

MBB Lab 1 PowerPoint Handout

Anatomy of the Neck

Don't be intimidated by the length of this PowerPoint Handout. Many of the slides are review from MSI or previous MBB labs. All review slides are indicated by: **(Review)**.

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Cervical Vertebral Column (Review)

- Recall that the secondary curve that develops in the cervical region is the cervical lordosis (Figure 1).
- The C7 vertebra has a long spinous process. When the neck is fully flexed, the long spinous process of the C7 vertebra projects more posteriorly than that of nearby vertebra and can therefore be easily seen and palpated. For this reason, the C7 vertebra is known clinically as the **vertebra prominens** (Figure 2).
- The **transverse foramina** are associated with the transverse processes of each cervical vertebra. The transverse foramina collectively form the **transverse foraminal canal** that contains the vertebral artery. Typically the vertebral artery enters the canal at C6 or C5 (not C7) (Figure 3). Upon exiting the transverse foramen of the C1 vertebra the vertebral artery turns medially to course on the posterior arch of the atlas before turning superiorly to enter the cranial cavity through the foramen magnum.

Figure 1

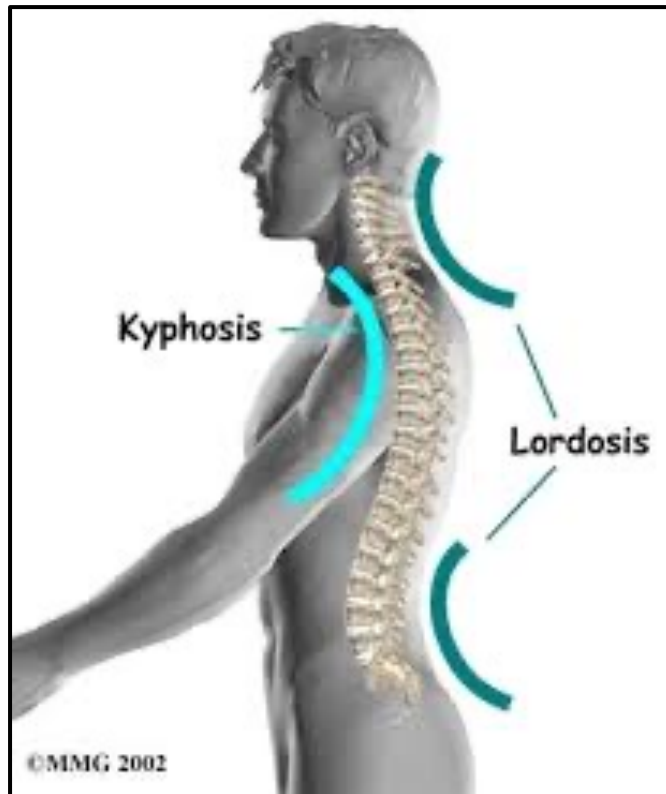


Figure 2

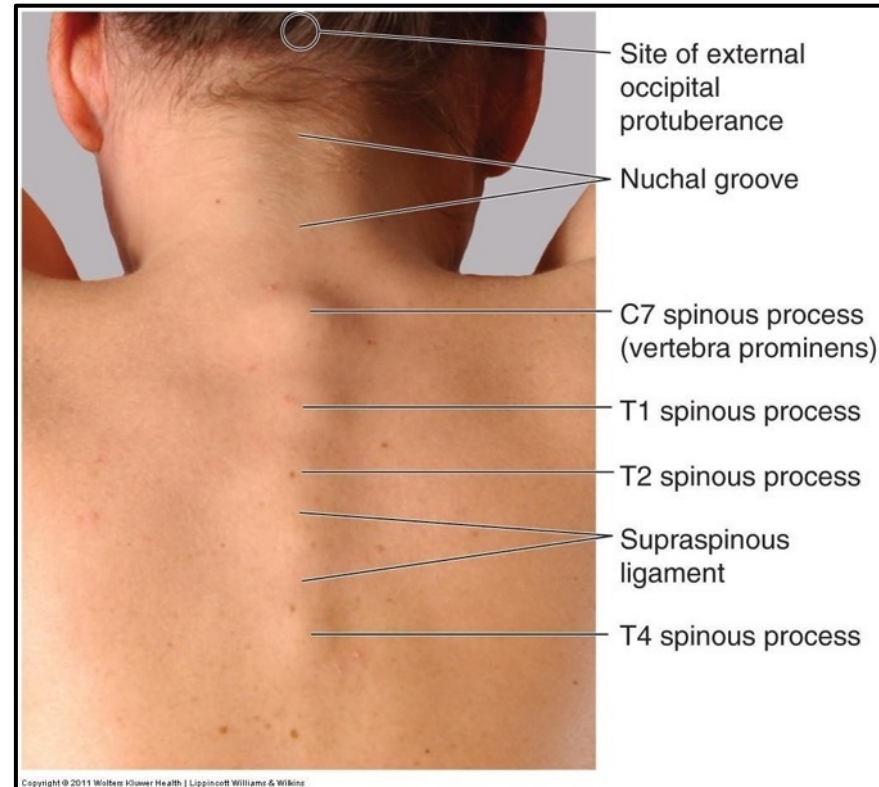
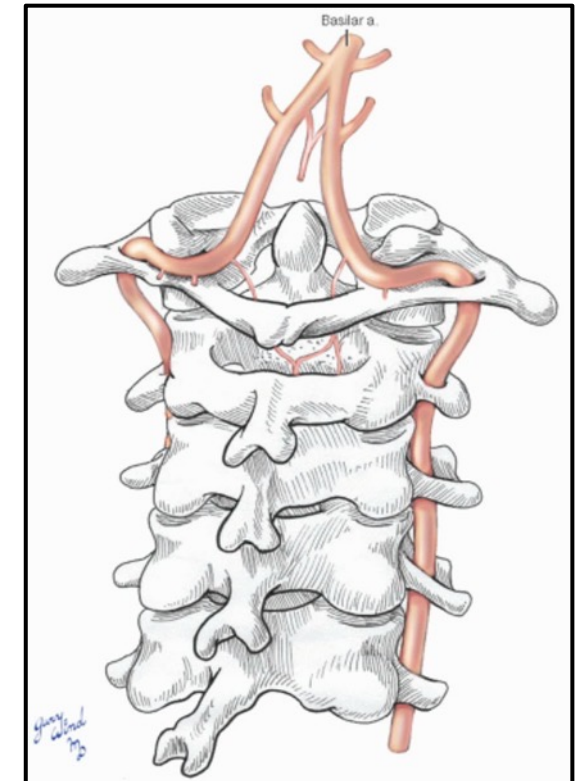


Figure 3



Thoracic Outlet (Review)

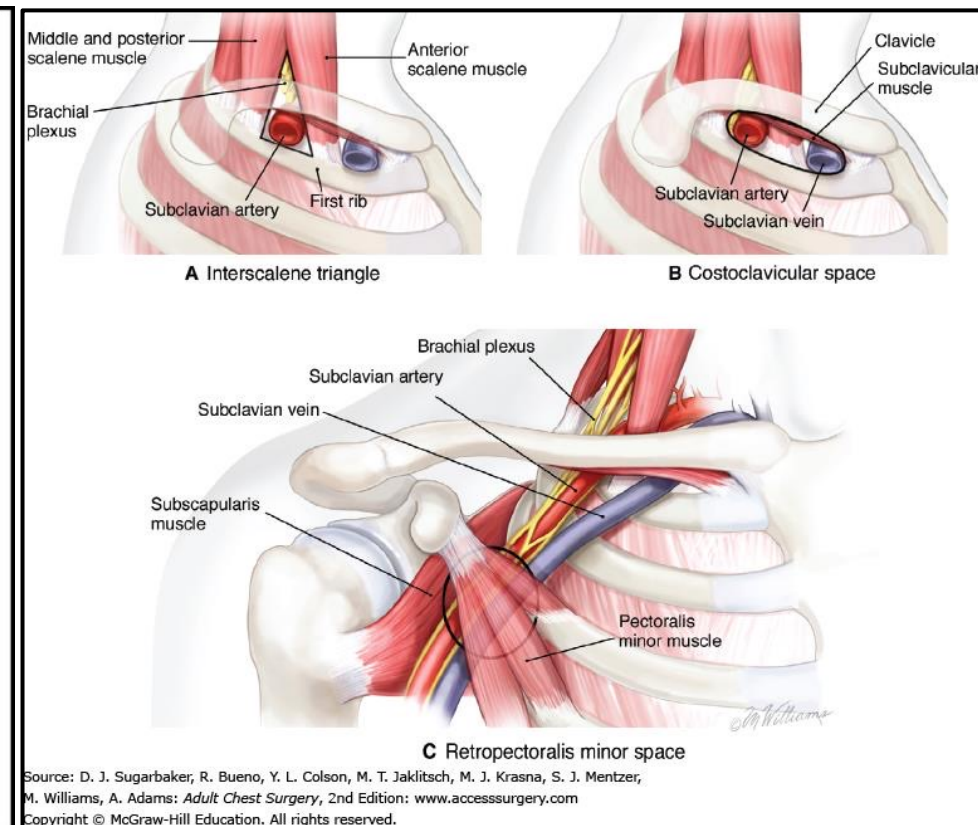
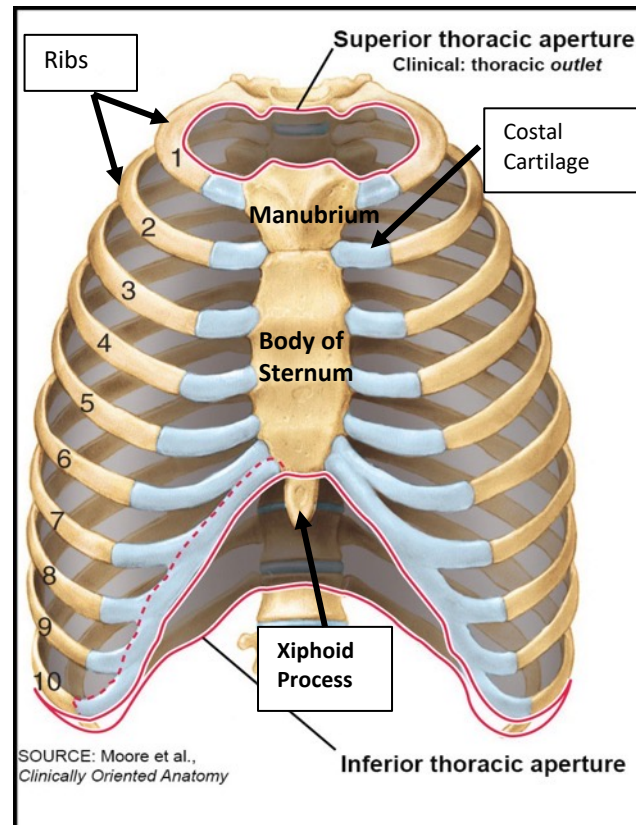
The aperture defined by the internal margins of the T1 vertebra, the first pair of ribs, and the manubrium outline a space clinically referred to as the thoracic outlet. Anatomically, this opening is referred to as the superior thoracic aperture.

- All vessels supplying and draining the head, neck, and upper limbs pass through the thoracic outlet.
- In addition to passing through the thoracic outlet, vessels passing to and from the upper limbs must also pass inferior to the clavicle, which is why these vessels are named subclavian (artery and vein).

CLINICAL ANATOMY: Thoracic outlet syndrome (TOS) is a condition arising from compression of the subclavian vessels and/or brachial plexus as they pass through the thoracic outlet into the axilla. Despite the significant pathology associated with TOS, some general disagreement exists among experts on the specific anatomy, etiology, and pathophysiology of the condition, presumably because of the wide variation in symptoms that manifest in patients. In addition, a definitive gold standard for diagnosis is lacking. Symptoms associated with TOS have traditionally been divided into vascular and neurogenic categories, a distinction based on the underlying structure(s) implicated. Of the two, neurogenic TOS (nTOS) is much more common, and typically presents as compression of the brachial plexus; primarily, but not exclusively, involving its lower trunk.

Three sites of possible compression are identified.

- Interscalene triangle
- Costoclavicular triangle
- Subcoracoid or sub-pectoralis minor space, which is a passageway inferior to the coracoid process and posterior to the pectoralis minor tendon.



Hyoid Bone (Review)

- The **hyoid bone** is located at the level of the C3/(C4) vertebrae in the lateral cervical radiograph (Figure2).
- The **hyoid bone** is unique in that it does not articulate with another bone. It is suspended from the styloid process of the temporal bone by the stylohyoid ligaments. In addition, it is connected to the thyroid cartilage of the larynx by the thyrohyoid ligament and supported by suprahyoid muscles, infrahyoid muscles, and the middle pharyngeal constrictor.
- The hyoid bone consists of three components (Figure 1):
 - **Body**
 - **greater horn**
 - **lesser horn**

Figure 1

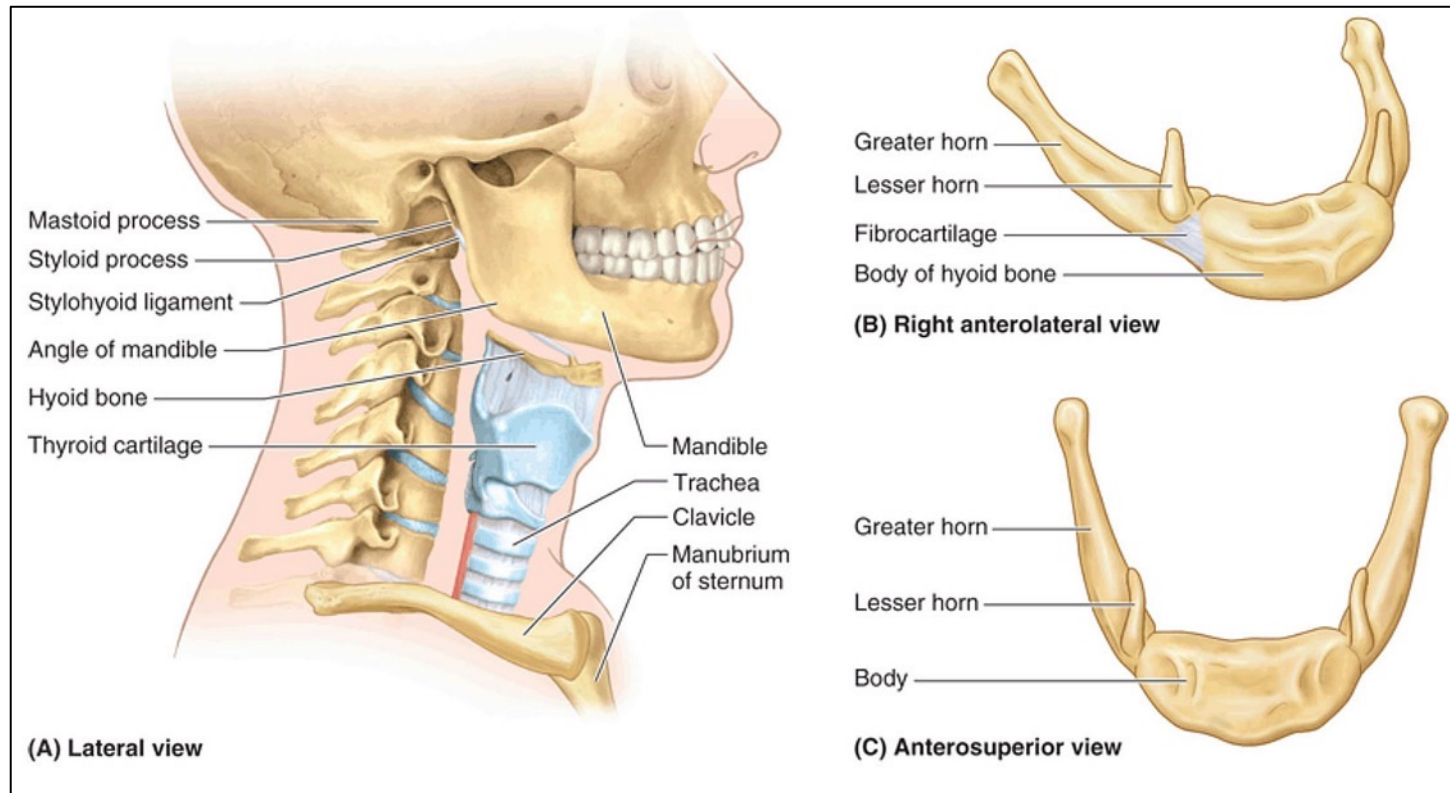
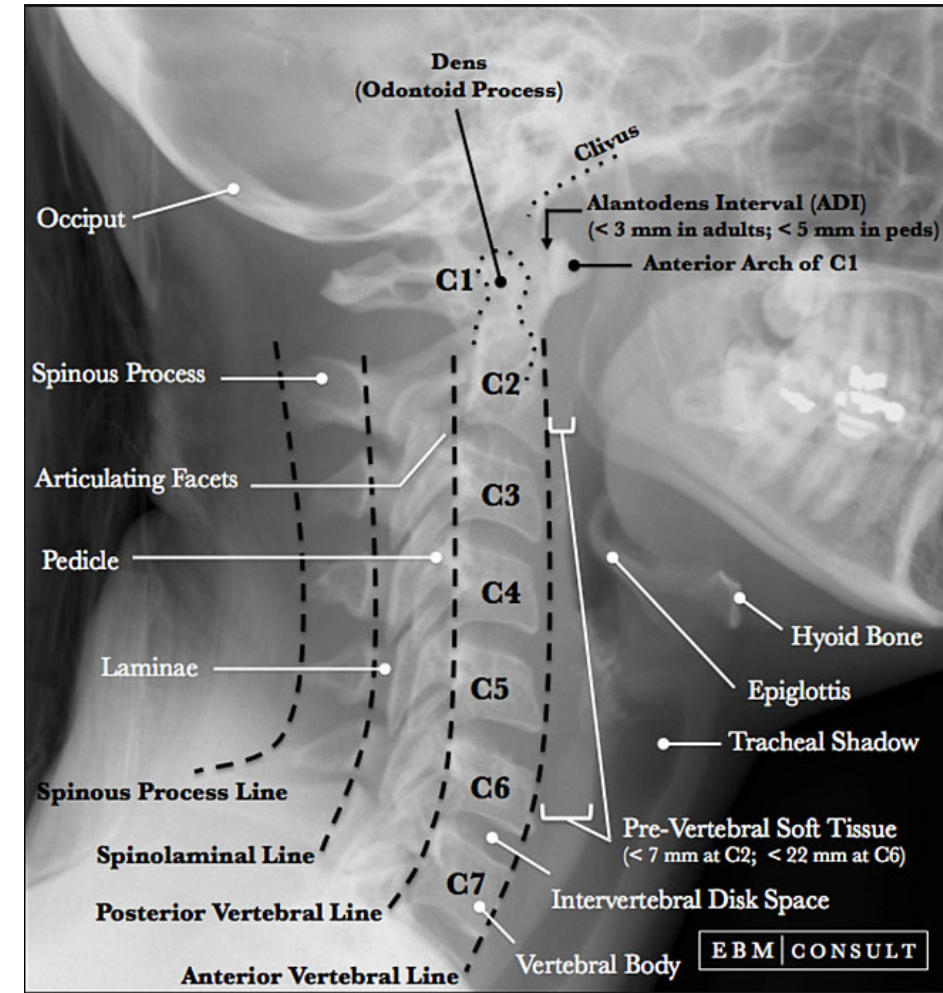


Figure 2

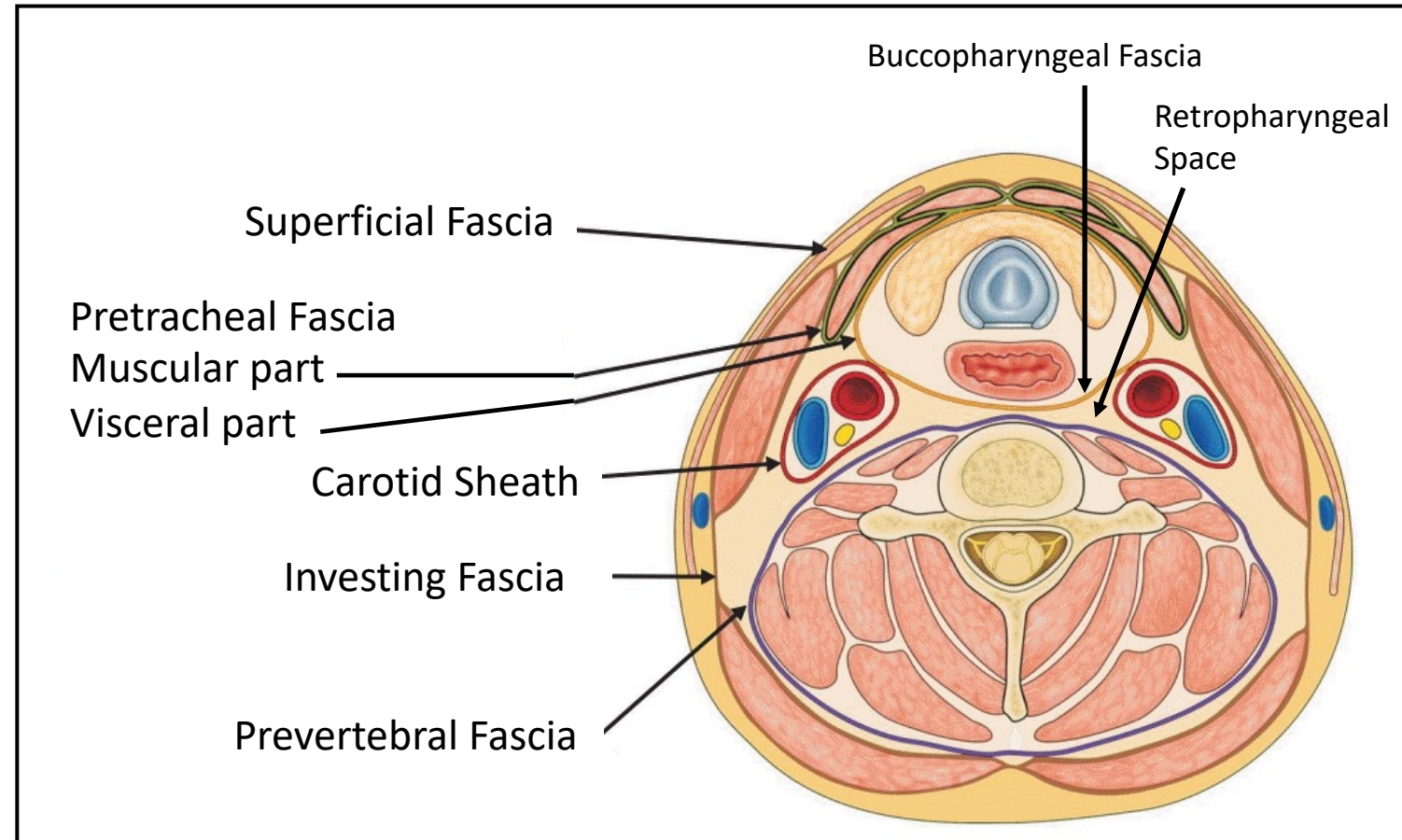


Cervical Fascia (Review)

The neck is a conduit for structures passing to the trunk from the head and vice versa. Included among these structures are numerous arteries, veins, nerves, muscles and viscera. These structures, which are crowded together within the neck, are compartmentalized by different layers of deep cervical fascia.

The **deep cervical fascia** consists of 3 layers that form sheaths around the structures of the neck. The arrangement of deep fascia can be described as “two tubes within a tube”.

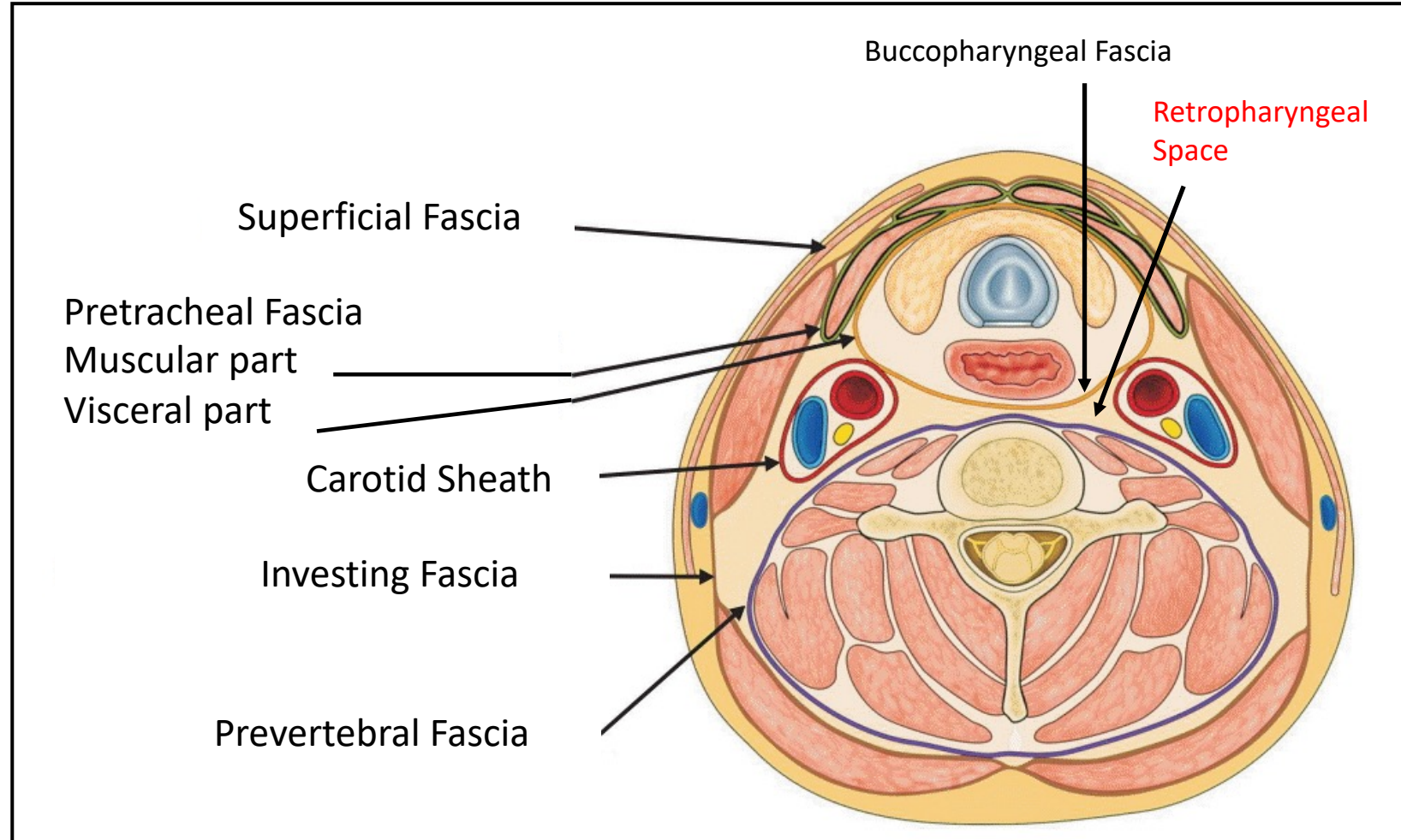
- **Investing layer** of deep cervical fascia is the outermost (superficial) layer of deep cervical fascia that completely surrounds the neck. The investing fascia is attached superiorly to the skull, and inferiorly to the manubrium, clavicles, and scapulae. Posteriorly it attaches to the spinous processes of cervical vertebrae. This fascia is named “investing” because it splits to surround both the **trapezius** and the **sternocleidomastoid** muscles.
- **Prevertebral fascia** is a posterior “tube” of fascia surrounding the cervical vertebral column and the muscles associated with it.
- **Pretracheal fascia** is the anterior “tube” of fascia, which can be divided into two parts
 1. The muscular part surrounds the infrahyoid muscles.
 2. The visceral part surrounds the viscera of the neck, which includes the, larynx, trachea, pharynx, esophagus, and thyroid gland. Note that the portion of the pretracheal fascia located posterior to the wall of the pharynx is termed the buccopharyngeal fascia. The space between the prevertebral fascia and the buccopharyngeal fascia (retropharyngeal space) is a potential conduit for the spread of infection from the pharyngeal region to the mediastinum in the thoracic cavity. This space will be observed in a future lab.
- All three layers listed above contribute to form the **carotid sheath**, which is a tubular fascia extending from the cranial base to the root of the neck. The carotid sheath encloses the common and internal carotid arteries, internal jugular vein, and vagus nerve.



Cervical Fascia: Retropharyngeal Space

The deep cervical fascial layers are clinically important because they determine the direction and extent to which an infection in the neck may spread to the thorax.

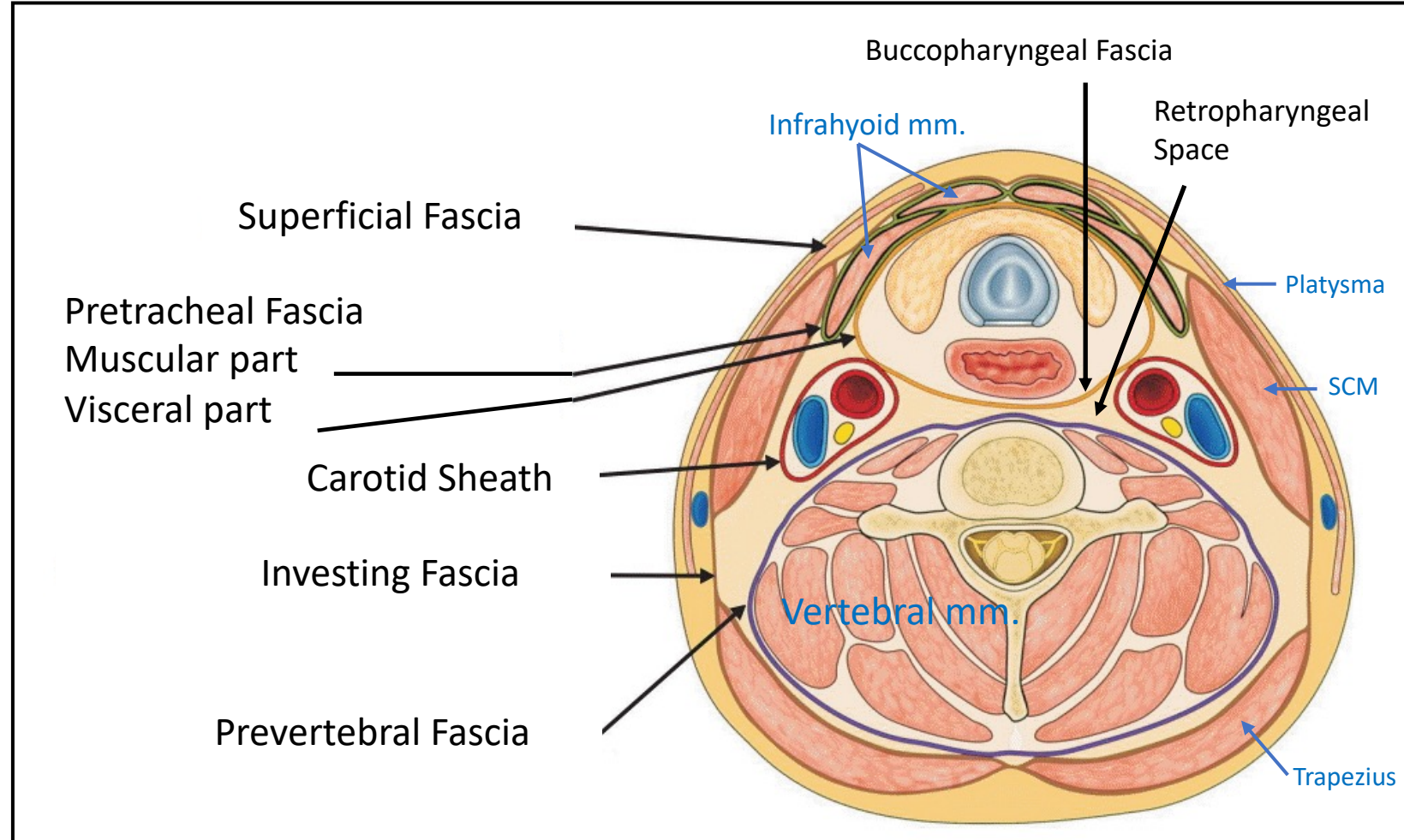
CINICAL ANATOMY: The **retropharyngeal space** is a potential space between the prevertebral fascia and the **buccopharyngeal fascia**. It is a potential conduit for the spread of infection from the pharyngeal region to the mediastinum in the thoracic cavity.



Neck Muscles: Overview

The muscles of the neck organized into groups according to their deep cervical fascia separations.

- The **platysma muscle** is located within the superficial fascia. Recall that it is innervated by the cervical branch of the facial nerve.
- **Sternocleidomastoid** and **trapezius** muscles are enclosed by **investing fascia**.
- Vertebral muscles are surrounded by **prevertebral fascia**.
- **Suprahyoid muscles** are *deep* to the **investing fascia**.
- **Infrahyoid muscles** are enclosed by **pretracheal fascia** (muscular part of pretracheal fascia).



Neck Muscles: Sternocleidomastoid and Trapezius (Review)

The **sternocleidomastoid** is named for its attachments to the mastoid process, clavicle and sternum.

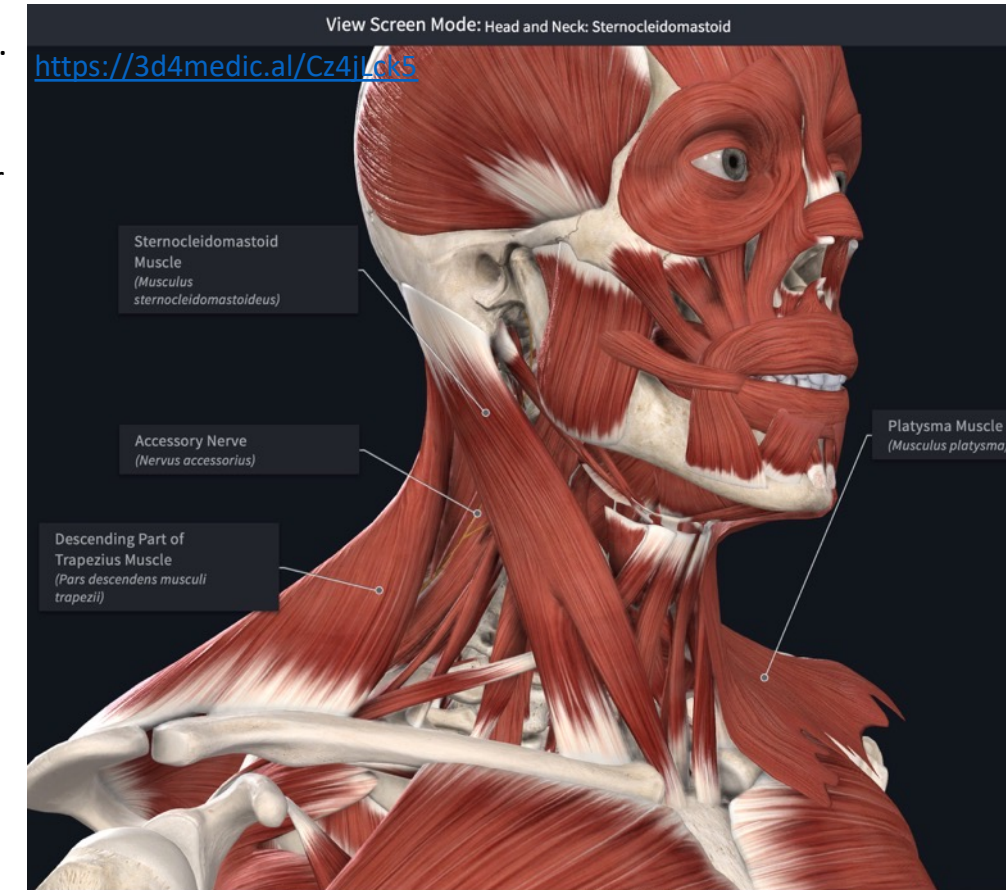
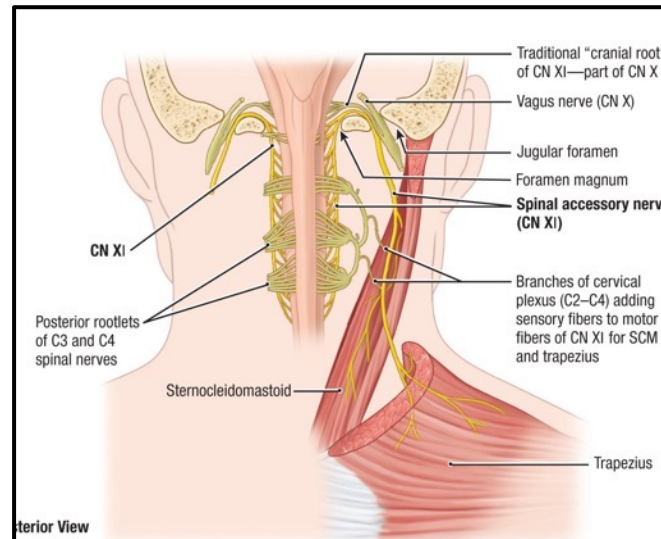
- It forms the separation between the anterior and posterior triangles of the neck.

The **trapezius** is attached to the occipital bone, nuchal ligament, spinous processes C7-T12, scapular spine, acromion, and the lateral clavicle.

- It forms the anterior border of the posterior triangle.

Both muscles are innervated by the **spinal accessory nerve**.

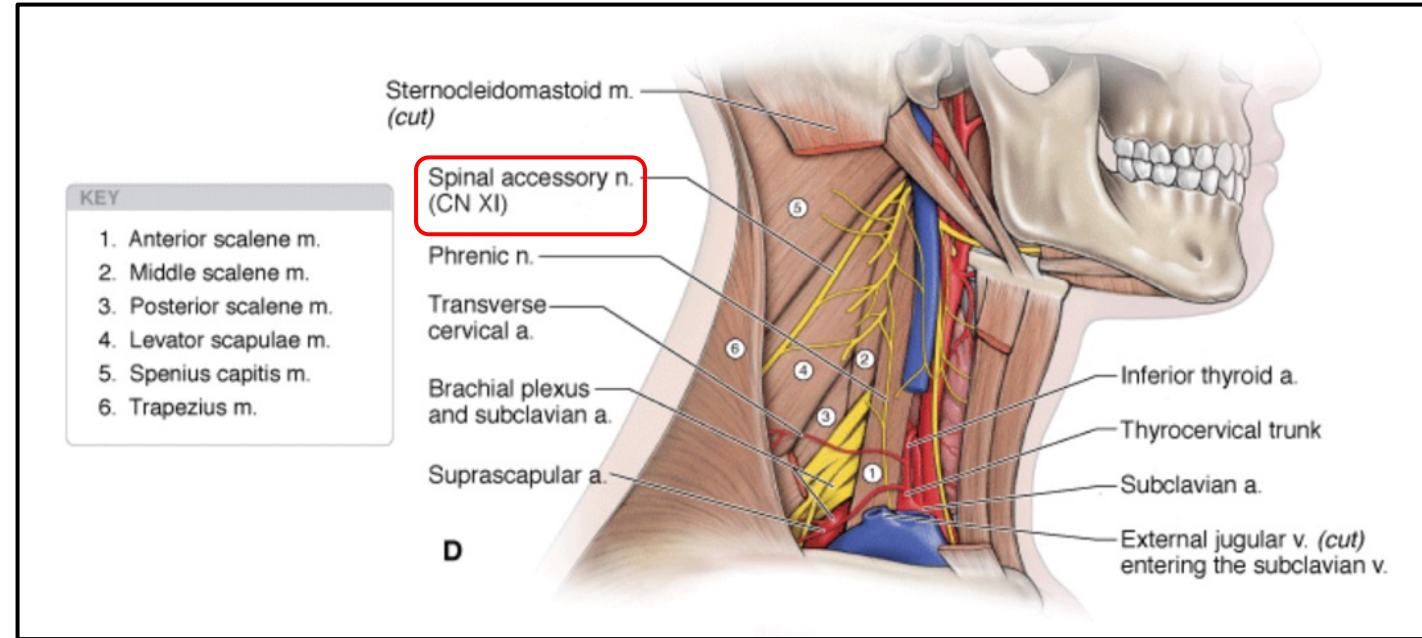
- After exiting the jugular foramen, the spinal accessory nerve descends along the internal carotid artery to reach the sternocleidomastoid muscle, which it innervates. It then traverses the posterior triangle of the neck to supply motor fibers to the trapezius.



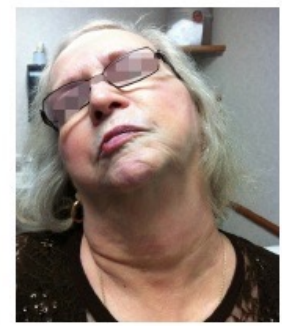
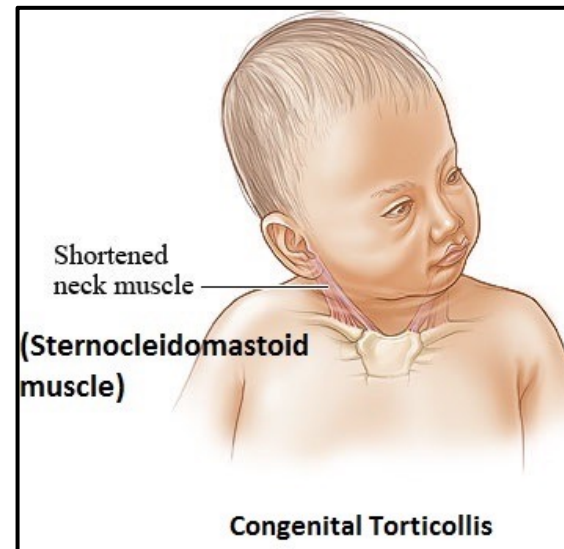
MUSCLE	INNERVATION	BLOOD SUPPLY	ACTION
Trapezius	Spinal accessory n	Transverse cervical a	<ul style="list-style-type: none"> • Superior fibers elevate scapula, upward rotation scapula (rotates glenoid cavity super) • Middle fibers retract scapula • Inferior fibers: depress scapula, upward rotation scapula (rotates glenoid cavity superiorly)
Sternocleidomastoid	Spinal accessory n		Bilateral contraction: flexion of the head and neck Unilateral contraction: <ul style="list-style-type: none"> • Ipsilateral lateral flexion • Contralateral rotation

Sternocleidomastoid: Clinical Anatomy (Review)

CLINICAL ANATOMY: The superficial course of the **accessory nerve** through the posterior triangle of the neck makes it susceptible to injury during lymph node biopsies, removal of tumor masses, and other surgical procedures in this region.



CLINICAL ANATOMY: Torticollis (twisted neck) is a contraction or shortening of the cervical muscles that produces a twisting of the head and slanting of the head. The most common type of congenital torticollis results from a fibrous tissue tumor that develops in the sternocleidomastoid muscle before or shortly after birth. When torticollis occurs prenatally, the abnormal position of the infant's head usually necessitates a breech delivery.



The right SCM is causing torticollis in all photos.

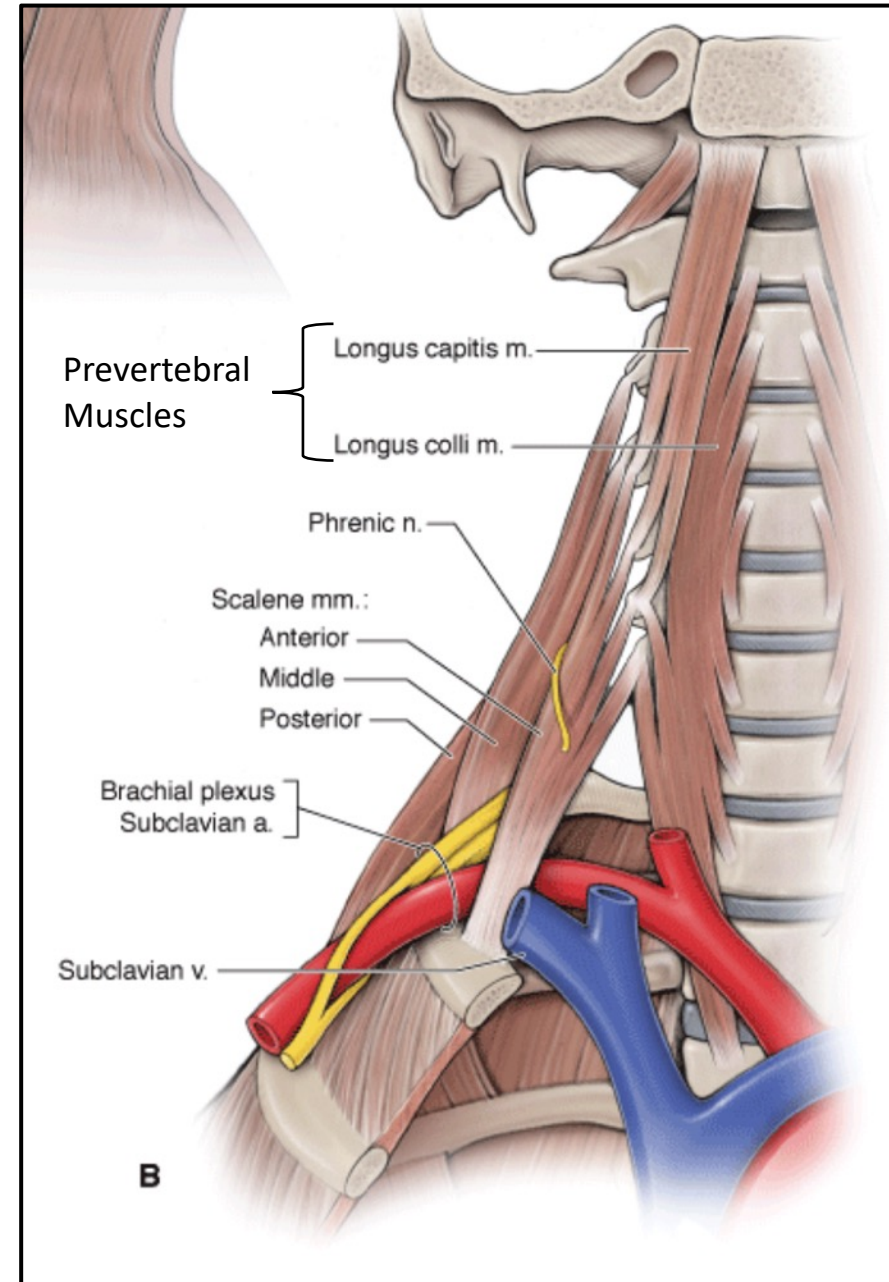
Neck Muscles: Vertebral Muscles (Review)

The vertebral muscles are surrounded by **prevertebral fascia** and can be organized into three groups.

- Prevertebral muscles: These muscles are in an anterolateral position relative to the vertebral column. The prevertebral fascia covering them forms the posterior boundary of the retropharyngeal space.
- Deep cervical muscles: This group is located posteriorly in the neck and consists of splenius, erector spinae, and transversospinalis muscles.
- Scalene muscles: The **anterior, middle, and posterior scalene muscles** attach to the cervical transverse processes and the first two ribs. The anterior scalene, middle scalene, and first rib form the boundaries of the **interscalene triangle**.

****The most important vertebral muscles in this series of labs are the **scalene muscles** because of their anatomical relationships to the following structures in the posterior triangle of the neck.**

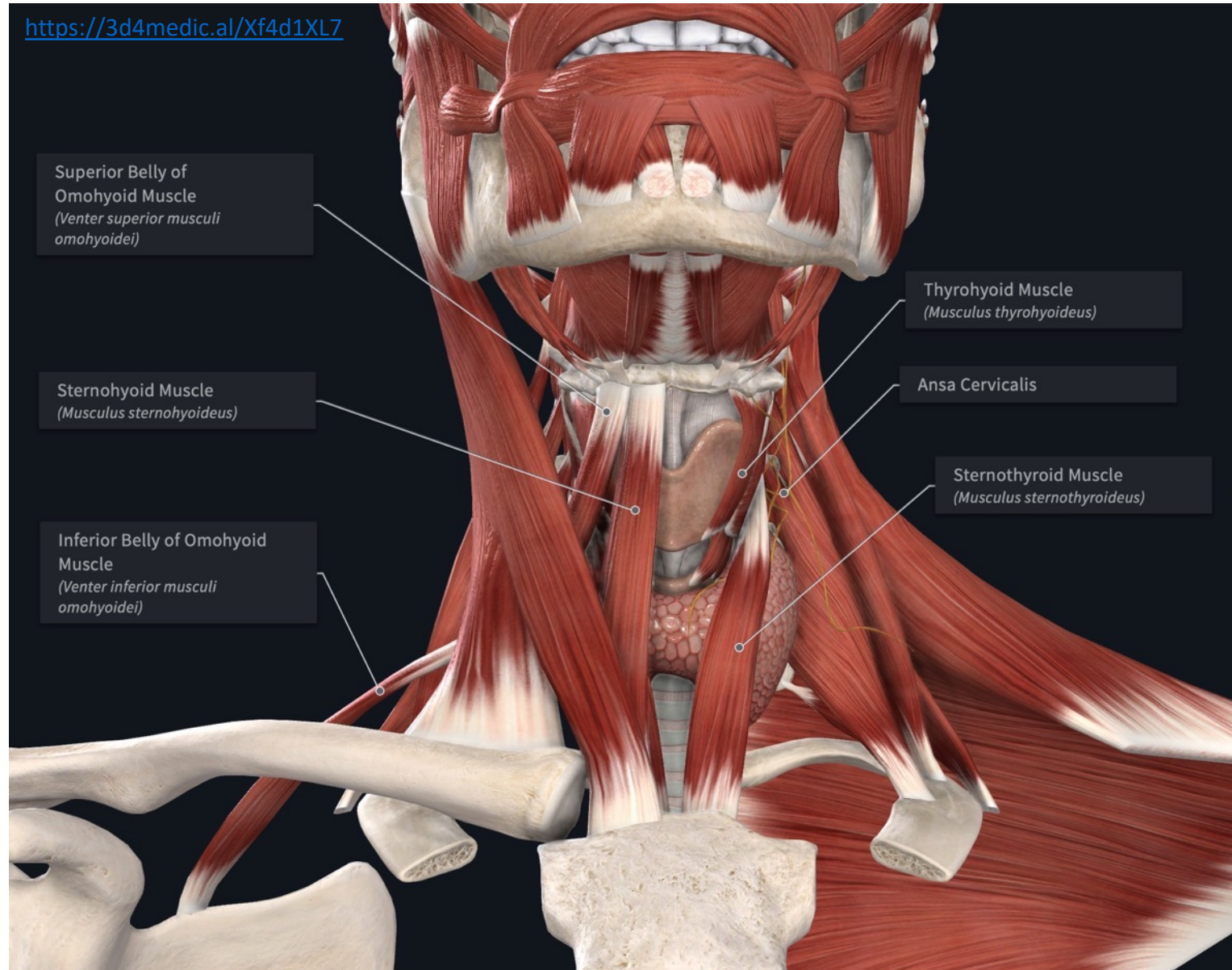
- The **rami of the brachial plexus** pass *through* the **interscalene triangle** to form the trunks of the brachial plexus.
- The **subclavian artery** passes *through* the **interscalene triangle**.
- The subclavian vein passes *anterior* to the **anterior scalene muscle**.
- The **phrenic nerve (C3-C5)** *descends* along the anterior surface of the **anterior scalene muscle** on its path to the thorax.
- The **dorsal scapular nerve** *pierces* the **middle scalene muscle**.



Neck Muscles: Infrahyoid Muscles (Review)

The muscles located inferior to the hyoid are referred to as the infrahyoid muscles. They are also known as the strap muscles because of their flattened, strap-like appearance.

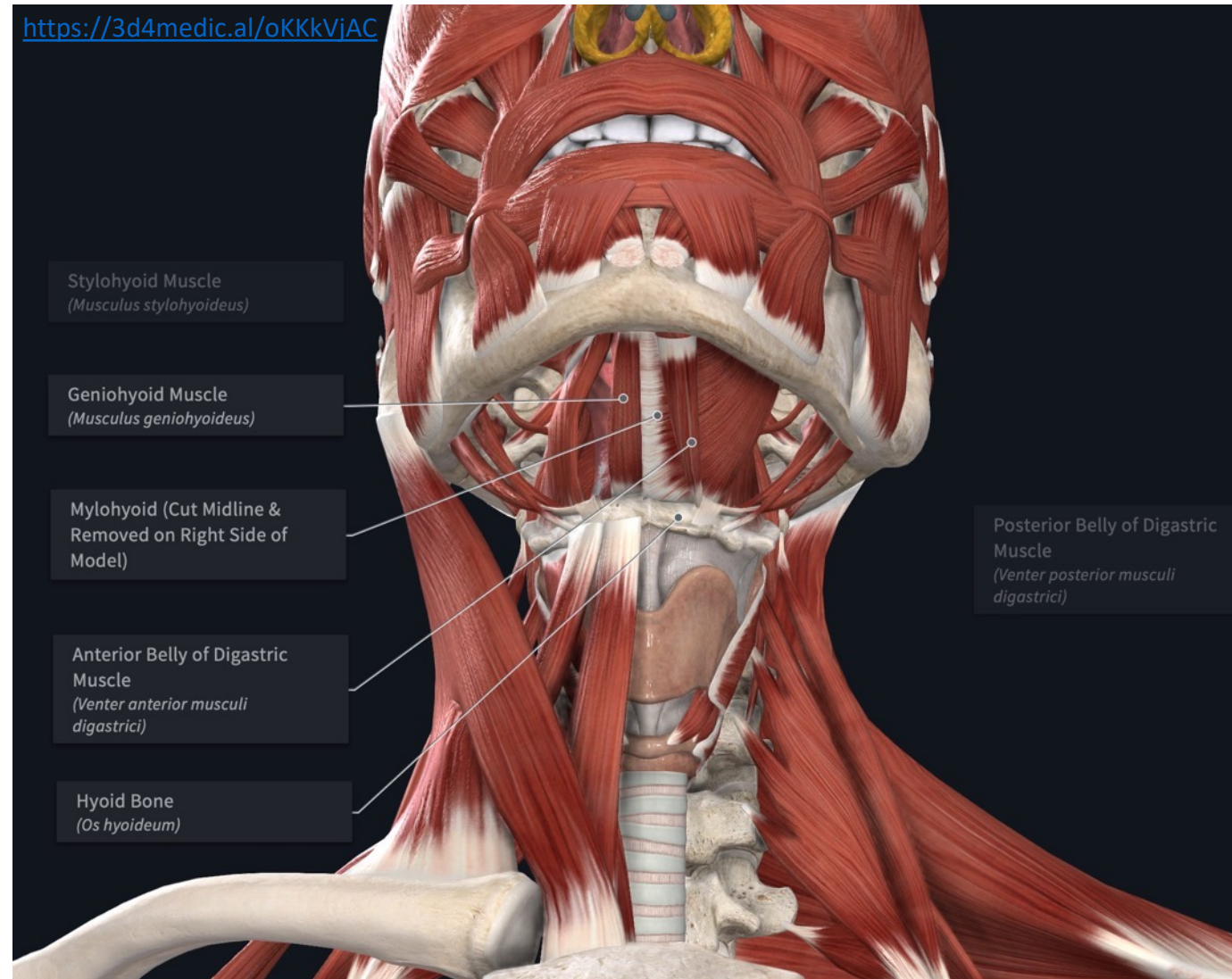
- They consist of 4 pairs of muscles surrounded by **pretracheal fascia**.
- The **infrahyoid muscles** function to depress or stabilize the hyoid bone and thyroid cartilage during swallowing and speech. They are innervated by the ventral primary rami of C1-3 via the ansa cervicalis of the cervical plexus.
- They are named according to their origins and insertions.
- Muscles
 - **Sternohyoid**
 - **Sternothyroid**
 - **Thyrohyoid**
 - **Omohyoid**



Neck Muscles: Suprahyoid Muscles (Review)

The the **suprahyoid muscles** muscles are attached to the hyoid bone and project in a superior direction.

- They are located **deep to the investing fascia** of the deep cervical fascia.
- They function primarily to elevate the hyoid during speaking and swallowing.
- Muscles
 - **Digastric muscle**
 - **Anterior belly:** innervated by CN V3
 - **Posterior belly:** innervated by the facial nerve
 - **Stylohyoid muscle:** innervated by the facial nerve
 - **Mylohyoid muscle:** innervated by CN V3
 - **Geniohyoid:** innervated by C1



Neck Triangles: Anterior vs Posterior (Review)

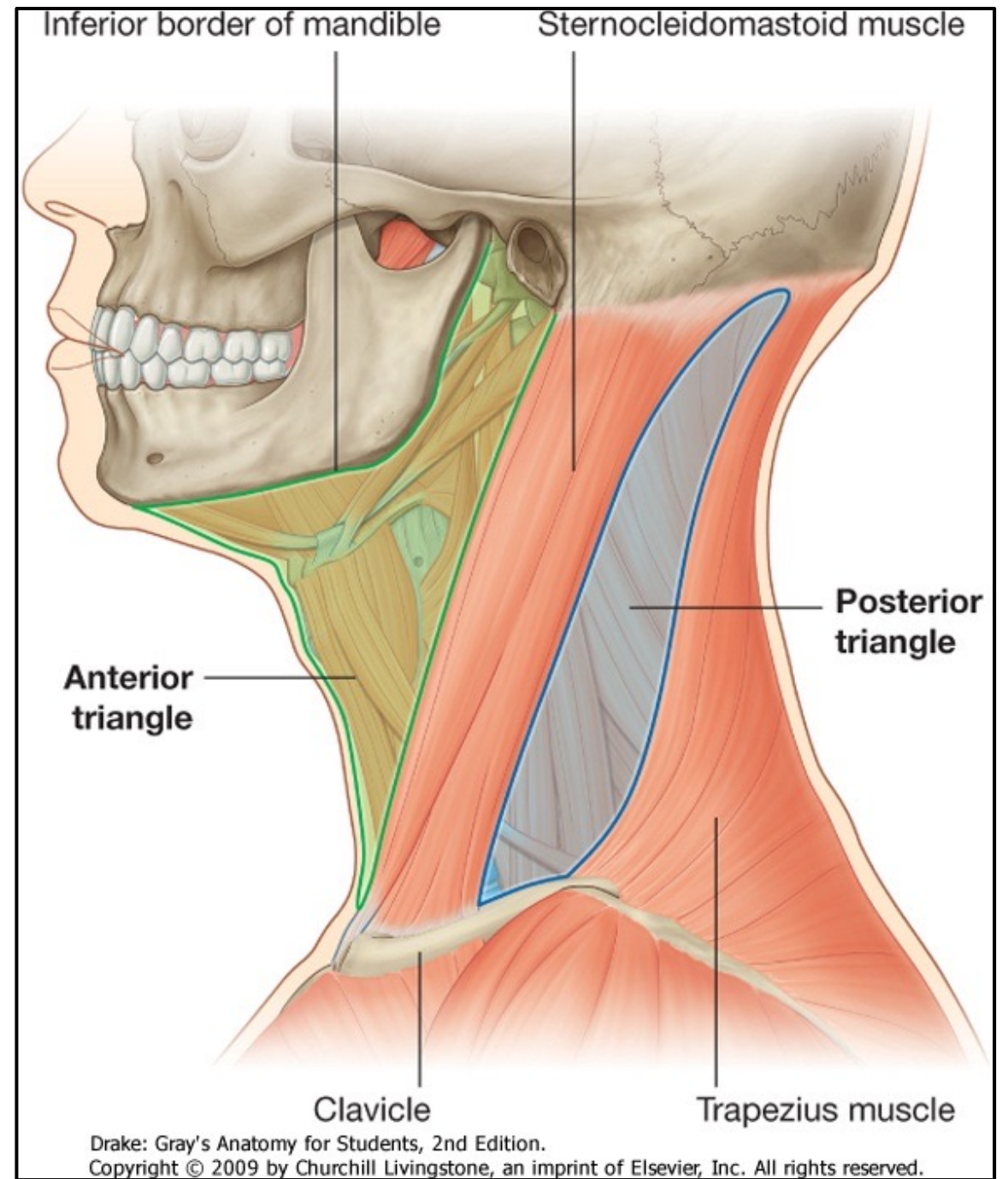
Posterior triangle boundaries

- Anterior border of the trapezius muscle
- Posterior border of the sternocleidomastoid muscle
- Superior surface of the clavicle
- The roof is covered by investing fascia and
- The floor is covered by prevertebral fascia

Anterior triangle boundaries

- Anterior border of the sternocleidomastoid muscle
- Anterior midline of the neck
- Inferior border of mandible.
- The roof is covered by investing fascia.
- The floor is covered by pretracheal fascia and carotid sheath.

Each triangle can be further subdivided into smaller triangles.



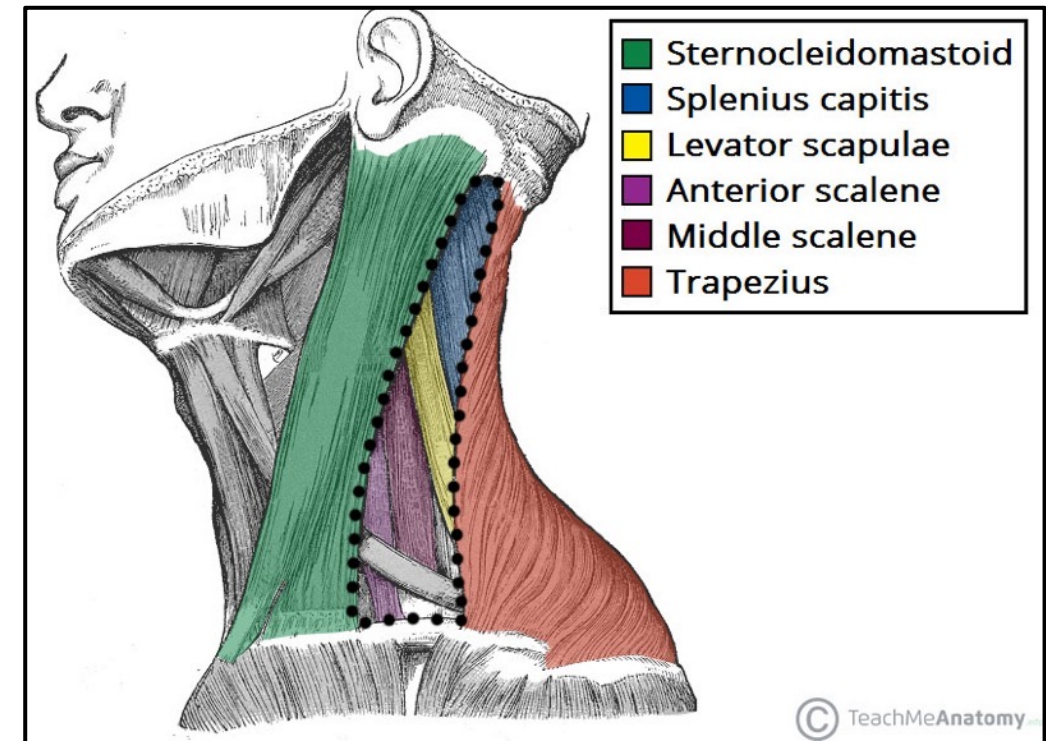
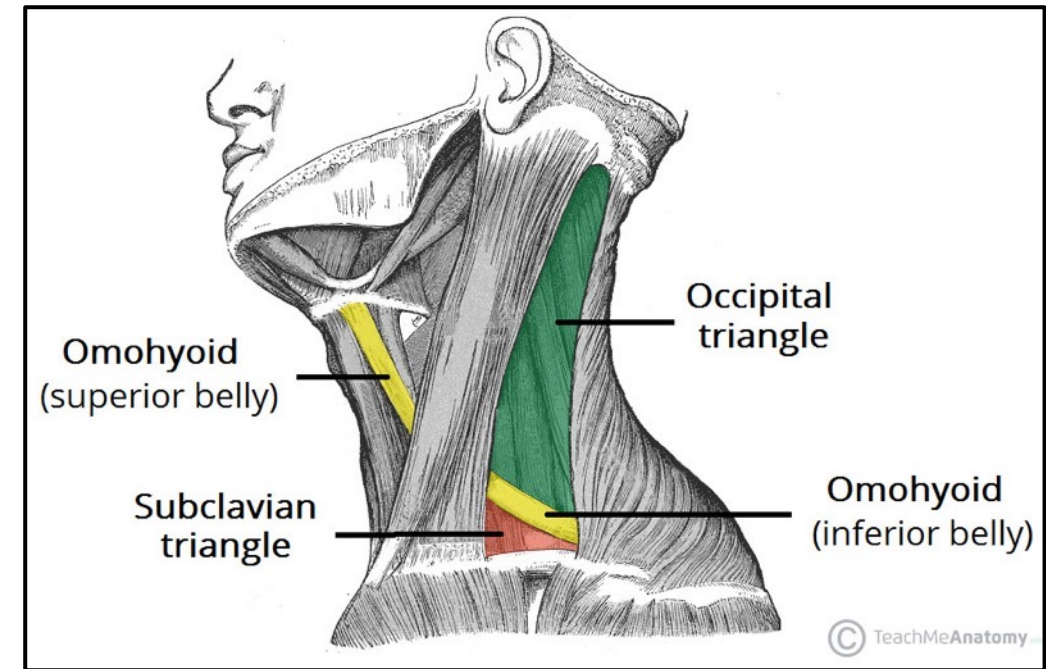
Posterior Triangle: Boundaries & Contents Summary (Review)

The posterior triangle is further divided into two smaller triangles by the inferior belly of the **omohyoid muscle**.

- **Occipital triangle**
- **Subclavian (supraclavicular or omoclavicular) triangle**

Contents of the Posterior Triangle

- Nerves
 - **Accessory nerve**
 - **Phrenic nerve**
 - **Brachial plexus rami and trunks**
 - **Dorsal scapular nerve**
 - **Suprascapular nerve**
 - **Long thoracic nerve**
- Cutaneous nerves of cervical plexus
- Muscles (Several muscles previously learned in MSI form the floor of the posterior triangle.)
 - Splenius capitis muscle
 - Levator scapula muscle
 - **Anterior, middle, and posterior scalene muscles (interscalene triangle formed by anterior and middle scalene muscles)**
- Vessels
 - **External jugular vein**
 - **Subclavian vein**
 - **Subclavian artery**
 - **Transverse cervical artery**
 - **Suprascapular artery**



Anterior Triangle: Boundaries & Contents Summary (Review)

Muscular triangles:

- Boundaries: midline, superior belly of omohyoid, anterior border SCM
- Contents: Infrahyoid muscles

Carotid triangles:

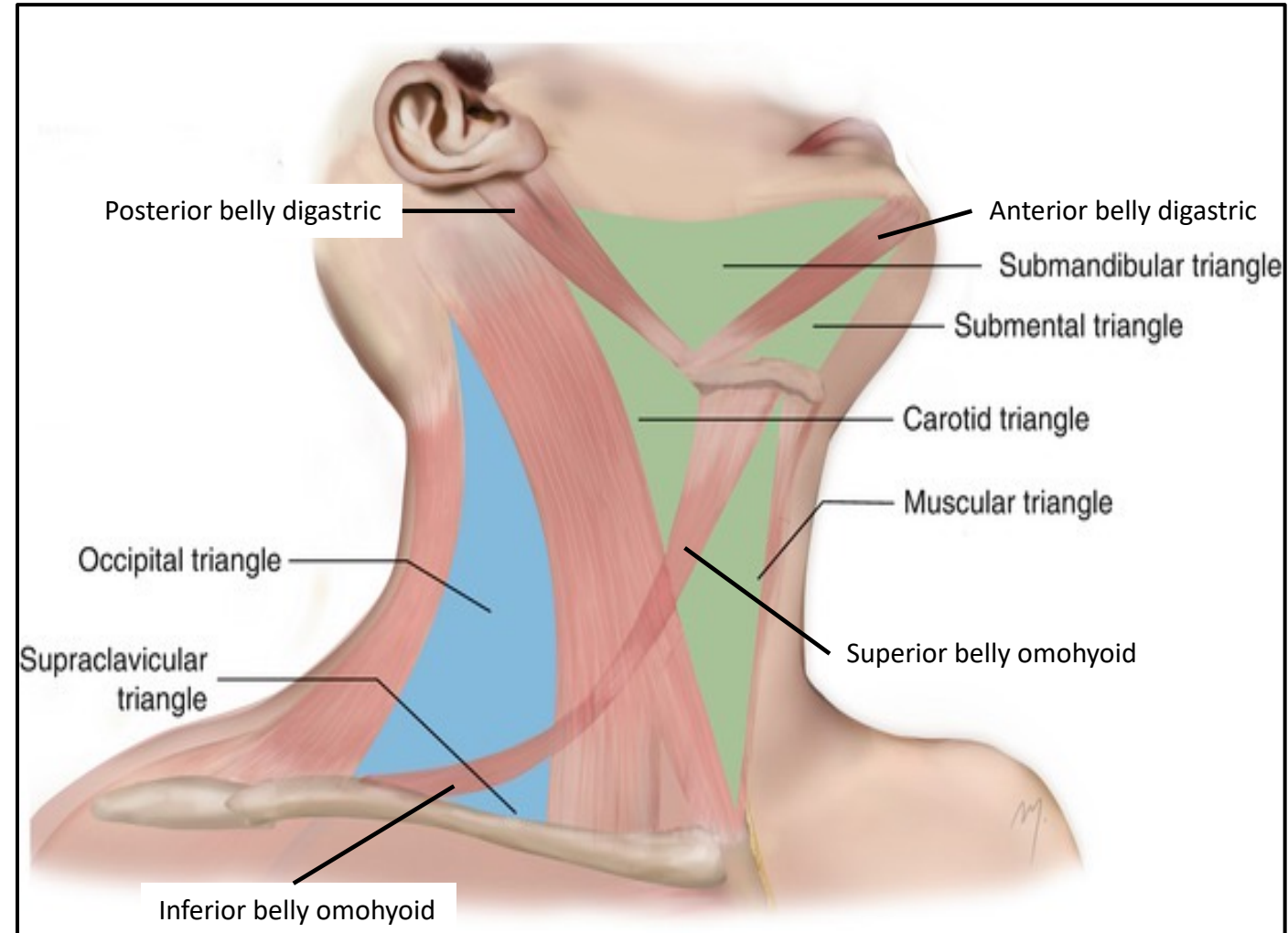
- Boundaries: anterior border of SCM, superior belly of omohyoid, posterior belly of digastric
- Contents: carotid arteries and branches, internal jugular vein, CN X, XI, XII, ansa cervicalis, deep cervical lymph nodes, sympathetic trunk adheres to posterior wall of carotid sheath

Digastric (submandibular) triangles:

- Boundaries: two bellies of digastric, mandible
- Contents: Submandibular gland and lymph nodes, CN XII, facial artery and vein

Submental triangle (single, midline triangle):

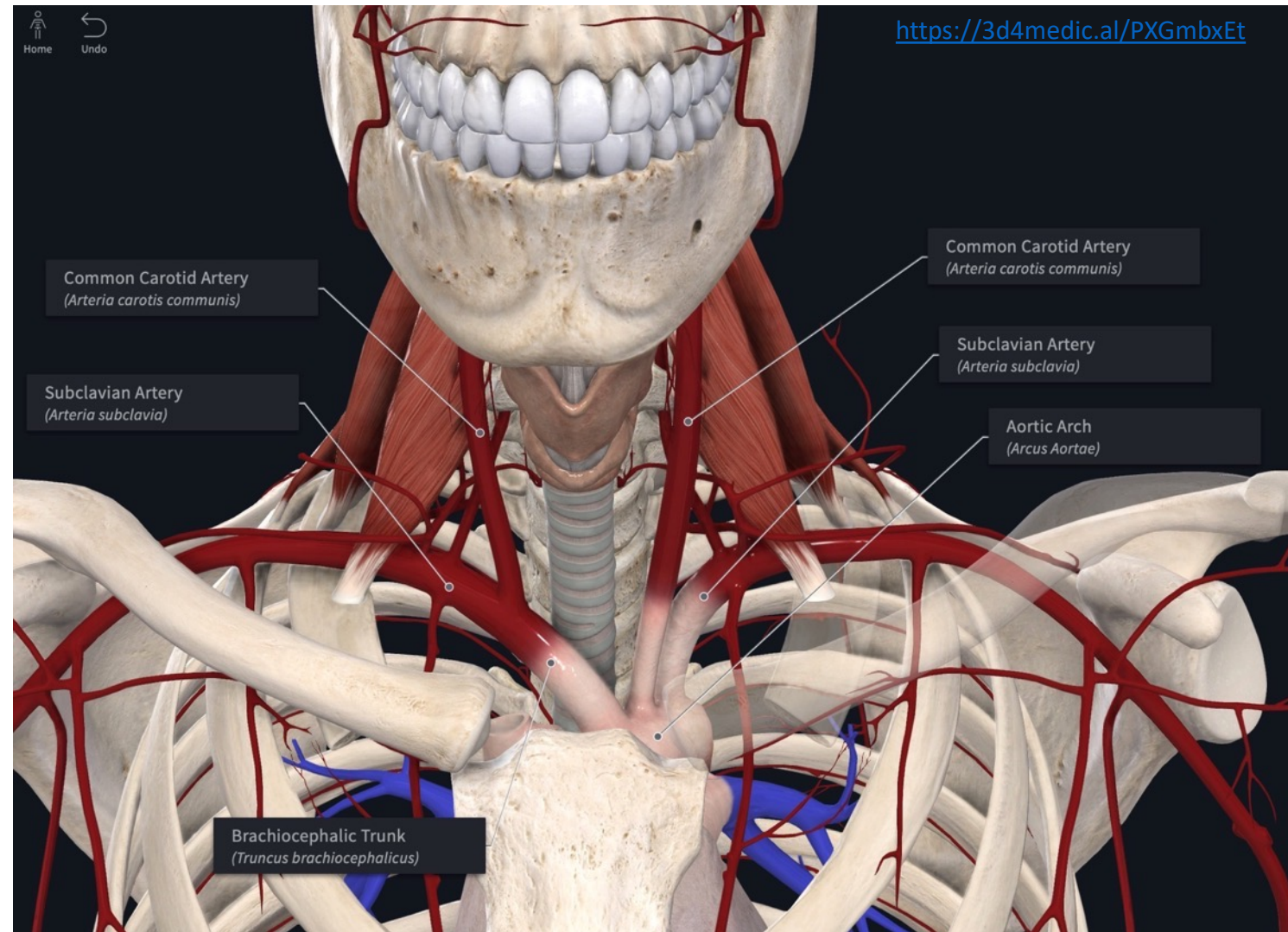
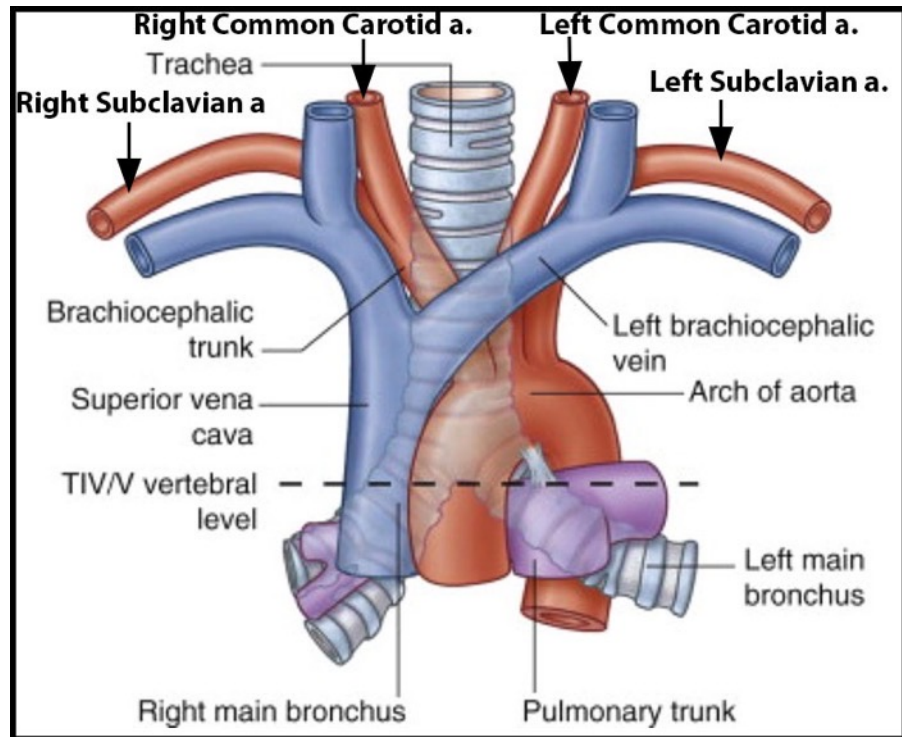
- Boundaries: anterior bellies of digastric muscles, hyoid bone
- Contents: Submental lymph nodes



Aortic Arch Branches Supplying Blood to Head and Neck

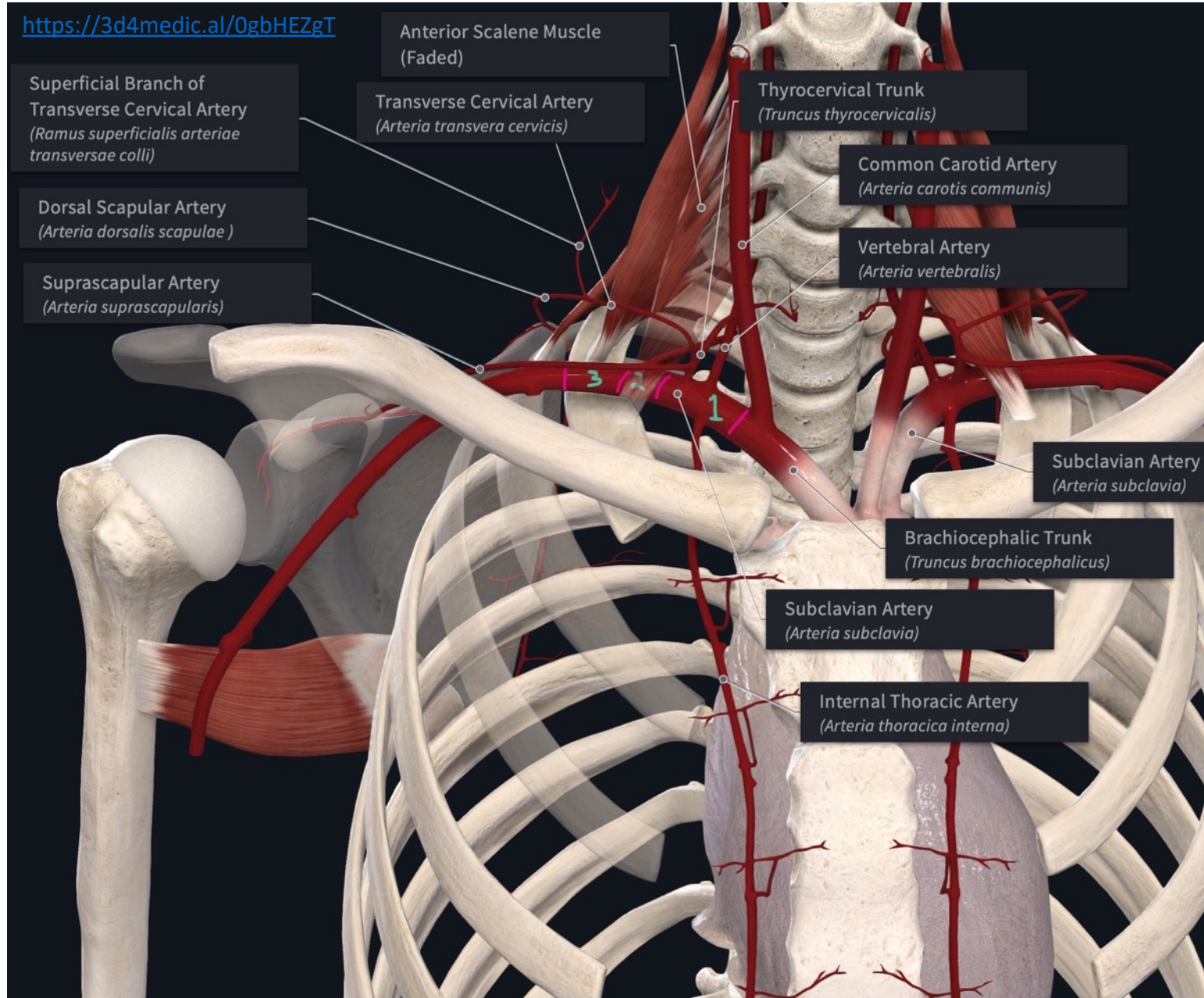
The head and neck receive their blood supply from branches of the **right and left common carotid** and **right and left subclavian arteries**.

- On the right side of the body, the subclavian and common carotid arteries are branches of the **brachiocephalic trunk**.
- On the left side of the body, each artery branches directly from the **arch of the aorta**.



Subclavian Artery & Thyrocervical Trunk (Mostly Review)

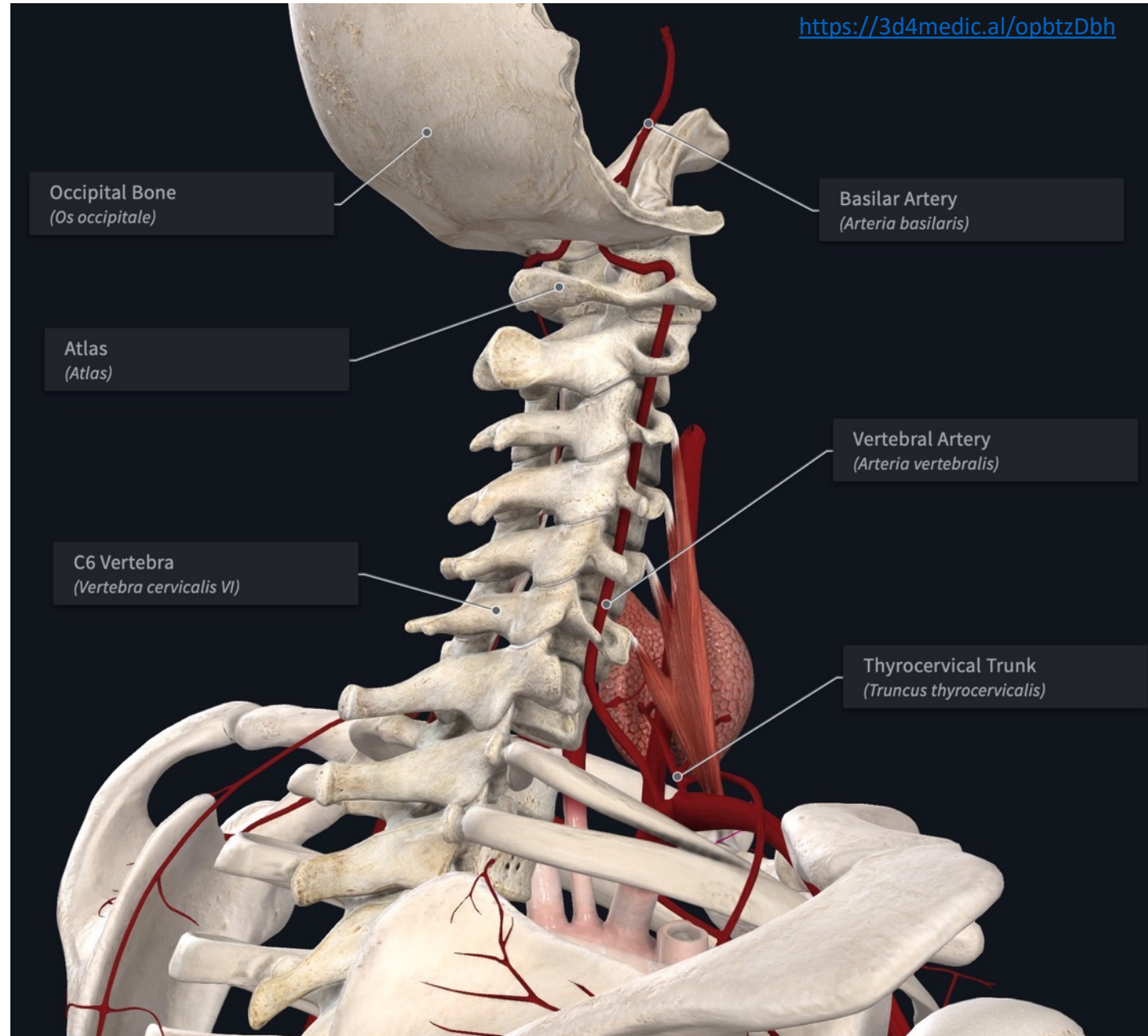
- The subclavian artery consists of **3 parts**. The landmark that defines the divisions is the **anterior scalene muscle**.
 - Medial to anterior scalene = 1st part
 - Posterior to anterior scalene = 2nd part
 - Between anterior scalene and lateral boundary of first rib = 3rd part.
- Branches of the 1st part
 - **Vertebral artery**
 - Internal thoracic artery (Details in in Thorax)
 - **Thyrocervical trunk** has 4 main branches
 - **Ascending cervical**
 - **Inferior thyroid artery**
 - Transverse cervical artery (Details in MSI)
 - Suprascapular artery (Details in MSI)
- Branches of the 2nd part
 - Costocervical artery (Details in Thorax)
- Branch of 3rd part: (Variable)
 - **Dorsal scapular artery**: The deep branch of the transverse cervical artery can be replaced by a direct branch from the subclavian.



Vertebral Artery

The **Vertebral Artery** is the first branch of the **subclavian artery**.

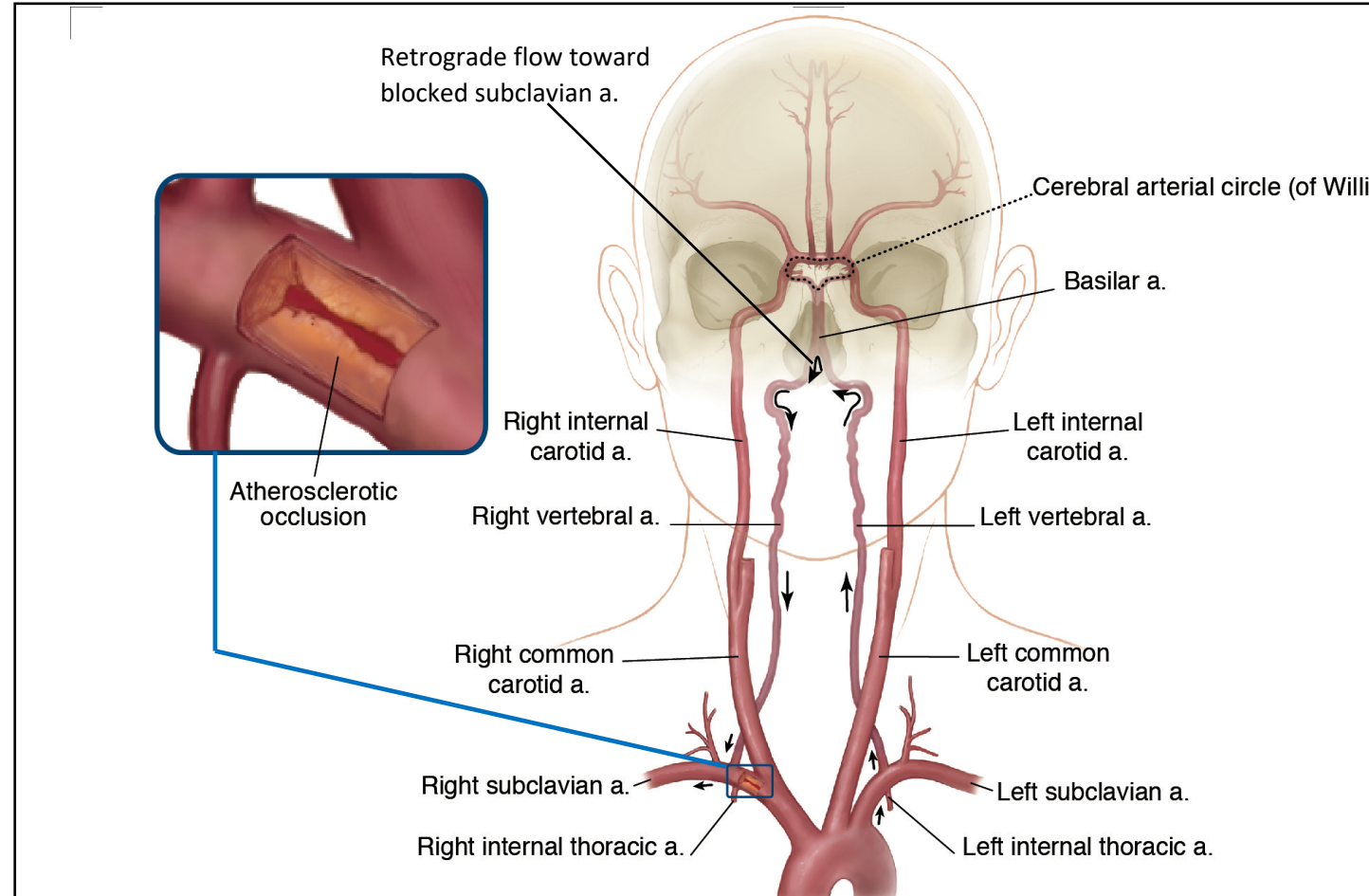
- It ascends in the root of the neck to enter the transverse foramen of the C6 vertebra.
- It continues to ascend the neck through the remaining transverse foramina (during which it gives off spinal and muscular branches).
- After exiting the transverse foramen of C1 (atlas), it curves medially to pass along the superior surface of atlas' posterior arch.
- It then turns superiorly to enter the cranium via the **foramen magnum**.
- Upon entering the **cranial cavity**, it ascends on the brainstem where it gives off branches to supply the spinal cord, medulla and cerebellum. At the lower border of the pons, the right and left **vertebral arteries** join to form the **basilar artery**.



Subclavian Steal Syndrome

CLINICAL ANATOMY: Subclavian steal syndrome may occur when one subclavian artery is stenotic (narrowed) *proximal* to the origin of vertebral artery. To maintain blood flow into the areas distal to the stenosis, the following can occur.

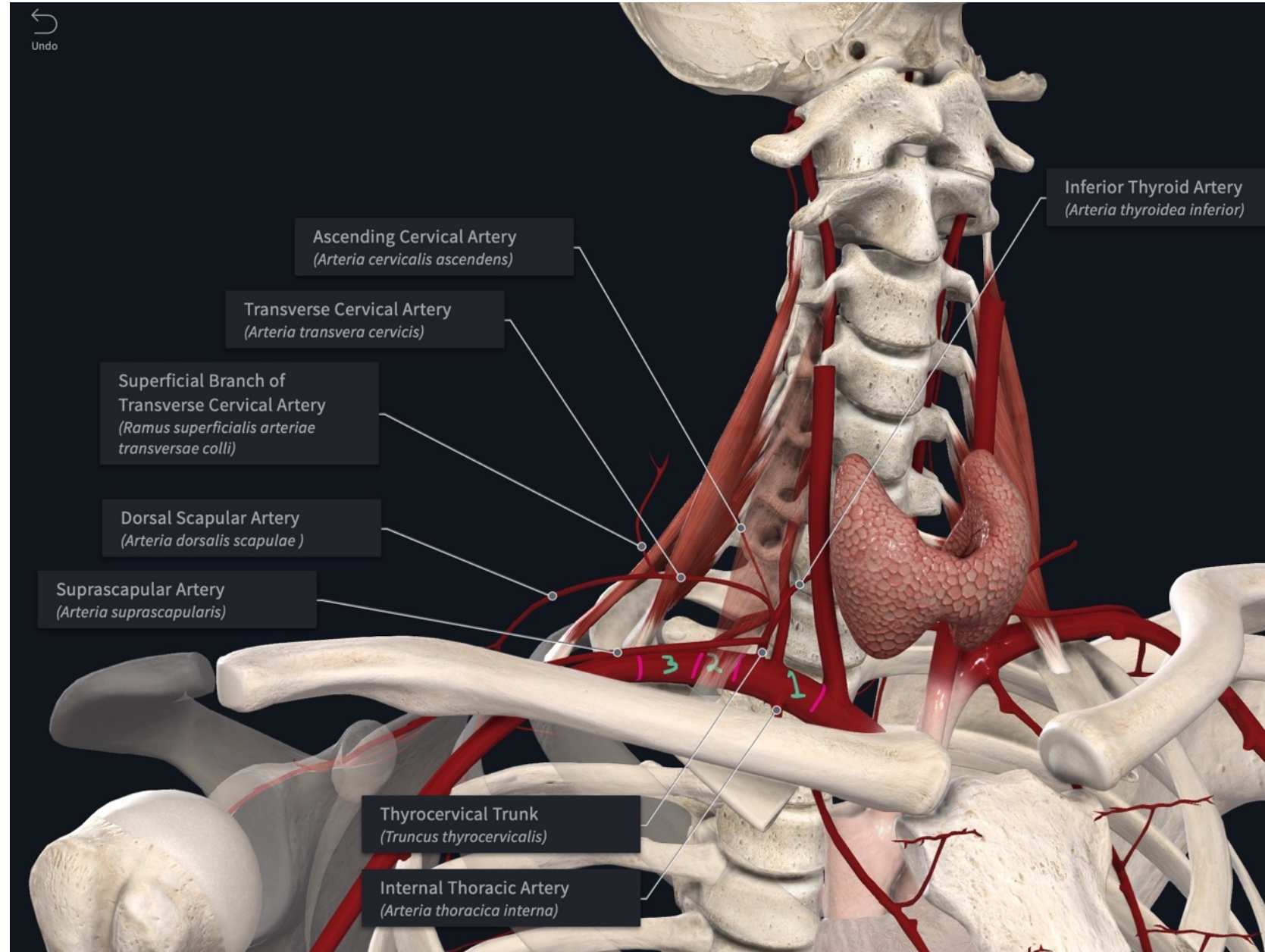
- Blood in the vertebral artery on the opposite side of the stenosis flows in a retrograde direction upon entering the basilar artery.
- This retrograde flow allows blood to enter the vertebral artery on the side of the stenosis, which ultimately maintains perfusion distal to the site stenosis in the subclavian artery.
- As a result of this retrograde flow in the vertebral artery, the following occurs.
 - Blood flow is maintained to the upper extremity on the side of the stenosis, but blood pressure will be reduced.
 - Blood flow to the brain is reduced, which induces brain ischemia and neurological symptoms.



Thyrocervical Trunk (Review)

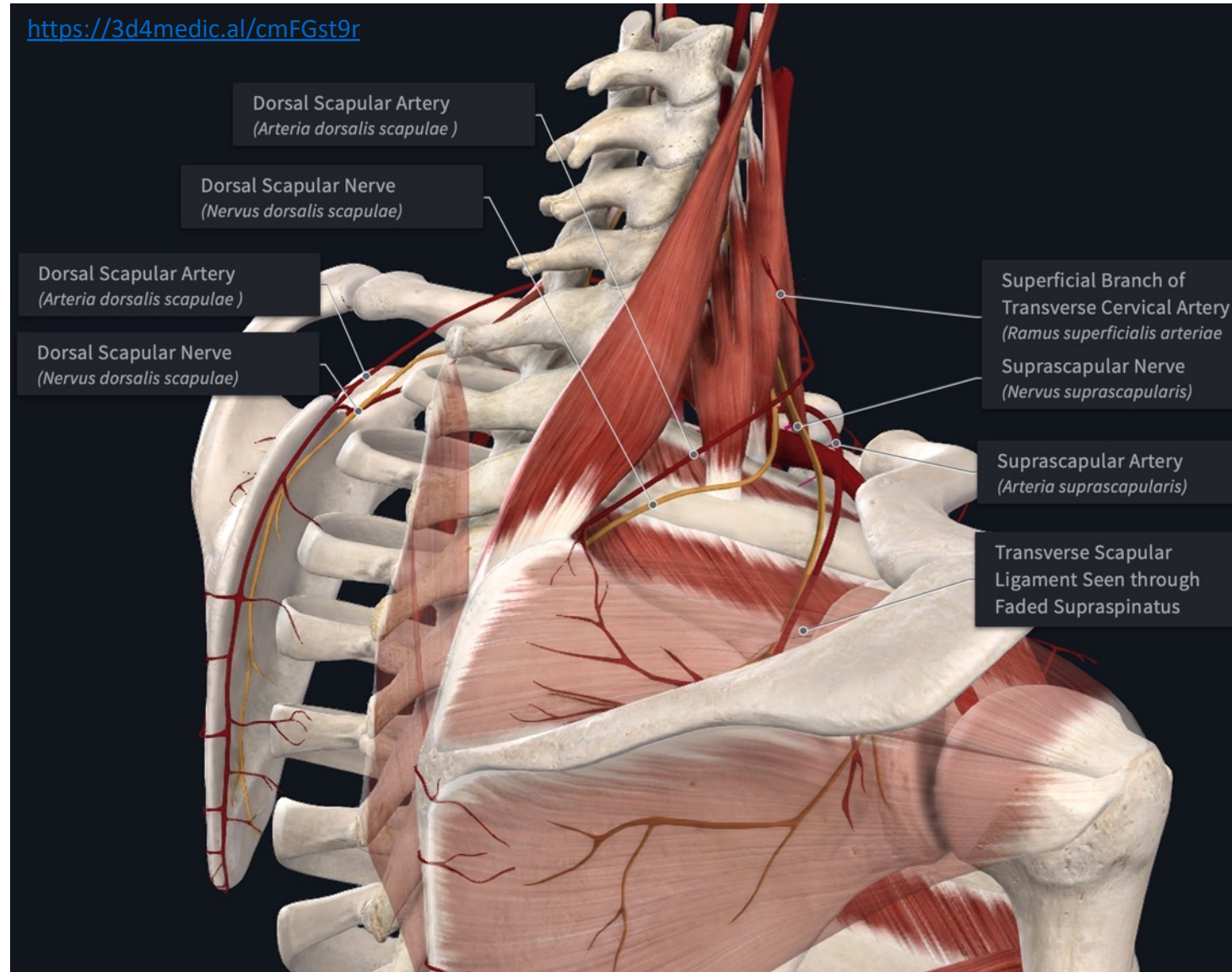
Thyrocervical trunk is a short, wide artery that only travels for a short distance before it divides into the following branches:

- The **inferior thyroid** artery ascends to supply the inferior aspect of the **thyroid gland**.
- The ascending cervical artery is a small, and less significant branch compared to the other branches of the thyrocervical trunk. It contributes many small spinal branches that pass through the intervertebral foramina of the neck as well as giving off multiple small muscular branches to the lateral muscles of the upper neck.
- Suprascapular artery: Review from MSI (Next Slide)
- Transverse cervical artery: Review from MSI (Two slides after this one.)



Suprascapular Artery (Review)

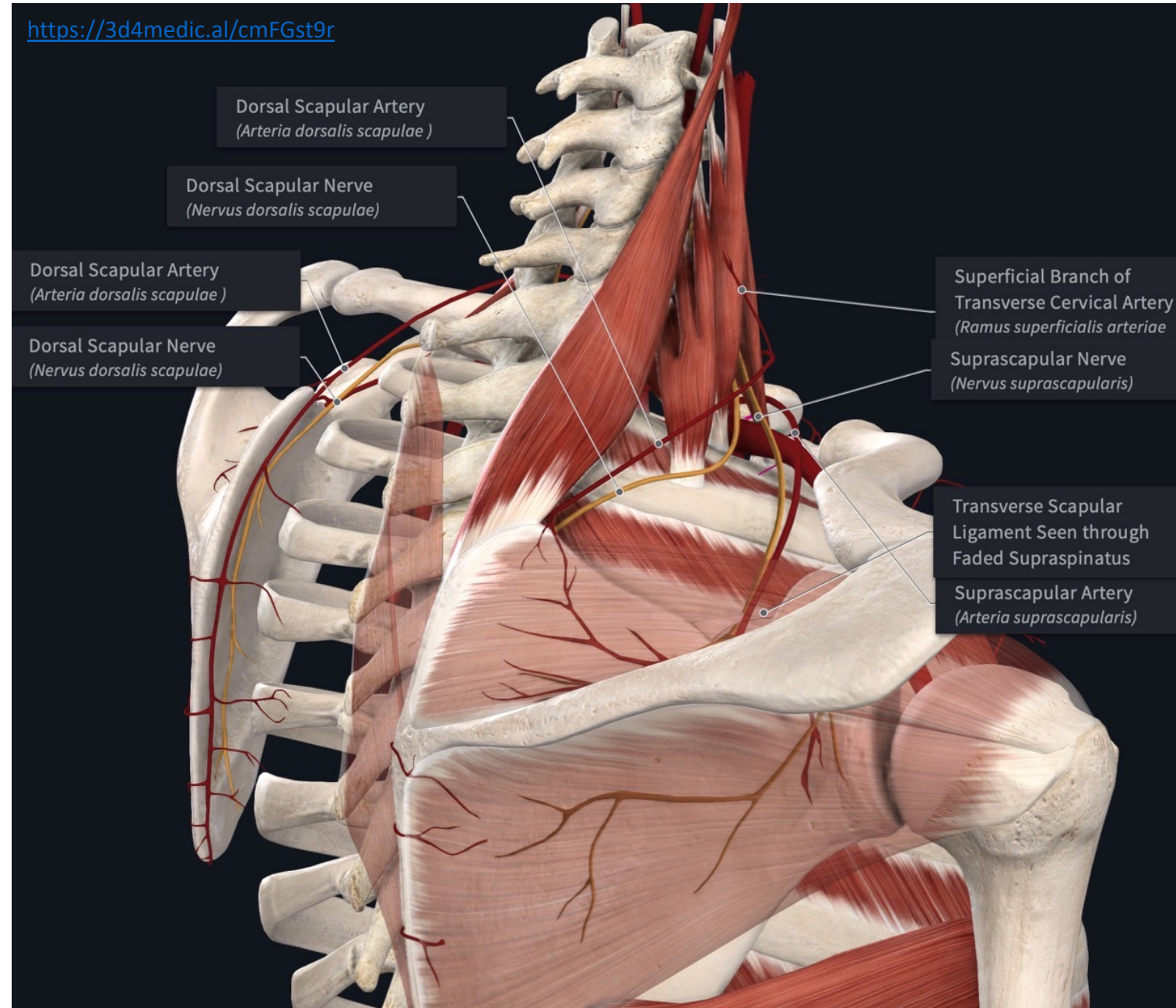
- The **suprascapular artery** branches from the **thyrocervical trunk** in a lateral direction to pass anterior to the anterior scalene muscle.
- It then dips inferiorly to cross the 3rd part of the subclavian artery on its course to the scapula.
- At the scapula, the artery passes *superior* to the **transverse scapular ligament** to enter the supraspinous fossa
 - In this region, the **suprascapular nerve** joins the artery, but the nerve passes deep to the transverse scapular ligament.
 - The well-known mnemonic for this anatomical relationship is: "Army goes over the bridge, Navy goes under the bridge"
 - Army = Artery, which passes superior to ligament
 - Navy = Nerve, which passes inferior to ligament
- After crossing the **transverse scapular ligament**, the artery and nerve course through the supraspinous fossa to ultimately enter the infraspinous fossa by passing through the **spinoglenoid notch (greater scapular notch)**. In the infraspinous fossa, the vessel forms collateral circuits with the dorsal scapular artery and the circumflex scapular arteries.
- The suprascapular artery primarily supplies the following structures.
 - Supraspinatus m.
 - Infraspinatus m.
 - Forms scapular anastomosis with dorsal scapular and circumflex scapular arteries.



Transverse Cervical Artery (Review)

The **transverse cervical artery** branches from the **thyrocervical trunk** on a lateral course to pass anterior to the anterior scalene muscle. In most situations, the vessel bifurcates to form the following branches.

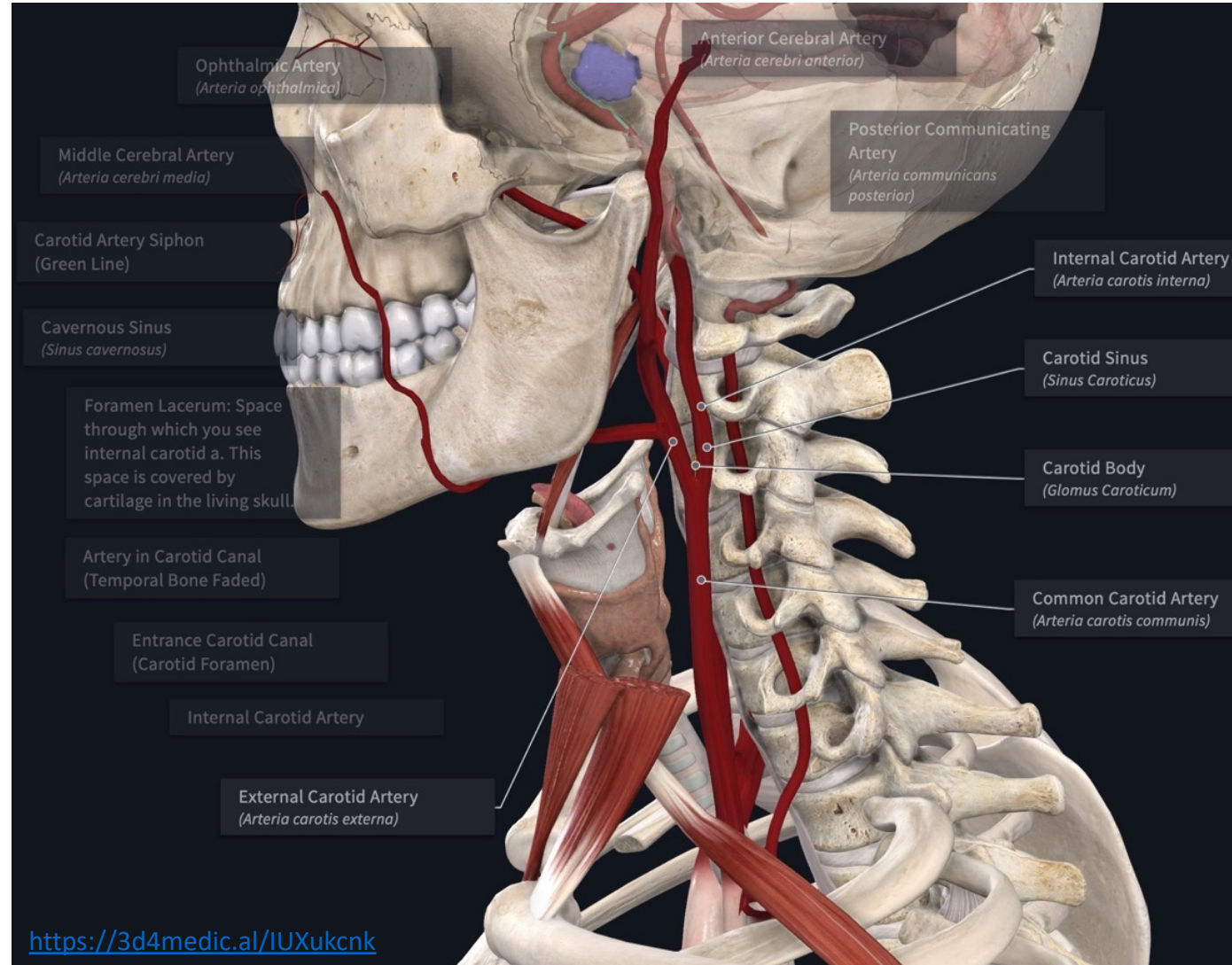
- Superficial transverse cervical artery that courses between the trapezius and the rhomboids. This vessel is accompanied by the accessory nerve (CN XI) along its path.
- Deep transverse cervical artery (aka: **dorsal scapular artery**) courses deep to levator scapula and the rhomboid muscles (supplies both muscles) to travel along the medial border of the scapula. This vessel is accompanied by the **dorsal scapular nerve** along its path.
 - NOTE: The dorsal scapular artery can arise from the 3rd part of the subclavian. In this situation, the deep transverse cervical artery may be absent.
 - Regardless of where the dorsal scapular artery branches, it forms collateral circulation with the **circumflex scapular artery** and the **suprascapular artery**.
- The transverse cervical artery primarily supplies the following muscles.
 - Trapezius
 - If the dorsal scapular branches from the transverse cervical artery:
 - Rhomboid major and minor
 - Levator scapula
 - Forms scapular anastomosis with suprascapular and circumflex scapular arteries



Carotid Arteries

On each side of the neck, the **common carotid arteries** ascend in the neck where they divide into external and internal carotid arteries at the **carotid bifurcation**. The carotid bifurcation typically occurs slightly superior to the to the **upper border of the thyroid cartilage** (approximately at the vertebral level C3 or C4)

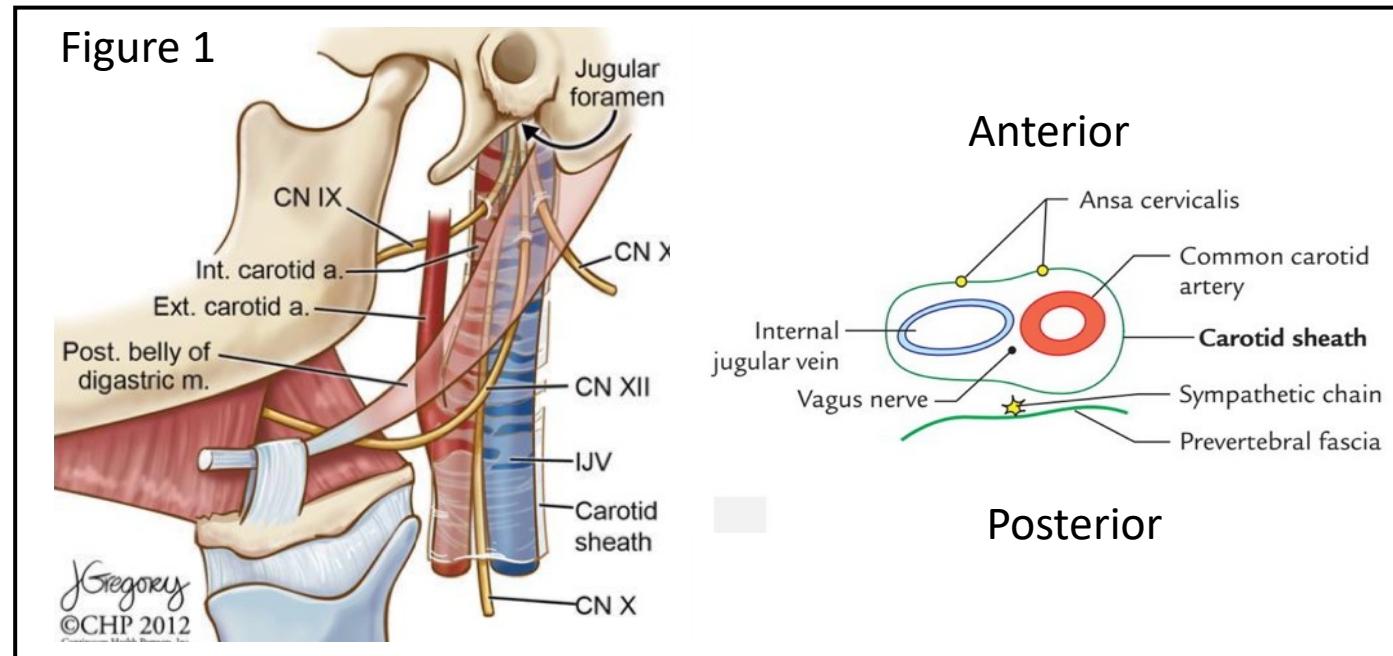
- The posterior aspect of the carotid bifurcation consists of an area known as the **carotid body**.
 - This small area is densely populated by chemoreceptors sensitive to the partial pressure of O₂ (primarily) and CO₂ in the blood.
 - The wall of the carotid body is innervated primarily by the glossopharyngeal nerve.
- The **external carotid artery** gives off 8 branches that supply the neck, face, and scalp. Its branches will be detailed in an upcoming slide.
- **Internal carotid artery** (next slide)
 - The **carotid sinus** is a dilation at the beginning of the **internal carotid artery**.
 - The wall of the carotid sinus contains numerous receptors (baroreceptors) sensitive to changes in arterial blood pressure.
- The **internal carotid artery** ascends in the neck to enter the cranial cavity. The path of the internal carotid artery into, and through the skull, is outlined on the next slide.



Carotid Sheath

All three layers of deep cervical fascia fuse to form the **carotid sheath**, which is a fibrous connective tissue wrapping of the **common carotid artery, internal carotid artery, internal jugular vein**, and the **vagus nerve**. It extends from the level of the first rib to the base of the skull (Figure 1).

- The **common carotid arteries** ascend in the neck within the carotid sheath where they divide into external and internal carotid arteries at the **carotid bifurcation** (Figure 2).
- The external carotid artery exits from the carotid sheath (Figure 1).



The C6 transverse process contains a large **anterior tubercle** (Figure 2). When taking the carotid pulse in the neck, the common carotid artery is compressed against this large anterior tubercle of the C6 vertebra. For this reason, this tubercle is sometimes referred to as the carotid tubercle (Figure 2).

CLINICAL ANATOMY: The carotid pulse is easily palpated in the neck where the the carotid artery lies in a groove between the trachea and the infrahyoid muscles. It is usually palpated just deep to the anterior border of the SCM at the level of the cricoid cartilage, which is about the C6 vertebral level .

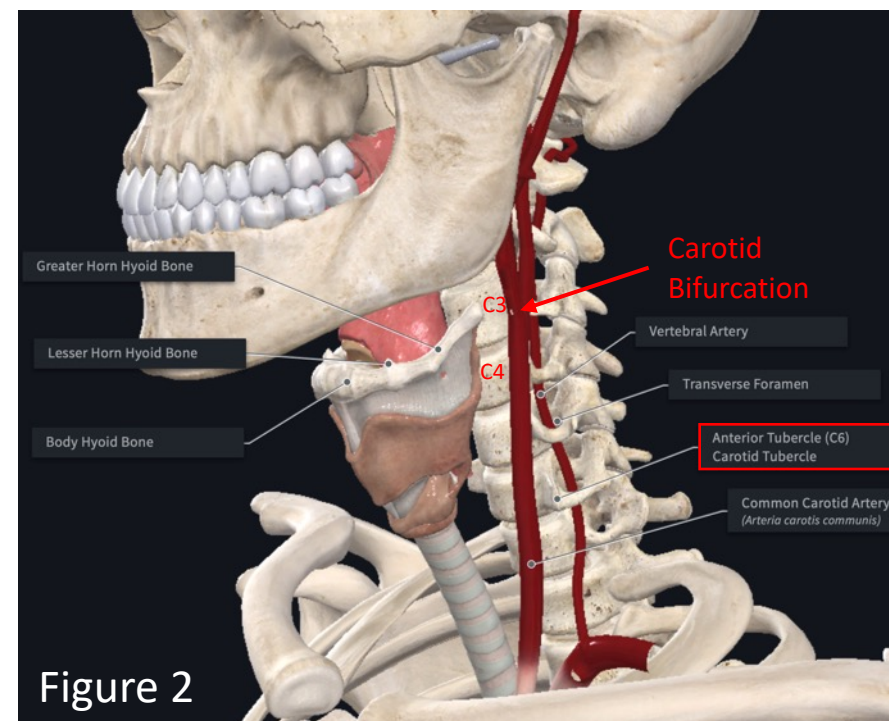


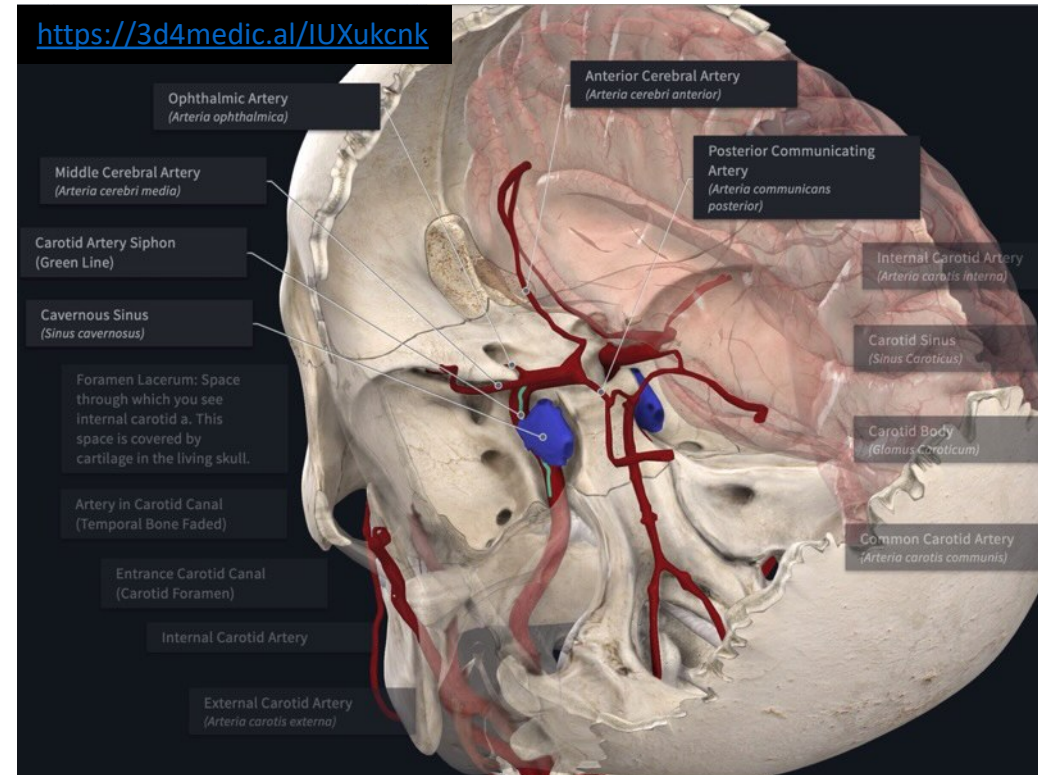
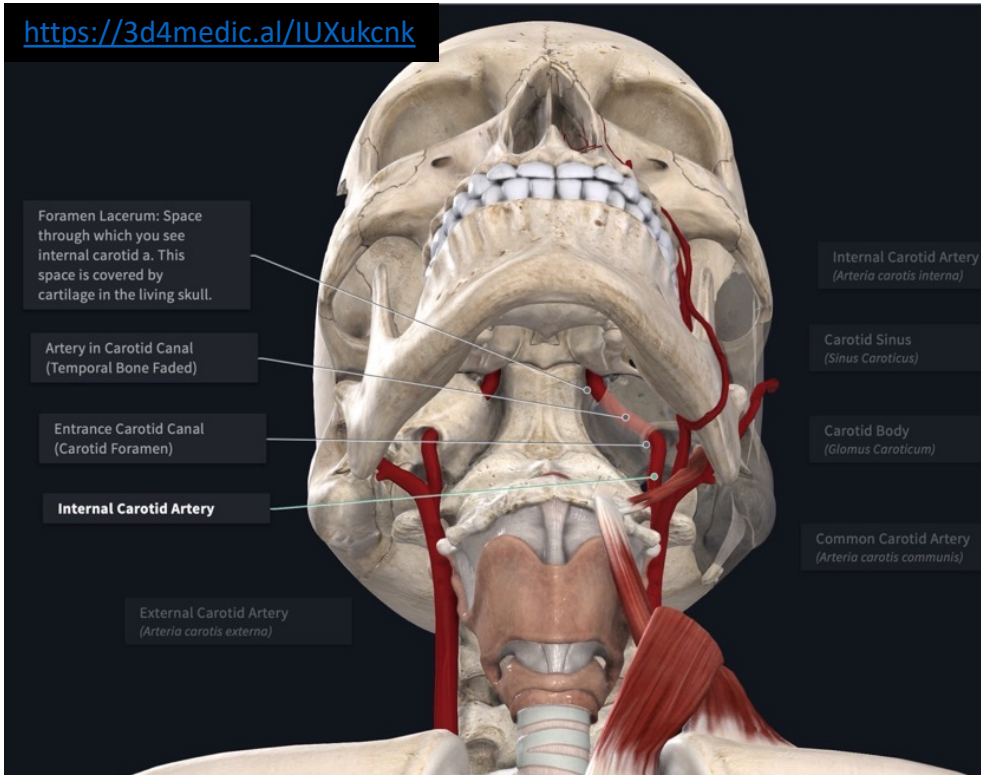
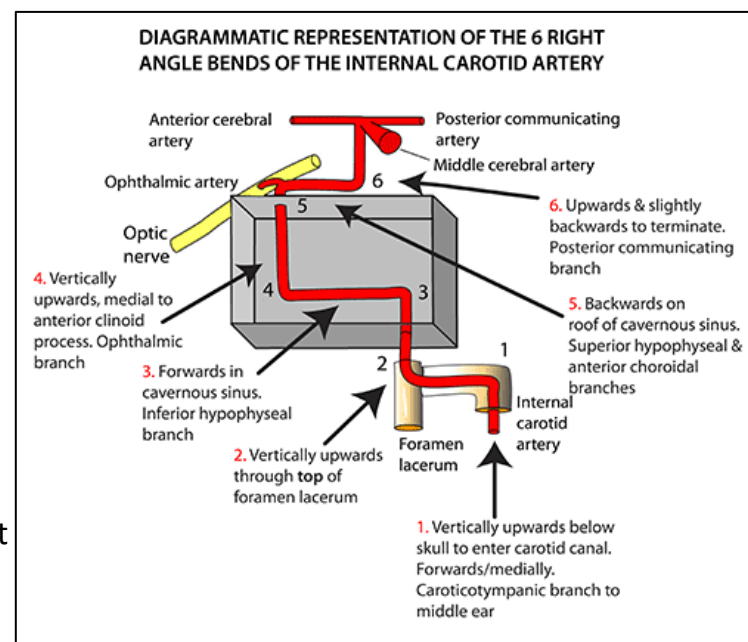
Figure 2

Internal Carotid Artery

[Moyer PRL: Path of Internal Carotid Artery \(Panopto\)](https://3d4medic.al/IUXukcnk)

On the inferior side of the skull, the internal carotid artery enters the **carotid canal**, which is a passageway through the **temporal bone**. The opening into the carotid canal is sometimes referred to as the carotid foramen, but this isn't considered an accepted anatomical term.

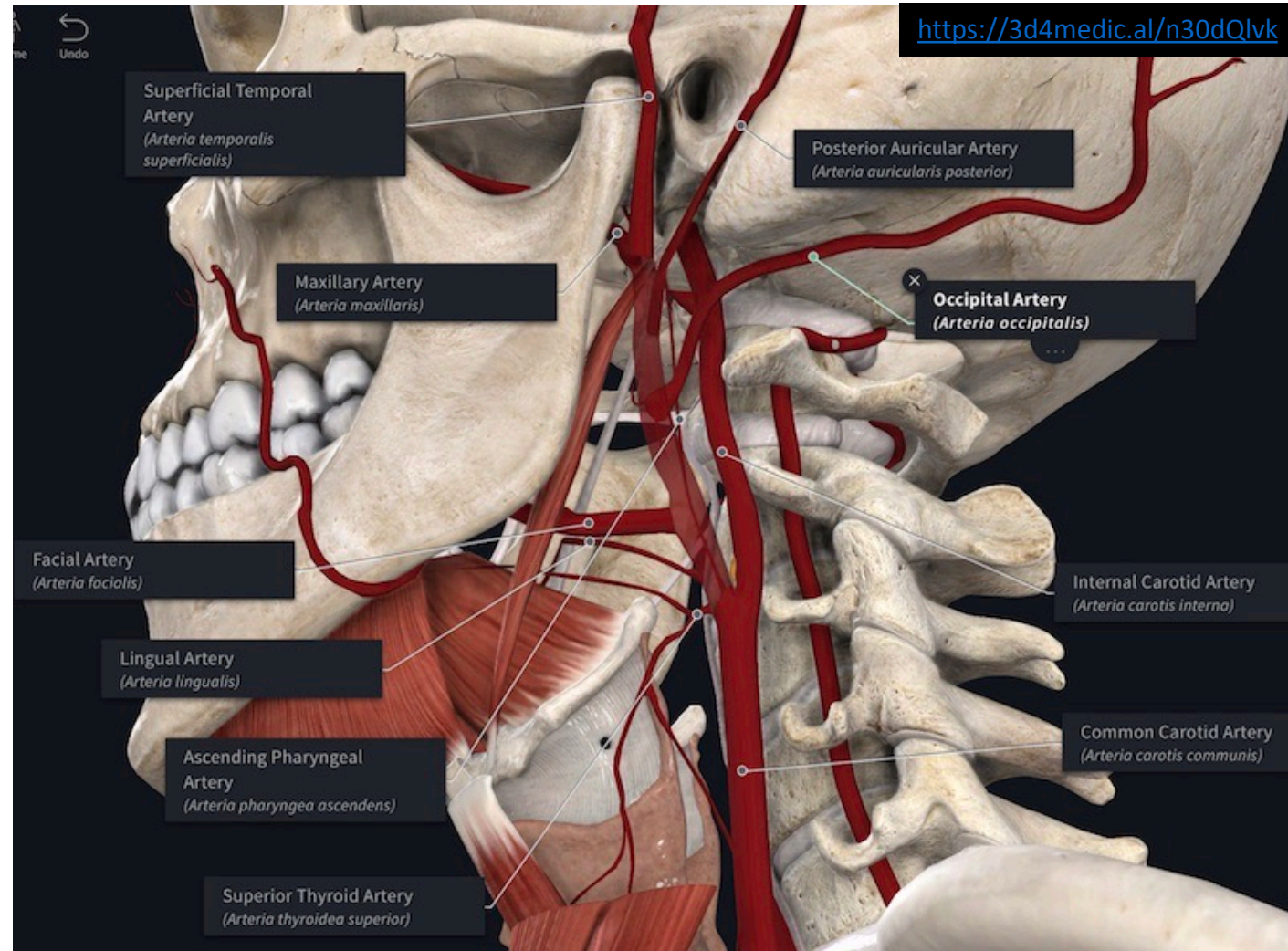
- Intracranial path of **internal carotid artery** (The path of the internal carotid artery will be revisited in **Labs 2 and 5**.
 - The artery passes through the **carotid canal** in an anterior and medial direction.
 - After exiting the **carotid canal**, it crosses through the superior region of the **foramen lacerum**. (Note that the foramen lacerum isn't a foramen in the living skull because its inferior margin is covered by cartilage.) The internal carotid artery courses superior to the cartilage covering the **foramen lacerum's** inferior opening.
 - It then enters the **cavernous sinus** where it makes a characteristic S-shaped bend, which is referred to as the **siphon** of the internal carotid artery. The artery then emerges from the **cavernous sinus** near the optic nerve. It is now anterior relative to where it entered the **cavernous sinus**. After exiting the **cavernous sinus**, the **internal carotid artery** forms its first intracranial branch, which is the **ophthalmic artery** that passes through the optic canal.



External Carotid Artery

The common carotid artery branches into the internal and external carotid arteries at the level of the superior edge of the thyroid cartilage. The external carotid artery supplies the neck, face, and scalp with the following branches. From inferior to superior, the following mnemonic can be helpful: *Some Anatomists Like Freaking Out Poor Medical Students*

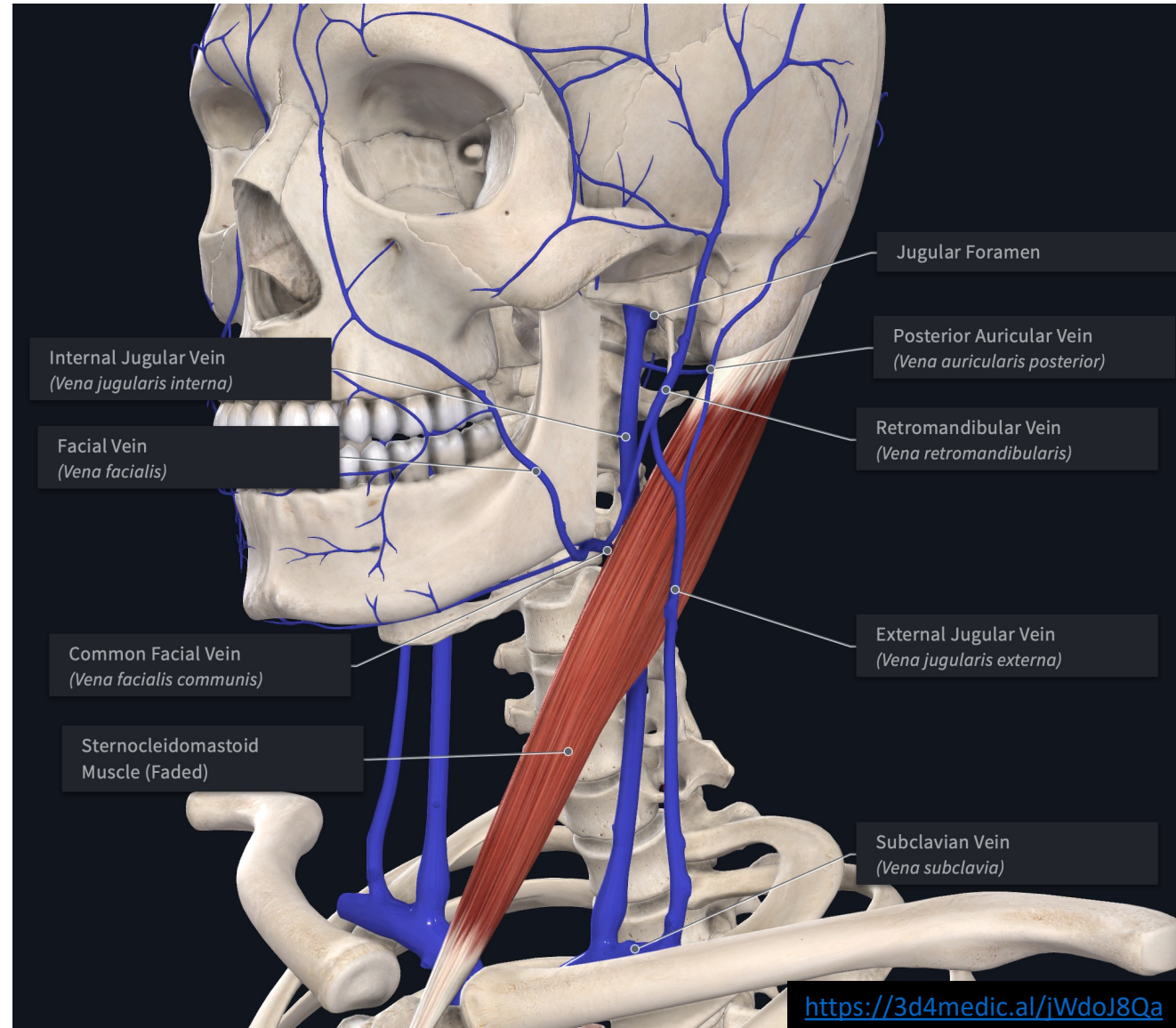
- **Superior thyroid a.** branches at the level of the hyoid bone and supplies the larynx and thyroid gland.
- Ascending pharyngeal a. is the smallest branch and is the only branch we won't attempt to identify in the lab. It supplies the pharynx.
- The **lingual a.** passes deep to the hyoglossus muscle and is the primary blood supply to the tongue.
- The **facial a.** ascends after branching to pass deep to the posterior belly of the digastric m, stylohyoid m., and the submandibular gland. It then hooks around the inferior border of the mandible to enter the face along the anterior border of the masseter muscle. It ascends the face across the cheek and along the lateral aspect of the nose to terminate as the angular artery at the medial canthus of the eye.
- After branching, the **occipital a.** courses in a posterior direction to pass through the apex region of the posterior triangle to enter the occipital region of the scalp, which it supplies.
- The **posterior auricular a.** branches in a posterior direction from the external carotid artery to pass posterior to the auricle of the ear to supply the scalp in that region.
- The **maxillary a.** is the largest of the two terminal branches. After its formation, it passes through the parotid gland to course medial to the neck of the mandible. It then passes through the infratemporal fossa to enter the pterygopalatine fossa. Its many branches supply deep structures of the face along its path.
- The **superficial temporal a.** is the smaller of the two terminal branches. Within the parotid gland, it is formed where the maxillary artery branches from the external carotid artery. It ascends anterior to the auricle of the ear over the zygomatic arch to supply structures in the temporal region.



Intracranial and Extracranial Venous Drainage

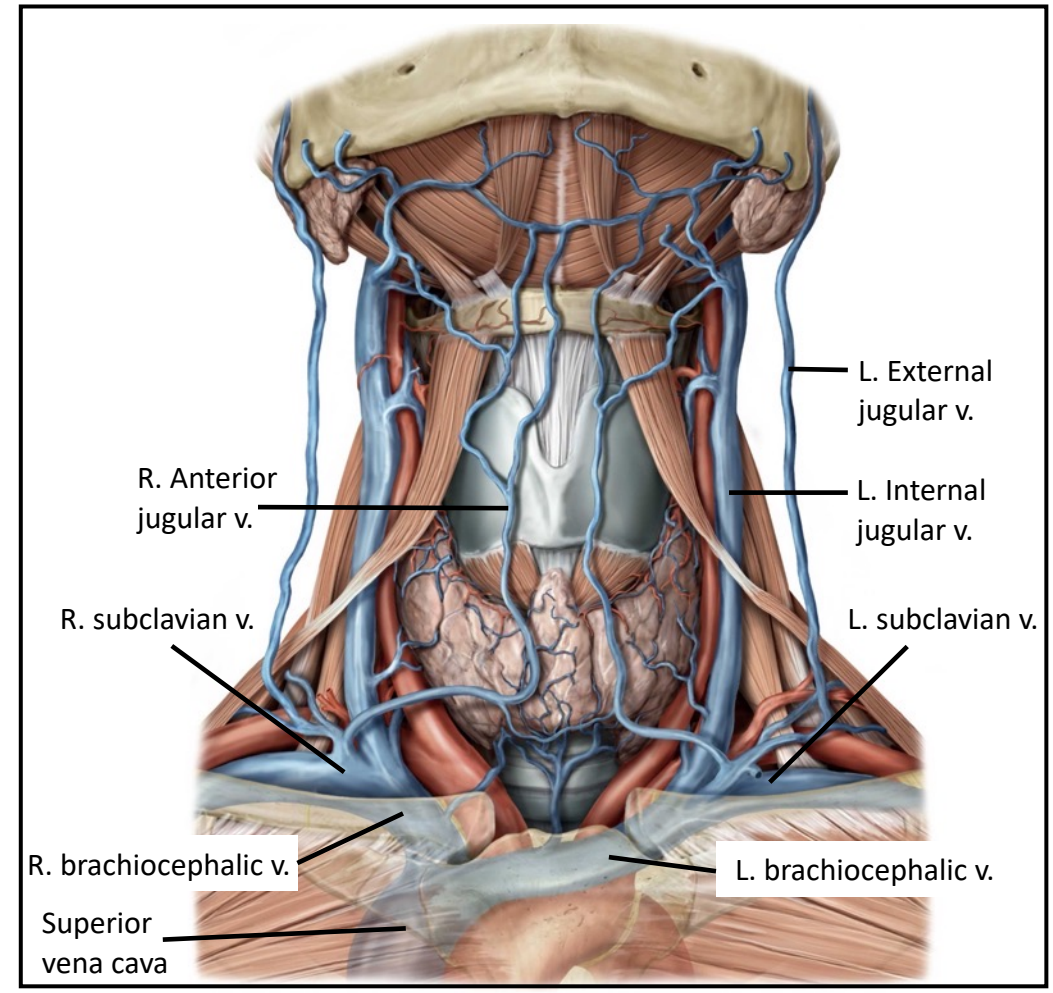
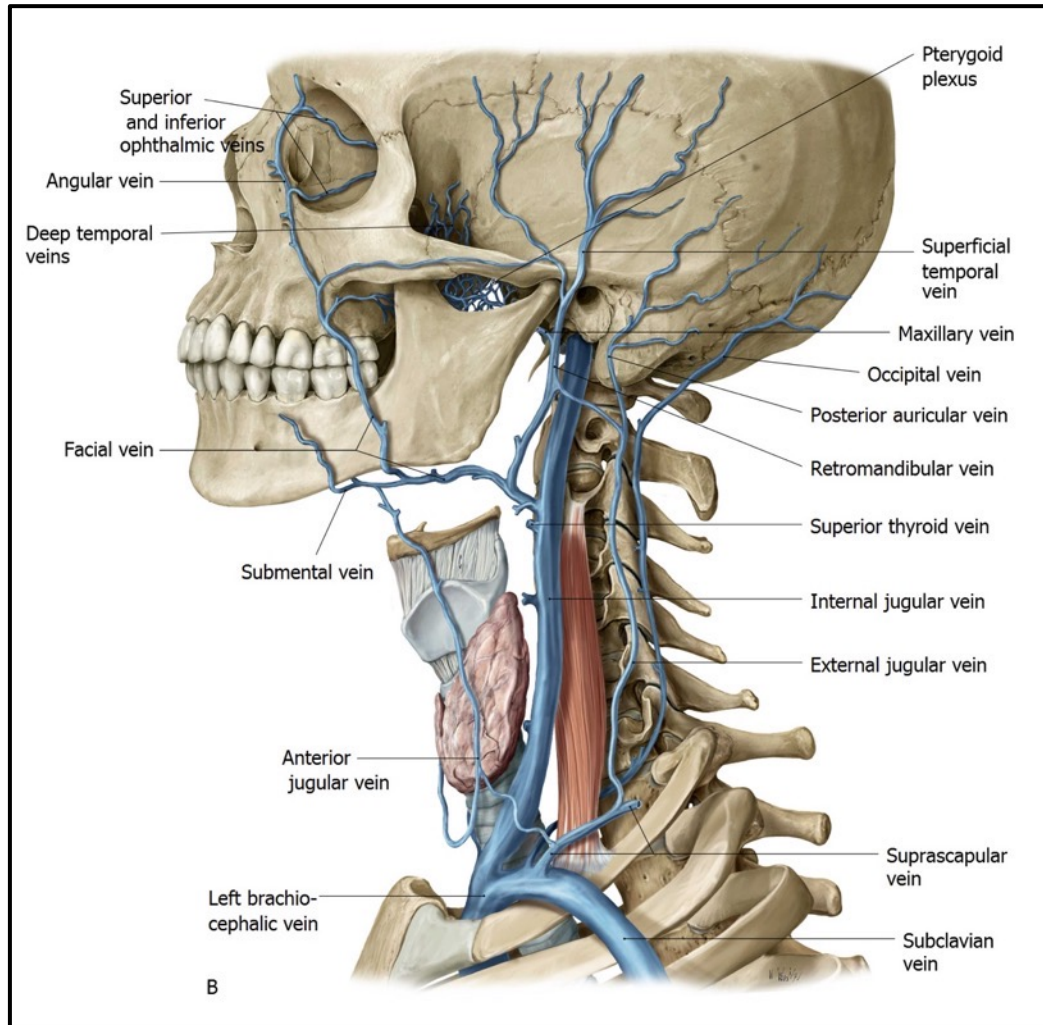
Veins draining the head & neck can be subdivided into two primary groups.

1. Intracranial veins are located within the cranial cavity.
 - Intracranial venous blood is collected from cerebral, cerebellar, emissary, diploic veins, and other named veins into dural venous sinuses.
 - Most (not all) of the venous blood collected in the **dural venous sinuses** drains into the jugular bulb region of the internal jugular vein. The **internal jugular vein exits** the cranial cavity by passing through the **jugular foramen**.
2. Extracranial veins are located outside of the cranial cavity.
 - The **internal jugular vein** descends the neck within the carotid sheath along with the internal carotid artery and the vagus n. Along its descent, it receives blood from tributaries that drain the face and neck. The internal jugular vein joins the subclavian vein to form the brachiocephalic vein.
 - The **external jugular vein** receives venous blood from the face and scalp and is initially formed by the union of the retromandibular vein (posterior division) and the posterior auricular vein. As it descends in the neck, it obliquely crosses the sternocleidomastoid's superficial surface. It terminates by draining into the subclavian vein.



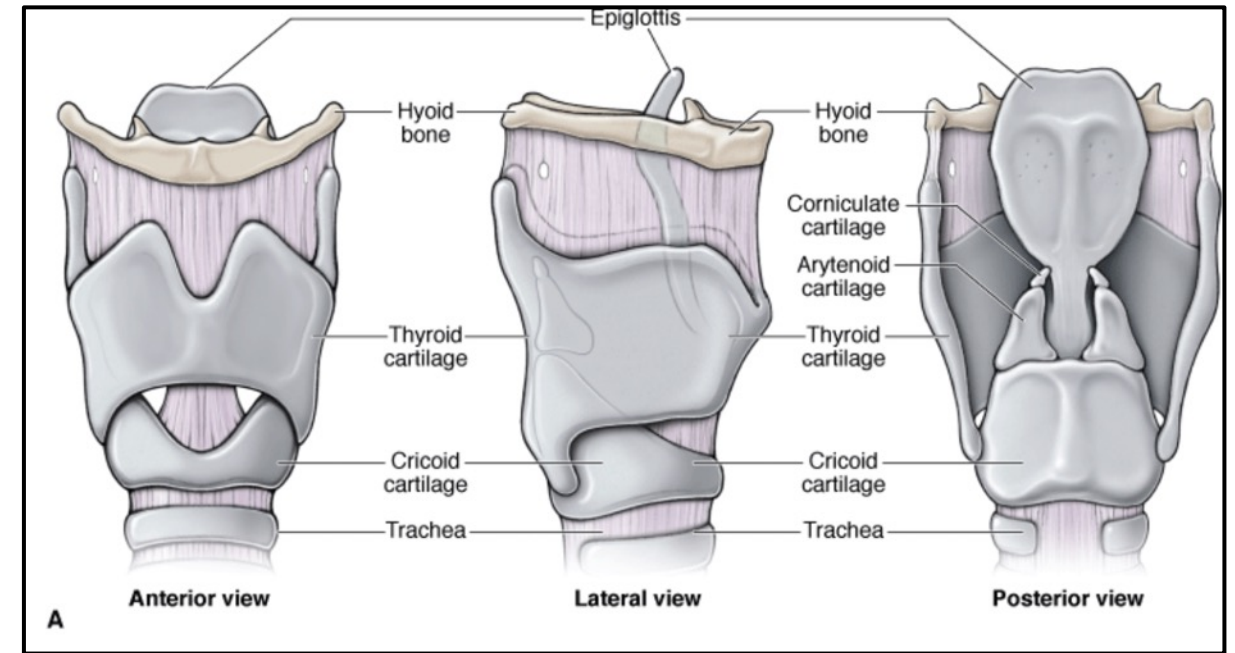
Head & Neck Venous Drainage

Dural Venous Sinus	Receives Blood From	Drains Blood To
External jugular v. (L and R)	Scalp, pinna, and side of the face (union of posterior auricular vein and retromandibular vein)	Subclavian vein
Internal jugular v. (L and R)	Brain (dural venous sinuses), anterior face, and neck	Joins with subclavian v. to form brachiocephalic vein
Brachiocephalic v. (L and R)	Subclavian v. and internal jugular v.	Superior vena cava

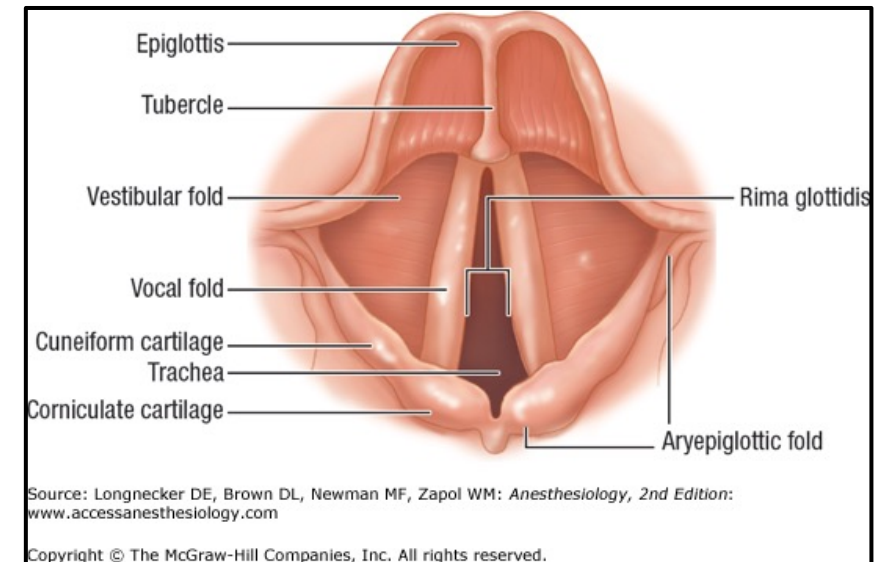


Larynx: Introduction

- The **larynx** is an air passageway that connects the laryngopharynx to the trachea.
- Its main functions are to maintain a patent airway, phonation, and prevent food from entering the air passageways.
- It is composed of nine cartilages (3 paired and 3 unpaired) connected by ligaments and membranes.
 - The **thyroid cartilage** is the largest cartilage forming the larynx. It is unpaired and is composed of two large plates that are joined anteriorly to form a protrusion called the **laryngeal prominence** (Adam's apple). The superior boundary of the thyroid cartilage is typically at the vertebral level C4 in women and as low as C5 in men .
 - The **cricoid cartilage** is an unpaired cartilage inferior to thyroid cartilage. It forms a complete ring around the larynx and is connected by ligaments to both the thyroid cartilage and the trachea. It is located at the level of the C6 vertebra. Its inferior edge delineates the boundary between the larynx and the trachea of the respiratory tract, and between the pharynx and the esophagus of the digestive tract.



- The **arytenoid cartilages** are paired pyramidal-shaped cartilages that rest on the superior side of the posterior portion of the cricoid cartilage.
- Attached to the apex of each arytenoid cartilage are the **corniculate cartilages**.
- The cuneiform cartilages are 2 small, club-shaped cartilages that lie anterior to the corniculate cartilages in the aryepiglottic folds. They form small, whitish elevations on the surface of the mucous membrane just anterior of the arytenoid cartilages.
- The **epiglottis** is an unpaired cartilage of the larynx composed of elastic cartilage, which allows it to be flexible. During swallowing, the epiglottis covers the laryngeal inlet. When not actively swallowing, the unattached end projects superiorly from the larynx and extends into the oropharynx.

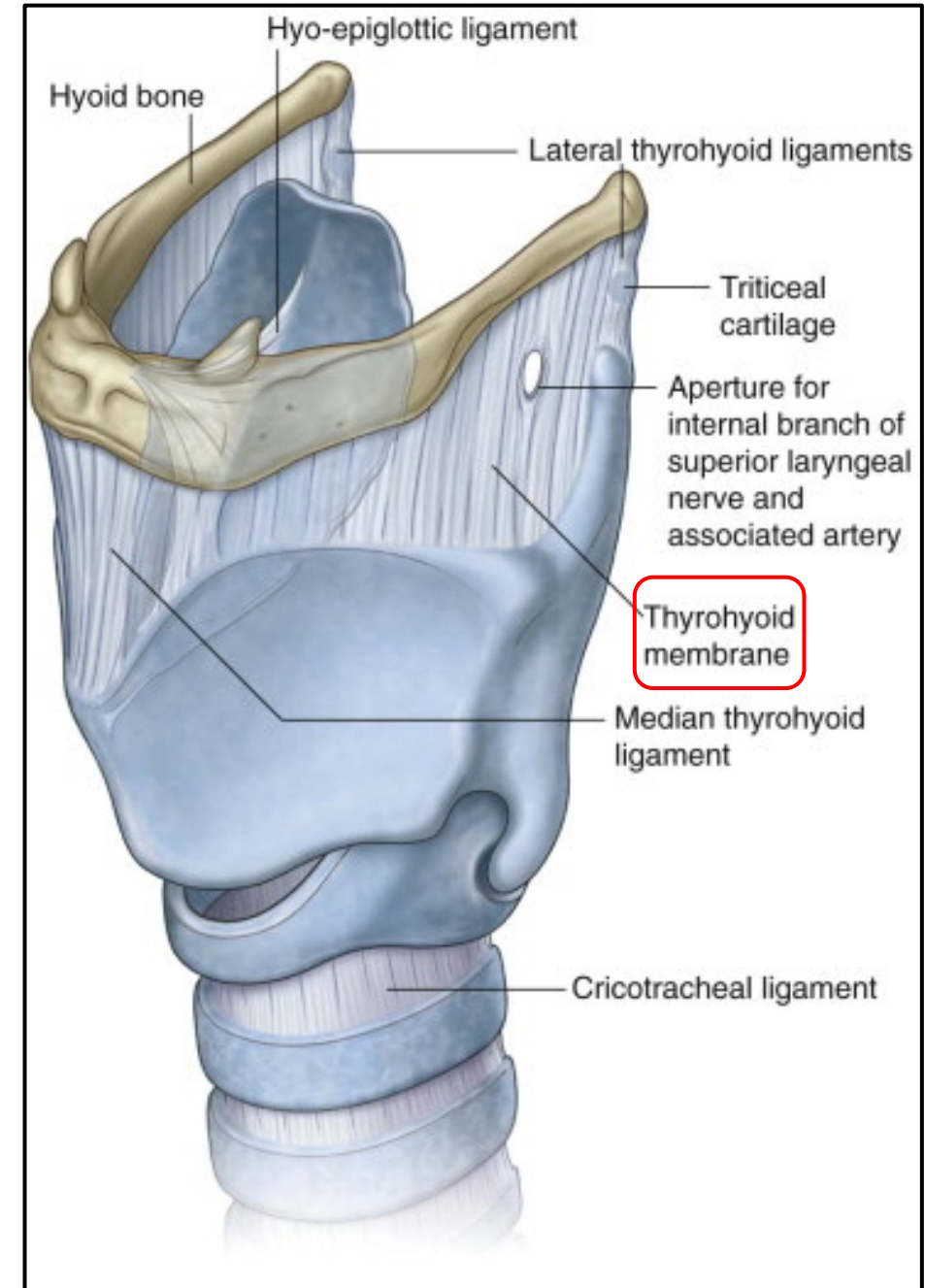
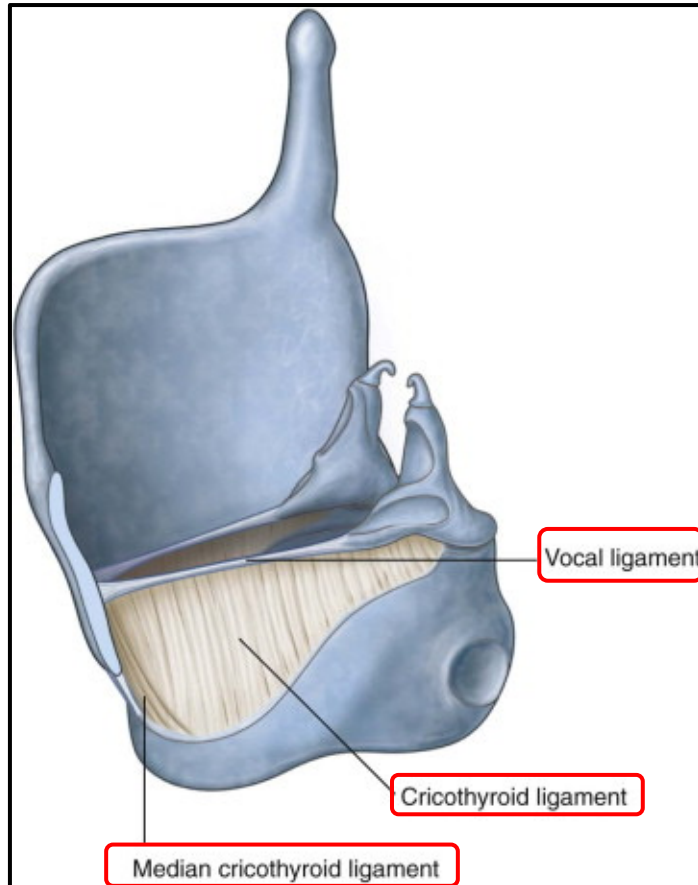


Source: Longnecker DE, Brown DL, Newman MF, Zapol WM: *Anesthesiology*, 2nd Edition: www.accessanesthesiology.com

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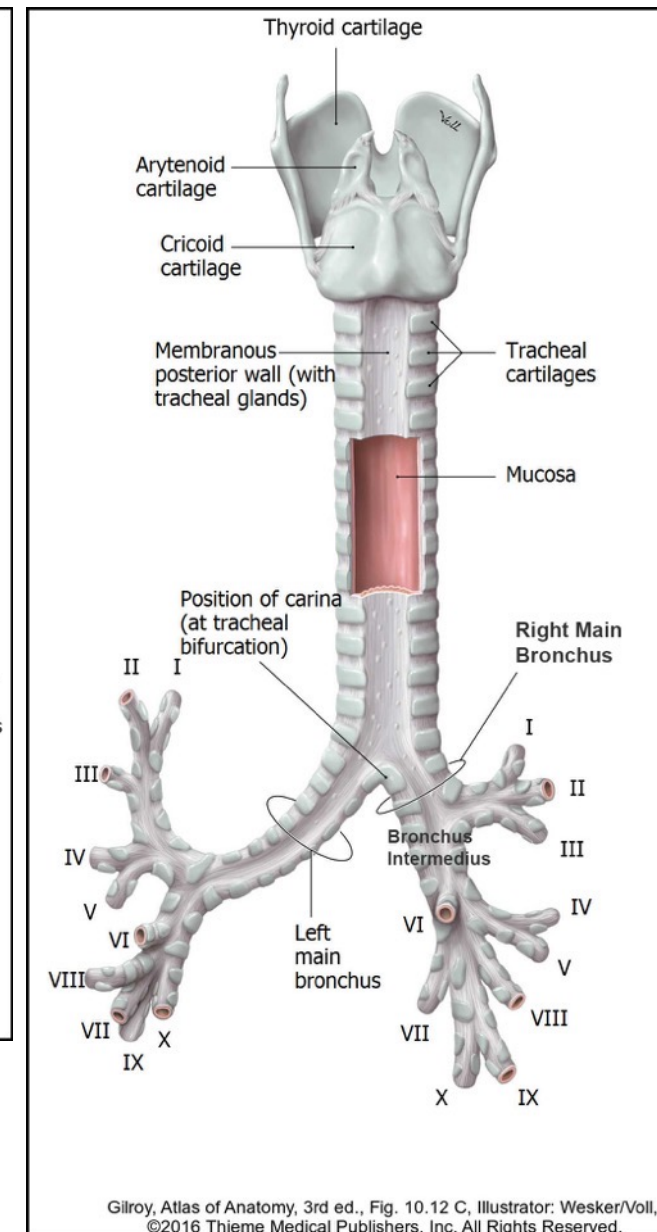
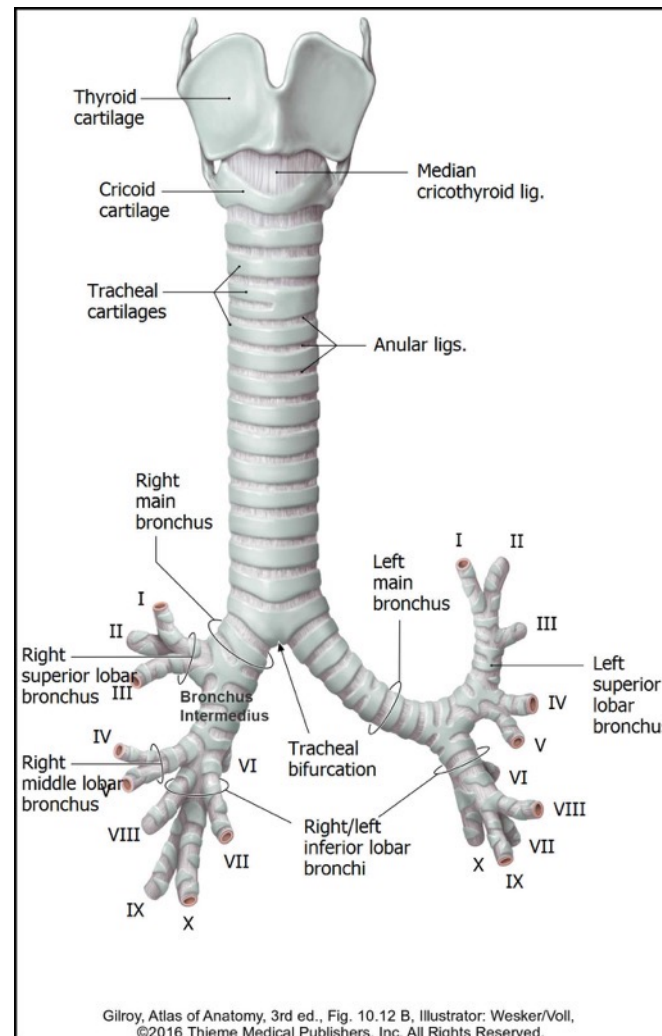
Larynx: Ligaments

- The **cricothyroid ligament (membrane)** is thickened anteriorly in the midline to form the median cricothyroid ligament (Figure 2).
- **Thyrohyoid membrane** spans the space between the thyroid cartilage and hyoid bone
- The **vocal ligaments** extend from the posterior side of the junction between the plates of the thyroid cartilage to the base of the arytenoid cartilages. They are involved in the production of sound. We will explore the muscles involved in phonation in the next PowerPoint Handout.



Trachea

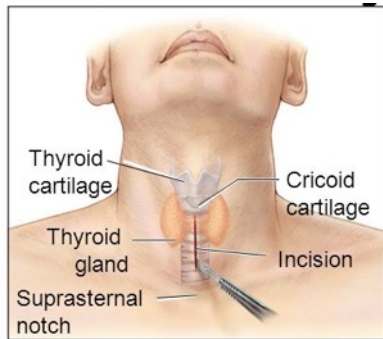
- The **trachea** (windpipe) extends from the inferior end of the larynx into the mediastinum of the thoracic cavity where it bifurcates (divides) into a right and left main bronchus. The termination point of the trachea is at the level of the body where the manubrium meets the body of the sternum.
- The tracheal wall consists of **“C” shaped cartilaginous rings** of hyaline cartilage that maintain the trachea as patent tube (an open passageway). The function of the tracheal rings (and the cricoid cartilage as well) is to keep the airway patent during inspiration.
- The ends of the cartilage in the wall of the trachea are joined by smooth muscle called the trachealis muscle. The trachealis muscle contracts during coughing to decrease the luminal diameter, which increases the velocity of air moving through the trachea to assist with movement of mucus or a foreign substance toward the throat.



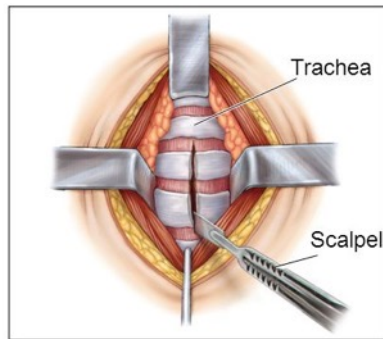
Tracheostomy vs. Cricothyrotomy

The procedure by which a round or square opening is made in the anterior wall of the trachea in order to insert a tube is called a tracheostomy; it is performed to establish an alternate airway for patients whose trachea or larynx is obstructed. This procedure is used when the airway needs to be maintained for several days or more. Because large blood vessels and the thyroid gland overlie the trachea, the above procedures are usually done under controlled conditions. In an emergency, an incision can be made in the median cricothyroid ligament (a cricothyrotomy) to quickly establish a temporary airway due to the absence of major vessels in this location. However, an incision at this location can potentially injure the vocal folds.

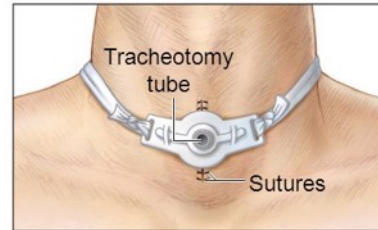
Tracheostomy



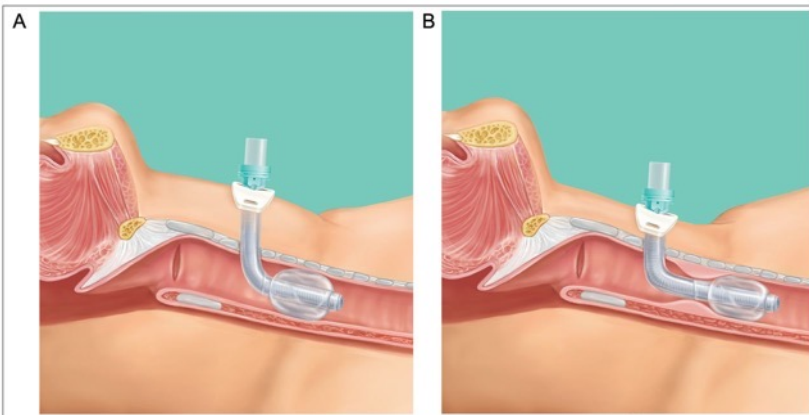
① Incision is made superior to suprasternal notch. Thyroid may have to be cut as well.



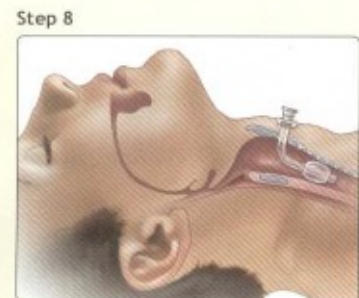
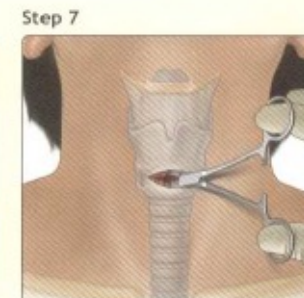
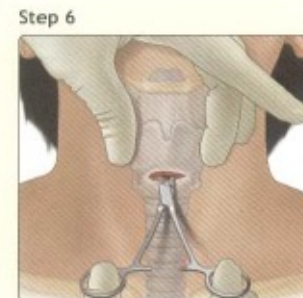
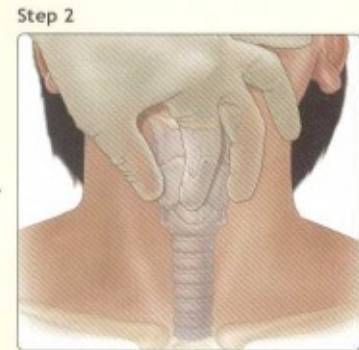
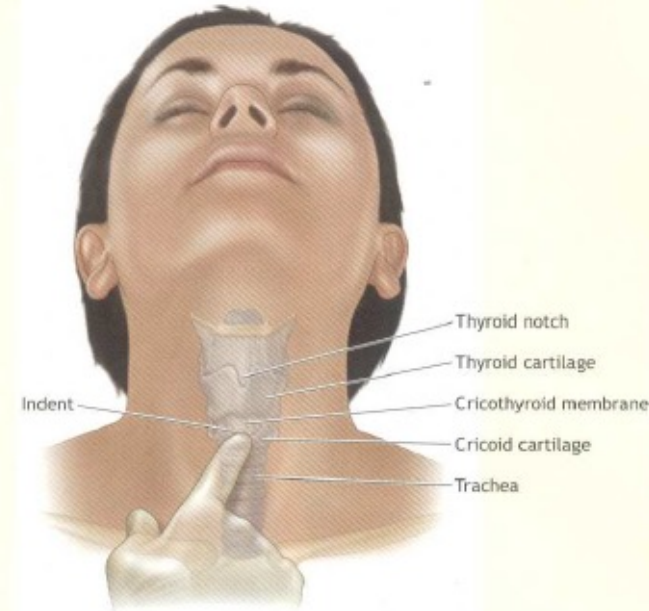
② Retractors separate the tissue, and an incision is made through the third and fourth tracheal rings.



③ A tracheostomy tube is inserted, and the remaining incision is sutured closed.



Cricothyrotomy

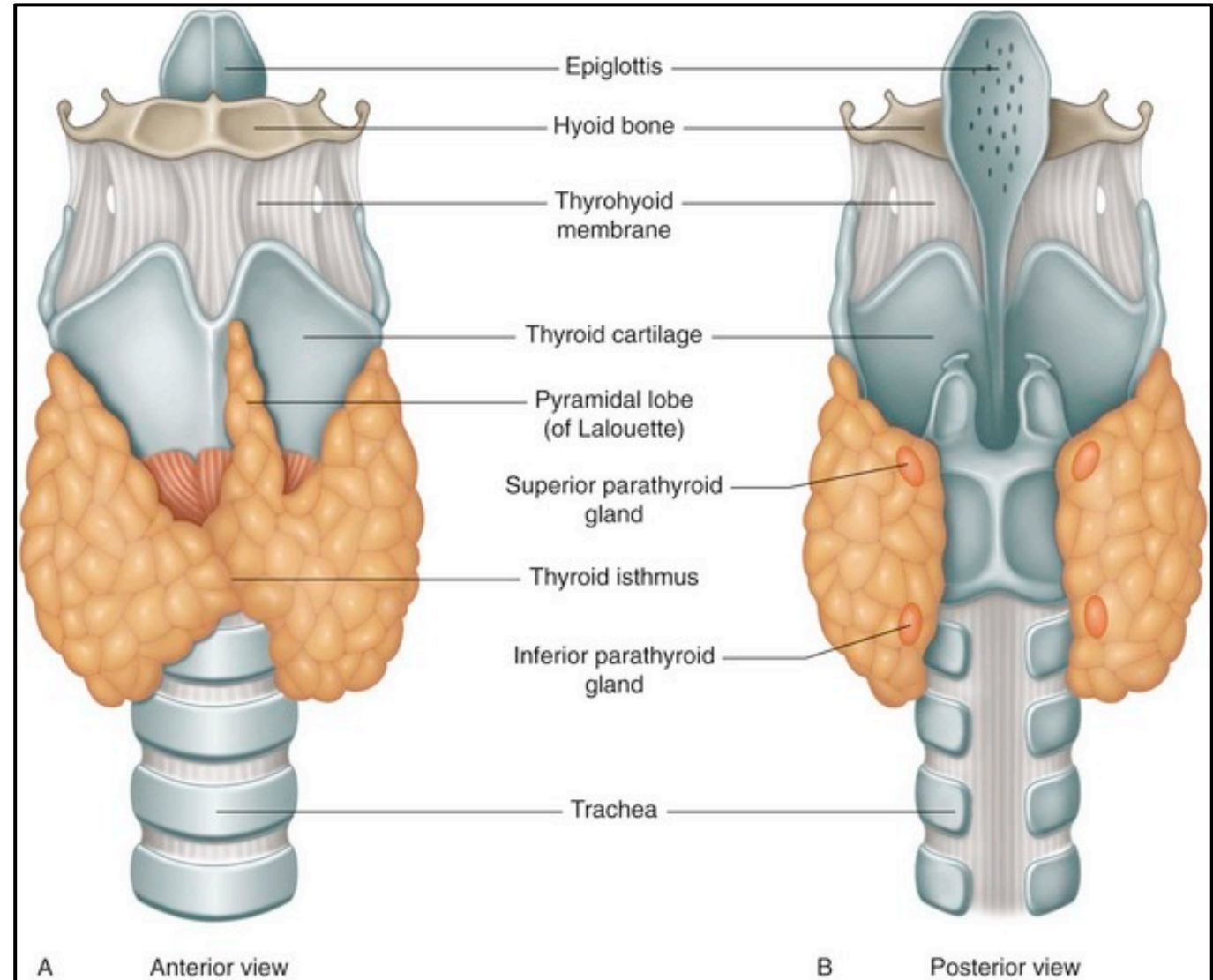


■ Figure III-1 Surgical Cricothyrotomy. (Illustrations correlate with selected steps in Skill III-B.)

Thyroid Gland: Lobes

- The **thyroid gland** consists of two **lobes** (right and left), usually connected by an **isthmus**.
 - The isthmus is located anterior to the 2nd and 3rd tracheal rings, deep to the infrahyoid muscles.
 - An extra lobe, called a **pyramidal lobe**, is sometimes present projecting superiorly from the isthmus. The pyramidal lobe is a remnant of the thyroglossal duct and is considered a normal component of the thyroid gland.

CLINICAL ANATOMY: Pyramidal lobes and accessory thyroid tissue develop from remnants of the epithelium and connective tissue of the embryonic thyroglossal duct. Pyramidal lobes are present in approximately 50% of individuals.



Thyroid Gland: Blood Supply and Venous Drainage

- Arterial blood supply to the thyroid gland is via the following vessels (Figures 1 and 2).
 - The **superior thyroid artery** is the first branch of external carotid of the external carotid artery.
 - The **inferior thyroid artery** is a branch of thyrocervical trunk, which branches from the first part of the subclavian artery.
 - A third branch, the **thyroid ima artery**, is an uncommon source of blood to the thyroid gland. When present, it arises from the brachiocephalic trunk or arch of the aorta and follows a midline course along the anterior surface of the trachea to enter the thyroid gland's inferior surface (Figure 1).

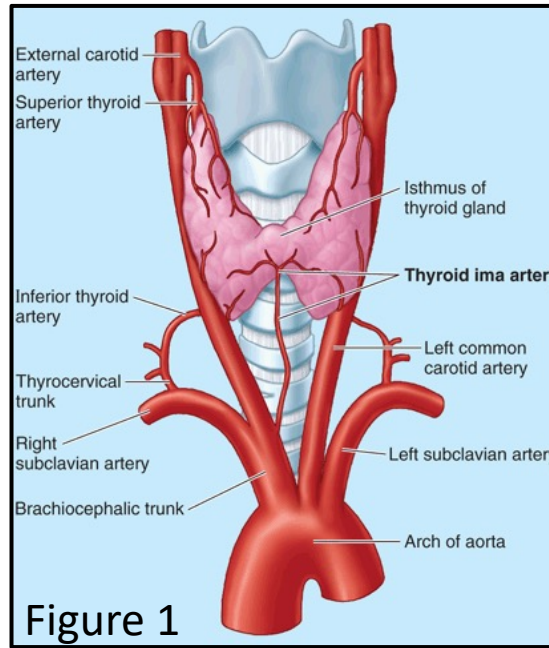


Figure 1

CLINICAL ANATOMY: A thyroid ima artery (Figure 1) is a rare anomaly important for surgeons to be aware of during head and neck surgical procedures (thyroidectomy) and emergent airway creation (tracheostomy). If inadvertently cut, it can be a source of hemorrhaging that is difficult to control, especially if the cut vessel retracts posterior to the manubrium.

- Venous drainage of the thyroid gland is via the following veins.
 - The **superior and middle thyroid veins** drain to the internal jugular,
 - The **inferior thyroid veins** drain into the brachiocephalic veins (Figure 2).

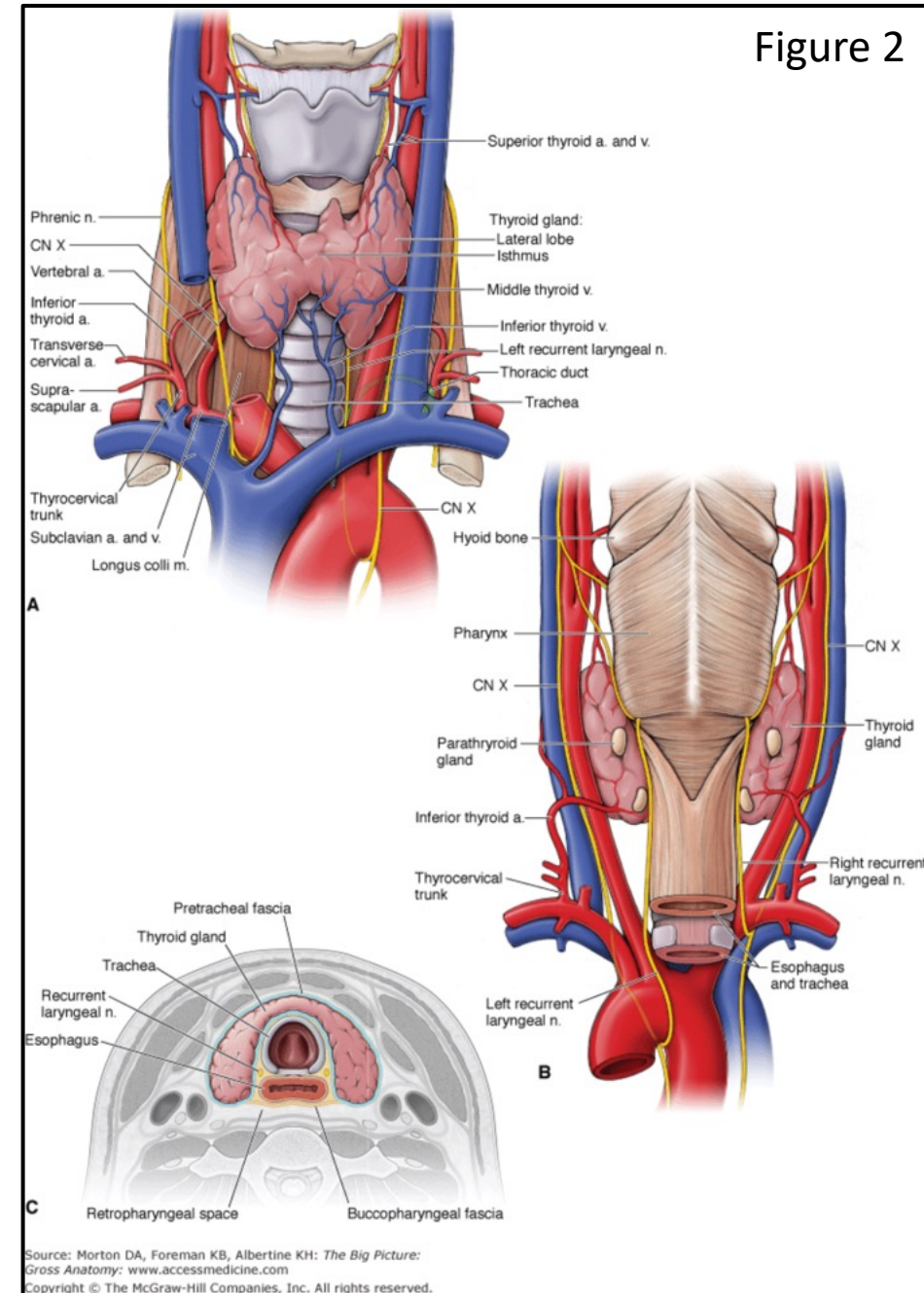


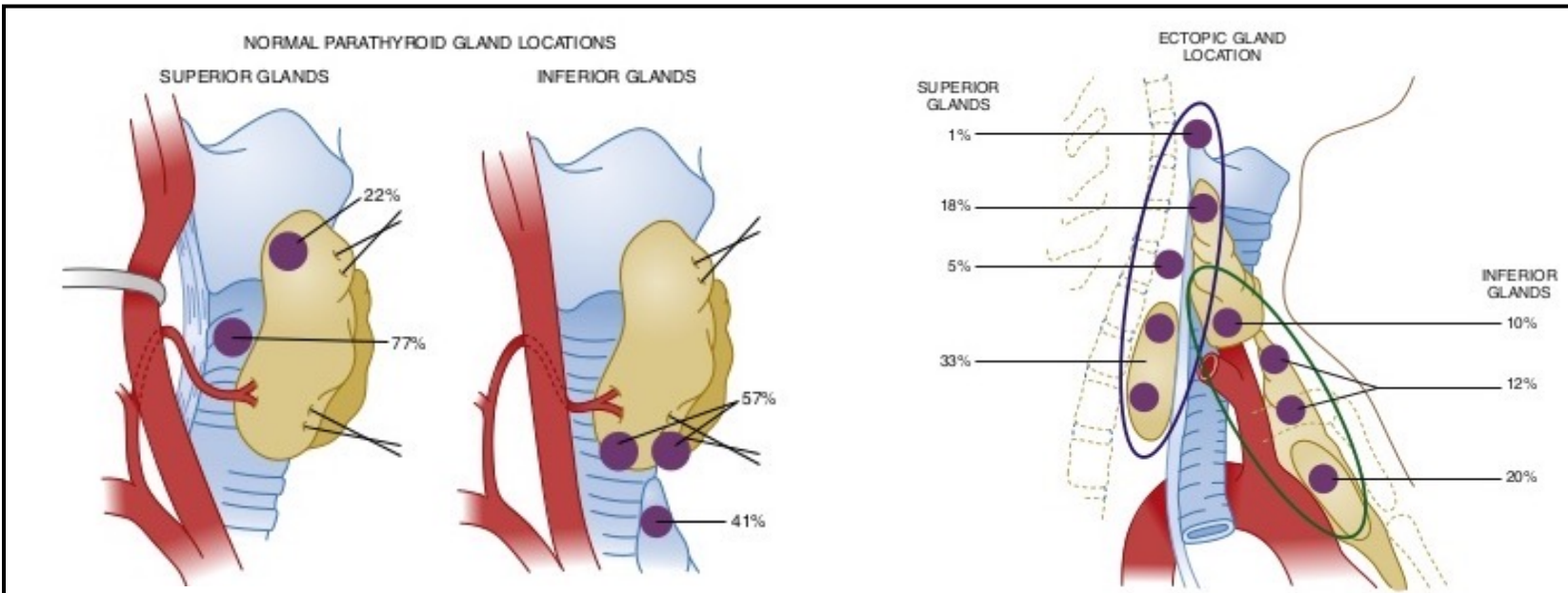
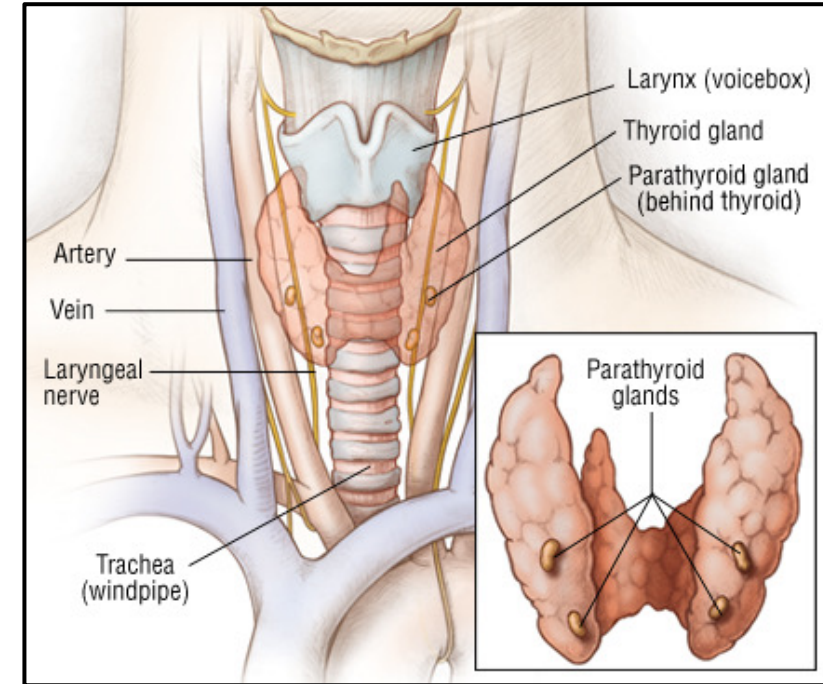
Figure 2

Parathyroid Glands

The **parathyroid glands** are usually located on the posterior surface of each lobe internal to the connective tissue sheath of the thyroid gland.

- Normally two glands are present on each lobe, although the total number of glands varies between 2 and 6.
- Parathyroid glands are difficult to locate in the embalmed cadaver.

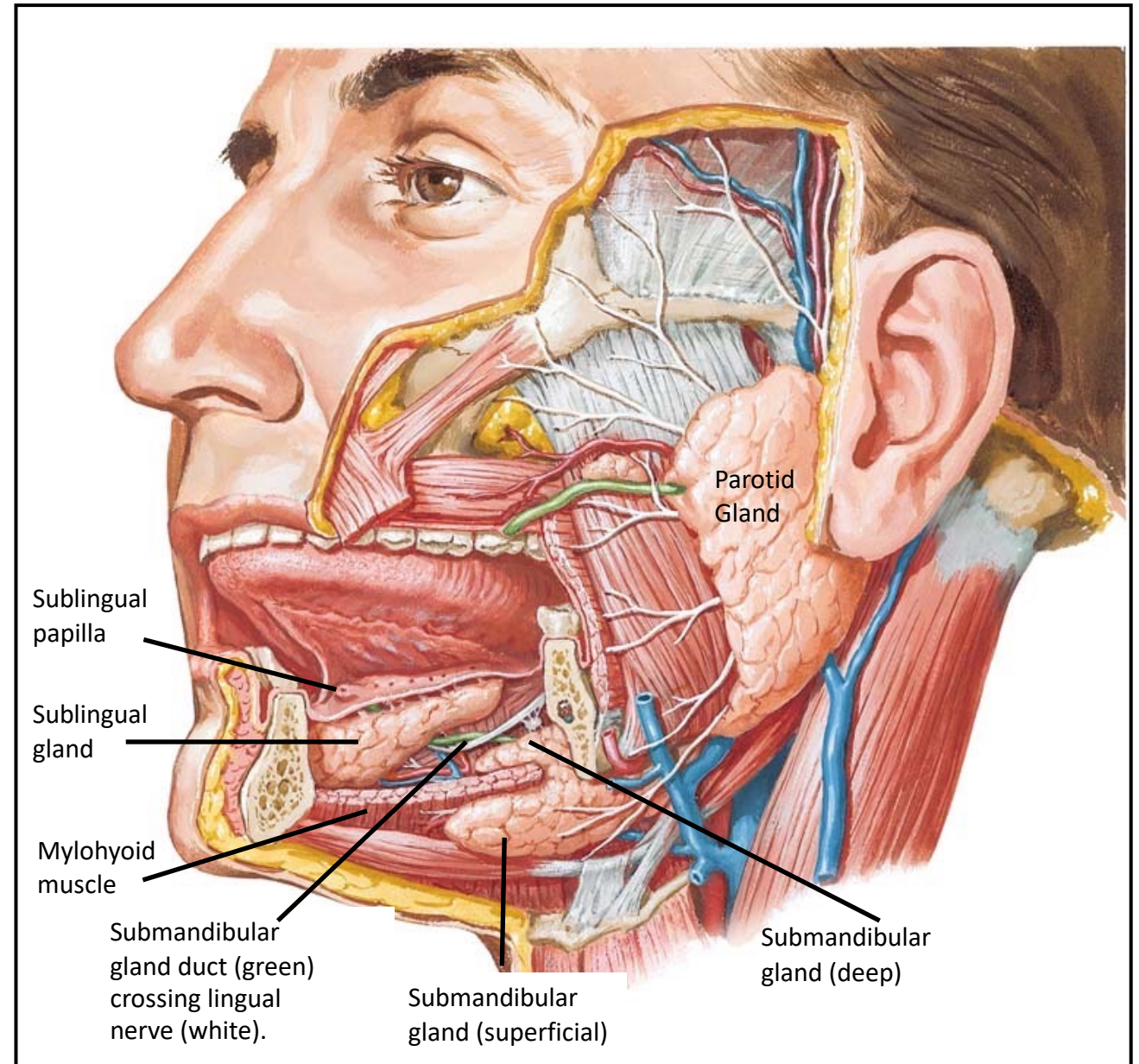
CLINICAL ANATOMY: An ectopic parathyroid gland is defined as a gland not in its typical location. The most common site for an ectopic inferior parathyroid gland is intrathymeric, which results from abnormal migration during embryogenesis. The common site for an ectopic superior thyroid gland is in the tracheoesophageal groove, which is most likely the result of pathological displacement from its normal anatomical position. Ectopic parathyroid glands are an important diagnostic challenge for surgeons.



Submandibular gland

The **submandibular gland** consists of a superficial part and a deep part, which are separated by the mylohyoid muscle. The two parts are continuous with each other and form a "U" shape that hooks around to posterior border of the mylohyoid muscle.

- The **superficial part** is located outside the oral cavity and is the largest portion of the gland. It is located in the submandibular triangle medial to the body of the mandible. However, it is common for the gland to project inferiorly beyond the inferior margin of the mandible..
- The **deep part** hooks around the posterior margin of mylohyoid muscle to enter the oral cavity proper. It lies on the lateral surface of the hyoglossus muscle lateral to the root of the tongue.
- The **submandibular (Wharton's) duct** arises from the deep part of the gland and ascends on its path to open as 1-3 orifices on a small **sublingual papilla** (caruncle) at the base of the lingual frenulum. In the oral cavity, the lingual nerve on its path to the tongue, loops under the submandibular duct.

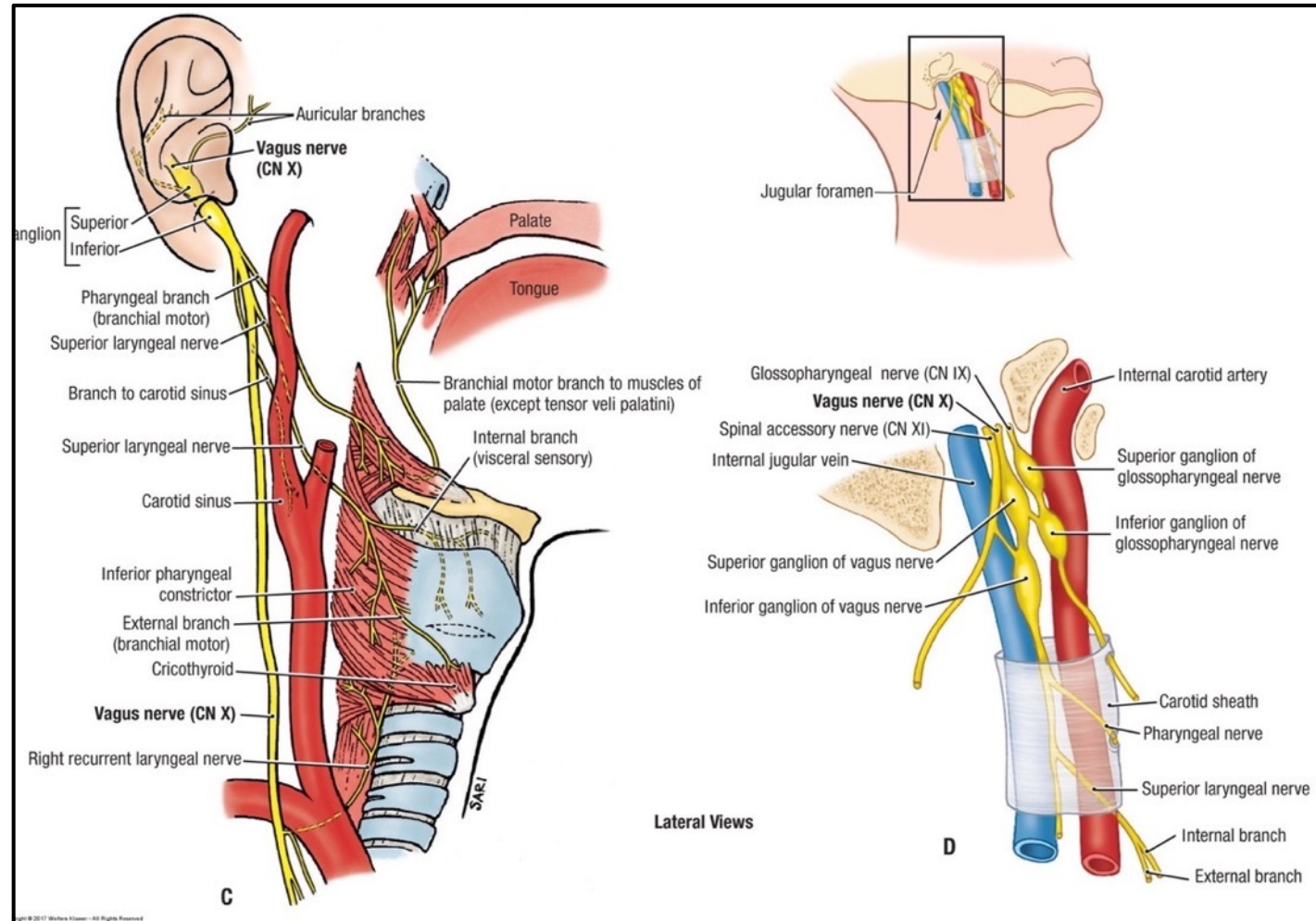


Vagus Nerve (CN X): The Details

Pathway: The **vagus nerve** emerges from the medulla as several rootlets that merge and exit the cranial cavity through the jugular foramen. The vagus nerve's two sensory ganglia are located at the jugular foramen (superior and inferior ganglia). As the nerve descends beyond the inferior ganglion, it is contained within the carotid sheath throughout its path in the neck. Inferior from the root of the neck, the nerve takes a different path on each side of the body. It exits the neck by passing into the thoracic cavity.

Branches in the neck

- **Pharyngeal branches** provide **branchial motor innervation to superior, middle, and inferior constrictor muscles and muscles of the soft palate (except tensor veli palatini).**
- The **superior laryngeal nerve** branches from the vagus, descends inferiorly, and divides into the internal and external laryngeal branches.
 - The **internal laryngeal nerve branch** passes through the thyrohyoid membrane and **provides somatic sensory innervation the laryngeal mucosa superior to the true vocal fold (vocal cords), laryngopharynx, and epiglottis.**
 - The **external laryngeal nerve branch** provides **branchial motor innervation to cricothyroid muscle of the larynx and a few fibers innervate inferior portion of the inferior pharyngeal constrictor muscle (cricopharyngeus) .**
- **Cardiac nerves** branch from the vagus within the carotid sheath, descend inferiorly within the sheath, join with the cardiac plexus in the thorax, and ultimately innervate the heart.
 - **Visceral motor: SA node AV node**
 - **Visceral sensory: aortic bodies and arch (chemoreceptors and baroreceptors)**



Vagus Nerve (CN X): The Details (Continued)

Branches (Continued)

- The **recurrent laryngeal nerves** branch from the vagus nerve in different locations on the right side of the body compared to the left.
 - On the right side of the body, the recurrent laryngeal nerve loops around the subclavian artery
 - On the left side of the body, the recurrent laryngeal nerve loops around the arch of the aorta.
 - After looping around their respective structures, both the right and left vagus nerves ascend in the neck in the tracheoesophageal groove.
 - **Motor innervation: intrinsic muscles of the larynx (except cricothyroid), upper esophageal muscle,**
 - **sensory innervation: mucosa of the larynx inferior to the true vocal fold (vocal cords) and sensory innervation to the trachea.**
- The vagus nerves course along either side of the distal esophagus where they share branches with each other to form the esophageal plexus surrounding the esophagus. Just before passing through the diaphragm, the vagus nerves again become separate and distinct to form the anterior and posterior vagal trunks. The vagal trunks then pass through the diaphragm with the esophagus into the abdomen **where the trunks divide into branches that innervate the stomach and intestinal tract as distal as the left colic flexure.**

Test:

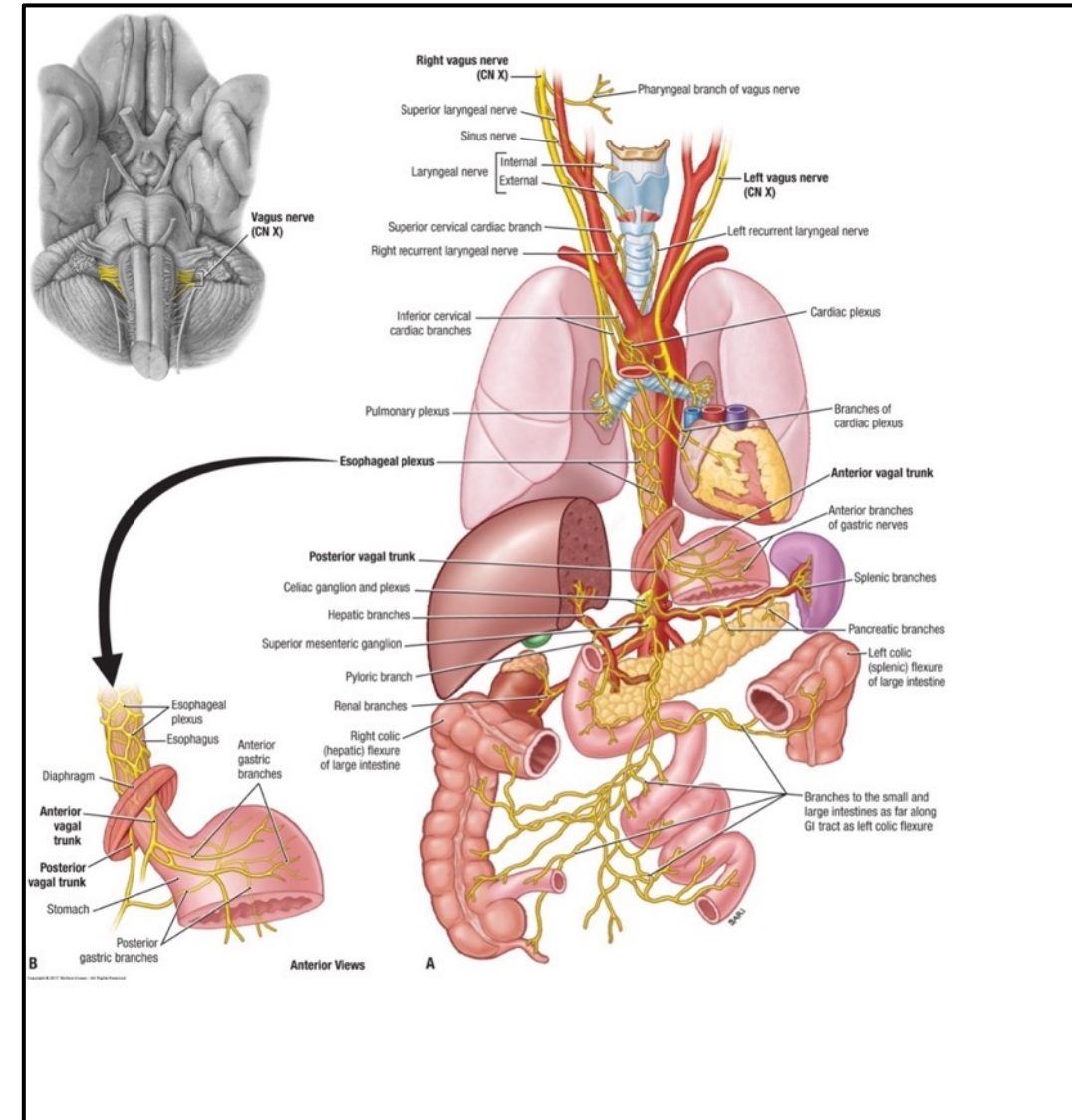
- Efferent limb of gag reflex
- Observing the soft palate while patient says: "Ahh."

Positive Test:

- Gag Reflex: The uvula does not elevate following eliciting of gag reflex
- Patient saying "AHH:" Lack of symmetric elevation of the soft palate

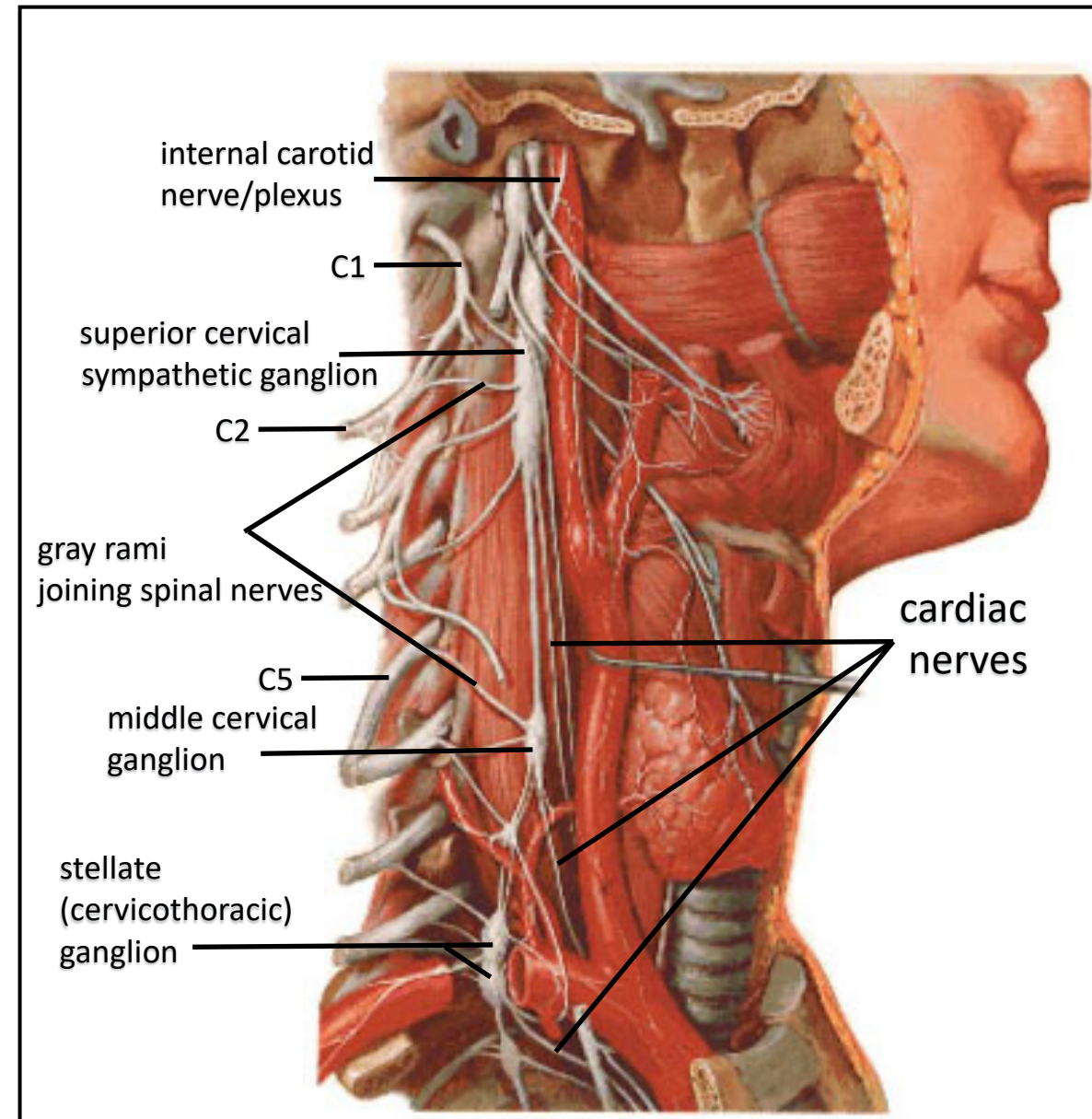
Clinical:

- Damage to CN X may result in breathiness of the voice, tachycardia, and orthostasis.



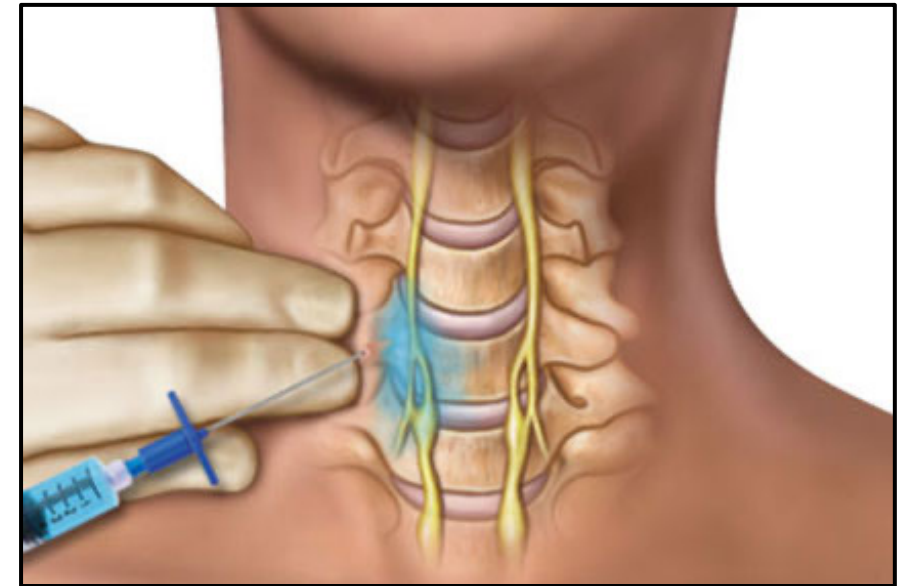
Sympathetic Trunk

- The sympathetic trunk courses through the deep part of the neck posterior to the carotid sheath.
- In the cervical region, the sympathetic chain consists of 3 ganglia.
 - **Superior ganglion**
 - **Middle ganglion** (smaller than that superior)
 - **Inferior ganglia:** Occasionally the inferior cervical ganglion fuses with the first thoracic ganglion to form the **stellate (cervicothoracic) ganglion**.
- Recall that sympathetic fibers originating in the T5-9 regions of the spinal cord form the greater splanchnic nerve destined to synapse in ganglia in the abdomen. Therefore, the fibers originating from the T1-4 (and sometimes T5 due to overlap) innervate the head, neck, upper limb and thorax.
- Preganglionic fibers travel superiorly in the sympathetic chain to reach the cervical ganglia where they form synapses, and postganglionic fibers can exit the ganglia by several routes (all postganglionic):
 - **Cardiac nerves** course to the thoracic cavity where they contribute to the cardiac plexus. We will study this pathway in more detail in the Cardiovascular System.
 - **Gray rami** connect the sympathetic chain to the cervical spinal nerves.
 - C1-4 (cervical plexus) are supplied by the superior ganglion.
 - The brachial plexus (C5-T1) is supplied by the middle and lower cervical/first thoracic ganglion.
 - **Internal carotid plexus (nerve)** consists of sympathetic fibers destined for the head (all structures not supplied by cervical nerves). These fibers exit the the **superior cervical ganglion**, and form a plexus along the internal carotid artery and its branches.
 - The inferior cervical ganglion supplies sympathetic fibers that course along the subclavian arteries and vertebral arteries.

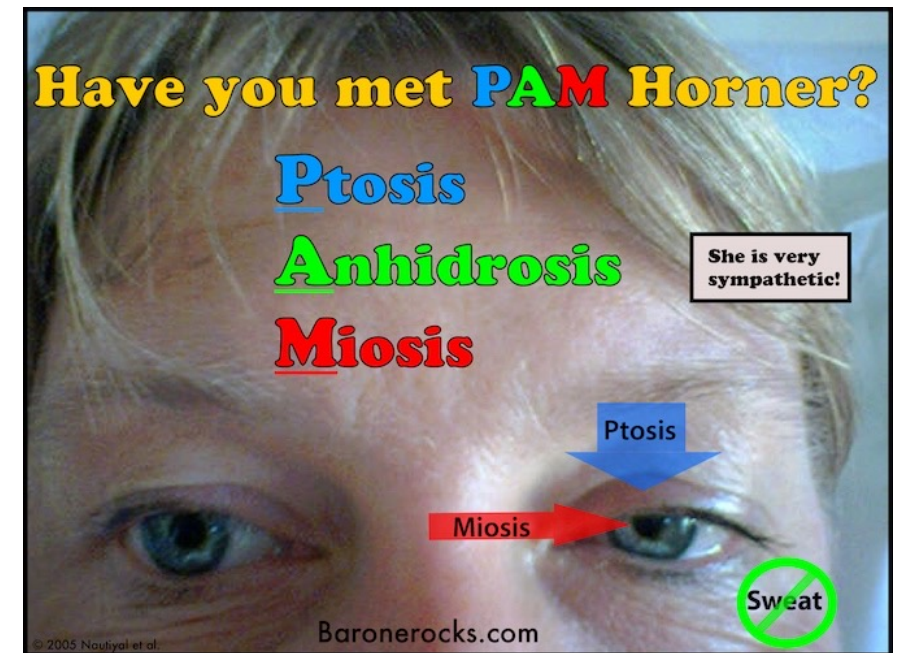


Clinical Anatomy: Stellate Ganglion Block & Horner Syndrome

CLINICAL ANATOMY: Sympathetic fibers to the head, neck, and upper extremities pass through the stellate ganglion, which in most people is formed by the fusion of the inferior cervical and first thoracic sympathetic ganglia. Stellate ganglion blocks are used to treat conditions and pain of the face and upper extremity that involve the sympathetic nervous system (Figure 1). It is used to treat sympathetic pain syndromes involving the upper extremity, such as CRPS (Chronic Regional Pain Syndrome), ischemic neuropathies, herpes zoster, and post-herpetic neuralgia. It is also proven successful in reducing pain and improving blood flow in vascular insufficiency conditions, such as Raynaud's disease, frostbite, and vasospasm.



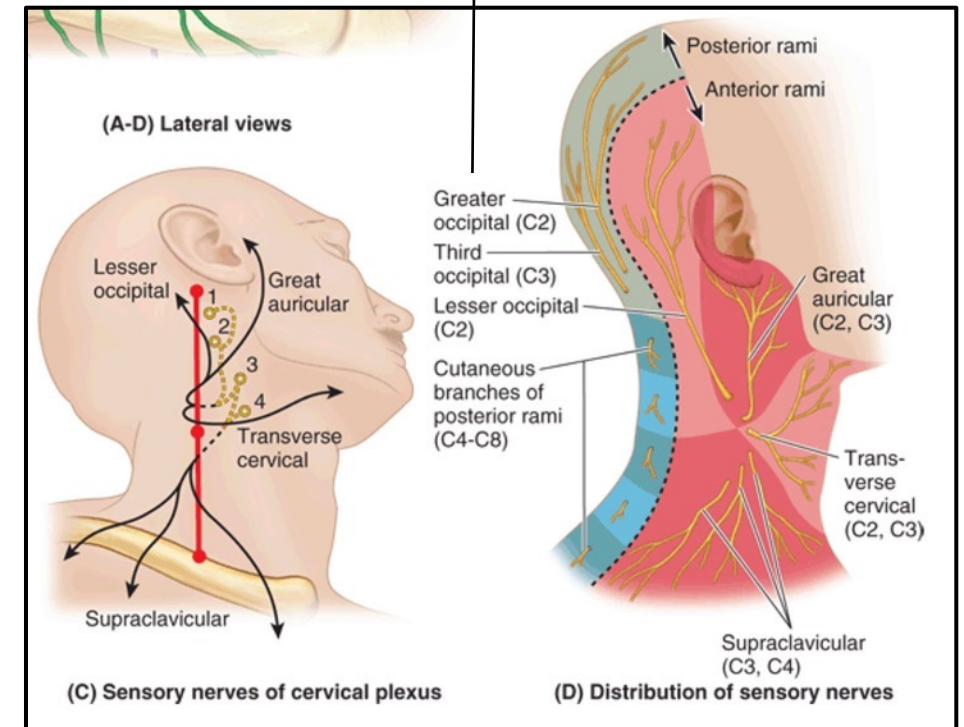
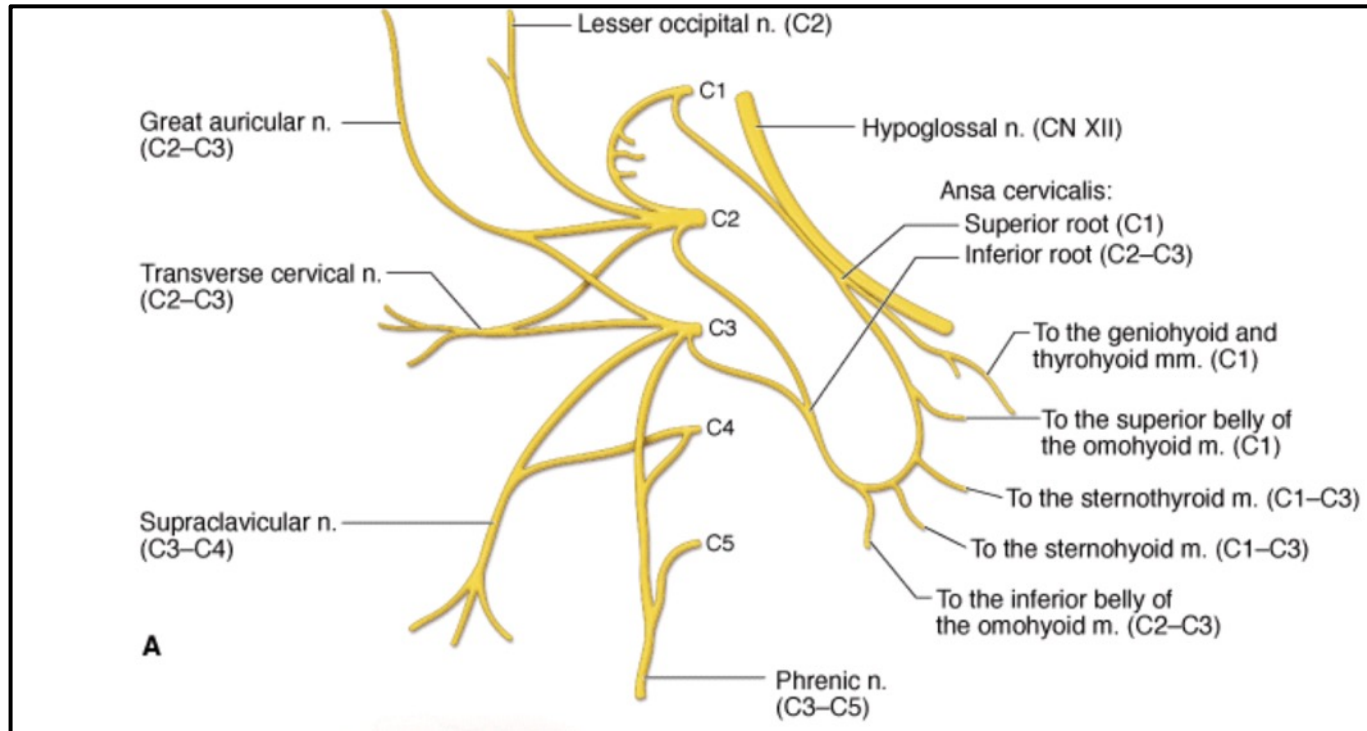
CLINICAL ANATOMY: Horner syndrome is a neurological syndrome that results from damage to the sympathetic pathways that supply the head and neck region. The constellation of signs and symptoms occur on the same side of the body as the lesion. The typical signs of Horner syndrome include constriction of the pupil (miosis), drooping of the eyelid (ptosis), redness and increased temperature of the skin (vasodilation), and absence of facial sweating (anhidrosis). Horner syndrome may result from a variety of factors, including carotid artery dissection; the development of a tumor in neck or chest cavity, particularly a neuroblastoma and a tumor of the upper part of the lung (Pancoast tumor); the development of a lesion in midbrain, brain stem, upper spinal cord, neck, or eye orbit; inflammation or growths affecting the lymph nodes of the neck; and/or surgery or other forms of trauma to the neck or upper spinal cord.



Cervical Plexus: Cutaneous Branches (Review)

- The **cervical plexus** of nerves arises from the ventral rami of the C1-C4 cervical spinal nerves.
- Branches of the **cervical plexus** include cutaneous branches and motor branches
- Cutaneous branches: The cutaneous branches are superficial branches that innervate the skin.
 - **Lesser occipital nerve** (C2): skin over the lower, lateral region of the scalp
 - **Great auricular nerve**: (C2-C3): skin over parotid gland and angle of mandible
 - **Transverse cervical nerve** (C2-C3): skin covering anterior portion of the neck
 - **Supraclavicular nerve** (C3-C4): skin covering lower portion of neck, upper chest, and shoulder regions
- Motor branches: Next slide

Recall that the greater occipital nerve is derived from the *dorsal* ramus of C2

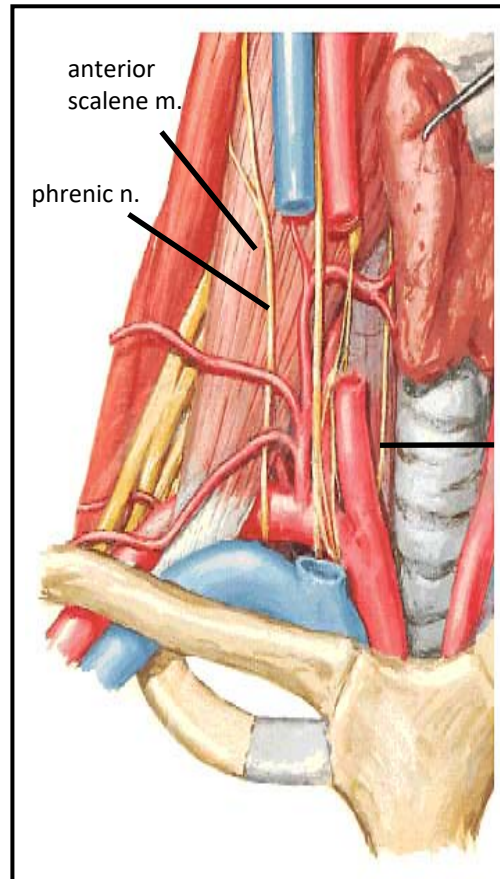


Cervical Plexus: Motor Branches (Review)

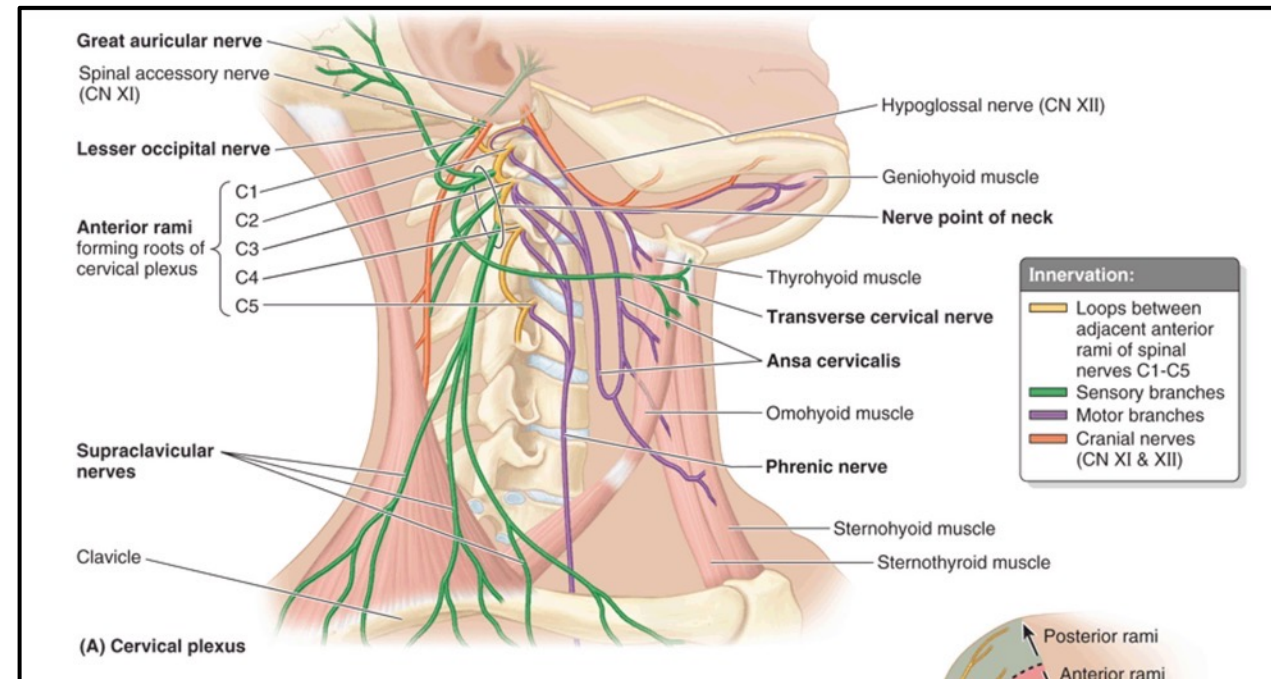
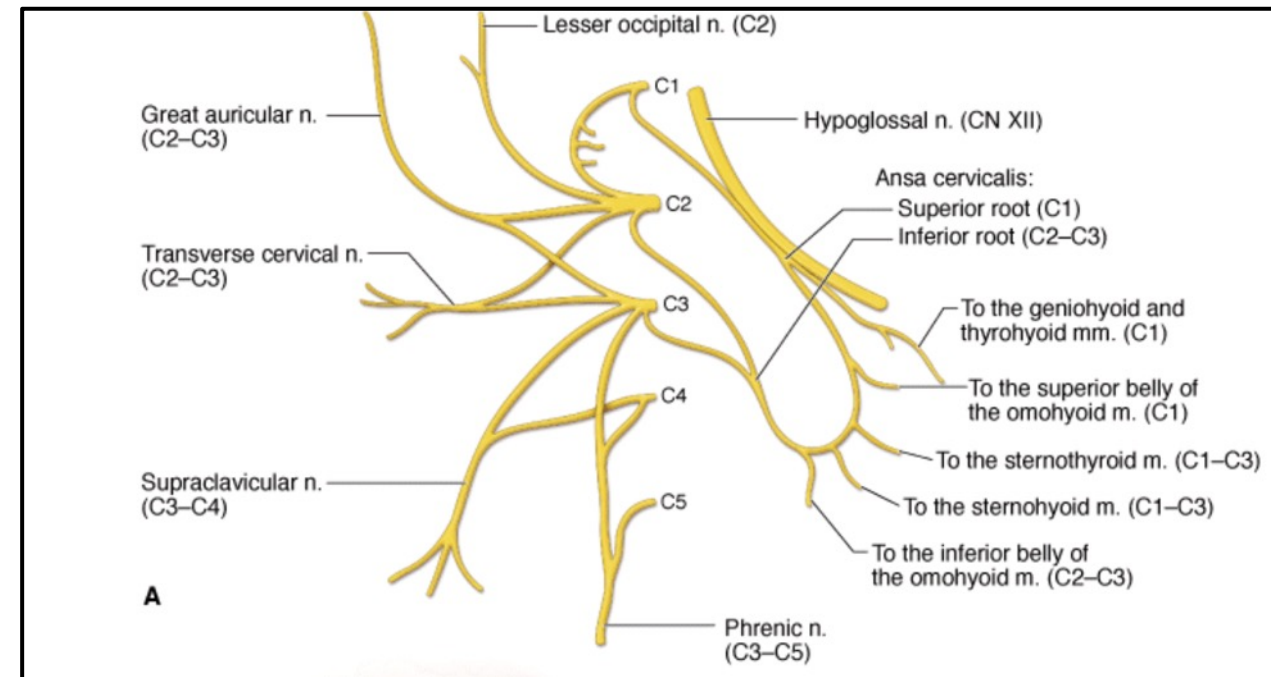
Motor branches: The deep branches are motor branches that innervate skeletal muscles.

- C1 courses along with with the hypoglossal nerve for a short distance and innervates the **thyrohyoid** and **geniohyoid** muscles.
- Fibers from C1 form the superior root of the **ansa cervicalis**.
- Fibers from C2 and C3 join to form the inferior root of **ansa cervicalis** at a location that is anterior to the internal jugular vein.
- The inferior root and superior root join to form the **ansa cervicalis**, which contains only motor fibers. Motor nerves branching from the **ansa cervicalis** supply the following muscles.

- **Omohyoid**
- **Sternothyroid**
- **Sternohyoid**

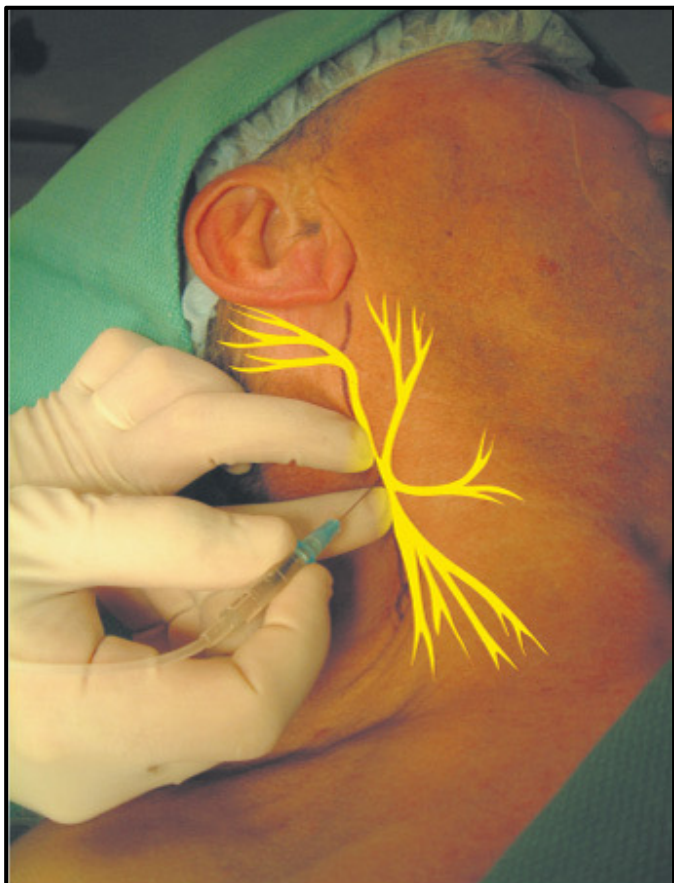


- The cervical plexus also provides branches that form the **phrenic nerve**. The **phrenic nerve** is formed by fibers from C3, C4, and C5 and courses toward the thorax on the **anterior scalene muscle**. The motor fibers (axons) of the phrenic nerve innervate the diaphragm.

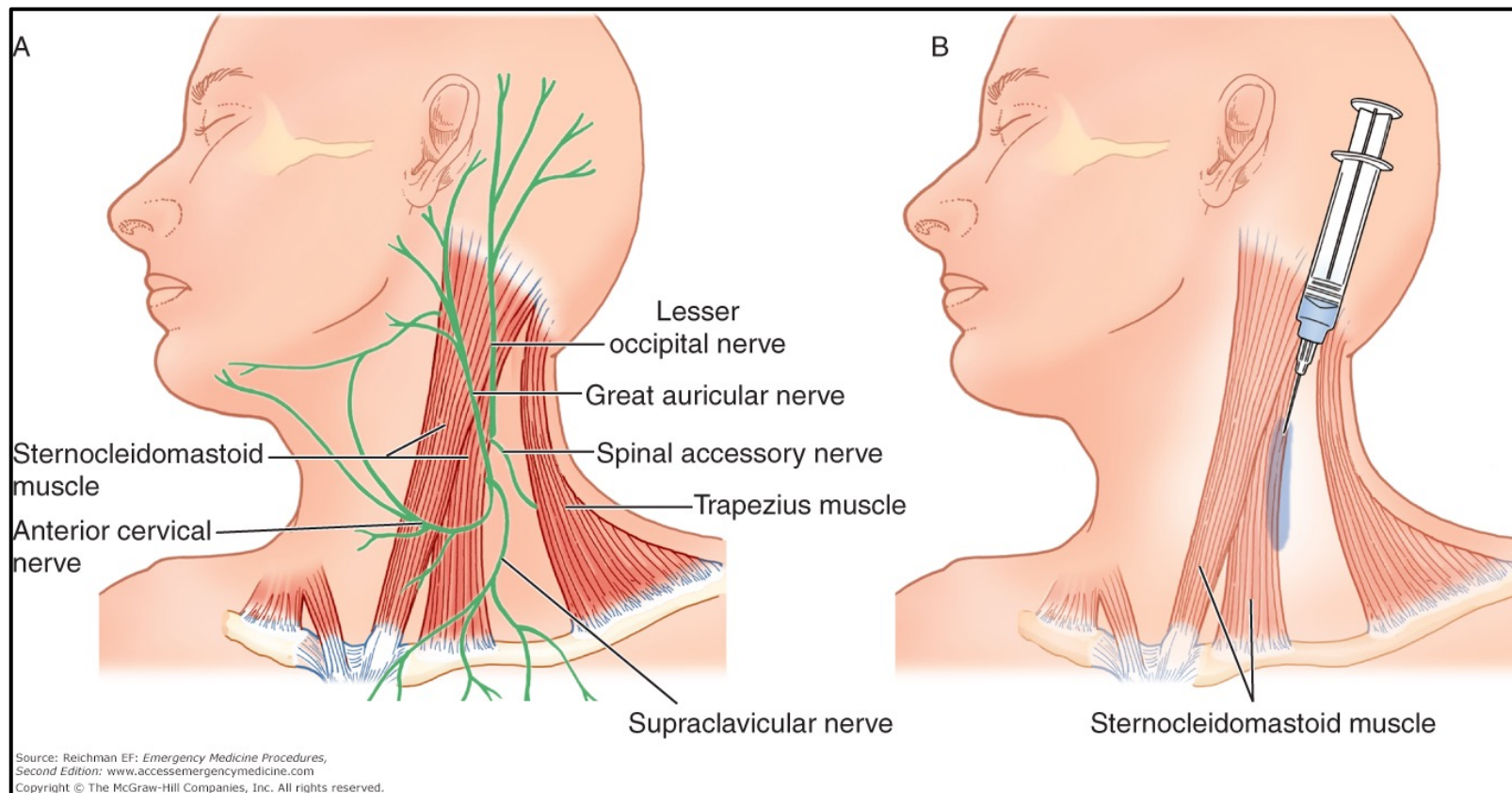


Cervical Plexus: Anesthesia Block (Review)

A **cervical plexus block** provides anesthesia and analgesia to the head and neck region. Depending on the type of surgery, the plexus can be blocked either at a superficial region (superficial to investing fascia) region, a deep region (deep to prevertebral fascia), or both. Sometimes an injection can also be performed at an intermediate level (between investing fascia and prevertebral fascia). The superficial branches of the plexus innervate the skin and superficial structures of the head, neck, and shoulder. The deep branches innervate the muscles of the deep anterior neck and the diaphragm.



Source: Hadzic A: *The New York School of Regional Anesthesia Textbook of Regional Anesthesia and Acute Pain Management*: <http://www.accessanesthesiology.com>
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Lymph Drainage

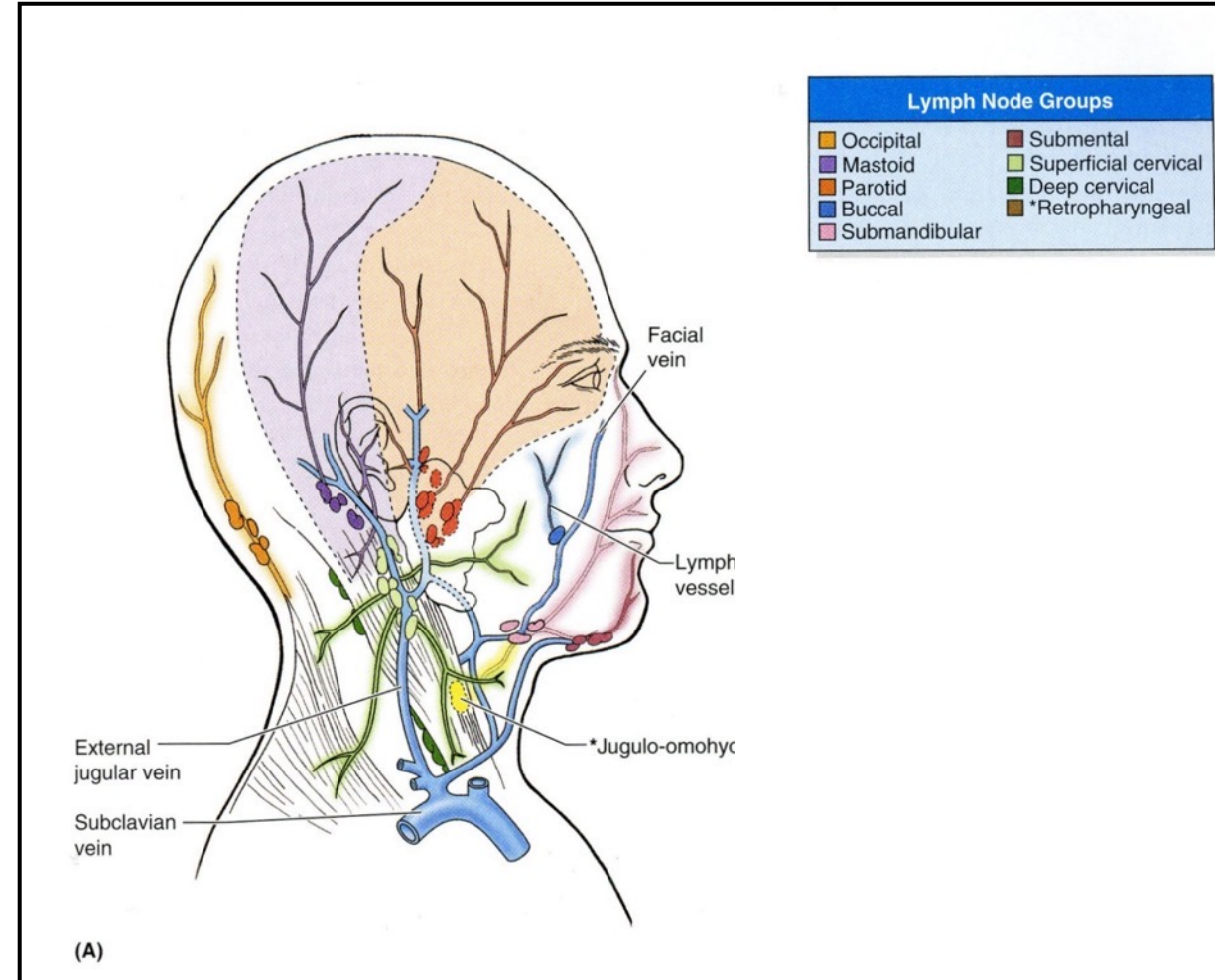
Five groups of **superficial lymph nodes** form a ring around the base of the skull. These nodes are responsible for the lymphatic drainage of the face and scalp.

- **Occipital nodes:** drainage is from the posterior scalp and neck
- **Mastoid nodes (retro-auricular/posterior auricular nodes):** drainage is from the posterolateral half of the scalp
- **Pre-auricular and parotid nodes:** drainage is from the anterior surface of the auricle, the anterolateral scalp, the upper half of the face, the eyelids, and the cheeks
- **Submandibular nodes:** drainage is from structures along the path of the facial artery as high as the forehead, as well as the gingivae, the teeth, and the tongue
- **Submental nodes:** drainage is from the center part of the lower lip, the chin, the floor of the mouth, the tip of the tongue, and the lower incisor teeth.

The **superficial cervical nodes** are a collection of lymph nodes along the external jugular vein on the superficial surface of the sternocleidomastoid muscle. They primarily receive lymphatic drainage from the posterior and posterolateral regions of the scalp through the occipital and mastoid nodes, and send lymphatic vessels in the direction of the deep cervical nodes.

Lymphatic flow from these superficial lymph nodes passes in several directions:

- Drainage from the occipital and mastoid nodes passes to the superficial cervical nodes along the external jugular vein.
- Drainage from the pre-auricular, parotid nodes, submandibular nodes, and the submental nodes pass to the **deep cervical nodes**.



Lymph Drainage (Continued)

The **deep cervical nodes** eventually receive all lymphatic drainage from the head and neck either directly or through regional groups of nodes. From the deep cervical nodes, lymphatic vessels form the right and left jugular trunks, which empty into the right lymphatic duct on the right side or the thoracic duct on the left side .

The **deep cervical nodes** are a collection of lymph nodes that form a chain along the internal jugular vein.

- They are divided into upper and lower groups where the intermediate tendon of the omohyoid muscle crosses the common carotid artery and the internal jugular vein.
- The most superior node in the upper deep cervical group is the **jugulodigastric node** . This large node is where the posterior belly of the digastric muscle crosses the internal jugular vein and receives lymphatic drainage from the tonsils and tonsillar region.
- Another large node, usually associated with the lower deep cervical group because it is at or just inferior to the intermediate tendon of the omohyoid muscle, is the **jugulo-omohyoid node**. This node receives lymphatic drainage from the tongue.

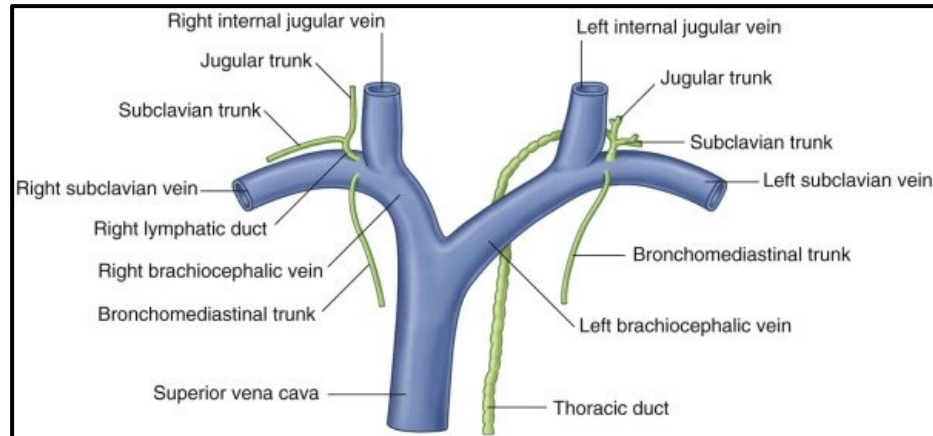
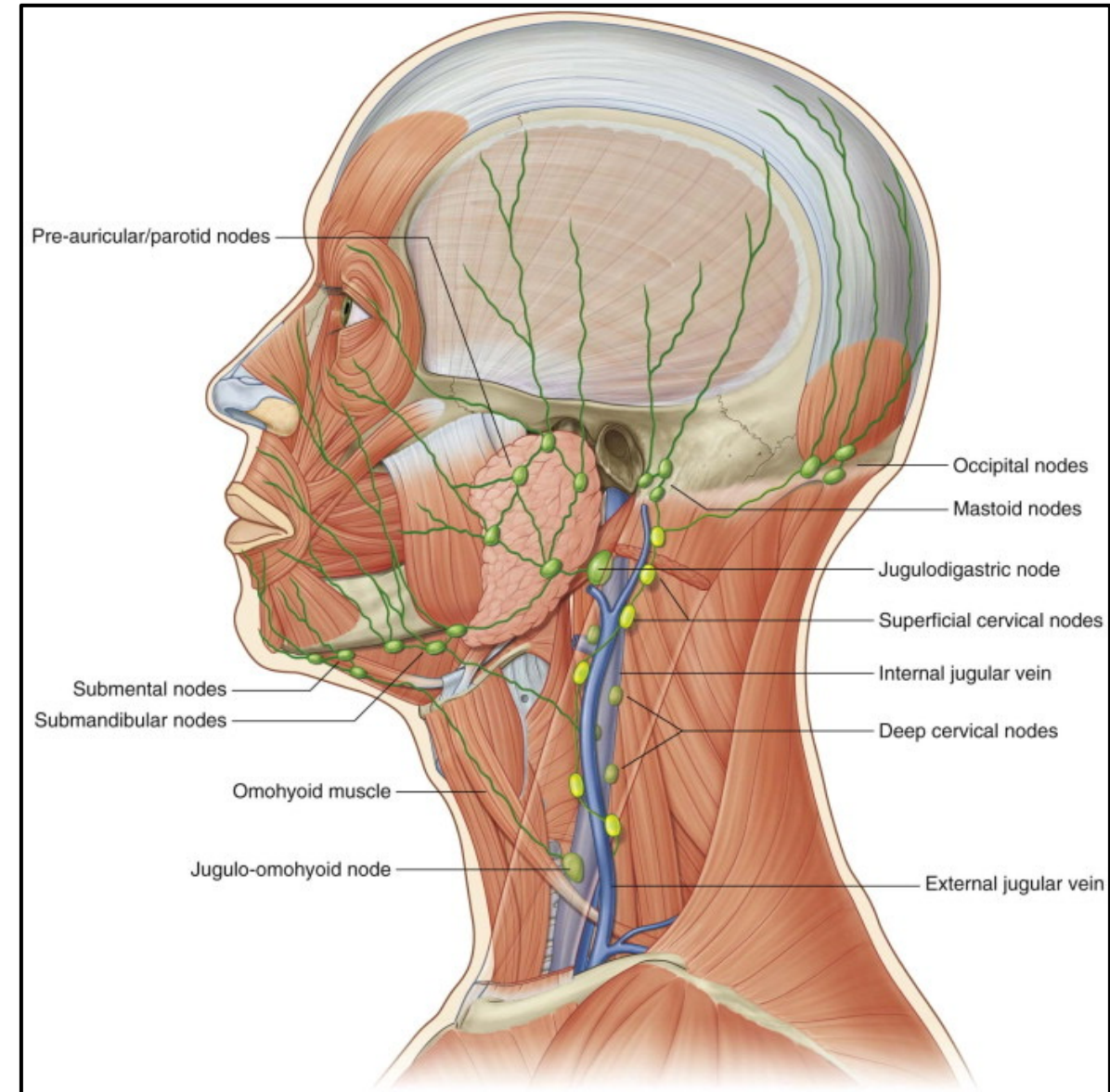


Figure 2

Figure 1



Neck Anatomic Levels

Lymph nodes in the neck have been historically divided into seven anatomic levels for the purpose of head and neck cancer staging and therapy planning. The table below is the most updated information regarding anatomical boundaries by the American Head and Neck Society and the American Academy of Otolaryngology. The details in the table are for your reference and can help you delineate boundaries, but you don't need to memorize the boundaries in the table or the subgroups of levels. **However, you should be able to identify each of the 6 areas on a cadaver or image.**

Table 3. Anatomical Structures Defining the Boundaries of the Neck Levels and Sublevels

Level	Boundary			
	Superior	Inferior	Anterior (Medial)	Posterior (Lateral)
IA	Symphysis of mandible	Body of hyoid	Anterior belly of contralateral digastric muscle	Anterior belly of ipsilateral digastric muscle
IB	Body of mandible	Posterior belly of muscle	Anterior belly of digastric muscle	Stylohyoid muscle
IIA	Skull base	Horizontal plane defined by the inferior body of the hyoid bone	Stylohyoid muscle	Vertical plane defined by the spinal accessory nerve
IIB	Skull base	Horizontal plane defined by the inferior body of the hyoid bone	Vertical plane defined by the spinal accessory nerve	Lateral border of the sternocleidomastoid muscle
III	Horizontal plane defined by inferior body of hyoid	Horizontal plane defined by the inferior border of the cricoid cartilage	Lateral border of the sternohyoid muscle	Lateral border of the sternocleidomastoid or sensory branches of cervical plexus
IV	Horizontal plane defined by the inferior border of the cricoid cartilage	Clavicle	Lateral border of the sternohyoid muscle	Lateral border of the sternocleidomastoid or sensory branches of cervical plexus
VA	Apex of the convergence of the sternocleidomastoid and trapezius muscles	Horizontal plane defined by the lower border of the cricoid cartilage	Posterior border of the sternocleidomastoid muscle or sensory branches of cervical plexus	Anterior border of the trapezius muscle
VB	Horizontal plane defined by the lower border of the cricoid cartilage	Clavicle	Posterior border of the sternocleidomastoid muscle or sensory branches of cervical plexus	Anterior border of the trapezius muscle
VI	Hyoid bone	Suprasternal	Common carotid artery	Common carotid artery

