

CNS

ANATOMY

10

Writer: Omar Ismail

Science: Obada Froukh

Final: Obada Froukh

Doctor: Mohammed Alsalem

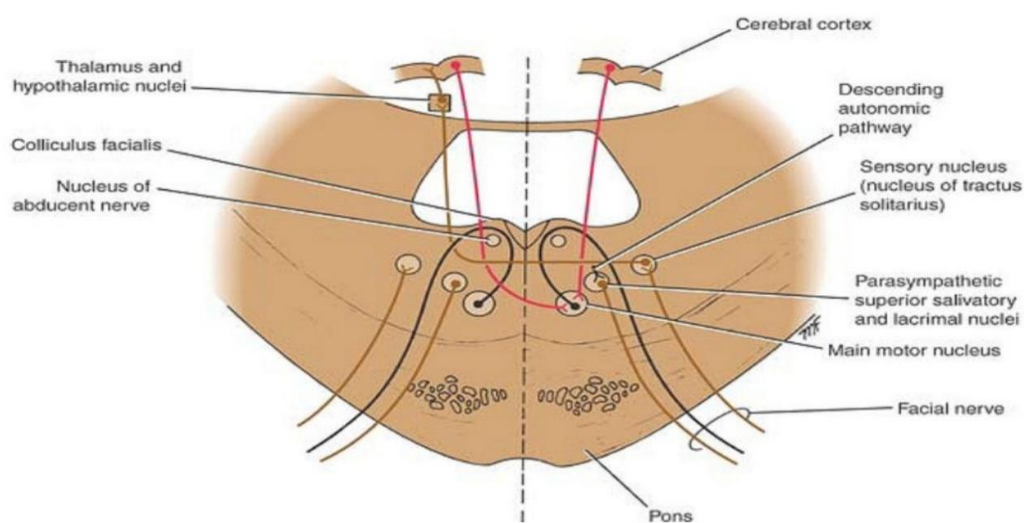


In this sheet, we'll continue discussing the cranial nerves that originate from the brainstem.

Facial nerve (cranial nerve VII):

The facial nerve is a mixed nerve (motor, sensory, and parasympathetic)

1. **Main motor nucleus** is found in the deep reticular formation of the lower part of the pons (*remember cranial nerves 6,7,8 emerge from the pontomedullary junction*), then the motor fibers go posteriorly and curve around the abducens nucleus, and this curve forms a bulge in the fourth ventricle called **the facial colliculus**, then the fibers go anteriorly to leave the brainstem.
 - The upper part of the face receives upper motor neurons from both hemispheres.
 - The lower part only receives upper motor neurons from the contralateral hemisphere.
2. The parasympathetic nuclei (**superior salivatory lacrimaly nucleus**) lie posterolateral to the motor nucleus.
Both the salivatory (*for the sublingual and submandibular glands*) and the lacrimaly (*emotional tears*) parts receive fibers from the hypothalamus (*the hypothalamus is responsible of the ANS*), the lacrimaly part also receives fibers from the trigeminal sensory nuclei (*reflex tears for foreign bodies*).
3. **Sensory nucleus:**
 - Taste of the anterior two thirds of the tongue: The cell bodies of the first order neurons are in **the geniculate ganglia** (*from chorda tympani*), and they synapse with the second order neurons in the **nucleus of tractus solitarius**, from there it ascends to the **VPM nucleus of the thalamus** then radiates to the **primary gustatory cortex** (area 43) in the parietal lobe.
 - General sensation from the skin of the external acoustic meatus is carried with the facial nerve (**geniculate ganglion**) into the spinal **trigeminal nucleus**.



Course:

The nerve emerges from the **pontomedullary junction**

(remember sensory fibers go towards the brain while motor away from the brain),

then enters the **internal acoustic meatus** in the petrous part of

temporal bone and passes through the **facial canal** first

behind the medial wall of the cavity of the middle ear (*tympanic cavity*) where it curves and forms

the geniculate ganglion (knee), then it continues in the posterior wall of the tympanic cavity to

finally emerge from the stylomastoid foramen.

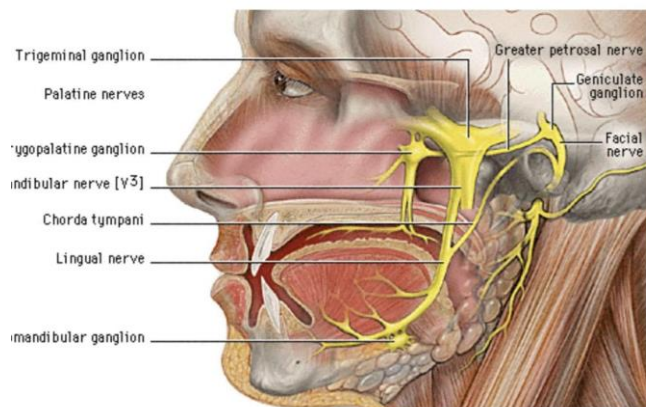
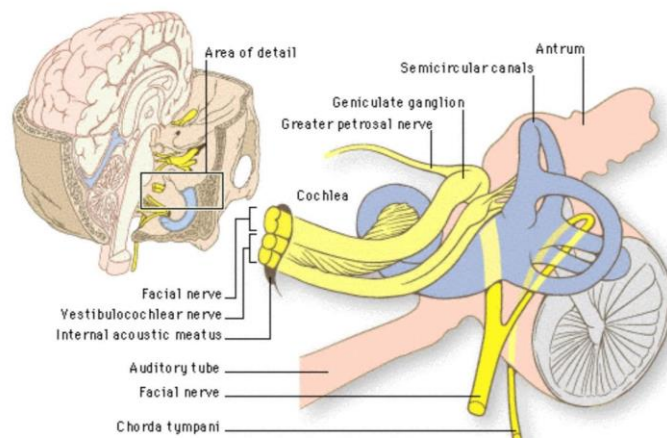
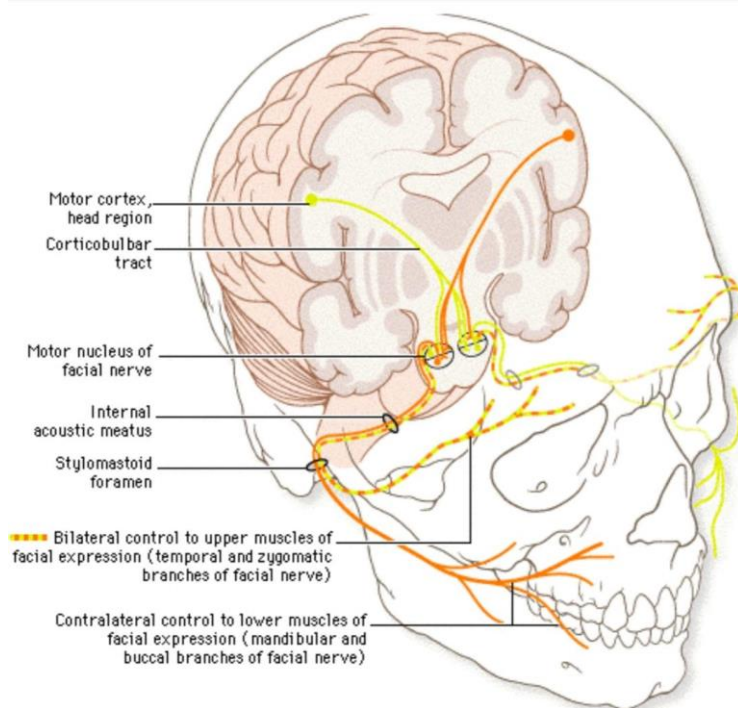
It gives two branches in the tympanic cavity:

1. Chorda tympani:

It leaves the middle ear through the **petrotympanic fissure** and enters the **infratemporal fossa**, then attaches to the **lingual nerve**, it carries two types of fibers, preganglionic parasympathetic from the salivatory lacrimatory nucleus (*submandibular ganglia*), and taste fibers from the anterior two thirds of the tongue.

2. Greater petrosal:

Emerges from the **geniculate ganglion**, then passes through the middle ear to enter the middle cranial fossa through the **greater petrosal foramen**, afterwards it passes **over foramen lacerum** and joins the **deep petrosal nerve** (*sympathetic fibers from the superior cervical ganglia*) to form



the **nerve to pterygoid canal**, which passes through the pterygoid canal to reach the **pterygopalatine fossa**.

The parasympathetic fibers synapse in the **pterygopalatine ganglia** which is suspended by the **maxillary nerve** and leave with the **zygomatic nerve** till they reach the orbit where the fibers attach to the **lacrimal nerve** and ascend to innervate the **lacrimal gland**.

*The greater petrosal carries preganglionic parasympathetic from the salivatory lacrimatory nucleus.

Facial nerve injury:

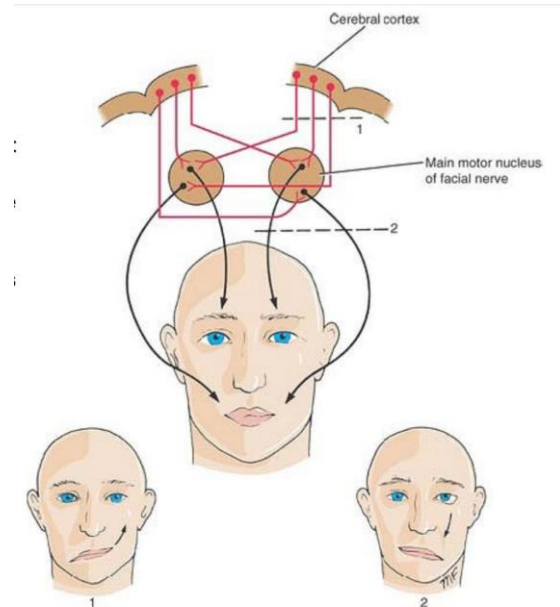
Location of the lesion

1. In the pons: Abducens and facial not working.
2. Internal acoustic meatus: Vestibulocochlear and facial
3. Chorda tympani: Loss of taste over the anterior two thirds of the tongue

Order of the neuron affected:

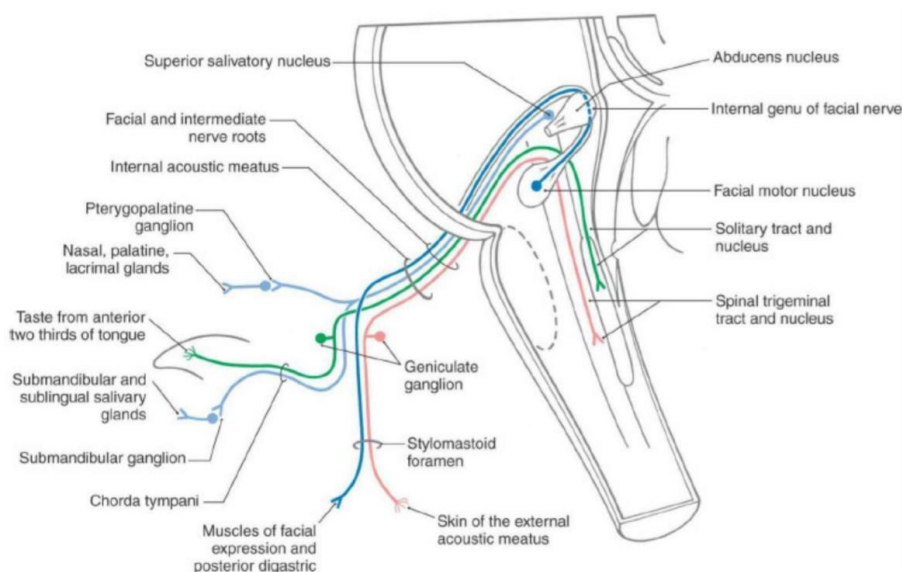
1. Lower motor neuron lesion -> ipsilateral half paralysis
2. Upper motor neuron lesion -> contralateral lower part paralysis

*Remember that the upper part of the face is supplied bilaterally by upper motor neurons, so if there is a lesion on one side the other side will compensate.



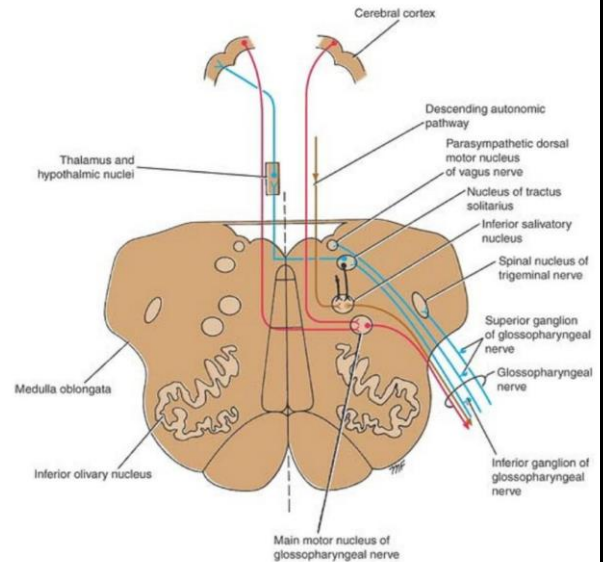
Bell's palsy:

Usually unilateral, lower motor neuron paralysis, the cause is still not known.



Glossopharyngeal nerve (cranial nerve IX):

1. **Motor nucleus**, deep in the reticular formation of the medulla, arises from the superior end of nucleus ambiguus, and only supplies the stylopharyngeus muscle.
2. Parasympathetic nucleus (**inferior salivatory nucleus**), posterior to nucleus ambiguus, receives from the hypothalamus (*all autonomic from the hypothalamus*) and passes to the otic ganglia (supplies the parotid gland).
3. **Sensory nucleus** (general, taste, and visceral sensation):
 - Taste from posterior third of the tongue: cell bodies of the first order neurons are in the **inferior ganglia** (*special and visceral sensory*), then it synapses with the second order neurons in **nucleus tractus solitarius**, and from there it ascends to synapse in the **VPM** of the thalamus to reach **primary gustatory cortex**.
 - Visceral sensation comes from the **carotid sinus** (baroreceptor). The glossopharyngeal passes between the internal and external carotid in the neck, and there it carries the visceral sensation from the carotid sinus. Cell bodies of the first order neurons are in the **inferior ganglia**, then they synapse in the **nucleus tractus solitarius** which is connected to the **dorsal nucleus of the vagus nerve** (*parasympathetic of the vagus*) which induces the carotid sinus reflex that reduces the blood pressure.
 - General sensation from the skin of auditory meatus, middle ear, auditory tube, pharynx except the nasopharynx (*maxillary*), and posterior 1/3 of the tongue (*common sensation*), the cell bodies are in the **superior ganglion**, and then it goes to the **spinal nucleus of trigeminal** (*it carries general sensation from many cranial nerves but primarily from the trigeminal*).



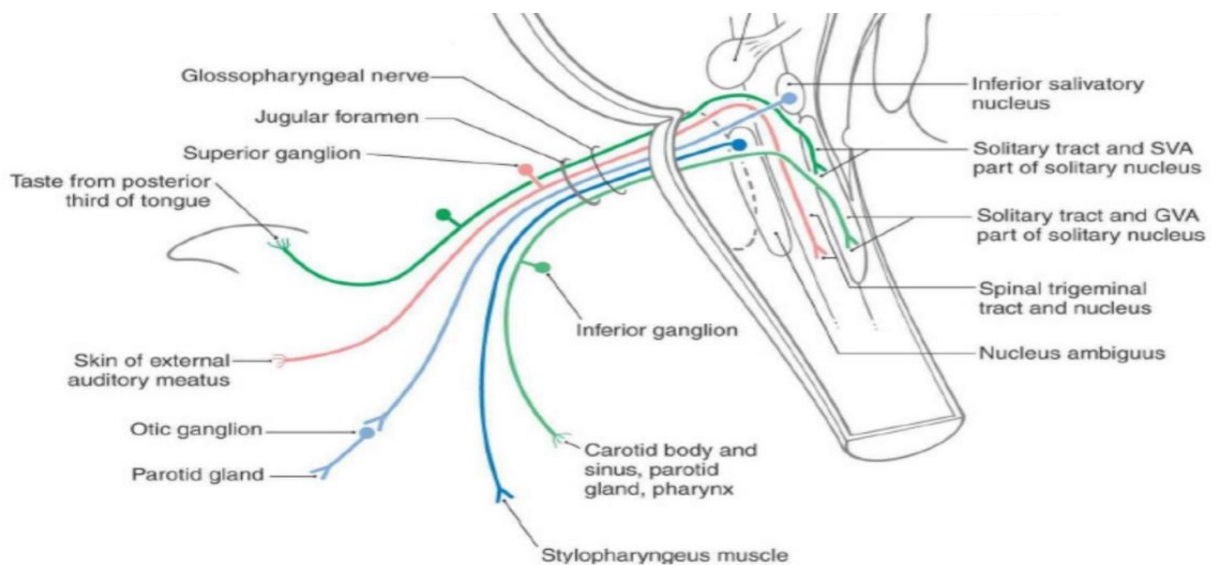
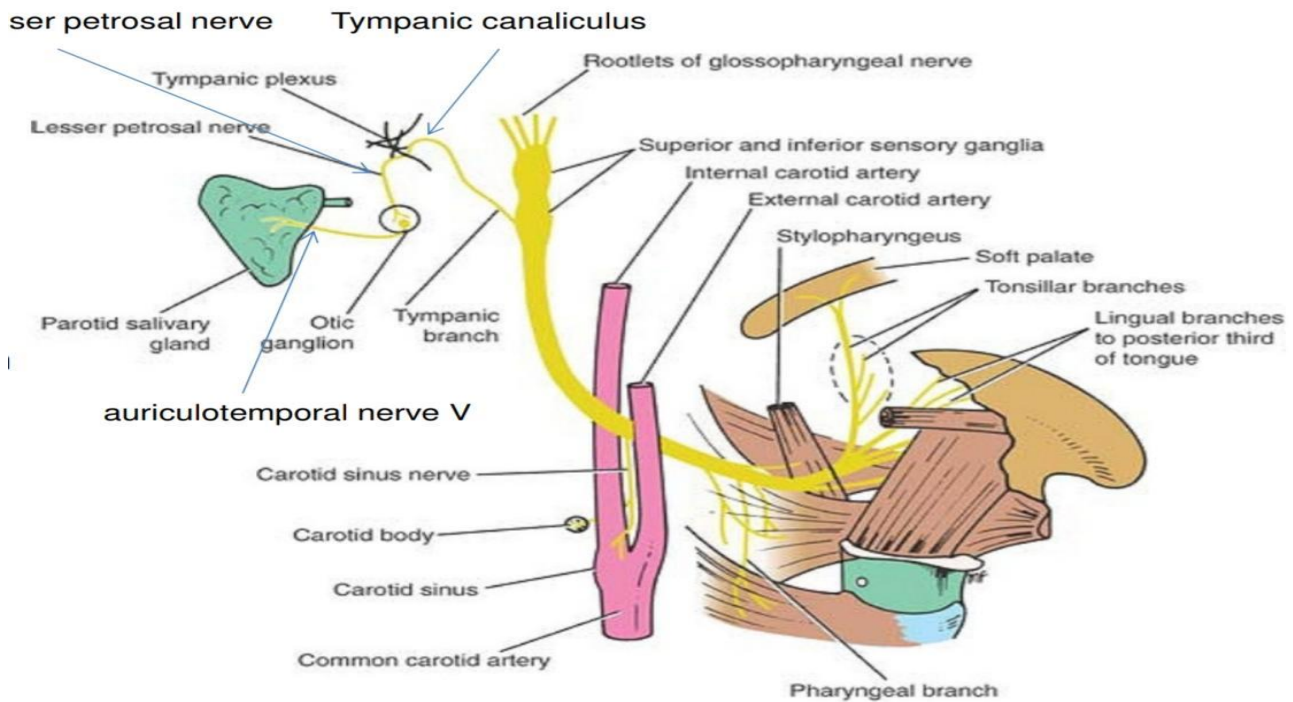
Course:

1. The glossopharyngeal nerve emerges from the groove between the olive and the inferior cerebellar peduncle.
2. Descends from jugular foramen to leave the skull and there it forms two ganglia (superior and inferior)
3. At the level of the inferior ganglia, it gives a branch called tympanic branch (*preganglionic parasympathetic fibers*)
4. It enters through the tympanic canaliculus to reach the tympanic cavity where it joins the tympanic plexus near the tympanic membrane (*that's a lot of tympanic I know*)

5. It leaves the tympanic cavity as the lesser petrosal nerve through the lesser petrosal hiatus to reach the middle cranial fossa.
6. From the middle cranial fossa, it descends through foramen ovale to the infratemporal fossa and synapses in the otic ganglia which is suspended by the mandibular nerve, and through the auriculotemporal it reaches the parotid gland.

Injury:

- Loss of the gag reflex (*normally induces vomiting*)
- Loss of the carotid sinus reflex
- Loss of taste from the posterior third of the tongue



Vagus nerve (cranial nerve X):

1. Motor nucleus (lower part of nucleus ambiguus).

Supplies the constrictor muscles of the pharynx and the muscles of the larynx.

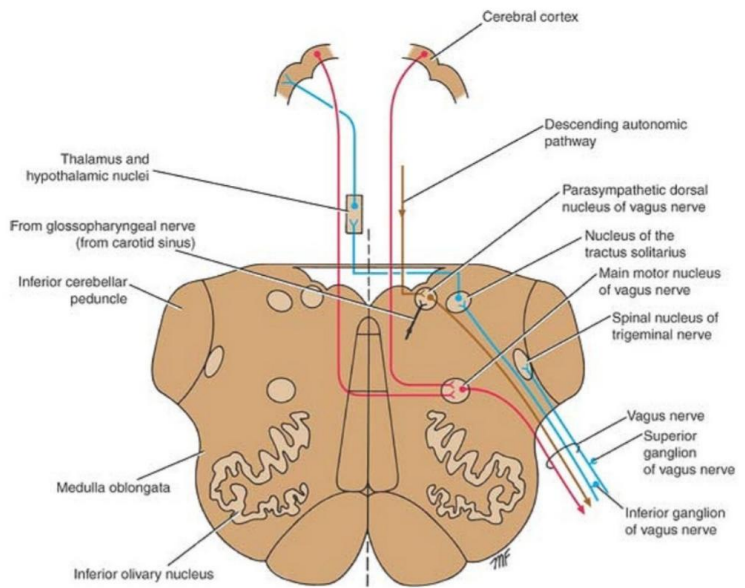
2. Dorsal nucleus of Vagus

(*parasympathetic*), anterior to the floor of the lower part of the fourth ventricle, it receives afferents from the hypothalamus and glossopharyngeal nerve (*carotid sinus reflex*).

Efferent to involuntary muscles of the bronchi, heart, esophagus, stomach, small intestines, and large intestines as far as the distal one-third of the transverse colon.

3. Sensory nucleus:

- Taste from the epiglottis: carried to the lower part of **nucleus tractus solitarius**, cell bodies of the first order neurons in the **inferior ganglia** (*don't confuse it with the inferior ganglion of the glossopharyngeal, both have superior and inferior ganglia*).
- General sensation: cell bodies of the first order neurons in the **superior ganglia**, then to the **spinal nucleus of trigeminal**. carries sensation from the outer ear, mucosa of the larynx, and the dura of posterior cranial fossa.



Course not required; just remember that it can reach the abdomen.

Injury:

- Uvula deviates to the healthy side.
- Hoarseness of voice (*paralysis in the muscles of the larynx*)
- Dysphagia and nasal regurgitation (*paralysis in the muscles of the pharynx*)
- Arrhythmia in heart and irregularity in GI tract because (*parasympathetic dysfunction*)

Accessory nerve (cranial nerve XI):

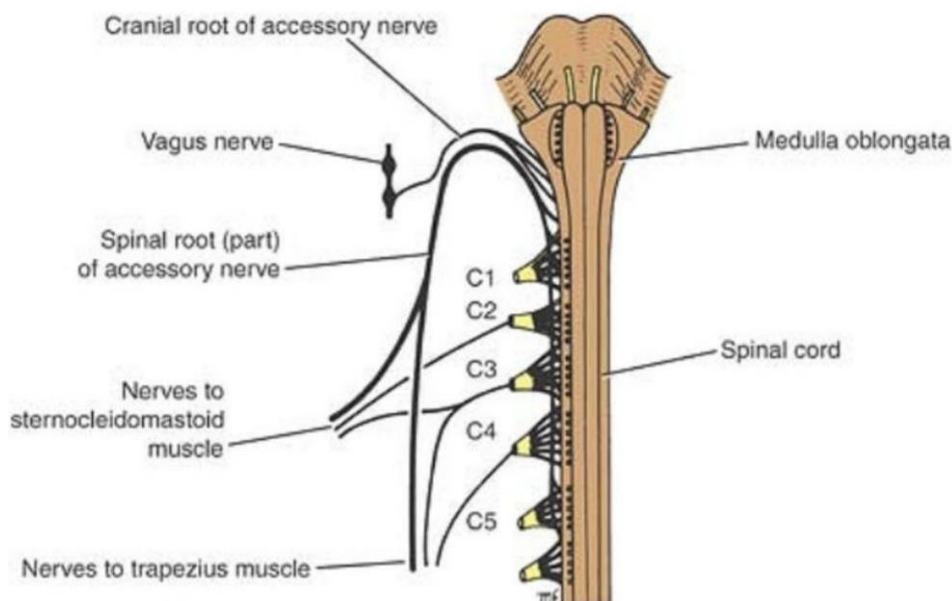
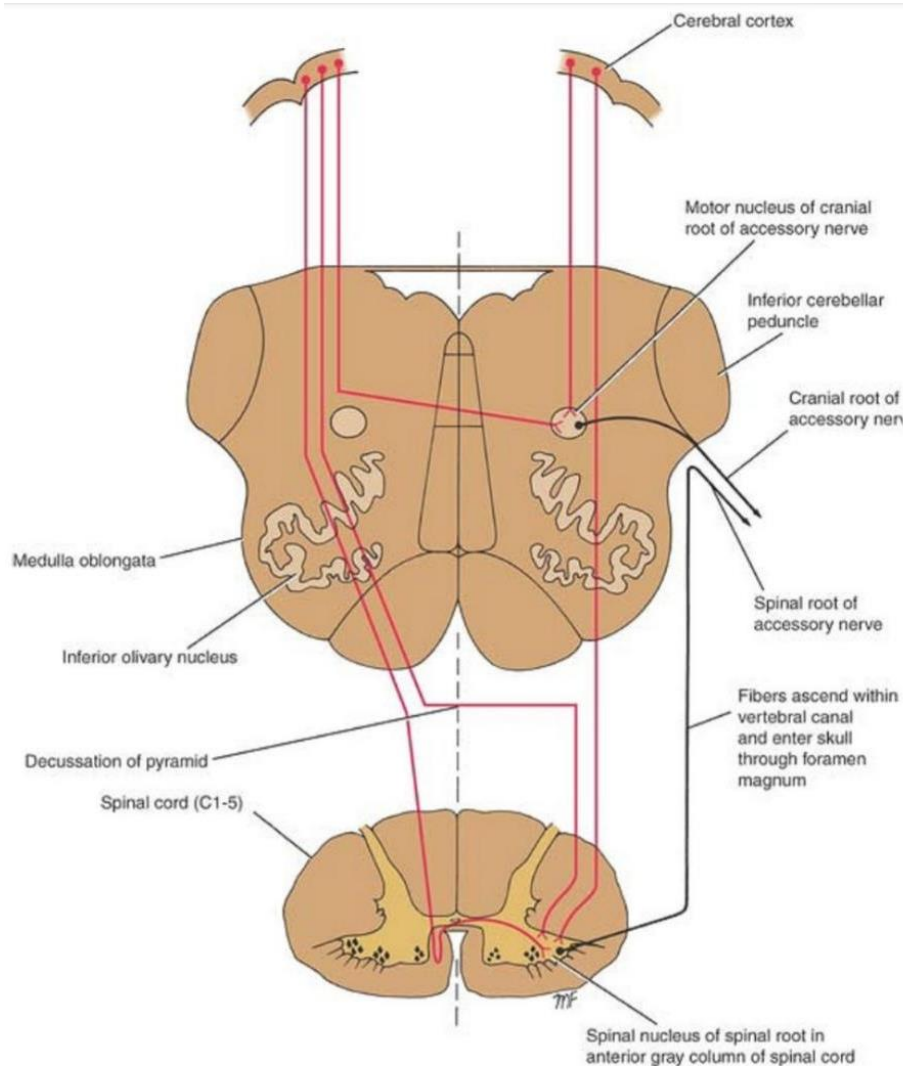
Motor and has two roots:
cranial and spinal.

1. Cranial root from nucleus ambiguus.
2. Spinal root originates from the spinal cord (lamina IX from the upper 5 cervical segments).

The spinal root ascends to the cranial cavity through foramen magnum to join the cranial root, they then move together (*fibers of the two roots don't mix*) and leave through the jugular foramen.

They separate once more and the cranial root joins the vagus nerve and courses along with it, while the spinal descends by itself and supplies the trapezius and sternocleidomastoid.

*The soft palate is thought to be supplied by the cranial root.

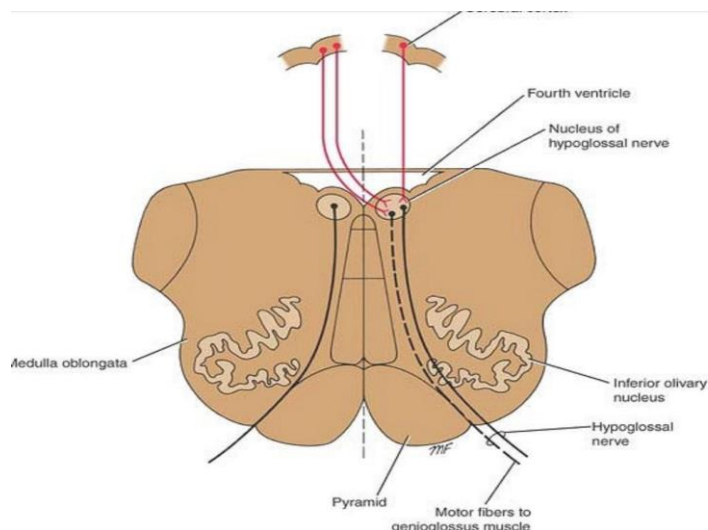


Hypoglossal nerve (cranial nerve XII):

Has one motor nucleus, Beneath the floor of the lower part of the fourth ventricle.

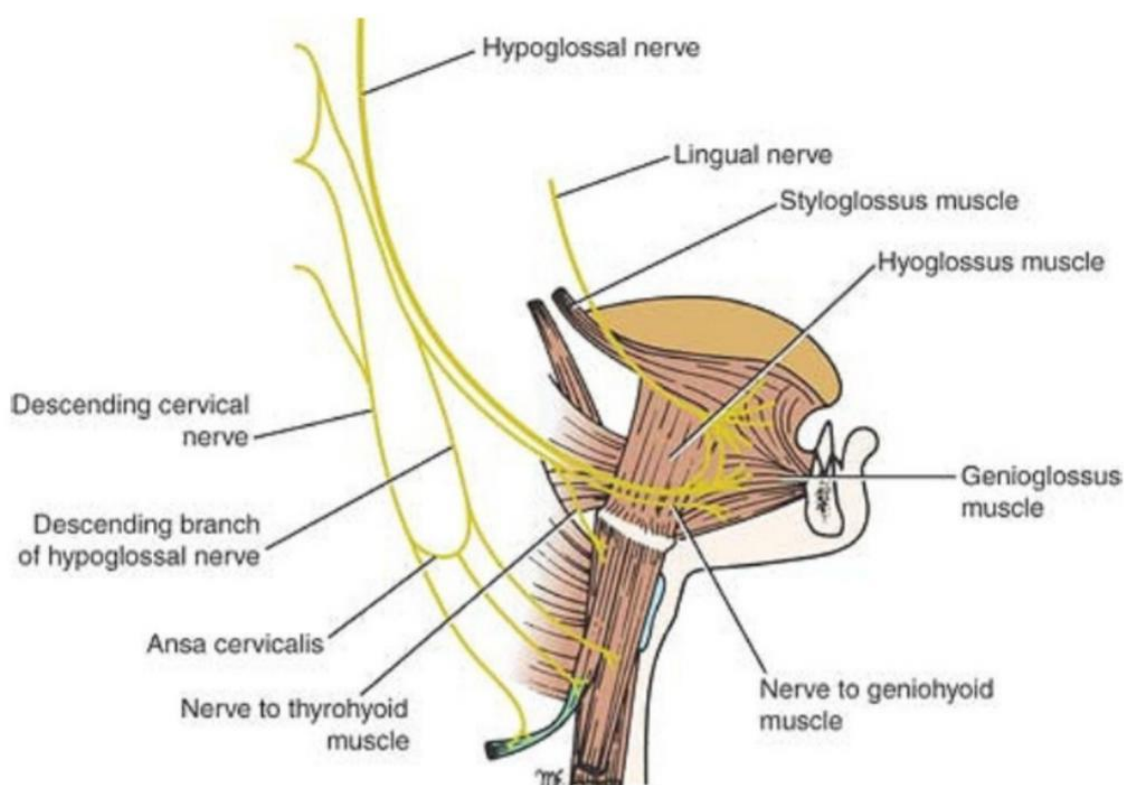
Supplies all the muscles of the tongue except palatoglossus (*from the vagus*).

Cells responsible for supplying the genioglossus muscle receive from the opposite cerebral hemisphere (not bilateral).



Course:

- Emerges between the olive and the pyramid (*the other medullary cranial nerves emerge between the inferior cerebellar peduncle and the olive*).
- Leaves the skull through the hypoglossal canal.
- Courses between the internal carotid artery and the internal jugular vein to eventually reach the tongue, during its course it attaches to the C1 spinal nerve but doesn't mix with it.



Injury:

Lower motor neuron lesion: Tongue deviates toward the paralyzed side during protrusion with muscle atrophy (ipsilateral)

Upper motor neuron lesion: On protrusion, tongue will deviate to the side opposite the lesion (*genioglossus paralysis*) with no atrophy.



Reticular formation:

Deeply placed continuous network of nerve cells and fibers that extend from the spinal cord through the medulla, the pons, and the midbrain, it might reach some superior structures like the thalamus and subthalamus but it's mainly in the brainstem.

Divided into three longitudinal columns:

- Median column: intermediate-size neurons
- Medial column: large neurons
- Lateral column: small neurons

General function:

1. Control of skeletal muscle
2. Control of somatic and visceral sensations
3. Control of the autonomic nervous system (*vital centers*)
4. The reticular activating system (*it switches the cortex on and off*)

