

Lecture: 11

Anatomy and Physiology of the IX, X, XI & XII Cranial Nerves

Dr. Eyad M. Hussein

Ph.D. of Neurology

**Consultant & Head of Neurology Department,
Nasser Hospital**

الرجاء تحويل الجوال إلى وضع
الصامت مع الشكر

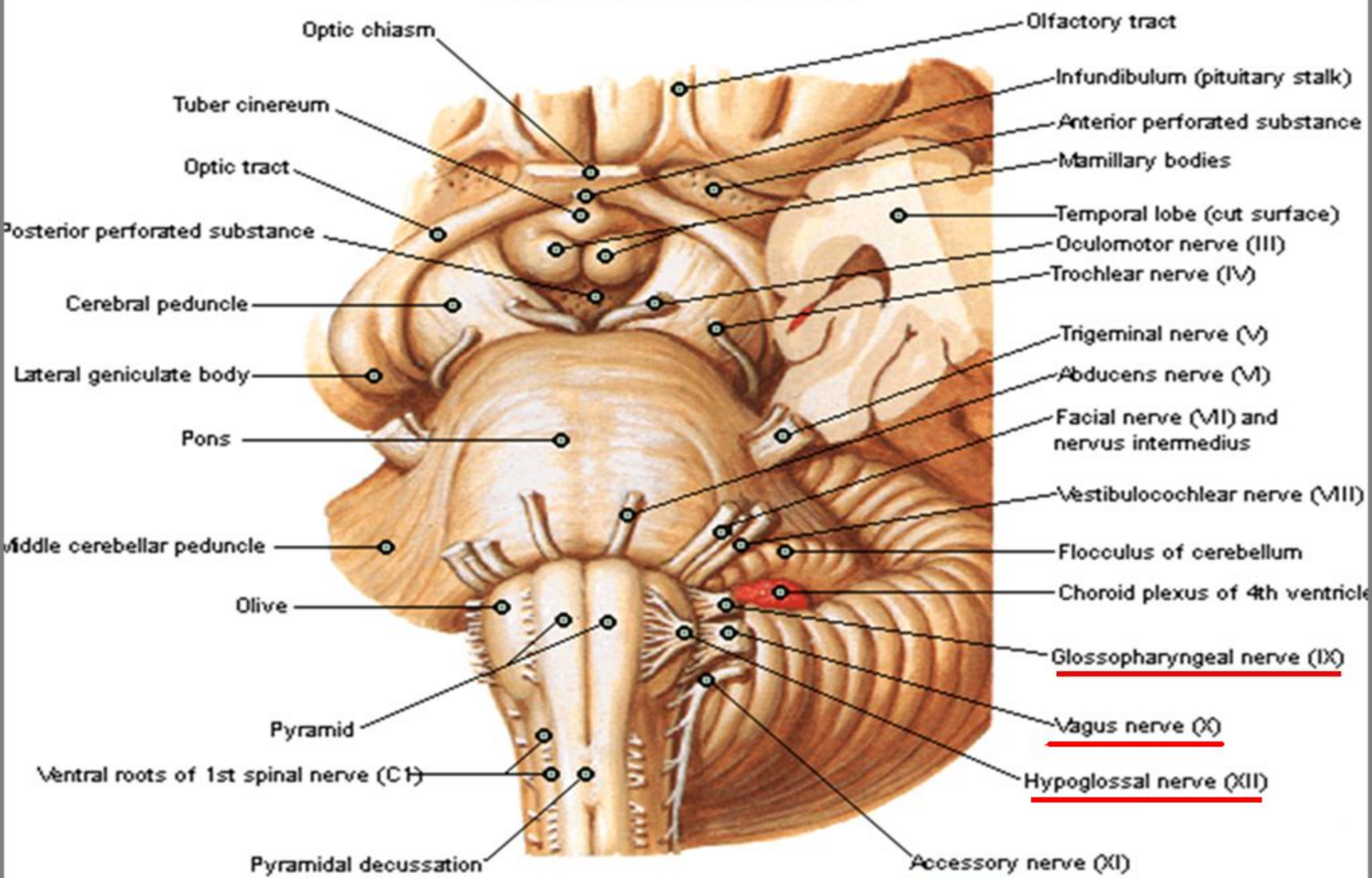
Alushta Beach

The Glossopharyngeal Nerve (IX)

- The glossopharyngeal N. is a mixed nerve containing:
 - a. Sensory fibers.
 - b. Parasympathetic fibers.
 - c. Motor fibers.
- It is more important as sensory than as a motor nerve.
- **Origin:** from posterolateral sulcus of medulla.

Brainstem

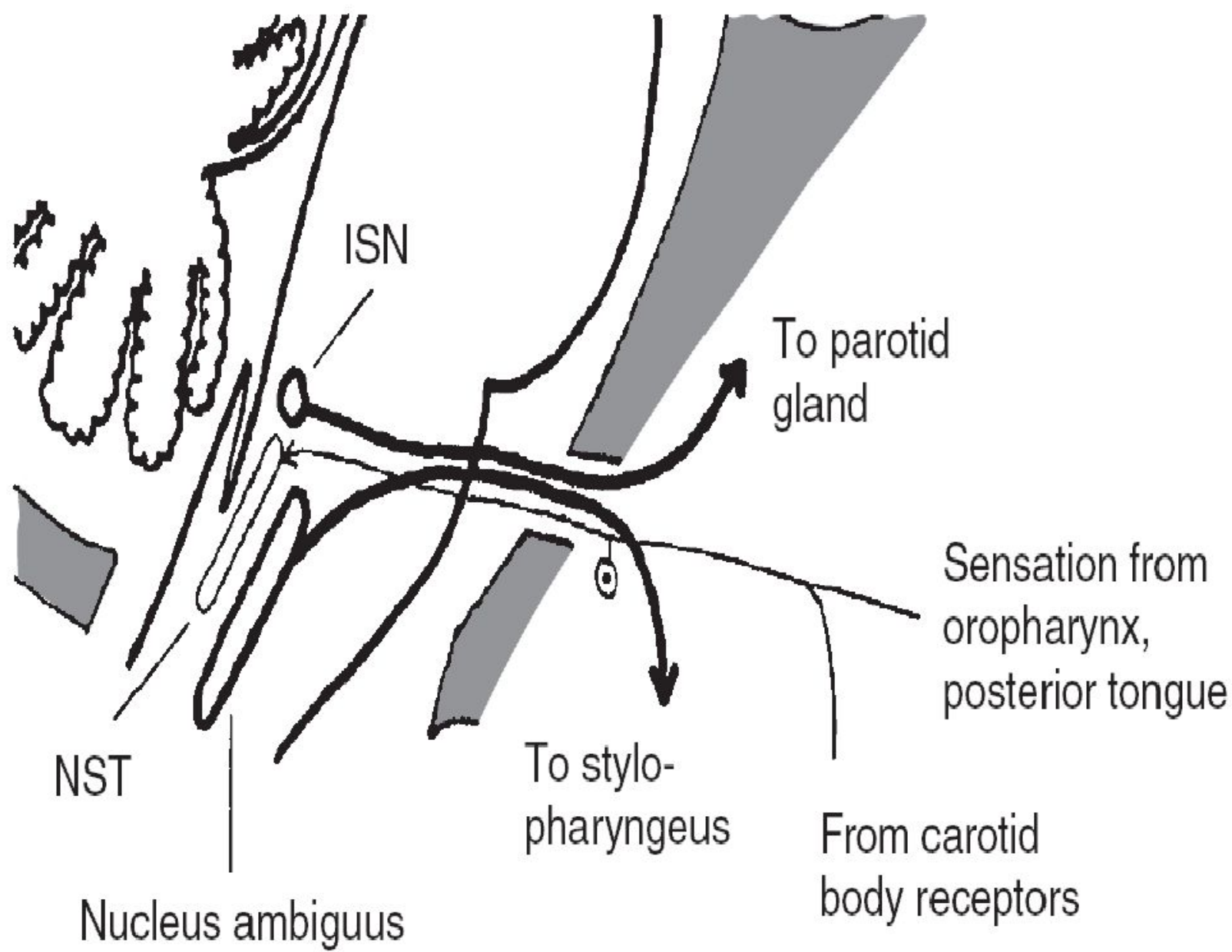
Anterioinferior View



Nuclei of the Glossopharyngeal Nerve

It has three nuclei:

- 1. The upper part of nucleus ambiguus:** it lies in the medulla **(motor function).**
- 2. The inferior salivary nucleus:** it lies in the medulla **(parasympathetic function).**
- 3. The solitary nucleus:** it lies in the medulla **(sensory function).**



Functions of the Glossopharyngeal Nerve

1. Sensory function: supplies the:

- a. Posterior 1/3 rd of the tongue (taste and general sensation).
- b. Mucous membrane of the pharynx and tonsil.
- c. Carotid sinus and carotid body.

2. Parasympathetic function: supplies the parotid gland.

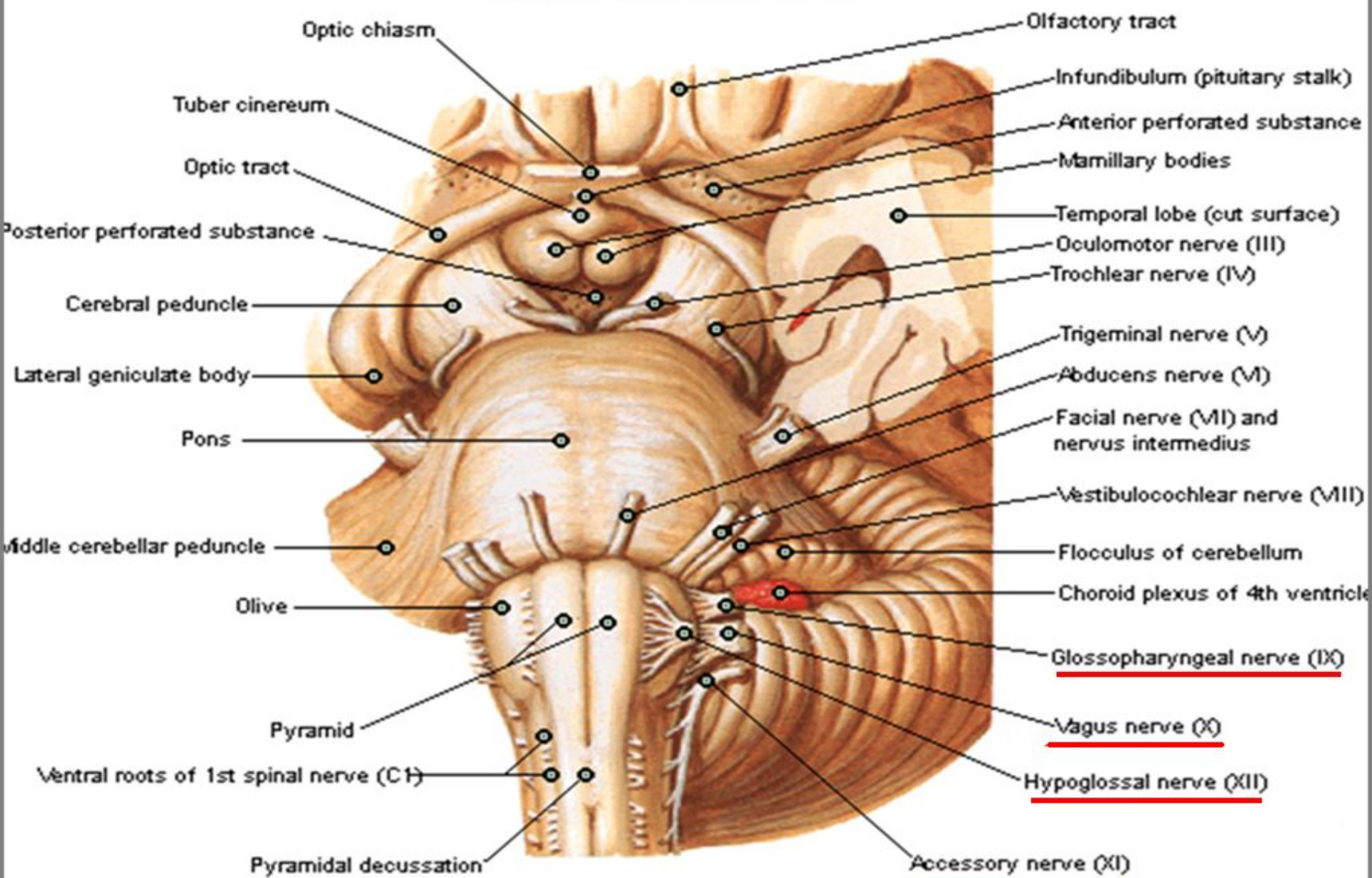
3. Motor function: supplies one muscle only the stylopharyngeus muscle.

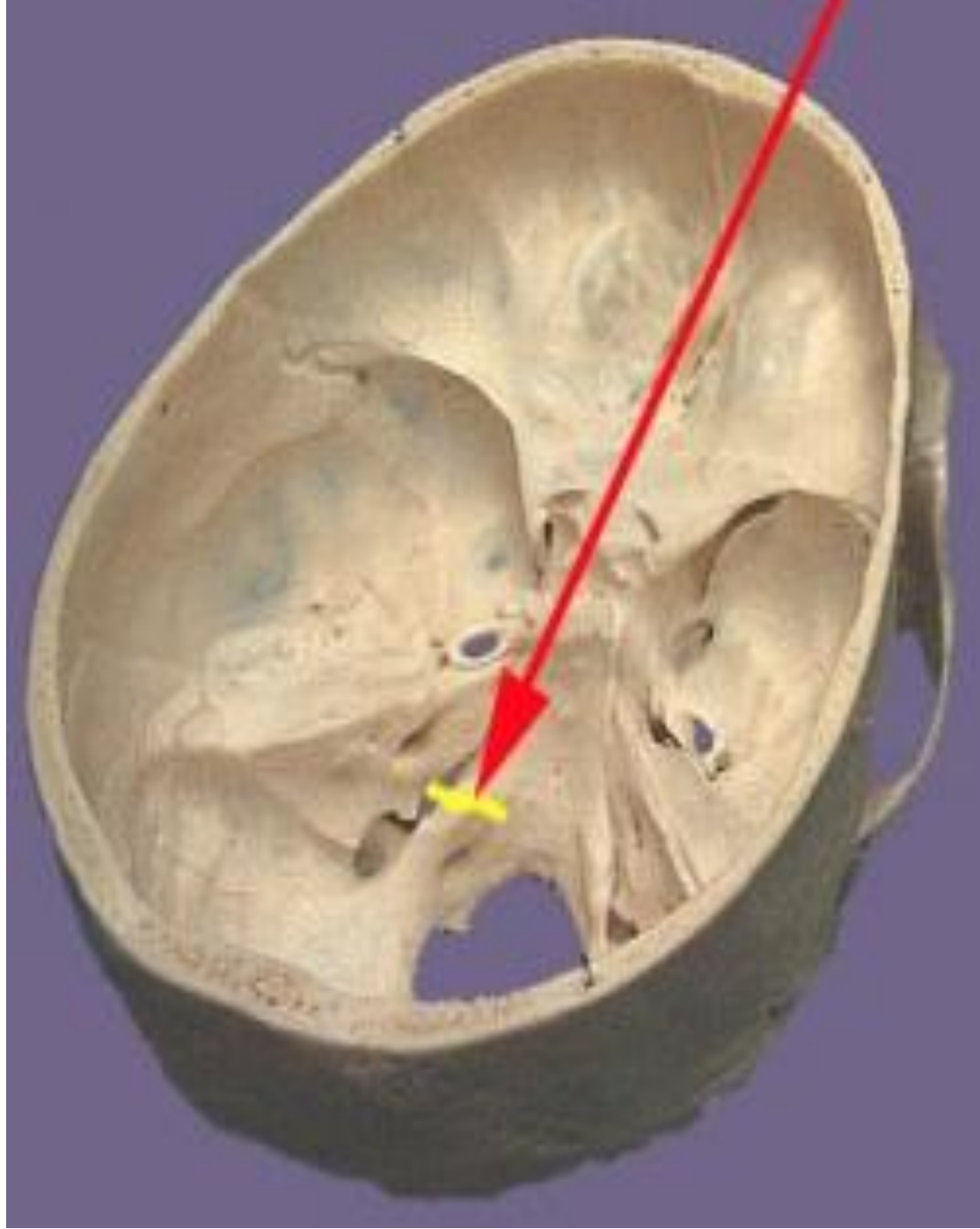
Course of Glossopharyngeal Nerve

1. Arises by 4-5 rootlets from the posterolateral sulcus of medulla.
2. It leaves the skull through the jugular foramen.
3. While it lies in jugular foramen it has 2 small sensory ganglia (superior and inferior).
4. It descends downwards inside the upper carotid sheath superficial to vagus nerve and between IJV & ICA.
5. Then it leaves the carotid sheath and passes forwards with stylopharyngeus muscle between the ICA & ECA.
6. Ascends deep to hyoglossus muscle to reach the tongue.

Brainstem

Anterioinferior View





Branches of the Glossopharyngeal Nerve

1. Meningeal branch (sensory):

- Arises from the intracranial part of the IX cranial nerve.
- Supplies meninges of posterior cranial fossa.

2. Tympanic branch or Jacobson's nerve (parasympathetic nerve):

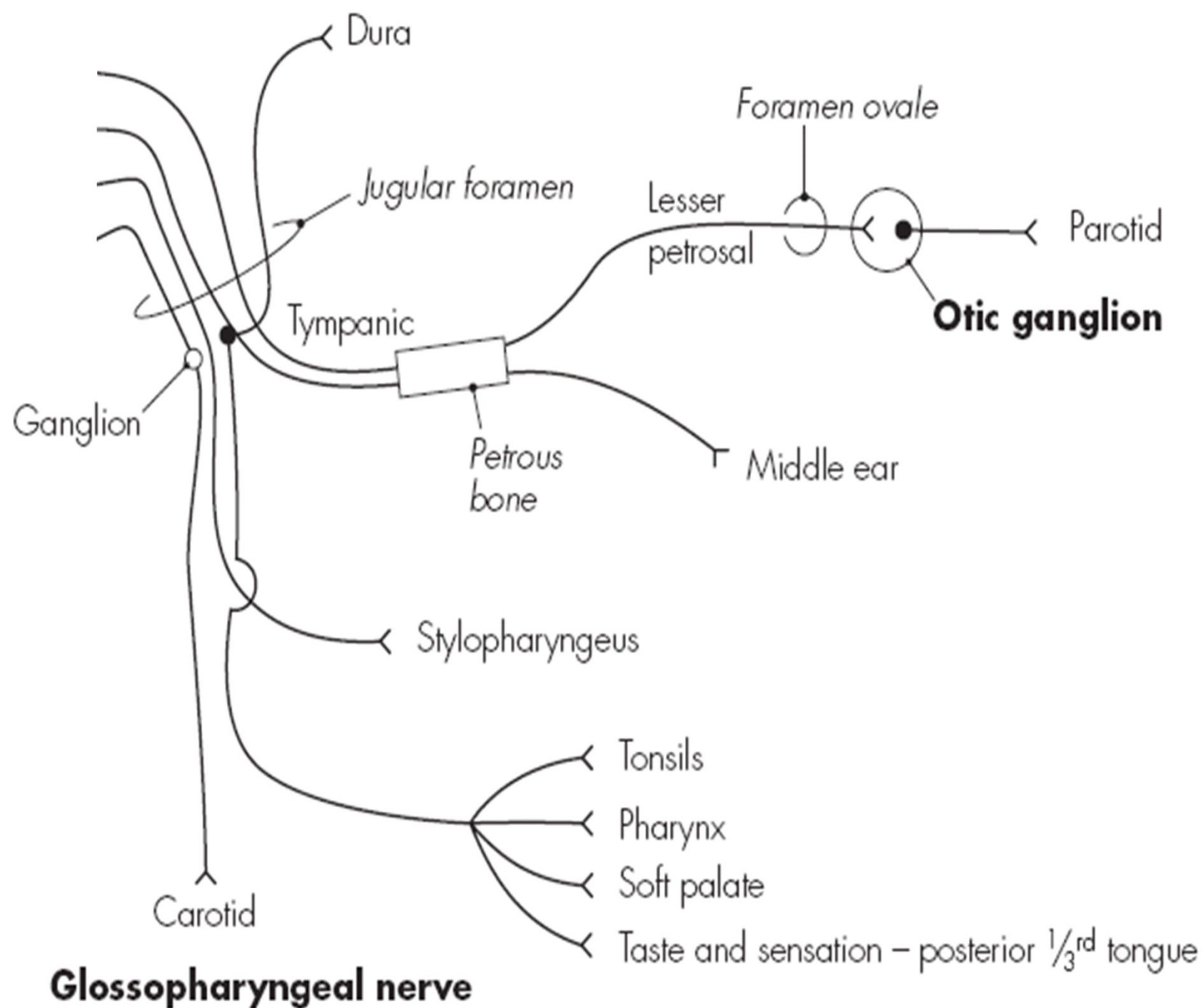
- Arises from the inferior ganglion of the IX cranial nerve in the jugular fossa.
- It passes through the tympanic canaliculus → Tympanic nerve → reaches the middle ear cavity → Tympanic plexus → Lesser superficial petrosal nerve → passes through the foramen ovale → to reach infratemporal fossa to relay in the otic ganglion “**Preganglionic parasympathetic nerve**”.

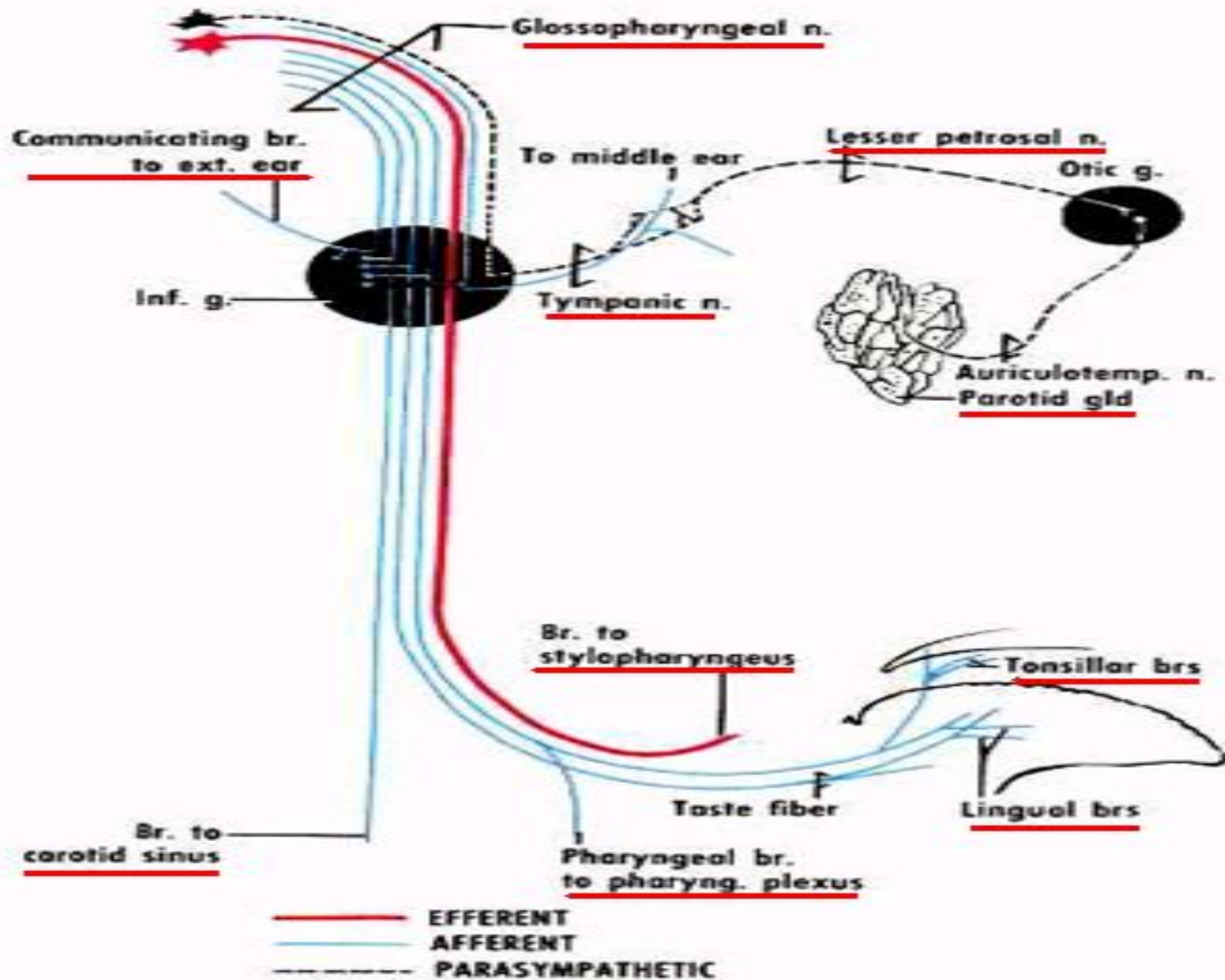
- 
4. Nerve to stylopharyngeus muscle (**motor**).
 5. Tonsillar branches (**sensory**): to the palatine tonsil.
 6. Lingual branches (**sensory**): terminal branch to mucous membrane of the posterior 1/3 rd of the tongue (taste and general sensation).
 7. Carotid branch (**sensory**): sensory nerve to the carotid sinus and carotid body.
 8. Pharyngeal branches (**sensory**): they enter the formation of the pharyngeal plexus and supplies the mucous membrane of pharynx.



The pharyngeal plexus receives:

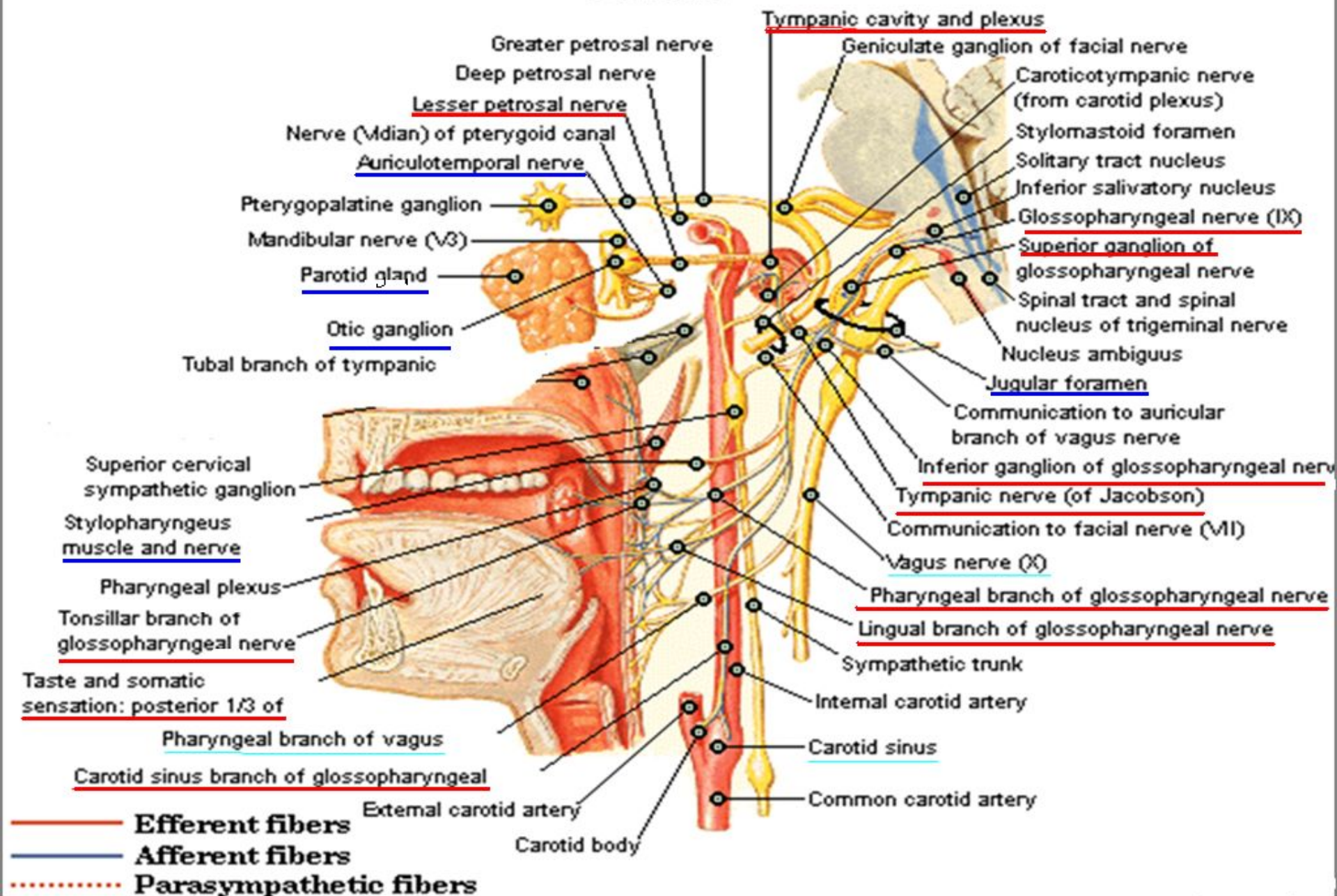
- a. Sensory fibers:** from the glossopharyngeal nerve.
- b. Motor fibers:** from the pharyngeal branches of vagus and cranial accessory nerves.
- c. Sympathetic fibers:** from the pharyngeal branches of the superior cervical sympathetic ganglion.

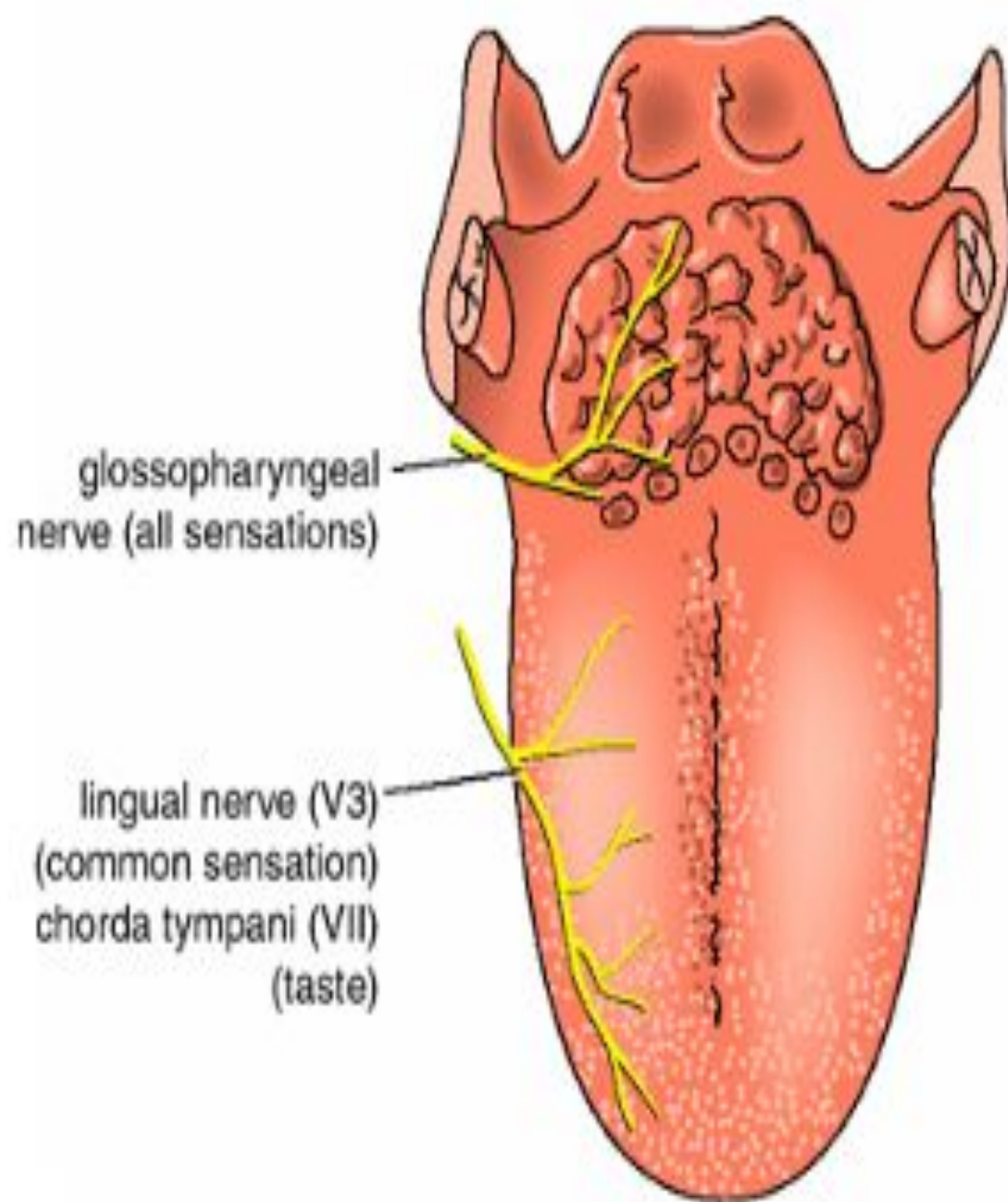




Glossopharyngeal Nerve

Schema





Lesion of the Glossopharyngeal Nerve

1. Loss of taste and general sensation from the posterior 1/3 of the tongue.
2. Loss of sensation in the pharynx
3. Ipsilateral loss of pharyngeal reflex .
4. Some pharyngeal weakness (dysphagia).

The Vagus Nerve (X)

□ The vagus nerve is the longest of the cranial nerve.

□ **Origin:** the vagus nerve leaves the brain by about 10 rootlets from the posterolateral sulcus of the medulla.

◆ **It is a mixed nerve with:**

a. Motor fibers.

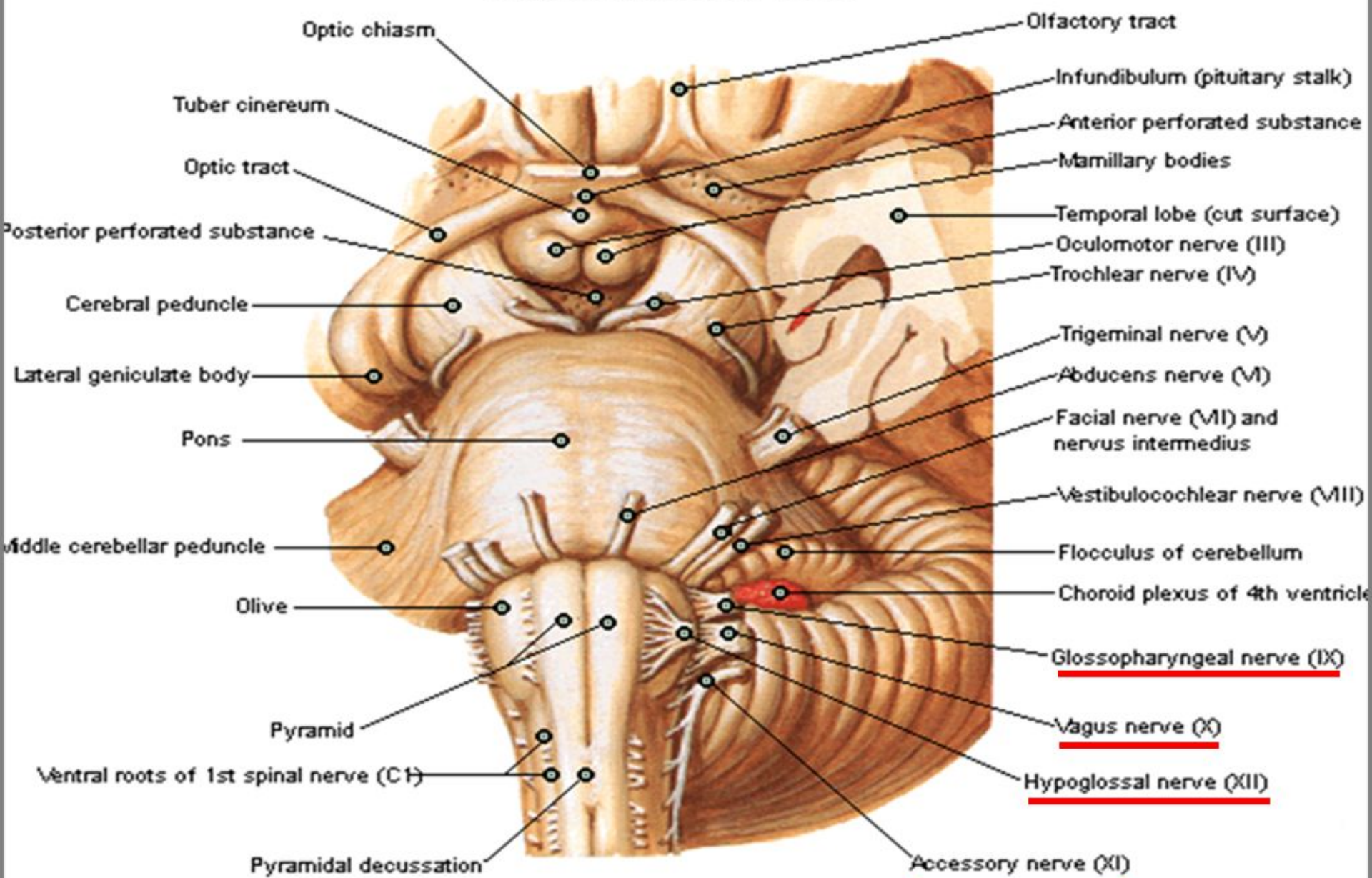
b. Parasympathetic fibers

c. Sensory fibers.

◆ It is the most important parasympathetic nerve in the body.

Brainstem

Anterioinferior View



Nuclei of the Vagus Nerve

It has three nuclei:

1. Dorsal motor nucleus of vagus “parasympathetic”:

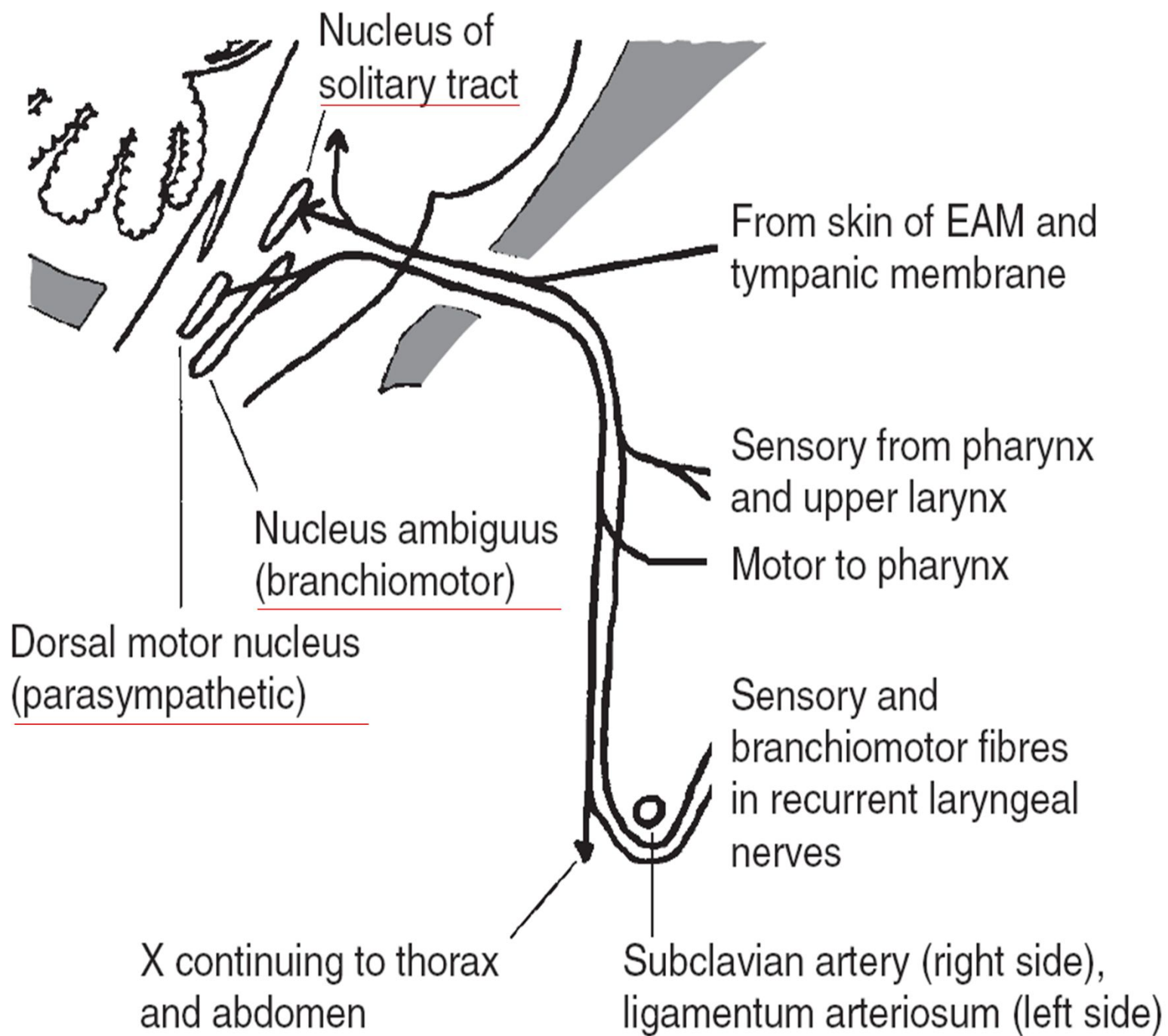
Gives parasympathetic fibers to respiratory system, digestive tract and the heart.

2. Main part of nucleus ambiguus “Somatic Motor”:

Gives motor fibers to the muscles of the larynx, pharynx and palate.

3. Solitary nucleus “Sensory”:

Receives taste and general sensations from the epiglottis and general sensation from the areas supplied by the parasympathetic fibers.



Function of the Vagus Nerve

1. The parasympathetic fibers supply:

- a. The smooth muscles and glands digestive system.
- b. The smooth muscles and the glands of the respiratory system.
- c. The heart.

2. The motor fibers supply:

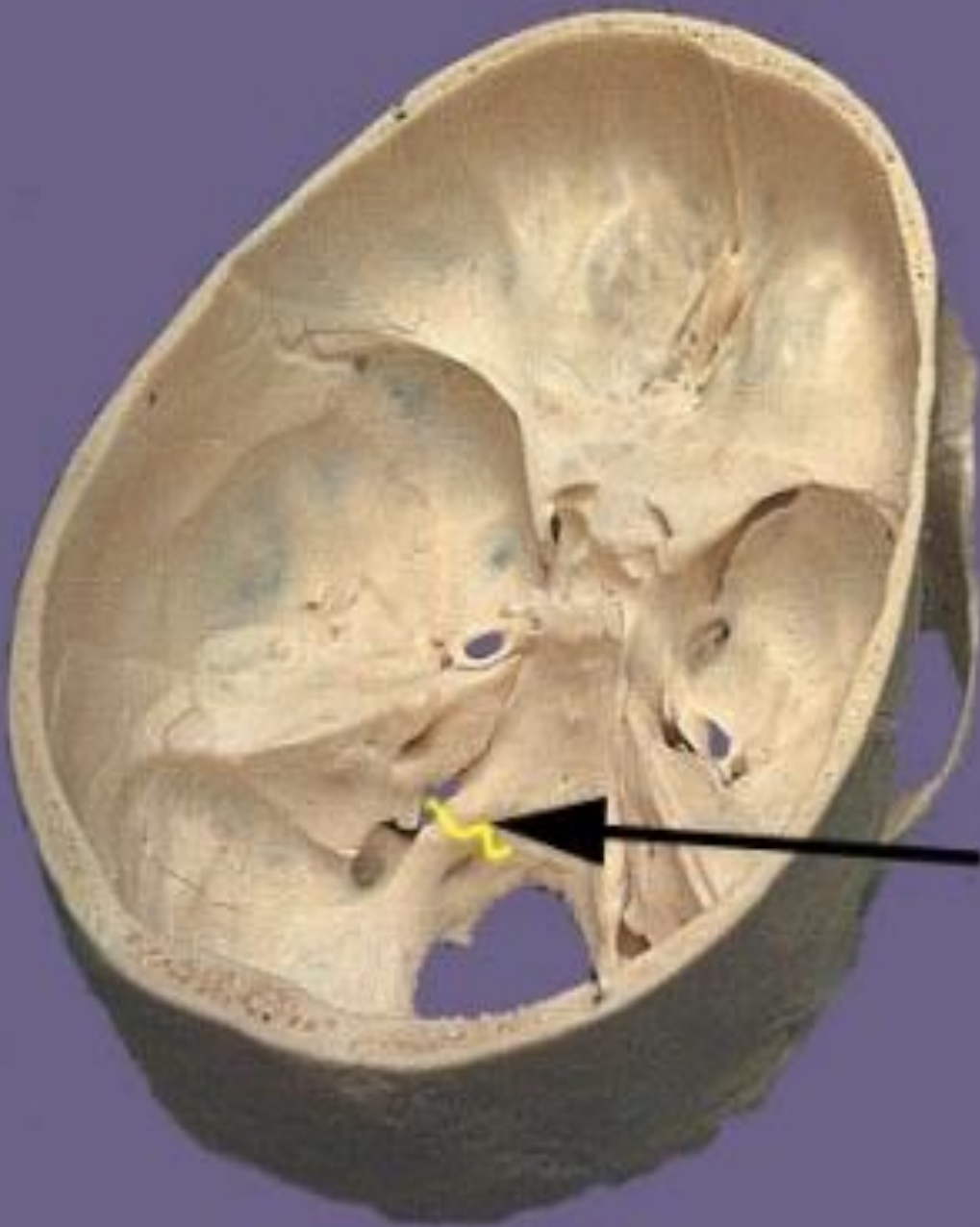
- a. All the muscles of the larynx.
- b. All the muscles of the pharynx except the **stylopharyngeus M.**
- c. All the muscles of the palate except the **tensor palati muscle.**

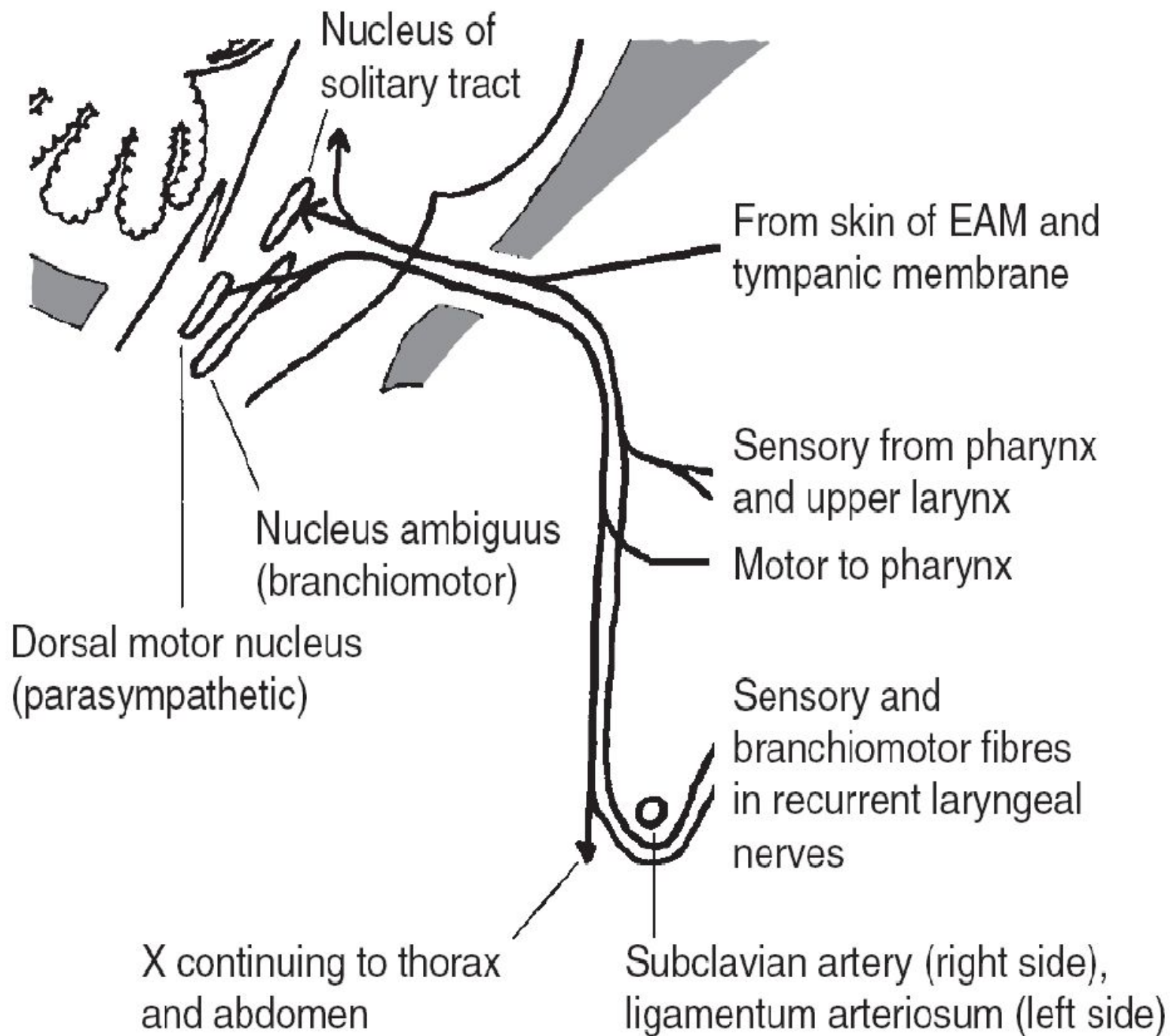
3. The sensory fibers:

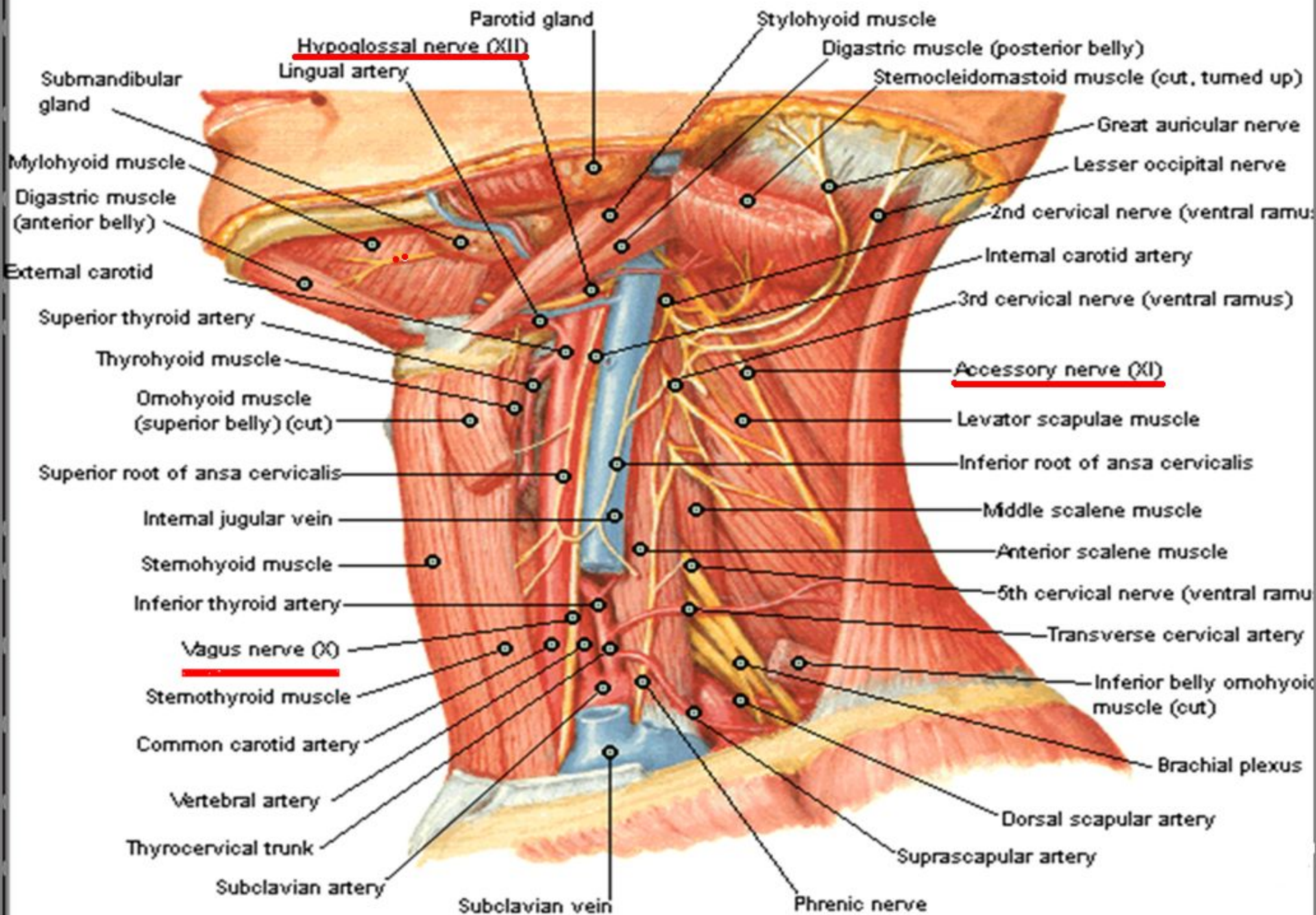
- a. Receive sensation from the mucous membrane of the respiratory and digestive system mainly.
- b. Receives taste sensation from the epiglottis.
- c. Skin of the back of the auricle, external auditory meatus , lower and posterior part of the tympanic membrane.
- d. Meninges of the posterior cranial fossa.

Course and Relations of Vagus Nerve in the Neck

1. It leaves the skull through the jugular foramen. Here it has **two sensory ganglia:**
 - a. **Superior ganglion in the jugular foramen.**
 - b. **Inferior ganglion just below the jugular foramen.**
2. The cranial root of accessory nerve joins with the inferior ganglion of vagus nerve.
3. The vagus nerve descends vertically downwards inside the carotid sheath, first between IJV and ICA, then it descends between IJV and CCA.
4. The vagus nerve crosses in front of first part of subclavian artery to enter the thorax.







Branches of the Vagus Nerve

I. Branches from the superior ganglia:

1. **Meningeal nerve (sensory):** to the dura mater of the posterior cranial fossa.
2. **Auricular nerve “Alderman's nerve or Arnold's nerve”:** to the skin of the back of the auricle, external auditory meatus , lower and posterior part of the tympanic membrane.

II. Branches from the inferior ganglia:

1. Pharyngeal branch:

- Its fibers mostly derived from the cranial accessory nerve.
- Its fibers supply all pharyngeal muscles except **the stylopharyngeus** and all muscles of the soft palate except **the tensor palati muscle**.

2. Superior laryngeal branch: it divides into two branches:

- a. Internal laryngeal branch (sensory):** supplies the upper 1/2 of the larynx (above the vocal cord) and taste sensation from epiglottis.
- b. External laryngeal branch (motor):** supplies cricothyroid muscle.

3. Carotid body branch.

III. Branches in the neck:

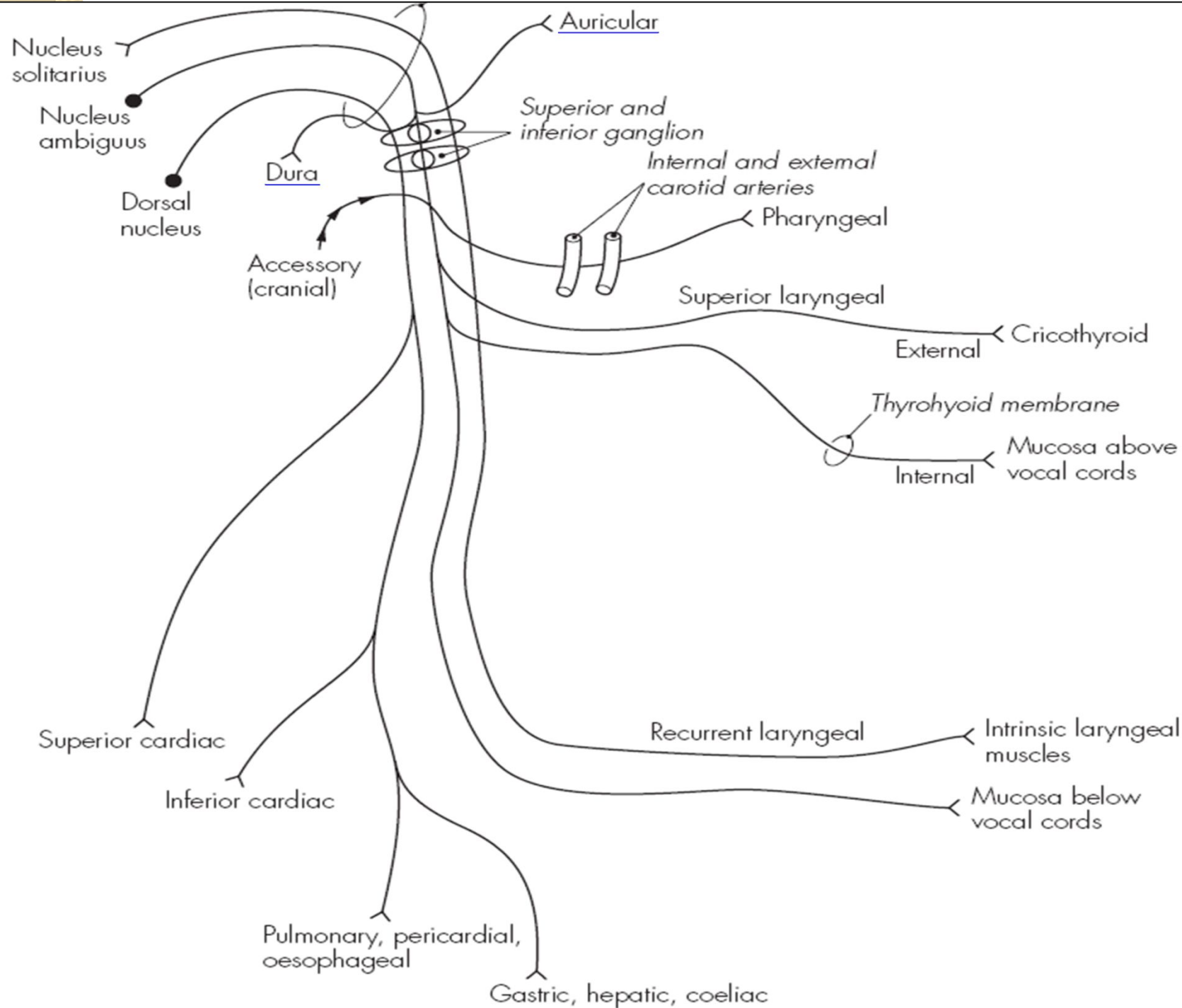
1. **Upper and lower cardiac nerve:** arise from the vagus nerve in the upper and lower parts of the neck → in front the first part of subclavian artery → they enter the thorax and end in the cardiac plexus.
2. **Recurrent laryngeal nerve.**

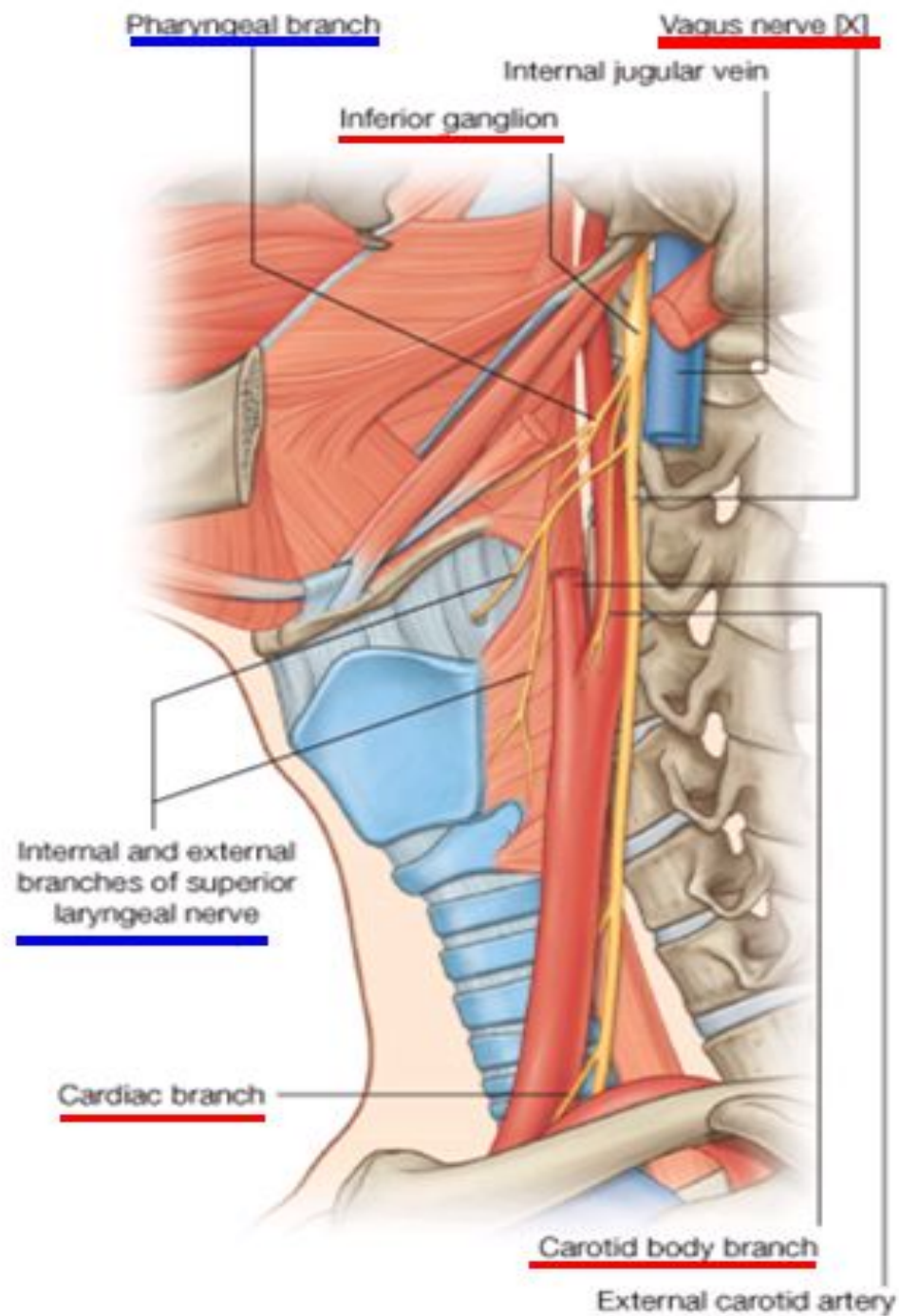
IV. Branches in the thorax:

3. **Pulmonary branches of vagus nerve:** both vagus nerves send a few fibers to form posterior and anterior pulmonary plexuses.
4. **Esophageal branches of vagus nerve:** right and left vagus nerves form esophageal plexuses.

V. Branches in the abdomen:

Abdominal branches of vagus nerve to abdominal viscera.





Recurrent Laryngeal Nerves (motor & sensory)

a. Right Recurrent laryngeal nerve:

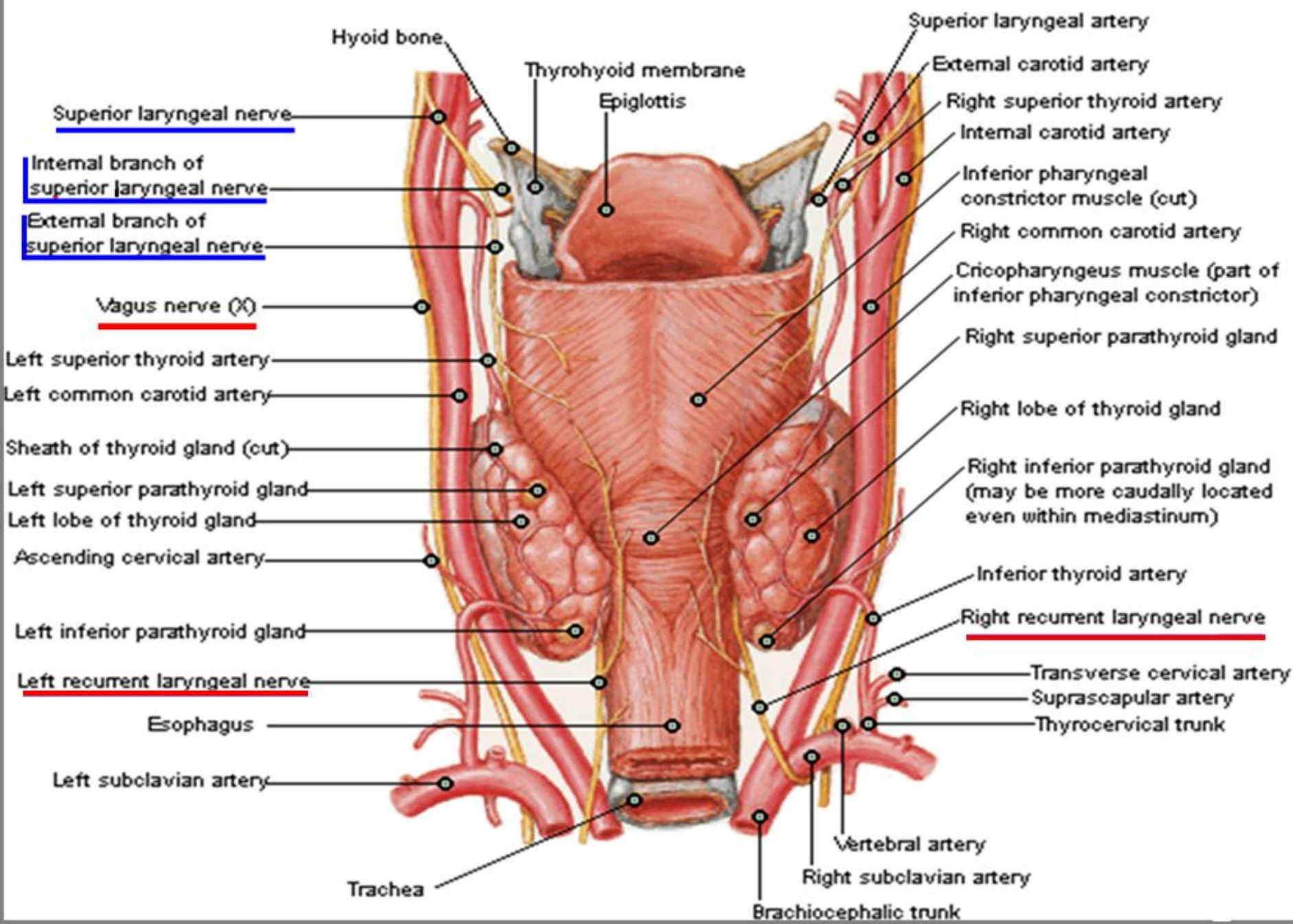
- Arises from the right vagus nerve in front of the first part of subclavian artery. Then it hooks below then behind the subclavian artery.
- It ascends along the right groove between the trachea and esophagus closely related to medial surface of thyroid gland.

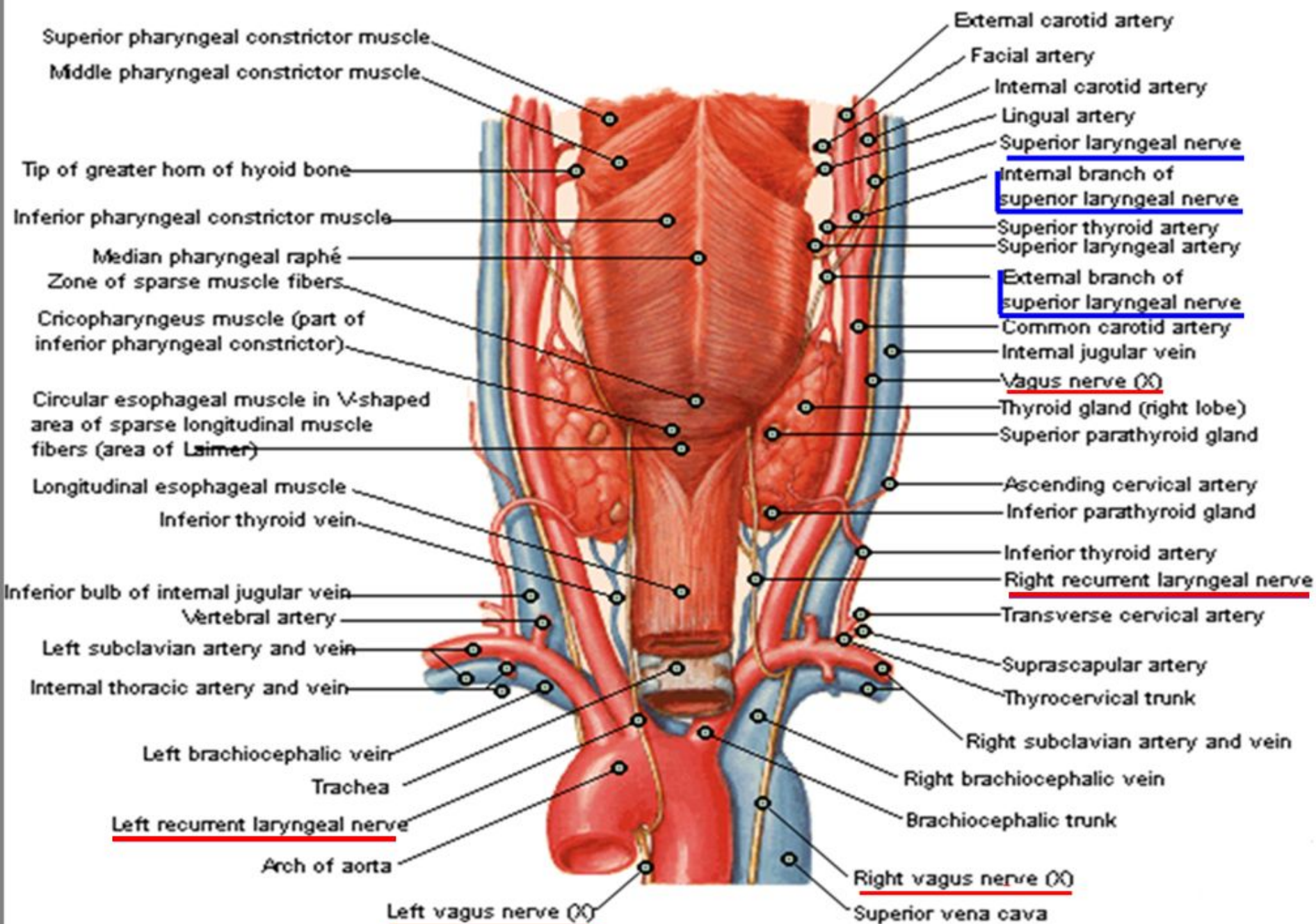
b. Left Recurrent laryngeal nerve:

- Arises from the left vagus nerve at left side of arch of aorta. Then it hooks below then behind the arch of aorta.

Branches of each recurrent laryngeal nerve supplies:

- 1.Motor:** for all laryngeal muscles (except cricothyroid muscle from external laryngeal nerve). It also gives branches to the trachea, esophagus and inferior constrictor muscle of pharynx.
- 2.Sensory:** to the mucous membrane of the lower 1/2 of larynx (below vocal cords).





Lesion of the Vagus Nerve

1. Palatal paralysis:

- a. Nasal tone of speech.
- b. Drop of palatal arch on paralyzed side and shift uvula to opposite side.
- c. Fluid regurge.
- d. Loss of palatal reflexes.

2. Pharyngeal paralysis:

- a. Neurogenic Dysphagia.
- b. Loss of pharyngeal reflex.

3. Laryngeal paralysis: hoarseness of the voice.

Others: tachycardia and constipation.

The Accessory Nerve (XI)

It is a purely motor nerve and has two parts (roots):

1. The cranial root: arises from the medulla oblongata.

Joins the vagus nerve and distributed with its pharyngeal and laryngeal branches.

2. The spinal root: arises by the upper 4-6 cervical segments of the spinal cord from the AHCs.

Supplies two muscles:

- a. Sternocleidomastoid muscle:** turn the head to opposite side.
- b. Trapezius muscle:** shoulder shrugging.

Course and Relations of the Accessory Nerve

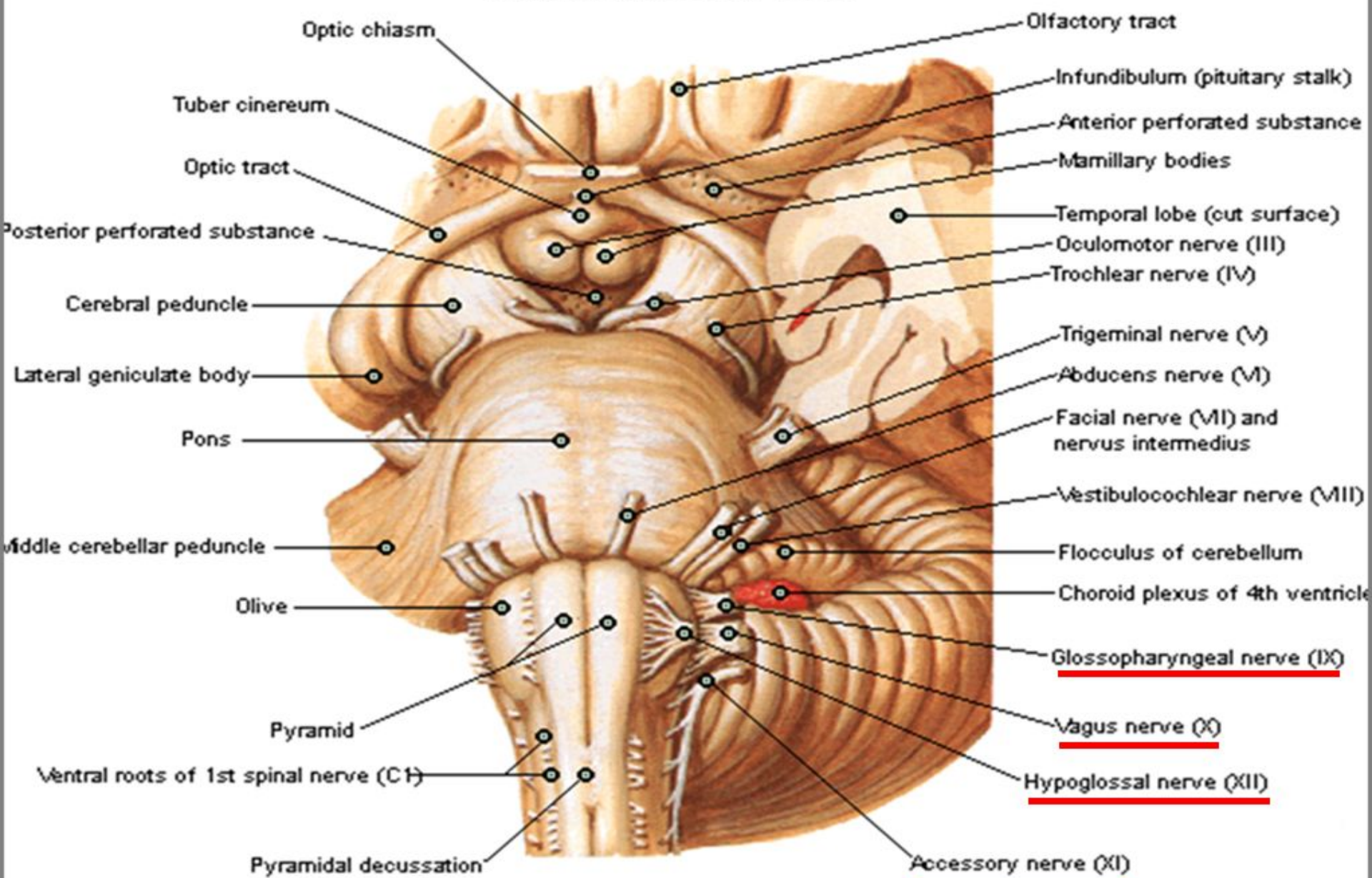
- The spinal root ascends through the foramen magnum to join the cranial root inside the cranial cavity.
- The "united" accessory nerve then leaves the cranial cavity through the jugular foramen.
- Just below the jugular foramen the two roots of the accessory nerve separate from each other.
 1. **The cranial root:** joins with the inferior ganglion of the vagus nerve and is distributed with its pharyngeal and laryngeal branches.
 2. **The spinal root:** has the following course in the neck:

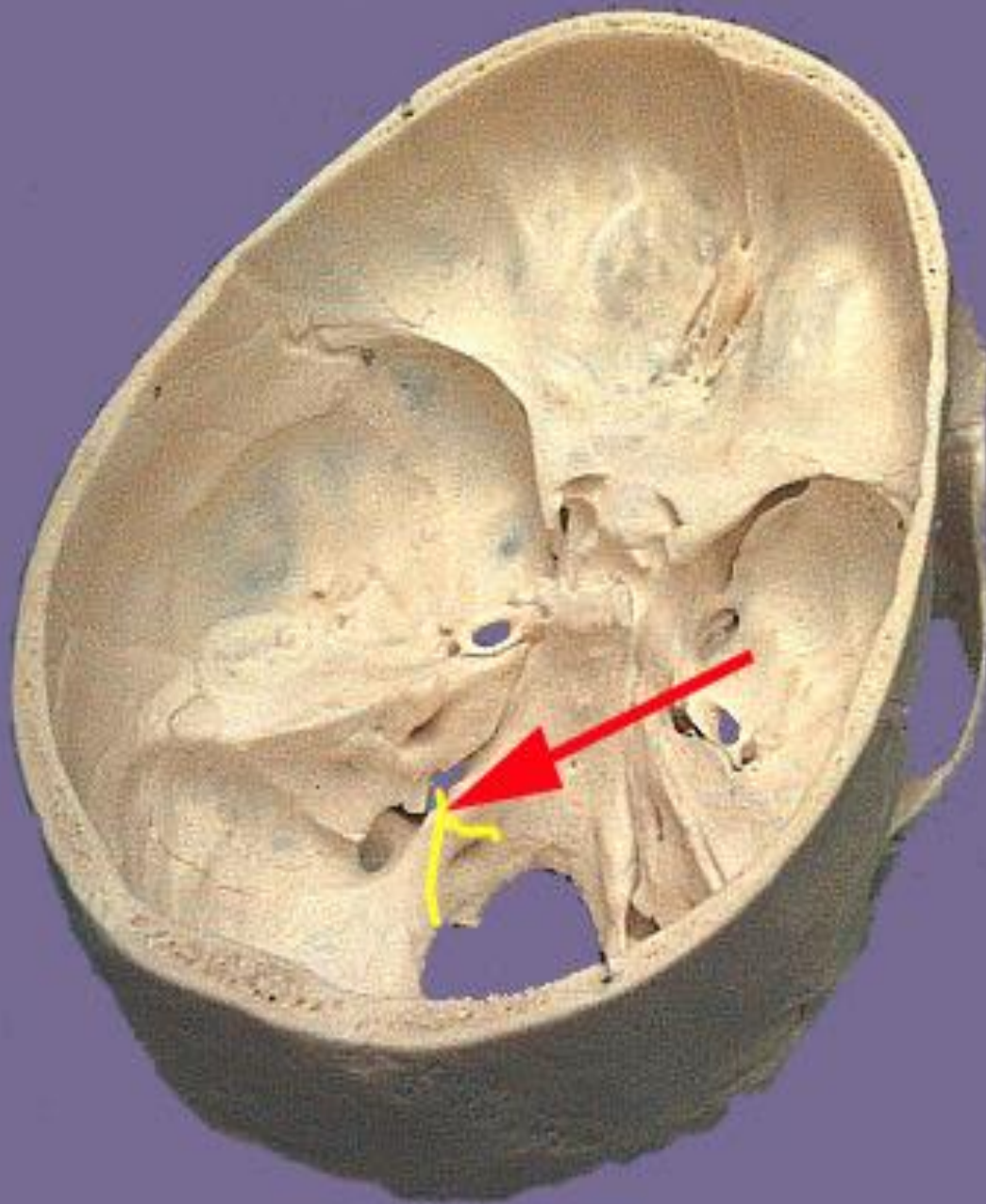
Extracranial Course of the Spinal Accessory Nerve

- The spinal part descends along the ICA to reach the sternocleidomastoid muscle.
- It then continues down and moves across the posterior triangle of the neck to supply the trapezius muscle.

Brainstem

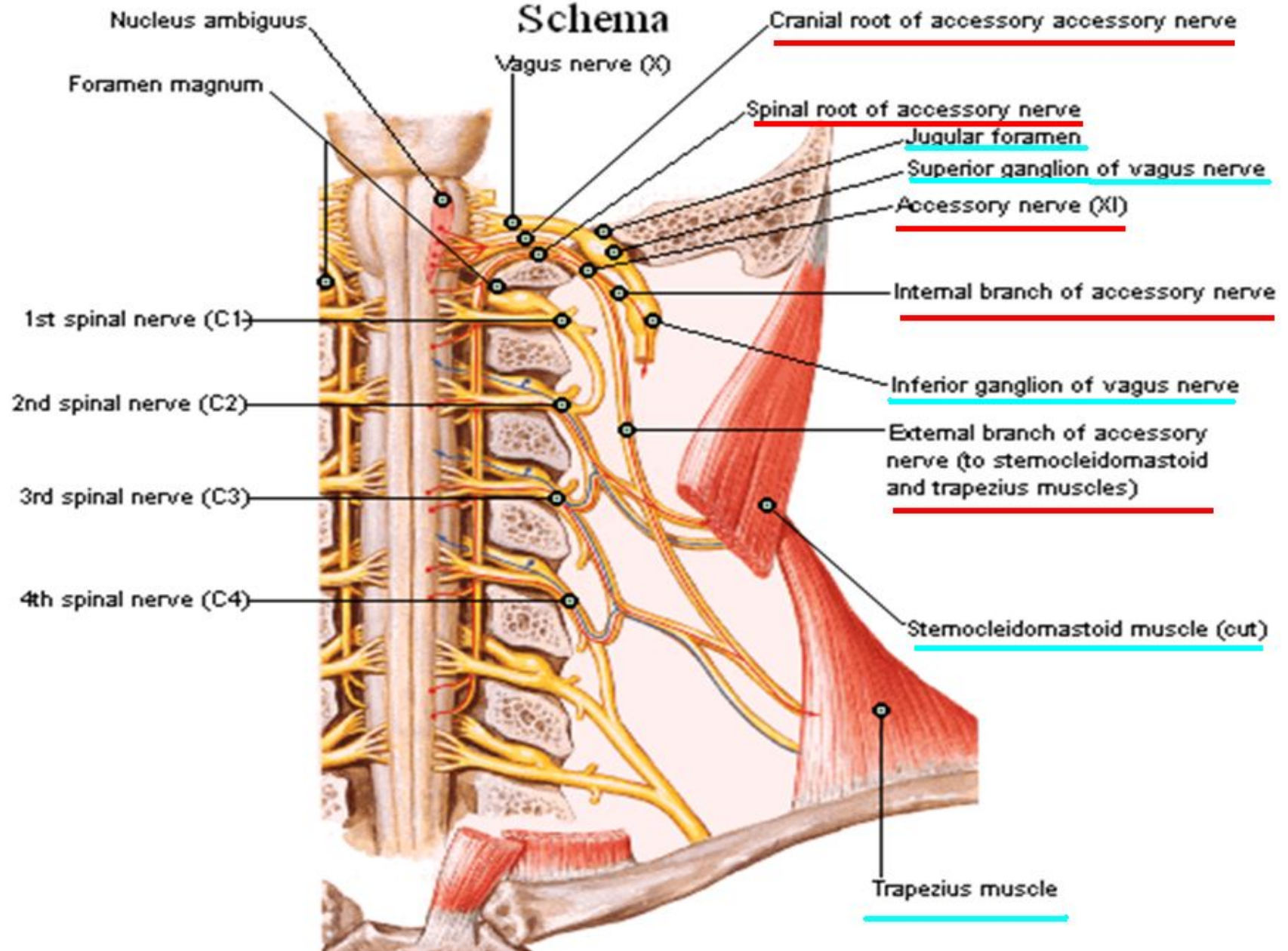
Anterioinferior View





Accessory Nerve

Schema



Transverse cervical nerve

Lesser occipital nerve

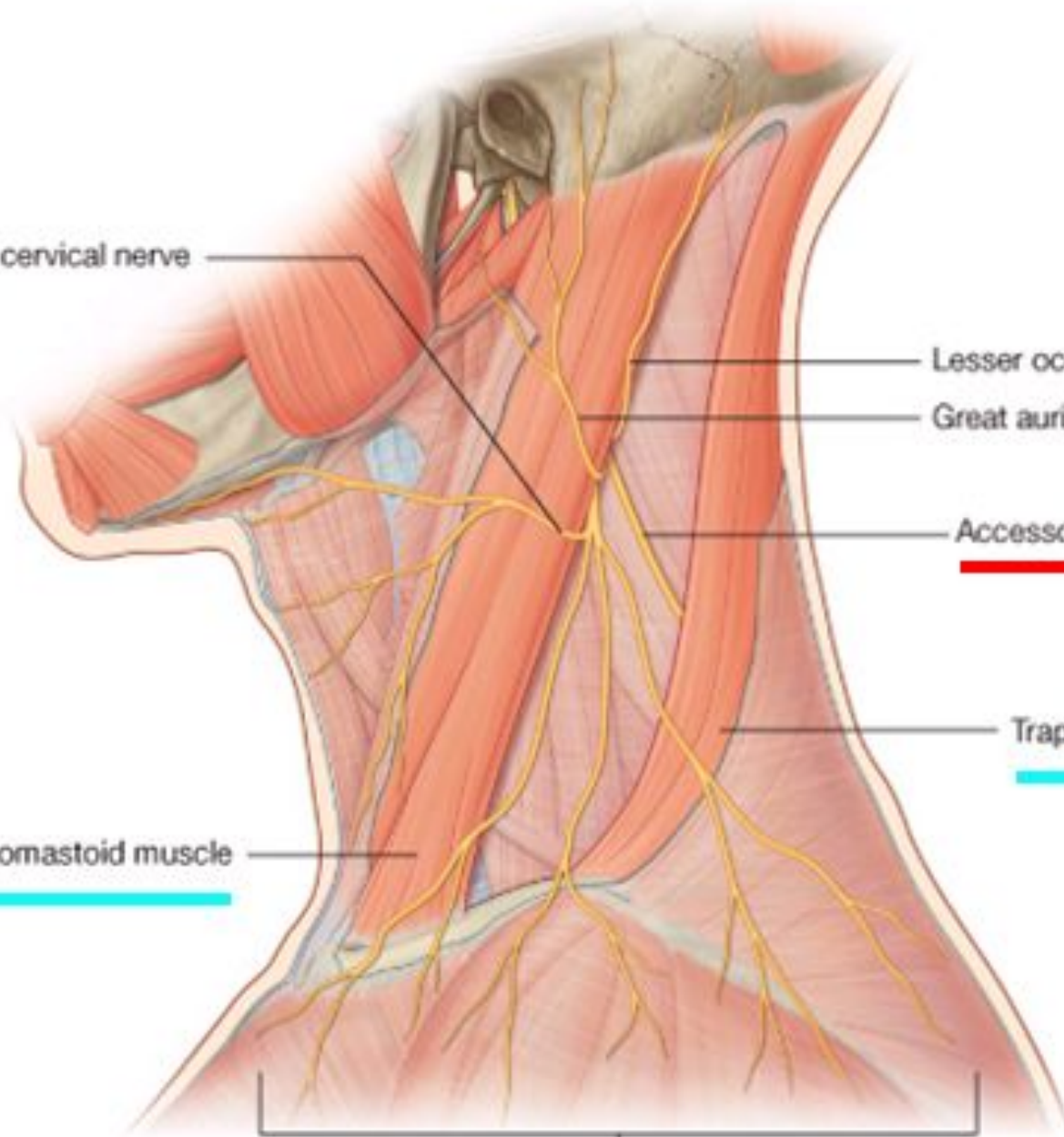
Great auricular nerve

Accessory nerve [XI]

Trapezius muscle

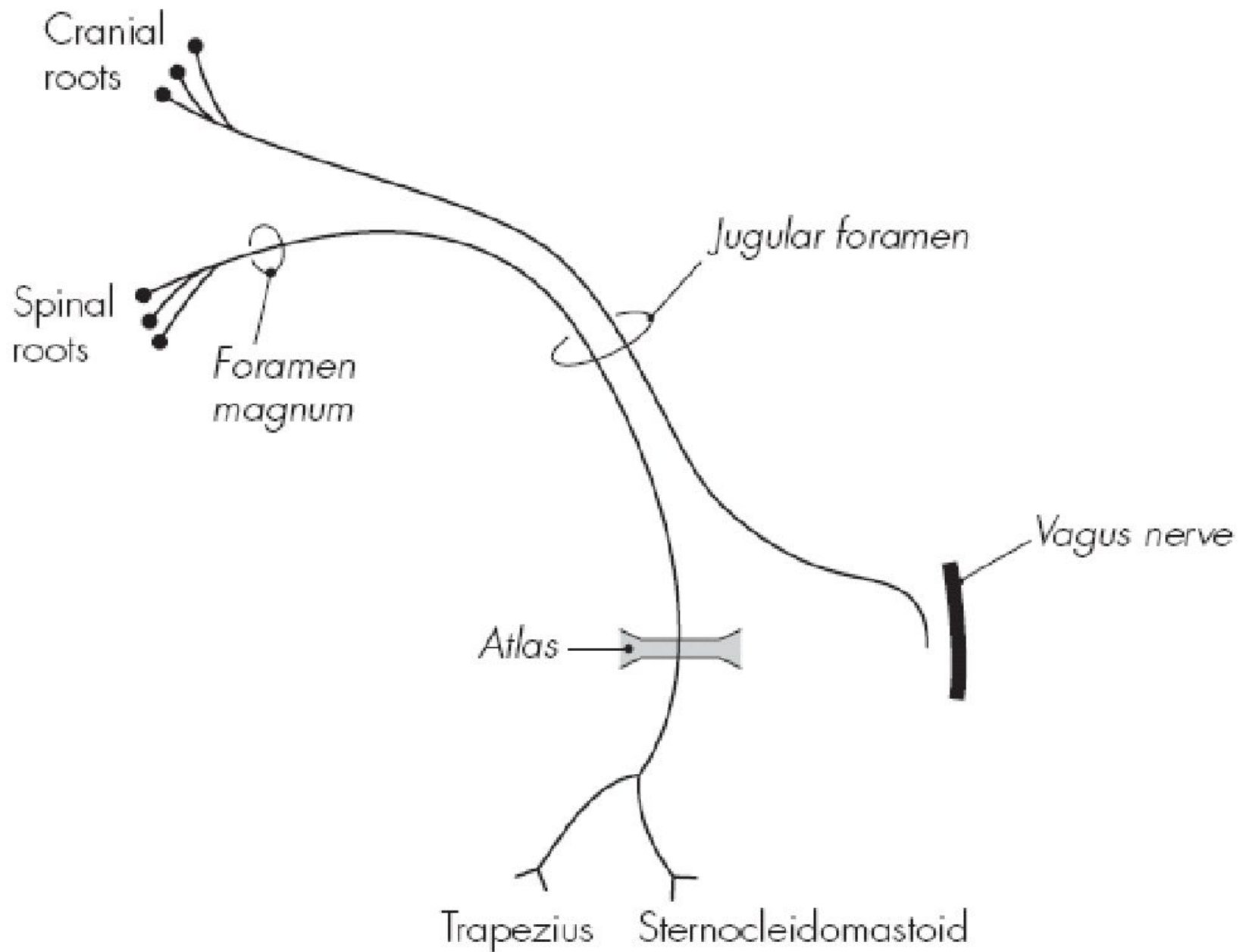
Sternocleidomastoid muscle

Supraclavicular nerves

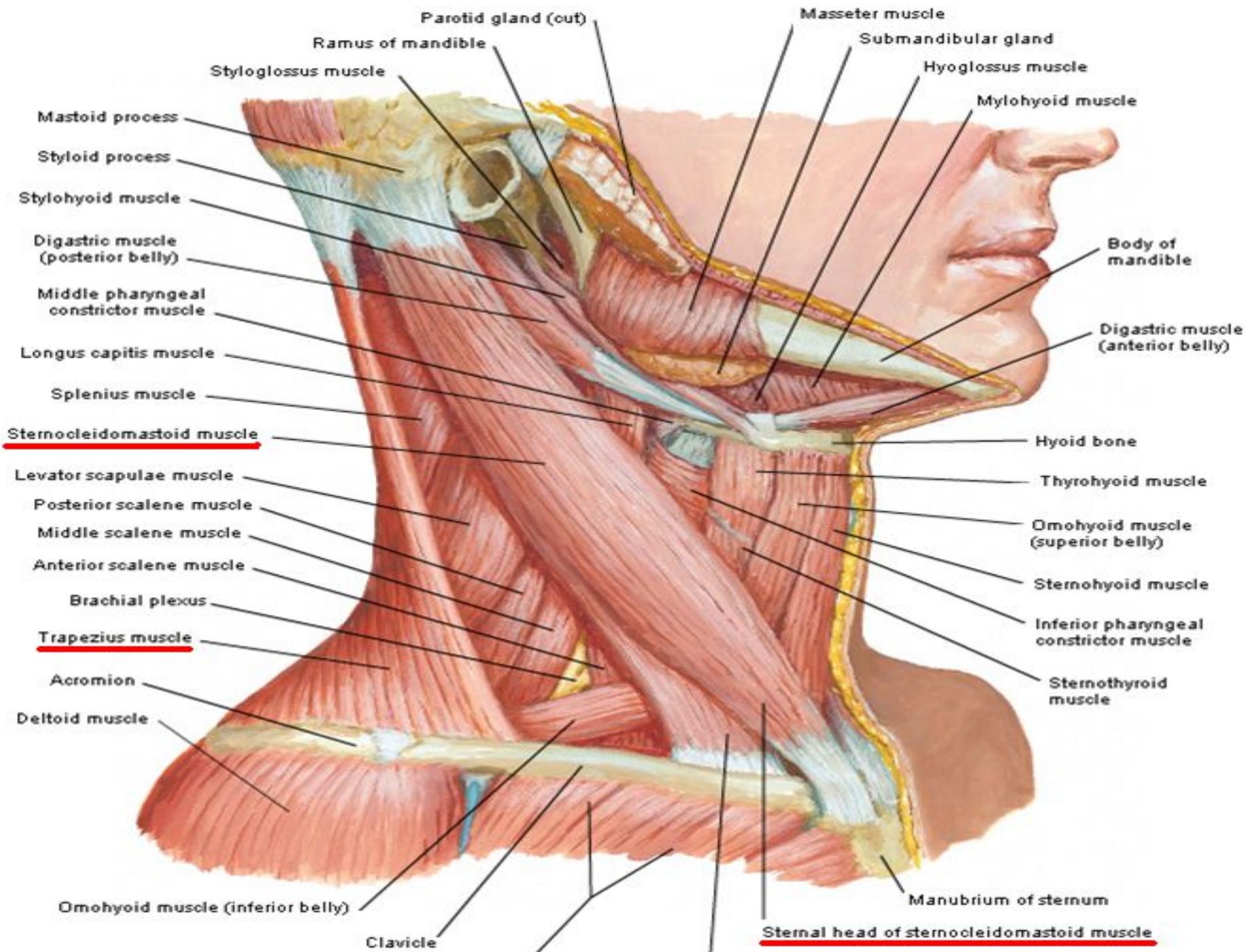


Branches of the Accessory Nerve

1. **The cranial accessory nerve (Internal branch):** joins the vagus nerve and distributed with its:
 - a. **Pharyngeal branches:** supplying all muscles of pharynx (except stylopharyngeus muscle) and all muscles of the palate (except tensor palati muscle).
 - b. **Laryngeal branches (motor fibers of recurrent laryngeal nerve):** supplying the muscles of the larynx except cricothyroid muscle.
2. **The spinal accessory nerve (External branch):** supplies two muscles:
 - a. **Sternocleidomastoid Muscle.**
 - b. **Trapezius Muscle.**



Accessory nerve



Lesion of the Spinal Accessory Nerve

- Ipsilateral paralysis of sternocleidomastoid muscle (rotation of the head and neck to the same side).
- Ipsilateral paralysis of trapezius muscle (inability to shoulder shrugging).

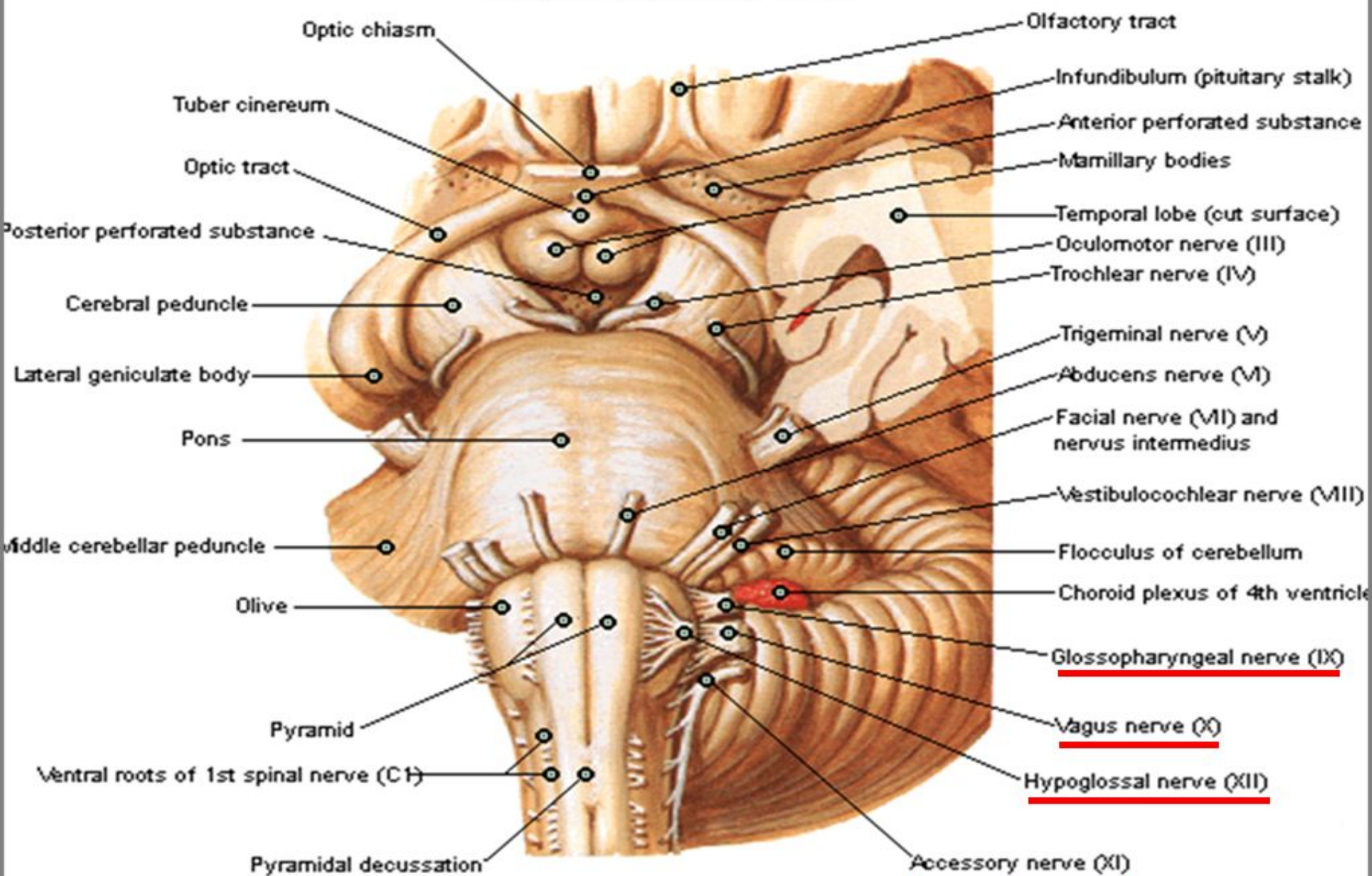
The Hypoglossal Nerve (XII)

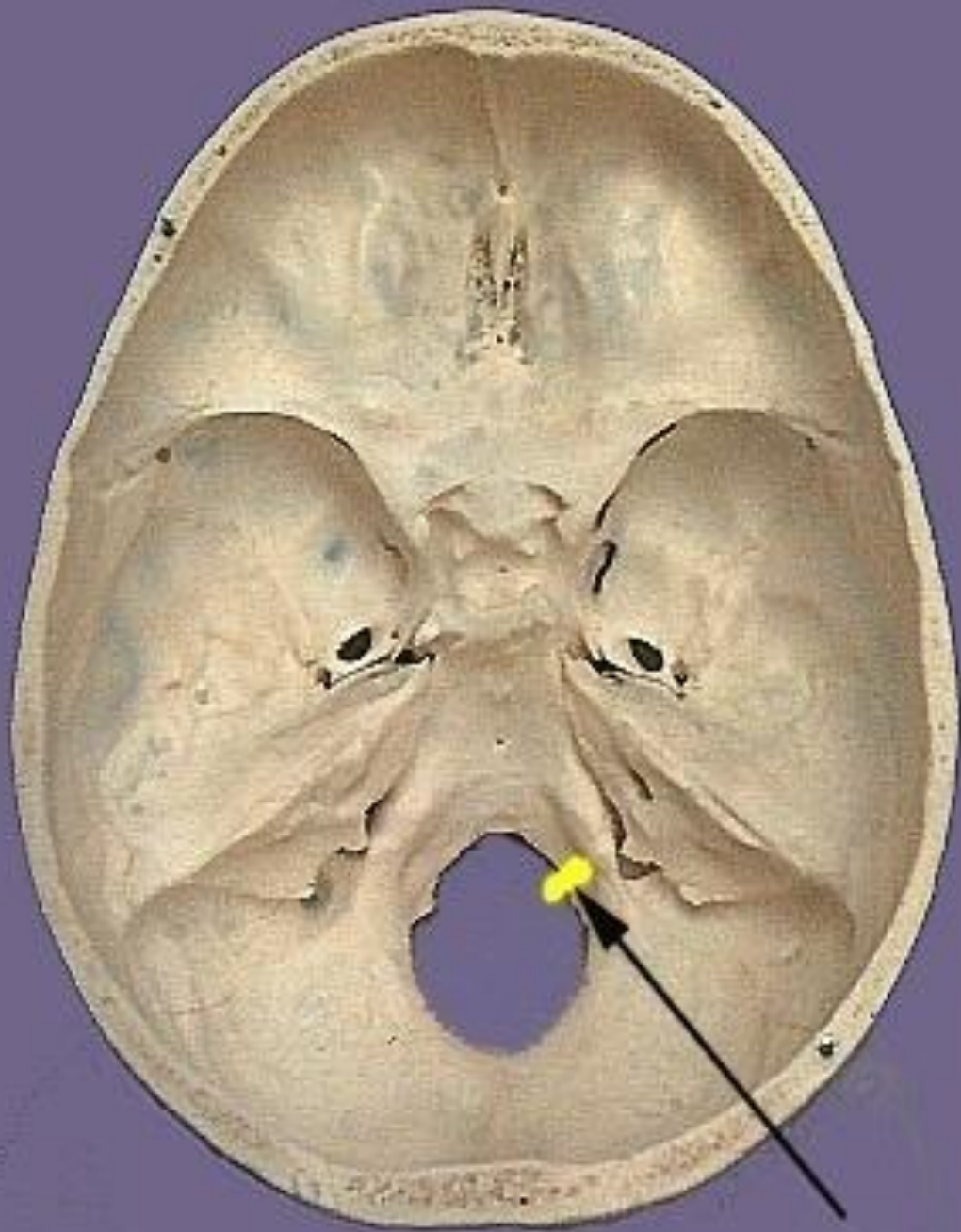
(The motor nerve of the tongue)

- Movements of the tongue are important in chewing, speech and initial stages of swallowing.
- **Origin:** from the anterolateral sulcus of medulla oblongata. It receives a communicating branch from C1.
- **Function:** the hypoglossal nerve is a purely motor nerve which supplies:
 1. All the internal muscles of the tongue
 2. All the external muscles of the tongue: **hyoglossus, genioglossus and styloglossus, except the palatoglossus** (soft palate muscle supplied from the pharyngeal plexus).

Brainstem

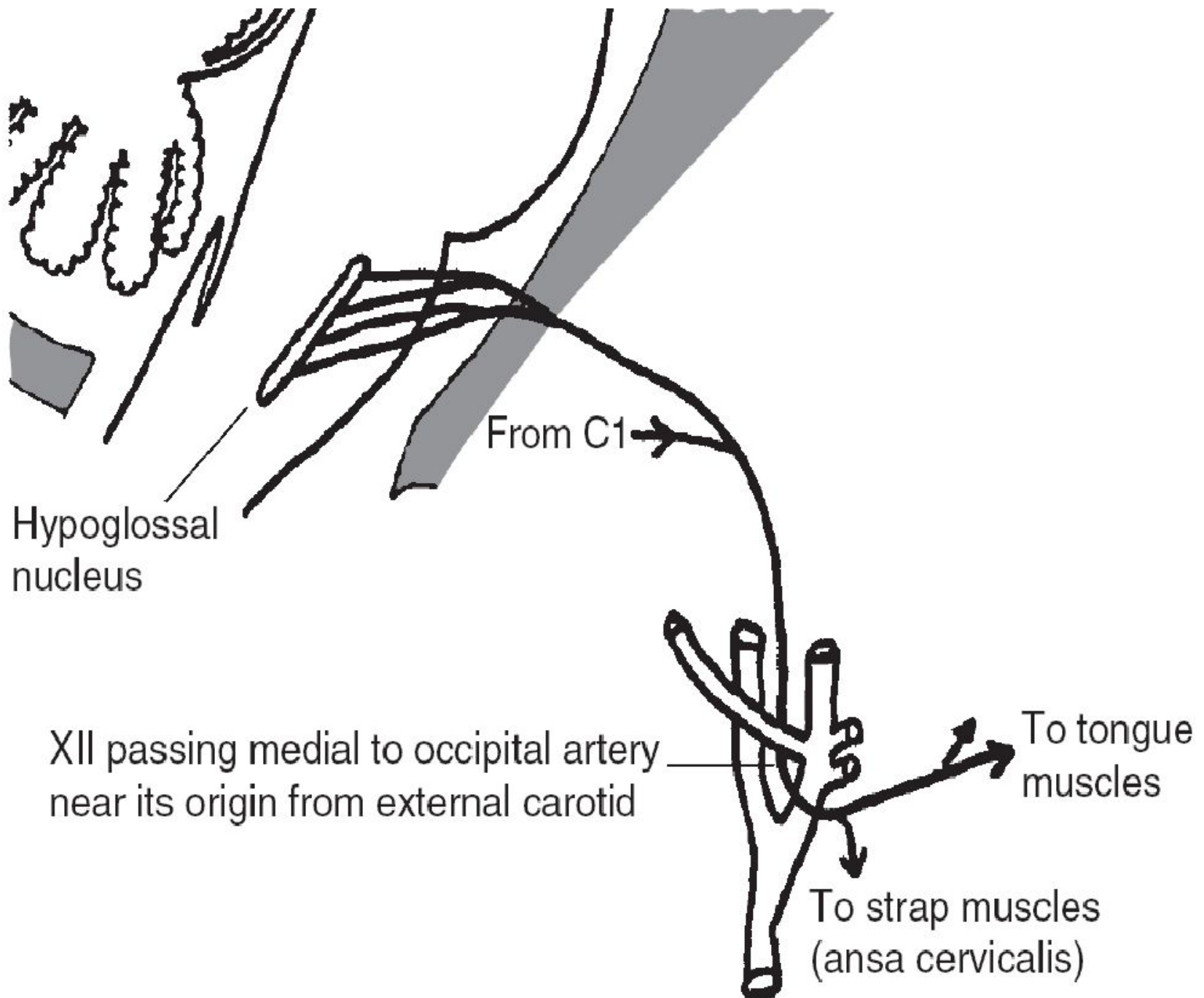
Anterioinferior View



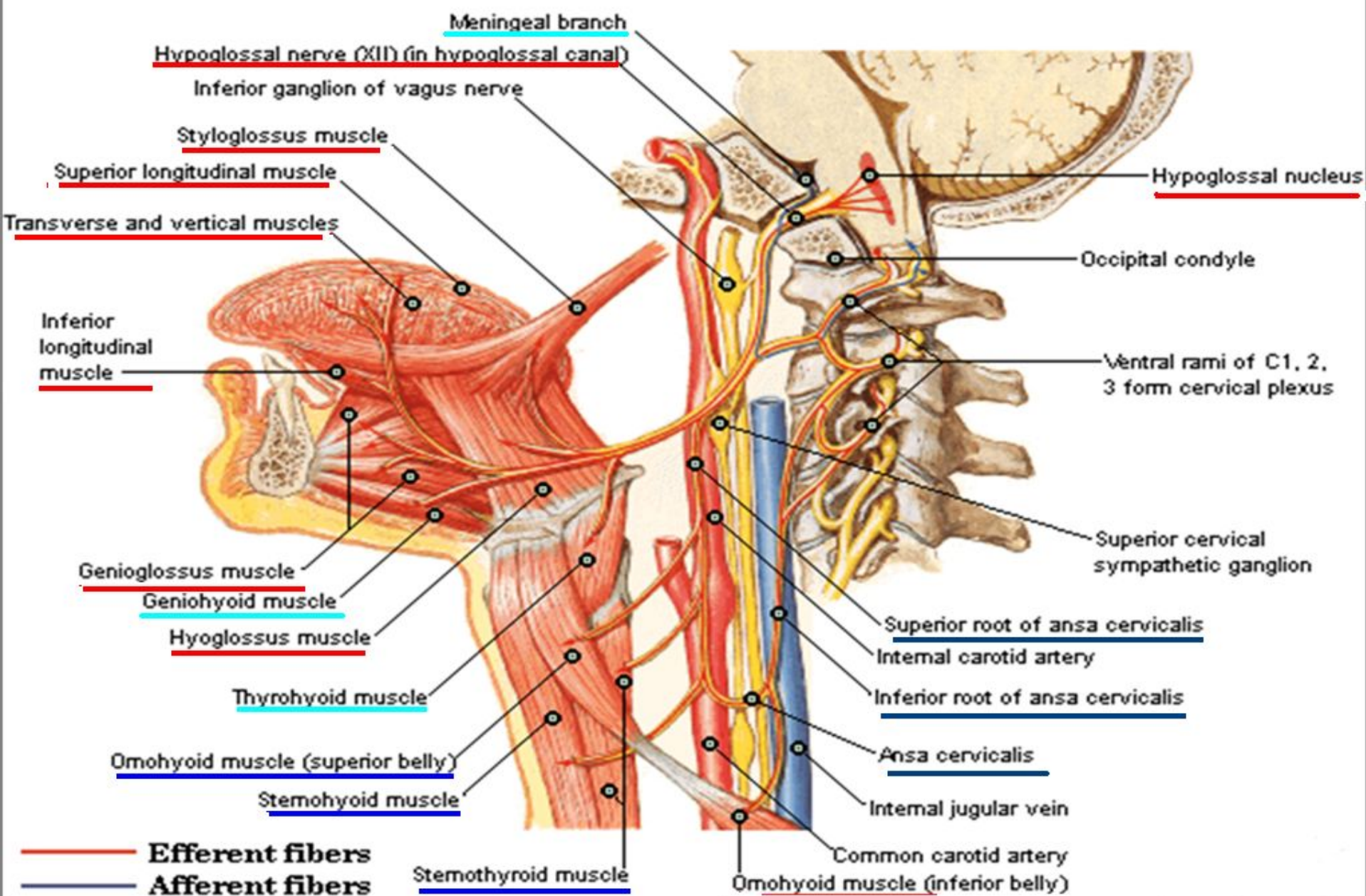


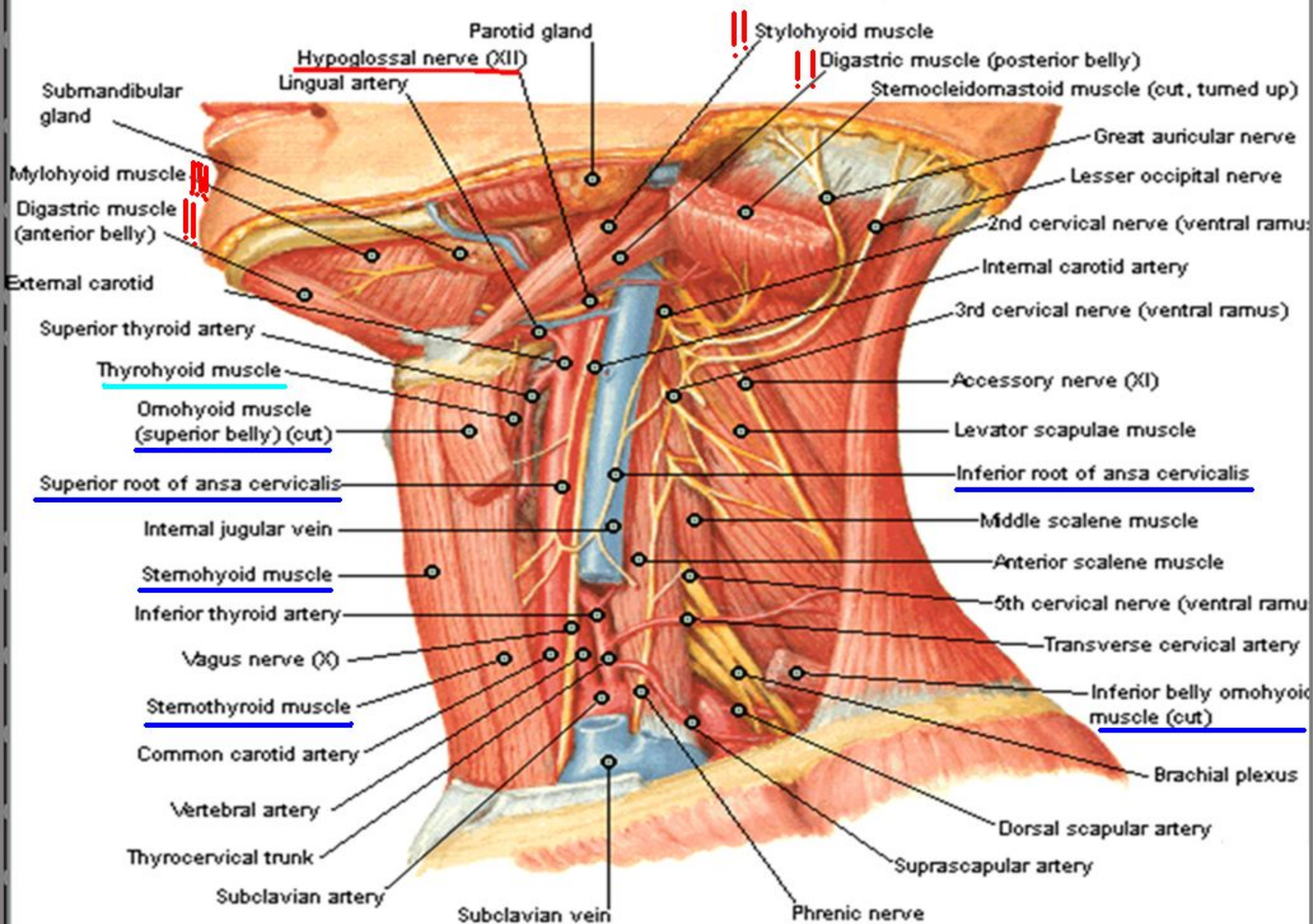
Course and Relations of Hypoglossal Nerve

1. Arises from **the hypoglossal nucleus** in the medulla.
2. The hypoglossal nerve emerges from the medulla by 12 rootlets from the anterolateral sulcus.
3. The rootlets pass laterally and unite to leave the skull through the hypoglossal canal.
4. It descends downwards inside the upper carotid sheath superficial to vagus nerve and between IJV & ICA.
5. It reaches the submandibular region where it runs on hypoglossal muscles.
6. It disappears deep to mylohyoid muscle and finally supplies the muscles of the tongue.



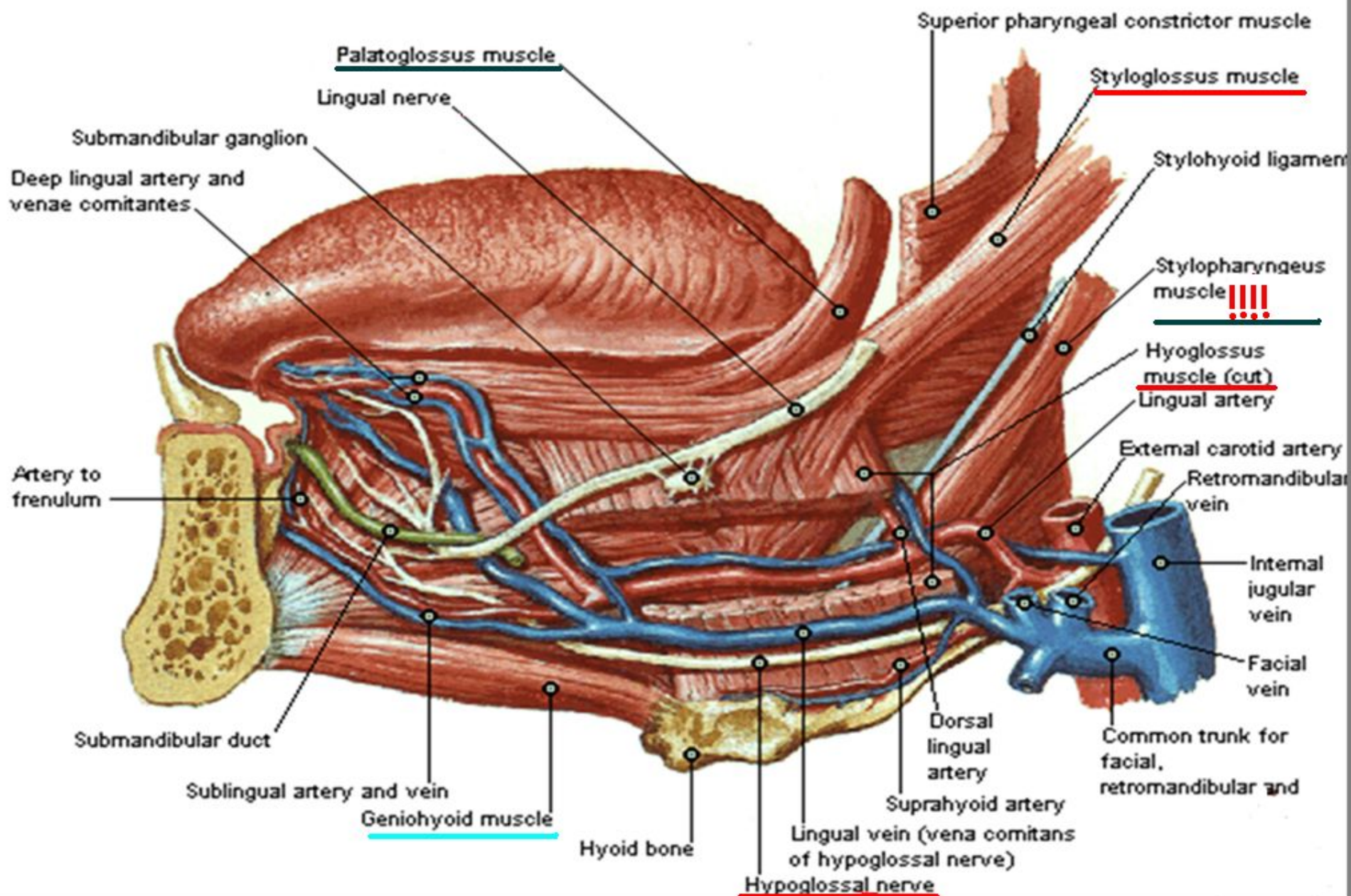
Hypoglossal Nerve Schema





Tongue and Related Structures

Sagittal Section

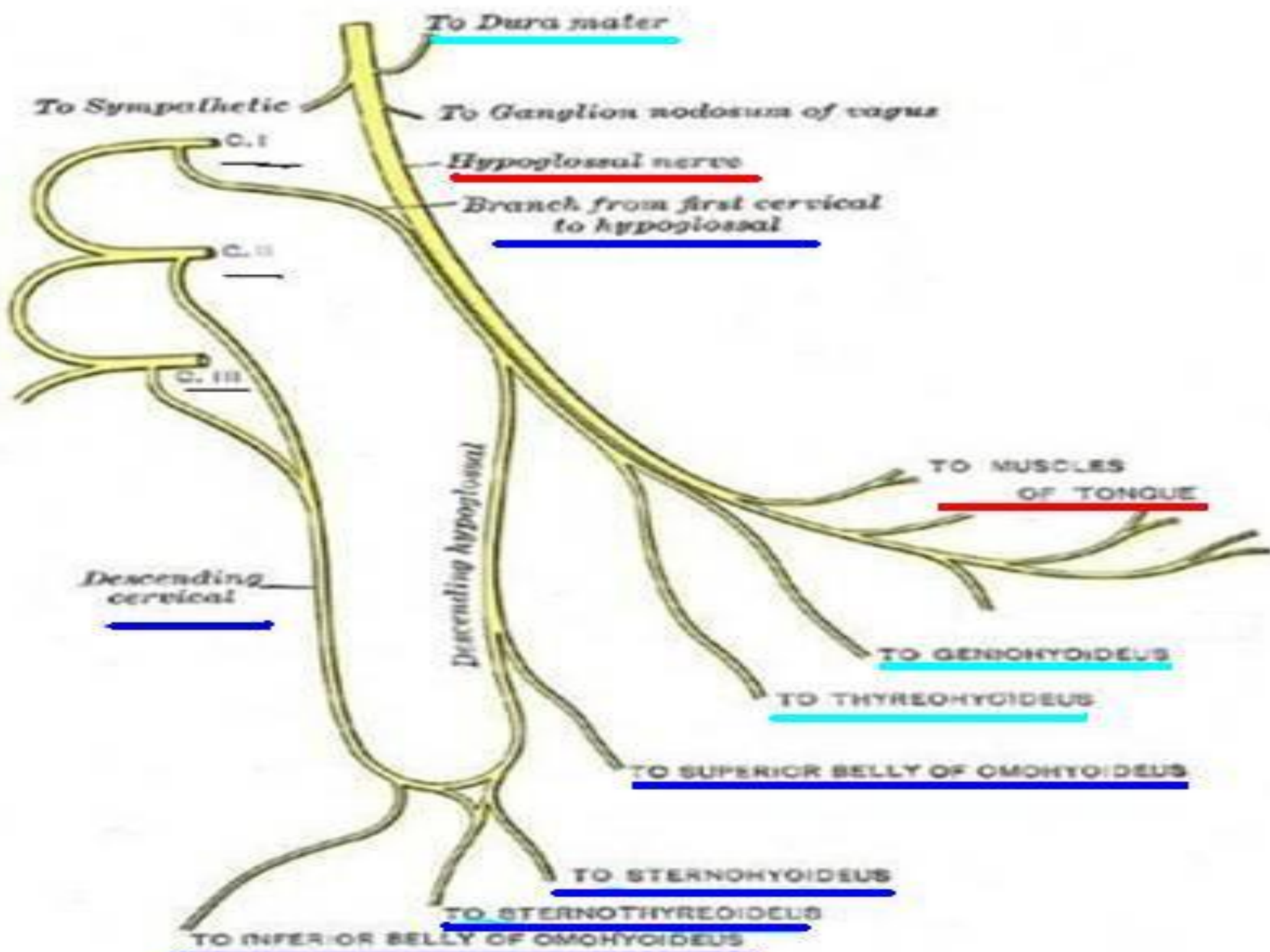


Branches of Hypoglossal Nerve Itself

1. Nerve to styloglossus muscle.
2. Nerve to hyoglossus muscle.
3. Nerve to genioglossus muscle.
4. Nerve to all internal muscles of the tongue.

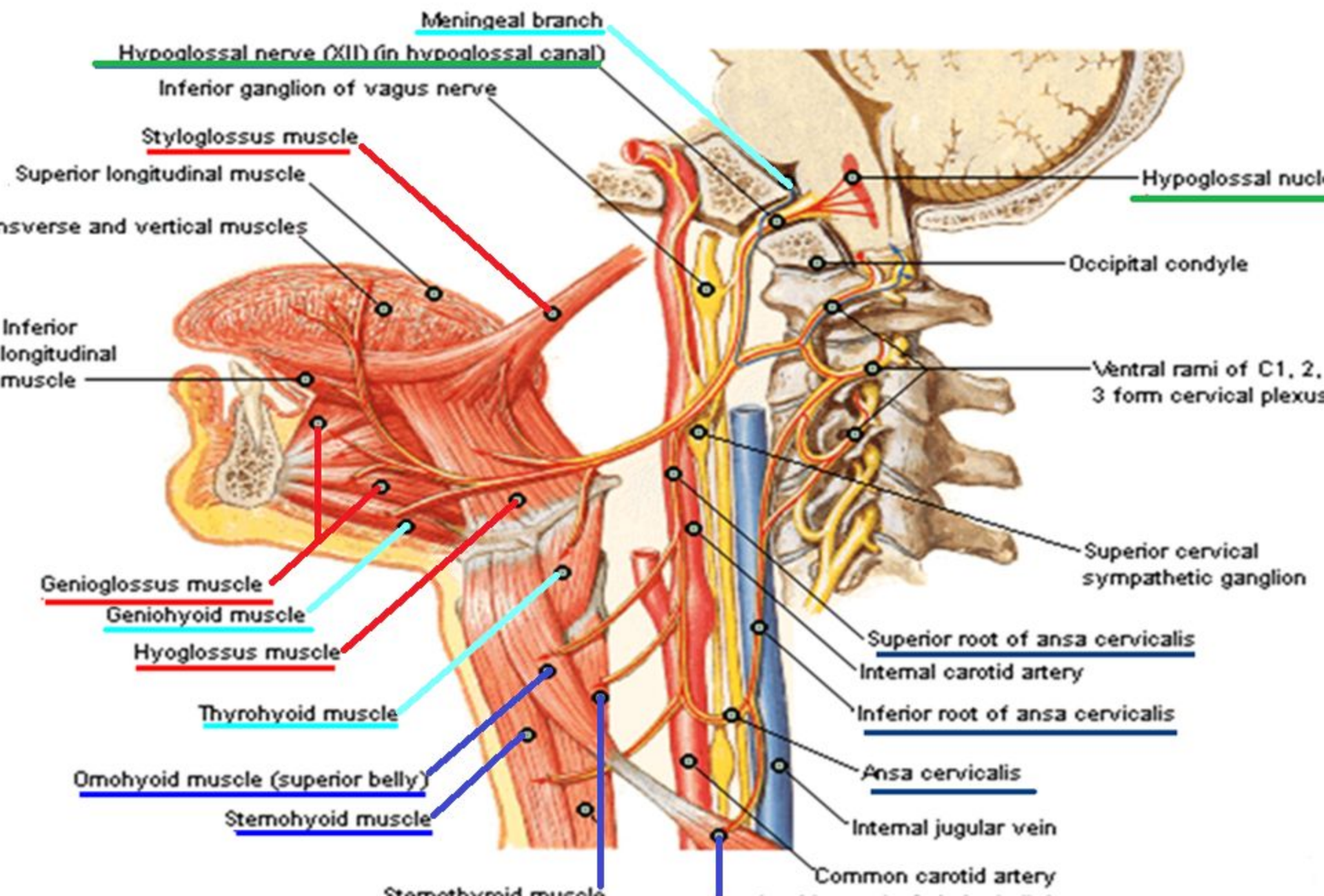
Branches from C1 Joining Hypoglossal Nerve

1. Meningeal branch (sensory) to dura mater.
2. Nerve to geniohyoid muscle.
3. Nerve to thyrohyoid muscle.
4. Descends hypoglossi: forming the superior limb of **ansa cervicalis** passes downward and joins the descending cervical nerve (C₂ and C₃) to form the **ansa cervicalis**. Branches from this loop supply the **omohyoid, sternohyoid, and sternothyroid muscles**.



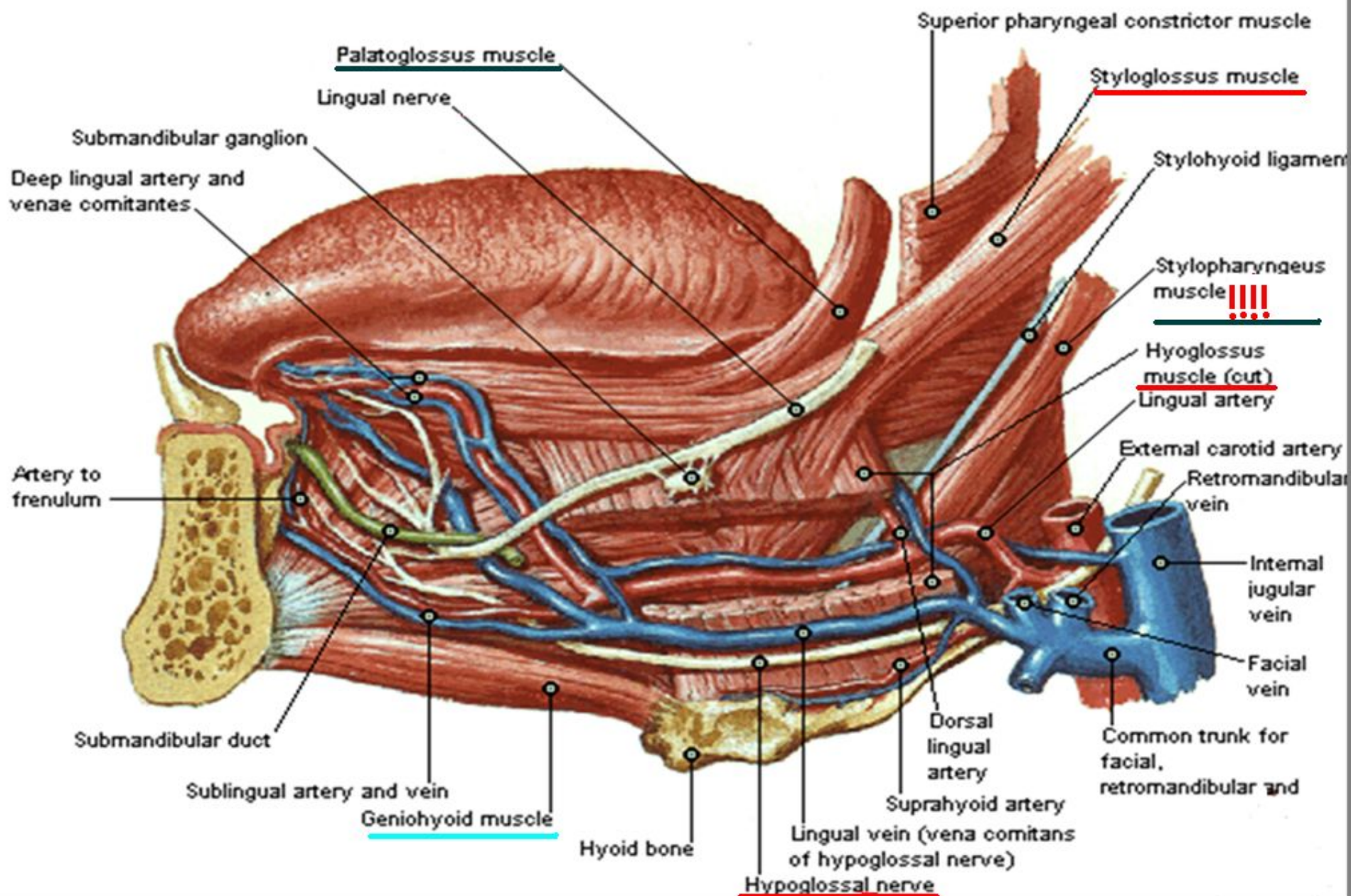
Hypoglossal Nerve

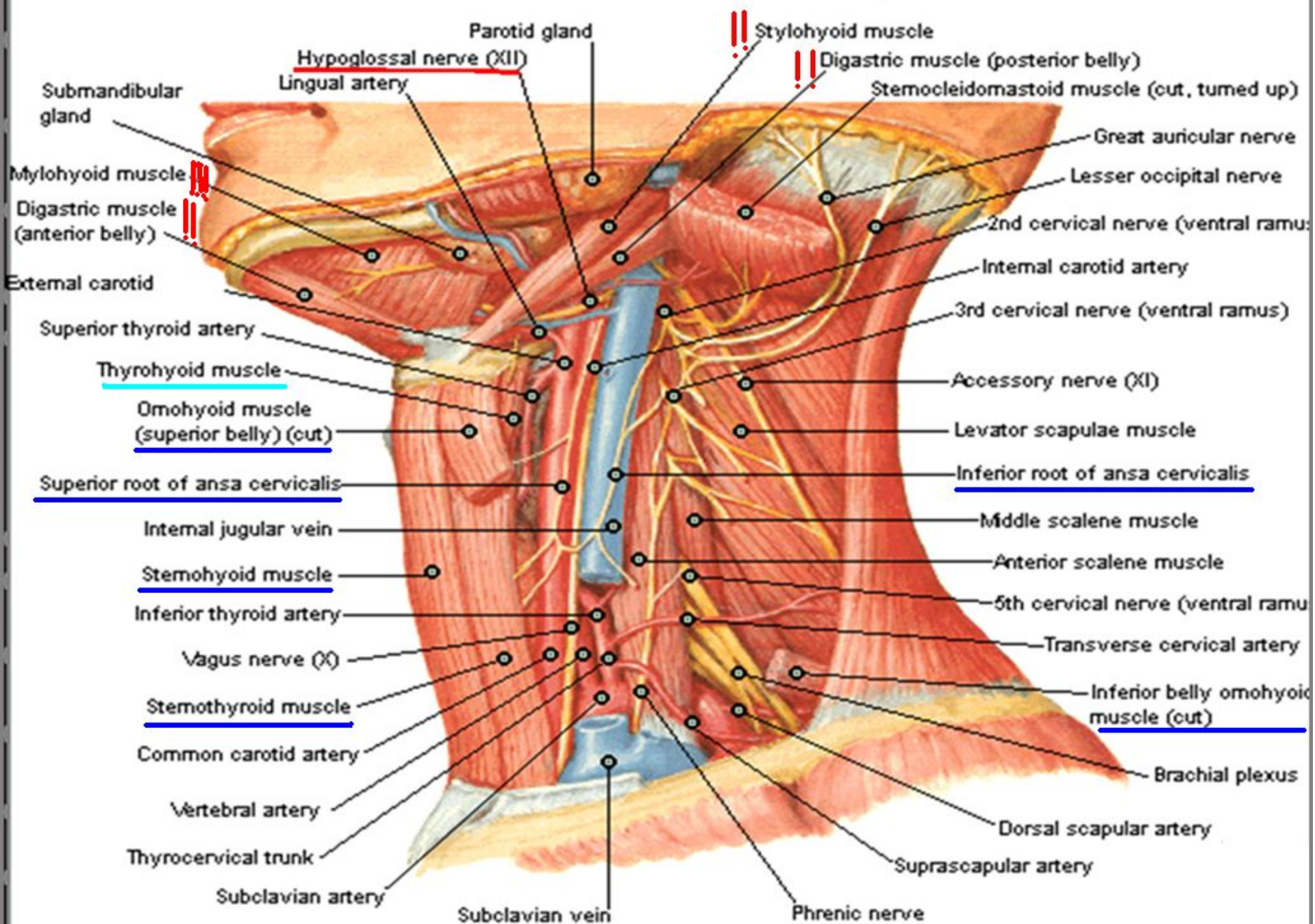
Schema



Tongue and Related Structures

Sagittal Section





Thank You

