

Functions of Saliva:

1. antibacterial :
 - a) Lactoferrin: Scavenges the free iron in the fluid & inflamed areas so:
 - suppress the free radical-mediated damage
 - decrease the availability of the metal to invading microbial & neoplastic cells
 - a) IgA :
 - the **predominant** immunoglobulin in saliva
 - contributes to the local immunity & exerts its anti-inflammatory protective functions by inhibiting IgG & IgM modulated functions
 - in the form of **dimer**
 - role IgA as a protective agent against the formation of **dental** plaque is unknown
 - IgG, IgM also contributes to the immunity
 - a) Lysozyme:
 - aid in breaking down **cell walls** leading to **bacterial cell lysis**
 - a) ABO isohemagglutinogens
 - b) Peroxidases: Helps breakdown salivary thiocyanate into products that interfere with bacterial cell metabolism.
1. digestion :
 - amylase : 40 % of body amylase, helps in starch digestion & has antibacterial effect
 - lingual Lipase
1. **lubricating** the food bolus and **lavaging** the oral cavity surfaces with a **biofilm** barrier:
 - mucins** are the best lubricating substance in saliva, forming a biofilm that protects the mucosa and dentition from chemical irritants, carcinogens
1. maintaining tooth integrity: prevents caries and promotes dental **calcification**
2. modulation of taste: most gustatory & olfactory stimulation is parotid secretions
3. providing buffering capacity ; buffering system in saliva consists of:
 - bicarbonate
 - phosphate
 - urea
 - amphoteric proteins.

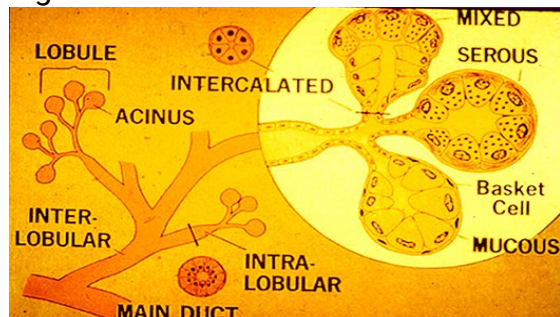
Saliva Composition:

>99% water; salts (calcium phosphate, calcium carbonate); (amylase, albumin, lysozyme, lactoferrin, **Ig A**)

hypotonic to plasma (Hypotonic saliva improves taste by decreasing the masking effect of normal plasma sodium levels)

Ph: 6.2-7.4

the **submandibular calcium** concentration in the saliva is **higher** than in the parotid saliva which leads to higher rate of stone formation in addition to the more dependent location + higher **mucin** concentration



parotid gland is serous, low in mucin & high in enzymes

The most important ion in secretion of amylase is Ca

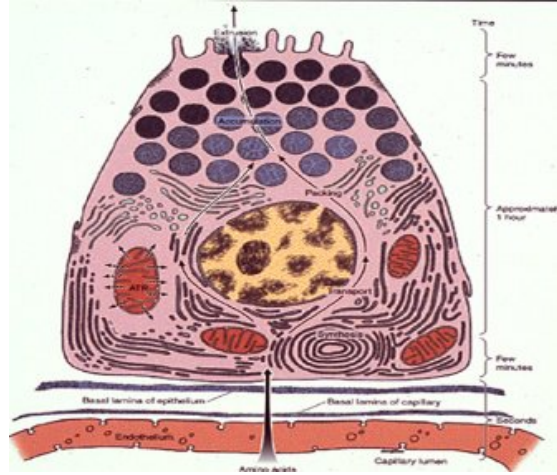
plasma iodine ratio for mixed saliva under physiological condition is greater than 20

Secretory unit of salivary gland:

Secretory unit is made of:

- a) Acinus
- b) Secretory ducts(interlobular):

1)



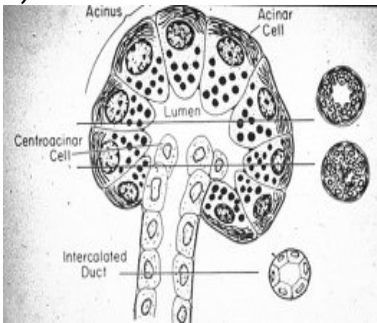
Intercalated duct

2) Intralobular/striated duct

a) Collecting duct(extralobular)

Salivary acini are classified into:

- 1) Serous
- 2) Mucinous
- 3) Mixed



Acini leads to **intercalated** duct which is made of **single cuboidal** cell

Intercalated duct leads into **intralobular** duct which also known as **striated** duct

Serous cells are filled with **basophilic** secretory granules

Serous acinar cells produce secretory granules with **amylase**

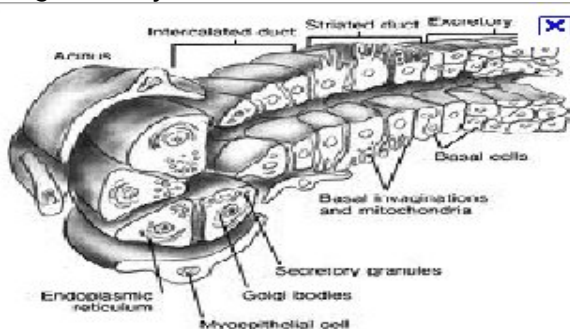
Myoepithelium cells:

- ✓ elongated/star shap
- ✓ nonsecretory cells
- ✓ long branching processes that surrounds the **acini** & the **proximal** duct
- ✓ it has **contractile** properties & play role in expelling preformed secretions:
 - a) Adenosinetriphosphate activity
 - b) Intercellular gap junction

Salivary secretions:

- ✓ main **triggers** for salivary production:
 - mastication
 - gustatory stimuli: **Acidic** foods are the **best** stimulus and **sweet** tastes the least.

✓



Note: **Olfaction** is surprisingly a **poor** secretory

stimulus

- ✓ The production of saliva is an **active** process involving:
 - 1) cell synthesis
 - 2) active transport.
- ✓ Saliva secretion is active too, intercalated stage process composed of:
 1. **Primary** acinar secretions
 2. Ductal secretions (modification)

- 1) Primary secretion is by the **acinus** which is the site of:
 - a. **all** fluid generation
 - b. **Most** (approximately 85%) **exocrine protein** secretion.
 - o The fluid component is derived from the **local** vascular bed in the form of an **isotonic** solution and secreted into the acinar lumen.
 - o The fluid secretion occur by way of **osmotic coupling** of transepithelial fluxes of NaCl & water (water is drawn into the acinar lumen by osmotic gradient of NaCl)
 - o It is **dependant** on the activity of Na-k ATPase which is located on the **basolateral** domain of the acinus
 - o The Na-K ATPase maintain a high intracellular [k] & low [Na] which contributes to the resting membrane potential

- 1) The secretory ducts:
 - o It is water-**impermeable** In contrast to the water-permeable cells of the acinus
 - o Most of the sodium (**Na⁺**) and chloride (**Cl⁻**) in the primary secretion is reabsorbed in the duct, and a **small** amount of potassium (**K⁺**) and bicarbonate (**HCO₃⁻**) is secreted.
 - o This makes the saliva **more alkali & less isotonic (hypotonic)**
 - o **Some** proteins are added to the salivary fluid as it traverses the secretory duct

The degree of hypotonicity depends on flow rate:

Rapid flow rates decrease transport time resulting in lower hypotonicity.

Slower flow rates provide greater transit time increasing hypotonicity.

Gland	Acinar type	Viscosity	Percentage of Whole Unstimulated Daily Saliva
Parotid	Serous	Watery	25
Submandibular	Mixed	Semi-viscous	71
Sublingual	Mucous	Viscous	3-4
Minor	Mucous	Viscous	Trace

% of salivary gland secretions contribution to the

saliva:

1. Without stimulation (base line secretions):
 - submandibular gland secretes 60 -70% of saliva
 - parotid gland: 20-30%
 - sublingual & minor gland: 5-10 %
1. With gustatory & Olfactory stimulation of the ANS:
 - parotid gland secretes 75% of the saliva
1. Minor salivary glands regardless of the state of stimulation contributes to 7-8 % of total saliva

control of salivatory secretions:

Resting acinar cells show a membrane potential of -20 to -35 mV.

On stimulation by the autonomic nervous system, the cells hyperpolarize (become more negative) as a result of the efflux of K⁺ and the influx of Cl⁻.

This hyperpolarization, which occurs contrary to other excitable cells that depolarize on stimulation, is known as the secretory potential

combination of sympathetic and parasympathetic systems :

- 1) parasympathetic being the dominant
- 2) Sympathetic stimulation of the salivary glands tends to be more intermittent

parasympathetic:

dominant neurotransmitter: acetylcholine

so the atropine is anti-sialagogue because it competes with acetylcholine for receptor sites

2nd messenger: ca

Functions: Fluid formation, Transport activity in the acinar & ductal cells

parotid gland: medulla oblongata **inferior** salivatory nucleus **glossopharyngeal** nerve jacobson's Nerve tympanic plexus lesser petrosal nerve **otic ganglion** postganglionic parasympathetic fibers carried by **auriculotemporal branch of V3**

Submandibular & sublingual gland: Medulla oblongata **superior** salivatory nucleus nervus intermedius of **facial** nerve chorda tympani **lingual** nerve **submandibular ganglion** postganglionic parasympathetic fibers submandibular & sublingual glands

Sympathetic:

Dominant **beta** adrenergic neurotransmitter: **norepinephrine**

2nd messenger: **cAMP**

Functions:

- 1) Exostosis
- 2) Protein metabolism

So it modulate the composition of saliva by increasing exocytosis from certain cells

Originate from superior cervical ganglion

Sympathetic stimulation produce scanty viscous saliva

Salivary flow Rate:

1–1.5 L of saliva/day

steadily increase as the child grows & reach a max value by the age of 3-4 yr

Hyposalivation: unstimulated salivary flow less than 0.25 ml/min

The most important factor in oral hygiene is salivary flow rate

Factors affecting the rate

A. **Increase** the rate:

- 1) Mastication
- 2) Before an episode of vomiting

A. **Decrease** the rate:

- 1) During sleep
- 2) Before & During exercise: due to vasoconstriction (sympathetic)+ dehydration

Excessive salivation in cerebral palsy can be treated by **lateral tympanic neurectomies** (resection of **inferior** tympanic nerve of glossopharyngeal nerve)

conditions predisposing to xerostomia:

- 1) uremia
- 2) sjogren syndrome
- 3) antimuscarinic & sympathomimetic drugs

Minor vs major salivary glands:

Major salivary glands:

located distant from the oral mucosa

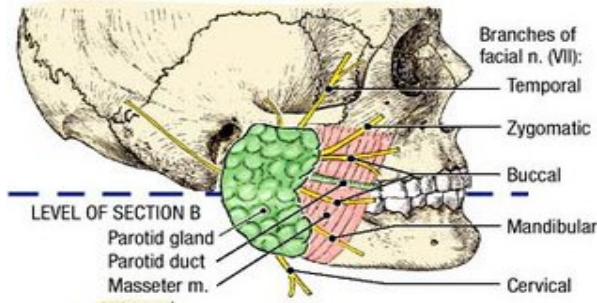
Connected to the mucosa by excretory ducts.

All of the major salivary glands are derived from oral cavity epithelium which proliferates and burrow into the surrounding mesenchyme to form a solid cord.

The minor glands:

lie within the mucosa or submucosa of the oral cavity and oropharynx

Either open directly onto the surface of the mucosa or are connected to it via short excretory ducts.



Embryology of salivary glands:

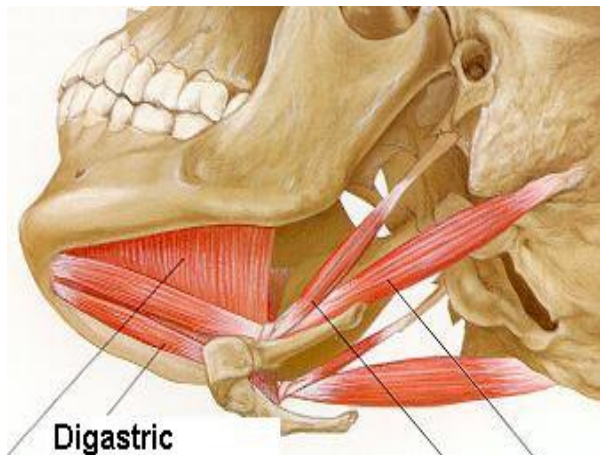
Major salivary glands:

outpouchings of oral ectoderm into the surrounding mesenchyma

The primordia originate at the sites of the eventual duct orifices

Parotid: 5.5 wk

Submandibular : 6wk



Sublingual: 8wk

Minor salivary glands: arise from oral ectoderm and nasopharyngeal endoderm and form simple tubuloacinar systems

Parotid Gland

Largest of major salivary glands

Entirely serous secretions, high enzymes

lies in the pre-auricular area deep to the skin & subcutaneous tissue:

75% of the gland overlies the Masseter muscle

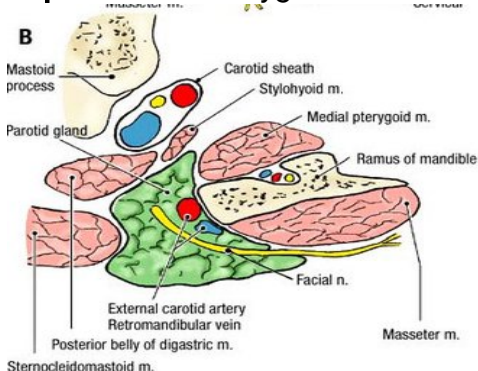
25% retromandibular

Borders:

Anterior border: Masseter muscle

Posterior border: EUC & SCM

Superior border: zygomatic arch



Inferior tail: lies between the **ramus** of the mandible and scm
over the posterior belly of digastrics muscle

o Styloid process, styloid muscles, carotid artery, jugular vein

Relations:

Directly related to:

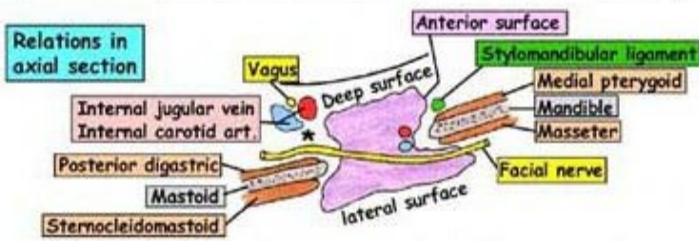
Masseter muscle + medial pterygoid

Mandibular ramus + mastoid process

Within the gland:

1) Facial nerve

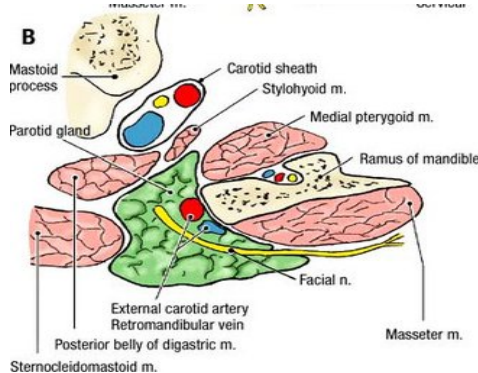
- 2) Retromandibular vein
- 3) **External** carotid artery
- 4) L.N
- 5) Fibers of auriculotemporal nerve fibers



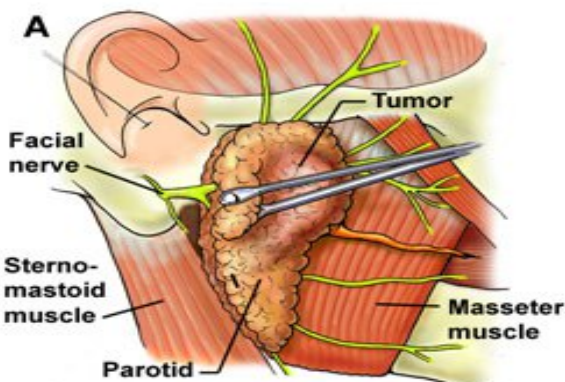
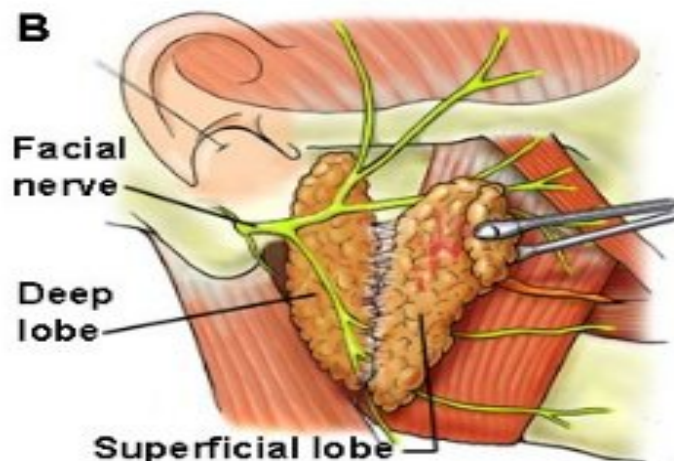
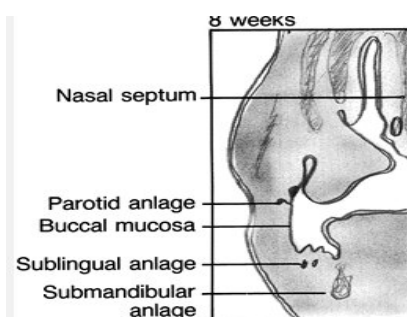
The deep lobe is related to:

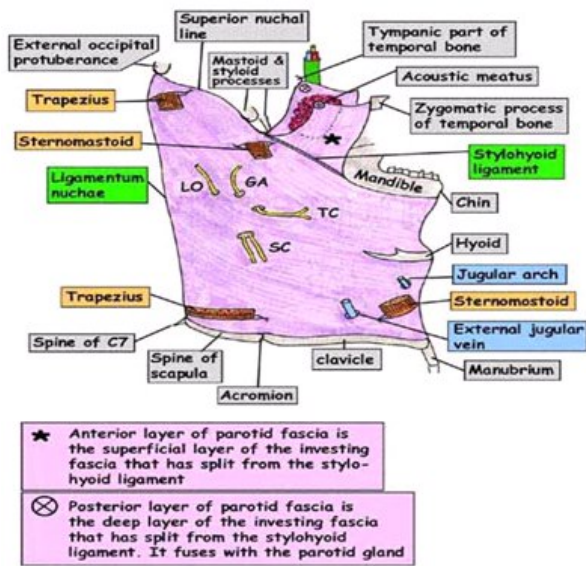
Internal jugular vein
Internal carotid artery
Styloid process
Muscles associated with the styloid process

Note that:



The **external** carotid artery lies **within** the parotid gland
internal carotid artery is related to the **deep** parotid
 no relationship between the nerves in the carotid sheath and the parotid gland
 The facial nerve enters the parotid fossa between the **posterior belly** of digastrics muscle and **stylohyoid muscle**
 The facial nerve subdivides **within the gland**
Facial nerve splits the gland into superficial (larger) and deep lobe (smaller)
 facial nerve is superficial to the **retromandibular vein** & external carotid artery





Parotid gland capsule:

The gland is enclosed by superficial investing layer of deep cervical fascia, which splits to surround the gland forming the capsule.

Superficially The fascial envelope is continuous:

anteriorly with the fascia covering the **masseter** muscle

posteriorly with fascia enveloping **sternocleidomastoid** muscle.

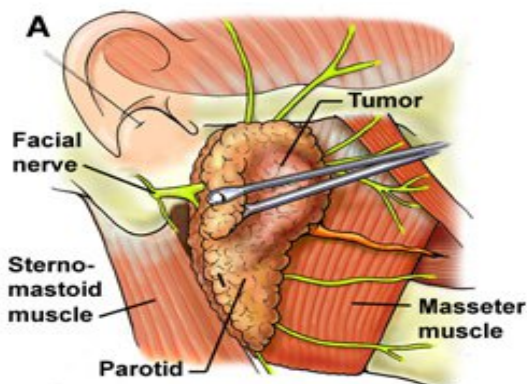
The **deep** layer of parotid fascia forms the **unyielding stylomandibular membrane** stretches from the:

- anteriorly** : mandible
- inferiorly** : stylomandibular ligament
- Posteriorly** : styloid process

Occasionally, parotid tissue can herniate through a weakness in the stylomandibular membrane and lie in the **lateral** pharyngeal wall.

For this reason, **tumors deep** in the parotid gland can present as **parapharyngeal** masses

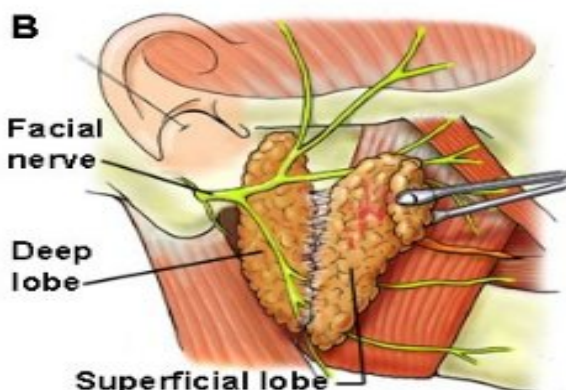
But this membrane is **not** considered a barrier between the **deep** lobe of the parotid & **parapharyngeal space**



The fascia sends **septa** into the **glandular** tissue, which prevents **separation** of a surgical plane between the gland and its fascia.

This fascial layer is largely **tough** and **inelastic**, but this gland is largely constrained by the capsule, leading to:

- Severe** pain occurring in advance of **overt** enlargement of the gland.
-



Prevent the parotid gland from becoming

obvious until it has reached a **large** size

3. suppurative or other **expansive** process in the parotid gland requires **surgical drainage**.

The capsule also can determine the position and expansion of tumors arising within the gland:
the superficial lobe:

The majority of tumors arise in superficial lobe
expand towards the superficial surface of the gland

deep lobe tumors:

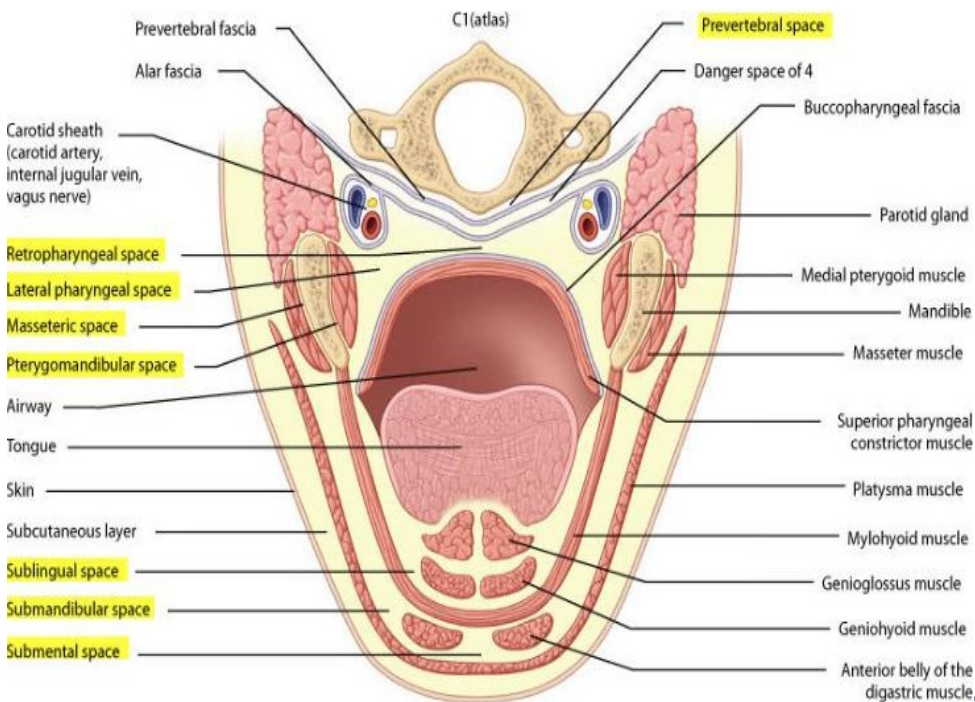
constrained by the stylomandibular ligament
expand into the parapharyngeal space
distorting the lateral pharyngeal wall.

Tumors originating in both deep & superficial lobe:

may be restrained by stylomandibular ligament and the posterior aspect of the mandibular ramus to form a dumb bell-shaped mass

Note:

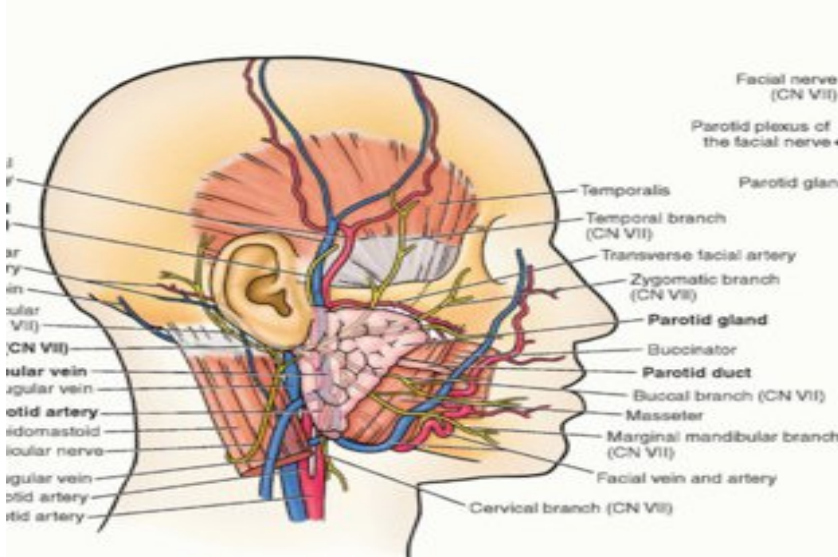
✓



Stylomandibular ligament

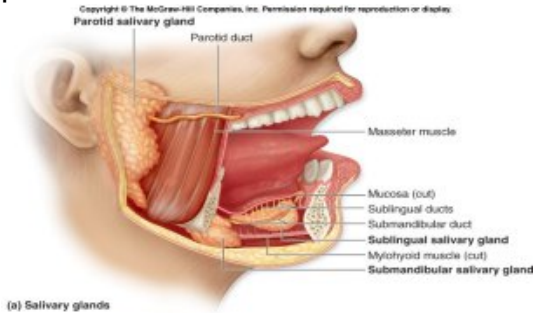
runs **within** the gland separate the deep & superficial lobe **anteriorly**

- ✓ Stylomandibular ligament should be **divided** to access the deep lobe; Separates the parotid gland from the submandibular gland
- ✓ **No** significant barrier between the **deep** lobe & **parapharyngeal** space:
- ✓ The relatively **thin** fascia covering the **apex** of the gland can lead to the spread of sepsis into the **parapharyngeal** (note that the **medial aspect of the deep lobe forms the lateral wall of the parapharyngeal space**)
- ✓ **Deep** lobe lies in the **prestyloid** compartment of **parapharyngeal** space.



Stenson duct:

- ✓ Made of low cuboidal cells which are surrounded by the smooth muscles
- ✓ Originates from the extraglandular ductules from deep & superficial lobe
- ✓ Originates from the deep lobe
- ✓ 1.5 cm below the zygomatic arch
- ✓ 4-6 cm in length
- ✓ Transverses over the Masseter muscle
- ✓ The duct goes below & parallel with transverse facial artery
- ✓ parallel to the buccal branch of the facial nerve (it is either above/below it)
- ✓



(a) Salivary glands

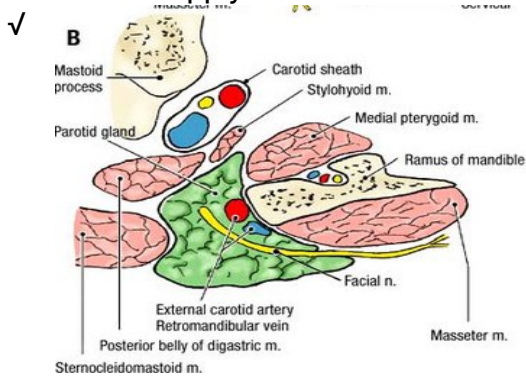
at the anterior edge of the Masseter muscle it Goes medially through the buccinator and Pierces the oral mucosa opposite to 2nd upper molar

Major stimulus of parotid gland secretions:

1. **gustatory** stimulation
2. mechanical stimulation of **chewing**

Blood supply:

Arterial blood supply:



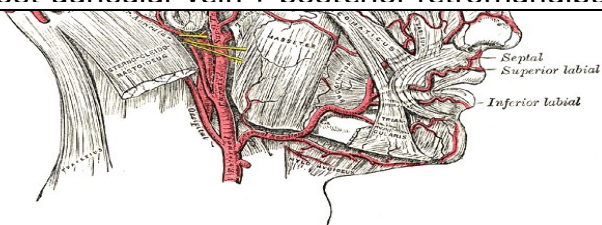
External carotid artery courses medial to the parotid gland and bifurcates into superficial temporal artery and maxillary artery

- ✓ The superficial temporal artery gives off Transverse facial artery which parallels the parotid duct slightly superior
- ✓ This artery supplies:
 - o Parotid gland
 - o Parotid duct
 - o Masseter muscle

Venous drainage:

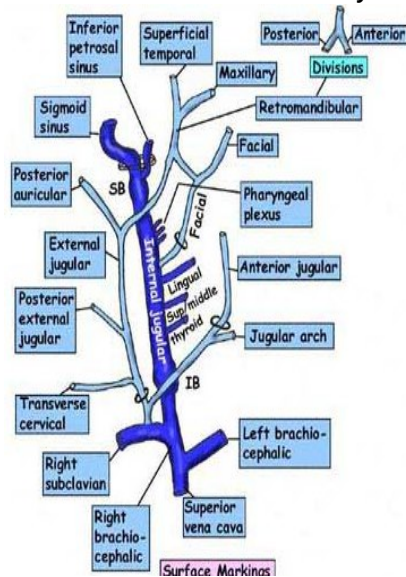
- ✓ the main venous drainage of parotid gland is posterior facial vein

- ✓ Superficial temporal vein + internal maxillary vein = retromandibular vein
 - ✓ Retromandibular vein has 2 branches (anterior & posterior)
 - ✓ Facial vein + anterior retromandibular vein = common facial vein
 - ✓ Common facial vein drain into the internal jugular vein
 - ✓ Post-auricular vein + posterior retromandibular vein = external



so ultimately the venous drainage of the parotid gland is into both external & internal Jugular veins

Location of the retromandibular vein:
lateral to the carotid artery



in 90 % it lies deep to both facial nerve trunks
in 10 % it crosses either trunk laterally
exists the parotid gland at the **lower pole**

Lymphatic drainage:

Unique features of parotid gland lymphatic drainage:

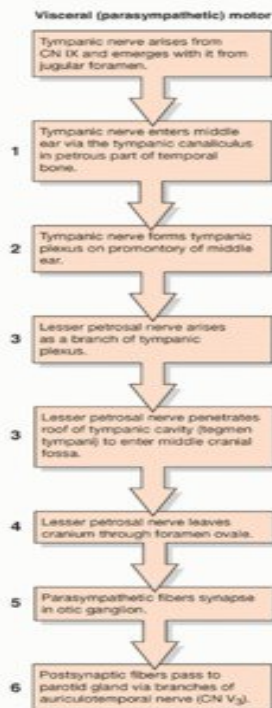
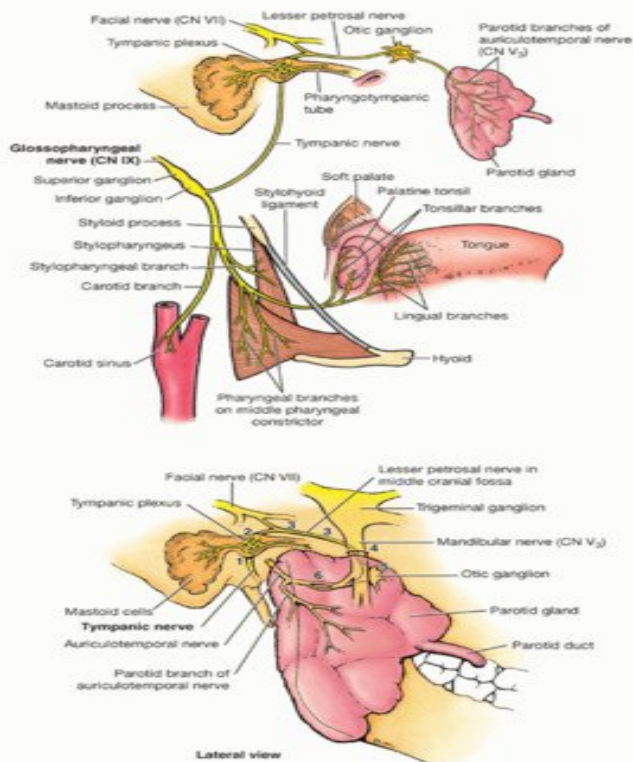
- o Lymph nodes are contained within the gland
- o It is the only gland with two layers of lymph node:
 - a) Superficial : between the gland & capsule
 - b) Deep: within the gland
- o # of superficial L.N is more than the deep L.N
- o Both of them drain into superficial & deep cervical lymph node

Nerve supply:

Autonomic supply:

Sympathetic: superior cervical ganglion

Parasympathetic: glossopharyngeal nerve Inferior Tympanic tympanic plexus superior tympani
lesser petrosal otic ganglion auriculotemporal nerve



Frey's syndrome:

gustatory sweating (sweating in response to gustatory stimulus)

occurs over the **pre-auricular** skin

secondary to cross re-innervation of the **divided** auriculotemporal nerve post parotidectomy with the **cutaneous** nerve

So aberrant cross innervations of **postganglionic parasympathetic cholinergic** fibers from the auriculotemporal nerve of the parotid gland To **postganglionic sympathetic** fibers to the **sweat** glands; So sweat glands will be stimulated by acetylcholine

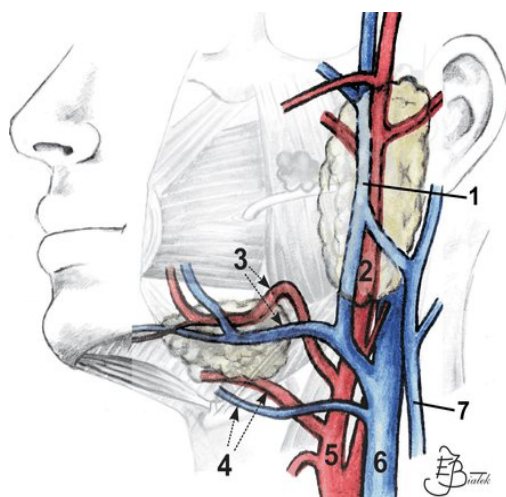
can be treated by **section** of **Jacobson's** nerve

Sensory innervations:

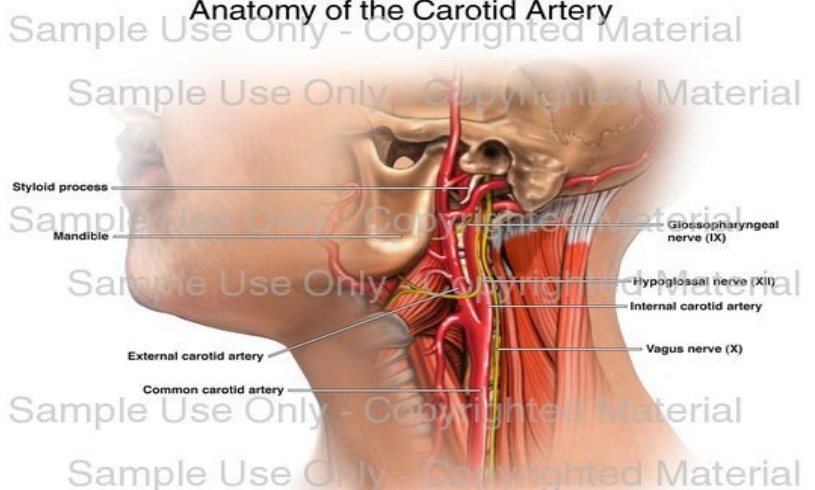
Greater auricular nerve:

arises from C3

Has anterior + posterior divisions

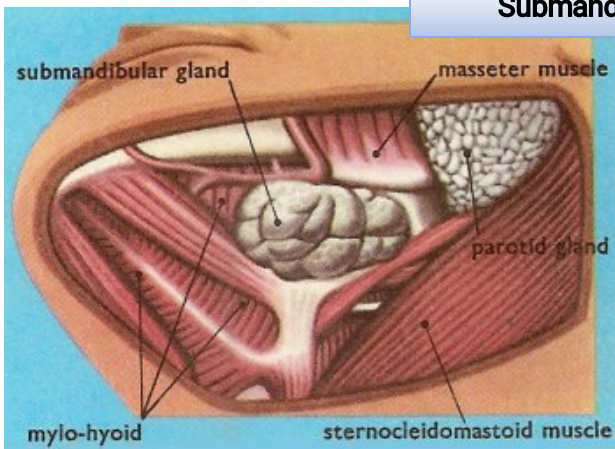


Anatomy of the Carotid Artery



The **posterior** division can occasionally be preserved to avoid Auricular numbness

Submandibular gland



The border of the gland:

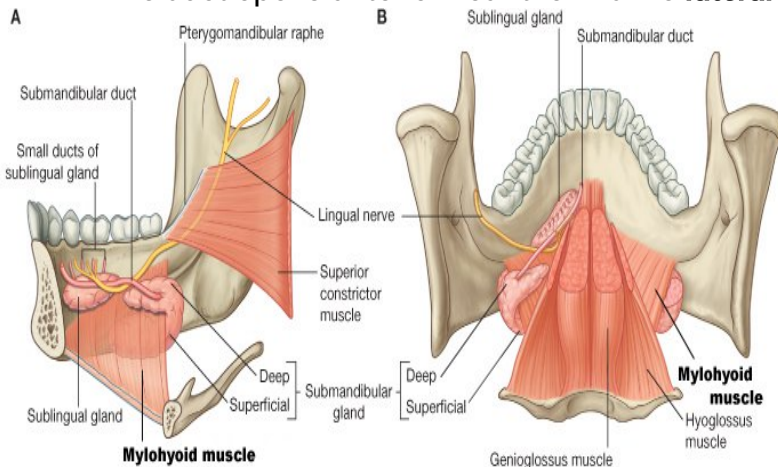
Superiorly: inferior margin of the mandible

Inferiorly: anterior & posterior belly of the digastrics muscle

the **posterior** border of the **Mylohyoid** muscle divides the submandibular gland into superficial & deep lobes (the mylohyoid is retracted during surgical excision)

Ducts originate from the **anterior** aspect of the **deep** submandibular gland between the **mylohyoid** muscle & **hypoglossal** muscle

The duct opens anterior near the midline **lateral** to the **frenulum**



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Blood supply of the submandibular gland

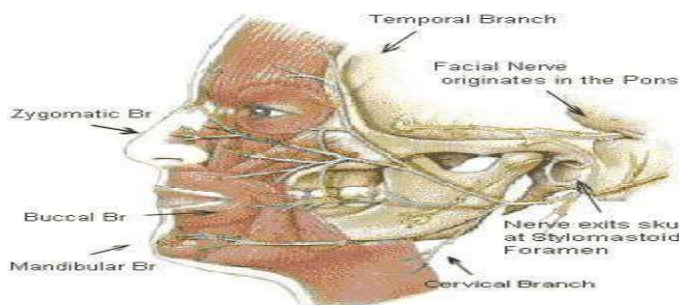
Facial artery:

It runs **forward & upward** over the **superficial** lobe

Deep to the **posterior** belly of **digastrics** muscle

It is normally should be divided & ligated in 2 places

Facial vein:



Lies lateral to the gland

Nerve supply:

1. Facial nerve:

- o via chorda tympani nerve carries the secretory innervations to the submandibular gland (preganglionic parasympathetic fibers)

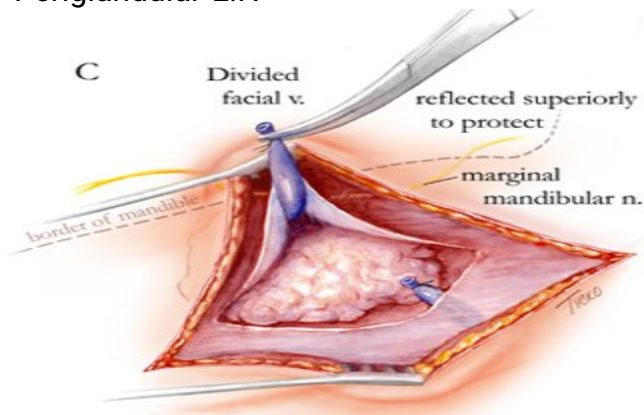
1. Lingual nerve:

- o a branch from mandibular division of the trigeminal nerve
- o provides sensory innervations
- o attach to the deep superior surface of the submandibular gland via nerve fibers of the submandibular ganglion
- o so the flat lingual nerve is pulled into an easily identifiable angular shape by retraction of

the submandibular gland

Lymph nodes:

Periglandular L.N



intraglandular

Unlike parotid gland which has both periglandular &

Relation of Mandibular branch of the trigeminal nerve to the submandibular gland:

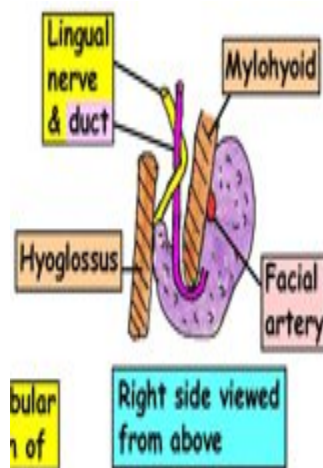
Supply the **corner** of the mouth

Lies **superficial** to the **capsule** of the gland

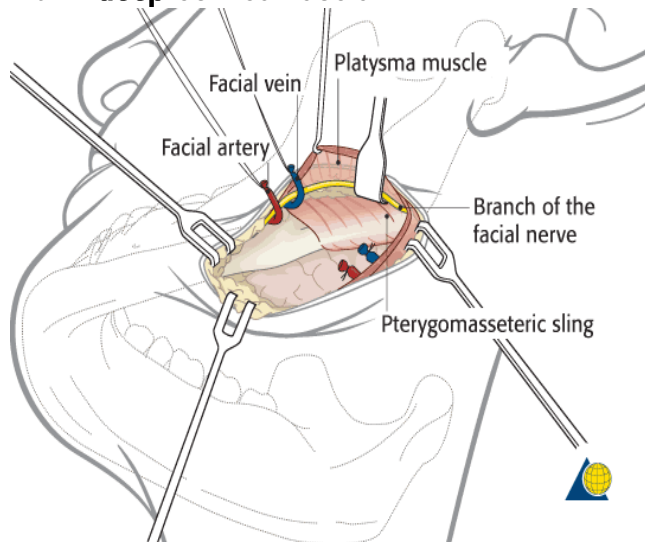
At risk during excision of the gland

It can be protected by making the incision just **above** the hyoid bone and doing the dissection in the plane between the **gland** & the **capsule**

The neurovascular bundle relationship to submandibular gland:



The **mandibular nerve + facial vein** lie **deep** to the platysma muscle within **deep** cervical fascia



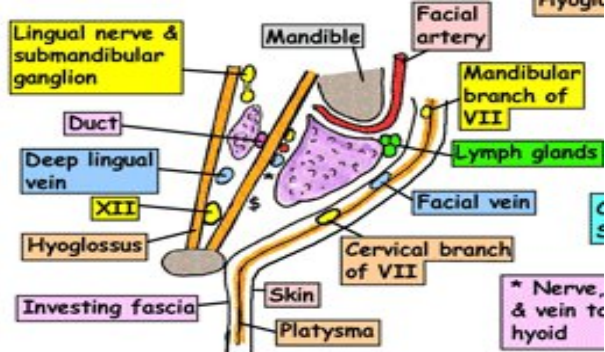
anterior facial vein

Facial artery lies **deep** and **anterior** to the

Marginal branch of facial nerve lies **superficial to** the artery and vein

Protection of the marginal branch during submandibular gland:

By **ligating** and **dividing** the facial **artery** and **vein** and then **retracting** the vessels **superiorly**, the marginal mandibular branch of the facial nerve remains included in the **superior** flap and is thus **protected**.



Sublingual gland duct:

Typically there are about 10 ducts of Rivinus that drain the gland but occasionally several of these small ducts may join to form a larger sublingual/Bartholin's duct.

Half of the sublingual gland duct opens directly into the submandibular duct

Hypoglossal nerve relation : (inferior to Wharton's duct)

Provides motor supply to the tongue

It is **medial** to the posterior belly of the digastrics muscle which is medial to the submandibular gland

Lingual Nerve relationship to the submandibular gland (Wharton's) duct:

Superior to Wharton's duct

it crosses the duct on its **lateral** surface near its origin

The lingual nerve re-cross the duct on its **medial** surface near its termination

Lingual nerve (branch of the trigeminal) attaches to the deep lobe by nerve fibers via **submandibular ganglion**

With what other organs do the salivary glands share the same embryologic origin?

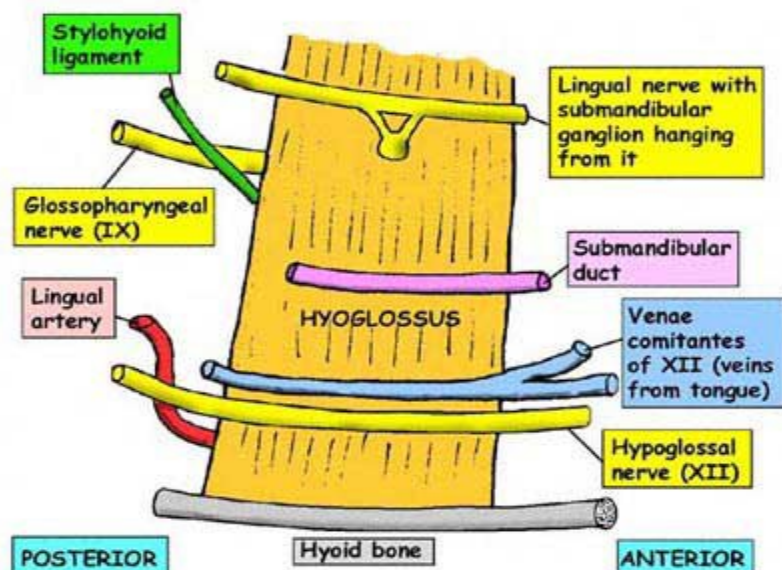
Liver, gallbladder, and pancreas (all come from mesodermal buds of the foregut).

When does the parotid gland encase the facial nerve? Third month gestation.

What membrane separates the parotid gland from the submandibular gland? Stylomandibular membrane.

Where does the retromandibular vein lie in relation to the facial nerve?

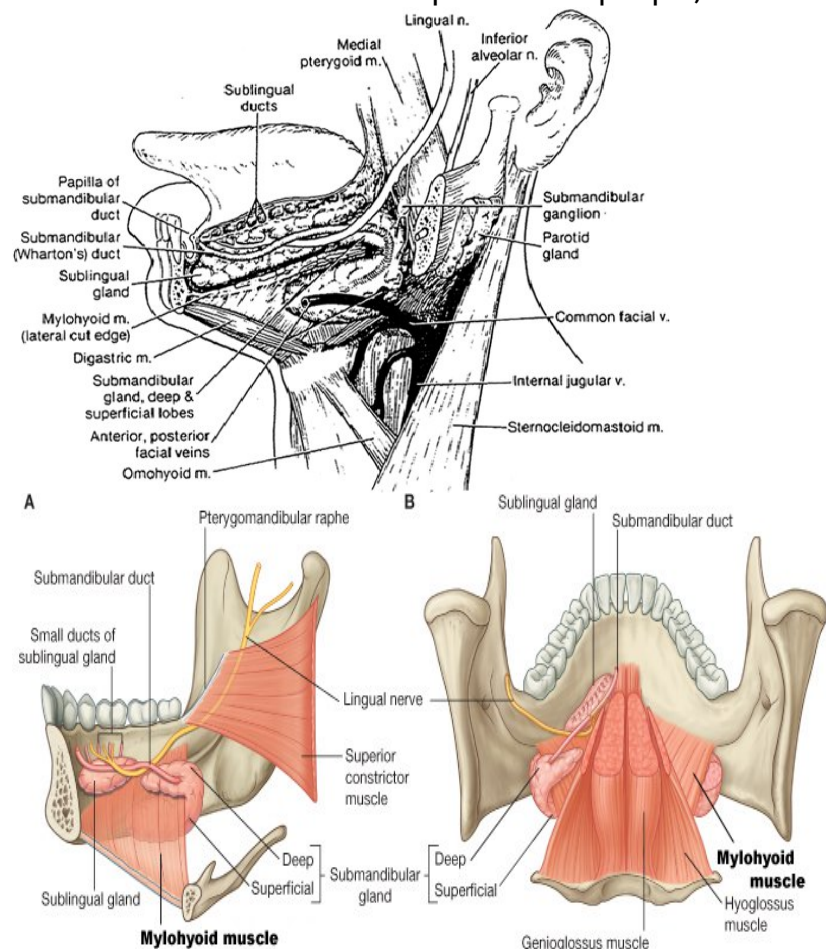
HYOGLOSSUS & ITS RELATIONS



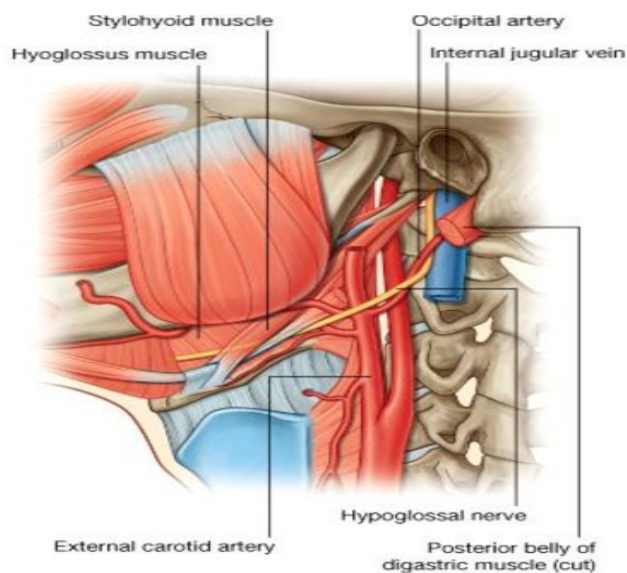
- The mylohyoid muscle (not shown) overlaps the anterior edge of hyoglossus
- Hyoglossus is supplied by the hypoglossal nerve as are all the muscles of the tongue except palatoglossus (pharyngeal plexus)
- Further anteriorly, under the mylohyoid, the lingual nerve passes lateral to the submandibular duct, then dips under it to appear on its medial side to enter the tongue
- The venae comitantes of the hypoglossal nerve pass posteriorly to join the facial vein

In most people, it courses deep to both

trunks of the facial nerve. In up to 10% of people, the vein crosses either trunk laterally.



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Mouth anatomy

Boundaries:

Anteriorly : the vermilion border

Posteriorly:

Superiorly : the junction of the hard palate & soft palate

Inferiorly : circumvallate papillae (linea terminalis)

PAPILLAE

Filiform for grip,
keratin tips - pink
after chewing, white

Fungiform
Taste buds

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

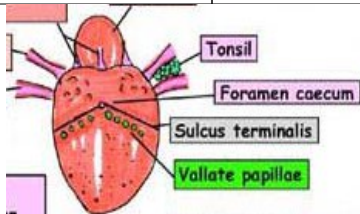
Topography:

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 subpopulations

Gustatory subpopulations differ in **sensitivity** to chemical stimuli

however, 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 folate

taste 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

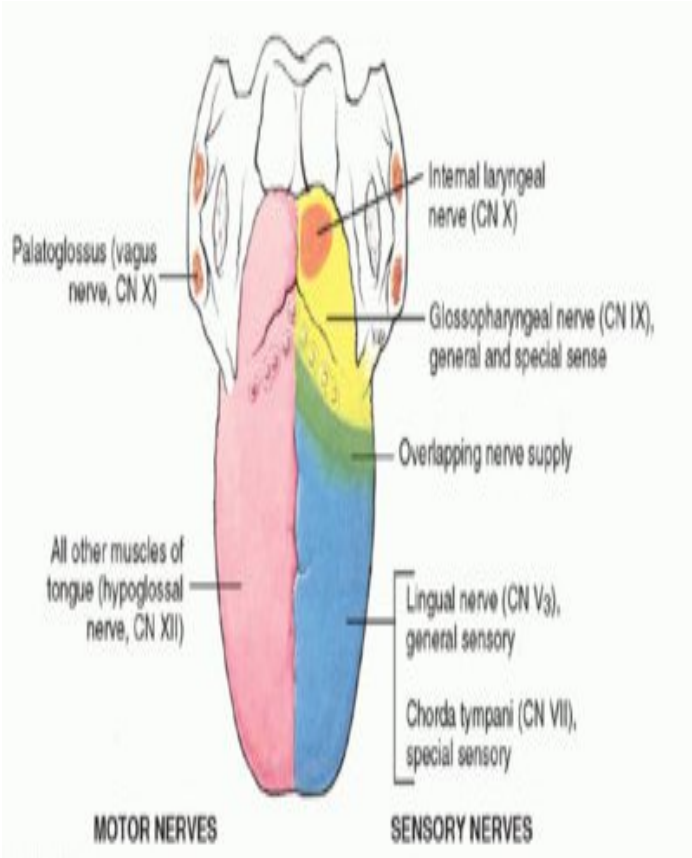
The muscles of the tongue comprise:

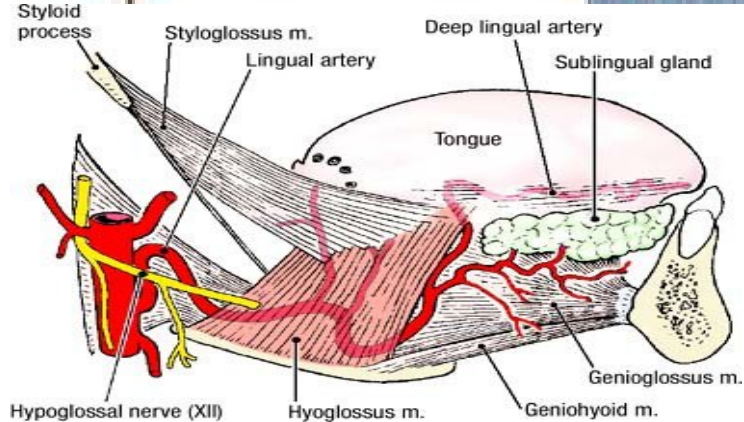
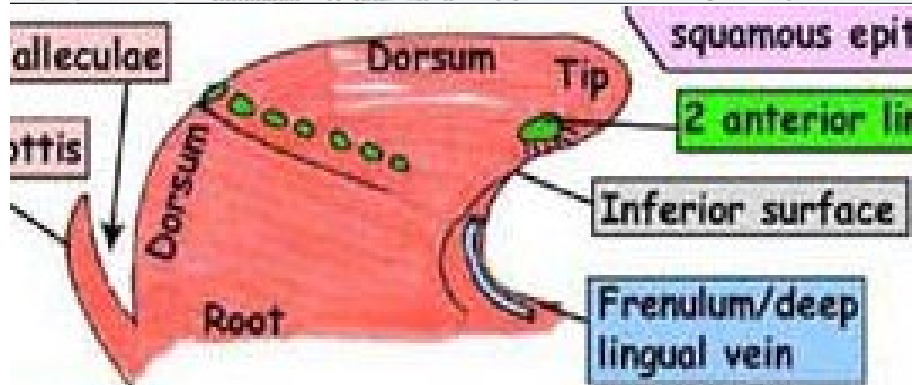
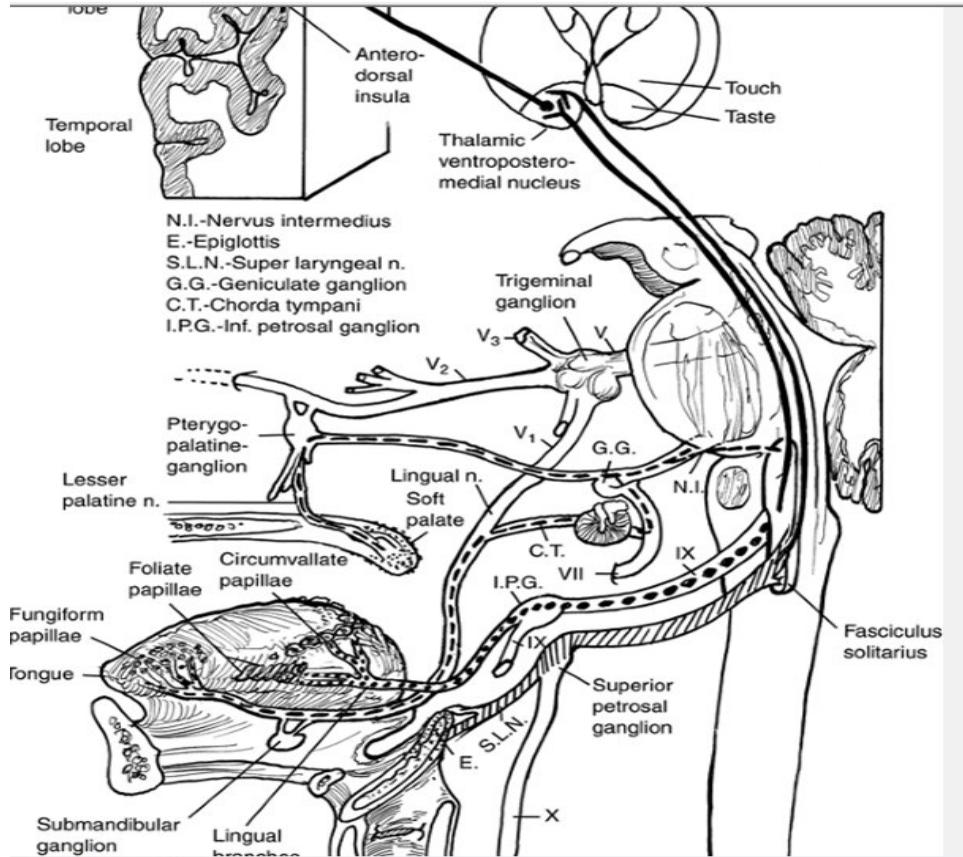
Muscle	Origin	Insertion	Action	Nerve	Blood supply
Genioglossus	superior genial tubercle (mental spine) behind the mandibular symphysis (above the origin of the geniohyoid muscle)	inferior fibers : attached to the upper anterior surface of the hyoid body (near the midline) Intermediate fibers: pass backwards into the posterior part of the tongue superior fibers : ascend forwards to enter the whole length of the ventral surface of the tongue from root to apex, intermingling with the intrinsic muscles.	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 opposite side.	Hypoglossus nerve	1-lingual artery (sublingual branch) 2-facial artery (submental branch)
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	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)

	stylomandibular ligament (a fibrous cord extending from the tip of the styloid process to the lesser cornu of the hyoid bone)				
Palatoglossus	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) artery

extrinsic muscles: extending outside the tongue and moving it **bodily** (change the position)
intrinsic muscles: lying wholly within it and altering its **shape**.

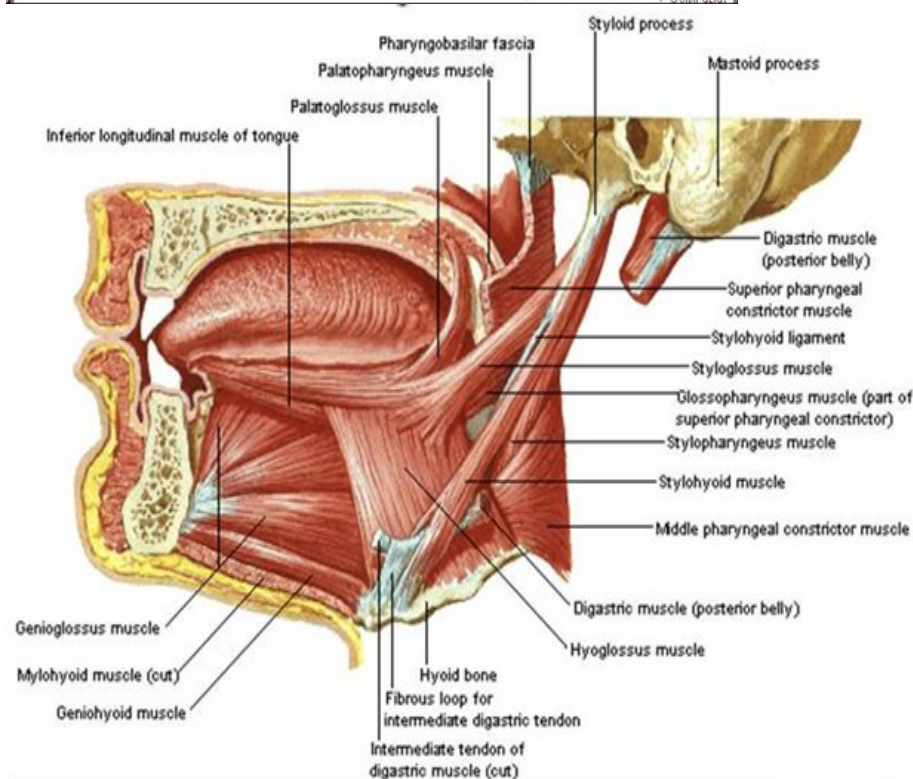
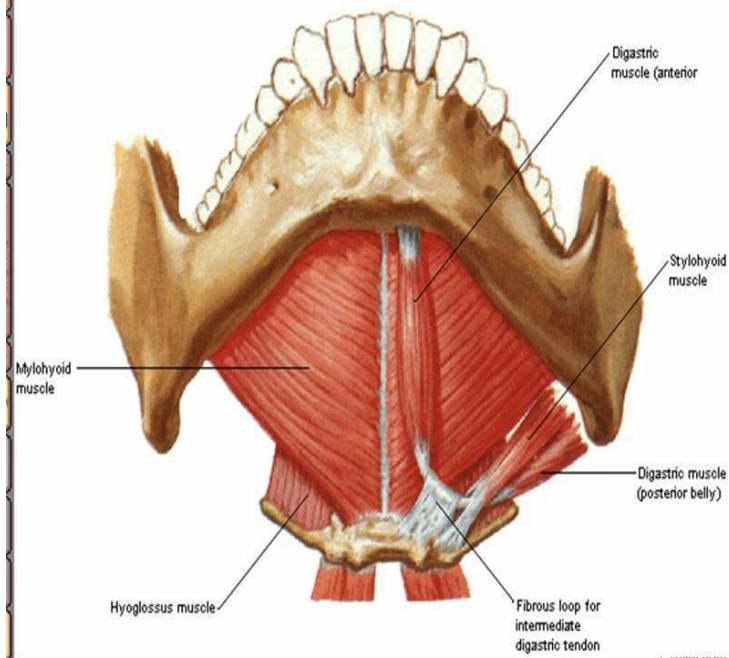
The **extrinsic** musculature is composed of 4 pairs of muscles:





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 nucleus solitarius
Posterior 1/3	Lingual branch glossopharyngeal nerve nucleus solitarius	Circumvalate (which is anterior to sulcus terminalis) Tongue base + Valleculae [lingual nerve]

lingual surface of the epiglottis, pharynx, larynx	Internal laryngeal nerve superior laryngeal nerve vagus nerve	Internal laryngeal nerve superior laryngeal 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 degenerates incase of de-nervation

Some drugs may decrease taste sensation like pencillamine & 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** nervepterygopalatine 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 **buttons** from a **sensory** dendrites

Ganglia:

Facial nerve: geniculate ganglion

Glossopharyngeal nerve: **inferior** petrosal nerve

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

Innervation of the palate:

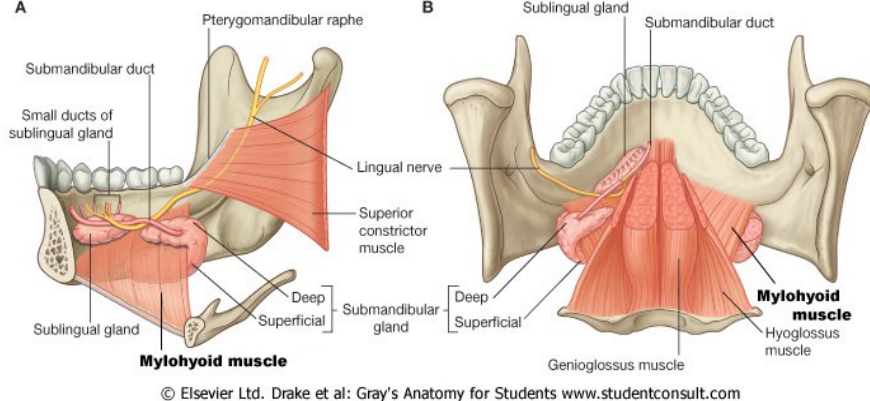
Hard palate:

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

2nd palate: greater palatine nerve; greater palatine artery

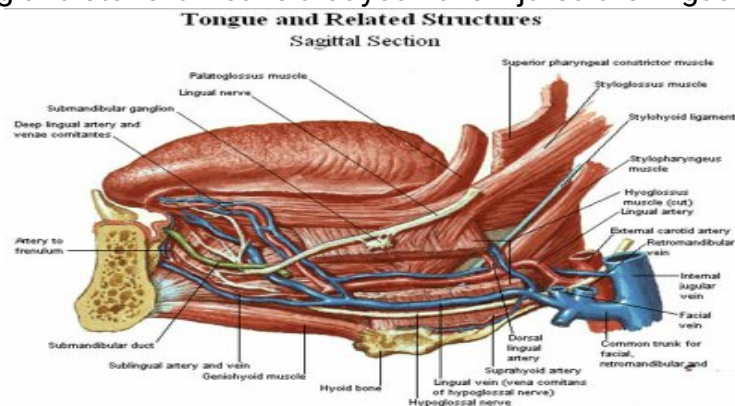
Soft palate (part of the oropharynx): lesser palatine nerve

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:

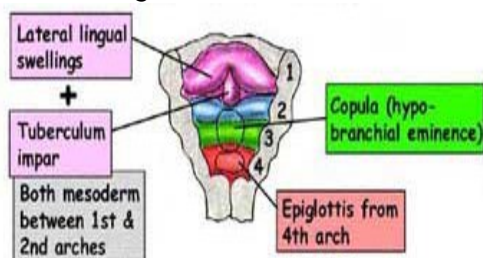
Lingual artery: a branch of external carotid artery

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 :

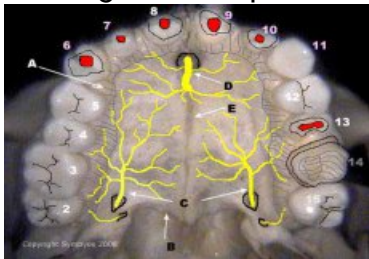
Filiform + fungiform papillae develop

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**

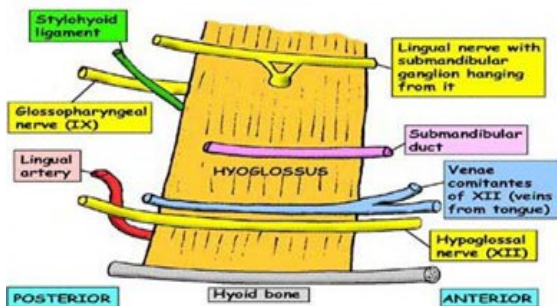
Note:

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:

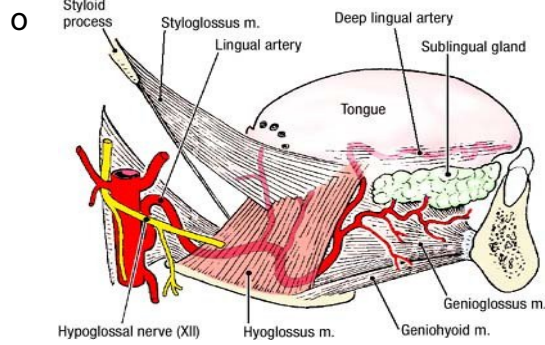
Origin : greater + lesser horns of the hyoid bone

Insertion : the lateral side of the tongue

Innervations : hypoglossal nerve

Action : depress the tongue

Relations :

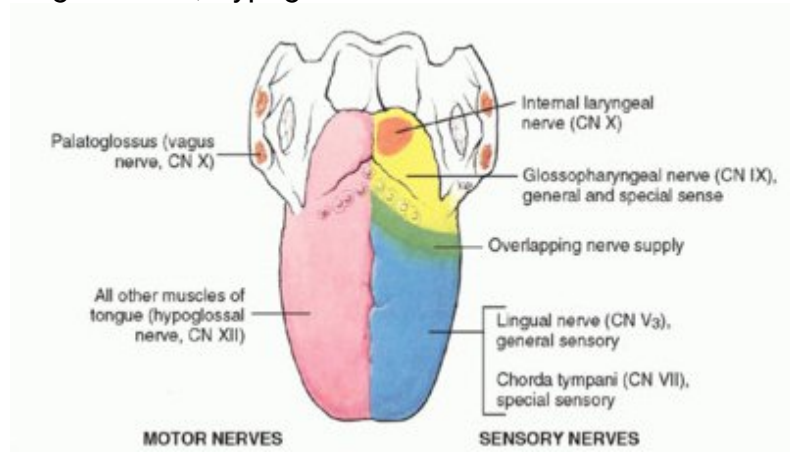


Medial surface : lingual artery + glossopharyngeal nerve

- 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



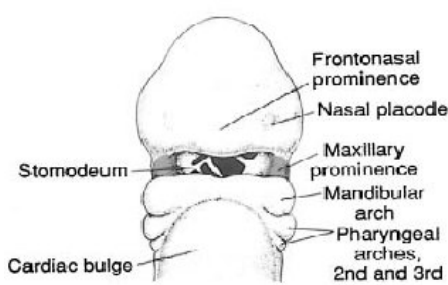
Palate embryology

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.

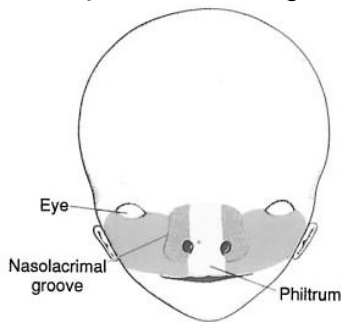


Paired **maxillary prominence** : 1st brachial arch structures

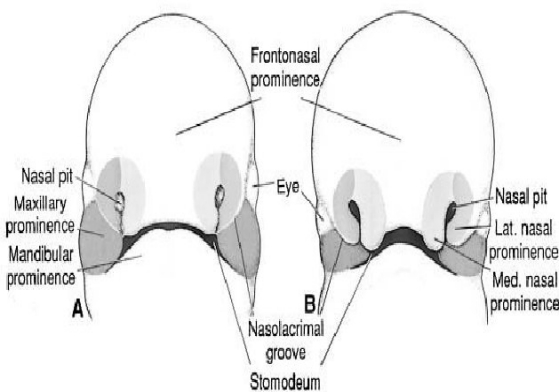
forming sides

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

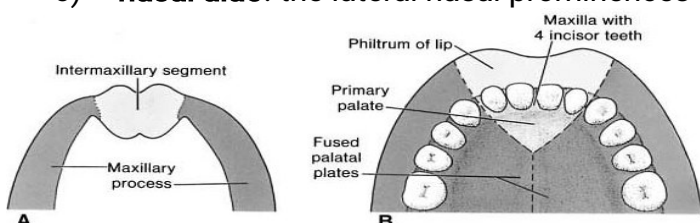


Table 176-1 -- STRUCTURES CONTRIBUTING TO THE FORMATION OF THE FACE

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:

- central maxillary alveolar arch that houses the 4 incisor teeth
- 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 **1week** 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 palcodo	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%.

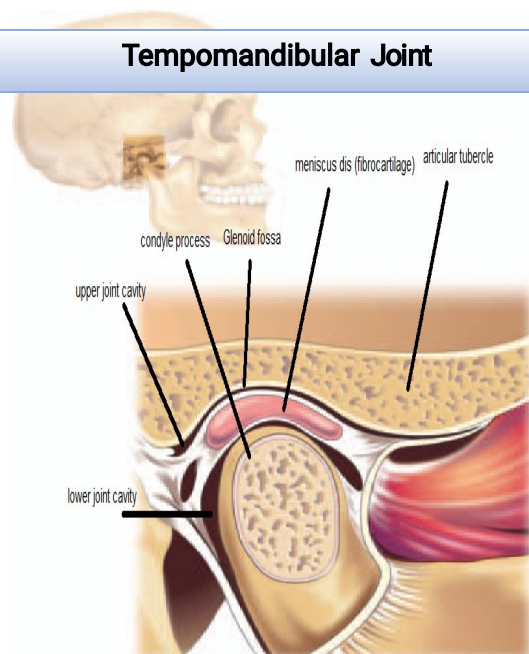
What immunoglobulin is produced by the tonsils? Antigen-specific secretory IgA.

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.

Tempomandibular Joint

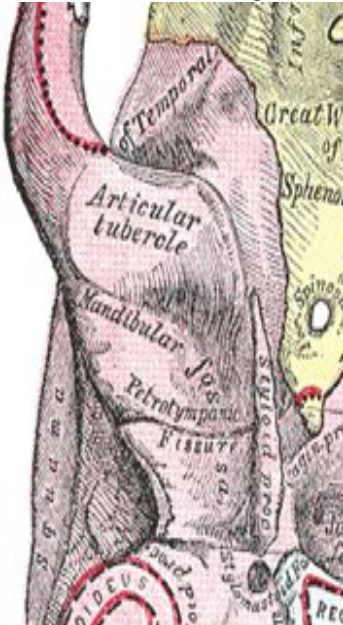


TMJ is **synovial/ginglymoarthrodial** (hinge & sliding/ transverse movement) joint between

squamous part of the temporal part & **mandible**

The TMJ is composed of 3 parts:

1. **Glenoid fossa** of the temporal bone
Anteriorly: articular tubercle
Posteriorly: separated from the tympanic bone by the squamotympanic fissure
Laterally: zygomatic arch
Medially: styloid process
1. **Articular eminence** of the temporal bone
2. **Condylod process** of the mandible
Made of **spongy** bone with **marrow & growth** center
Articular region of the condyle is one of the **most important** mandibular growth sites



The TMJ differs from other joints by the presence of **avascular fibrous tissue** covering the **articulating** surface with an **interposed** meniscus dividing the joint space into an upper & lower compartments

TMJ receives nourishment from the **synovial membrane** which is highly vascularized

Articular disc (meniscus):

Located Between the condyle and temporal bone

Fibrocartilagenous connective tissue that is thicker at the ends

The articular disc is **attached** to the condyle, so when the condyle glides forward and backward, the disc moves with it.

The disc is **avascular & aneural** in the **center** (main load-bearing area) but vascular and innervated at the periphery

Surrounding the articular disc is a fibrous **capsule** that encloses the **entire** joint.

The capsule is divided into **upper** and **lower** cavities by the disc; these cavities are filled with **synovial fluid**.

The **upper** cavity is responsible for **gliding** movement

The **Lower** cavity is responsible for **rotational** movement

Supporting ligament:

temporomandibular ligament is the main supporting ligament

stylomandibular + sphenomandibular ligaments (have no function TMJ articulation)

Blood supply:

Superficial temporal artery; Maxillary artery: deep auricular artery; anterior tympanic artery

Sensory Innervation:

Auriculotemporal nerve

Masseter nerve

Posterior deep temporal nerve

Lateral pterygoid nerve

Costen Syndrome:

Due to TMJ abnormality usually due to impaired bite

Symptoms: Vertigo, Tinnitus, Feeling of Blocked ear, Otagia, Frontal, parietal, occipital pain

Management: NSAIDs, hot compressors, slow exercise of the joint, bite correction by orthodontist

Muscles of TMJ (muscles of mastication):

Deep muscles: Lateral & medial pterygoid muscle:

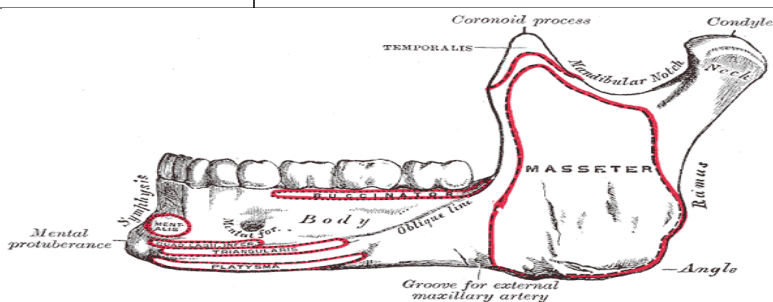
the **superior** part of the **lateral** pterygoid muscle is inserted into the **disk** of **TMJ**

Lateral pterygoid muscle **protract** the mandible

Superficial muscles: Temporalis muscle, Masseter Muscles

Head of masseter	Superficial head (larger part)	Deep Head (smaller part)
Origin	Inferior border of the anterior 2/3 of the zygomatic arch	Inferior border of the posterior 1/3 of the zygomatic arch Medial border of the zygomatic arch
Insertion	Angle of the mandible Inferiolateral part of the mandibular ramus	Coronoid process Superiolateral mandibular ramus
Action	Elevates the mandible	Elevation

Muscle name	Origin	Insertion of the mandible	Direction of vector
Lateral pterygoid	Infratemporal surface of the greater wings Lateral surface of the lateral pterygoid plate	Capsule; TMJ Disc Neck of the condyle	Horizontal-anterior
Temporalis process	Temporalis fossa	Coronoid process	Vertical-superior-posterior
Masseter process	Zygomatic process	Coronoid process Mandibular ramus (superficial fibers: inferiolateral Deep fibers: superiolateral)	Superficial fibers: Oblique anterior Deep fibers: Oblique posterior Total fibers: Vertical superior
Medial pterygoid	Medial surface of the lateral pterygoid the tuberosity of the maxilla & tubercle of the palatine bone	Medial surface of mandibular angle	Oblique anterior



Actions	Muscles
Depression (Open mouth)	Lateral pterygoid Suprahyoid Infrahyoid
Elevation (Close mouth)	Temporalis Masseter Medial pterygoid
Protrusion (Protrude chin)	Masseter (superficial fibres) Lateral pterygoid Medial pterygoid
Retrusion (Retrude chin)	Temporalis Masseter (deep fibres)
Side-to-side movements (grinding and chewing)	Temporalis on same side Pterygoid muscles of opposite side Masseter

Note **unilateral** excision of the **condyle** decrease the ability of the **ipsilateral** lateral pterygoid to open the mouth

This joint allows both gliding & hinge movement:

Gliding movement: in the **upper** compartment between the temporal bone & meniscus

Hinge movement: in the **lower** compartment between meniscus & condyle

What is normal interincisal opening? 40-50 mm.

TONSILLITIS, TONSILLECTOMY AND ADENOIDECTOMY

ANATOMY

Adenoids

formed during 3rd-7th months of embryogenesis

functional and mechanical obstruction of ET with adenoid inflammation play significant role in development of middle ear disease

blood supply:

- o pharyngeal branches of external carotid artery
- o minor branches from internal maxillary and facial arteries

sensation: CN IX and X

three types of surface epithelium:

- o ciliated pseudostratified columnar
- o stratified squamous
- o transitional

at the roof and posterior wall of the nasopharynx

Function in the production of antibodies (IgA, IgG and IgM).

Tonsils

- o situated on the side of the oropharynx between the palatoglossal (anterior tonsil pillar) and palatopharyngeal folds (posterior tonsil pillar).
- o part of Waldeyer's ring (a ring of lymphoid tissue consisting of the adenoids, the palatine tonsils and the lingual tonsils (which are embedded in the posterior third of the tongue). The ring as a whole is thought to have some protective function as a barrier against infection in the first few years of life.
- o The tonsil is enclosed by a fibrous capsule, outside of which is a layer of areolar tissue. This separates the capsule from the pharyngobasilar fascia covering the superior constrictor muscle that forms the tonsil bed

- o may extend down to hypopharynx
- o hyperplasia: abnormal tongue position, tongue-thrust habit, aberrant speech patterns, altered orofacial growth
- o blood supply: **FAIL**: facial, ascending pharyngeal, internal maxillary, lingual arteries
 - upper pole:
 1. internal maxillary artery _ palatine branches _ ascending/descending palatine arteries
 2. ascending pharyngeal artery
 - lower pole:
 1. facial artery _ tonsillar branch (most important) *
 2. dorsal lingual artery
 3. ascending pharyngeal artery
- o Lymphatic drainage:
 - superior deep cervical and jugular lymph nodes
- o No afferent lymphatics: Crypts lined by specialized antigen processing squamous epithelium
- o Sensation: CN IX and branches of lesser palatine nerve via sphenopalatine ganglion
- o histology:
 - Reticular cell epithelium
 - squamous layer
 - antigen presenting cells (M-cells)
 - extrafollicular area
 - T-cells
 - lymphoid follicle
 - Mantle zone (mature B-cells)
 - germinal center (active B cells)

MICROBIOLOGY AND IMMUNOLOGY

Microbiology

acute tonsillitis:

- o classically GABHS (strep. pyogenes)
- o other aerobic and anaerobic bacteria and viruses also implicated
- o H. influenzae, S. aureus, S. pneumoniae, polymicrobial infection, BLPO, anaerobes
- o viruses: initiators of mucosal inflammation, crypt obstruction and ulceration with secondary bacterial infection (e.g. influenza, para-influenza, adenoviruses, enteroviruses and rhinoviruses) may be responsible for tonsillitis in up to 50% of occasions

Immunology

- o tonsils and adenoids involved in both local immunity and in immune surveillance
- o no specific adverse effects with T+A; but still provide immune function
- o tonsils and adenoids should be removed only for clearly defined clinical disease

PATHOGENESIS OF ADENOTONSILLAR DISEASE

- o various theories
- o viral infection with secondary bacterial invasion
- o inflammation and loss of integrity of crypt epithelium (chronic cryptitis and crypt obstruction) stasis of crypt debris and antigen persistence
- o other factors: environment, host factors, widespread use of antibiotics, ecological considerations and diet

CLINICAL CLASSIFICATION OF ADENOIDS AND TONSILS

Adenoids

Acute Adenoiditis:

- o purulent rhinorrhea, nasal obstruction, fever, +/- otitis media or otitis media with effusion (glue ear).
- o loud snoring after episode of acute infection

Recurrent Acute Adenoiditis:

- o 4 or more episodes during 6 month period
- o prophylactic Abx controversial
- o daily low-dose (one half to one third full dose) or episodic prophylaxis (short course with onset of URI)

Chronic Adenoiditis:

- o nasal discharge, malodorous breath, PND, chronic congestion
- o ? role of extraesophageal reflux

Obstructive Adenoid Hyperplasia:

- o chronic nasal obstruction (snoring and obligate mouth breathing), rhinorrhea, hyponasal voice, Intermittent sucking

Tonsils

Acute Tonsillitis:

- o sore throat, fever, dysphagia, tender cervical nodes particularly the jugulodigastric nodes.
- o erythematous tonsils with exudates
- o Pain may radiate to the ears or may occur in the neck due to cervical lymphadenopathy.
- o Swallowing may be painful (odynophagia)
- o voice may sound muffled.
- o There may be trismus and dribbling.
- o Some children may have abdominal pain and occasionally vomiting.
- o The tonsils are found to be hyperaemic on examination with pus and debris in the crypts.

- o Glandular fever, agranulocytosis, leukaemia and diphtheria must always be borne in mind.

Recurrent Acute Tonsillitis:

- o 4-7 episodes in 1 year
- o 5 episodes/year for 2 consecutive years
- o 3 episodes/year for 3 consecutive years

Chronic Tonsillitis

- o no true consensus on definition
- o symptoms > 4 weeks

Obstructive Tonsillar Hyperplasia

- o snoring, dysphagia, voice changes (muffling or hyponasality)
- o unilateral tonsillar hyperplasia should raise suspicion of malignancy

CLINICAL EVALUATION

Adenoids

- o Rare adenoid facies appearance (an open lip posture, prominent upper incisors, a short upper lip a thin nose and a hypoplastic maxilla with a high arched palate)
- o when medical therapy fails, adenoidectomy is the first step in controlling infection in the nose/nasopharynx; about 67% of children show resolution
- o sinusitis may take 2-3 months to clear after adenoidectomy
- o nasality of speech:
 - o sounds that emphasize nasal emission: milkman, Mickey Mouse
 - o loss of appropriate nasality further supports obstructive adenoid hyperplasia
- o lateral x-rays of limited use
- o examination of the nasopharynx with a postnasal mirror
- o allergy evaluation
- o r/o reflux
- o r/o occult or overt submucous cleft palate _ risk of VPI with surgery
 - o occult cleft:
 - o bifid uvula
 - o abnormal movement of palate
 - o midline diastasis of muscles
 - o history of fluid regurgitation through nose
 - o nasopharyngoscopy: if tolerated
 - o loss of midline bulge signifies absence of musculus uvulae _ associated with higher risk of development of VPI postop.

The only reliable means of assessing the size of the adenoid is examination under general anaesthetic,

Tonsils

significant rare complications of GABHS: poststreptococcal glomerulonephritis, rheumatic fever

obstructive tonsillar hyperplasia: snoring, choking and coughing, frequent awakenings, restless sleep, dysphagia, daytime hypersomnolence, behavioural changes, FTT, CHF (rare)

unless significant (+3 or +4) hyperplasia, tonsils should be left in situ (if no history of recurrent or chronic infection)

polysomnography:

important to measure peak end-tidal CO₂ _if elevated then hypoventilation is present

used mostly in child where diagnosis is unclear or who has an unusual risk for surgery

MANAGEMENT OF DISEASES OF THE ADENOIDS AND TONSILS

Adenoids

recurrent or chronic cases treated with antibiotics effective against B-lactamase-producing organisms

hyperplasia _ 6-8 wk course of intranasal steroids

indications for adenoidectomy: AH with chronic nasal obstruction or obligate mouth breathing, OSA, FTT, cor

pulmonale, swallowing abnormalities, speech abnormalities, severe orofacial/dental abnormalities, infection,

recurrent/chronic Chronic rhinosinusitis, recurrent/chronic otitis media with effusion (glue ear), chronic otitis media, neoplasia

contraindications for adenoidectomy:

Recent upper respiratory tract infection.

Cleft palate. The adenoids assist in closure of the nasopharynx from the oropharynx during speech and deglutition. They should be avoided to be removed in a child who has had a cleft palate repair or a congenitally short palate. All children who have a bifid uvula should have a submucous cleft excluded.

overt or submucous cleft palate (relative contraindications)

lateral or superior adenoidectomy may suffice if severe OSA present

neurologic or neuromuscular abnormalities with impaired palatal function

Anemia, disorders of hemostasis (uncontrolled bleeding disorder).

Complications

1. Immediate.

- o Anaesthetic complications.
- o Soft palate damage.
- o Dislocation of the cervical spine. C-spine subluxations from hyperextension
- o Reactionary haemorrhage.

1. **Intermediate.**
 - Secondary haemorrhage.
 - Subluxation of the atlanto-occipital joint (secondary to infection).
1. **Late.**
 - Eustachian tube stenosis.
 - Hypernasal speech (rhinolalia aperta). often improves with time and speech therapy but may be sufficiently severe to require a pharyngoplasty to correct the problem. It is less likely to occur if children with palatal abnormalities are excluded from operation. Some surgeons advocate removal of the upper part of the adenoid mass leaving a lower ridge of adenoid tissue against which the defective palate may continue to make contact.
 - Persistence of symptoms.
 - nasopharyngeal stenosis
 - torticollis (**Grisel's syndrome**)
 - vertebral body decalcification and anterior transverse ligament laxity from infection/inflammation causes pain and torticollis
 - non-traumatic subluxation of the atlanto-axial joint caused by inflammation of the adjacent tissues. This is a rare disease that usually affects children.
 - Progressive throat and neck pain and neck stiffness can be followed by neurologic symptoms such as pain or numbness radiating to arms (radiculopathies).
 - In extreme cases, the condition can lead to quadriplegia and even death from acute respiratory failure.
 - The condition often follows soft tissue inflammation in the neck such as in cases of upper respiratory tract infections, peritonsillar or retropharyngeal abscesses.
 - Post-operative inflammation after certain procedures such as adenoidectomy can also lead to this condition in susceptible individuals such as those with Down's syndrome
 - Diagnosis can be established using plain film x-rays as well as CT scan of the neck/cervical spine.
 - Children with Down's syndrome have inherently lax ligaments making them susceptible to this condition.
 - In select cases, these children may require pre-operative imaging to assess the risk for complications after procedures such as adenoidectomy.
 - Treatment includes anti-inflammatories medications and immobilization of the neck in addition to treatment of the offending infectious cause (if any) with appropriate antibiotics. Early treatment is crucial to prevent long-term sequelae. Surgical fusion may maybe required for residual instability of the joint.
- o The most serious complication is reactionary haemorrhage. This is treated in the same manner as posttonsillectomy haemorrhage. The child should be returned to theatre and an attempt made to localize and diathermy the bleeding point. A postnasal pack should be inserted if necessary.

Tonsils

- acute tonsillitis: first line antibiotics: penicillin
- Complications of acute tonsillitis**
 1. **Local.**
 - Severe swelling causing respiratory obstruction.
 - Abscess formation: Peritonsillar (quinsy), Parapharyngeal, Retropharyngeal.
 - Acute otitis media.
 - Recurrent acute tonsillitis (chronic tonsillitis).
 2. **General.** Septicaemia, Meningitis, Acute rheumatic fever., Acute glomerulonephritis.
- chronic tonsillitis: clavulin or clindamycin for 3-6 weeks obviates need for tonsillectomy in 15% of children
- indications for surgery:
 - o obstruction, TH with chronic nasal obstruction, OSA, FTT, cor pulmonale, swallowing abnormalities, speech abnormalities, severe orofacial/dental abnormalities, infection, recurrent/chronic disease, tonsilolithiasis, recurrent/chronic otitis media, neoplasia
 - o tonsillitis with: -peritonsillar abscess, abscessed cervical nodes, acute airway obstruction, cardiac valve disease persistent
 - o tonsillitis with: persistent sore throat, tender cervical nodes, halitosis,
 - o Previous episodes of peritonsillar abscess (quinsy).
 - o Part of another procedure (UVPP, access to glossopharyngeal nerve or styloid process).
- post-tonsillectomy: 10-day course of amoxicillin to help reduce pain and malodorous breath

PERITONSILLAR ABSCESS

- secondary to infection of peritonsillar salivary gland (**Weber gland**) located between tonsil capsule and muscles of tonsillar fossa
- tx: hydration, pain relief and antibiotics effective against Staph. aureus and oral anaerobes

LINGUAL TONSILS

- extraesophageal reflux is a prime contributor to chronic lingual tonsillitis
- surgical excision rarely necessary

UNILATERAL TONSIL HYPERPLASIA

- suspect unusual infection (Mycobacterium tuberculosis, atypical mycobacteria, fungal organism, or actinomycosis) or neoplasia (squamous cell carcinoma or lymphoma).
- Asymmetry in a patient with recurrent bouts of acute tonsillitis.
- Apparent enlargement (peritonsillar abscess or parapharyngeal mass).

Contraindications for tonsillectomy:

- o Recent episode of tonsillitis or upper respiratory tract infection (within 2 weeks).
- o Bleeding disorder.
- o Oral contraceptives.
- o Cleft palate.
- o During certain epidemics (e.g. polio).

Differential diagnosis of ulceration of the tonsil

A working diagnosis can usually be determined from the history and clinical examination. Investigations include a full blood count, chest radiograph, serological tests and biopsy. Possible causes include:

1. Infection.

- Acute streptococcal tonsillitis.
- Diphtheria.
- Infectious mononucleosis.
- Vincent's angina.

2. Neoplasm.

- Squamous cell carcinoma.
- Lymphoma.
- Salivary gland tumours (adenoid cystic carcinoma or mucoepidermoid tumour).

3. Blood diseases.

- Agranulocytosis.
- Leukaemia.

4. Other causes.

- Aphthous ulceration.
- Behçet's syndrome.
- Acquired immunodeficiency syndrome (AIDS).

CONTROVERSIES IN TONSILLECTOMY, ADENOIDECTOMY, AND TYMPANOSTOMY TUBES

Absolute Indications for Tonsillectomy/Adenoidectomy

- o obstruction unresponsive to antimicrobial therapy and causing FTT
- o suspected malignancy
- o persistent/recurrent tonsillar haemorrhage

obstruction that result in OSA

Relative Indications for Tonsillectomy

- o recurrent acute tonsillitis
- o chronic tonsillitis
- o obstructive tonsils
- o peritonsillar abscess

AAO-HNS - Indications for tonsillectomy

- o 3 or more episodes per year
- o hypertrophy causing malocclusion
- o upper airway obstruction
- o peritonsillar abscess unresponsive to nonsurgical treatment
- o halitosis not responsive to medical management
- o suspected neoplasm

Indications for observation post op

- o age < 3
- o OSA
- o significant associated medical problems
- o neurologic delay
- o craniofacial abnormalities
- o living long distance from hospital
- o questionable caregiver at home
- o known coagulopathy
- o emesis or hemorrhage
- o poor oral intake

Techniques for tonsillectomy:

- o electrocautery, dissection snare
- o intracapsular partial tonsillectomy
 - o uses microdebrider
 - o advantages: effective, less pain, quicker return to normal diet
 - o disadvantages: tonsillar regrowth, increased intraoperative blood loss

Adjuvant treatment

- perioperative antibiotics
 - fewer episodes of fever, offensive odour
 - improved oral intake

- less pain, fewer days to return to normal activity
- perioperative steroids
- decreased post-op emesis
- decreased post-op pulmonary distress, subglottic edema
- pain reduction

Complications

1. Immediate

- o pulmonary edema
- o atlantoaxial subluxations, Anaesthetic reaction, death, Haemorrhage.
 - o Damage to teeth, endotracheal tube injury
 - o Trauma to the posterior pharyngeal wall (careless insertion of the tongue blade).
 - o Dislocation of the temporomandibular joint by over-opening the mouth gag.

2. Early.

- Secondary haemorrhage.
- Haematoma and oedema of the uvula.
- Infection (may lead to secondary haemorrhage).
- Earache (referred pain or acute otitis media).
- Pulmonary complications (pneumonia and lung abscess are rare).
- Subacute bacterial endocarditis (if the patient has a cardiac defect).

3. Late.

- Scarring of the soft palate (limiting mobility and possibly affecting voice).
- Tonsillar remnants (which may be the site of recurrent acute infection).

hemorrhage:

- primary bleeding: < 24H (the vast majority occur within the first 8 hours)
Blood must be cross-matched and an intravenous infusion started. The tonsillar fossae should be inspected to identify a bleeding point. Any clot should be removed if possible and a gauze swab soaked in 1:1000 adrenaline applied to the fossa. If the bleeding continues, or there is any doubt, the patient should be prepared for a second anaesthetic and the bleeding point ligated under general anaesthesia. The second anaesthetic is hazardous and should only be administered by an experienced anaesthetist.
- secondary bleeding: 7-10 days post-op
The infection and haemorrhage will usually settle after treatment with antibiotics (i.v. penicillin and metronidazole or erythromycin). It is unusual for such a patient to have to go back to theatre and when this is necessary the tonsillar fossae are found to be sloughy and friable and it is difficult to locate and ligate any specific bleeding point. It may be necessary to suture the faucial pillars together, or over Kaltostat or a gauze swab which is removed the next day.
- o The most significant complication is haemorrhage, which occurs in approximately 2% of cases.
Most of the deaths associated with tonsillectomy are directly or indirectly associated with this complication. It is essential to ensure adequate haemostasis at the end of the tonsillectomy procedure as blood in the airway at this time may cause laryngeal spasm or can occlude the airway.
The postnasal space should always be checked for a blood clot (the so-called 'coroner's clot').
Patients are nursed in the reverse Trendelenburg position (head down) so that blood trickles out of the mouth rather than being swallowed or aspirated.

Elective Indications for Adenoidectomy

- o obstructive adenoids
- o recurrent/chronic adenoiditis
- o recurrent/chronic sinusitis
- o recurrent acute otitis media and recurrent/chronic otitis media with effusion

Indications for Myringotomy and Placement of Tympanostomy Tubes

- o chronic otitis media with effusion unresponsive to medical management for 3 or more months bilateral or for 6 months or longer unilateral; earlier when significant hearing loss (eg. > 25 dB), speech/language delay, severe retraction pocket, disequilibrium/vertigo, or tinnitus is present
- o recurrent episodes of OME not meeting criteria for chronic disease, but cumulative duration excessive (eg 6 of 12 months)
- o recurrent AOM, especially when ABx prophylaxis fails to reduce the frequency, severity and duration of attacks; minimum frequency of three or more episodes in 6 months or four or more episodes in 12 months with one being recent
- o ETD, when persistent or recurrent signs and symptoms, disequilibrium/vertigo, tinnitus, or a severe retraction pocket, unrelieved by medical treatment; patulous eustachian tube; and during hypobaric treatment in patients with a prior history of otitis media/eustachian tube dysfunction, or when eustachian tube dysfunction develops during treatments
- o tympanoplasty when eustachian tube function is poor
- o suppurative complication, present or suspected

Tubes Only vs Tubes and Adenoidectomy

- o Recommendations (Bluestone): first surgical procedure for chronic OME unresponsive to medical treatment is only tubes and withhold adenoidectomy unless child meets criteria for this procedure.
- o if COME recurs following spontaneous extrusion of tubes, then recommend adenoidectomy irrespective of size of the adenoids and a myringotomy and aspiration of the middle-ear effusion

RANDOMIZED CONTROL TRIALS FOR

TONSILLECTOMY, ADENOIDECTOMY AND TYMPANOSTOMY TUBES

Evidence from RCTs

- o tonsillectomy in children who meet the frequency severity and characteristics of episodes will be more effective than not performing this operation
- o adenoidectomy can reduce the frequency of recurrent acute otitis media in children who had had tympanostomy tubes previously inserted, but continued to experience recurrent attacks after the tubes had extruded
- o lack of efficacy of adenoidectomy, +/- tonsillectomy, for children who had never received tympanostomy tubes in the past
- o adenoidectomy is efficacious in children who had COME, whether or not tympanostomy tubes had been previously placed
- o tympanostomy tube placement without addition of adenoidectomy is effective in the management of both COME and recurrent AOM
- o myringotomy alone for COME no more effective than no surgery

No RCT trials to date

- o addressing efficacy and safety of tonsillectomy for chronic tonsillitis
 - o current recommendations:
 - o trial of antimicrobial agent may be beneficial in some children prior to recommending surgical interventions, especially in infants and very young children, when the operation has come increased risk; the clinician may be able to delay surgery until child grows older, if the antibiotic treatment is successful
- o peritonsillar abscess as an indication for tonsillectomy also has not been evaluated by a prospective randomized clinical trial
- o no prospective randomized clinical trials have demonstrated that adenoidectomy is effective in reducing the morbidity of sinusitis in children. Benefit of adenoidectomy remains uncertain
- o even though these studies are not available, adenoidectomy should still be considered on an individualized basis for chronic sinusitis