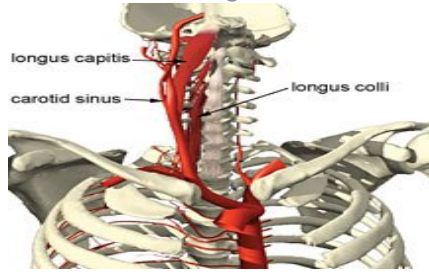


Common Carotid Artery:

Origin: Rt: Brachiocephalic artery, Lt: Aortic arch [has no branches]

Surface marking: Sternoclavicular joint; Tubercle of lateral process of C6 (Chassaignac's tubercle)



Bifurcation level: Greater cornu of the hyoid

Enclosed with

Carotid sheath which contains also vagus nerve & internal jugular vein

Internal Jugular vein is located lateral & posterior to the carotid artery

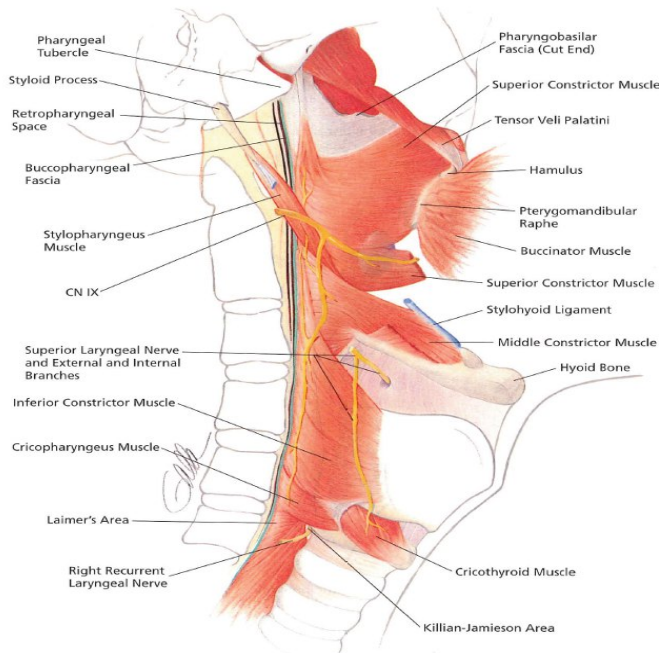
Vagus Nerve: in between

Covered by: Sternocleidomastoid muscle; Infrahyoid muscles

Relation:

Anteromedially: Thyroid gland; Larynx; Trachea; Inferior constrictor muscle

Posteriorly: Longus colli & capitis, Cervical sympathetic trunk, Anterior tubercle of C4-7 vertebrae, Vertebral artery



Internal and External Carotid artery:

Carotid sinus:

Dilation at point of division the vessels

may be confined to origin of **internal** carotid artery

histologically, the media is thinner & adventitia thicker

stretch receptors are innervated by **glossopharyngeal nerve** and they are the main baroreceptors

Carotid Body

located **deep** to the bifurcation

reddish-brown in color, measures 6*3mm

features glomus cells containing dopamine

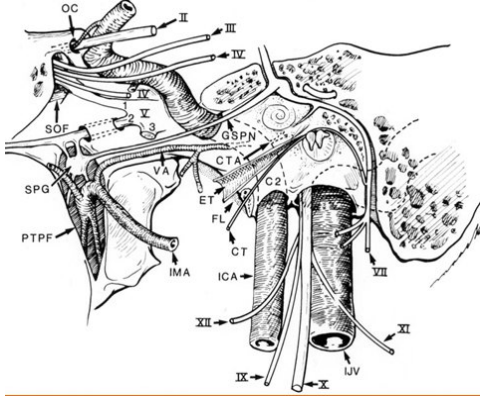
innervated by **glossopharyngeal nerve**

Internal Carotid artery

The internal carotid artery enters the skull base:

Medial to: Glenoid fossa, Styloid process, Stylomastoid foramen

Posterior to: Sphenoid sinus



Posteriomedial to: Eustachian tube

Anterior to: jugular foramen

becomes encased in the petrous portion of the temporal bone, positioned:

Posterior to the ET & sphenoid spine

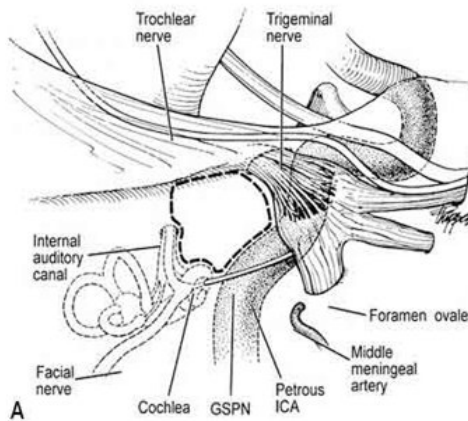
Medial to Glenoid fossa

Anterior to styloid process

The **spine** of the sphenoid bone is the **most** consistent and **reliable** extracranial landmark for locating **ICA** where it enters the petrous portion of the temporal bone

Vertical segment: anterior to the hypotympanum, Gives carototympanic branches to the middle ear cavity

Horizontal segment



when it passes medially to the osseous eustachian tube then artery bends in an anteromedial direction to form the horizontal segment.

It runs under the gasserian ganglion and separated from it by thin bony plate

It is not uncommon for the osseous eustachian tube to be dehiscant where it is in contact with the internal carotid artery.

The GSPN is the most reliable intracranial landmark for the petrous portion of the internal carotid artery

The course of the GSPN is directly above and in the same direction as the horizontal portion of the petrous portion of the internal carotid artery.

2nd Vertical segment:

turns vertically across the foramen lacerum to pass alongside the lateral wall of the sphenoidal sinus & medial wall of the cavernous sinus.

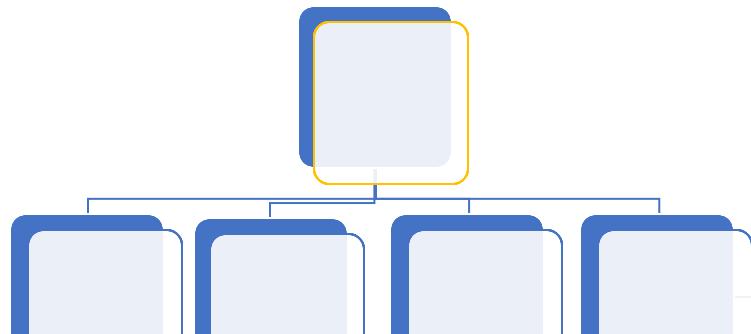
The impression of the internal carotid artery within the lateral wall of the sinus usually can be seen with endoscopy.

The internal carotid artery traverses the cavernous venous sinus just before entering the intracranial space

Branches of external carotid artery

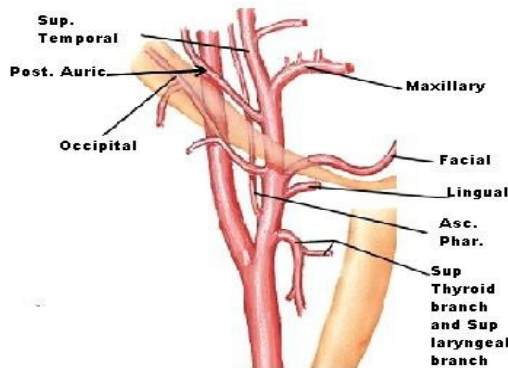
External carotid branches in sequence: **[SALFO PIS]**

1. Superior thyroid a
2. Ascending pharyngeal a
3. Lingual a
4. Facial a
5. Occipital a



6. Posterior auricular a
 7. Internal Maxillary a
 8. Superficial temporal a
- 1-5 branches in the carotid triangle
the terminal branch of carotid artery at the level of mandibular condyle branch into mandibular & temporal

Superior thyroid



Located in the **muscular** triangle + **carotid** triangle
Supplies the area between the **thyroid** and **hyoid** bone
Arise **below** the hyoid bone



Ascending pharyngeal

The ascending pharyngeal artery is the **smallest** branch given off from the external carotid artery. It arises from the **back** part of that artery about one-half of an inch above the bifurcation of the common carotid artery.
It ascends between the internal carotid artery and the side of the pharynx and beneath the stylopharyngeus muscle and the glossopharyngeal nerve to the **base** of the skull.
They also **communicate** through canals with the **ascending palatine artery** from the anterior facial arteries off of the external carotid
It is divided into:

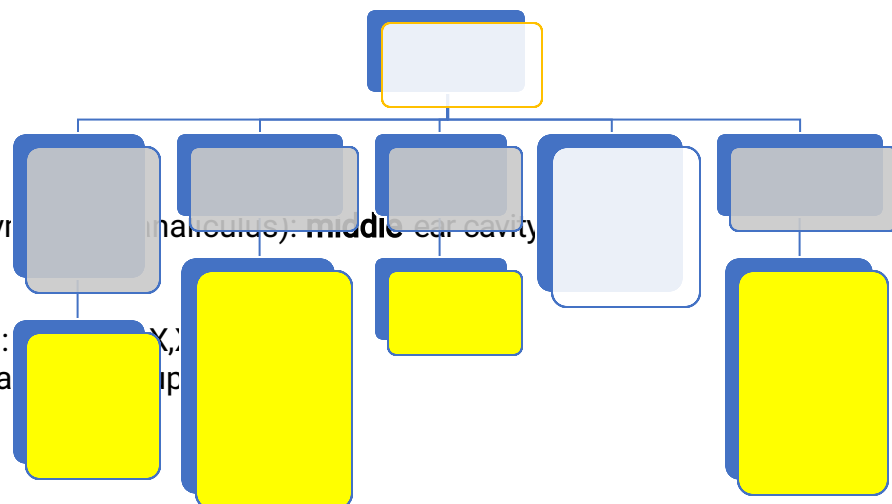
Pharyngeal trunk (extracranial):

- Superior pharyngeal artery
- Middle pharyngeal artery
- Inferior pharyngeal artery
- Eustachian tube artery

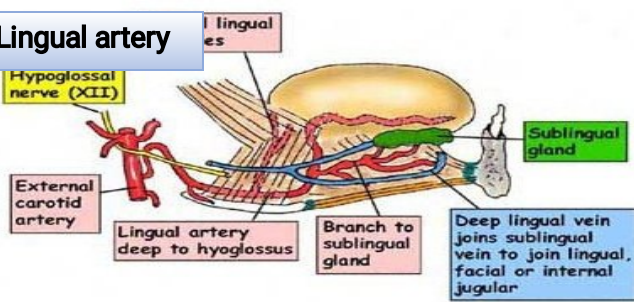
Inferior tympanic artery (via inferior tympanic foramen): middle ear cavity

Neurocranial trunk (Intracranial):

- Caval branch
- Jugular branch (via dorello's canal): X, jugular foramen
- Hypoglossal branch (via hypoglossal foramen): XII, hypoglossal foramen



Lingual artery

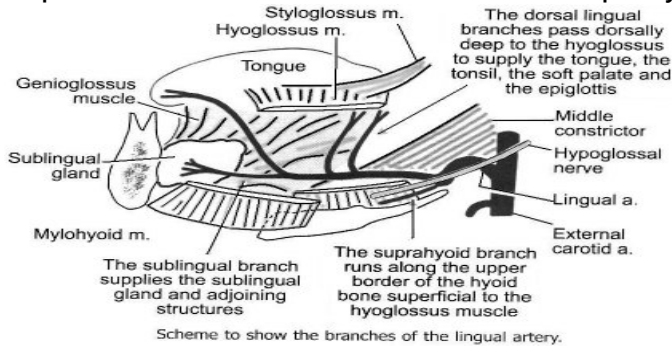


The lingual artery arises from the external carotid artery opposite the tip of the **greater cornu** of the hyoid bone.

1st part of the artery:

lies in the **carotid triangle**

Superficial to the middle constrictor of the pharynx.



It forms a characteristic **upward** loop which is

crossed by the hypoglossal nerve.

The lingual loop permits free movements of the hyoid.

2nd part of the artery:

lies between the **hyoglossus muscle** & **middle constrictor**

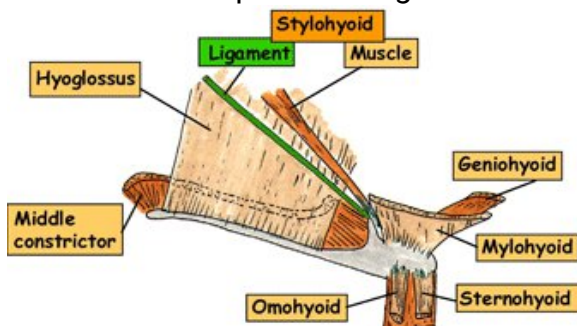
hypoglossus muscle which separates it from the hypoglossal nerve.

Dorsalis branch arise from this part

3rd /deep part/arteria profunda linguae:

run upwards along the **anterior** margin of the hyoglossus;

Forward to the tip of the tongue.



Lies between the genioglossus muscle & **mylohyoid**

muscle.

Branches: deep lingual + sublingual artery

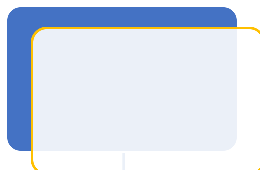
So middle constrictor+ genioglossus are **deep** to the lingual artery

Hypoglossus + mylohyoid are **superficial** to the lingual artery

Glossopharyngeal nerve lies **medial** to the **lingual artery**

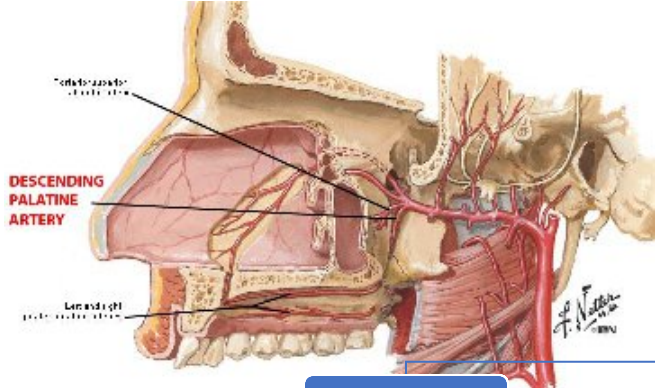
Note that the lingual nerve is deep to the hypoglossal nerve

Terminal branch of the lingual artery is the deep lingual artery



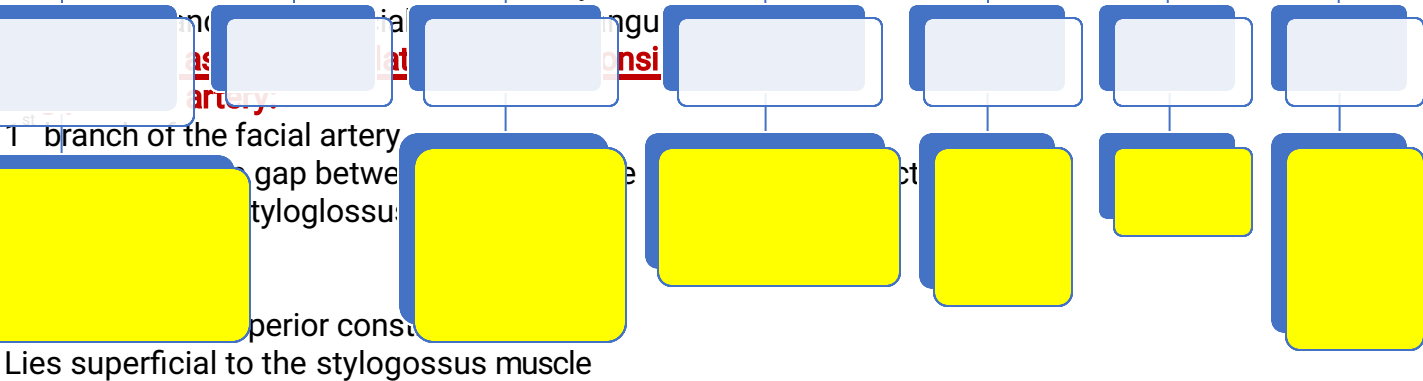
Facial artery

Pathway of the facial artery



the submandibular salivary gland, passes upward medially along the lateral side of the face, over the zygomatic bone, and terminates at the medial canthus of the eye.

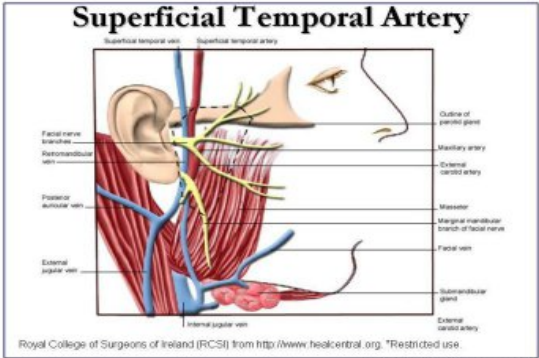
Re
As



Lies superficial to the styloglossus muscle

Occipital

The **occipital artery** arises from the external carotid artery **opposite** the facial artery



It is covered by the posterior belly of the Digastricus and the Stylohyoideus, and the hypoglossal nerve winds around it from behind forward

Branches

Sternocleidomastoid branches

Auricular branch

Mastoid branch

Descending branches

Occipital branches

Posterior Auricular

The **posterior auricular artery** arises from the external carotid artery, **above** the Digastric muscle and Stylohyoid muscle, **opposite** the **apex** of the styloid process

The posterior auricular artery supplies blood to the scalp **posterior to the auricle** and to the auricle itself.

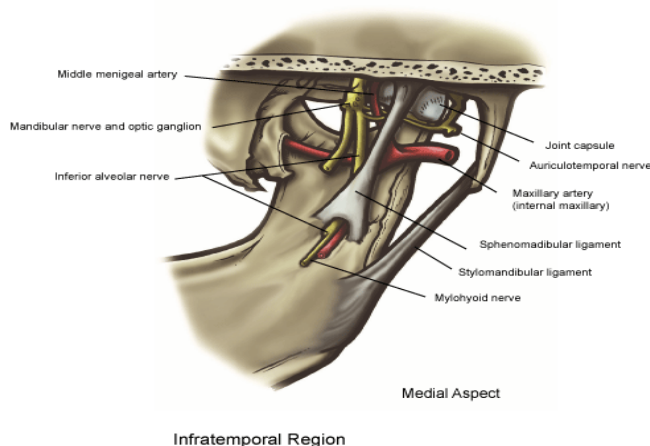
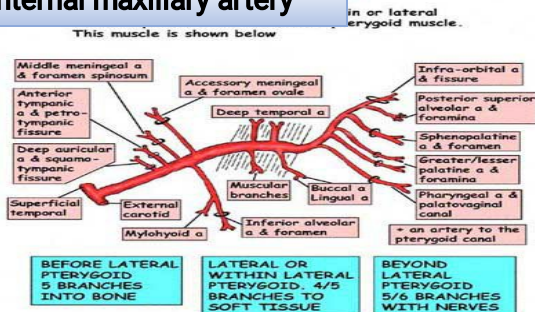
Branches: stylomastoid branch which becomes the **posterior tympanic artery** which gives 2 branches:

- 1- **stapedius branch**
- 2- **mastoid branch**

Superficial temporal

Its pulse is palpable superior to the zygomatic arch, **anterior** and **superior** to the tragus.

Internal maxillary artery



It passes forward either lateral **or** medial to the pterygoid muscles

If it takes the medial course, the artery then turns laterally again to emerge between the 2 heads of the muscle

The artery is divided into **3** divisions by the **lateral pterygoid muscle** with 5 branches coming from each part:

Mandibular part: to bone

Pterygoid part: to soft tissue

Pterygopalatine part: with the nerves

The maxillary artery enters the Infratemporal fossa between the sphenomandibular* ligament & the neck of mandible inferior & parallel to Auriculotemporal branch

Then goes to the Pterygopalatine fossa via the Pterygomaxillary Fissure

* **Sphenomandibular ligament**: extends from the sphenoid **spine** to the **angle** of the mandible

Table 32.7

Branches of the **maxillary artery**

Part	Artery	Distribution
Mandibular part	① Inferior alveolar a.	Mandible, teeth, gingiva
	② Anterior tympanic a.	Tympanic cavity
	③ Deep auricular a.	Temporomandibular joint, external auditory canal
	④ Middle meningeal a.	Calvaria, dura, anterior and middle cranial fossae
Pterygoid part	⑤ Masseteric a.	Masseter muscle
	⑥ Deep temporal aa.	Temporalis muscle
	⑦ Pterygoid branches	Pterygoid muscles
	⑧ Buccal a.	Buccal mucosa
Pterygopalatine part	⑨ Descending palatine a.	Greater palatine a. Lesser palatine a.
		Hard palate
	⑩ Posterosuperior alveolar a.	Soft palate, palatine tonsil, pharyngeal wall
	⑪ Infraorbital a.	Maxillary molars, maxillary sinus, gingiva
	⑫ A. of pterygoid canal	Maxillary alveoli
	⑬ Sphenopalatine a.	Lateral posterior nasal aa. Posterior septal branches
		Lateral wall of nasal cavity, choanae Nasal septum

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The 1st part of the maxillary artery gives off 5 branches **to bones**:

1. **Deep auricular a**: Supply the external auditory canal
2. **Anterior tympanic**: Supply the middle ear cavity
3. **Middle Meningeal a**:
Passes between the sphenomandibular ligament & lateral pterygoid muscle
Between the **2 roots** of Auriculotemporal nerve
Give branch to:
1- superior tympanic artery which goes with lesser petrosal nerve through superior tympanic canaliculus
2- superficial petrosal a which goes with greater petrosal N through the facial hiatus
1. **Inferior alveolar artery**:
Passes down 2 join the inferior alveolar nerve 2 enter the Mandibular foramen
Give mylohyoid artery before the entry into the Mandibular foramen

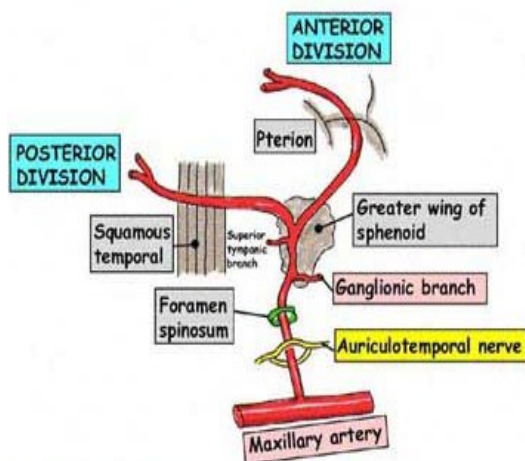
1. Accessory Meningeal a

The 2nd part of the maxillary artery gives off **5** branches to the **soft tissue (muscles of mastication)**:

1. **Anterior Deep Temporalis muscle**: run deep to the Temporalis fascia and superficial to the skull
2. **Posterior Deep Temporalis muscle**
3. **Masseteric**: masseter muscles
4. **Lateral & medial pterygoid muscles**
5. **Buccal artery & lingual artery**

The 3rd part of the artery:

Moves through the **Pterygomaxillary fissure** from the Infratemporal fossa into the Pterygopalatine fossa



except the **superior posterior alveolar branch** which branch in the Infratemporal fossa
branches **go with Nerves**

1. **Posterior superior alveolar artery:**

The only branch that does not divide in the Pterygopalatine fossa
Goes through the posterior superior alveolar foramen
Give supply to : gum, molar, premolar, maxillary sinus

1. **Infra-orbital artery:**

terminal branch of the maxillary artery
Goes through the infratemporal **fissure**
supply the floor of the orbit & lateral aspect of the nose

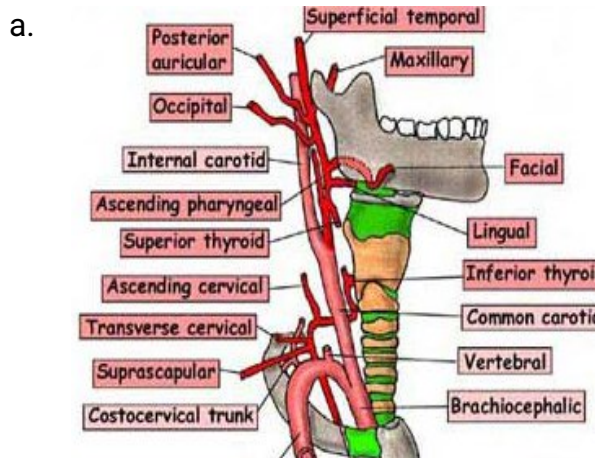
1. **Sphenopalatine artery**

goes through the sphenopalatine foramen
emerge in the nose posterior to the posterior end of the middle turbinate
gives intranasally the following branches:

- 1) **posterior superior lateral nasal branches** : supply the posterior superior part of the **lateral** wall of the nasal cavity
- 2) **posterior superior septal/medial branch** :
supply the posterior superior part of the **septum**
continues ant along the septum to enter the hard palate via incisive canal

1. **Descending palatine artery:**

go through the palatine canal
divide into Greater & lesser palatine artery and emerge from the greater & lesser palatine foramen



greater palatine artery:

emerge from the greater palatine artery
pass anterior to the incisive foramen
supply the hard palate gingival, mucosa, glands
anastomose with sphenopalatine artery at the incisive canal

- a. **lesser palatine artery supply:** soft palate, tonsil

1. **Vidian artery**

goes through the vidian/pterygoid **canal** to supply the vidian nerve

supply the auditory tube + sphenoid sinus

1. **Pharyngeal Artery**

Goes through palatovaginal **Canal**

Supply the auditory tube + **Nasopharynx**

Note:

The **maxillary artery** after it gives the **infra-orbital artery** & **posterior superior alveolar artery** is enters the **pterygomandibular fissure**

The name of the maxillary artery after it enters the pterygomandibular artery is **sphenoplatine artery**

Subclavian artery

Scalenus anterior muscle divides the **Subclavian artery** into **3** divisions

Each Subclavian artery:

enters the neck behind the sternoclavicular joint

ends by becoming the axillary artery

origin:

left side: aortic arch

right side: brachiocephalic trunk

branches:

First Part:

Vertebral artery

Thyrocervical trunk:

- o Inferior thyroid artery
- o Transverse cervical artery
- o **Suprascapular** artery

Internal thoracic artery

Second Part:

Costocervical trunk

Dorsal scapular artery

Relations: From anterior to Posterior:

Subclavian **vein**: **anteroir** scalenus muscle: Subclavian **artery**: brachial **plexus**: **middle** scalenus muscle

Vagus nerve + Phrenic nerve lies between the **1st part of the Subclavian artery & Subclavian vein**

Phrenic nerve is then becomes **superficial to** scalenus **anterior**

The subclavian artery gives rise to the thyrocervical trunk. The transverse cervical and suprascapular arteries usually course **laterally** over the surface of the **phrenic** nerve. This relation allows identification of these structures

Vertebral Artery Triangle : an important triangle extending from the **root** of the neck

Borders:

scalenus **anterior** muscle

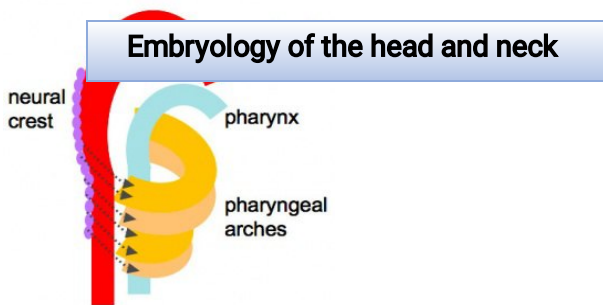
longus colli muscle

superior aspect of the 1st part of the subclavian artery

(Pre)Vertebral Fascia surrounds this area.

Contents of the triangle of the vertebral artery:

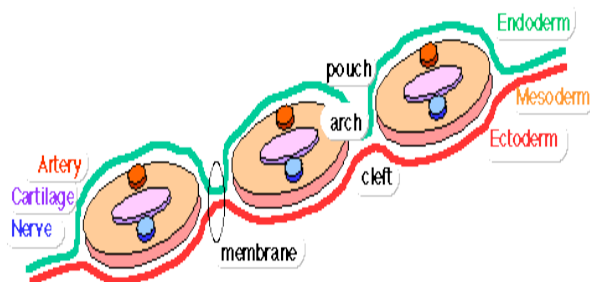
Vertebral artery (from the first division of the Subclavian artery) and vein ascend to the **apex** of triangle and enter the foramen transversarium of **C6**.



the 1st 8th weeks constitute the period of **greatest** embryonic development of the head & neck

Pharyngeal/Branchial apparatus:

1. Pharyngeal **arch** (#6)
- 2.



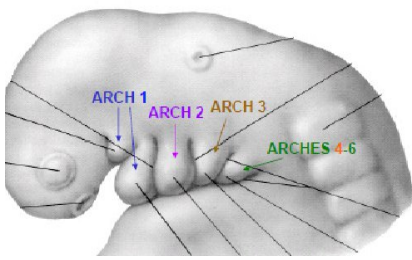
Pharyngeal **cleft** (#6)

3. Pharyngeal **pouch** (#6)
4. Pharyngeal **membrane**

Pharyngeal apparatus consists of all **3** trilaminar embryo layers:

1. Cleft (externally): Ectoderm
2. Arch: Mesoderm & neural crest
3. Pouch (internally): endoderm

1- **The pharyngeal / branchial arch:**



Series of **externally** visible tissue bands lying under the early brain over the **ventrolateral** surface of the head and neck region

Starts to form in the 4th week

In humans, 6 arches form:

The 5th arch do not form or degenerates rapidly (1,2,3,4 and 6)

The 4th and 6th arch fuses

So only four are **externally** visible on the embryo.

Each arch has own Cartilage, Nerve, muscle, artery (= **aortic arch artery**)

The nerves are located anterior to the arteries except in the 5th or it is called the 6th cartilage

Each nerve innervates structures derived from its associated arch

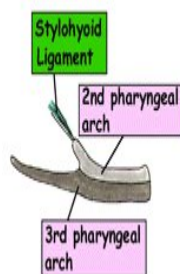
1. Arch 1 (Mandibular Arch) has 2 prominences:

[post-trematic nerve: mandibular V3, pre-trematic nerve: Corda tympani VII]

Maxillary process: forms maxilla, zygomatic process, squamous part temporal bone and secondary palate

mandibular process: forms lower jaw and anterior 2/3 of the tongue; contains Meckel's cartilage

o



Meckel's cartilage:

upper part: the malleus (head & neck), incus (body & short process)

middle part: anterior malleolar ligament and sphenomandibular ligament

lower part: mandible

1. Arch 2 (Hyoid Arch)

[post-trematic nerve: Facial VII, pre-trematic nerve: Jacobson's nerve (of glossopharyngeal IX)]

Lesser horn+ upper part of the hyoid bone

Reichert's cartilage (manubrium of malleus, long process & lenticular process incus, **stapes except the vestibular face of the footplate** (it is derived from the otic capsule, hence otosclerosis a disease of otic capsule will affect primarily the footplate)

The second (hyoid) arch enlarges and grows so that by the 6th week it will overlap the 3rd, 4th and 6th arches and covers them.

o It fuses with the neck skin(C2) burying the ectoderm of the 3rd, 4th & 6th arch

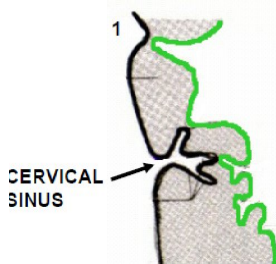
o The space between the 2nd arch and the other 3 arches is called the cervical sinus of his.

o The cervical sinus is lined by ectoderm.

o There is not normally communication with the pharyngeal lumen

It can at a later time, enlarge and form cysts that are called cervical cysts

1.



CERVICAL SINUS

Arch 3:

[post-trematic nerve: glossopharyngeal IX]

Greater horn + lower part of the hyoid bone

1. Arch 4: Forms the thyroid cartilage + **uniform** cartilage
2. Arch 6: Forms the rest of the larynx cartilages

Note:

All Ossicles + the **inner** ear **except** the endolymphatic sac are adult size at birth

The **inner** ear develops from **ectoderm** & reach adult size at **4th** fetal month

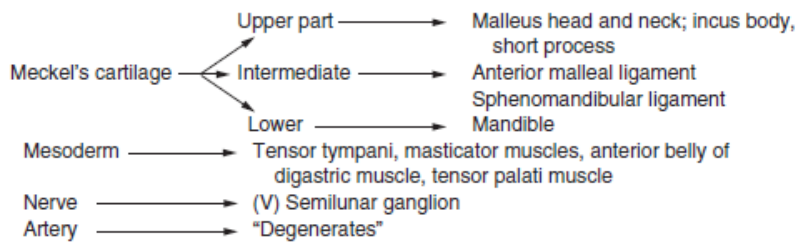
The endolymphatic sac is the 1st to appear & last one to stop growing

XII is **caudal** to **all** pharyngeal arches

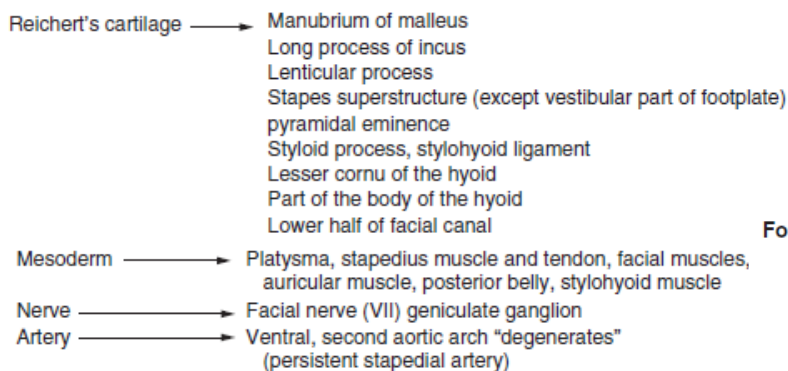
SCM is derived from the cervical somites (posterior & inferior to the pharyngeal arch)

ARCHES

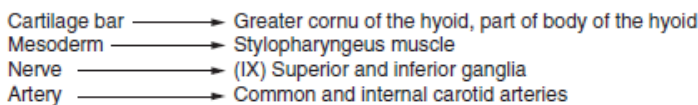
First Arch (Mandibular Arch), Meckel's Cartilage



Second Arch (Hyoid Arch)



Third Arch



Note:

the 1st arch is innervated by 2nd (maxillary) & 3rd divisions (Mandibular) of the trigeminal nerve; gives anterior belly M.

the 2nd arch gives rise to platysma, Stapedius, facial muscles, auricular muscles (anterior, posterior and superior), stylohyoid, posterior belly of digastric M.

6th is innervated by the **recurrent** laryngeal nerve of the vagus nerve (motor fibers from **cranial accessory** nerve)

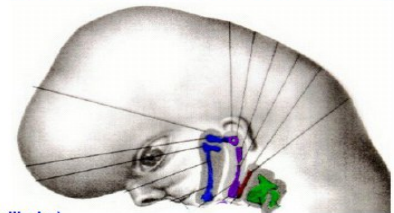
Pharyngeal arch ectoderm derivatives:

The ectoderm of the 1st arch:

the epithelium lining the buccal cavity, salivary glands, enamel of the teeth, Epithelium of the **body** of the tongue

The **external** surface ectoderm of the 1st arch gives rise to the epithelium over:

BRANCHIAL ARCH CARTILAGES



I First (Mandibular) Arch -

1. Malleus
2. Incus
3. Ant. Ligament Of malleus
4. Sphenomandibular ligament

II Second (Hyoid) Arch

1. Stapes
2. Styloid Process
3. Stylohyoid Ligament
4. Lesser horn, Upper 1/2 body Hyoid

III Third Arch -

- Lower 1/2 Body, Greater Horn Of hyoid

IV Fourth (Sixth) Arch -

- Cartilages Of larynx

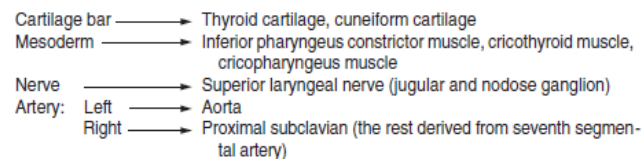
BRANCHIAL ARCH NERVES

Muscles of Arches are Innervated by Cranial Nerves

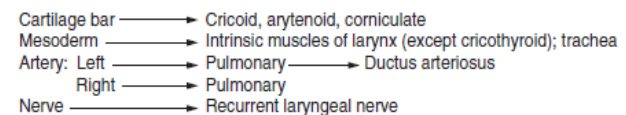


- 1) First Arch - Trigeminal (V)
- 2) Second Arch - Facial (VII)
- 3) Third Arch - Glossopharyngeal (IX)
- 4) Fourth Arch - Vagus

Fourth Arch



Fifth Arch



the maxilla, mandible, to some epithelium of the auricle

The ectoderm of the 2nd arch forms:

Epithelium of part of the auricle, Epithelium of external auditory canal, some of the epithelium behind the ear

The ectoderm of the 3rd and 4th arches:

mostly covered by the 2nd arch ectoderm.

What remains can be found around the external ear (innervated by cranial nerve 9), and the external auditory meatus, external tympanic membrane and back of the ear (innervated by cranial nerve 10).

Pharyngeal arch artery

There are 2 dorsal & 2 ventral aortas in **early** embryonic life, The 2 **ventral** aorta fuse **completely**, The 2 **dorsal** aorta fuse **caudally**, The **Fate** of the pharyngeal arch artery:

1st aortic arch: Contributions are thought to persist as **maxillary artery**

2nd aortic arches: The 2nd arch artery has an upper branch which becomes the **Stapedius** artery the later on degenerates during late fetal period but can persist

3rd aortic arch: Stem of the **internal** carotid artery (and part of the common carotid artery).

4th aortic: On the **right**: the **proximal** subclavian artery; On the **left**: portion of the **arch** of the aorta.

6th aortic arch:

On the **right**: pulmonary arteries

On the **lt**: pulmonary arteries & **ductus arteriosus** in neonate/ligamentum arteriosum in adult

Note: if the Rt 4th artery degenerates the Rt subclavian will arise from the dorsal aorta

Persistent **ligamentum arteriosus** is an abnormality of the **4th** arch

Sinus derived from	2 nd brachial arch	3 rd arch	Rt 4 th Arch	Lt 4 th Arch
Relation to the glossopharyngeal N/ superior laryngeal N	Superficial to it	Deep to it	Inferior to superior laryngeal nerve	Inferior to superior laryngeal nerve
Relation to hypoglossal N	Superficial to it	Superficial to it	Lateral to it	Lateral to it
Internal carotid artery/Subclavian/ aortic arch	Superficial to it	Deep to it	Deep to subclavian artery	Medial to ligamentum arteriosum & aortic arch
Peirce	The middle constrictor deep to stylohyoid ligament	Thyrohyoid membrane above the internal branch of superior laryngeal nerve entry		
Opens into	Tonsillar fossa	Upper part of Pyriform fossa	Lower part of pyriform fossa	Lower part of the pyriform fossa

1- Pharyngeal cleft:

ectodermal cleft between adjacent arches

the ectoderm of the 1st branchial groove forms the lining of the external auditory meatus and the external surface of the TM

the mesenchyme of 1st and 2nd arches which are located on either side of this pharyngeal groove will also give rise to the auricle

Collaural fistula:

o 1st brachial cleft defect

o Passes between the external auditory canal & the skin of the neck (between the neck of the mandible & SCM)

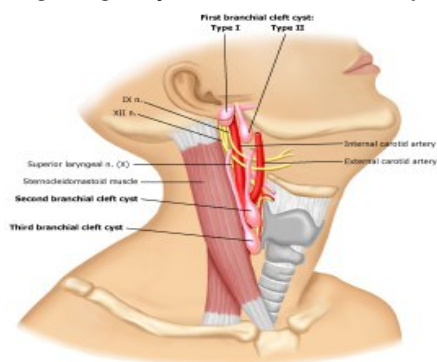
1- Pharyngeal pouch:

out-pocketing from rostral foregut between adjacent arches internally separates each arch, has:

ventral & dorsal wings; Derivatives:

Pouch	Dorsal	Ventral
Pouch 1	Tubotympanic recess (Eustachian tube + tympanic cavity)	Obliterated
Pouch 2	Dorsal pharyngeal wall + nasopharynx + adenoid + Contributes to the middle ear cavity	Supratonsillar fossa + Tonsils
Pouch 3	Inferior parathyroid gland	Thymus
Pouch 4	Superior parathyroid gland	C-cells (Calcitonin)

The ET develops from the 1st brachial pouch between the 2nd pharyngeal arch & pharynx
The 2nd pouch derivatives are innervated by glossopharyngeal nerve
The mastoid air cells develop as expansion of the tympanic cavity
DiGeorge syndrome: 3rd + 4th pouch fail to differentiate into thyroid & parathyroid glands



As these out pocketing pouches develop into glandular elements, their connection with the pharyngeal lumen (referred to as pharyngobranchial duct) become obliterated

If the obliteration fails to occur a branchial cyst/sinus is formed
the branchial sinuses & fistula present at birth

branchial cysts:

- o present in early adult hood (20-30 yr)
- o branchial cyst are rarely associated with internal opening
- o lined with squamous epithelium & have lymphoid tissue lining their walls

Pharyngeal pouch anomalies:

- o complete branchial fistulas: fistula opens to both the external surface and the pharynx (above the tonsil) connecting these structures
- o incomplete branchial fistulas: open externally on the anterolateral surface of the neck or internally to the pharynx by way of a ruptured pharyngeal membrane

note the course of the cyst is deep to its own structures

the most common internal fistula is the 2nd

Cutaneous opening is always anterior to the SCM

Tracts are always subplatysma

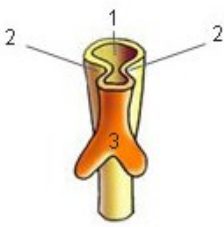
Deep to the external carotid artery

- 1- Pharyngeal membrane: contact area of the ectoderm (of the pharyngeal cleft) & endoderm (of pharyngeal pouch)
only 1st pair persist as tympanic membrane

STRUCTURES DERIVED FROM BRANCHIAL ARCHES AND POUCHES

ARCH/NERVE	SKELETAL	LIGAMENTS	MUSCLES	POUCH
First (V)	1) Malleus 2) Incus	1) Ant. ligament of malleus 2) Sphenomandibular ligament	1) Muscles of Mastication 2) Tensor tympani 3) Tensor palati 4) Mylohyoid 5) Ant. belly of Digastric	1) Auditory tube 2) Tympanic cavity
Second (VII)	1) Stapes 2) Styloid process 3) Hyoid bone - lesser horn, upper half of body	Stylohyoid ligament	1) Muscles of Facial Expression 2) Stapedius 3) Stylohyoid 4) Post. belly of Digastric	Lining (crypts) of palatine tonsils
Third (IX)	Hyoid bone - greater horn, lower half of body	-----	Stylopharyngeus	1) Inferior parathyroid gland 2) Thymus
Fourth (X)	Cartilages of Larynx	-----	1) All muscles of Larynx 2) All muscles of Pharynx (except Stylopharyngeus) 3) All muscles of Soft Palate (except Tensor palati)	1) Superior parathyroid gland 2) C-cells of Thyroid
Sixth (XI)	-----	-----	1) Sternocleidomastoid 2) Trapezius	-----

Note: First Branchial Groove (Cleft) becomes External Auditory Meatus
First Branchial Membrane becomes Tympanic Membrane



Larynx embryology

The entire respiratory system is an outgrowth of the primitive pharynx

So Any congenital malformation of the pharynx and oesophagus is always associated with certain degree of malformation of larynx and trachea

The most common TEF is atresia of the esophagus with distal anastomosis of the esophagus with the trachea

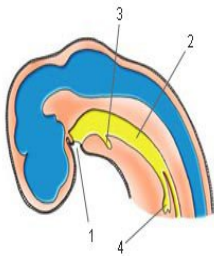
The **lower** respiratory system (larynx, trachea, bronchus) begins its development:

during the **4th** week as **respiratory** diverticulum **caudal** to the **hypobranchial** eminence

respiratory diverticulum: **evagination** (outgrowth) of the **ventral** wall of the **foregut** (pharynx)

The diverticulum elongates in the **caudal** direction and soon becomes separated from the foregut by the **esophagotracheal septum**

The **cranial** end of the tube forms the larynx and trachea and the caudal end the bronchi and lungs



The **endodermal** lining of the respiratory diverticulum gives rise to the **epithelial** lining of the larynx, trachea, bronchi and alveoli

Mesoderm of the pharyngeal arch **4 + 6th** give rise the **cartilaginous** and **muscular** components of the trachea and lungs:

4th branchial arch give rise to :

Supraglottic therefore, related to the development of the oral cavity and oropharynx

cartilage: thyroid cartilage + **coniform** cartilage

nerve: **superior** laryngeal branch of vagus nerve

muscles: cricothyroid m

6th branchial arch:

Glottis and subglottis

Cartilage: The rest of the laryngeal cartilage

Nerve: **recurrent** laryngeal nerve of the vagus nerve

Muscles: rest of intrinsic muscles

During the **6th** week the laryngeal lumen becomes **obliterated** by the mesenchyme

During the **10th** week **recanalization** occurs

Details of larynx cartilage development:

Arytenoid swellings: appear on **both** sides of the **tracheobronchial** diverticulum and, as they enlarge, the epithelial walls of the groove adhere to each other, and the aperture of the larynx is **occluded** until the **third** month

aryepiglottic folds : The arytenoid swellings grow upwards and deepen to produce the aryepiglottic folds.

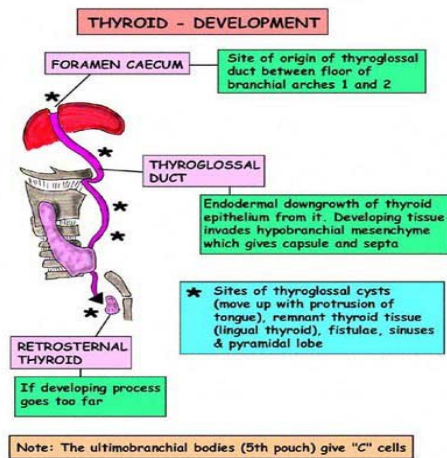
Epiglottis: The hypobranchial eminence (related to the **4th** & **6th** arch).

Thyroid cartilage: develops from the ventral ends of the cartilages of the **4th** pharyngeal arch, appears as two lateral plates each with **two** chondrification centres.

cricoid cartilage and the cartilages of the trachea: develop from the **sixth** arch, during the sixth week

True & false V.C are formed between the **8th** & **10th** wk

Ventricle is formed at the 12th wk



Note:

Laryngeal movement can be detected by the 3rd month of gestation
in the late 2nd trimester occurs the following :

- o the epiglottis and soft palate overlaps for the 1st time
- o the larynx remains intranasal during fetal swallowing
- o pulmonary granular epithelium matures and produce surfactant
- o the skull base undergoes remodeling of its shape

Thyroid Gland Development:

diverticulum of endodermal origin can be identified between the first and second arches on the floor of the pharynx. situated between the tuberculum impar and the copula. (The tuberculum impar together with the lingual swellings becomes the anterior two-thirds of the tongue, and the copula is the precursor of the posterior one-third of the tongue.) The ventral diverticulum develops into the thyroid gland.

During development it descends caudally within the mesodermal tissues. At 4.5 weeks the connection between the thyroid diverticulum and the floor of the pharynx begins to disappear. By the 6th week it should be obliterated and atrophied, if persists a thyroglossal duct cyst is present. tract travels either superficial to, through, or just deep to hyoid and reaches the foramen cecum

7th week The thyroid reaches the final Adult position

Parafollicular C cells arising from neural crest of the 4th pharyngeal pouch as ultimobranchial bodies migrate & infiltrate the forming lateral thyroid lobes

Thyroid part	The origin
Medial part	Endoderm of 1 st + 2 nd pharyngeal pouch
Lateral part	the 4 th pharyngeal pouch
Parafollicular C cell	Neural crest of the 4 th pharyngeal pouch

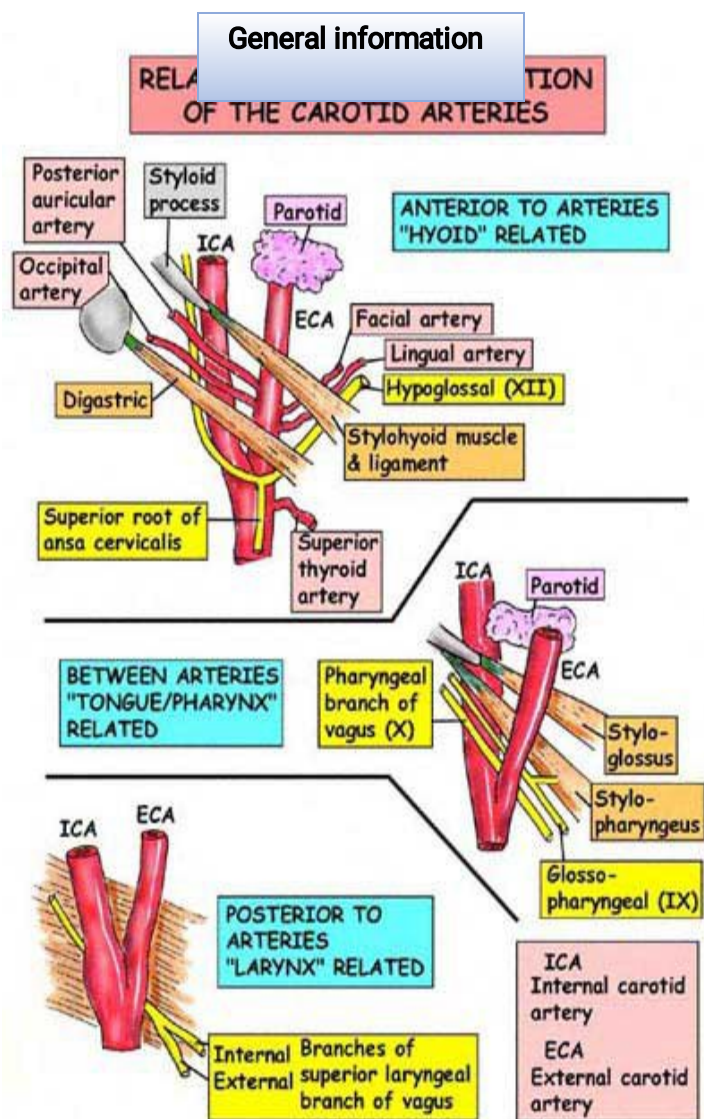
Congenital anomalies:

- 1- lingual thyroid: Result from complete arrest of the thyroid gland descend
- 2- pyramidal lobe:
 - o Occur if the inferiormost portion of the thyroglossal duct is maintained
 - o More prominent among children as it undergoes progressive degeneration with age
- 1- persistent thyroglossal duct: When the thyroglossus duct persist as epithelial tract from the foramen cecum to the laryngeal level
- 2- thyroglossal cyst:
 - Persistent of the thyroglossal duct as series of midline blind pouch in close association with the hyoid bone
 - So surgery for thyroglossal cyst resection requires:
 - o resection of the midportion of the hyoid bone
 - o identification & resection of any cranially extending tract leading toward the base of the tongue
- 1- complete congenital absence of the thyroid gland: Is seldom noticed until few weeks after birth because the fetus is supplied with sufficient maternal thyroid hormone to permit normal development

Embryology of salivary glands: **All** salivary glands originates from the **ectoderm** of the **1st pouch**

Summary of structure origin	
Structure	Origin
Epiglottis	Hypobranchial eminence
Thyroid cartilage Cuneiform cartilage Cricothyroid muscle	4 th arch
Rest of the larynx	6 th arch

Structure	Time of development
Epiglottis	3 rd wk
Thyroid & cricoid cartilage	5 th wk
Arytenoids(vocal process last 1 2 develop) & corniculate	12 th wk
Cuneiform	28 th wk



Note:

Pharyngeal branch of vagus lies in between the bifurcation

superior laryngeal nerve deep to it

inferior laryngeal branch of the vagus nerve is **not** related to carotid artery

Relationship of nerves & internal jugular vein

superficial: spinal accessory nerve

deep : hypoglossal nerve

Vagus nerve:

superficial: hypoglossal nerve

superior & inferior roots of ansa cervicalis

deep: C1

Phrenic nerve:

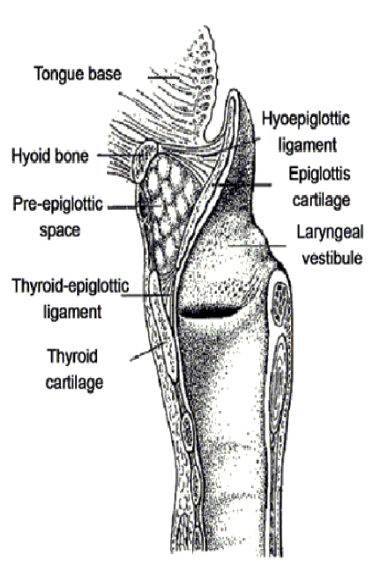
Can be identified by its location

Superficial to: ant scalene muscle

Deep to: transverse cervical artery

Ipsilateral ptosis of the upper eyelid following radical neck dissection is due to:

Inadvertent dissection deep to common carotid artery (injury to the sympathetic chain)



Anatomy of the larynx

The larynx is short (1.5 Inch= 44 mm)

Lies

Below the base of the hyoid and the tongue

Anterior to the esophagus

Between C3/4-C7 vertebra in men (from the tip of the epiglottis to inferior surface of the cricoids cartilage)

Boundaries

Superior border: the tip of the epiglottis and the aryepiglottic folds

Inferior Border: the inferior rim of the cricoid cartilage

Anterior boundary:

- o lingual surface of the epiglottis
- o Thyroid cartilage
- o Anterior arch of the cricoid cartilage
- o Thyrohyoid membrane
- o Cricothyroid membrane

Posterior boundary: cricoid cartilage and the arytenoid region.

Adult Vs Infantile larynx:

Infant larynx is shorter, narrower, more funnel shape, higher

Smaller compared to the body size

The cartilage is softer & can easily prolapse during forced inspiration

The **narrowest part is the junction between the Subglottic area with the trachea** and even slight swelling at this area may result in marked airway obstruction

Larynx in male VS female:

There is a little difference in the size of the larynx between boys & girls

At puberty the AP diameter doubles in men to reach a final diameter of 36 mm in men & 26 mm in women

Higher in women

Function of the larynx:

Protection of the entry into the airways (primary function)

Respiration

Phonation

The frame work of the larynx :

The larynx is made of:

Hyoid bone

9 cartilages: 3 paired and 3 single cartilages

Ligaments and membranes that connects the cartilage to give it stability

2 set of muscles:

- o **intrinsic muscles** the control the tension & orientation of the vocal cords
- o **Extrinsic muscles** that adjust the position of larynx during swallowing

Respiratory mucosa: covers the **interior** surface of the larynx which is continuous above with the pharynx and below with trachea

A- Hyoid Bone:

U shaped bone

It is suspended into the styloid process by the stylohyoid ligament

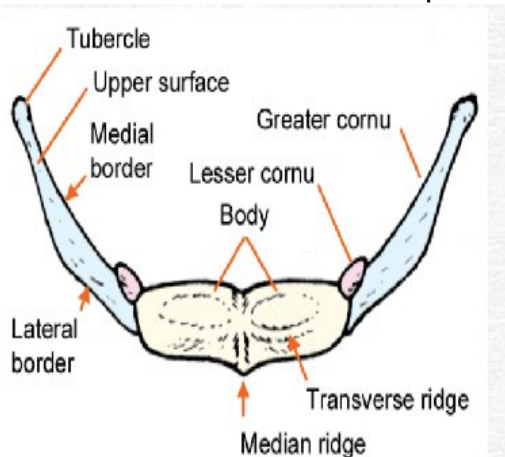
lies beneath the mandible but above the larynx near the level of C3

Provides the upper attachment of many of the extrinsic laryngeal muscles

Suspends the larynx in the Neck

Consists of:

- o Body anteriorly from which the greater cornua projects backwards on each side
- o The lesser cornua are 2 small conical eminences which are attached to the upper part of the body of the hyoid by a fibrous band (at the junction between the body & the greater cornu) & sometimes to the greater cornua by way of synovial joint
- o Ossification occurs around the puberty



A- Cartilage

- o 9 cartilages: 3 paired and 3 single cartilages

- o Types of cartilage:

Hyaline cartilage: Thyroid, cricoids, arytenoids

Elastic cartilage: Epiglottis, corniculate and cuneiform cartilage

- o They have areas of deficiency in the perichondrium

- o Ossification timing:

Male: 3rd decade

Female: 4th decade

- o The cartilage is more susceptible to tumor invasion when they are ossified

Ossification/calcification of the larynx cartilage:

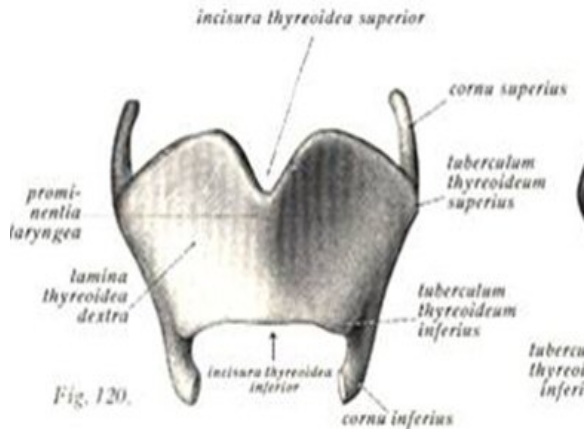
Calcification occurs in the hyaline cartilage not in the elastic cartilage

So the following cartilages **do not undergo calcification:**

1. Epiglottis
2. Apex of the arytenoid cartilage
3. Corniculate cartilage
4. Cuneiform cartilage
5. Pinna

Calcification of laryngeal cartilages start **25 year** and ends around **65 years:**

1. Hyoid Bone:
 - 6 ossification centers
 - Starts to ossify shortly after birth
 - Ossification ends at the age of 2 years
1. Thyroid cartilage:
 - 2 ossification center
 - Starts to ossify at the age of puberty
 - From inferior superior
 - Superior margin are never calcified
1. Cricoids cartilage:
 - Ossifies later
 - Starting from posteriosuperior caudally



Single cartilage:

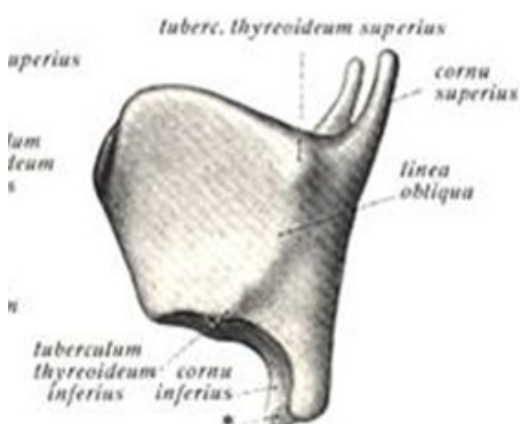
1- Thyroid cartilage:

The most **prominent** & the **largest** laryngeal cartilage

It acts as the anterior “protective housing” of the vocal mechanism.

It has a **shield** shape that is made of 2 laminae

The inferior **2/3** of these laminae are fused anteriorly in the medial plane in a **wedge** shape to form a projection called the **laryngeal prominence (adam’s apple)**



The angle of fusion: **90** in men **120** in women

So the larynx is more prominent in men because of the smaller angle of thyroid lamina fusion & the **longer** AP diameter

Immediately **superior** to the laryngeal prominence is a **V-shaped thyroid notch**.

It has **anterior** attachment of the **vocal folds** and **posterior** articulation with **cricoid cartilage**.

The **superior** border of the thyroid lamina gives attachment to **thyrohyoid ligament**

The **Inferior** border (on the **medial** portion of its inner aspect) gives attachment to **cricothyroid ligament**

On the external surface of the thyroid lamina :

Oblique line curves downward, forward from the superior thyroid tubercle (situated at the root of the superior horn) to the inferior thyroid tubercle (at the lower border of the lamina).

This line provides attachment for:

- 1- **inferior** constrictor muscle of the pharynx
- 2- sternothyroid muscle
- 3- thyrohyoid muscles.

On the Internal surface of the thyroid lamina:

Just below the thyroid notch in the midline is attached the thyroepiglottic ligament

Below the attachment of the thyroepiglottic ligament on each side of midline is attached

Vestibular ligament/false vocal cord

Vocal cords; the fusion of the **anterior** ends of the 2 vocal ligaments produce the anterior

commissure

Vocalis muscles

Thyroepiglottic muscle

Thyroarytenoid muscle

The remaining part of the **inner** surface of the thyroid cartilage is smooth & lined with **loosely** attached mucus membrane

Thyroid cartilage horns

The **posterior** border of each **lamina** projects superiorly as the **superior horn** and inferior as the **inferior horn** (L. cornua).

Superior cornua	Inferior cornua
Long	Shorter
Narrow	Thicker
curves upwards backwards & medially	curves downward & medially
Attached to the lateral thyroid ligament	articulation with the cricoid cartilage

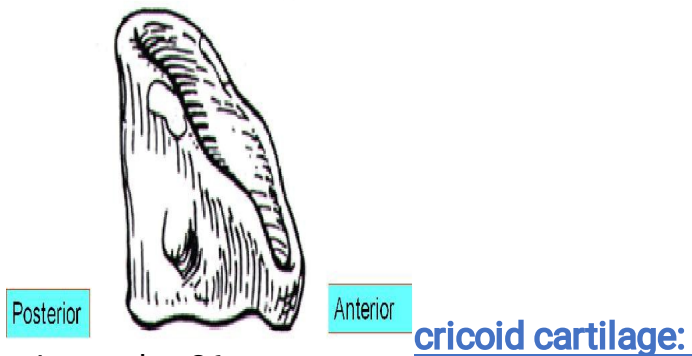
Inferior cornua:

On the **medial** surface of its lower end is a small oval facet joint for articulation with the cricoid cartilage which allows the thyroid cartilage to tilt **anteriorly** or **posteriorly** in a visor-like manner

The thyroid cartilage begins to gradually **ossify** after the age of **20** years:

This process accounts for many **age**-related changes in **pitch** and **resonance** of the voice.

1-



Located at C6

It has a signet ring shape

The only cartilage that forms a complete Ring in the respiratory system

It is thicker and stronger than the thyroid cartilage

It forms the Inferior part of the anterior and lateral walls & most of the posterior wall of the larynx

Made of:

Arch	Lamina
narrow portion	wide portion
Located anteriorly	Located Posteriorly
1 cm in height	2 cm in height

Articulation:

Arytenoid: Superior surface of the posterior aspect is flattened centrally to provide an area of articulation for the arytenoid cartilages.

Thyroid cartilage: Posterolaterally at the junction between the arch & the lamina there is Facet for articulation with the inferior cornu of the thyroid cartilage

This articulation forms a visorlike apparatus, allowing rotation in a sagittal plane, which opens or closes the anterior cricothyroid space.

Calcification of the posterior part of the lamina can be confused radiologically with F.B

External surface: **Vertical ridge** in the midline of the lamina gives attachment to the longitudinal muscles of the esophagus & produce a shallow concavity on each side for the origin of posterior cricoarytenoid muscle

Inner surface: Lined **entirely** with mucus membrane

1- Epiglottis:

Thin Leaf like

Covered with pale mucous membrane

Points posteriorly into the hypopharynx

The epiglottic cartilage forms:

- o superior part of the anterior wall
- o superior margin of the inlet of the larynx.

It is situated:

- o At the level of C5
- o Posterior to the root of the tongue and body of the hyoid bone
- o Anterior to the inlet of the larynx

Anterior surface:

- o Forms the posterior wall of the vallecula (vallecula is situated between the base of the tongue & the epiglottis)
- o Covered with mucous membrane superiorly
- o The mucous membrane reflects on to the base of the tongue, forming median glossoepiglottic fold & 2 lateral glossoepiglottic fold

Posterior surface:

- o Indented by numerous small pits into which mucus gland projects
- o The inferior part of the posterior surface of the epiglottic cartilage that projects posteriorly is called the epiglottic tubercle.

Epiglottic attachment:

- 1- **thyroepiglottic ligament**: attach the inferior part of the epiglottis to the thyroid cartilage in the midline just inferior to the thyroid notch
- 2- **Hyoepiglottic ligament**: attach the anterior surface of epiglottic to the hyoid bone
The space between these ligaments forms the **pre-epiglottic space**
- 3- **Aryepiglottic fold**:
 - o **Free** fold of **mucus** membrane
 - o arise from the **side** of the epiglottis pass down to the **apex** of the arytenoids
 - o lies within them **cuneiform** cartilage
 - o separates the **glottis** from **pyriform** fossa
 - o During swallowing the extrinsic muscles elevates the larynx and the epiglottis flattens as it strikes the base of the tongue

Paired cartilage:

1- arytenoid cartilage:

The **chief** moving part of the larynx (muscles that adduct & abduct vocal cords acts by moving arytenoids cartilage)

Articulates with **posterior superior** surface of **cricoid** cartilage

Small three-sided Pyramid made of:

- o 3 surfaces:

Posterior Surface: Concave; Attachment site for arytenoid muscles (transverse & oblique); Covered by the transverse arytenoids muscle

Medial surface: narrow, smooth, and flattened, covered by mucous membrane; form the lateral boundary of the intercartilaginous part of the rima glottidis (posterior part); interarytenoid muscle connects the medial surfaces of the these cartilages

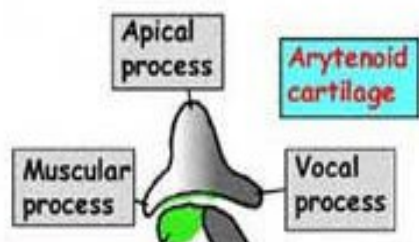
Anteriolateral Surface: irregular situated between the vocal process & muscular process, divided into 2 fossa by a crest running from the apex (curves at first backward and then downward and forward to the vocal process): the upper triangular fossa gives attachment to the vestibular ligament, the lower fossa gives attachment to the vocalis M & lateral cricoarytenoid

Apex: superiorly, attached to the aryepiglottic fold is curved backward and medially and is flattened for articulation with the corniculate cartilage
Base: smooth and concave surface articulate with the sloping shoulder of the upper border of the cricoid cartilage

this cricoarytenoid joint is a complex synovial joint (shallow ball and socket) with loose capsule which allow:

- o multiaxial rotation but minimal translation: moves the vocal process medially & laterally
- o gliding movement: adduct & abduct the arytenoids
- o the posterior cricoarytenoid ligament prevent forward movement of the arytenoid cartilage
- o The movement of the arytenoids controls the position and the length of the vocal cords

Muscular process (lateral angle) attached to the posterior cricoarytenoid & lateral cricoarytenoid



Vocal process (Anterior angle): attached to the Posterior part of the vocal cord (thyroarytenoid muscle)

1- corniculate cartilage (santorini):

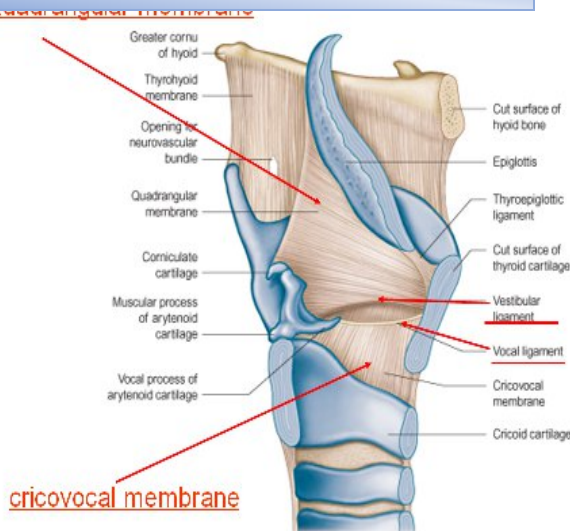
A pair of small conical nodules articulate with the arytenoids through synovial joint
 They are located in the posterior part **aryepiglottic folds**

1- cuneiform cartilage (wrisberg):

A pair of elongated pieces of cartilage placed within the **aryepiglottic** fold in front of the arytenoids cartilages.

So the **corniculate** & **cuneiform** cartilages support the **aryepiglottic** fold

Ligaments & membranes of the



Extrinsic Ligaments:

- 1- The ligaments connecting the thyroid cartilage with the hyoid bone:

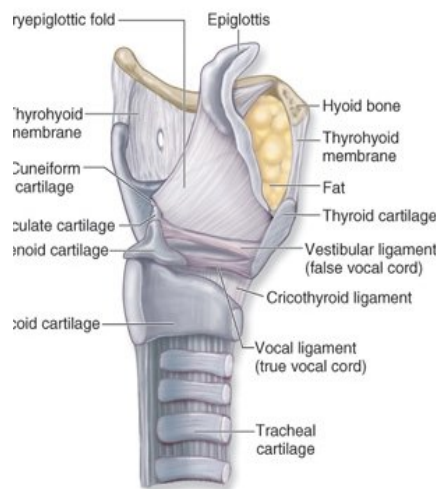
The Thyrohyoid Membrane:

Stretch between the **upper** border of the thyroid cartilage & **posterior** surface of the body & greater horn of the hyoid bone

Made of fibroelastic tissue reinforced by fibrous tissue in the midline as the **medial thyrohyoid ligament** and Posteriorly the **lateral thyrohyoid ligaments**.

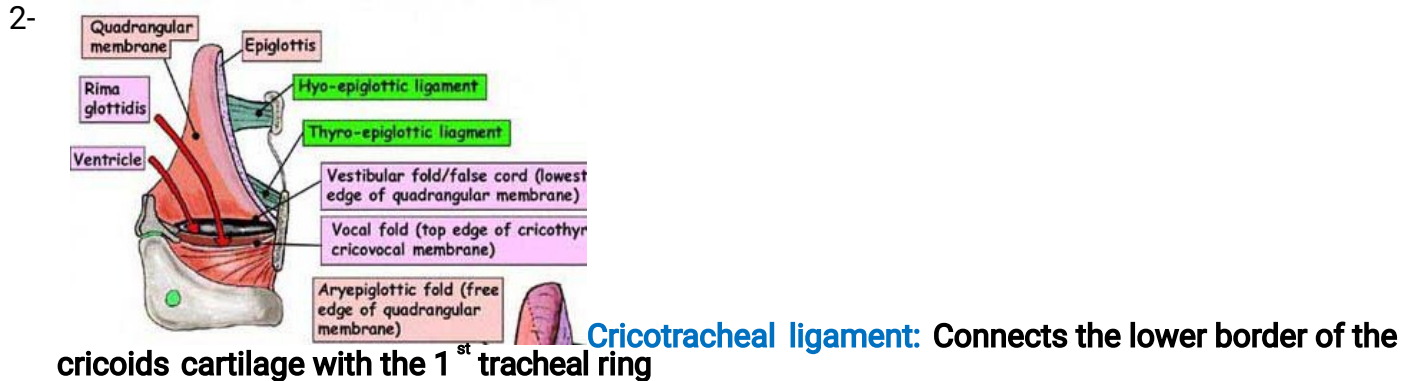
The lateral ligaments connect the tips of the superior horns of the thyroid cartilage to the posterior ends of the greater horn of the hyoid bone.

The ligaments often contain a small nodule of cartilage (cartilage triticea)



The membrane is pierced by **superior laryngeal artery** & **internal branch of the superior laryngeal nerve**

1- **hyoepiglottic ligament: attaches the hyoid to the epiglottis**



Note that the following structures form a barrier for tumor spread:

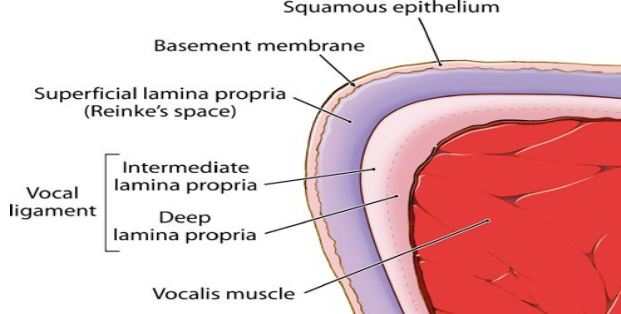
- o Quadrangular membrane
- o conus elasticus
- o thyrohyoid membrane
- o thyroid pericondrium

Intrinsic ligaments

Quadrangular ligament
conus elasticus

	Quadrangular membrane	cricothyroid membrane
Support	Supraglottis	glottis and subglottis
Attachment	Anteriorly : lateral edges of the epiglottis Posteriorly : arytenoids	Superiorly : anteriorly: anterior commissure, posteriorly: vocal processes of arytenoid Inferiorly : superior border of the cricoid cartilage
Vocal cord relation	The inferior free edge is Continuous with: vestibular ligament (false V.C)	Its medial upper free edge is: vocal ligament (True V.C)
Other structures	The superior free edge: aryepiglottic fold As it extends inferiorly, it becomes: Medial wall of the piriform sinus	Thickened anteriorly to form conus elasticus

Mucosal lining of the larynx:



Attachment of the mucous membrane:

Closely attached over:

- 1- **posterior** surface of the epiglottis
- 2- corniculate cartilage
- 3- cuneiform cartilages
- 4- Over the **vocal ligament**.

loosely attached: Elsewhere and prone to oedema

Type of mucosal lining:

Most of the larynx is lined by **pseudo stratified ciliated columnar** 'respiratory' epithelium.

Structures that is lined with **stratified squamous epithelium** :

- 1- **Anterior** surface of epiglottis
- 2- upper **1/2** of the **posterior** surface of the epiglottis
- 3- **upper** part of the **aryepiglottic** fold
- 4- **posterior** glottis (arytenoid)
- 5- vocal folds
- 6- **.5 cm** below the true vocal cord

Mucous glands distribution:

freely distributed throughout the mucous membranes

particularly numerous on:

- 1- posterior surface of the epiglottis where they form indentations into the cartilage
- 2- margins of the lower part of the aryepiglottic folds
- 3- saccules.

The free edge of the vocal folds do not possess any glands, It is lubricated from the glands within the saccules, The squamous epithelium of the vocal folds is therefore prone to desiccation if these glands cease to function, for example after radiation

True vocal folds:

The true vocal cords are made up of **5** layers:

- 1- Epithelium (stratified, transitional, respiratory):
stratified nonkeratinized squamous epithelium
The mucosal cover of most of the upper airway is respiratory epithelium, with numerous mucous glands
Over the free edge of the vocal fold, mucosa is adapted for periodic vibration with squamous epithelium and no mucous glands; This layer does not contain any mucous glands, and hence the mucoid secretions lining the cord must travel from the glands located anteriorly, superiorly and posteriorly to the edges of the vocal fold
Note: that the infra glottis surface of the vocal cords has mucus glands

- 1- lamina propria:

A **highly specialized** lamina propria separates the epithelium from underlying muscle.

The lamina propria serves as a **shock absorber**, or **impedance** matcher, so that the epithelium can vibrate **freely**, **without** restriction by the bulky underlying muscle.

The lamina propria of the vocal fold contains 3 layers:

Each layer has **unique mechanical** properties because of **varying** densities of **elastic** and **collagenous** fibers.

A- The **deep layer**: the stiffest, due to a **high** concentration of **collagen** fibers.

B- The intermediate layer:
like **rubber** bands

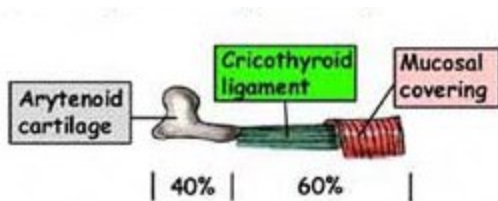
Elastic fibers are **most** numerous in this layer and **gradually decrease** toward the

epithelium and muscle

A- The superficial layer:

jelly-like substance, acellular and composed of extracellular matrix proteins (hyaluronic acid), water, loosely arranged fibers of collagen and elastin (lowest concentration of both elastic and collagenous fibers and offers the least impedance to vibration)
often referred to as **Reinke space**, although it is not actually a potential space.

- 1- Vocalis muscle (Medial part of the Thyroarytenoid muscle): inserts into thyroid cartilage as Broyle's tendon (serves as a pathway for tumor extension into thyroid cartilage)
the main body of the vocal fold, and very stiff
there is fibrous connection to conus elasticus

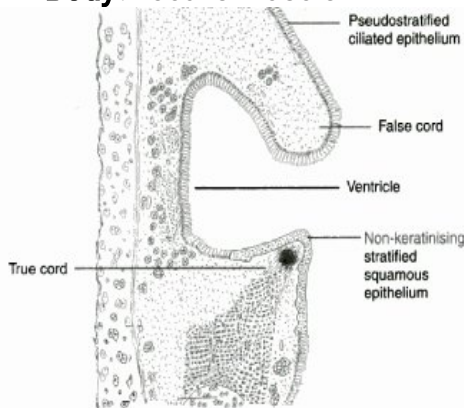


So the vocal cords are made of:

Cover: epithelium + superficial layer of the lamina propria

Transition: vocal ligament : intermediate + deep layer of the lamina propria (which are the free **upper** edge of cricothyroid membrane)

Body: vocalis muscle



The vocal fold **mucosa** and vocal **ligament** cover:

- 1- the vocalis muscle
- 2- entirety of the vocal process.

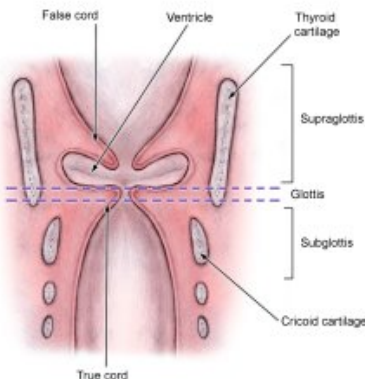
Vibration

the cover is the **vibratory part**

the **anterior 2/3** of the vocal fold is the **phonatory**, or **membranous** portion

The **posterior 1/3** of the vocal fold is the **aphonatory** (respiratory), or **cartilaginous** portion

The **max vibratory** part of V.C is at the **junction** between the **anterior 1/3 & posterior 2/3** = **middle** of the V.C membranous part



The true vocal cords have a curved **inferior** surface with **concavity** directed **inferiorly** this shape offers **minimal** resistance to air outflow and resists pressure from above.

Note:

true V.C are triangular in shape

thicker & wider posteriorly

False vocal cords lie **superior & lateral** to the true vocal cord

The ventricle of **Morgagni** is a narrow space between the true and false folds

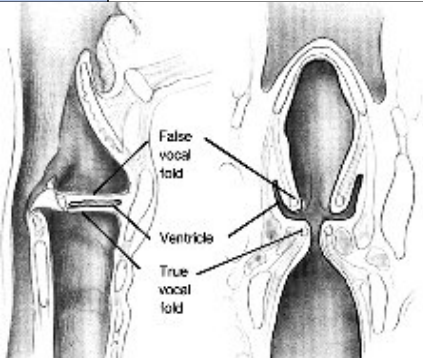
Arytenoids process is the **posterior** attachment for **both** true & false vocal cords
false vocal cord **cannot** be closed **independently** of **true** vocal cords

Larynx subdivisions

The larynx is subdivided into:

	From	To
Supraglottic area	Epiglottis	beginning of the squamous epithelium at the junction between the lateral wall and the floor of the ventricle of Morgagni (superior border of the true vocal cord)
Glottis area	Vertical plan	.5-1cm below the free border of true VC (Junction between squamous and respiratory epithelium)
Subglottic area	.5-1 cm below the free border of true V.C	Inferior border of the cricoids cartilage

1-



Supraglottic area:

Made of: Epiglottis, Arytenoids cartilage, Corniculate cartilage, Coniform cartilage, Aryepiglottic fold*, Interarytenoid notch, False vocal cord

Divided into:

- o 1-Vestibule, 2- Ventricle
- o 3- Laryngeal aditus: The plane of aditus is directed posteriorly & slightly rostrary
 - o Boundaries:
 - anteriorly: epiglottis
 - Laterally: aryepiglottic fold
 - Posteriorly: tips of corniculate cartilage & interarytenoid muscle

1- Glottic area:

It is the **narrowest** part of the larynx

The anteriorposterior diameter of the glottis: anterior commissurecricoid cartilage

Total length: Adult male= 2.5cm, Adult female= 1.6 cm

The vocal cord and the space between them is called glottis

The Glottis abduct into triangular shape during inspiration; Reduce (adduct) into a slit during voice production.

Made of:

Anteriorly: True vocal cord

Posteriorly: posterior third of the vocal cords, the posterior commissure with the interarytenoid muscle, the cricoid lamina, the cricoarytenoid joints, the arytenoids, and the overlying mucosa

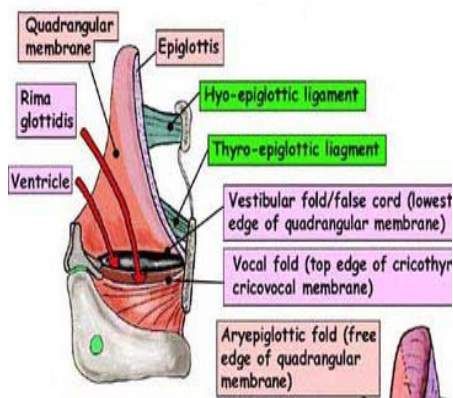
Superiorly: ventricle

1- Subglottic area:

Extends 1 cm below the vocal cords to the inferior surface of the cricoids cartilage

The cricoid cartilage is the skeletal support of the subglottis

So The subglottis is the only point in the airway with a completely rigid diameter



It has a smaller cross-sectional area than the trachea, so that a single foreign body that is small enough to pass through the subglottis does not cause total airway obstruction

Spaces in the larynx

The spaces around the larynx are filled with adipose tissue & loose connective tissue & are key in understanding the spread of tumours within the larynx; tumor may spread more easily through these spaces

Pre-epiglottic space:

C-shaped space located anterior to the epiglottis

Bounded by:

superiorly: by the median glossoepiglottic ligament

inferiorly: by the thyroid cartilage

Anteriorly: by the thyrohyoid membrane

posterolaterally by the epiglottis and aryepiglottic folds.

Not part of the larynx, but is an important area for the spread of laryngeal cancer

Paraglottic space:

Space located on either side of the epiglottis

The paraglottic space is lateral to the ventricles

It encompasses the laryngeal ventricles and saccules

between the laryngeal introitus and the medial wall of the pyriform sinus

Continued with the pre-epiglottic space (the posterolateral extension of the preepiglottic space).

Thus the preepiglottic and paraglottic spaces form a horseshoe-shaped fatty space surrounding the internal laryngeal structure

Bounded by:

anteriorly: the mucosa covering the lamina of thyroid cartilage

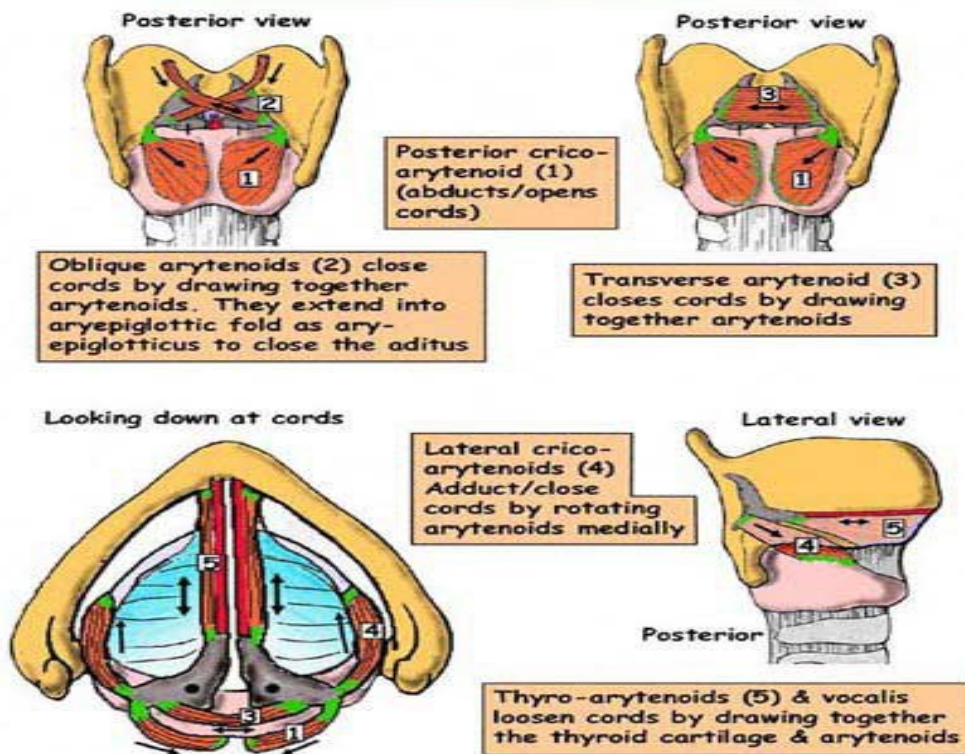
Posteriorly: the anterior reflection of the pyriform fossa mucosa.

Medially: conus elasticus and quadrangular membranes (vestibular fold)

Laterally: anterior mucosa covering thyroid cartilage + mucosa of medial wall of pyriform fossa

Intrinsic muscles

LARYNX - INTRINSIC MUSCLES



Called intrinsic cause they Originate and insert into on the larynx, connecting elements of the larynx
 Function: responsible for altering the length, tension, shape, and spatial position of the vocal folds by changing the orientation of the muscular and vocal processes of the arytenoids with the fixed anterior commissure.

More interdigitaed than the limb muscles

Fast twitch

Open & close the glottis:

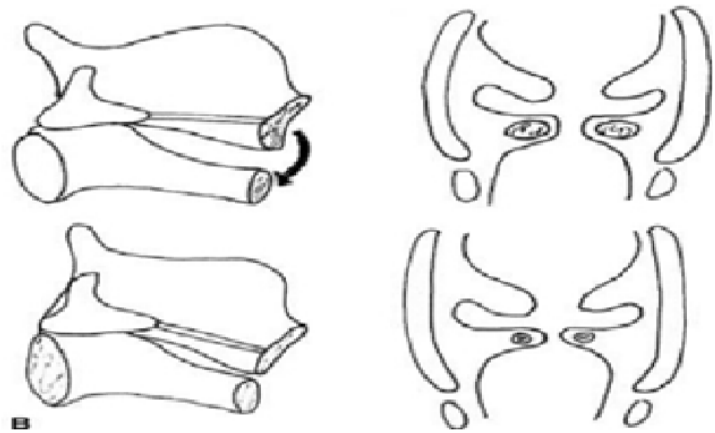
Note:

The posterior cricoarytenoid muscle is the only abductor of the vocal cords

The Transverse arytenoid muscle is the only unpaired intrinsic muscle

Transverse + oblique arytenoid muscle = interarytenoid muscle

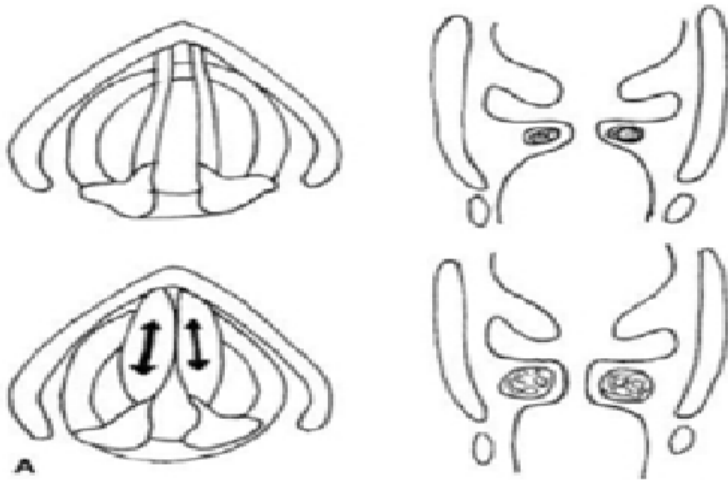
	Origin	Insertion	Action
Posterior cricoarytenoid	Posterior cricoids lamina	Muscular process of the arytenoids process	external rotation of the arytenoids rotating the arytenoid out & up(lateral &cephalad) abduct the V.C
Lateral cricoarytenoid	Lateral cricoids arch	Muscular process of the arytenoid process	Internal rotation of the arytenoid Medialization & downward & forward displacement of the V. Adduct v.c
Transverse arytenoid	Posterior surface of the muscular process + arytenoids	Crosses over and attaches to the same point on the other arytenoids Vocal process	Adduct v.c closes the posterior glottis
Oblique arytenoid	Posterior surface of the muscular process (superficial to the transverse)	Apex of the other arytenoid	Adduct v.c



cricothyroid

CRICOTHYROID has 3 special features that makes it different from other laryngeal muscles. These are:

- It is the only muscle that tightens the cords
- It is supplied the external branch of the superior laryngeal nerve and not the recurrent laryngeal
- It is the only intrinsic muscle of the larynx which on the outside of larynx



Thyroarytenoid

Thyroarytenoid muscle:

2 compartments:

Medial vocalis muscle = internal intensor of vc: Deeper & lower part

External: Small portion inserts on **quadriangular** membrane as **thyroarytepiglottic** muscle which narrows the laryngeal inlet

Control the tension of the vocal folds:

	Thyroarytenoid	Cricothyroid
Origin	Anterior interior surface of the thyroid cartilage	Lateral surface of the anterior arch of the cricoid. Fibres fan out & pass backwards in two groups
Insertion	Vocal process & anterior surface of the arytenoids cartilage	Lower oblique pass: Backwards & laterally to the anterior border of the inferior cornu of the thyroid cartilage. Anterior straight fibres: ascend to the posterior part of the lower border of the thyroid lamina
Action	Shortens, thickens the vocal folds Stiffness: a- The body of the fold: actively stiffened b- The transition layers: passively slackened The edge of the fold to be rounded. drop vocal pitch	the entire fold (all layers): Elongates, thins the vocal folds Stiffens the vocal folds The edge of the vocal fold becomes sharp Increase the pitch

Note: the **thyroarytenoid** has the **fastest** contraction time due to **heavily** myocin content of its fibers

The cricothyroid muscle lengthens the vocal folds by increasing the distance between the **angle** of the thyroid cartilage and arytenoids.

Cricothyroid: The only muscle that is not attached to the arytenoid

Note that **both cricothyroid muscle + vocalis** muscle (medial part of thyroarytenoid muscle) are: **tensor muscles**

Alter the shape of the laryngeal inlet:

	Aryepiglottic muscle	Thyroepiglottic muscle
Continuation of	Oblique arytenoid	Thyroarytenoid (lateral part)
Origin	Posterior aspect of the muscular process of the arytenoid	Back of the thyroid prominence
Insertion	Aryepiglottic fold	Aryepiglottic fold
Action	weak sphincter of the laryngeal inlet (closes)	Widens the inlet of the larynx pulling the aryepiglottic fold apart

Clinical application:

With very strong respiratory demand, the posterior cricoarytenoid muscle continues contracting during expiration, after the diaphragm has relaxed. This results in decreased resistance and faster outflow of air shortens the duration of expiration increases the rate of breathing.

During most conditions of breathing, respiratory rate is primarily controlled by varying the rate of exhalation

Extinsic muscles:

Connects the larynx to other structures

they act as a whole upon the larynx during swallowing

1. Depressor (strap muscles):

- Omohyoid (C2+C3)
- Sternohyoid (C2+3)
- Sternothyroid
- thyrohyoid muscles (C1) : can lower the hyoid or elevate the thyroid cartilage(according which part is fixed)

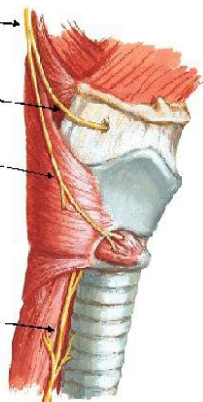
1. Superior Laryngeal Nerve

Internal Laryngeal Nerve

External Laryngeal Nerve

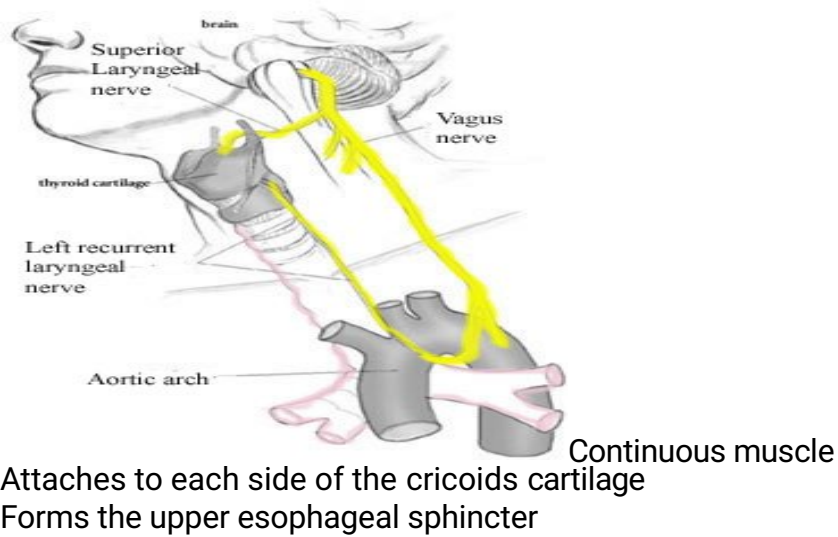
Recurrent Laryngeal Nerve

Netter 74 A



Elevator:

- Geniohyoid: C1
- Mylohyoid : V
- Stylohyoid: VII
- Digastrics muscle : anterior belly V, posterior belly VII
- Pharyngeal muscles (pharyngeal plexus):
 - Middle constrictor muscle
 - Inferior constrictor muscle
- Pull the larynx superior posterior
- Cricopharyngeus:
 - Lower part of the inferior constrictor muscle



The larynx is supplied by 2 branches of vagus nerve:

a) **Superior laryngeal nerve:**

Exit the nerve at **nodose ganglion**

Divides into 2 branches:

A- **External** branch (motor): Supply the **cricothyroid** muscle

B- **Internal** branch (Sensory):

Carries sensation from **at** and **above** the glottis

Enters through the **lateral thyrohyoid** membrane with B.V

Runs **submucosally** in the **pyriform** fossa

a) **Recurrent laryngeal nerve :**

Gives **motor** innervations to **all ipsilateral intrinsic** laryngeal muscles **except** cricothyroid (superior laryngeal)

interarytenoid m (receive **bilateral** innervations)

Carries **sensation** from: **Glottic & Subglottic** (below the vocal cords) and trachea

Nucleus:

Motor nucleus: nucleus **ambiguus**

Sensory: nucleus **solitaries** via nodose ganglion

Ligation of the superior laryngeal nerve results in:

1. Dysphonia
2. Loss of sensation in the

a) **Supraglottic**

Nerve supply of the larynx

Recurrent laryngeal nerve paralysis:

a) **Complete paralysis:**

Both adductors (except the cricothyroid) + abductor muscles will be paralysed

So the vocal cord will lie in cadaveric position (intermediate)

There is enough space between V.C so the patient will not develop stridor

but no vocal cord movement = difficulty in speech

a) **Incomplete paralysis:**

Abductor will be affected 1st

Pulmonary artery

www.drthalu.com

Course of recurrent laryngeal nerve:

Left recurrent laryngeal nerve:

- Descends into the chest with vagus nerve
- Leaves the vagus in the mediastinum
- Loop around ligamentum arteriosum and aortic arch
- Continues upward in the tracheoesophageal groove
- Enter the larynx behind the cricothyroid joint

Right recurrent laryngeal nerve:

- The loop occurs around the right subclavian artery
- There is 1% of the population with non-recurrent right laryngeal nerve
- The course of the **left** recurrent laryngeal nerve is **longer** than the **right** side
- The course of recurrent laryngeal nerve differs between the Right and left side due to **embryological** development
- The recurrent laryngeal nerve is the nerve of the 6th brachial arch
- The artery of the 6th brachial arch on the left is ductus arteriosus which is responsible for pulling the recurrent laryngeal nerve on the left side
- While on the right side the 6th segmental artery disappear so the recurrent laryngeal nerve is only pulled as inferior as the artery of the 4th arch (subclavian artery)

Incidence of injury of recurrent laryngeal nerve:

- Thyroidectomy: equal for right+ left
- Chest surgery: left more the right

Non-recurrent recurrent laryngeal nerve is likely to be associated with **anomalous Rt Retro-esophageal Subclavian artery** in which Rt subclavian artery arise from descending part of the aorta then pass behind

Blood supply

Arterial supply:

- Superior thyroid artery** : branch of **external** carotid artery
- Inferior thyroid artery**: branch of thyrocervical trunk

Venous drainage:

- Superior** thyroid vein + **Middle** thyroid veins : join the **internal** jugular vein
- inferior** thyroid vein: empties into the left **brachiocephalic** vein.

Lymphatic drainage :

Lymphatic drainage is separated into **upper** and **lower** drainage groups by the **vocal folds**

The larynx above the vocal folds (supraglottic):

- drain by vessels that accompany the superior laryngeal vein and pierce the thyrohyoid membrane emptying into the **upper** deep cervical lymph nodes + pre-epiglottic

The larynx below the vocal folds (glottis & supglottic):

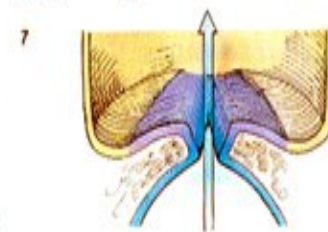
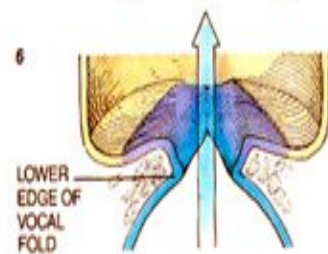
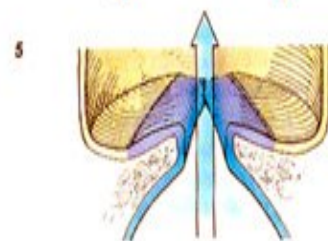
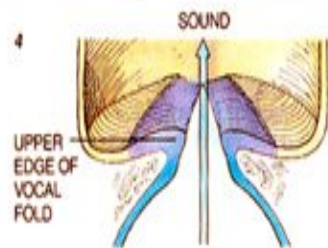
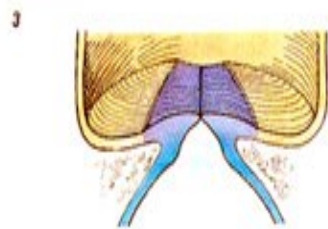
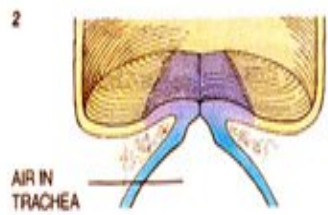
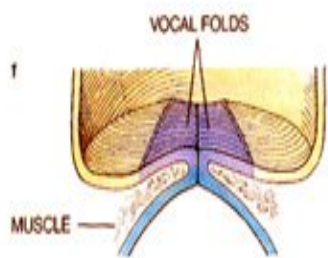
- drain into the **lower deep** cervical chain often through **prelaryngeal** and **pretracheal** nodes.

The vocal folds themselves:

- firmly bound down to the underlying vocal ligament and there are **no** lymphatics present in this plan

	Infant	Adult
Inlet orientation	Less oblique which predispose to aspiration	
Subglottic orientation	Downward & backward	Vertically oriented
This high position brings the epiglottis and the palate into close proximity (overlap) This overlap leads to formation of 2 separate paths: 1st for feeding, 2nd for breathing The child can: drink fluid & breath in the same time (obligatory nose breather in the first few months of life) this overlap is usually constant but may be interrupted during: crying, swallowing of dense bolus The tongue in high larynx is entirely intra-orally		
Location of the epiglottis tip	Basiocciput/C1	C3/C4
Location of the inferior margin of the cricoid cartilage	C4	C7
The larynx starts to descend at the 2nd year & reach the final position at adulthood At birth: C4 At 2 years: C5 At 5 years: C6 At 15 years: C7 This descend is the result of the cranial cavity expansion The epiglottis & soft palate will no longer overlap (so in children older than 3 years the epiglottis can no longer approximate the soft palate even during maximum swallowing) There will be creation of the oropharynx (supralaryngeal space) The low larynx allows expanded supralaryngeal pharynx (oropharynx) which: o serves as resonating chamber for modifying the fundamental frequencies of speech sounds Infant cannot enounce full range of vowel sounds because the high larynx limits the vocal tract The posterior part of the tongue will make the upper Anterior wall of the pharynx The epiglottis in adults: Becomes largely vestigial structure So patients who had partial/full epiglottectomy don't develop difficulty in swallowing The digestive & respiratory system will cross over so breathing & eating can't occur in same time predisposing to: 1- choking 2-aspiration of regurgitated food		
relationship of the hyoid bone to the thyroid cartilage	close approximation of the larynx to the hyoid	
larynx size ratio	1/3 of the adult larynx but it is proportionally larger than the adult larynx compared with the rest of the tracheobronchial tree	
Vocal cord consistency	1/2 the vocal cord is cartilaginous (vocal process of the arytenoid)	1/3-1/4 th of the V.C is cartilaginous
AP dimension of Glottis opening (Vocal cord length)	6-8mm	Male 24 mm Female 16 mm
Posterior transverse dimension	4mm	
Subglottic AP diameter		
Mature neonates	4.5-5.5 mm (narrowest part of URT in children)	
Premature neonates	3.5 mm (So if the tip of bronchoscopy of 3 mm in diameter could not pass through the subglottic area the child is diagnosed to have congenital subglottic stenosis)	
Epiglottic configuration changes	Omega shape, Softer, Narrower More acute angle between the epiglottis & glottis	
Thyroid cartilage angle	110-120	90 in male Stay the same in female
Collapse of laryngeal cartilage	Easily collapsed because it is softer	

Tracheal diameter	Premature 3mm Fully mature 6 mm	25mm
Treacheal ring	2 mm wide	
Average distance between the glottis & tracheal bifurcation	5.7cm	12 cm (tracheal length)



The predisposing factor for choking in adults:

1. Low position of the larynx allows crossing over of the digestive & respiratory system which allow a bolus of food to lodge easily in the laryngeal aditus
2. The crossing allows more frequent in coordination of these activity than is usually in mammals with largely separated tracts
3. The expanded oropharynx allows large bolus of food to be passed over the larynx over swallowing rather around it into the pyriform fossa

Narrowing the lumen in infants:

Circumferential mucosal edema of 1 mm within the larynx of an infant narrows the subglottic space by more than 60%.

edema will cause a marked diminution in potential airflow (Poiseuille's law states that flow is inversely proportional to radius)

Breathing and the larynx

Movement of the vocal cords during quite respiration: Inspiration=abduct; Expiration= adduct

posterior cricoarytenoid muscle contraction:

begin to contract with each inspiration **before** activation of the diaphragm

Widen the glottis during inspiration

Ceases only during: sleep; deep anesthesia

its action varies with the respiratory needs:

1. quiet breathing: imperceptible during unlabored breathing
2. With increasing respiratory drive: increases proportionately with diaphragmatic activity.
3. During strong respiratory demand: continues contracting during expiration after the diaphragm has relaxed, thus delaying expiratory adduction and facilitating the outflow of air.

Differences between posterior cricoarytenoid muscle contraction and diaphragmatic behavior: (oppose)

When the upper airway is **partially** occluded, inspiration generates **negative** airway pressure, which is a potent stimulus to the **posterior cricoarytenoid muscle** to dilate the upper airway. In contrast, the diaphragm responds by: decreasing inspiratory force (force of contraction) increasing the duration of inspiration.

Note:

Increasing diaphragmatic force increases the negative pressure, favoring airway collapse.

So to inspire the same volume, the diaphragm extends the duration of inspiration

PCA and the diaphragm **contraction** have opposing effects on patency of the lumen. PCA contraction dilates the airway, opposing the effects of the diaphragm.

Laryngeal spasm:

Occurs in response to mechanical stimulation (by secretions) of the larynx

Mostly occurs under light anesthesia

Results in: Apnea, Bradycardia, Hypertension

Treated by: Positive-pressure ventilation through a bag/mask, 100% O₂, succinylcholine

Larynx and phonation

The sound is produced when air is **forced out** the lungs through an **adducted** larynx

Phases of speech: Pulmonary, Laryngeal, Oral

Phonation requirements:

1. Breath support (Not necessary normal vital capacity)
2. Vocal cord approximation (not tight closure)
3. Favorable vibration prosperities (normal lamina propria)
4. Favorable vocal cord shape
5. Control of vocal cord length and tension (not necessary to be tight V.C)

Phonatory vibration of the vocal cords:

1. Mucosal **upheaval** moves from caudal to rostral
2. Vocal folds separate at mid cycle
3. Vocal folds change shape

4. The inferior vocal fold edge touches first

Vocal cord vibration:

vocal folds vibrate at rates of 75 to 1000 cycles/second

Vibration involves the **V.C cover** and the **body** is **stationary**

Vibration propagate by **subglottic air forces**

Reinke's edema interfere with **mucosal wave**

Vocal cord lubrication Affected by: air flow, Subglottic pressure

Parameters of voices:

1. Loudness:

- a) Subglottic air pressure
- b) Glottal resistance
- c) Rate of airflow
- d) **Amplitude** of vibration

1. Pitch:

- a) Length of V.C
- b) Tension of V.C
- c) Cross sectional mass of the V.C
- d) **Frequency**

1. Quality: Symmetry of vocal fold vibration

Cough & larynx

Coughing is the process by which material is expelled from the airway

Cough reflex consists of 4 phases:

- 1- rapid inspiration
- 2- forceful closure of both the vocal and vestibular folds : Air pressure is then built up below the adducted folds as the diaphragm ascends spasmodically until the folds separate explosively and mucus or foreign material is expelled
- 3- expiration
- 4- cessation

General notes:

True vocal cord has a **curved inferior** surface with concavity directed inferiorly, this shape offers:

Minimal Resistance to air outflow

Resists pressure from above (resist a pharyngeal pressure of **150mmHg**)

The **false** vocal cord function:

Mainly: mechanical flap valve preventing egress of air (resists **tracheal** pressure of **30mmHg**)

Helps produce the increase in intratracheal pressure needed for coughing, sneezing, micturition, parturition

Has little resistance to ingress of air

Useful in preventing aspiration of foreign material by physiological muscular contraction

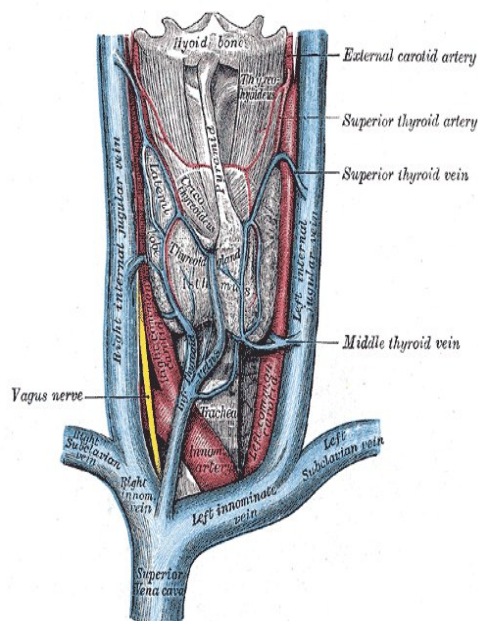
cricoarytenoid unit is the basic functional unit of the larynx, consists of :

1. arytenoid cartilage
2. cricoid cartilage
3. associated musculature
4. superior laryngeal nerve
5. Recurrent laryngeal nerves.

Preservation of at least one functional cricoarytenoid unit makes it possible to consider an organ preservation procedure.

It is the **cricoarytenoid unit**, not the vocal folds, that allows for physiologic speech and swallowing

Trachea



General levels

C3: hyoid bone

C4:

- o upper border of the thyroid cartilage
- o Bifurcation of common carotid artery

C6:

- o cricoids cartilage
- o Beginning of trachea
- o Beginning of esophagus

T4-T5 : bifurcation of the trachea into left and right bronchus (carina)

General information:

It is **completely** encircled by only the **1st** ring

The rest of cartilages are **deficient posteriorly**

Number of circle **16-20**

The thyroid isthmus overlies **2nd to the 5th** rings

Tracheostomy is made by removing the anterior half of the 3rd or the 4th ring

Blood supply is from:

Inferior thyroid artery

Bronchial artery supply the thoracic part

EMBRYOLOGY:

The trachea develops from **evagination** of the **foregut mesenchyme** in the **4th week** of development

The incidence of **Foreign body** aspiration is **equal** between the Rt & Lt in **children** because: The left main bronchus is not obliquely directed as adult

Postnatal development:

Normal ratio of the tracheal cartilage to membranous wall is approximately **4:1**

The trachea is approximate **4 cm** in length at birth, **12 cm** in the adult

The neonatal trachea is **more compliant** than the adult trachea and therefore **more likely** to **collapse**

The lung continue to grow until the age of **8 years**

Vessels that in direct contact with the trachea:

Brachiocephalic artery

Left Brachiocephalic vein

In **10 %** of people we have also **thyroid ima artery**

The thyroidea ima artery:

It ascends **infront** of the **trachea** to the **lower** part of the **thyroid gland**, which it supplies.

It appears to **compensate** for deficiency or absence of one of the other thyroid vessels.

The thyroidea ima artery, when present, arises from the **brachiocephalic trunk (innominate**

The boundaries of **submental** are the anterior belly of the digastrics

midline

Hyoid bone.

The boundaries of **submandibular/digastrics** are:

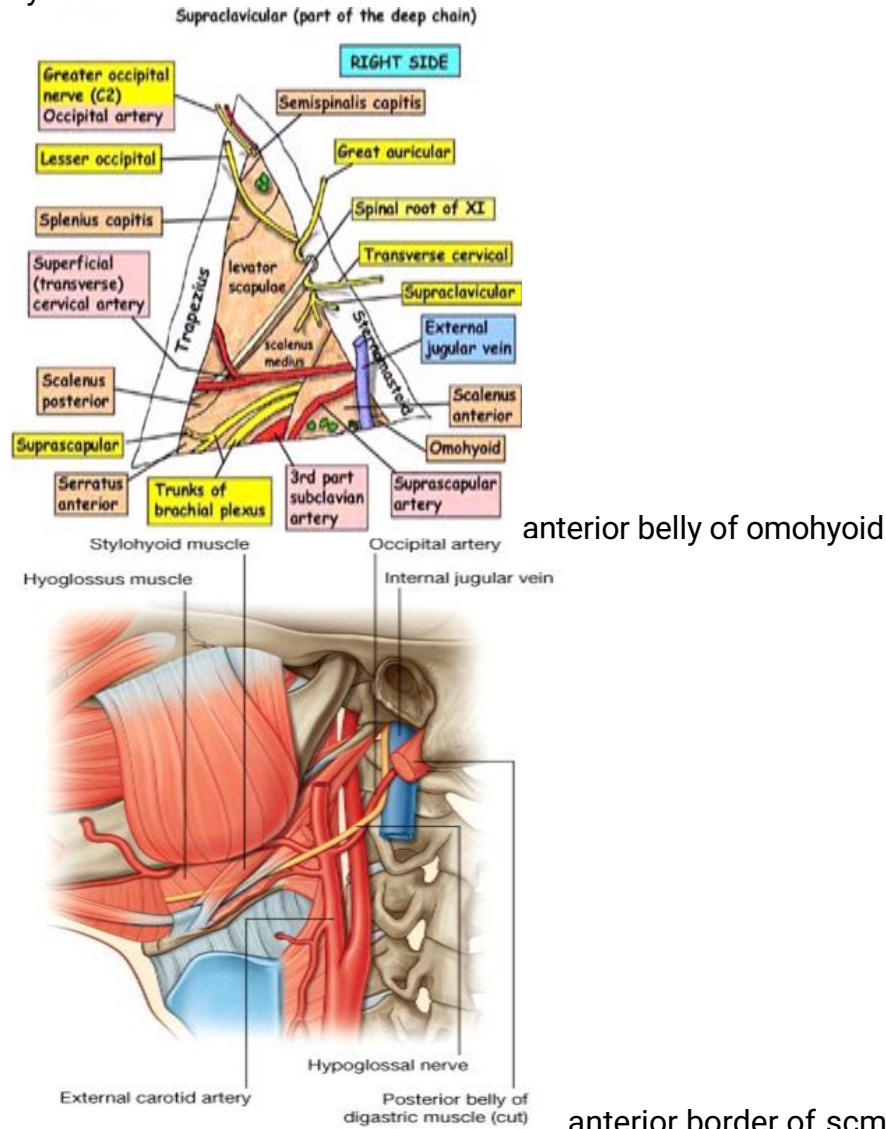
anterior & posterior belly of digastrics muscle

base of the mandible

line from the angle of the mandible to the mastoid process

The boundaries of **muscular**:

hyoid bone

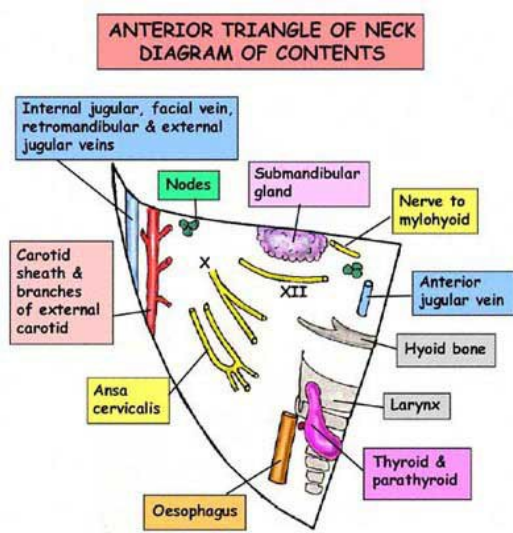


midline

the boundaries of **supraclavicular**:

posterior surface of scm

clavicle



posterior belly of omohyoid

Hypoglossal nerve course in the neck:

Moves from the carotid triangle into the submandibular triangle

Medial to:

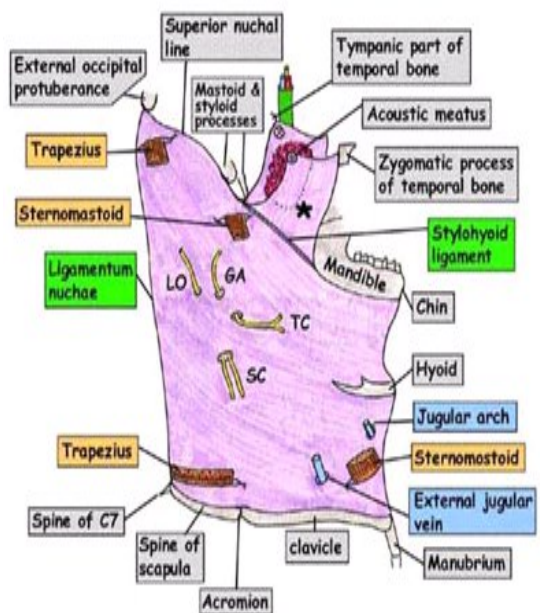
- o stylohyoid insertion
- o posterior belly of digastrics
- o mylohyoid

Lateral to:

- o Hypoglossal muscle

Triangle	Blood vessel	Nerves	Special structures
Sub-mental	Anterior jugular v		Submental salivary gland
Submandibular / Digastrics	Facial artery & v Submental a & v	Marginal mandibular branch of facial nerve Mylohyoid branch of V3 Hypoglossus	Submandibular gland Inferior portion of parotid gland
Carotid	Common carotid Internal carotid External carotid & its branches except the terminal & posterior auricular Internal jugular	Vagus nerve External & internal laryngeal branches Small part of Accessory nerve Hypoglossus glossopharyngeal	
Muscular	Lower part of the carotid sheath Superior thyroid artery Anterior jugular vein	Anas cervicalis External & internal laryngeal branches	Strap muscles, Thyroid gland, Parathyroid, Larynx, Trachea, esophagus
Occipital	Occipital artery Transverse cervical a	Spinal root of Accessory nerve Cervical plexus: - o Greater & lesser occipital - o Greater auricular - o Transverse occipital - o suprascapular	

Supra-clavicular	Subclavian vessels Thyrocervical trunk Suprascapular a External jugular vein	Brachial plexus	Pleura
-------------------------	--	-----------------	--------



★ Anterior layer of parotid fascia is the superficial layer of the investing fascia that has split from the stylohyoid ligament

⊗ Posterior layer of parotid fascia is the deep layer of the investing fascia that has split from the stylohyoid ligament. It fuses with the parotid gland

Fascia of the Neck:

1. Superficial cervical fascia
2. The deep cervical fascia:
 - a. superficial layer (investing): carotid sheath
 - b. middle, pretracheal or visceral layer:
 - 1) muscular/**infra**-hyoid portion
 - 2) pretracheal
 - 3) buccopharyngeal
 - a. deep layer or prevertebral:
 - 1) alar layer
 - 2) prevertebral division

1. Superficial cervical Fascia:

Lies deep to the dermis layer of the skin

Thin layer that invests the platysma muscle & muscles of facial expressions

It is closely associated with adipose tissue.

It contains cutaneous nerve

This fascia is penetrated by the blood vessels that supply the neck skin.

The subplatysmal flap therefore protects the blood supply to the skin.

1. Deep cervical Fascia:

1) Superficial investing Fascia:

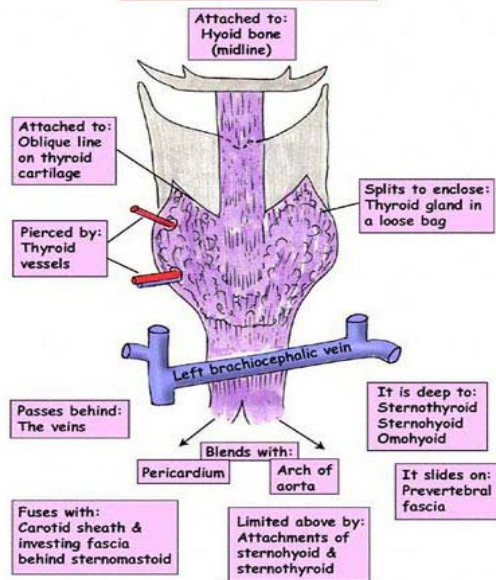
arise from:

- o ligamentum nuchae
- o spinous processes of the cervical vertebrae

It splits into anterior & posterior layer to enclose:

1. trapezius

2. omohyoid
3. sternocleidomastoid
4. parotid gland
5. submandibular gland



superior attachment is to :
 external occipital protuberance
 superior nuchal lines
 mastoid tip
 zygomatic arch

Anterior attachment: hyoid.

Inferior attachments: acromium, the clavicle and the sternum

The splitting of this fascial layer around the parotid forms a deep layer, which fuses with the fascia around the internal carotid artery.

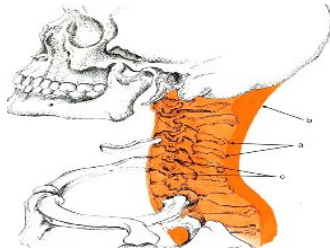
It also forms the stylomandibular ligament (which separates the anterior inferior tip of the parotid gland from the submandibular gland).

Deep to this layer runs the spinal accessory nerve

Forms the roof of the posterior triangle

1) Middle layer/ pretracheal /visceral layer:

This is derived from the superior layer of the deep cervical fascia



Muscular portion : encircles the strap muscles

Pretrachea

passes **deep** to the **strap** muscles

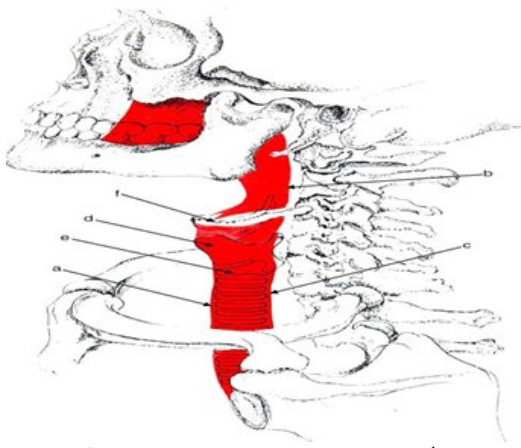
encircles: thyroid (**anterior** layer of the pretracheal fascia splits to encloses the thyroid cartilage), larynx, trachea, pharynx, oesophagus

Movement of the **hyoid** and **strap** muscles during **swallowing** elevates the **fascia** so that **thyroid** lumps characteristically move on deglutition.

buccopharyngeal fascia:

portion of the middle layer that is related to and encloses the **pharynx posteriorly**

Below the level of the pharynx it is called the **visceral** layer



superior constrictor muscles (both muscles arise from the pterygomandibular raphe)
Allow the pharynx to move freely, relative to neighbouring structures such as the carotid sheath and vertebrae.

Adheres **inferiorly** into the **pretracheal & visceral** fascia

Forms

- o midline raphe: through which Adheres at the midline to prevertebral fascia
- o pterygomandibular raphe : adheres to the lateral pharynx

Note: layers of the muscles:

- o facial expression: mastication: buccinators
- o Platysma: SCM , trapezius & omohyoid: strap muscle

1) Deep Layer / pre-vertebral fascia:

Forms a **tubular** sheath for the **vertebral column** and the **muscles**

Arises from the **ligamentum** nuchae and the **spinous** processes of the cervical vertebrae (like **investing** layer)

It forms the **floor** of the **posterior** triangles and allows the pharynx to glide during **deglutition**.

While the **investing** layer forms the **roof** of the **posterior** triangle

deep layer of deep cervical fascia (At the **transverse** processes of cervical spine) is divided into 2 distinct layers:

1. The prevertebral fascia: (posterior)

adheres to the anterior aspect of the vertebral bodies

extends from the skull base down the length of the spine

Extends laterally over the prevertebral musculature to fuse with the transverse processes and their attached ligaments.

It extends posteriorly to enclose the extensor musculature of the neck

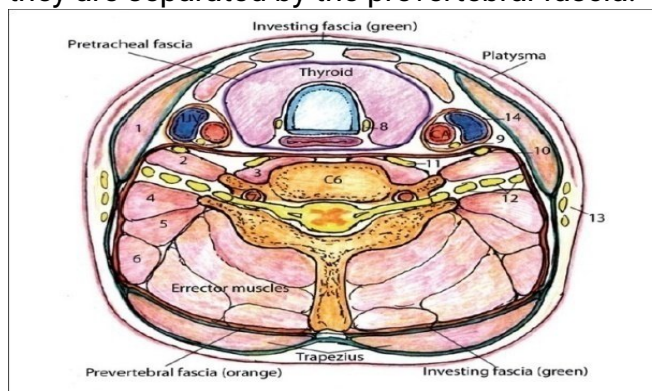
It is attached in the posterior midline to the spinous process of the vertebrae.

The prevertebral division forms:

the posterior wall of the so called danger space which extends from the skull base to the diaphragm

constitute the anterior wall of the prevertebral space.

Consequently, endogenous infections such as tuberculosis involving the vertebral bodies extend into the prevertebral space but not into the danger space, from which they are separated by the prevertebral fascia.



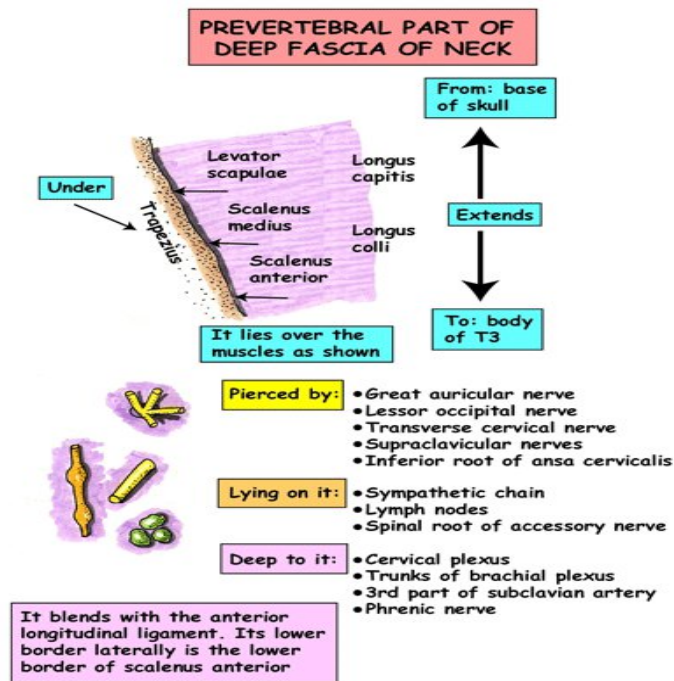
1. The alar fascia: (anterior)

lies between the prevertebral fascia and the visceral division of the middle layer of deep cervical fascia.

It courses from the transverse process to the contralateral transverse process vertically from the skull base to T2, where it fuses with the visceral layer of the middle layer of deep cervical fascia which lies in front of it. (This seals inferiorly the (retro)Pharyngeal space)

forms :

o



o posterior lateral portion of the retropharyngeal space

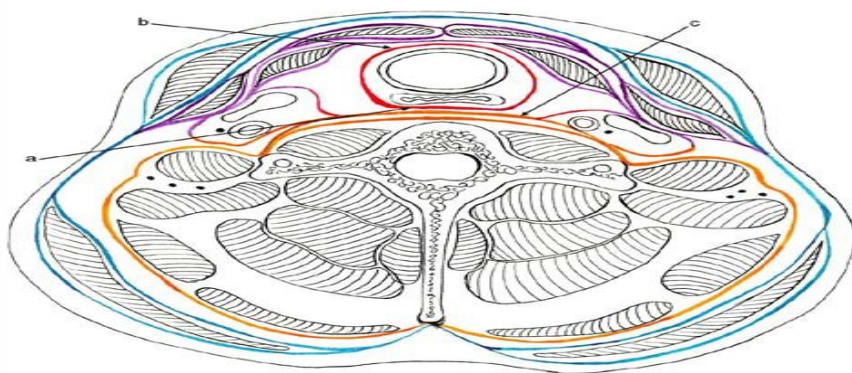
Carotid Sheath:

This is derived from the **superficial + middle + deep** layer of **deep** cervical fascia **medial** to the sternocleidomastoid

Extends from the **skull base** to the **adventitia** of the **aortic arch**

It contains **80 %** of the lymph nodes of the neck, the carotid arteries, the internal jugular vein, vagus nerve.

Constituents of the **anas cervicalis** are **embedded** in the carotid sheath

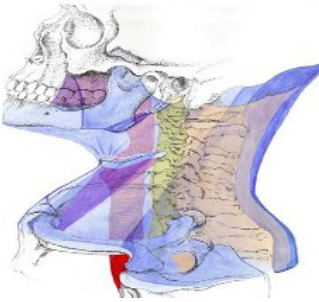
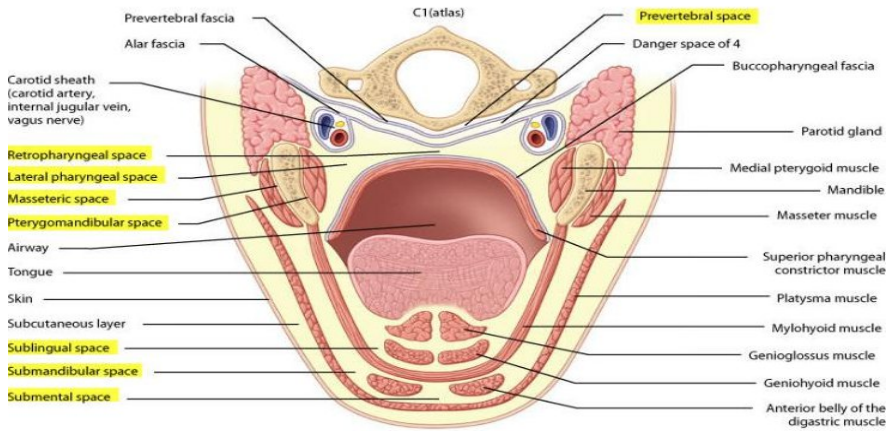
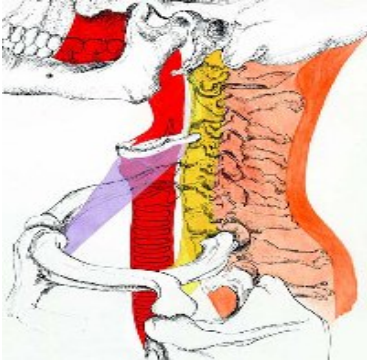


Deep Layers of Cervical Fascia

- Investing Layer
- Middle Layer
- Visceral Layer
- a- Retrovisceral (esophageal) fascia
- b- Pretracheal fascia
- Vertebral Layer
- c- Alar fascia
- Carotid Sheath

spread, called **Lincoln high** way of the neck

It is a potential venue for infection



	investing layer	Pre-vertebral fascia
Origin	the same: ligamentum nuchae and the spinous processes of the cervical vertebrae	
Relation to trapezoid muscle	Encloses the muscle	Deep to the muscle
Relation to the post triangle	Roof	Floor

TABLE	NECK SPACES	SPACES
Spaces involving entire length of neck:		
	Retropharyngeal space	
	Danger space	
	Prevertebral space	
	Visceral vascular space	
Spaces limited to above the hyoid bone:		
	Parapharyngeal space	
	Submandibular space	
	Parotid space	
	Masticator space	
	Peritonsillar space	
	Temporal space	
Spaces limited to below the hyoid bone:		
	Anterior visceral space	
	Suprasternal space	

Knowledge of these potential neck spaces is important in the understanding of the spread of infection and tumors in the neck.
They contain only loose areolar fascia.

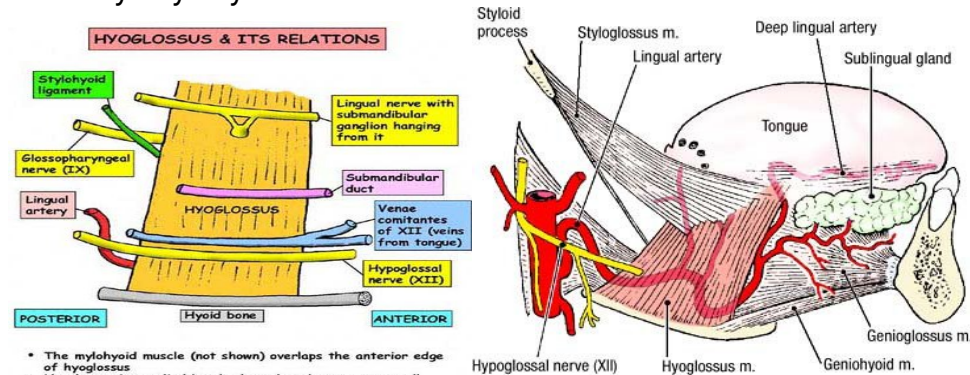
Spaces limited to the above of the hvoid

Sublingual space:

Bounderies:

Superiorly: floor of mouth and tongue

Inferiorly: mylohyoid muscle

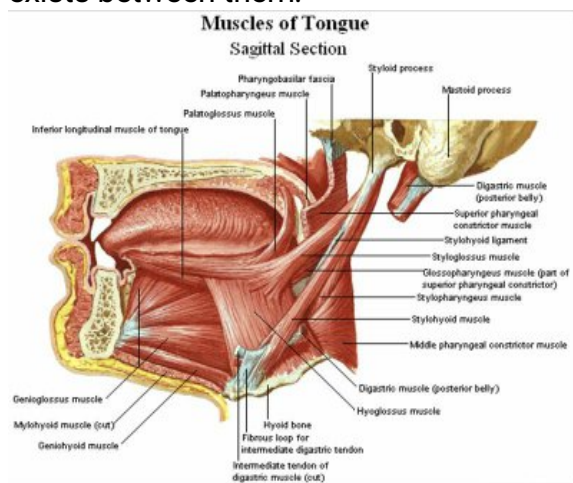


mandible

Posteriorly: hyoid bone

Medially: genioglossus, geniohyoid, and styloglossus muscles

This space communicates freely with that of the opposite side because no true fascial separation exists between them.



The sublingual space also communicates anteriorly with the submental space below through dehiscences in the mylohyoid muscle and raphe.

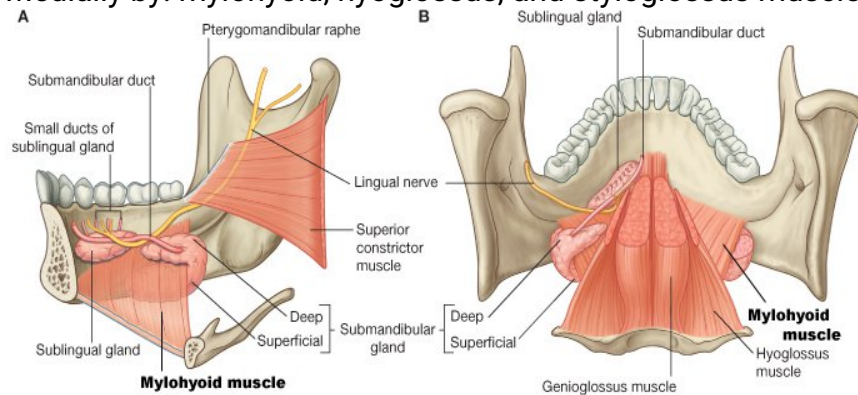
Get infections from: anterior teeth, bicuspsids , first molar tooth

Management: Intra-oral incision (but avoid the posteriolateral region which contains the lingual nerve)

Submandibular space

Boundaries:

Superiorly: separated from the sublingual space
Medially by: mylohyoid, hyoglossus, and styloglossus muscles



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Laterally by: body of the mandible.

Inferior boundary: anterior and posterior bellies of the digastric muscle

Posterior border: Stylomandibular ligament + posterior belly of digastric

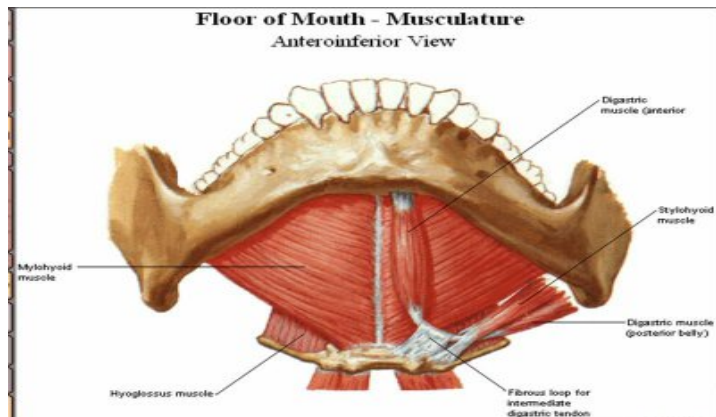
Lateral border: overlying skin, **superficial layer of deep cervical fascia**, platysma muscle

The contents of this space: tail of the submandibular gland, Wharton's duct, lingual nerve, hypoglossal nerves, facial artery, some lymph nodes and fat.

Note the submandibular gland lies in both the submandibular & sublingual space

Submental space (mylohyoid divides it into 2 parts)

Source of infection: infections of the 2nd and 3rd mandibular molar teeth



Clinically, a tense, ill-defined swelling is generally present below the mandible, which makes palpation of its inferior border difficult.

Management is by an external transverse cervical incision placed 2 finger breath beneath the body of the mandible to avoid injury to the mandibular nerve

Communication:

across midline: **opposite submandibular space**

Anteriorly: Communicate freely with the submental space

Midway: It communicates with the floor of mouth around the posterior border of the mylohyoid

Posteriorly: Communicate with the parapharyngeal space

It is subdivided by the mylohyoid muscle into : Sublingual, Submaxillary

Ludwig Angina

Definition: the collective involvement of the submandibular and sublingual spaces bilaterally and the submental space (spread by the facial planes not by the way of lymphatics)

Dental origin; arise from infections of the Mandibular molar teeth

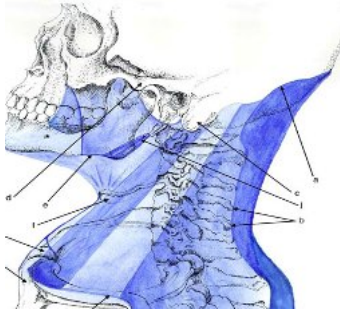
The causative organisms include a variety of aerobic and anaerobic gram-positive cocci (staph & strep) and gram-negative rods (bacteroid).

Clinically: collar of brawny edema extends across the entire upper anterolateral neck with elevation and progressive induration of the floor of the mouth

Since the mandible and superficial layer of deep cervical fascia provide unyielding barriers superiorly and laterally, the tongue is forced upward and posteriorly giving rise to airway obstruction. This is the most important danger in Ludwig's angina (rapidly spreading cellulitis involving the floor of the mouth)

Complications

1. Spread of infection to parapharyngeal and retropharyngeal spaces and hence to the mediastinum.
2. Airway obstruction due to laryngeal oedema, or swelling and pushing back of the tongue.
- 3.

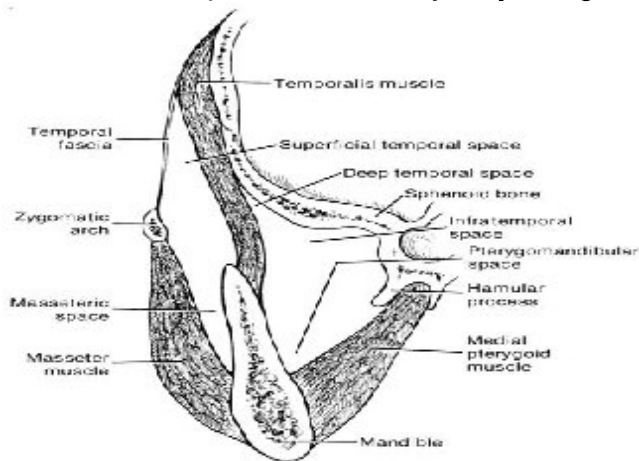


Septicaemia.

4. Aspiration pneumonia

Masticator space:

Collection of spaces defined by a **splitting** of the **investing** layer of the **deep** cervical fascia



, As it approaches the **mandible** and extends

superiorly:

- o temporal space
- o Masseteric space
- o pterygomandibular space

Boundaries:

- o **External:** fascia overlaying Masseter muscle
- o **Internal:** fascia medial to pterygoid muscle

Contents:

Masseter muscle, Medial & lateral pterygoid muscle

Ramus & posterior body of the mandible

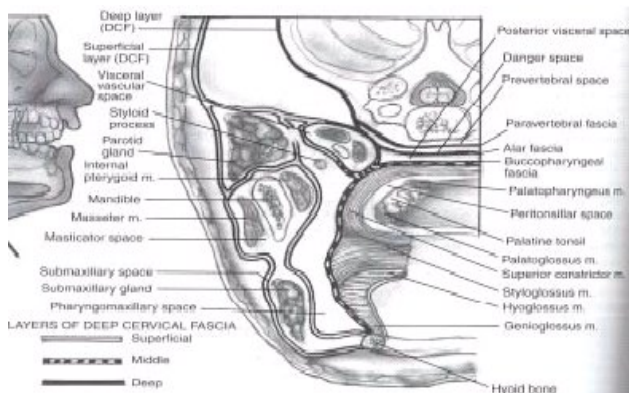
Tendon of insertion of Temporalis muscle

Inferior alveolar nerve (pterygomandibular space)

Internal maxillary artery (pterygomandibular space)

Infection source: mandibular/maxillary 3rd molar teeth

Involves **all** masticator muscles



Relation to other spaces:

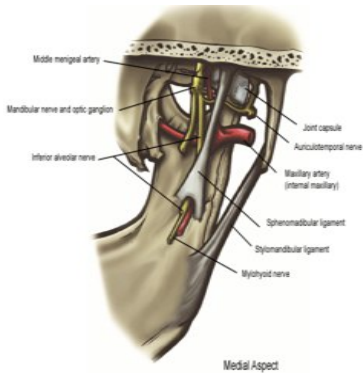
Lies anterior & lateral to the parapharyngeal space

Inferior to temporal space
Medial to the infratemporal space

Peritonsillar space:

This lies between the tonsil and **superior** constrictor.

It communicates through the fibres of the superior constrictor with retropharyngeal and parapharyngeal spaces.



Parapharyngeal /lateral space/pharyngomaxillary:

It is shaped like an inverted pyramid with the Base under temporal bone & apex in the neck at hyoid (C3)

Located on either side of the pharynx (Nasopharynx & oropharynx)

Borders:

superiorly: the base of skull (petrous part of temporal bone)

Inferior part: the greater cornu of the hyoid bone

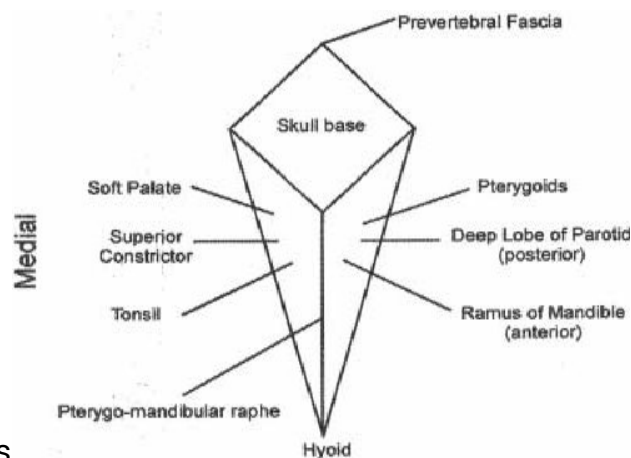
Medial Border:

lateral naso+oropharyngeal wall

Pharyngobasilar fascia

Tensor palatine

levator palatine



pharyngeal constrictors
Lateral border:

fascia covering medial pterygoid muscles

Ascending Ramus of the Mandible

Deep lobe of parotid gland

SCM at the level of C5

Anterior border: pterygomandibular raphe

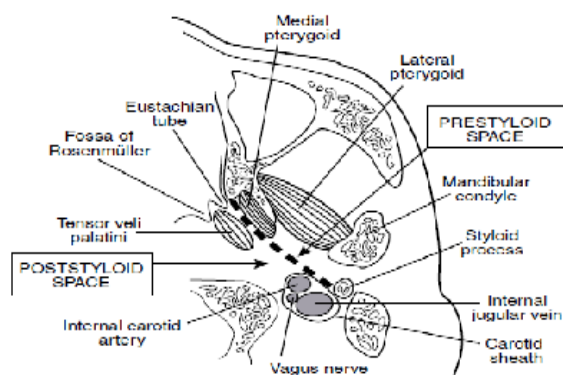
Posterior Border:

posterior part of the carotid sheath

Prevertebral fascia

Note:

parapharyngeal space has no anatomical floor, allowing communication from skull base to superior mediastinum



So infections can extend intracranially or into the

mediastinum

Middle ear infections can spread via involvement of the petrous apex or jugular foramen into the neck

Parapharyngeal abscess the approach is:

Anterior to the SCM for abscess low in the neck

Posterior to the SCM for abscess high in the neck

Fascial borders:

Medial: middle layer of deep fascia

Lateral: superficial layer of deep fascia (buccopharyngeal fascia)

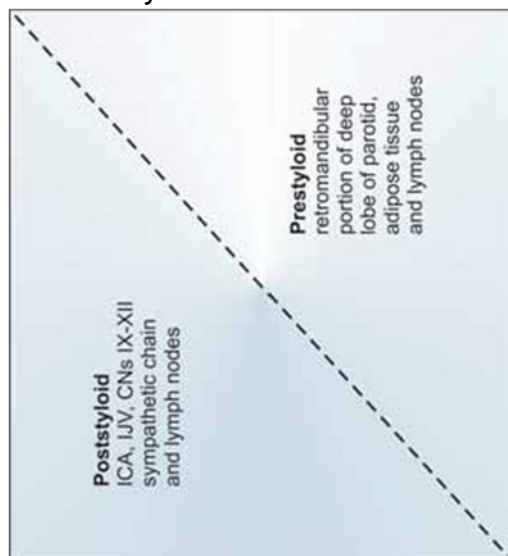
Posterior: anterior layer of carotid sheath

Masses in the parapharyngeal space can be palpable anterior to the upper part of scm

Parapharyngeal space divisions:

The parapharyngeal space is divided by A layer of fascia (buccopharyngeal fascia) that extends from the medial pterygoid plate and tensor palati to the spine of the sphenoid and the styloid process loosely divides into:

a)



The Prestyloid space (muscular):

- o anterolaterally
- o contains: Fat, Lymph Node, Medial & lateral pterygoid muscle, Styloid muscle, Internal maxillary artery, Ascending palatine branch of facial artery, Ascending pharyngeal artery, Mandibular branches (Auriculotemporal, Inferior alveolar, Lingual nerve), Deep lobe of

parotid gland

- o majority of tumors are salivary gland tumors

a) The poststyloid contains (neurovascular) (carotid space):

- o Posteromedially

- o Contains:

- carotid sheath: carotid arteries, internal jugular vein, cranial nerves IX, X, XI, XII (9-12):

- note that VI courses posteriolaterally after leaving the jugular foramen & is not involved to any extent in parapharyngeal space infections

- cervical sympathetic chain, Deep cervical lymph nodes.

- o The majority of tumors are either neurogenic or vascular in origin

Parapharyngeal space communicates with:

- retropharyngeal space (not free communication: there is condensation of fascia around the carotid sheath, which separates the parapharyngeal & retropharyngeal space)

- submandibular space

- Peritonsillar space

Note: bilateral spread of the infection is rare in the neck.

The most common causes of parapharyngeal abscess is: Tonsillitis, Dental infection (esp 3rd molar)

Others: salivary gland infection, Middle Ear infections (base of the parapharyngeal space is the petrous bone), Spread of retropharyngeal infections

This space is the most complex and clinically most important space Due to its central location and its relationship to other spaces in the neck:

- pharyngeal mucosal space : medial

- masticator space: anterolateral

- parotid space: lateral

- carotid space: posterior

- retropharyngeal space: posteromedial

The parapharyngeal space contains a fat pad, which is located **centrally**.

The radiological displacement pattern of this fat pad is useful for diagnosing lesions in this area. Prestyloid and lateral lesions will displace the fat posteromedially, while poststyloid lesions will displace this fat anteriorly

Parotid space masses: push the fat **medially**

Masseter space masses: **posterior**

Manifestation of parapharyngeal space infections:

- Retromandibular fullness, Medial displacement of the lateral pharyngeal wall, Parotid edema

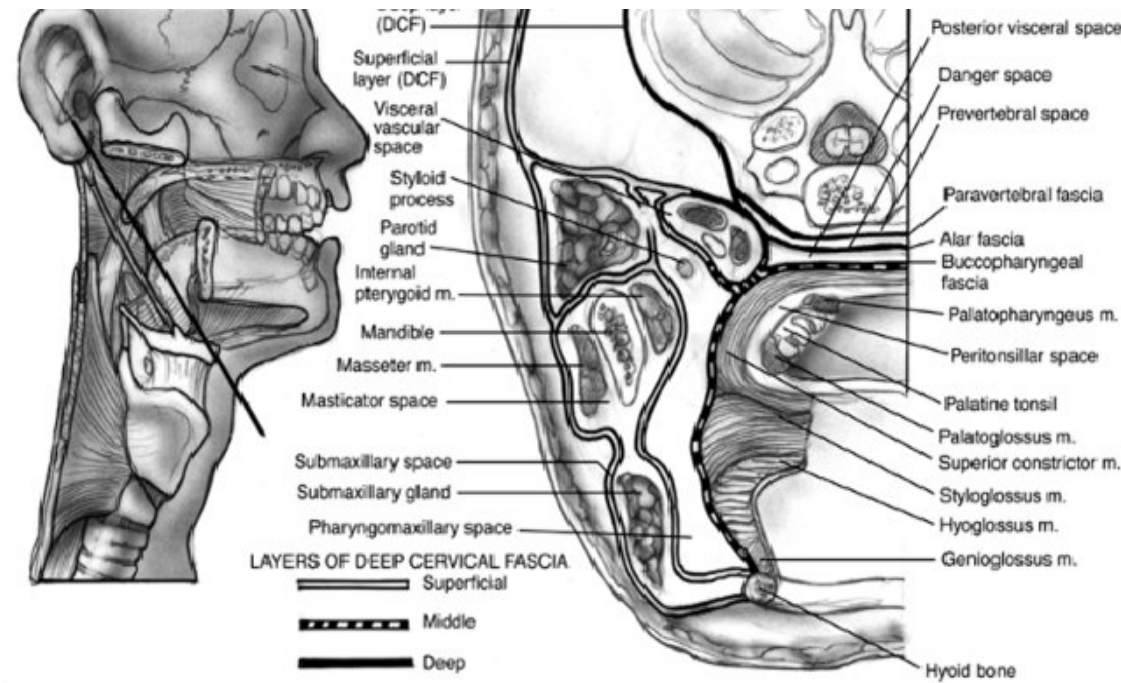
- Dysphagia, Trismus: due to irritation of the mastication muscles

Complication of parapharyngeal infection:

Internal jugular thrombosis, Carotid artery erosion, Mediastinitis

Cranial nerve paresis:

- o Horner syndrome: sympathetic chain
- o Horseshoe of voice: vagus
- o Tongue paresis: XII



relation ship of parapharyngeal space to other spaces

Spaces extending the whole length of the neck

These spaces communicates with mediastinum

Retropharyngeal space

This sits between the 2 parapharyngeal spaces and is **continuous** with both (but not freely)

Borders:

Superior boundary: the skull base

Anterior boundary: the musculature of the pharynx (buccopharyngeal Fascia)

posterior limit: alar division of prevertebral fascia

Inferior limit: It continues inferiorly behind the oesophagus and eventually communicates with the posterior mediastinum.

Contents: retropharyngeal lymph nodes of rouvier + loose alveolar tissue

retropharyngeal abscess: points to Posterior pharyngeal wall **OR** Posterior triangle of the Neck

May predispose to pus aspiration/mediastinitis

acute vs chronic abscess:

	acute retropharyngeal abscess	Chronic retropharyngeal abscess
Age group	Infants	Adult
Cause	results from suppuration in the retropharyngeal lymph node following URTI	due to T.B cervical vertebra may be involved
Approach of drainage	drained through the mouth	external approach through the neck

Danger space:

Between the alar division and the pre-vertebral division of the Prevertebral fascia

Lies between **retropharyngeal** & **prevertebral**

Extends from skull base to the **diaphragm**

Prevertebral

This is the potential space that lies between the cervical vertebrae and anterior longitudinal ligament posteriorly and the prevertebral fascia anteriorly.

It extends down to the third thoracic (T3) vertebra where the fascia is bound to the vertebra.

The prevertebral fascia is thin and infections in this space can rupture directly through into the posterior mediastinum.

Spaces limited below the hyoid

Pretracheal space/anterior visceral space

Located:

anterior and lateral to the thyroid cartilage

deep to the strap muscles

It contains the delphian node

It communicates with the superior mediastinum.

Muscles of the neck

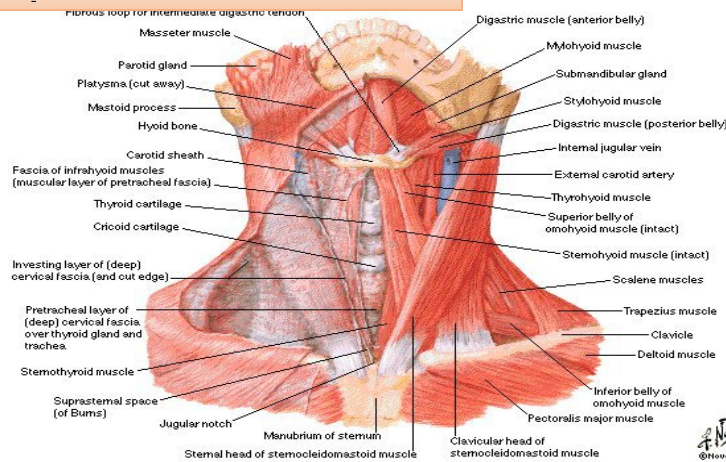
Group I : Superficial neck muscle : platysma

Group II: Lateral Neck muscle: sternocleidomastoid, trapezius muscle

Group III: Suprahyoid muscle: Superficial layer : Digastrics, Stylohyoid; **Intermediate layer :** Mylohyoid; **deep layer:** Geniohyoid muscle

Group IV: Infrahyoid muscle : Sternohyoid, Omohyoid, Sternothyroid, Thyrohyoid

Anteriolateral muscles of the neck



Group 1: superficial muscles of the Neck:

Platysma:

Origin: Superficial **fascia** over the **upper** part of the pectoralis fascia and the deltoid muscle

Course: Fibers cross the **clavicle**, and proceed obliquely upward and medially along the side of the neck.

Insertion:

Anterior fibers: Interlace, below and behind the **symphysis menti**, with the fibers of the muscle of the opposite side

Posterior fibers: cross the **mandible**, Some being inserted into the bone below the oblique line, Others into the skin and **subcutaneous** tissue of the lower part of the face. Many of these fibers blend with the muscles about the angle and lower part of the mouth

Relationship: Beneath it, the **external jugular vein** descends from the angle of the mandible to the clavicle.

Innervation : Cervical branch of Facial nerve

Blood supply : Submental branch of the facial artery

Action:

Draws the corners of the **mouth inferiorly** & widens it (as in expressions of sadness & fright).

Expression of surprise (pull the corner of the mouth downward & laterally partially opening the mouth)

With maximum contraction pulls the skin over the clavicle upward causing wrinkles

draws the **skin** of the neck superiorly when u clench the teeth

Increase neck diameter (In forced rapid respiration)

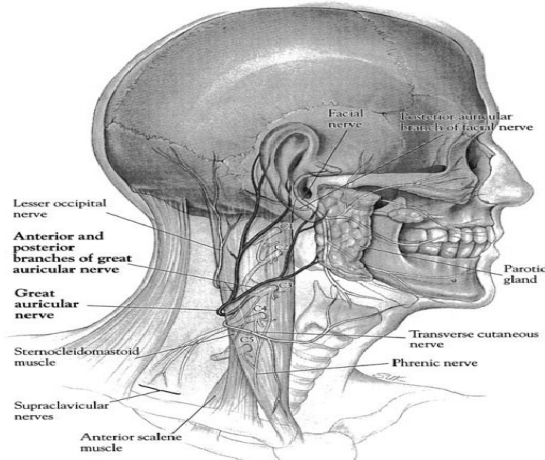
Group II: Lateral muscles of the Neck

1- Sternocleidomastoid Muscle:

Origin:

Sternal head: thick **tendon**, which inserts into the anterior & lateral surface of the manubrium

Clavicular head: **muscular** and inserts into the medial 1/3 of the clavicle.



Insertion: clavicular head mainly to the lateral aspect of the mastoid tip & sternal head mainly to the lateral 1/2 of the superior nuchal line.

Action: The muscle combines a cruciate and spiralized arrangement of fibres, This gives a complex action which:

- Tilts the head to the shoulder on the same side
- Rotates the head to the opposite side
- assist longus coli in neck flexion

Nerve Supply:

Motor: Spinal accessory motor C2-3

Sensory & proprioceptive Nerve Supply: Anterior/ventral Rami of **C2-4** segments

Fibrositis of the upper part of the SCM cause referred otalgia

Blood supply:

Comes from the superior and inferior ends of the muscle with anastomoses in the middle of the muscle.

The **superior** pedicle: branches of the **occipital** artery

The **inferior** pedicle: Branches of the **superior** thyroid vessels

Relation to other structures: External jugular vein & Cutaneous nerves lies deep to the platysma and superficial to SCM

1- Trapezius

Origin: medial 1/3 of the superior nuchal line, ligamentum nuchae down to the seventh cervical vertebra, and all the spinous processes and interspinous ligaments down to the 12th thoracic vertebra.

Insertion:

- o Superior fibers: insert into the clavicle and acromium
- o Inferior fibers (from the thoracic vertebrae): insert into the spine of the scapula.

Action:

Rotate the scapula so that the glenoid fossa points up.

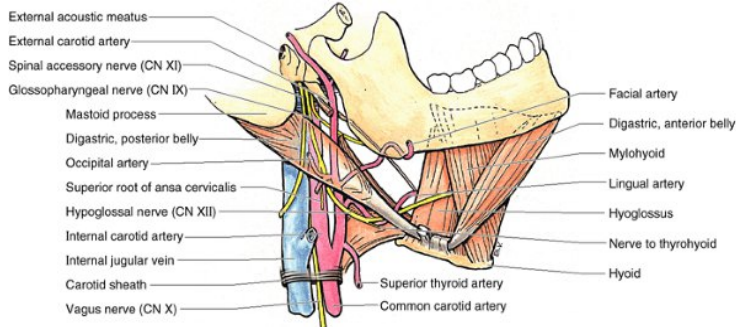
The trapezius is the major antigravity muscle of the shoulder girdle

Nerve supply:

Motor: spinal part of the accessory nerve from roots C1-6, Cervical plexus (some fibers)

Proprioceptive: the cervical plexus.

Paralysis: a common consequence of surgical damage to the accessory nerve in the posterior triangle due to malrotation of the scapula and traction on the brachial plexus, which leads to severe chronic neck pain.



Right lateral view

Group III: Suprahyoid muscle:

As a group assists in:

Elevating the Hyoid bone during swallowing

Depress the mandible & open the mouth when the hyoid is fixed by the infrahyoid muscles

Superficial layer:

1- **Digastric muscle:**

Origin of Posterior Belly: Digastric **ridge** (which is on the **medial** aspect of the mastoid tip)

Course:

- o **Posterior** Belly Runs anteroinferiorly and becomes an intermediate tendon, which runs below a **fibrous ring** that is attached to the **lesser** cornu of the hyoid (so is **not** directly attached into the hyoid bone), Movement of this tendon is lubricated by a **synovial sheath**.
- o **Anterior** belly then runs anterosuperiorly

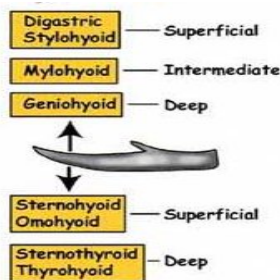
Insertion of the anterior belly: digastric fossa on the inner surface of the mandible.

Action: elevates hyoid during swallowing and assists the **lateral** pterygoid in depressing **mandible**

Innervation:

Posterior belly: facial nerve: Digastric branch

Anterior belly: trigeminal nerve: mandibular division: inferior alveolar branch: a branch from the nerve to mylohyoid, Reflecting its 1st and 2nd branchial arch embryology



This muscle encloses the Digastric triangle, forms a landmark for the **main trunk of the facial** nerve and represents a deep boundary of dissection for safe avoidance of the **Hypoglossal nerve**

Note that the **posterior** belly is **longer** than the **anterior** belly

The relationship of the posterior belly of digastrics muscle to other structures:

All vessels and nerves cross deep to this belly except for:

- o **cervical** branches of the **facial** nerve (CN VII)
- o

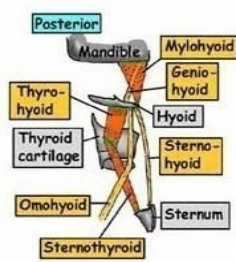
facial

branches of the **great** auricular nerve

- o **EJV** and its connections (superficial to SCM)

1- **Stylohyoid Muscle:** Narrow muscle located superior and anterior to the posterior belly of the Digastric muscle

- o Origin: Posterio-lateral aspect of the Styloid process
- o Insertion: Body of the hyoid at the Junction between the lesser horn and the body of the hyoid bone
- o Action: Retracts & elevates the Hyoid; Elongates the floor of the mouth



Innervation: Facial Nerve

Intermediate layer

- 1- **Mylohyoid Muscle:** A flat triangular muscle that with its opposite form the floor of the mouth
Origin: Oblique line of the mandible from the mandibular Symphysis to the last molar

Insertion:

Anterior + middle fibers: median raphe

Posterior Fibers: body of the hyoid

Action:

Elevates the floor of the mouth

Elevates the hyoid and assist in elevating the tongue upward or protrude the tongue

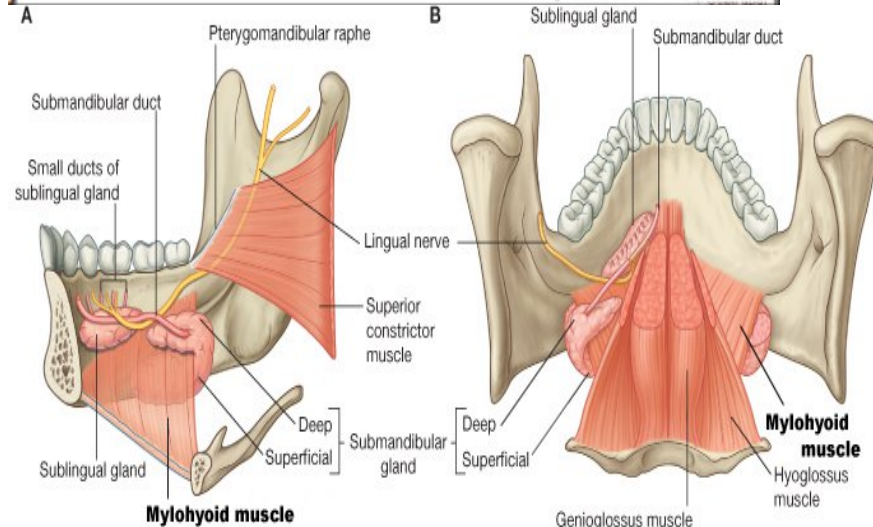
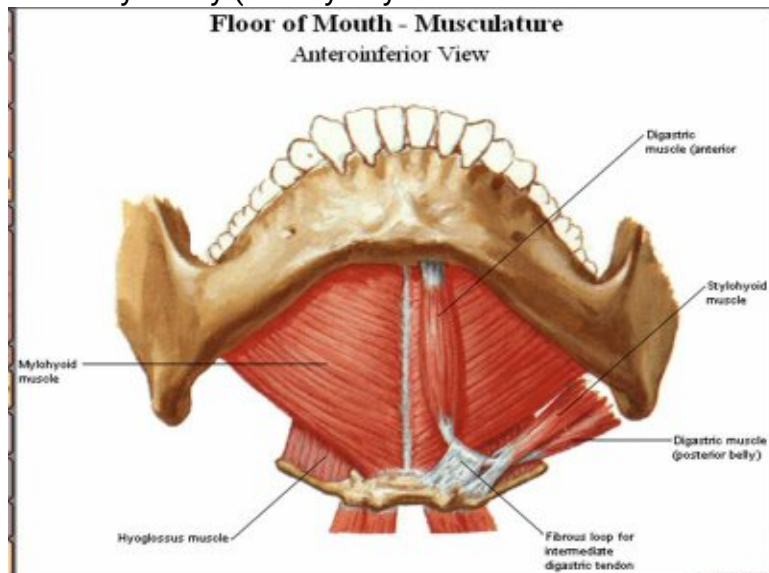
Lower the mandible and assists in opening the mouth; Acts in swallowing, sucking, mastication, blowing

Innervation: Trigeminal nerve: mandibular division: inferior alveolar branch: Mylohyoid branch

Blood supply:

lingual artery (sublingual branch)

maxillary artery (the mylohyoid branch of the inferior alveolar artery)



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facial artery (submental

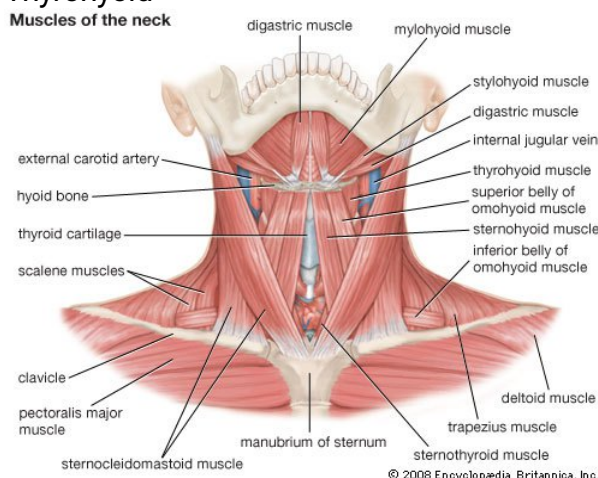
branch)

Deep layer:

- 1- **Geniohyoid muscle:** Narrow muscle that is located deep to the medial aspect of the Mylohyoid muscle
- o Origin: Inferior mental spine in the inner surface of the mandibular symphysis
 - o Course: Inferioposterior
 - o Insertion: The Contralateral Mylohyoid muscle; Body of the hyoid bone
 - o Action:
 - pulls & elevates the hyoid causing shortening of the floor of the mouth during swallowing
 - Retracts and depresses the mandible when the hyoid bone is fixed by the infrahyoid muscle
 - o Innervation: C1 root of the hypoglossal nerve

Group IV: Infrahyoid muscles: strap muscles:

Made of 4 muscles that cover thyroid, larynx & trachea: Sternohyoid, Omohyoid, Sternothyroid, Thyrohyoid



Forms the **floor** of the muscular triangle

The **lower** part is covered by the sternoclenomastoid

The strap muscles are retracted to reach the thyroid and the trachea

Form the anterior boundaries of neck level

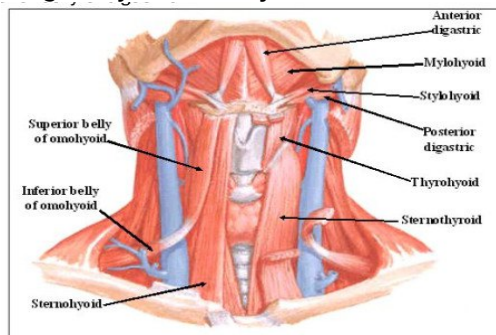
Action:

Move the larynx; Depress the mandible

Innervation: from **C1, C2 & C3** via **anas Cervicalis**

Omohyoid:

Origin: hyoid bone just lateral to the attachment of sternohyoid



Course: it courses inferiorly, it diverges laterally, runs deep to the sternomastoid and crosses the internal jugular vein at which point it becomes a tendon.

It is a useful landmark for the internal jugular vein.

Lateral to the internal jugular vein the inferior muscle belly develops, runs across the posterior triangle

Insertion: Suprascapular ligament and the lateral acromium.

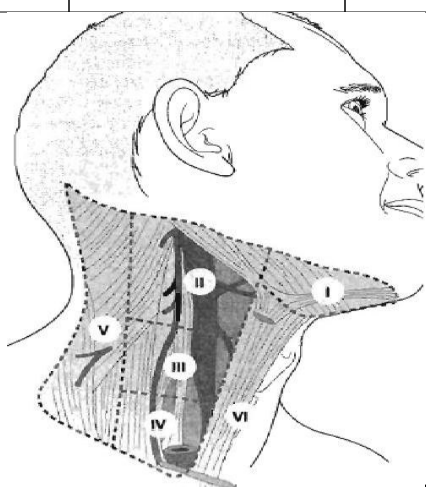
Nerve supply : ansa cervicalis

Embryologically: Its distal insertion is to the medial clavicle and it migrates laterally to the adult position

Function: is obscure.

Level	Triangle/neck area	Subzones	Drained structures
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Level 1	Submental	Zone 1a	anterior floor of mouth, lower lip, ventral tongue
1	Submandibular	Zone 1b	Rest of the oral cavity
Level 2	Upper jugular L.N	Zone IIa	Parotid, oropharynx, hypopharynx, larynx
		Zone IIb(submascular recess)	
Level 3	Middle jugular		Pharynx, larynx
Level 4	Lower jugular		Hypopharynx, larynx
Level 5	Posterior triangular	Zone Va = occipital	nasopharynx
		Zone Vb= supraclavicular	Thyroid gland
Level 6	Central /anterior		Paratracheal, pertracheal, peri thyroidal Delphian (precricoid)



Jugular Lymph node/deep cervical

80% of lymph nodes in the neck are closely associated with the internal jugular vein.

Upper Jugular / deep cervical

The most superior segment of the vein extends from the skull base to the level of the carotid bifurcation which coincides with the level at which the greater cornu of the hyoid bone crosses the internal jugular vein.

At the most superior extent of the vein, it runs deep to the digastrics muscle.

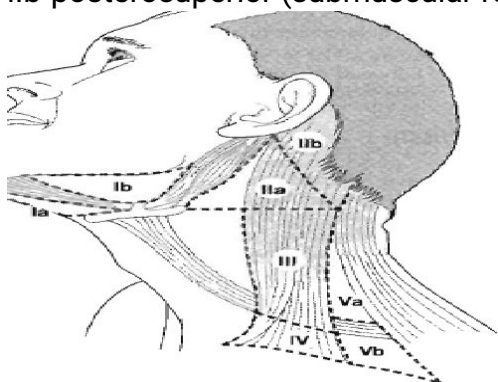
Nodes found here are referred to as the jugulodigastric nodes.

They drain the palatine tonsil

LEVEL II: The course of the spinal accessory nerve divides this level into two subzones:

Level IIa lies anteroinferior to the spinal accessory nerve

IIb posteriosuperior (submuscular recess).



It is a clinically useful anatomical differentiation because positive level IIa disease mandates IIb dissection

However elective dissection for laryngeal and hypopharyngeal malignancy can exclude level IIb.

Middle jugular/ deep cervical nodes

Found between the carotid bifurcation and the level at which the omohyoid tendon crosses the internal jugular vein.

Lower jugular/ deep cervical nodes:

are those between the tendon of omohyoid and down to the thoracic inlet. They are sometimes referred to as the prescalene group of nodes.

They form an important confluence between the mediastinal node group, the axillary group and the neck.

This communication can be a reason why neck nodes may appear secondary to disease outside the neck.

Note: the middle & lower jugular L.N lies below the level of hyoid bone and drain the hypopharynx

LEVEL V sub zones:

Va:

- o lies superior to the inferior belly of the omohyoid muscle
- o contains the chain of nodes along the accessory nerve, which drain the nasopharynx

Vb:

- o inferior to the omohyoid muscle.
- o contains nodes related to the thyrocervical trunk which drains the thyroid gland.

Note:

Nasopharynx: drain into retropharyngeal & upper deep cervical

All areas of the pharynx will drain ultimately into the lower deep cervical

Base of the tongue has rich bilateral drainage, hence the high incidence of neck metastases of tongue base CA

Tonsils drain into jugulodigastric lymph node

Pyriform fossa drain into para+pre tracheal L.N

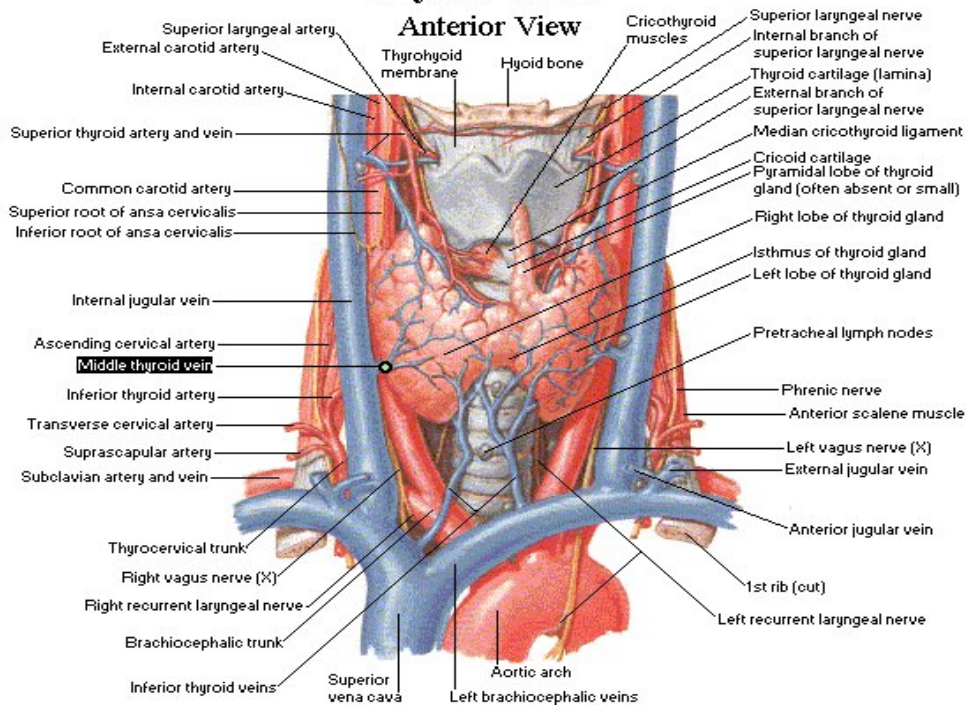
Arterial blood supply

Thyroid gland

	Superior thyroid artery	Inferior thyroid artery
Origin	external carotid artery	thyrocervical trunk which arise from the Subclavian artery
Course	along the inferior constrictor muscle	along the anterior scalene muscle crossing beneath the long axis of the common carotid artery behind the cricothyroid joint inferior to the inferior constrictor
Relation to the nerve	posteriolateral to the superior laryngeal nerve	Lies in 70% anterior to the recurrent laryngeal nerve Then The nerve will cross deep to the inferior thyroid artery at the inferior pole approximately 70% of the time and often branches above the level of the inferior thyroid artery before entry into the larynx
Relation to the thyroid pole	Enter the upper pole anteriorly	Enter the lower pole Posteriorly

Thyroid Gland

Anterior View



Inferior thyroid artery is also the

primary blood supply of the superior & inferior parathyroid gland

Venous drainage of the thyroid gland:

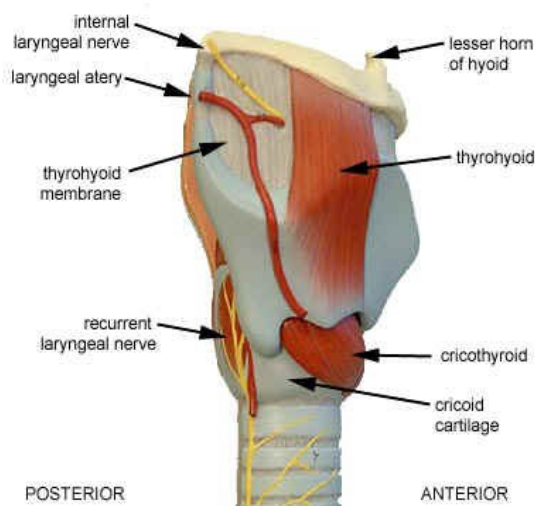
Superior and middle thyroid veins, drain into the anterior facial and internal jugular veins, inferior thyroid and thyroid ima veins which drain into the innominate veins brachiocephalic trunk

Lymphatic drainage of the thyroid gland:

1. Superior deep cervical
2. Inferior deep cervical
3. Paratracheal
4. Superior pretracheal L.N

Thyroid capsule:

The thyroid gland is enclosed by the **visceral** layer of the **middle** layer of the **deep** cervical fascia



The true thyroid capsule is tightly adherent to the thyroid gland and continues into the parenchyma to form fibrous septa separating the parenchyma into lobules.

The surgical capsule is a thin, film-like layer of tissue lying on the true thyroid capsule.

Posteriorly, the middle layer of the deep cervical fascia condenses to form the posterior suspensory ligament, or **Berry's ligament**, connecting the lobes of the thyroid to the **cricoid cartilage** and the **first two**

tracheal rings.

Thyroid gland position:

Isthmus **2nd-4th** tracheal ring

The inferior lobe may extend into the **6th** tracheal ring

Pyramidal lobe:

Approximately **40%** of patients have a **pyramidal lobe** that arises from either lobe or the **midline** isthmus and extends **superiorly**

What is the embryologic origin of the thyroid gland?

The median downgrowth of the first and second pharyngeal pouches in the area of the foramen cecum.

From which pharyngeal pouches are the inferior parathyroid glands derived? Third.

What is the predominant glycoprotein found in colloid? Thyroglobulin.

What is the function of pendrin?

Mediates exchange of iodide from the thyrocyte to the colloid, which is one of the first steps of thyroid hormone synthesis.

What is the NIS?

A Na/I symporter that serves to concentrate I into cells. It is found in the thyroid gland, salivary glands, gastric mucosa, placenta, ciliary body of the eye, the choroids plexus, the mammary glands, and certain cancers. Except for the thyroid gland, the NIS in these tissues does not respond to TSH.

What are the three plasma proteins that bind thyroid hormone?

Albumin, transthyretin, and thyroxine-binding globulin (TBG).

What percent of the population has more than four parathyroid glands? 10%.

What percent of the population has only three parathyroid glands? 3%.

What percent of parathyroid glands are located in the mediastinum? 2%.

True/False: The inferior glands vary more in location than the superior glands. True.

Where are the inferior parathyroids typically located?

Inferior and anterior to the inferior thyroid artery.

Where are the superior parathyroids typically located?

Superior and posterior to the inferior thyroid artery and more likely to extend posteriorly and inferiorly or be found retroesophageally.

What is the primary blood supply of the parathyroid glands?

The superior and inferior parathyroid arteries, which are usually branches of the inferior thyroid artery.

What are the three types of cells comprising the parathyroid glands? Chief cells, clear cells, and oxyphil cells.

Which cells produce PTH? Chief cells.

What percent of a parathyroid gland is composed of fat? 20-30%.

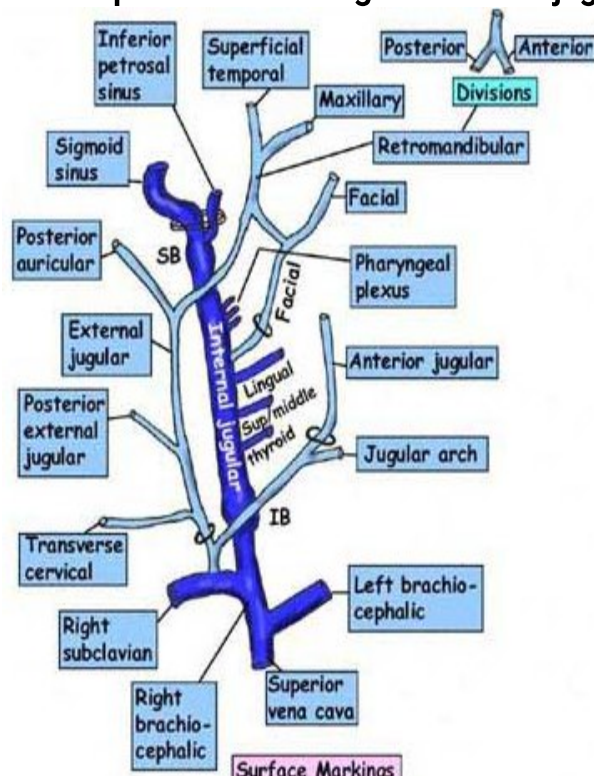
Which terminal of PTH is active? N-terminal.

Venous Drainage

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
 Posterior auricular vein + posterior retromandibular vein = external jugular vein

Note:

retromandibular vein = temporomaxillary vein = posterior facial vein
inferior petrosal vein + sigmoid sinus= jugular bulb



tributaries of internal jugular vein:

pharyngeal plexus
 common facial
 lingual
 superior & middle thyroid vein
 subclavian

note the inferior thyroid vein drain into the brachiocephalic trunk