal tip
2. columella
3. philtrum
4. **medial upper lip**

The maxillary prominences form:

- o the lateral aspects of the upper lip

The lateral nasal prominences are not involved in the formation of the upper lip but form the nose

The nose is formed of 5 facial prominences:

- a) **bridge** : the frontonasal prominence
- b) **tip and columella**: the fused medial nasal prominences
- c) **nasal alae**: the lateral nasal prominences

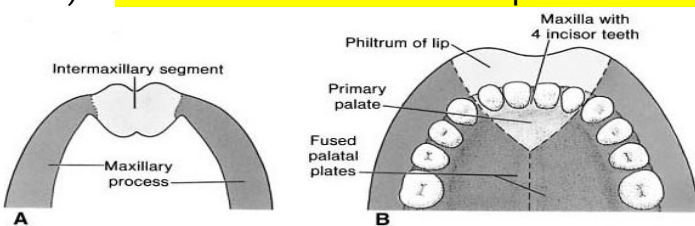


Table 176-1 -- STRUCTURES CONTRIBUTING TO THE FORMATION OF THE FACE

Prominence	Structures Formed
Frontonasal *	Forehead; bridge of the nose, medial and lateral nasal prominences
Maxillary	Cheeks, lateral portion of the upper lip
Medial nasal	Philtrum of the upper lip, crest and tip of the nose
Lateral nasal	Alae of the nose
Mandibular	Lower Lip

The cleft lip occur due to **failure** to maintain epithelial bridge secondary to lack of **mesodermal** proliferation

Palatogenesis:

begin at the end of the **5th week**, with complete fusion occurring by the **12th week** of development.

intermaxillary segment (**primary** palate) :

Formed by the **deeper** levels of fusion of the 2 **medial** nasal prominences **6th-7th week**

it includes:

- a) central maxillary alveolar arch that houses the 4 incisor teeth
- b) hard palate **anterior** to the incisive foramen

failure of medial nasal prominence result in **cleft palate** **anterior** to foramen incisive

failure of fusion of the medial nasal prominence with maxillary prominence result in minimal-to complete CL+/-P

Once the primary palate is completely developed, the **secondary** palate **begins** to develop

secondary palate:

segment of palate lying **posterior** to the incisive foramen

makes up the **major** portion of the palate
formed from the palatine shelves, which are two shelf like outgrowths of the **maxillary prominences**
fusion process :

it fuse with previously formed primary palate **anteriorly**

the nasal septum fuses with the newly formed secondary and primary palate.

Palatal fusion occurs from **anterior** to **posterior**

beginning at the **incisive foramen** at **8 weeks** of gestation and reaching completion in the **12 week** with uvular fusion

Failure of secondary palate fusion result in cleft palate **posterior** to the foramen incisive

The **degree** of clefting that is noted clinically is a consequence of the **time** in fetal development when the fusion process is interrupted

The palatine processes fuse about **1 week** later in **girls** which may explain the increased incidence of **CP in females**

The nasal septum grows **inferiorly** from fused median nasal prominence & fuse ventrally to dorsally to dorsally with the palate from **9-12 week**

Critical period for CL+/- Palate is from 4-6 week

Critical period of **palatal** development is from **8th week-12th week**

Event	Week
Facial prominence	4 th week
Nasal palcode	4 th week
Nasal pit & nasal prominence	5 th week
Fusion of the medial nasal prominence & maxillary prominence	6-7 th week
Formation of 1 palate	6-7 th week
Formation of 2 palate	8-9 th week
Fusion of 2 palate	8-12 th week
Fusion of the nasal septum with the palate	9-12 th week

What artery runs through the incisive foramen? Lesser palatine artery.

What muscles form the soft palate? Palatopharyngeus, salpingopharyngeus, levator and tensor veli palatini, muscular uvula, palatoglossus, and superior constrictor muscles.

At which points is the normal Vermillion the widest? At the peaks of Cupid's bow.

What is the name of the space between the cheeks and the teeth? Vestibule.

Why is the tongue a muscular hydrostat? It is a structure with incompressible muscles and no skeletal support that is capable of movement. Changes in the shape of the muscle do not change its volume

What is different about the palatoglossus compared to the other extrinsic tongue muscles? It is derived from the 4th branchial arch and its innervation comes from the nucleus ambiguus.

All the muscles participating in the oral phase of swallowing are striated muscles using

Acetylcholine for neurotransmission via nicotinic receptors.

What muscle functionally divides the oral cavity from the oropharynx? Palatopharyngeus.

How is the quality of taste determined? Via the central nervous system from the discharge pattern across all the sensory nerve fibers sensitive to the substance.

How is the intensity of taste determined? Via the central nervous system from the frequency of discharge across all the sensory nerve fibers sensitive to the substance.

A patient complains of not being able to taste. Upon further questioning, he admits to being able to taste salt crystals, sugar crystals, lemon juice and coffee but nothing else. What is the primary problem? Olfactory loss.

How does infant swallowing differ from adult swallowing? The pharyngeal phase of swallowing in infants is faster and more frequent.

What is the sequence of events during a normal swallow?

1. **Oral phase: Food is chewed and mixed with saliva.**
2. **Oropharyngeal phase: The food bolus is propelled posteriorly.**
3. **Pharyngeal phase: The soft palate elevates, glottis closes, pharyngeal constrictors contract, and the cricopharyngeus relaxes.**
4. **Esophageal phase: The bolus is propelled into the stomach by peristaltic waves.**

Boluses placed on the posterior tongue trigger swallowing at a lower volume than the anterior tongue.

what is the plica triangularis? Point at which the palatine and lingual tonsils meet.

In what percent of the population does the carotid artery lie deep to the floor of the tonsillar fossa? 1%.

What immunoglobulin is produced by the tonsils? Antigen-specific secretory IgA.

What artery provides most of the blood supply to the palatine tonsil? Tonsillar branch of the facial artery.

What is the normal thickness of the soft palate in adults? About 12 mm; gets thinner laterally.

What is the common insertion of the three pharyngeal constrictors? Median pharyngeal raphe.