

Lecture

Main Functions of the Cranial and Spinal Nerves

Dr. Eyad M. Hussein

Ph.D. of Neurology

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

الرجاء تحويل الجوال إلى وضع
الصامت مع
الشكر



The Cranial Nerves

- The cranial nerves consist of 12 pairs of nerves that arise from the brain.
- They exit/enter the cranium through openings in the skull.
- The olfactory, optic and vestibulocochlear nerves are purely sensory nerves “special sensory” **(128)**.
- The oculomotor, trochlear, abducent, accessory and hypoglossal nerves are purely motor nerves.
- The trigeminal, facial, glossopharyngeal and vagus nerves are mixed nerves **(10975)**.

Functional Modalities

- **Somatic:** skeletal muscle, joint, tendon, ligament, and skin.
- **Visceral:** smooth muscles, cardiac muscles, and glands.
 - **Sensory “Afferent”:**
 - ✓ **General.**
 - ✓ **Special.**
 - **Motor “Efferent”:**
 - ✓ **General.**
 - ✓ **Special.**
- **Organic sensations:** e.g. hunger, thirst and sexual sensations **“Hypothalamic Sensations”**.

Motor Functional Modalities

1. **General Somatic Efferent (GSE): somatomotor, or somatic motor fibers**, arise from motor neuron cell bodies in the AHCs of the spinal cord, which supply the skeletal muscles.
2. **General Visceral Efferent (GVE): visceral or autonomic efferent**, are the efferent nerve fibers of the autonomic nervous system (**motor innervation to smooth muscle, cardiac muscle, and glands**).
3. **The Special Visceral Efferent (SVE)**: which supply muscles of the trigeminal, facial, glossopharyngeal, vagus, and cranial accessory nerves.

Sensory Functional Modalities

1. **General Somatic Afferent (GSA): somatic sensory "afferent" fibers** arise from neurons in sensory ganglia and are found in all the spinal nerves, and conduct general sensations from the surface of the body through the dorsal roots to the spinal cord.
2. **Special Somatic Afferent (SSA): afferent nerves of the special senses**, (fibers include the optic nerve and the vestibulocochlear nerve).
3. **General Visceral Afferent (GVA): conduct sensory impulses (usually pain or reflex sensations)** from the internal organs, glands, and blood vessels to the central nervous system.
4. **Special Visceral Afferent fibers (SVA): afferent fiber that develop in association with the gastrointestinal tract.** They carry the special senses of smell (olfaction) and taste (gustation). The cranial nerves containing SVA fibers are the olfactory nerve (I), the facial nerve (VII), the glossopharyngeal nerve (IX), and the vagus nerve (X).

The Main Three Functions of the Cranial Nerves

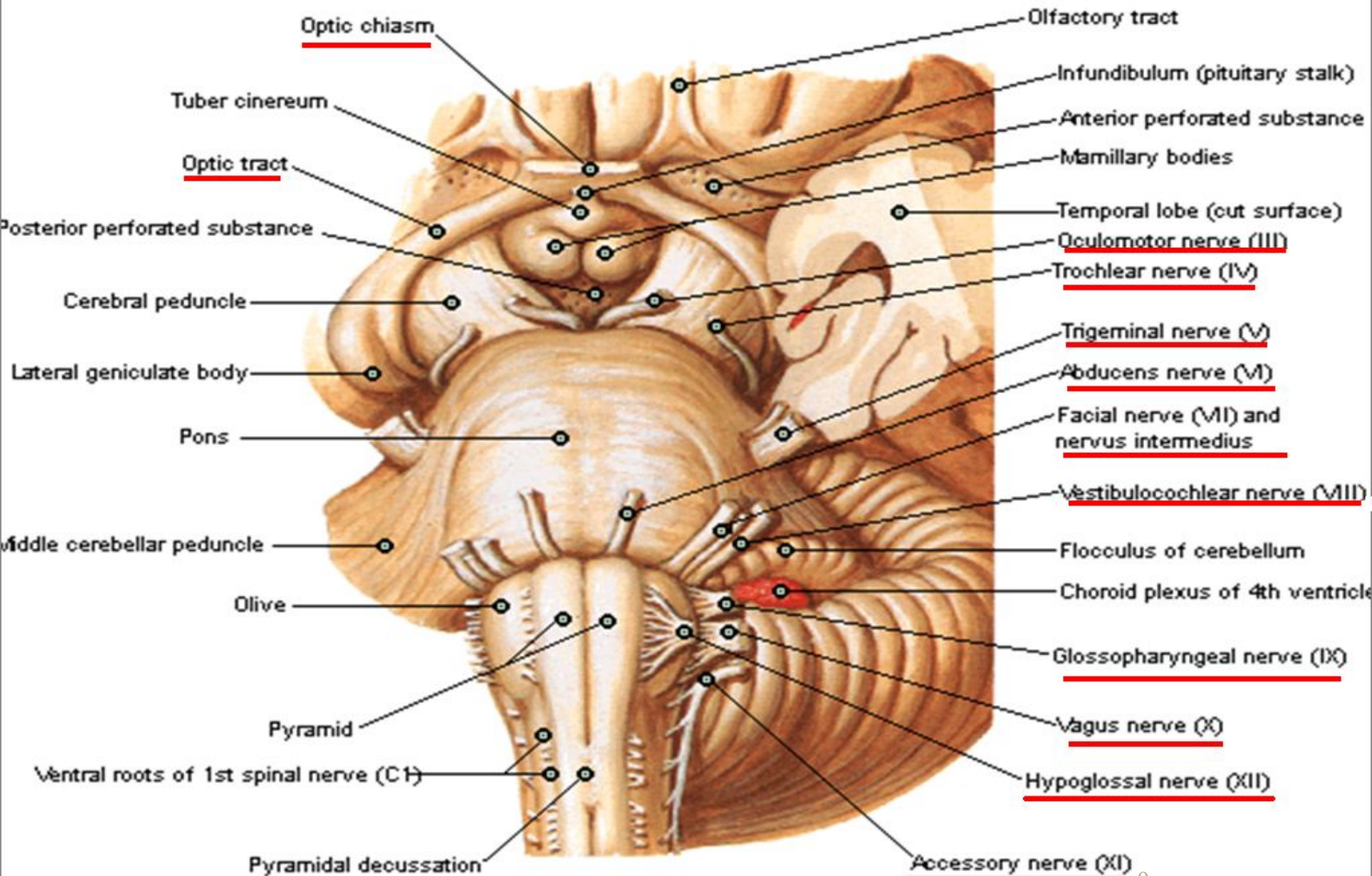
- 1. General Motor & Sensory Innervation:** of the skin, muscles, and joints in the head and neck region.
- 2. Special Senses: vision, hearing, smell, & Taste.**
- 3. Autonomic “Visceral” Functions”:** via parasympathetic innervation to the visceral organs.

Classification of the Cranial Nerves

No	Name	Function	Site of nucleus	Opening in the skull
1	Olfactory	Smell	Temporal Lobe	Cribriform plate
2	Optic	Vision	Occipital lobe	Optic canal
3	Oculomotor	Motor	Midbrain	Superior orbital fissure
4	Trochlear	Motor	Midbrain	Superior orbital fissure
5	Trigeminal: Ophthalmic Maxillary Mandibular	Sensory Sensory Mixed	Midbrain, Pons Pons Medulla oblongata Upper C. spinal cord	Superior orbital fissure Foramen rotundum Foramen ovale
6	Abducent	Motor	Pons	Superior orbital fissure
7	Facial	Mixed	Pons	Internal acoustic meatus, Facial canal, Stylomastoid foramen
8	Vestibulo-cochlear	Hearing and balance	Pons	Internal acoustic meatus
9	Glossopharyngeal	Mixed	Medulla oblongata	Jugular foramen
10	Vagus	Mixed	Medulla oblongata	Jugular foramen
11	Accessory	Motor	Medulla oblongata C1-C4 AHC of SC	Jugular foramen
12	Hypoglossal	Motor	Medulla oblongata	Hypoglossal canal

Brainstem

Anterioinferior View



I. The Olfactory Nerve

- **Olfactory Nerve:** (Latin for "to smell").
- **Function and modality:** **Special visceral afferent** (smell sensation).
- **Olfactory tract** located in the anterior cranial fossa and attached to the inferior surface of frontal lobe.

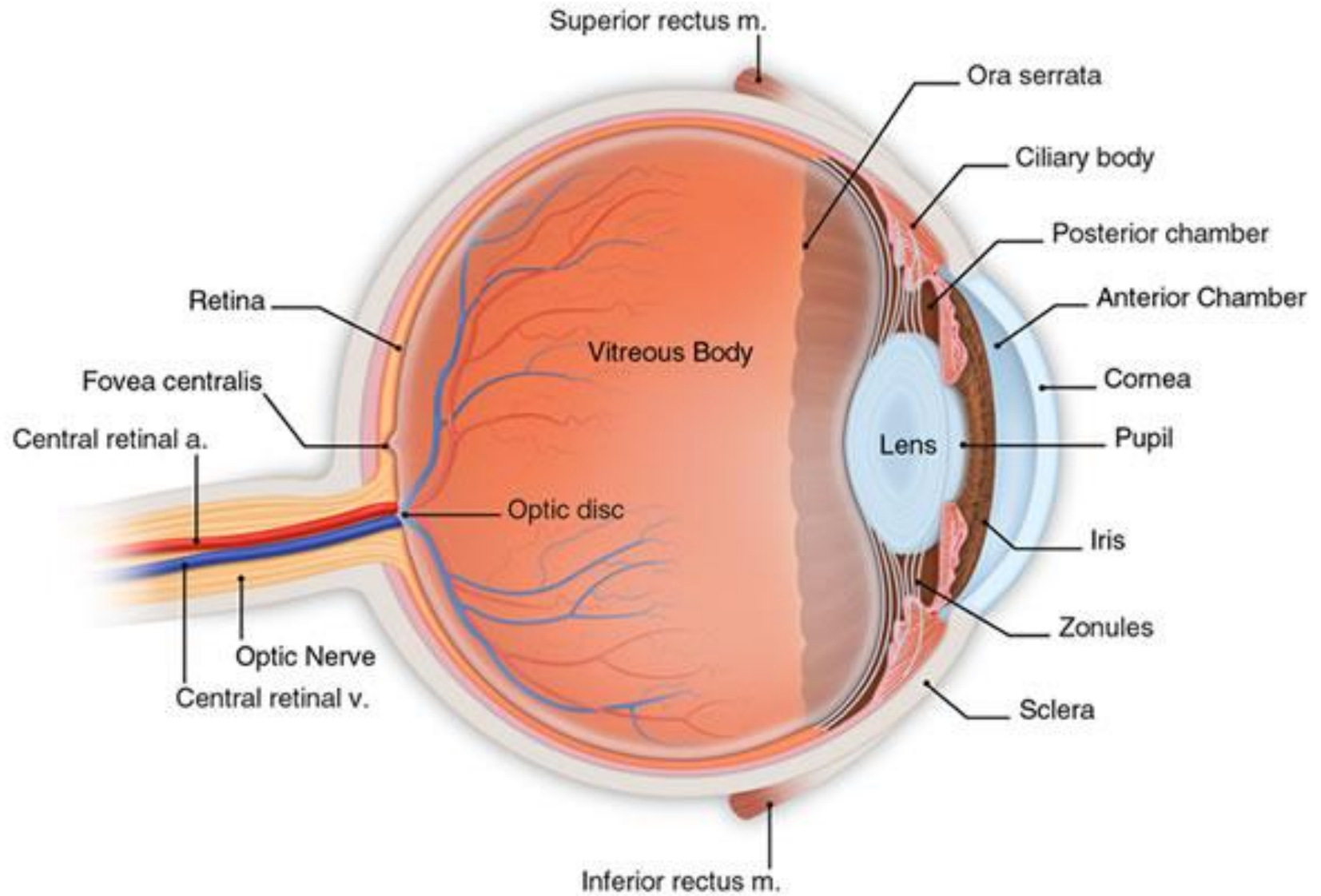


II. The Optic Nerve

❖ **Optic Nerve:** (Latin for "to see").

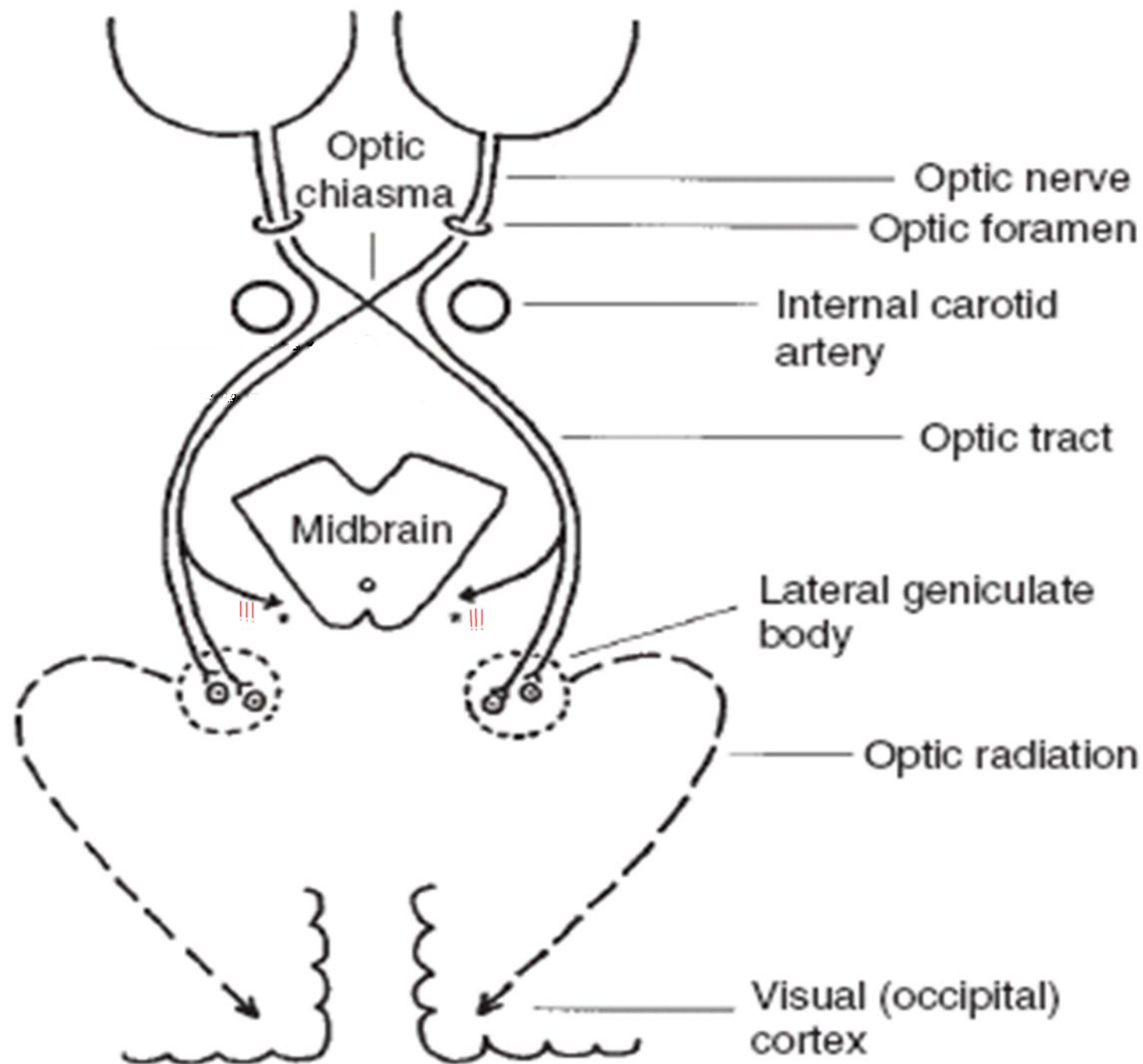
- A bundle of 1 million nerve fibers.
- Responsible for transmitting nerve signals from the retina to the brain.
- The optic disc is the front surface of the optic nerve.

❖ **Function and modality:** special somatic afferent (sense of vision) and pupillary light reflex.

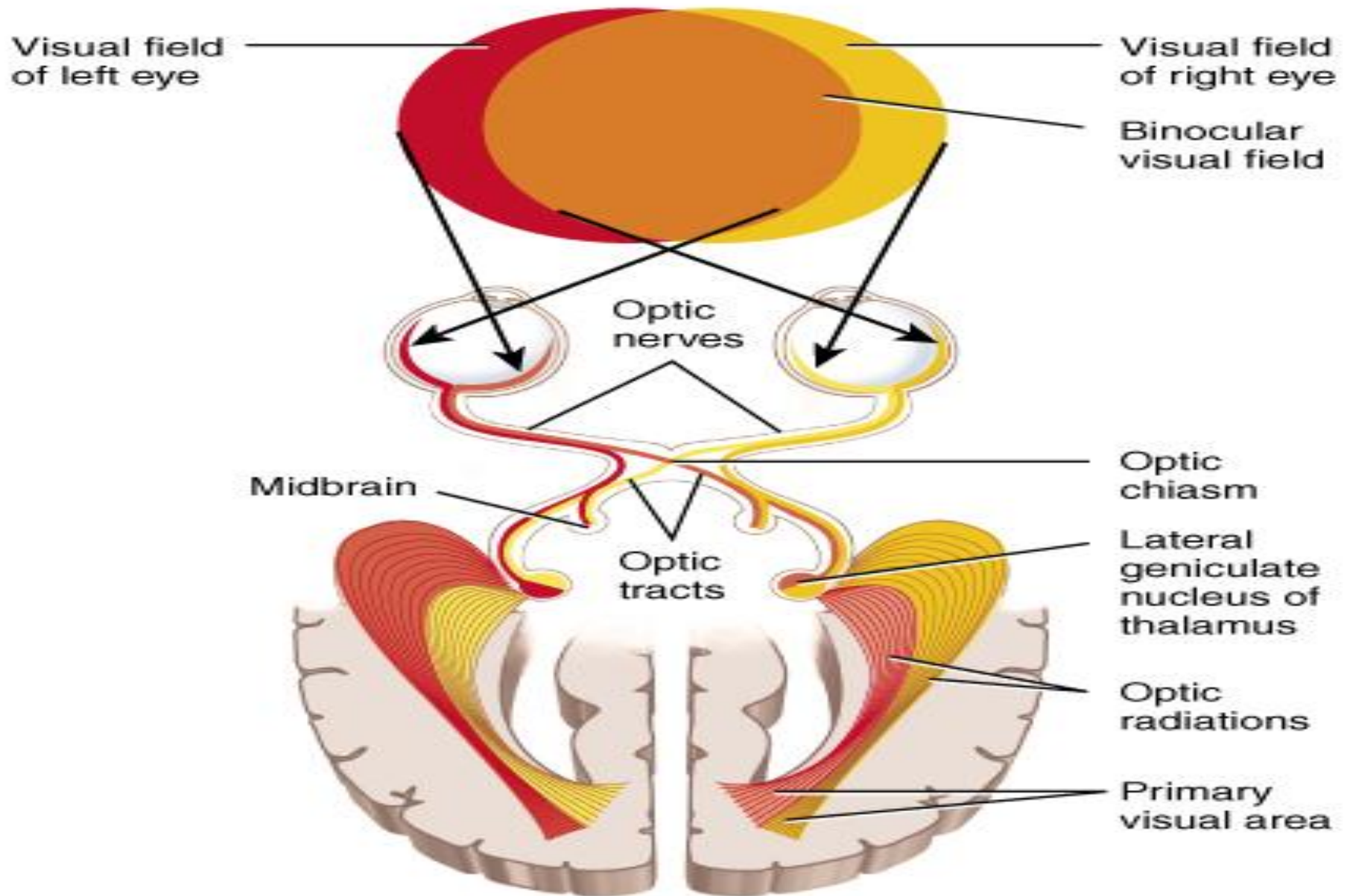


Pathway of the Vision

Receptors of light are **rods and cones of retina** → **optic nerve** → optic canal of the sphenoid bone → **optic chiasma** (the medial fibers decussate to the opposite optic tract, while the lateral fibers continue in the same optic tract) → **optic tract** (gives fibers to **Edinger-Westphale nucleus in midbrain for light reflex**) → relay in the lateral geniculate body → posterior limb of internal capsule → optic radiation → end in areas **17, 18, 19 of occipital lobes.**

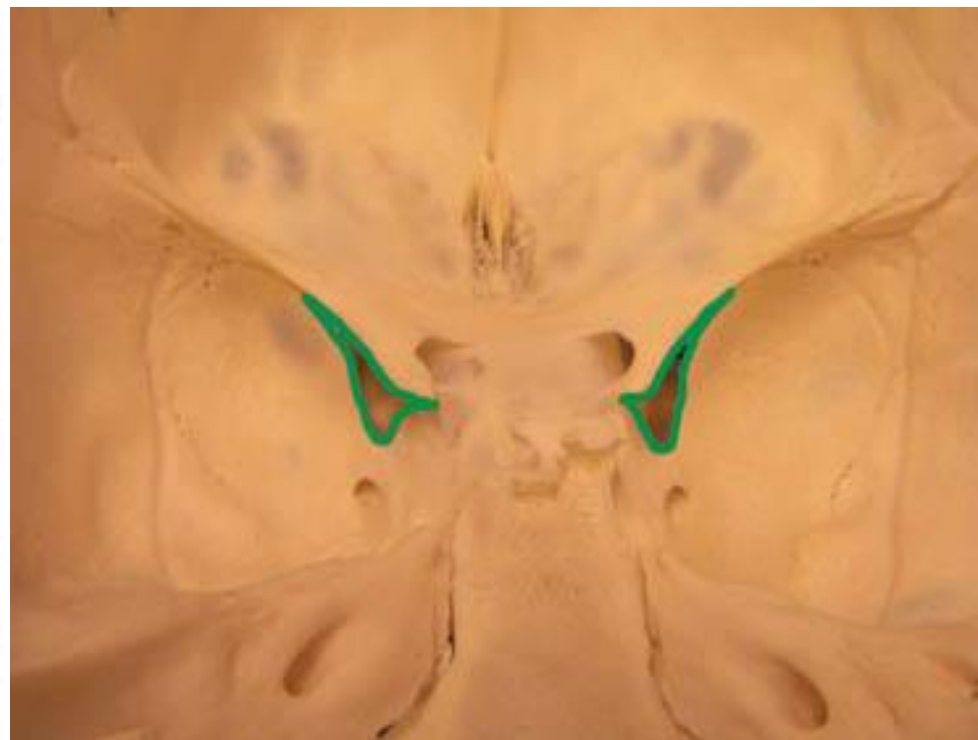


The Visual Pathway



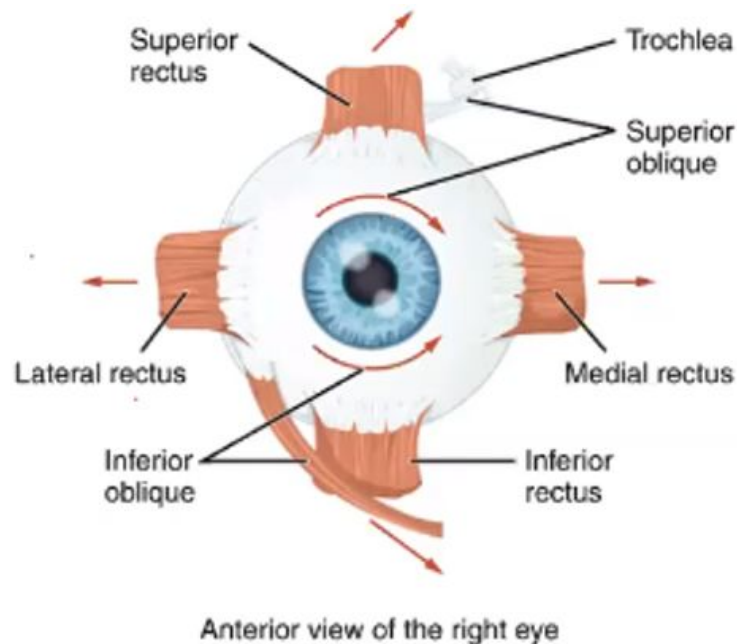
III. The oculomotor Nerve

- **Oculomotor nerve:** *(Latin for "eye" and "moving")*.
- **Function and modality:**
 1. **General somatic efferent:** supplies extraocular “skeletal muscles” for the eye ball movement.
 2. **General visceral efferent:** supplies intraocular smooth muscles for pupillary reaction and light reflex.
- **Site of nucleus:** it lies in the tegmentum of midbrain.
- Emerges from the ventral surface of the midbrain.
- **Foramen:** superior orbital fissure “**SOF**” of the sphenoid bone.



The oculomotor N. supplies all of the intra- and extraocular muscles, Except:

1. **Superior oblique muscle** → from the trochlear nerve – IV.
2. **Lateral rectus muscle** → from the abducent nerve – VI.
3. **Dilator pupillae muscle** → from the sympathetic fibers.
4. **Muller's muscle** → from the sympathetic fibers.



Structure of Oculomotor Nuclei

1. **The Edinger-Westphal nucleus:** parasympathetic function which supplies two intraocular muscles:
 - a. **Constrictor pupillae muscle** → Miosis.
 - b. **Ciliary muscle** → Responsible for light and accommodation reflexes.
2. **The lateral cell mass (motor function):** supplies five extra ocular muscles:
 - a. **Levator palpebrae superioris muscle.**
 - b. **Superior rectus muscle.**
 - c. **Medial rectus muscle.**
 - d. **Inferior oblique muscle.**
 - e. **Inferior rectus muscle.**
3. **The central nucleus of Perlia:** motor function which supplies **the medial recti muscles of the two eyes** allowing to contract together when both eyes converge to look to a near object.

Branches of the Oculomotor Nerve

1. Superior division “Somatic motor and sympathetic”:

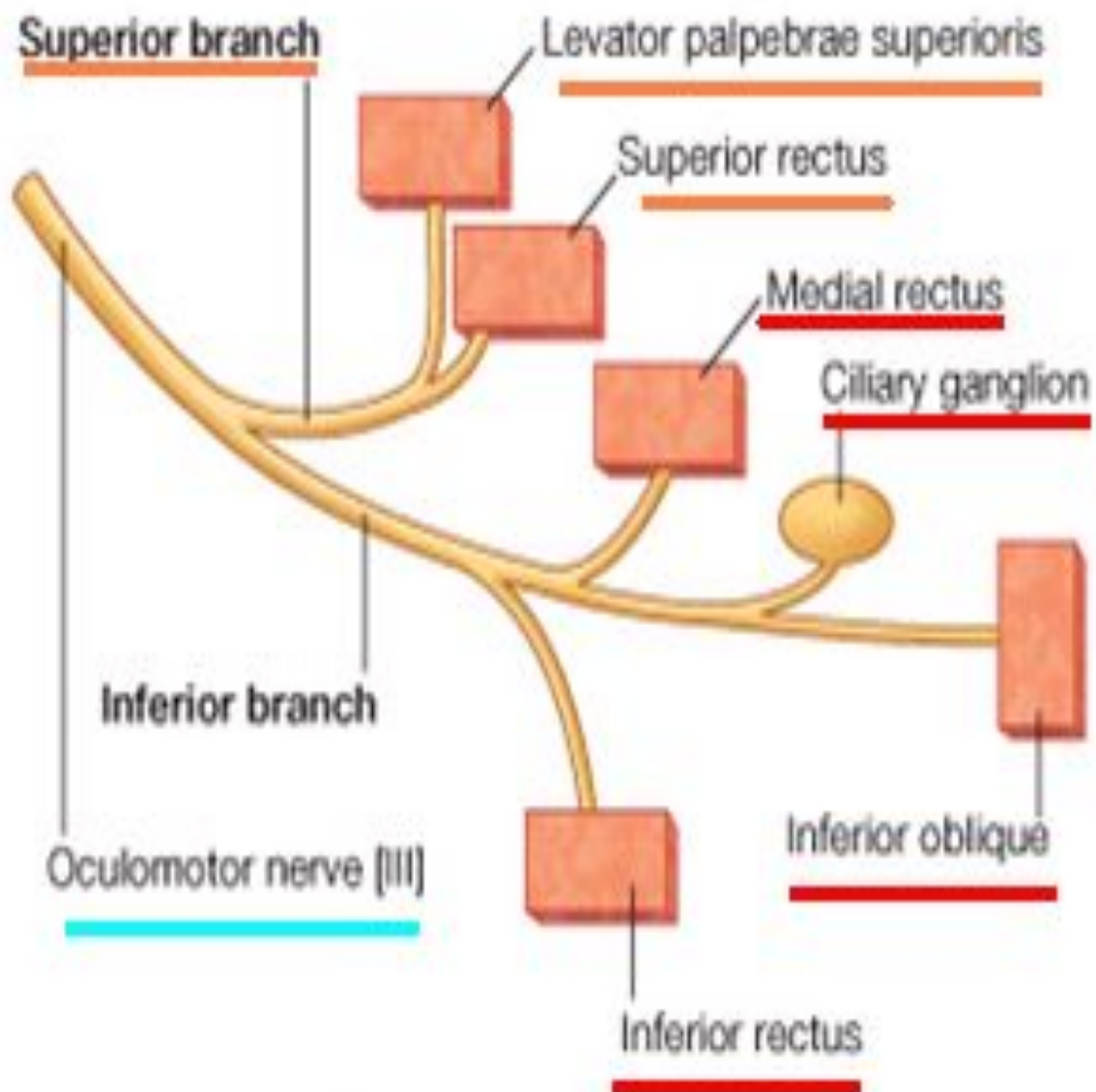
which supplies the:

- a. Levator palpebrae superioris muscle.
- b. Superior rectus muscle.

2. Inferior division “Somatic motor and parasympathetic”:

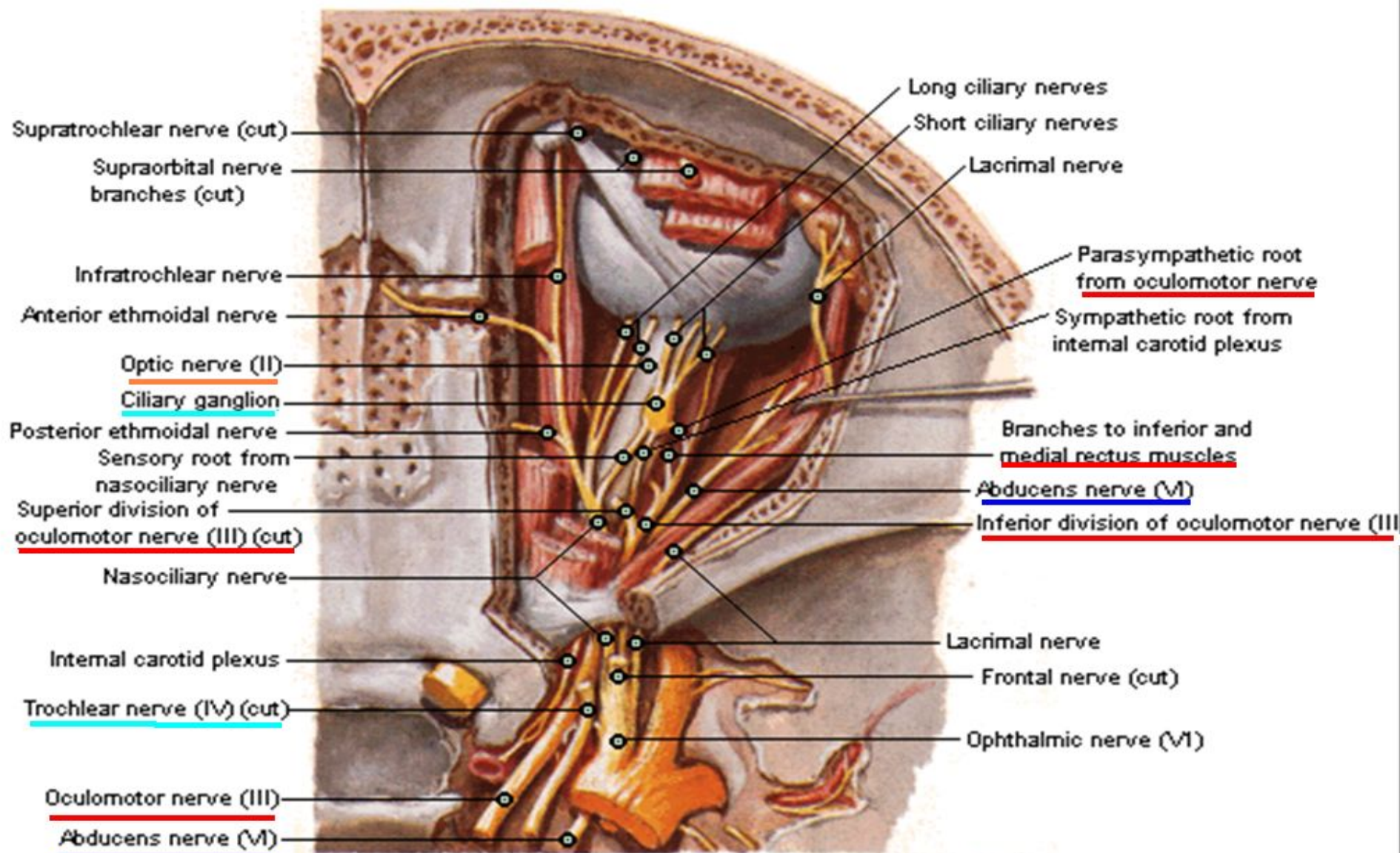
which supplies the:

- a. Medial rectus muscle.
- b. Inferior rectus muscle.
- c. Inferior oblique muscle.
- d. Constrictor pupillae muscle (via ciliary ganglion).
- e. Ciliary muscle (via ciliary ganglion).



Nerves of Orbit - Muscles Partially Cut Away

Superior View



IV. The Trochlear Nerve

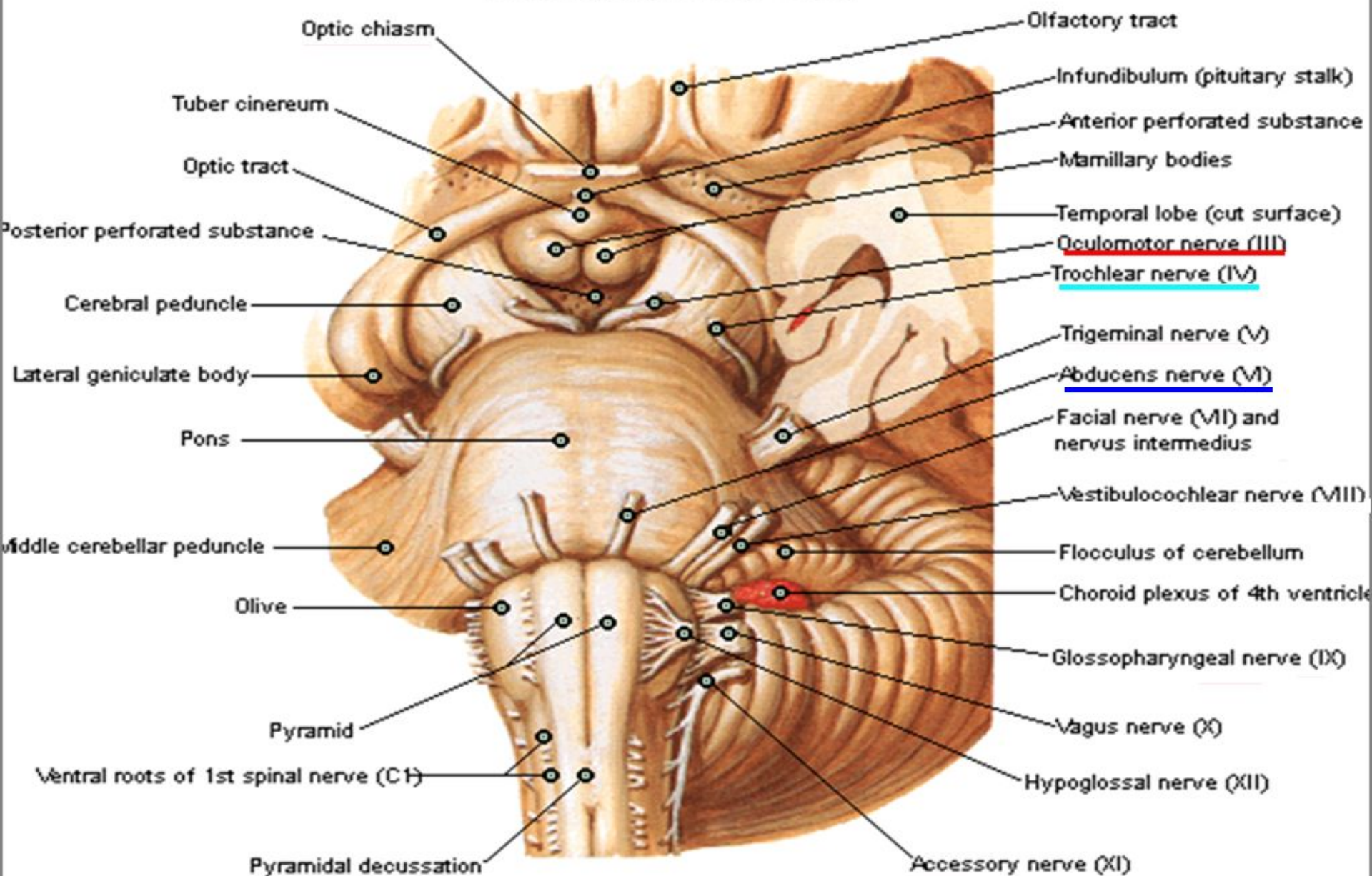
- It is purely a motor nerve and the smallest cranial nerve.
- **Function and modality:** general somatic efferent → supplies **the superior oblique muscle**, which abducts, depresses and internally rotates the eye
- **Site of the nucleus:** it lies in the tegmentum of the midbrain.
- Emerges from the posterior surface of the midbrain.
- **Foramen:** superior orbital fissure “**SOF**” of the sphenoid bone.

VI. The Abducent Nerve

- **Abducent nerve:** *(Latin for "abduction")*.
- **Function and modality:** general somatic efferent → supplies **the lateral rectus muscle**.
- **Site of the nucleus:** it lies in pons.
- The abducent nerve emerges from the lower border of the pons (between the pons and medulla oblongata).
- **Foramen:** superior orbital fissure **“SOF”** of the sphenoid bone.

Brainstem

Anterioinferior View



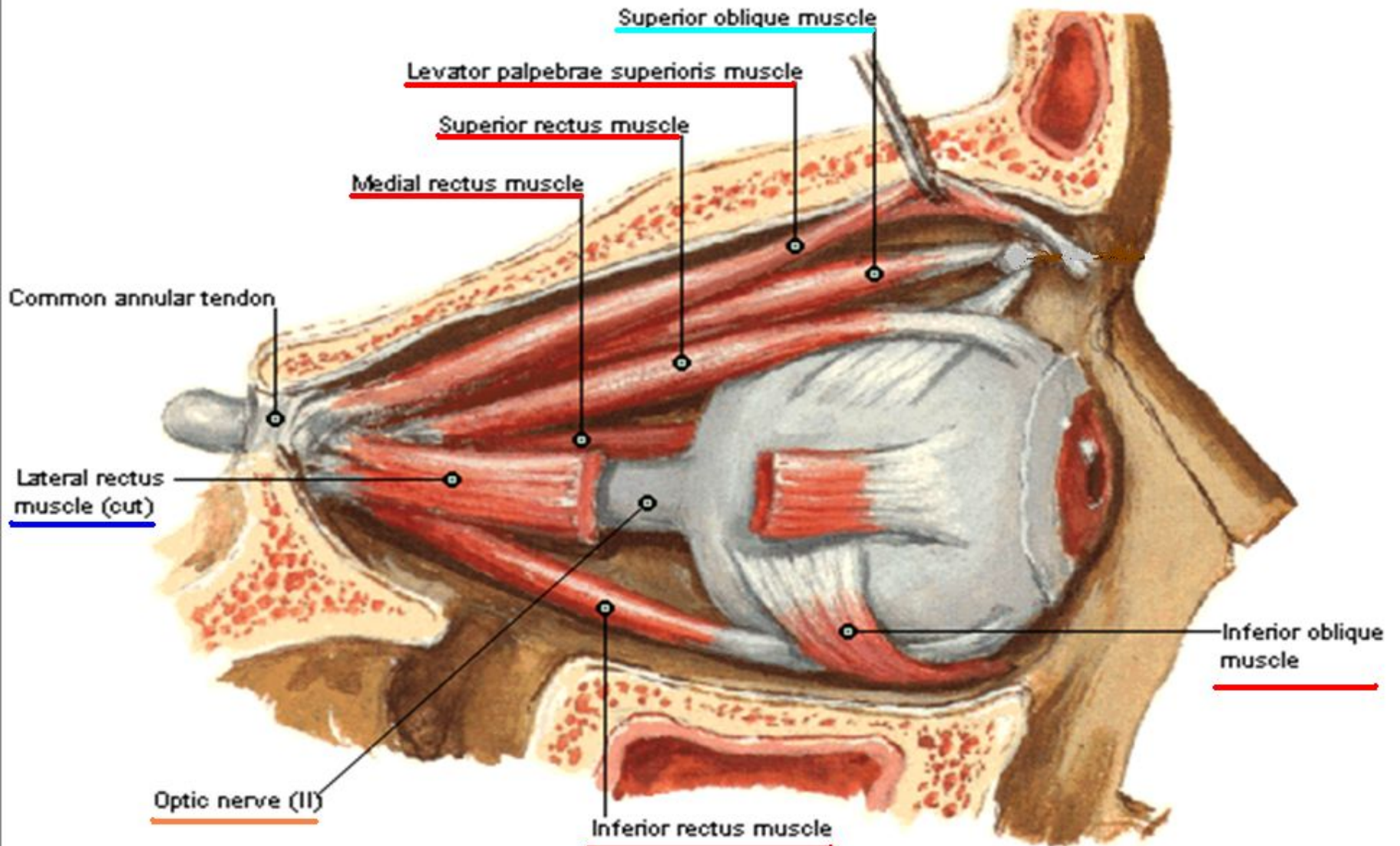


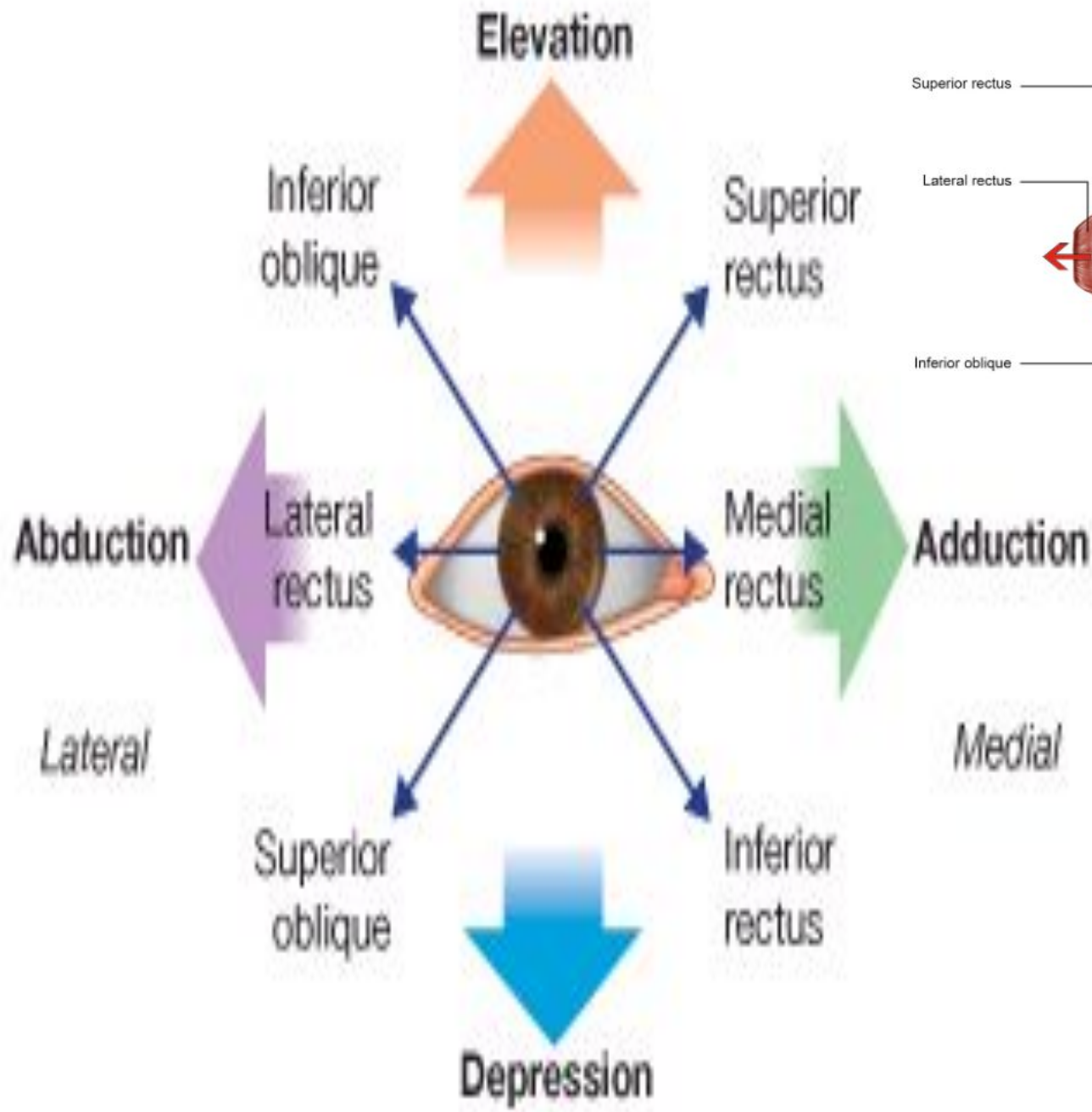
The Actions of the Ocular Muscles

1. **Lateral Rectus Muscle:** abducts (laterally) the eye ball.
2. **Medial Rectus Muscle:** adducts (medially) the eye ball.
3. **Superior Rectus Muscle:** elevates, **adducts** and rotates medially.
4. **Inferior Rectus Muscle:** depresses, **adducts** and rotates medially.
5. **Superior Oblique Muscle:** depresses, **abducts** and rotates laterally.
6. **Inferior Oblique Muscle:** elevates, **abducts** and rotates laterally.

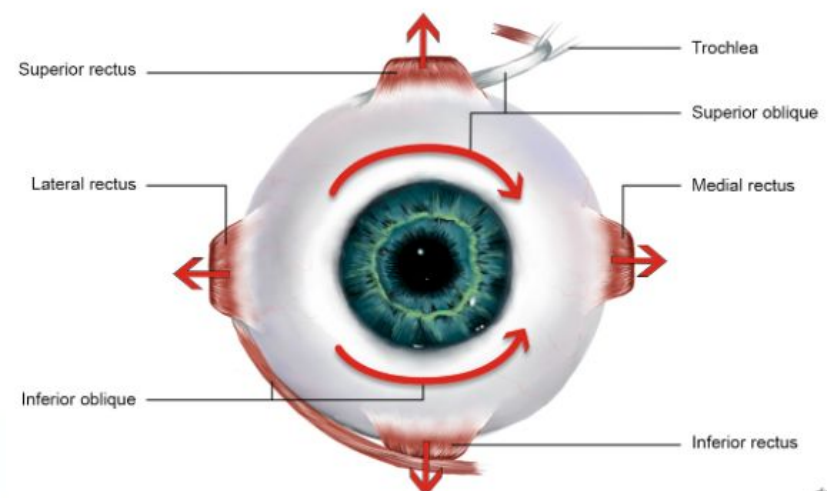
Extrinsic Eye Muscles

Right Lateral View





Right Eye, Anterior View



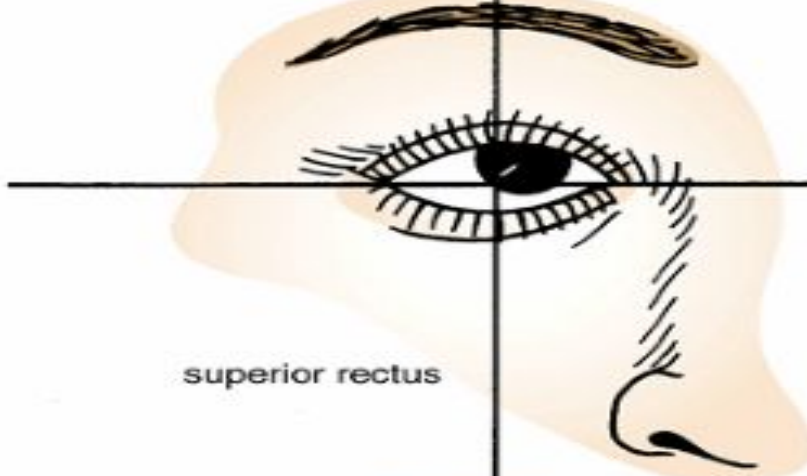


Diagram of the right eye showing the superior rectus muscle contracted, elevating the eye. A horizontal line and a vertical line intersect at the center of the eye. The superior rectus muscle is shown as a thickened band originating from the upper eyelid and extending towards the top of the eye.

superior rectus

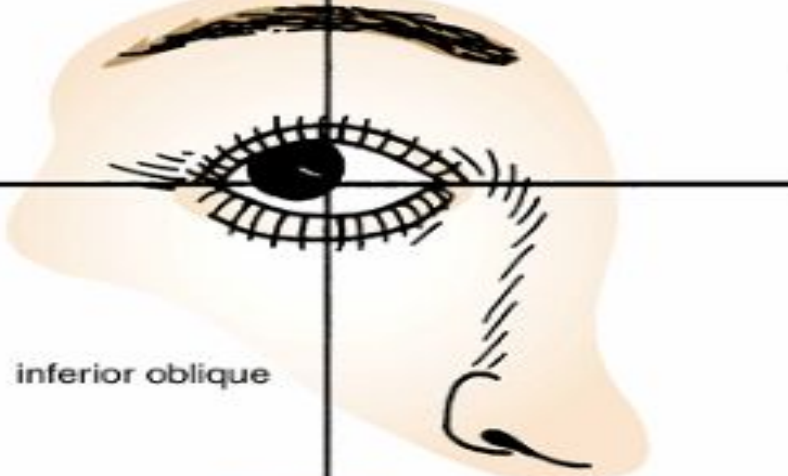


Diagram of the right eye showing the inferior oblique muscle contracted, elevating and abducting the eye. A horizontal line and a vertical line intersect at the center of the eye. The inferior oblique muscle is shown as a thickened band originating from the lower eyelid and extending towards the bottom-right of the eye.

inferior oblique

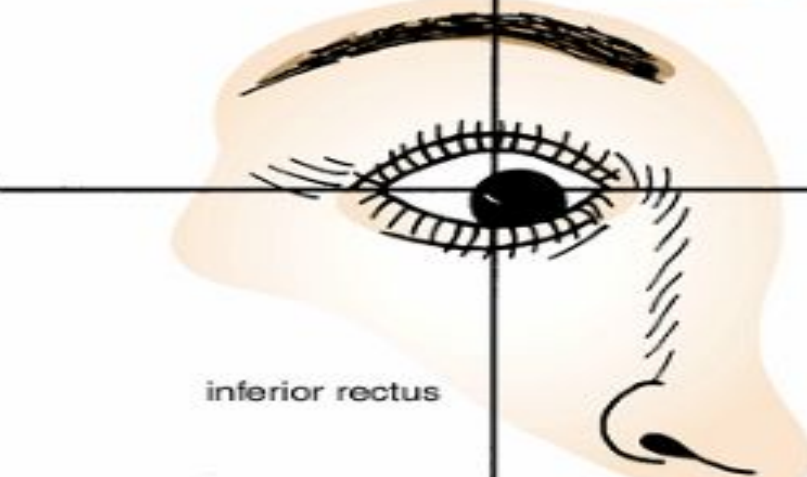


Diagram of the right eye showing the inferior rectus muscle contracted, depressing the eye. A horizontal line and a vertical line intersect at the center of the eye. The inferior rectus muscle is shown as a thickened band originating from the lower eyelid and extending towards the bottom of the eye.

inferior rectus

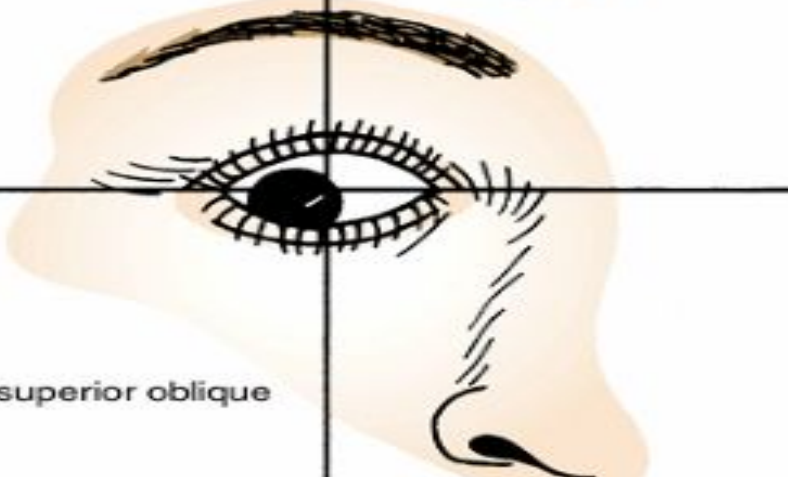


Diagram of the right eye showing the superior oblique muscle contracted, depressing and abducting the eye. A horizontal line and a vertical line intersect at the center of the eye. The superior oblique muscle is shown as a thickened band originating from the upper eyelid and extending towards the top-left of the eye.

superior oblique

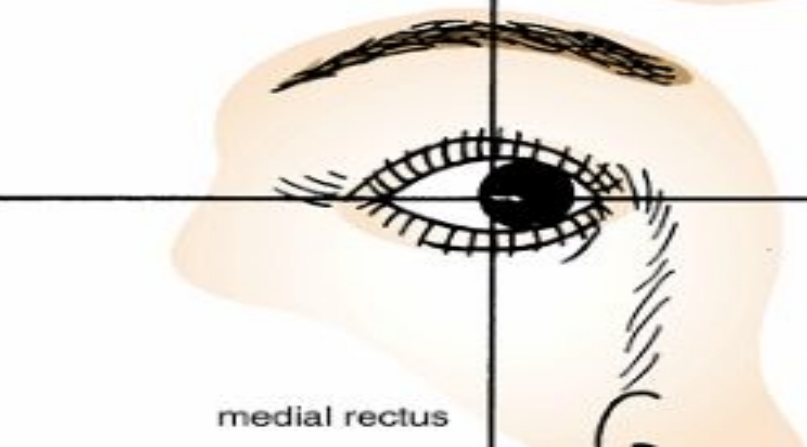


Diagram of the right eye showing the medial rectus muscle contracted, adducting the eye. A horizontal line and a vertical line intersect at the center of the eye. The medial rectus muscle is shown as a thickened band originating from the inner corner of the eye and extending towards the center of the eye.

medial rectus

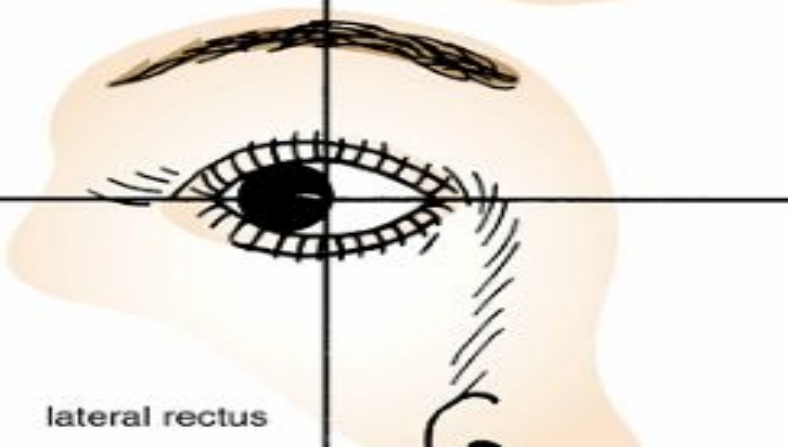


Diagram of the right eye showing the lateral rectus muscle contracted, abducting the eye. A horizontal line and a vertical line intersect at the center of the eye. The lateral rectus muscle is shown as a thickened band originating from the outer corner of the eye and extending towards the center of the eye.

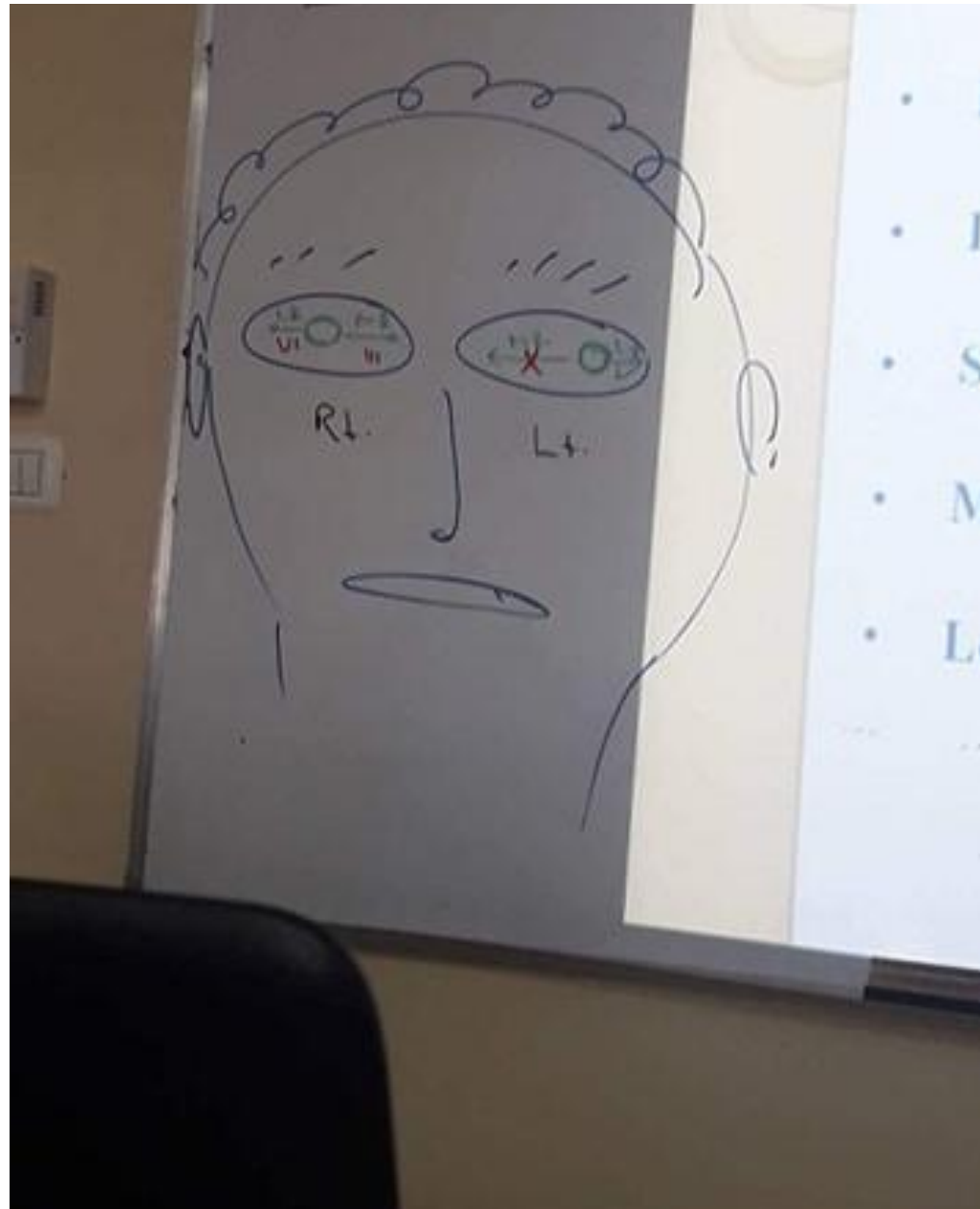
lateral rectus

Lesion of the Oculomotor Nerve

- **Ptosis:** paresis of the levator palpebrae superioris muscle.
- **Diplopia:** occurs only on elevation of eye lid.
- **Squint:** divergent paralytic.
- **Mydriasis:** dilated fixed pupil.
- **Loss of light and accommodation reflexes.**



Lesion of the Oculomotor Nerve



Lesion of the Trochlear Nerve

1. Diplopia on looking down and out.
2. Limitation of movement during examination for eye movement down and out.

Lesion of the Abducent Nerve

1. Diplopia on looking out wards.
2. Limitation during examination of eye movement in the outward direction.
3. Convergent paralytic squint.



Light Reflex

- **Direct Light Reflex:** Light in one eye leads to constriction (miosis) of the same eye
- **Indirect Light Reflex :** Light in one eye leads to constriction (miosis) of the opposite eye.

Pathway of Light Reflex

Fibers from rods and cones of retina → optic nerve → optic chiasma → optic tract → before reaching the lateral geniculate body → they pass to the third cranial (oculomotor) nerve nucleus (Edinger-Westphal nucleus) in midbrain of both side → through oculomotor nerve → ciliary ganglion → supply the constrictor pupillae muscle



Accommodation and Convergence Reflex

Patient is asked to follow your finger from a far point to a near one:

- ❖ Convergence (contraction of both medial recti muscle).
- ❖ Miosis (contraction of constrictor pupillae muscle).

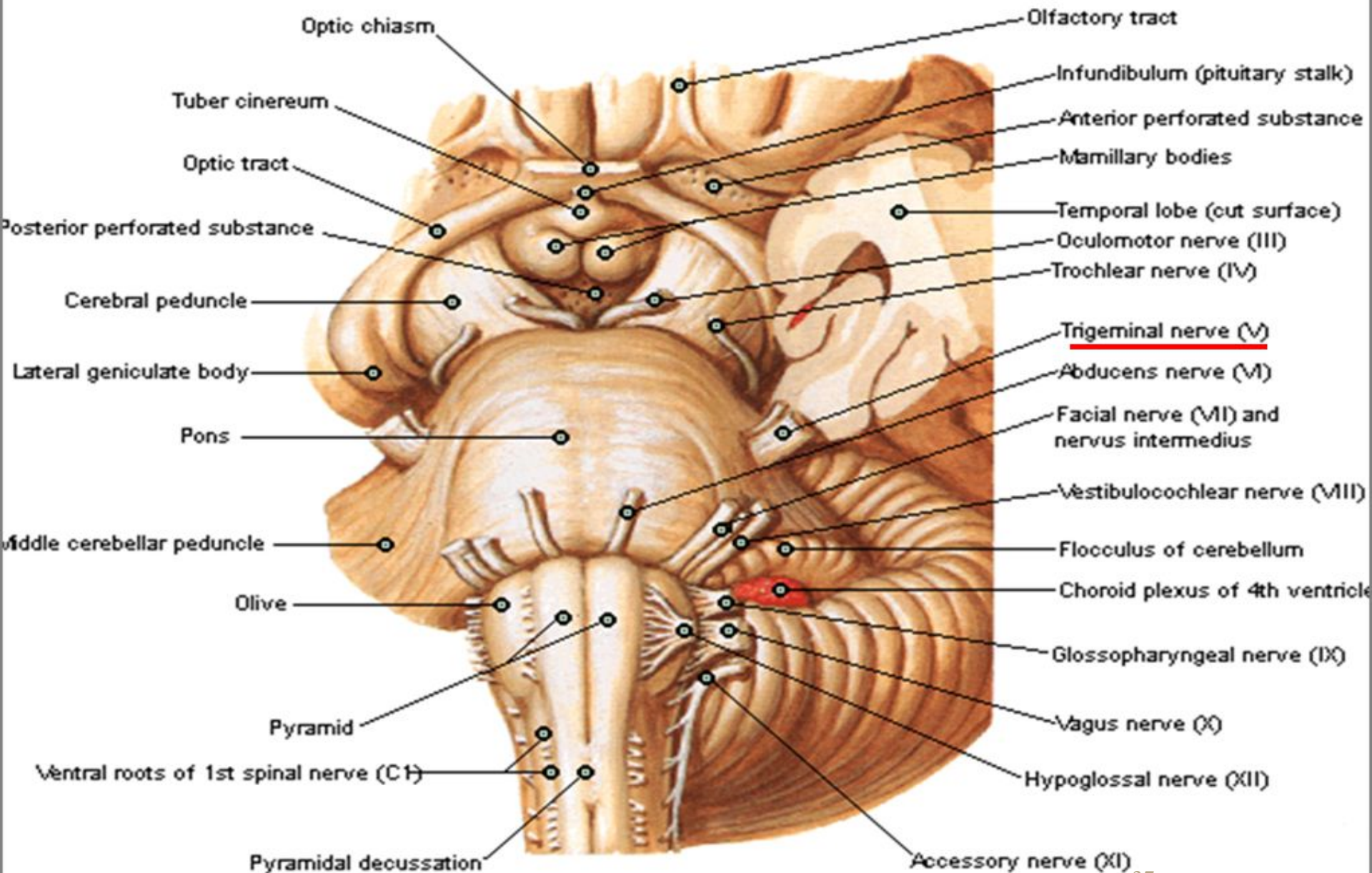


V. The Trigeminal Nerve

- The trigeminal nerve is **mixed nerve** (motor and sensory fibers).
- The trigeminal nerve is more important as a sensory nerve. **It carries:**
 - a. Pain, touch, and temperature sensations.
 - b. Proprioception (Deep) sensation.
- It is the thickest cranial nerve and arises by two roots:
 - a. **Large Root:** sensory function.
 - b. **Small Motor Root:** motor function.
- The two roots are attached to the ventro-lateral aspect of the pons.

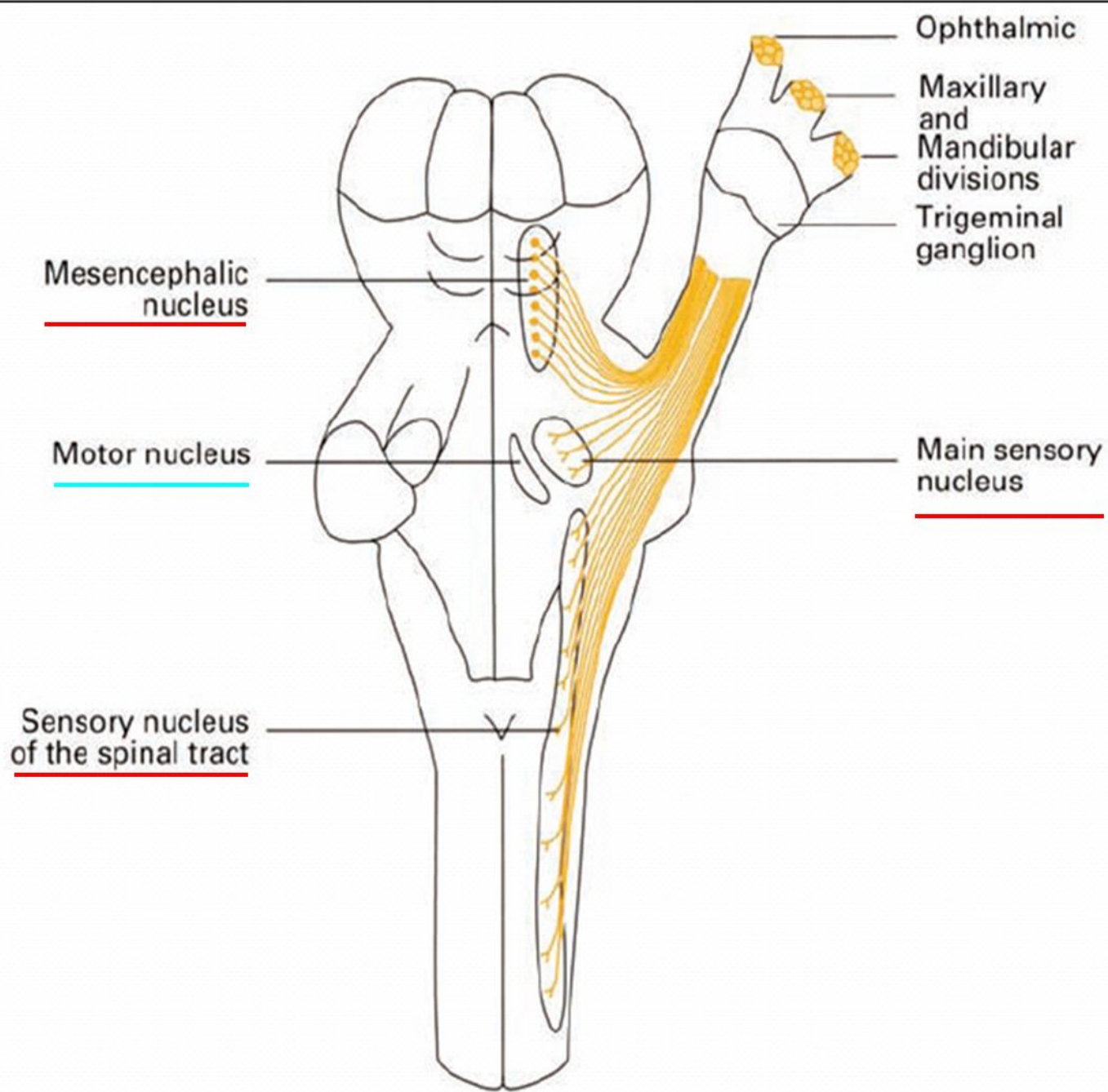
Brainstem

Anterioinferior View



Nuclei of the Trigeminal Nerve

1. **Main Sensory Nucleus:** lies in the middle part of the pons (for touch sensation).
2. **Spinal (Descending) Nucleus:** lies in the medulla oblongata and extends upwards to the lower part of the pons and downwards to the upper cervical spinal cord (for pain and temperature sensation).
3. **Mesencephalic Nucleus:** lies in the midbrain and upper part of the pons (deep sensation).
4. **Motor Nucleus (motor function):** lies in the middle of the pons. It give motor fibers that joins with the mandibular nerve.

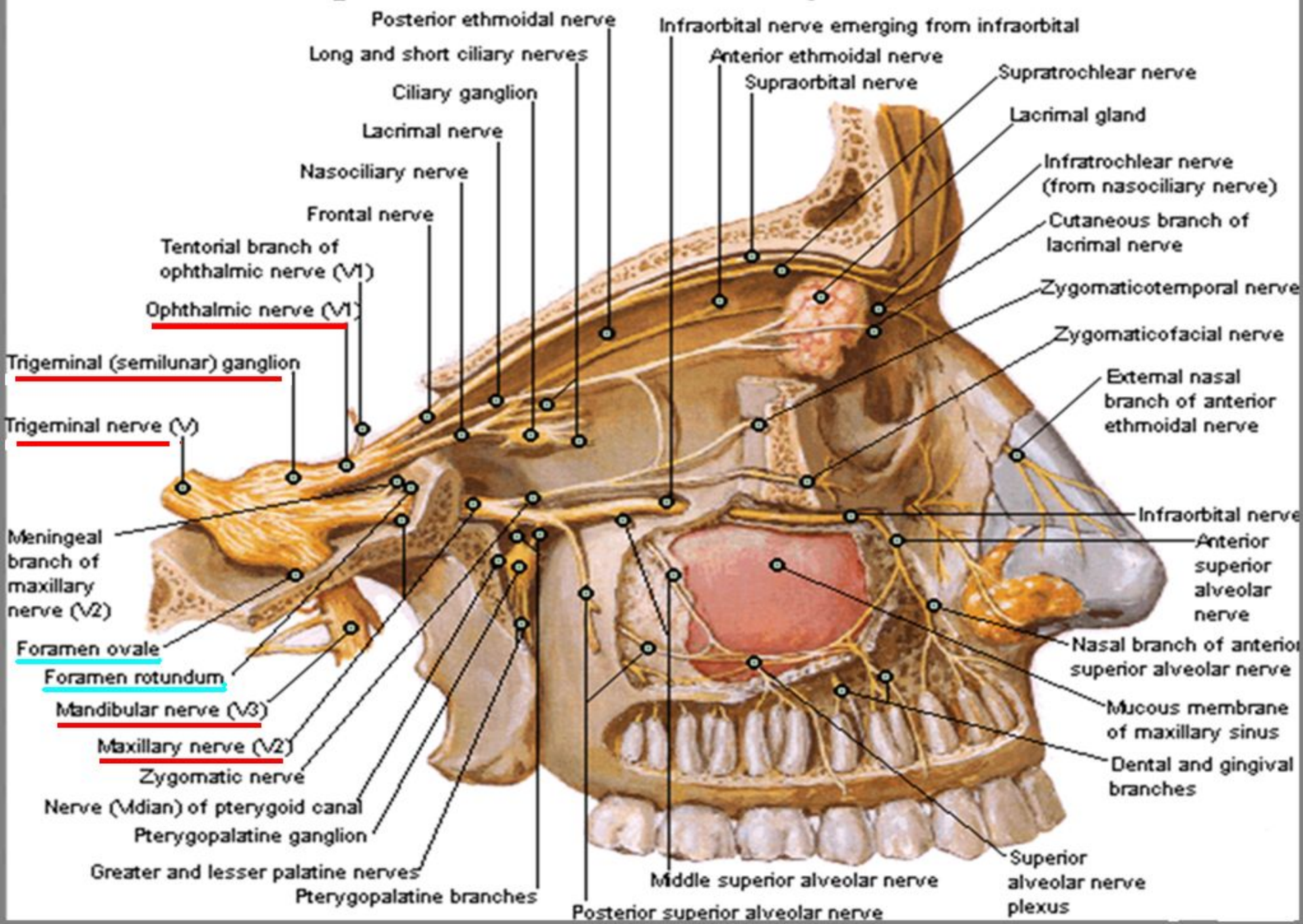


Branches of the Trigeminal Nerve

The trigeminal nerve has three branches:

1. Ophthalmic Nerve (V1): **sensory.**
2. Maxillary Nerve (V2): **sensory.**
3. Mandibular Nerve (V3): **mixed.**

Ophthalmic and Maxillary Nerves



The Ophthalmic Nerve (V_1)

- It is the first branch of the trigeminal nerve.
- **Function and modality:** general somatic afferent.
- **Foramen:** superior orbital fissure “SOF” of the sphenoid bone.
- **It supplies the:**
 1. Skin over forehead.
 2. Skin over upper eyelid.
 3. Eyeball, conjunctiva, & lacrimal gland.
 4. Corneal reflex.
 5. Nasal mucosa.
 6. Frontal sinus.
 7. External nose.
 8. Dura mater in the anterior cranial fossa.

The Maxillary Nerve (V₂)

- It is the second branch of the trigeminal nerve.
- **Function and modality:** general somatic afferent.
- **Foramen:** rotundum foramen.
- **It supplies the:**
 - Maxillary area of skin of the face.
 - Maxillary teeth (of the upper jaw).
 - Mucosa membrane related to maxilla.
 - Maxillary sinus.
 - Palatal reflex.
 - Dura matter in the middle cranial fossa.

The Mandibular Nerve (V_3)

- It is the third branch of the trigeminal nerve.
- **Functions and modalities:** mixed nerve **general somatic afferent & special visceral efferent.**
- **Foramen:** rotundum foramen.
- **Origin:** it is a mixed nerve formed of two roots:
 1. **Sensory root:** arises from trigeminal ganglion, runs forwards and laterally to the **foramen ovale.**
 2. **Motor root:** a smaller root which arises from trigeminal motor nucleus in the pons. It passes deep to the trigeminal ganglion to join the sensory root in the **foramen ovale.**

Sensory Functions of the Mandibular Nerve

- ❖ **The sensory part of the mandibular nerve carries general sensory information from the:**
 1. Mucous membranes of the mouth and cheek.
 2. Anterior two-thirds of the tongue.
 3. Lower teeth.
 4. Skin of the lower jaw.
 5. Jaw jerk.
 6. Side of the head and scalp.
 7. Meninges of the middle cranial fossa.

Motor Functions of the Mandibular Nerve

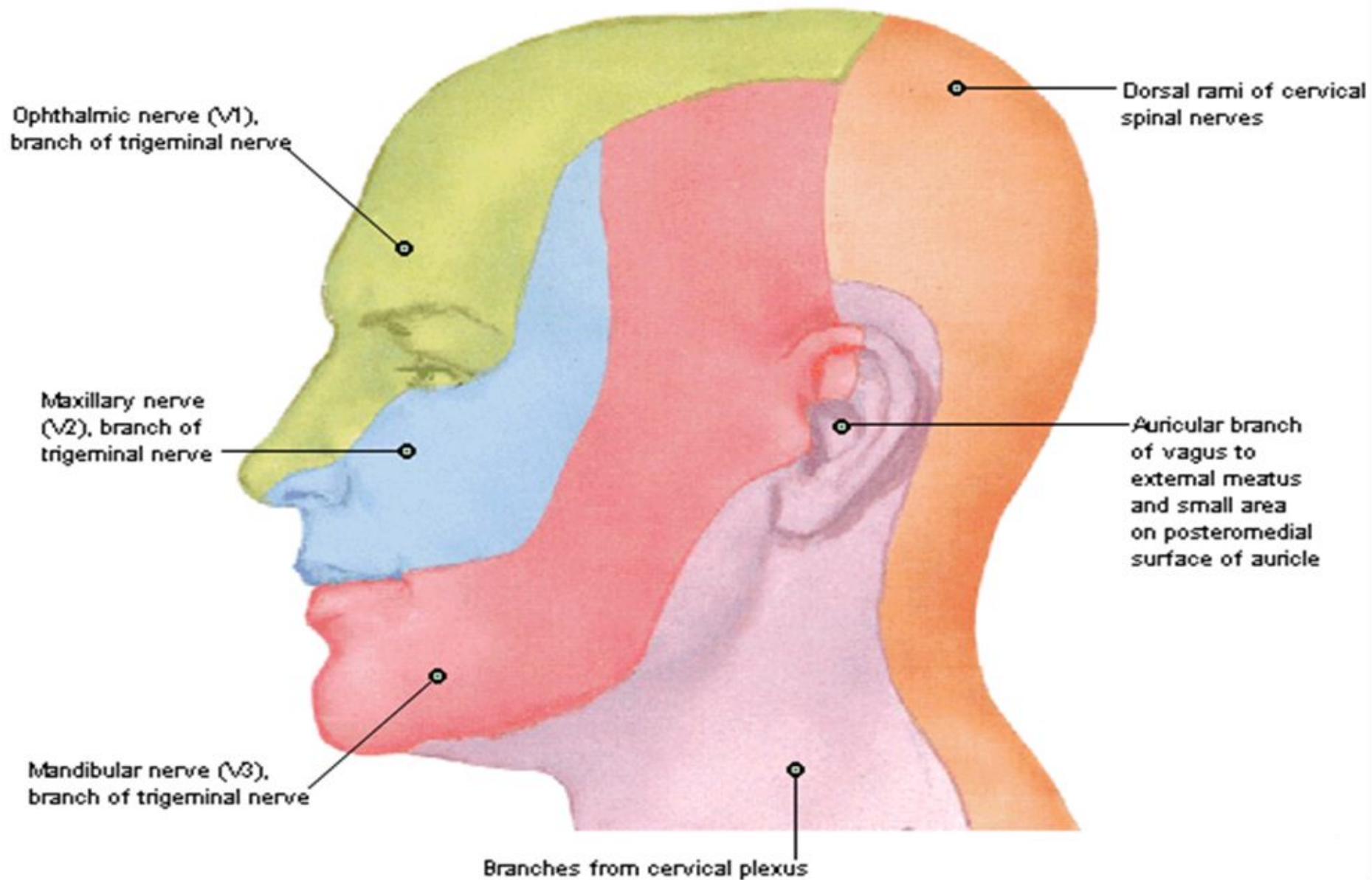
1. Motor fibers to muscles of mastication:

- a. Temporalis muscle.
- b. Masseter muscle.
- c. Medial pterygoids muscle.
- d. Lateral pterygoids muscle.

2. Motor fibers to other four muscles:

- e. Mylohyoid muscle.
- f. Anterior belly of digastric muscle.
- g. Tensor palati muscle (from otic ganglion).
- h. Tensor tympani muscle (from otic ganglion).

Dermatomes of Head and Neck



From ophthalmic division
of trigeminal nerve (V1)

Supraorbital nerve

Supratrochlear nerve

Palpebral branch
of lacrimal nerve

Infratrochlear nerve

External nasal branch of
anterior ethmoidal
nerve

From maxillary division
of trigeminal nerve (V2)

Infraorbital nerve

Zygomaticofacial nerve

Zygomaticotemporal nerve

From mandibular division
of trigeminal nerve (V3)

Mental nerve

Buccal nerve

Auriculotemporal nerve

Auricular branch
of vagus nerve (X)

Medial branches
of dorsal rami
of cervical spinal
nerves

Greater occipital
nerve (C2)

3rd occipital
nerve (C3)

From 4th, 5th,
6th and 7th
nerves in
succession below

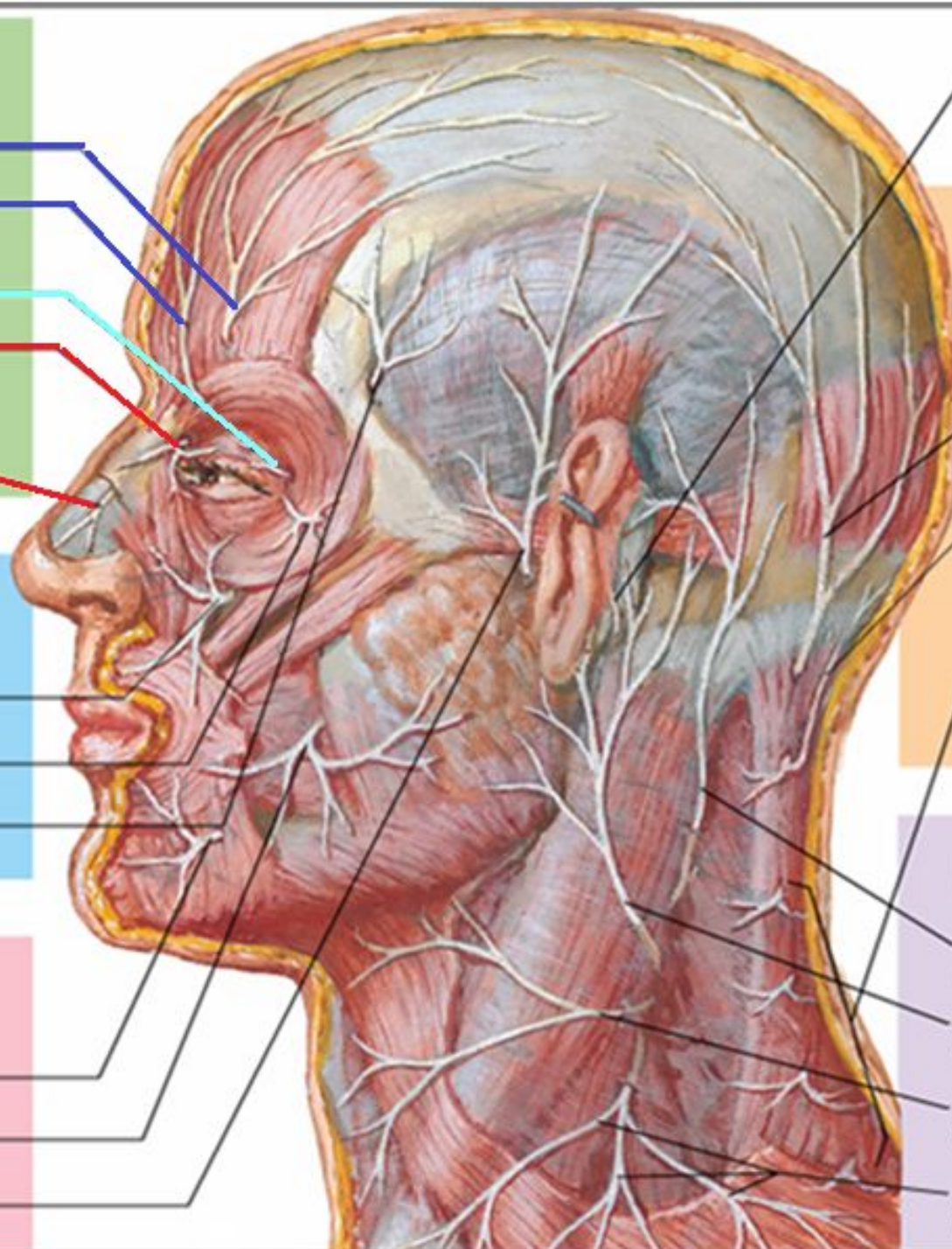
Branches from
cervical plexus

Lesser occipital
nerve (C2, 3)

Great auricular
nerve (C2, 3)

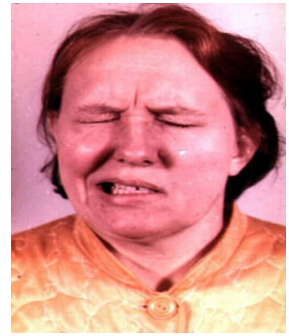
Transverse cervical
nerve (C2, 3)

Supraclavicular
nerves (C3, 4)



Trigeminal Neuralgia (TN)

”Tic Doloureux“



- TN is defined as paroxysmal, stereotyped attacks of severe sharp pain (**stabbing or electric-shock like pain**) in the distribution of one or more branches of the trigeminal nerve.

VII. The Facial Nerve

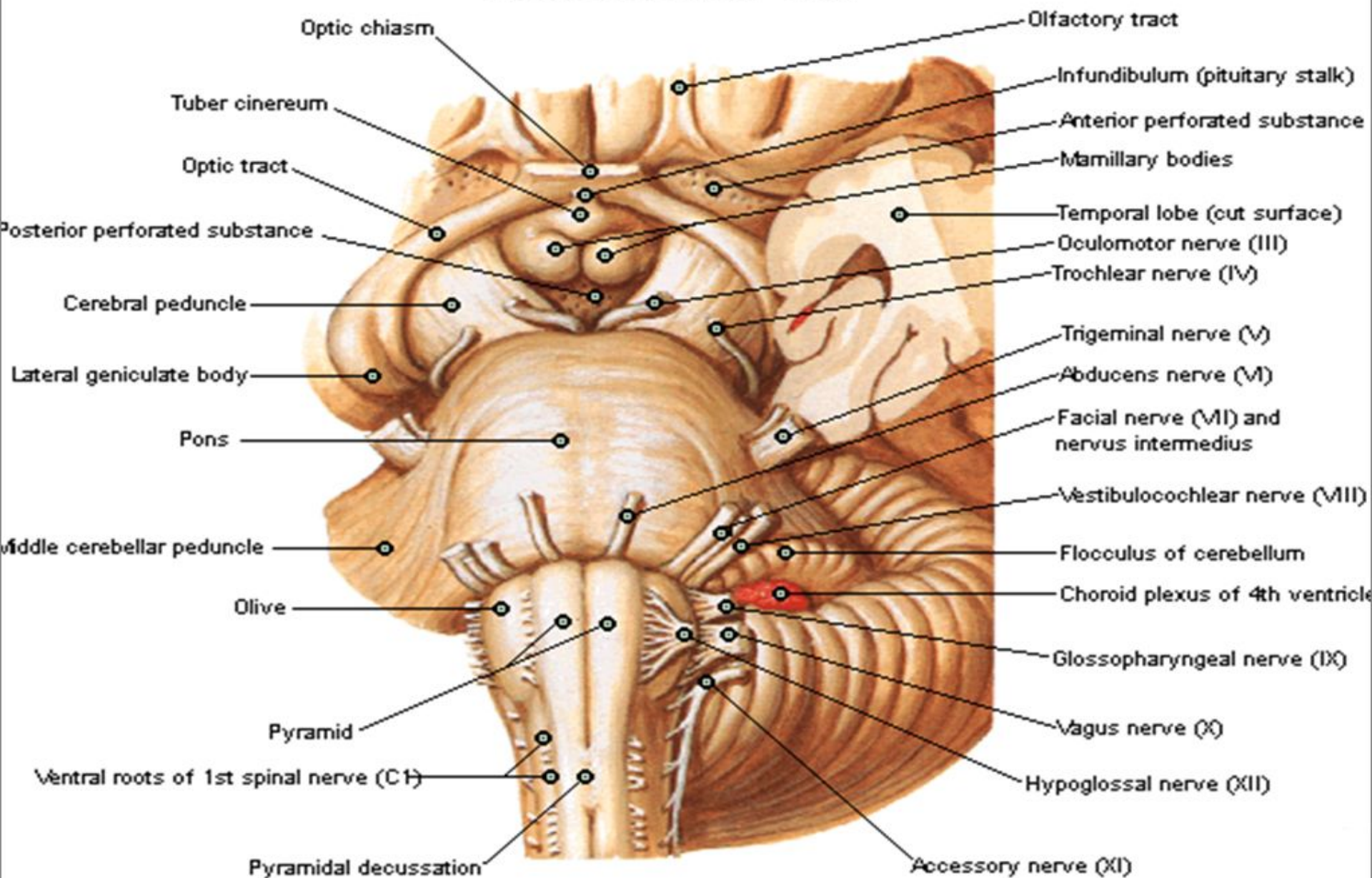
- It is a mixed nerve which contains motor, sensory and parasympathetic fibers.
- It is more important as **a motor** than as a sensory nerve.
- **Modalities:** GVE, SVE, GSA, & SVA.
- **Foramen:** Internal auditory meatus → Stylomastoid foramen.

Roots of the Facial Nerve

- **Facial Nerve (motor nerve):** is a purely motor nerve supplies all the muscles of face expression.
- **Nerve Intermedius:** consists of sensory and parasympathetic fibers.

Brainstem

Anterioinferior View



Nuclei of the Facial Nerve

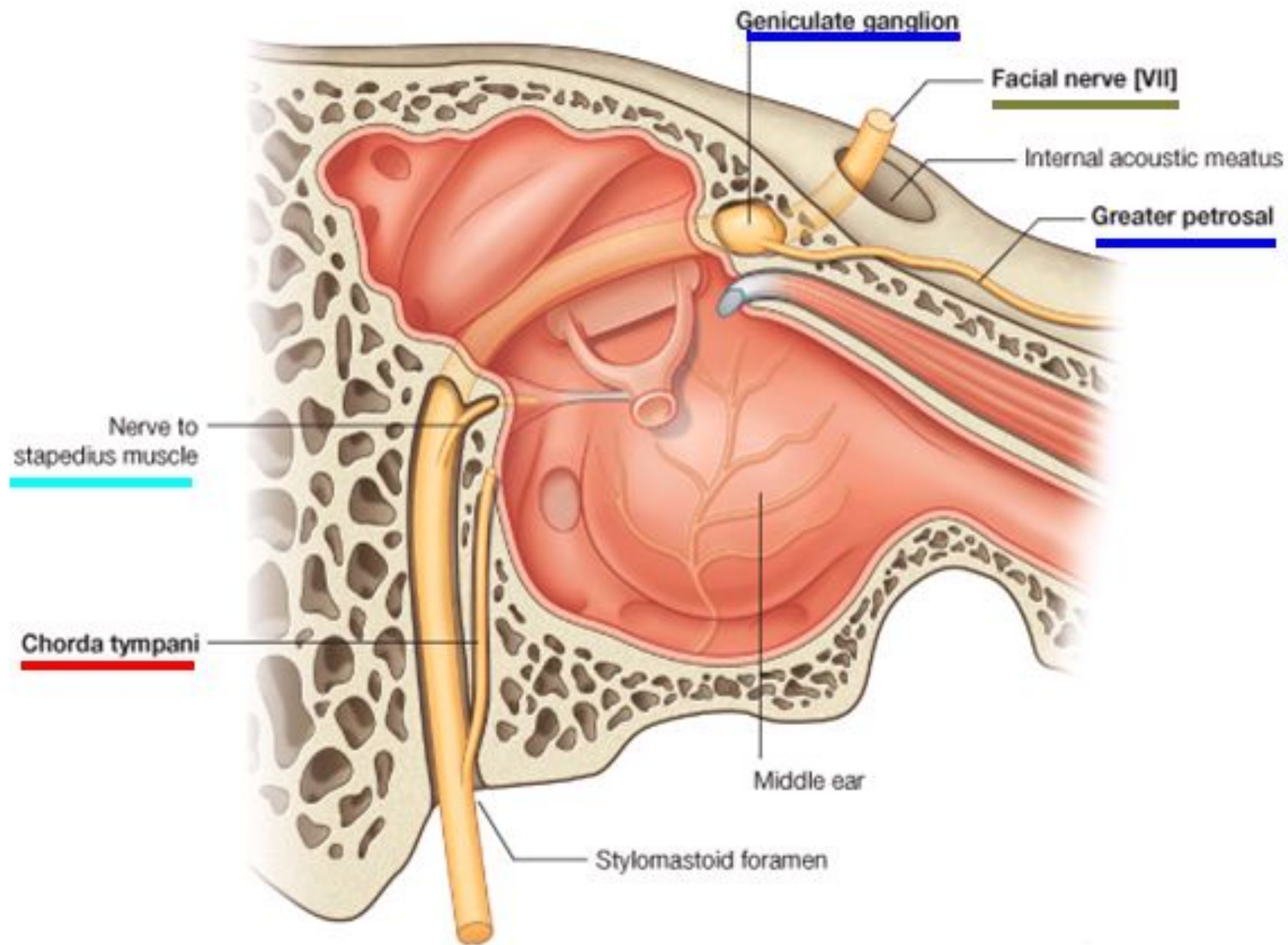
1. **Facial motor nucleus (Motor):** lies in **the pons** and supplies the facial muscles.
2. **Superior salivary nucleus (Parasympathetic):** lies in **the pons** for:
 - a. Submandibular and sublingual salivary glands (**Chorda tympani nerve**).
 - b. Glands of the palate, nose, lacrimal glands and nasopharynx (**Greater superficial petrosal nerve**).
3. **Solitary nucleus:** lies in **the medulla oblongata** for:
 - General sensation from the skin of the external auricle and tympanic membrane.
 - Taste sensations from the anterior 2/3 of the tongue.

Functions of the Facial Nerve

1. Motor function to muscles of facial expression.
2. Parasympathetic to all glands of head (submandibular, sublingual and lacrimal glands) except **the parotid gland** (glossopharyngeal nerve).
3. Sensory for skin of the external auricle and tympanic membrane.
4. Taste for anterior 2/3 of the tongue.
5. Corneal reflex.

Branches of the Facial Nerve Inside the Fallopian Canal

1. The greater superficial petrosal nerve “GSPN”.
2. Small branch to the stapedius muscle.
3. The chorda tympani.



Branches of the Facial Nerve

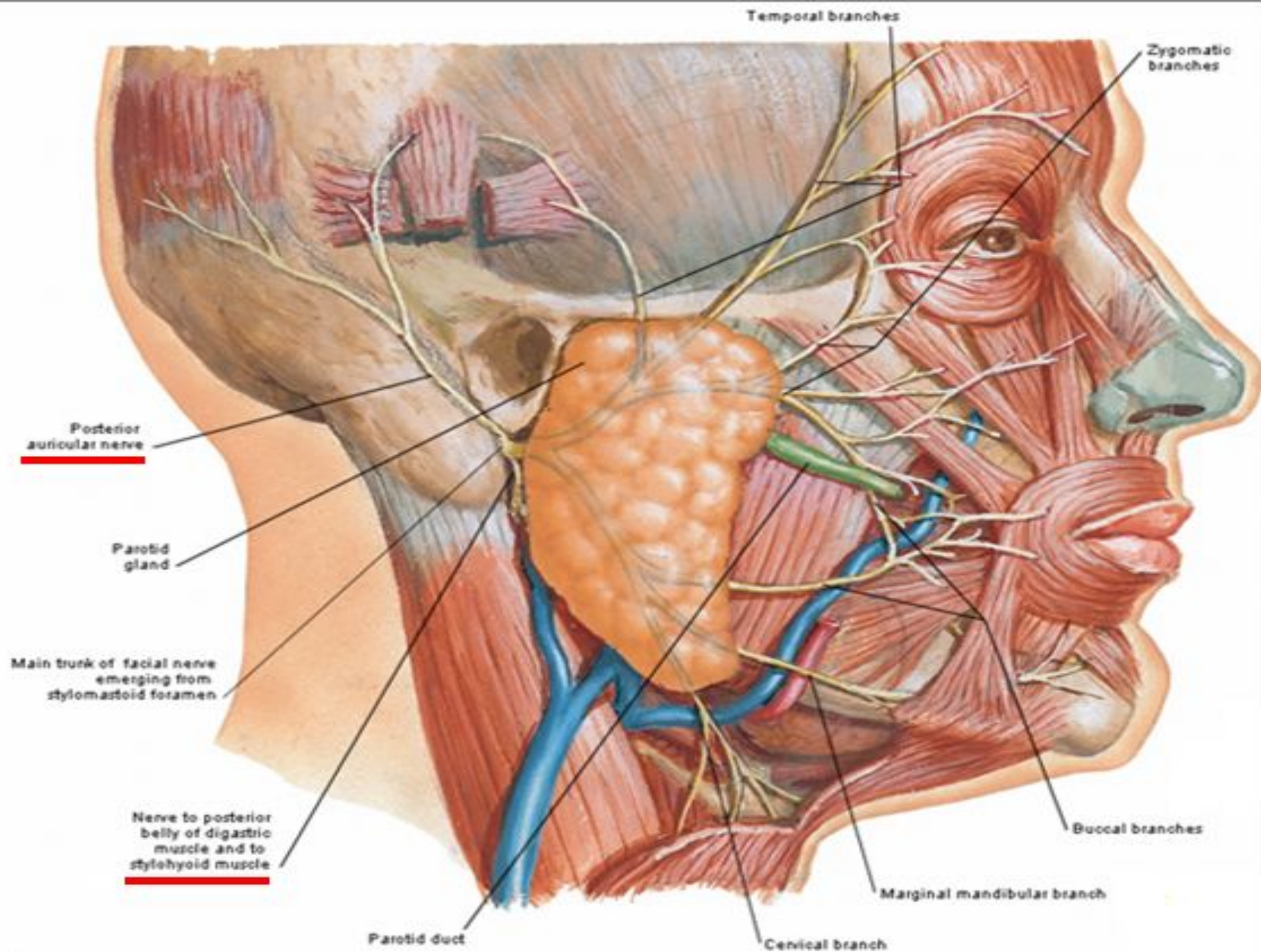
After it Leaves the Skull

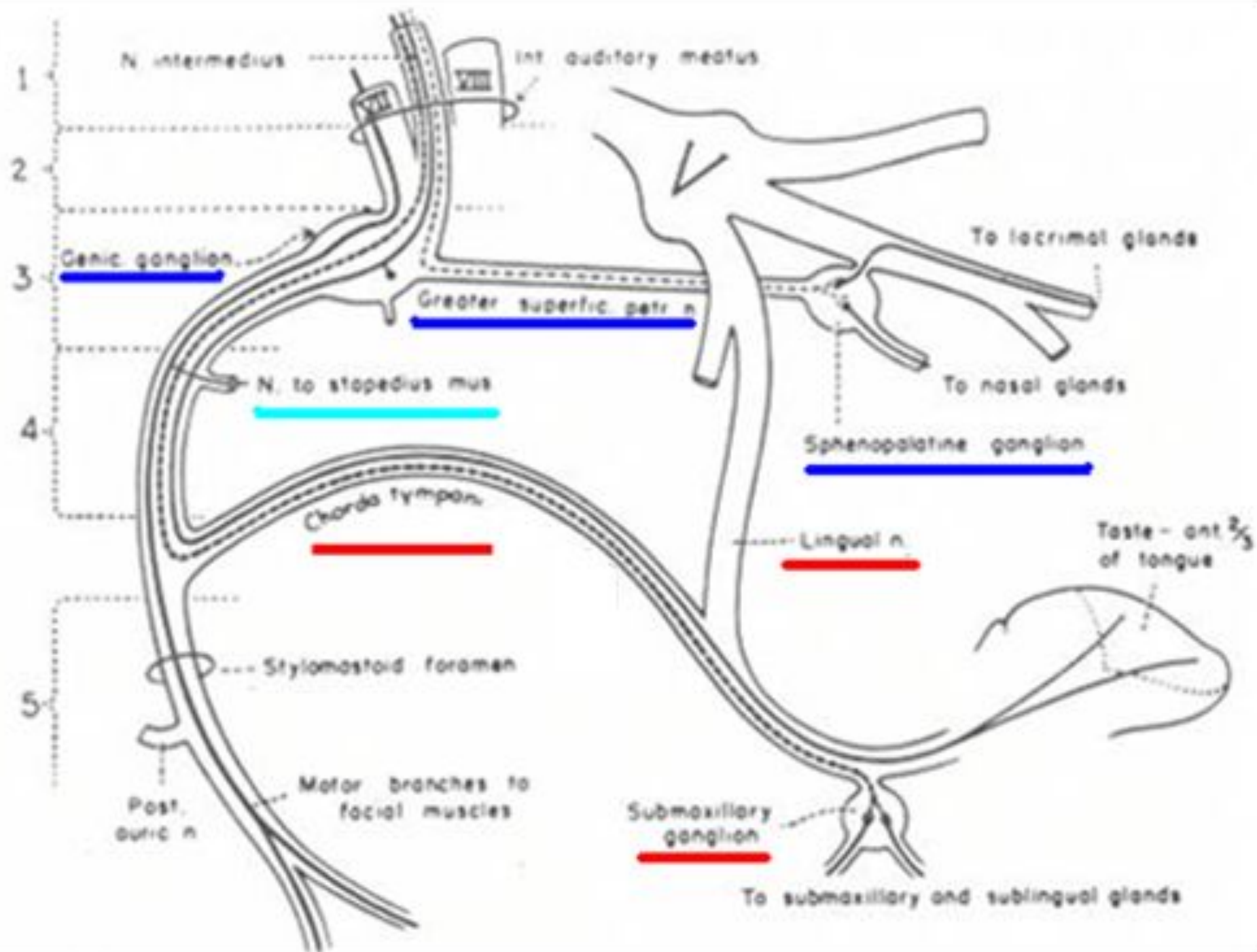
◆ Immediately after it leaves the skull “2 branches”:

1. The posterior auricular nerve.
2. The nerve to the posterior belly of the digastric muscle and to the stylohyoid muscle.

◆ Terminal branches of the facial nerve “5 branches”:

1. Temporal nerve (from temporofacial branch).
2. Zygomatic nerve (from temporofacial branch).
3. Buccal nerve (from cervicofacial branch).
4. Marginal mandibular nerve (from cervicofacial branch).
5. Cervical nerve (from cervicofacial branch).





Bell's Palsy

- ❖ **Sir Charles Bell “Scottish Surgeon”**
first described the anatomy and function of the facial nerve in the **1800**.
- ❖ **Bell's palsy:** defined as an acute peripheral facial nerve palsy of unknown cause.
- ❖ The annual incidence rate is between 13-34 cases per 100,000 population.
- ❖ **Etiology:** Herpes simplex virus reactivation.



(November 1774 – 28 April 1842 12)

Clinical Features of Bell's Palsy

Patients with Bell's palsy typically present with sudden onset (usually over hours) of unilateral facial paralysis, common findings include:

- Absent of forehead wrinkles “more by looking upwards”.
- Inability to close the eye.
- Absent nasolabial fold.
- Drop (asymmetrical) of mouth angle.
- Deviation the mouth to the non affected side.

Ramsay-Hunt Syndrome

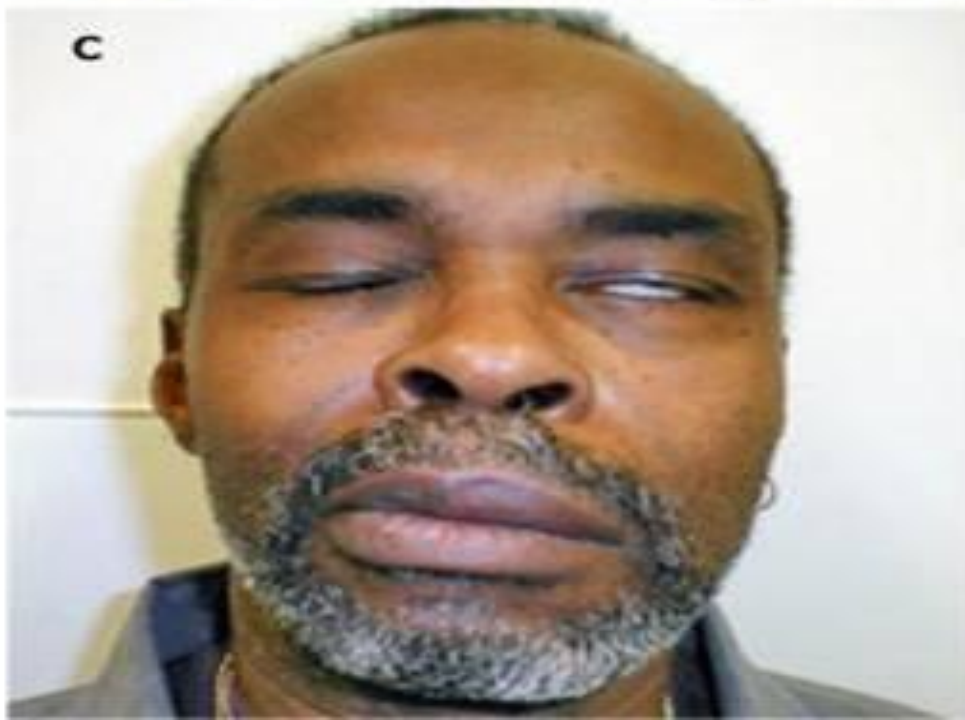
Ramsay Hunt syndrome: acute peripheral facial neuropathy associated with erythematous vesicular rash of the skin of the ear canal.

Etiology: varicella-zoster reactivation.

Clinical picture:

- Vesicular rash of the ear or mouth.
- Ipsilateral peripheral facial palsy.
- Vertigo and ipsilateral hearing loss.
- Tinnitus.
- Otalgia: ear pain.
- Headaches.
- Fever.



A**B****C**

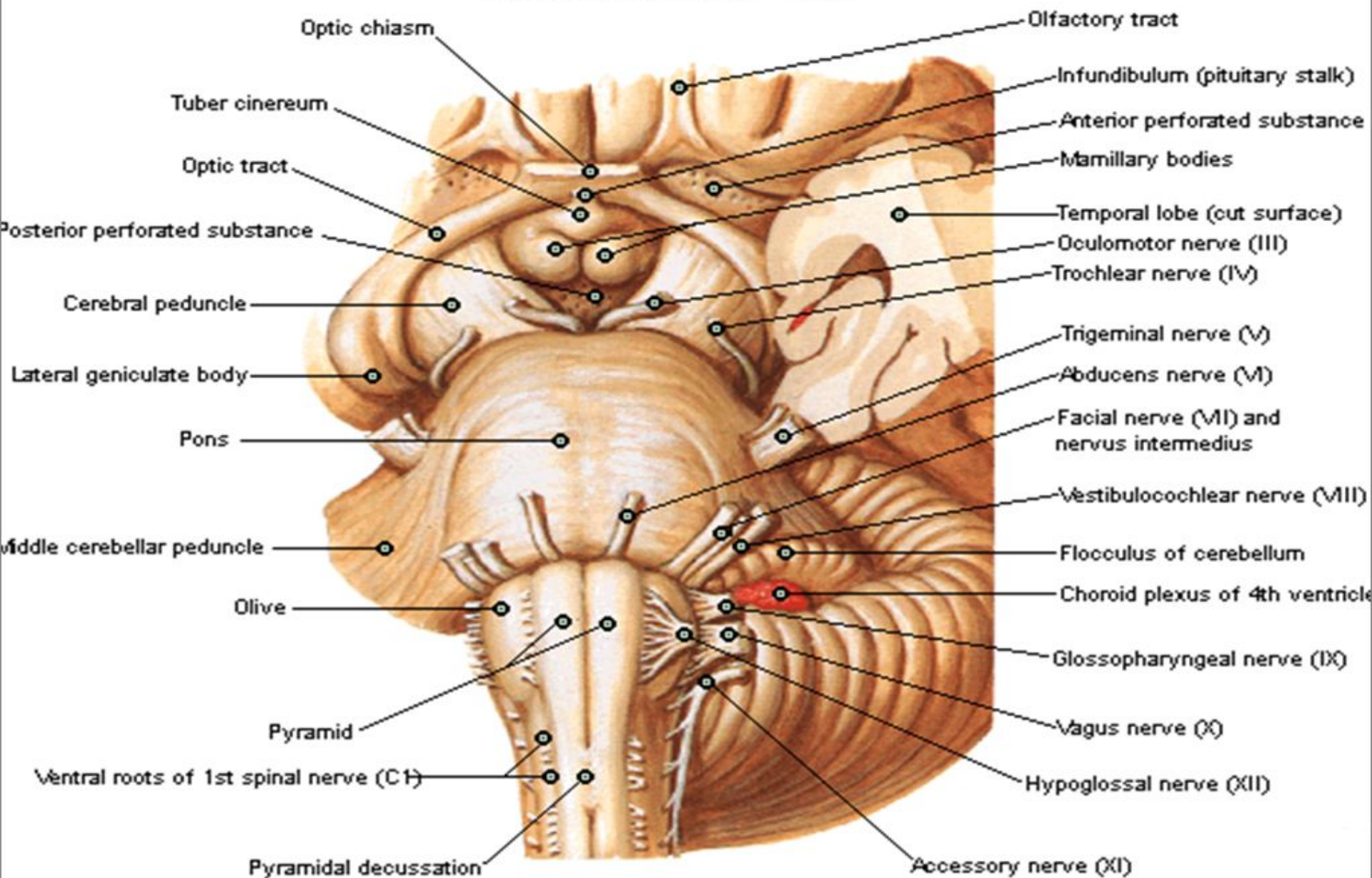
The Vestibulo-Cochlear Nerve (VIII)

(Auditory or Stato-Acoustic nerve)

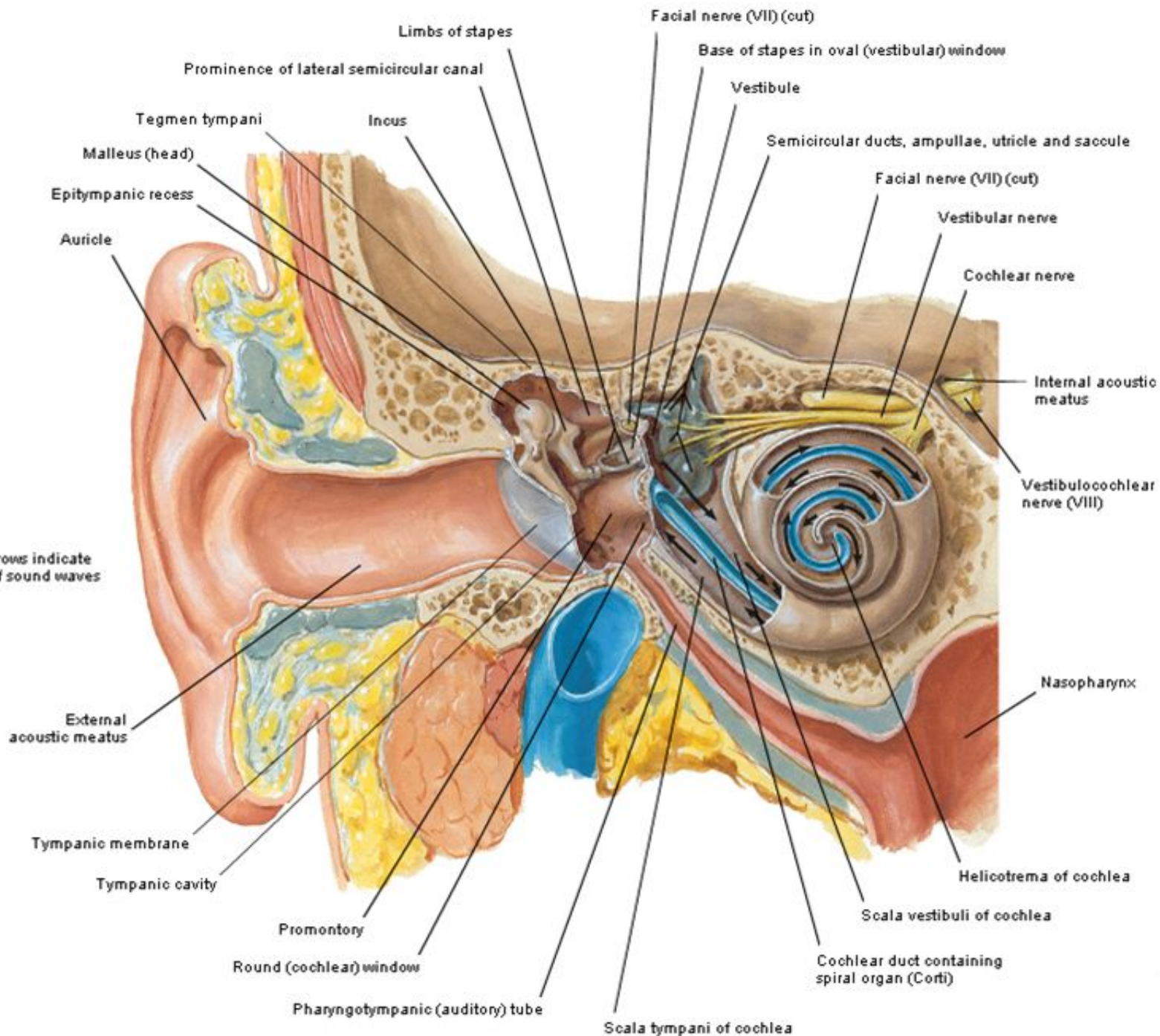
- It is a special sensory (hearing and balance) nerve.
- It emerges from the anterolateral surface between the pons and medulla oblongata with the facial nerve.
- **Function:** Hearing and balance.
- **Modality:** Special somatic afferent.
- **Foramen:** Internal auditory meatus.
- It has two divisions:
 - **Cochlear division.**
 - **Vestibular division.**

Brainstem

Anterioinferior View



Note: Arrows indicate course of sound waves

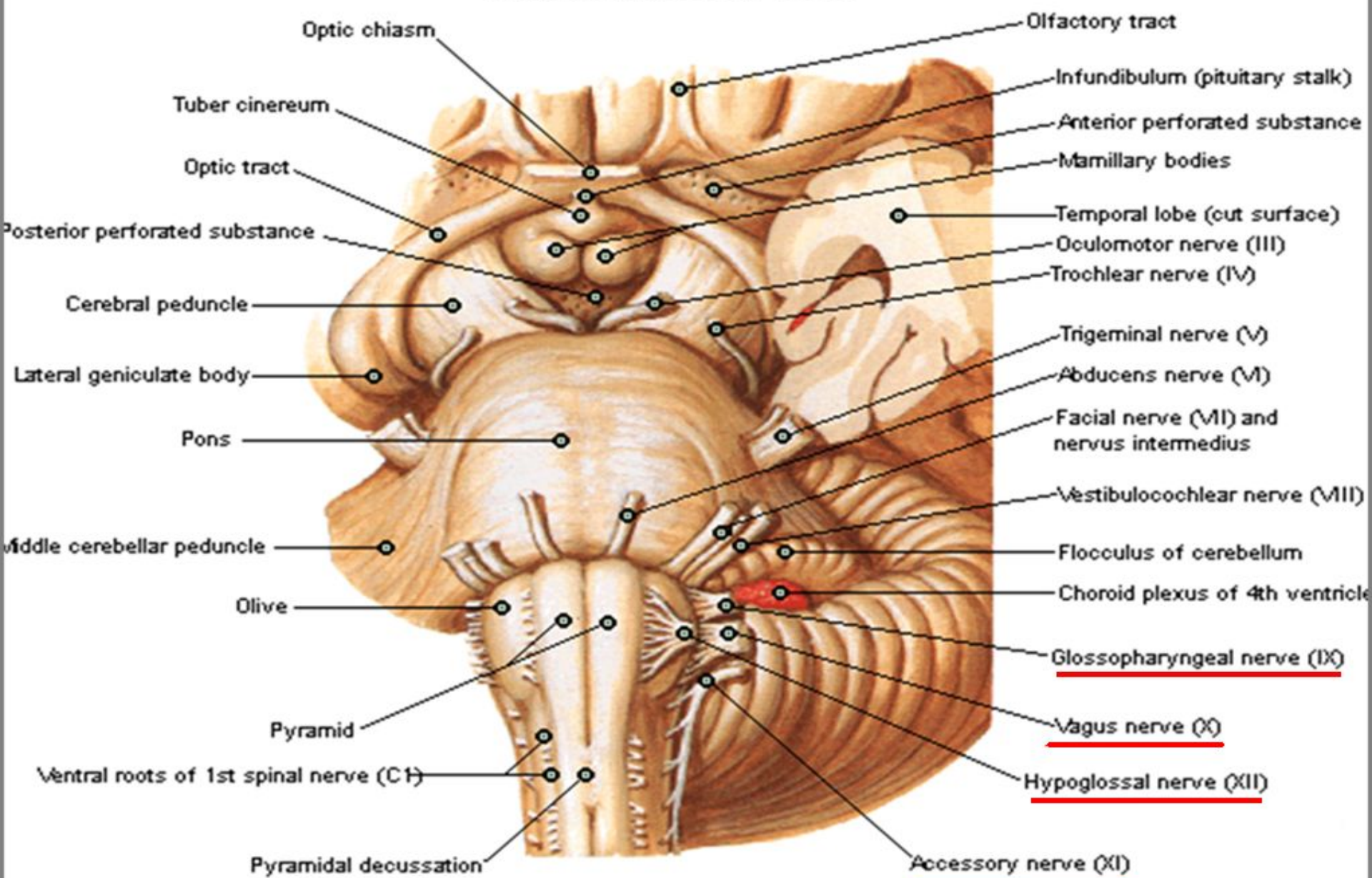


The Glossopharyngeal Nerve (IX)

- 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.
- **Modalities:** GVE, SVE, GSA, & SVA.
- **Foramen:** Jugular foramen.

Brainstem

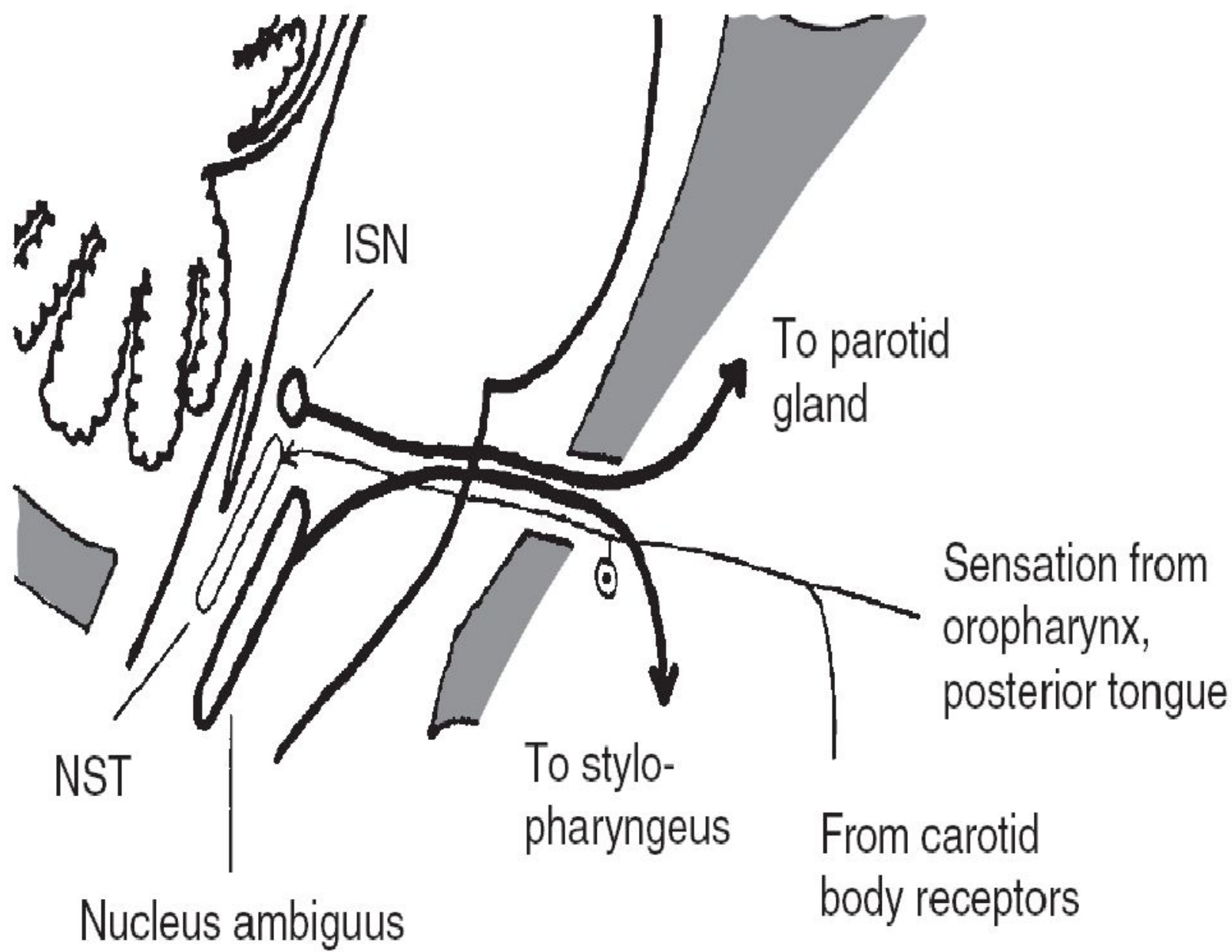
Anterioinferior View



Nuclei of the Glossopharyngeal Nerve

It has three nuclei:

- 1. The upper part of nucleus ambiguous:** 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).**



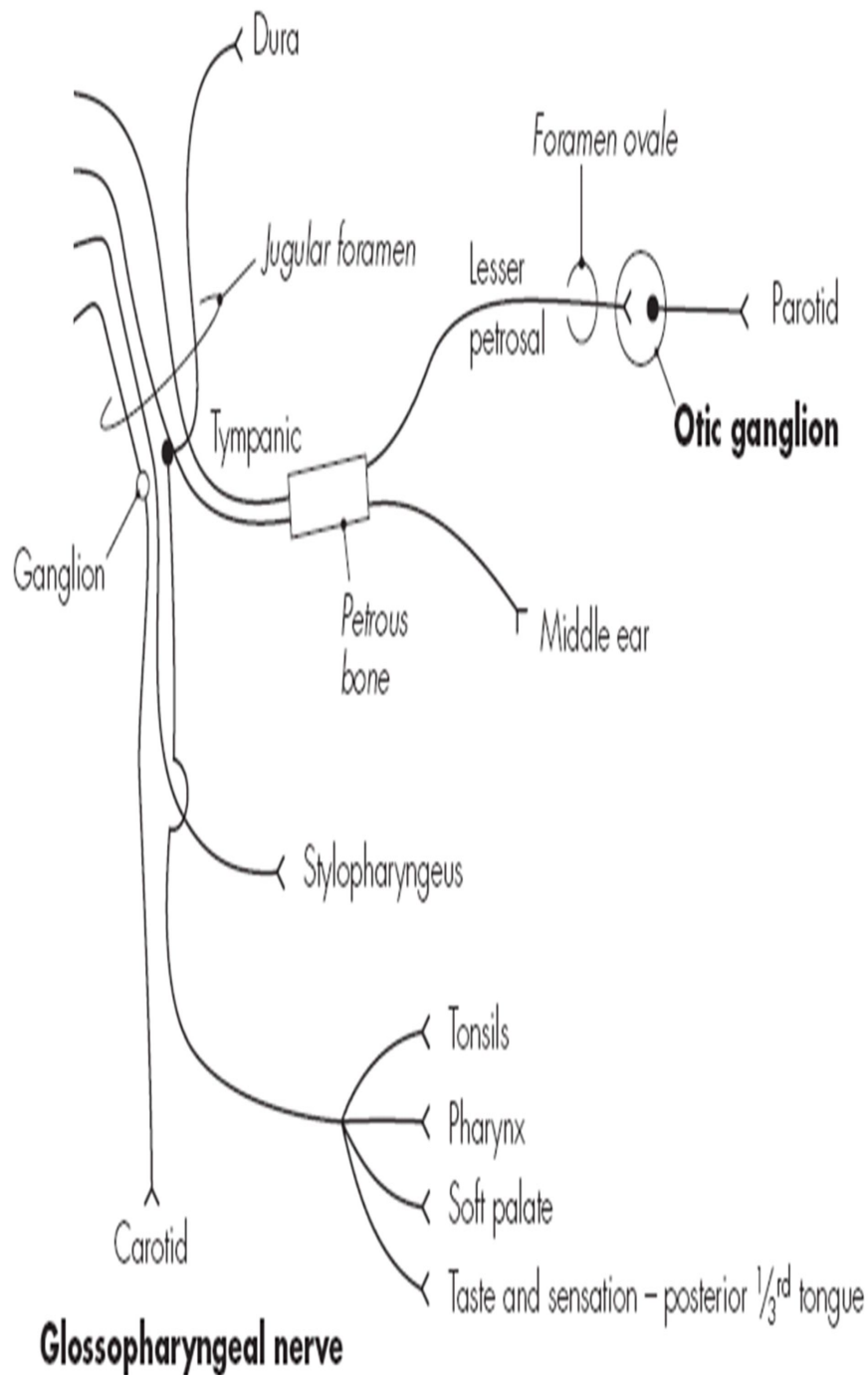
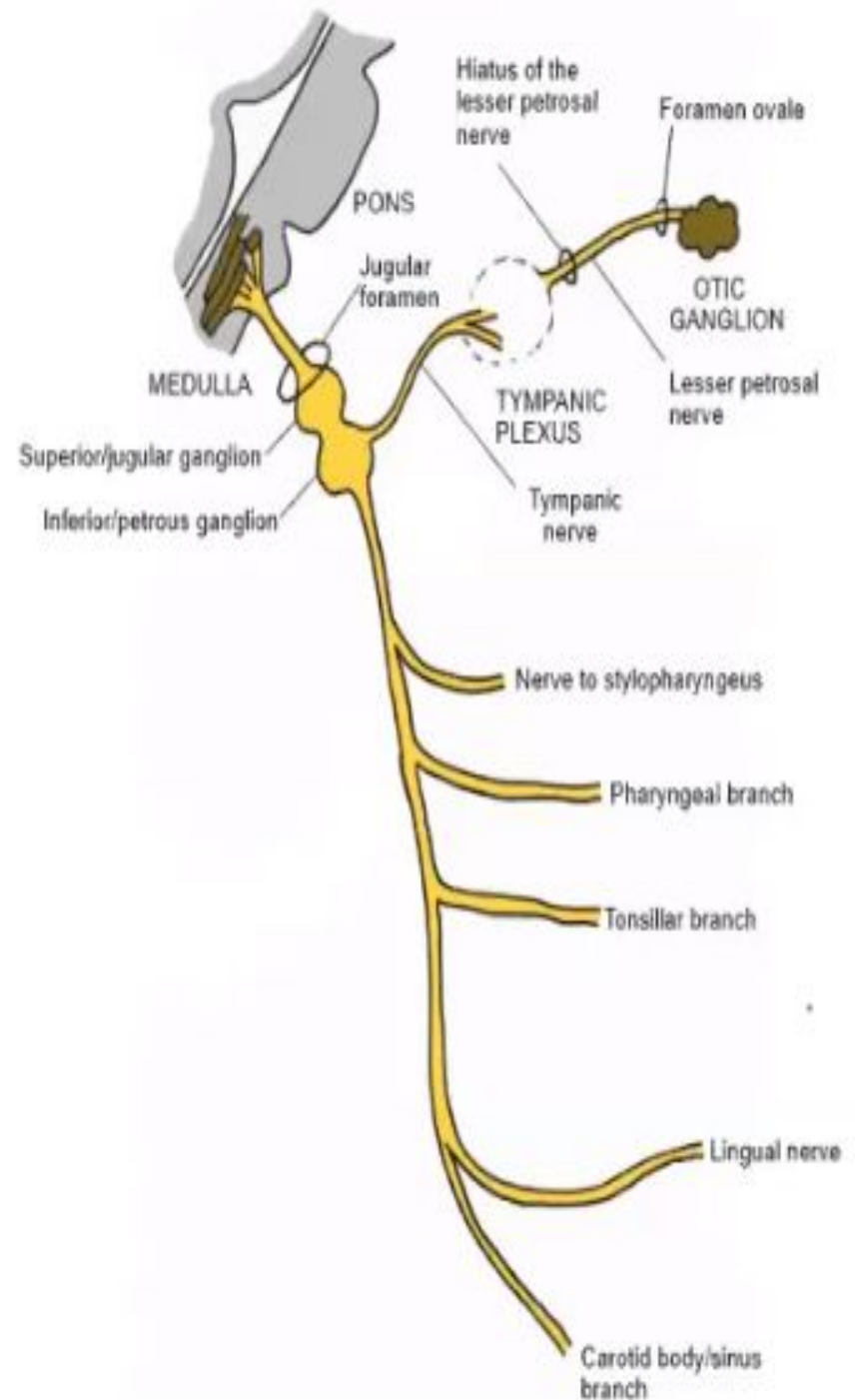
Functions of the Glossopharyngeal Nerve

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.



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:** from the posterolateral sulcus of the medulla.

◆ **It is a mixed nerve with:**

a. Motor fibers.

b. Parasympathetic fibers

c. Sensory fibers.

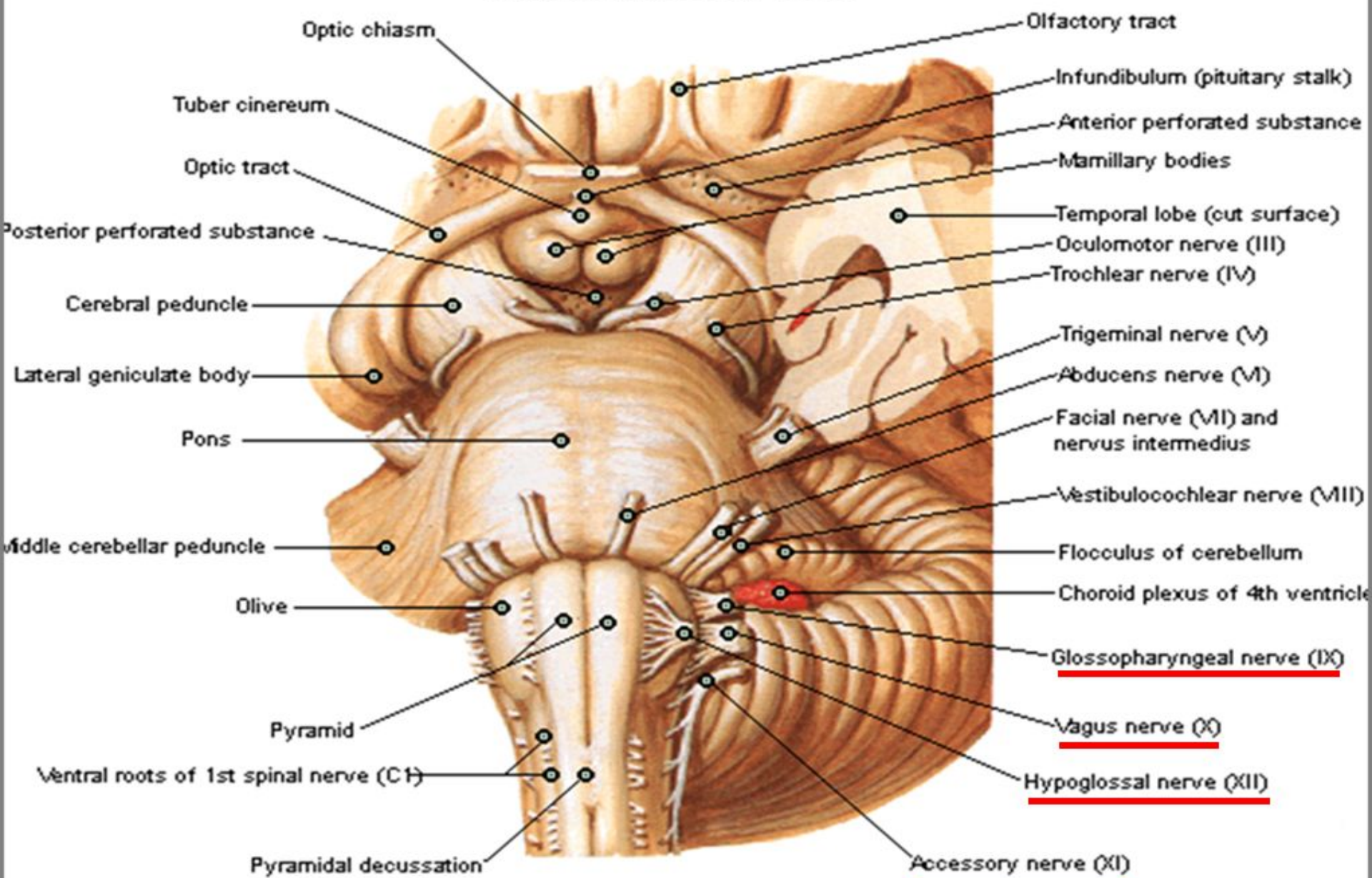
◆ It is the most important parasympathetic nerve in the
□ body.

□ **Modalities:** GVE, SVE, GSA, SVA & GVA.

□ **Foramen:** Jugular foramen.

Brainstem

Anterioinferior View



Nuclei of the Vagus Nerve

It has three nuclei:

1. Dorsal motor nucleus of vagus “Parasympathetic”:

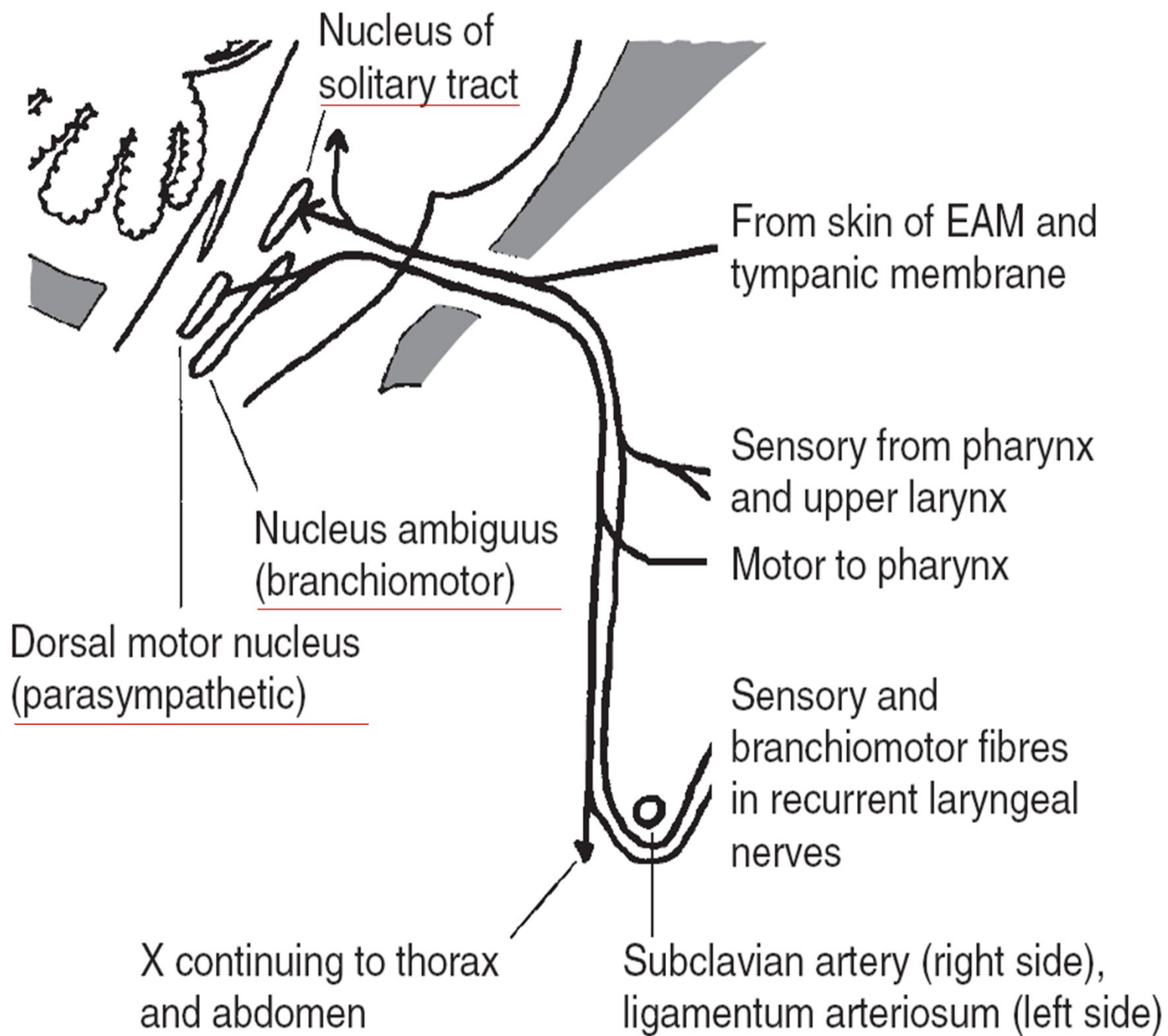
Gives parasympathetic fibers to respiratory system, digestive tract and the heart.

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:

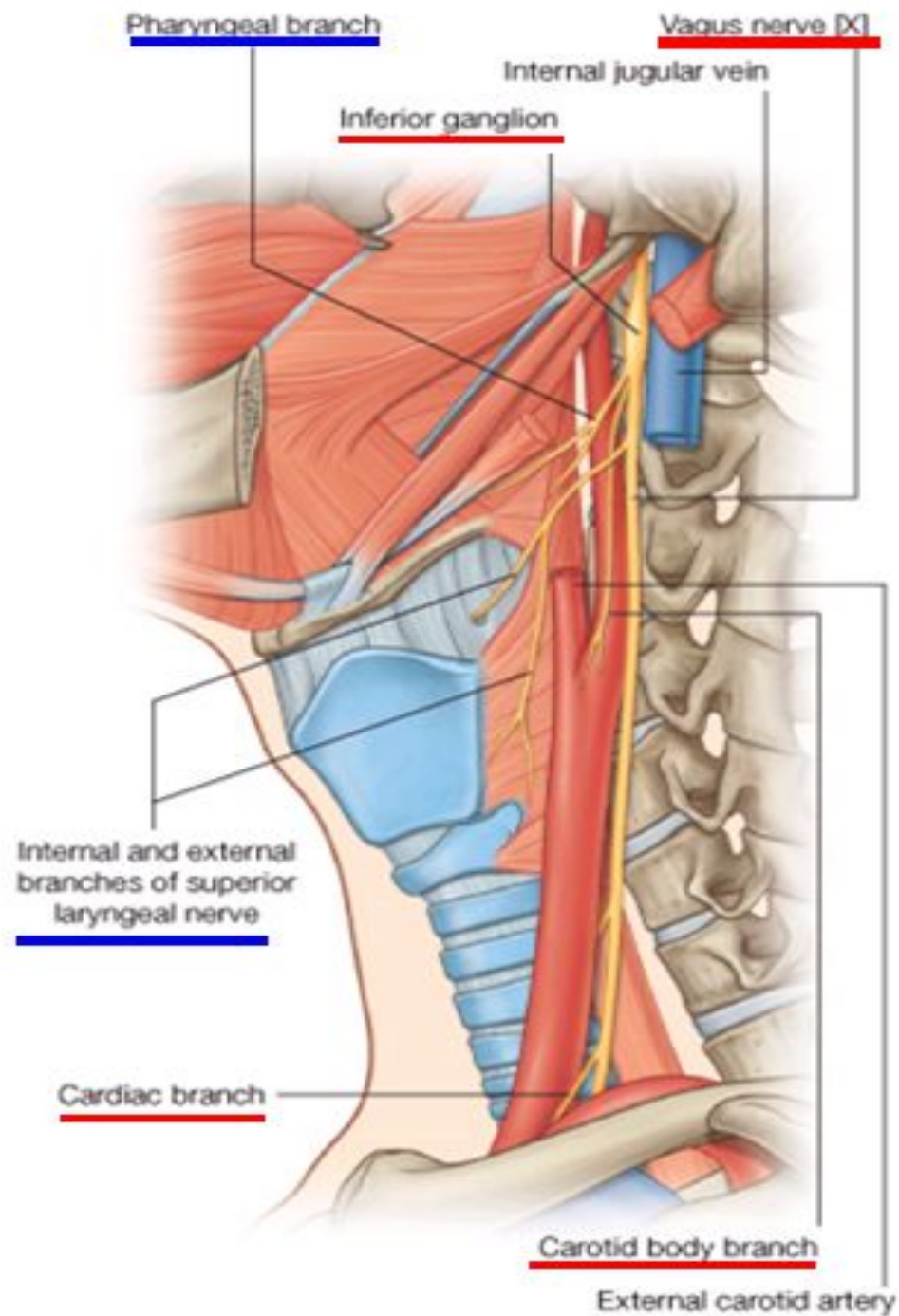
- a. The smooth muscles and glands digestive system.
- b. The smooth muscles and the glands of the respiratory system.
- c. The heart.

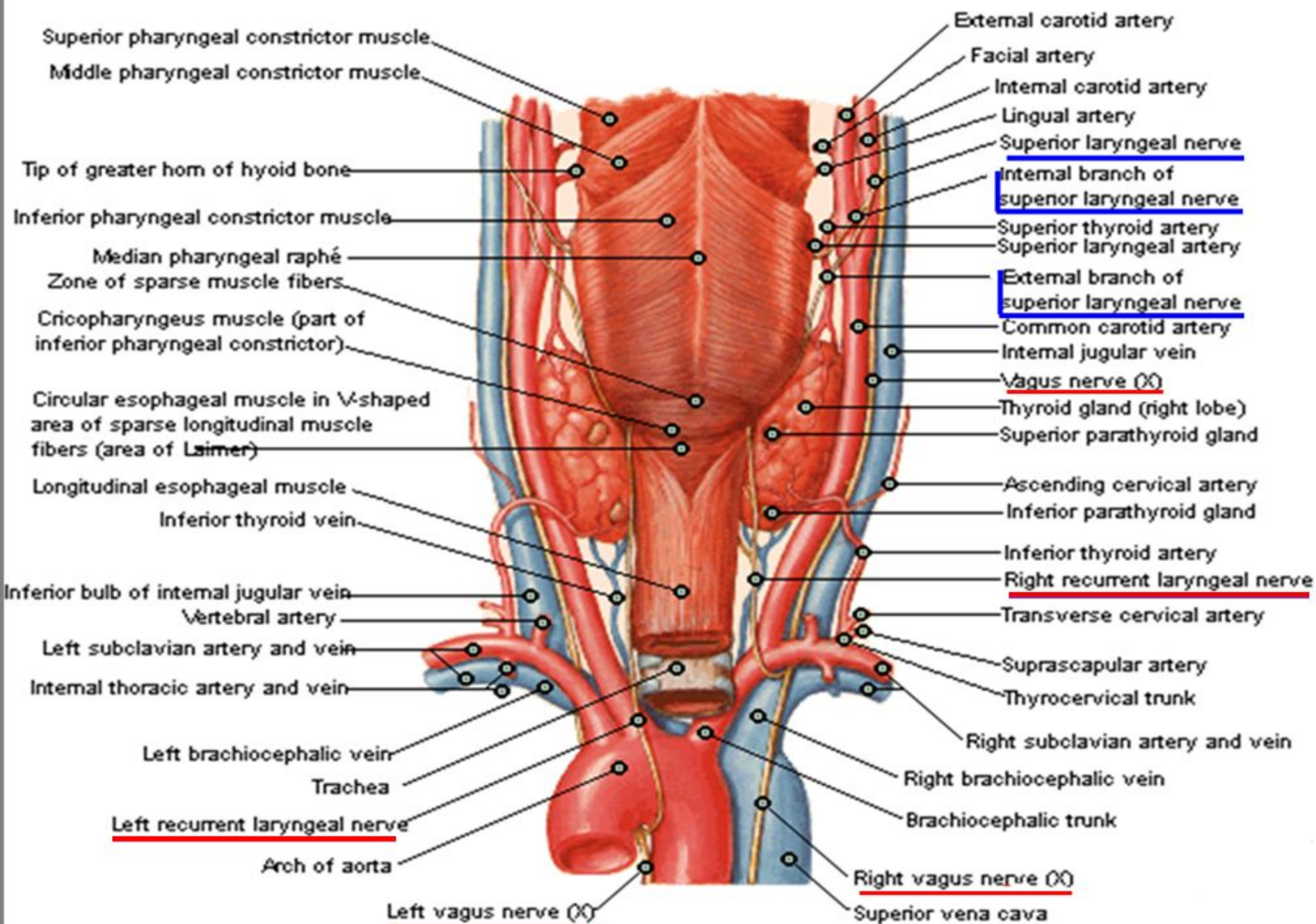
2. The motor fibers supply:

- 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.





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.

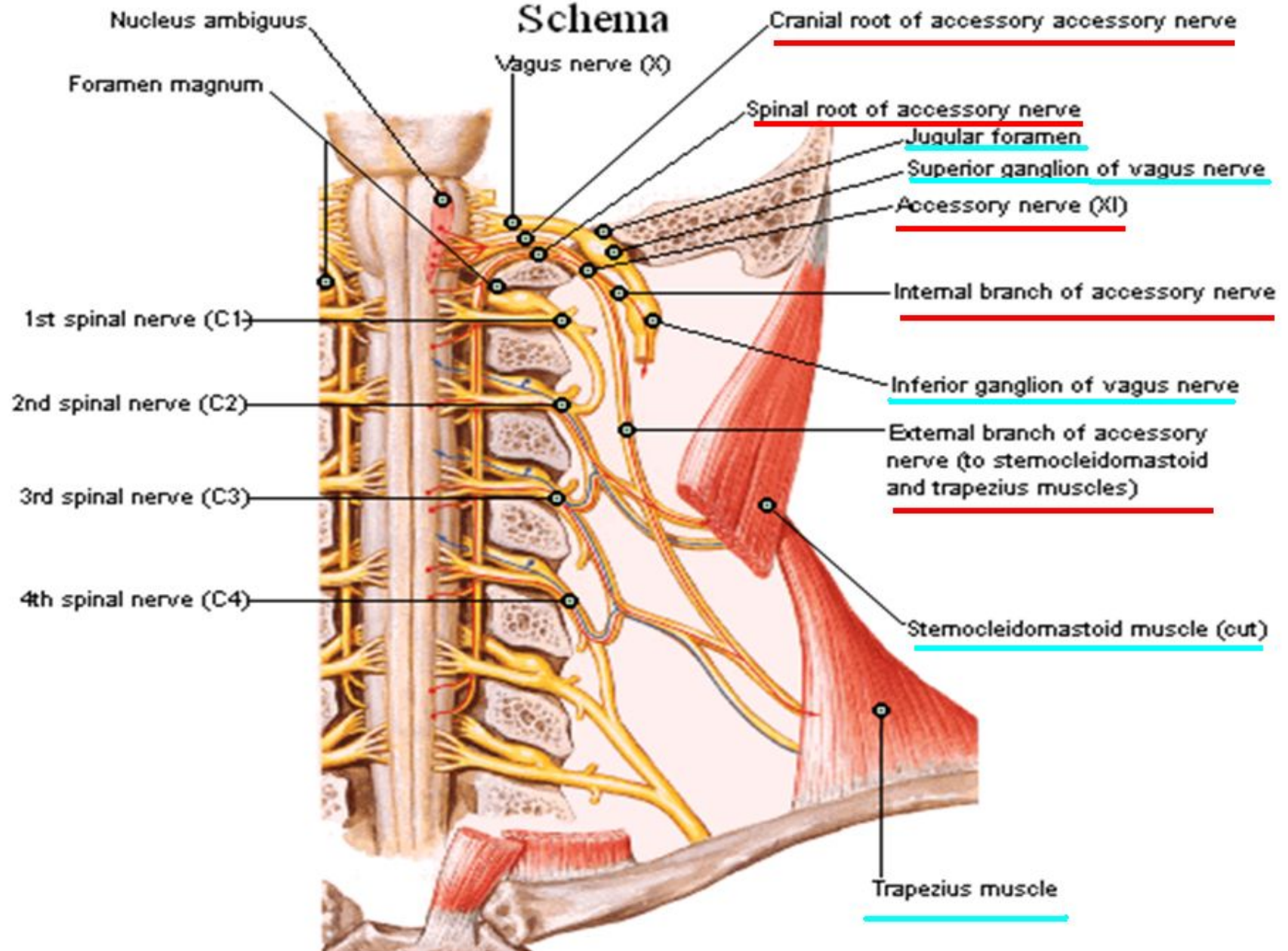
Others: tachycardia and constipation.

The Accessory Nerve (XI)

- **It is a purely motor nerve and has two 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.
- **Origin:** from the posterolateral sulcus of the medulla.
- **Modality:** General somatic efferent.
- **Foramen:** Jugular foramen.

Accessory Nerve

Schema



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).

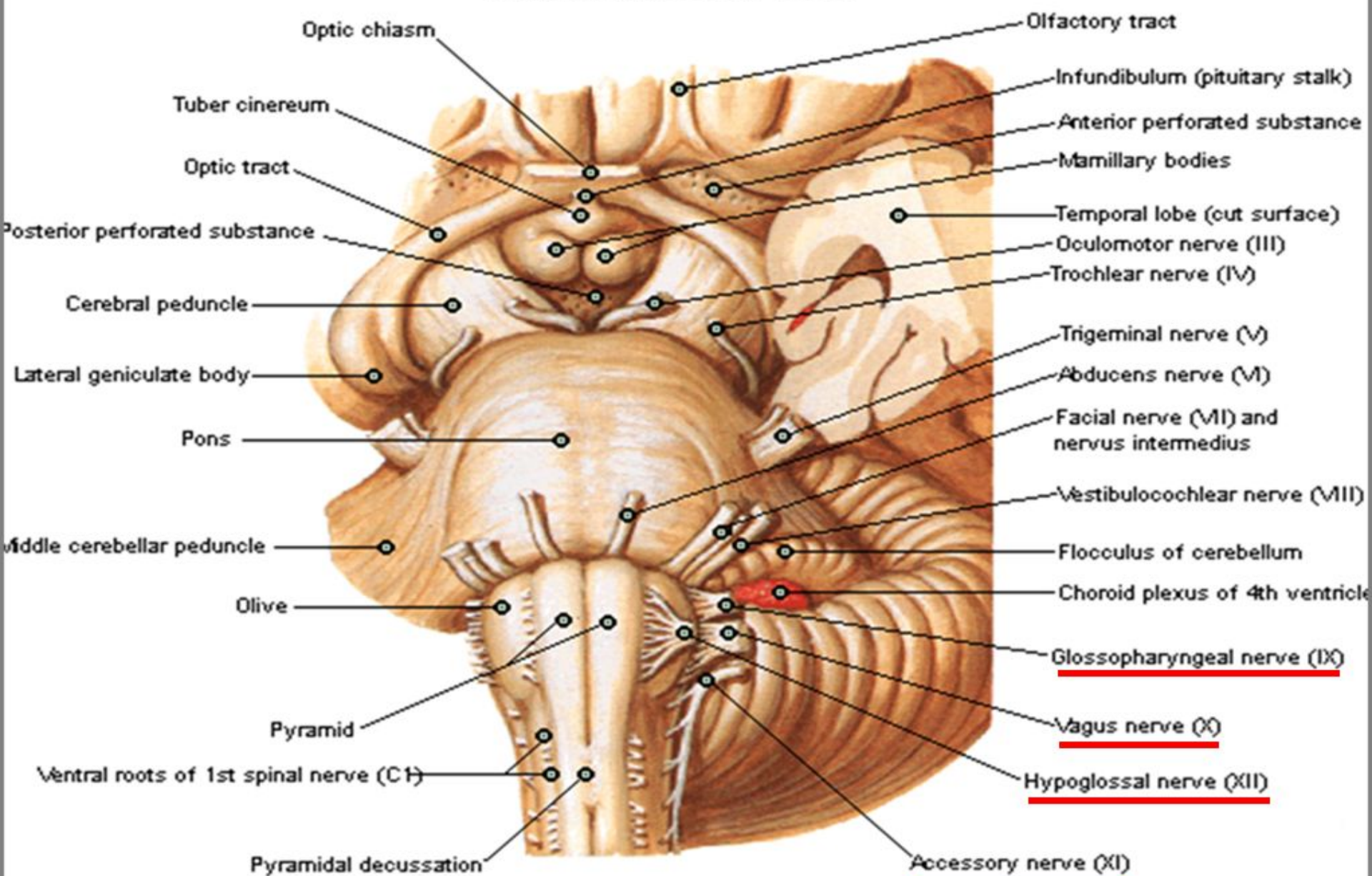
The Hypoglossal Nerve (XII)

(The motor nerve of the tongue)

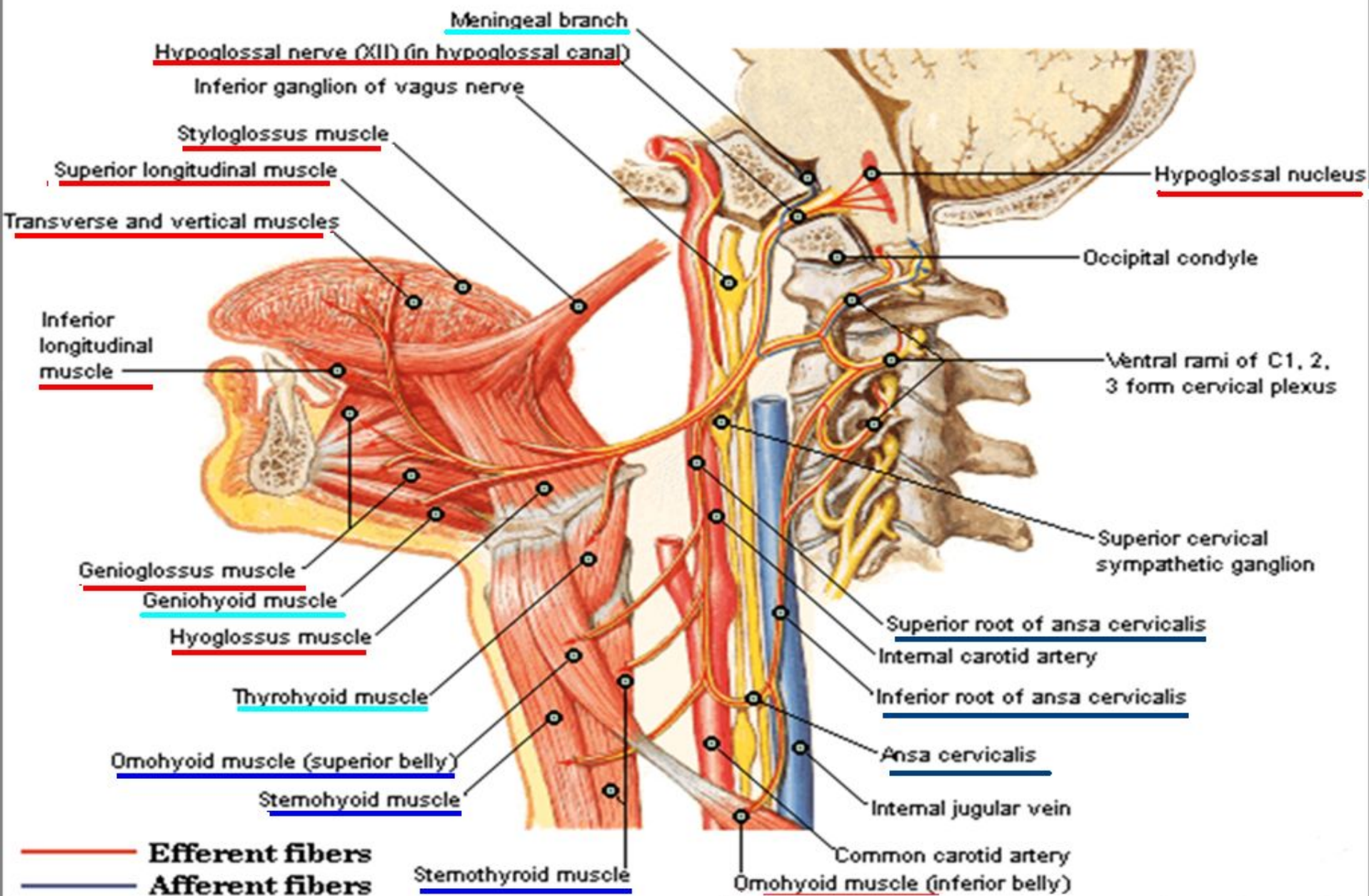
- **Origin:** from the anterolateral sulcus of medulla oblongata. It receives a communicating branch from C1.
- **Modality:** General somatic efferent.
- **Foramen:** Hypoglossal canal.
- **Function:** the hypoglossal nerve is a purely motor nerve which supplies:
 1. All the internal muscles of the tongue
 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



Hypoglossal Nerve Schema



The Spinal Roots and Nerves

□ **Each segment has four roots:** two posterior & two anterior.

1. Two posterior (dorsal) roots: there are sensory fibers (afferent fibers). Each posterior root has posterior spinal root ganglion.

2. Two anterior (ventral) roots: there are motor and autonomic fibers (efferent fibers).

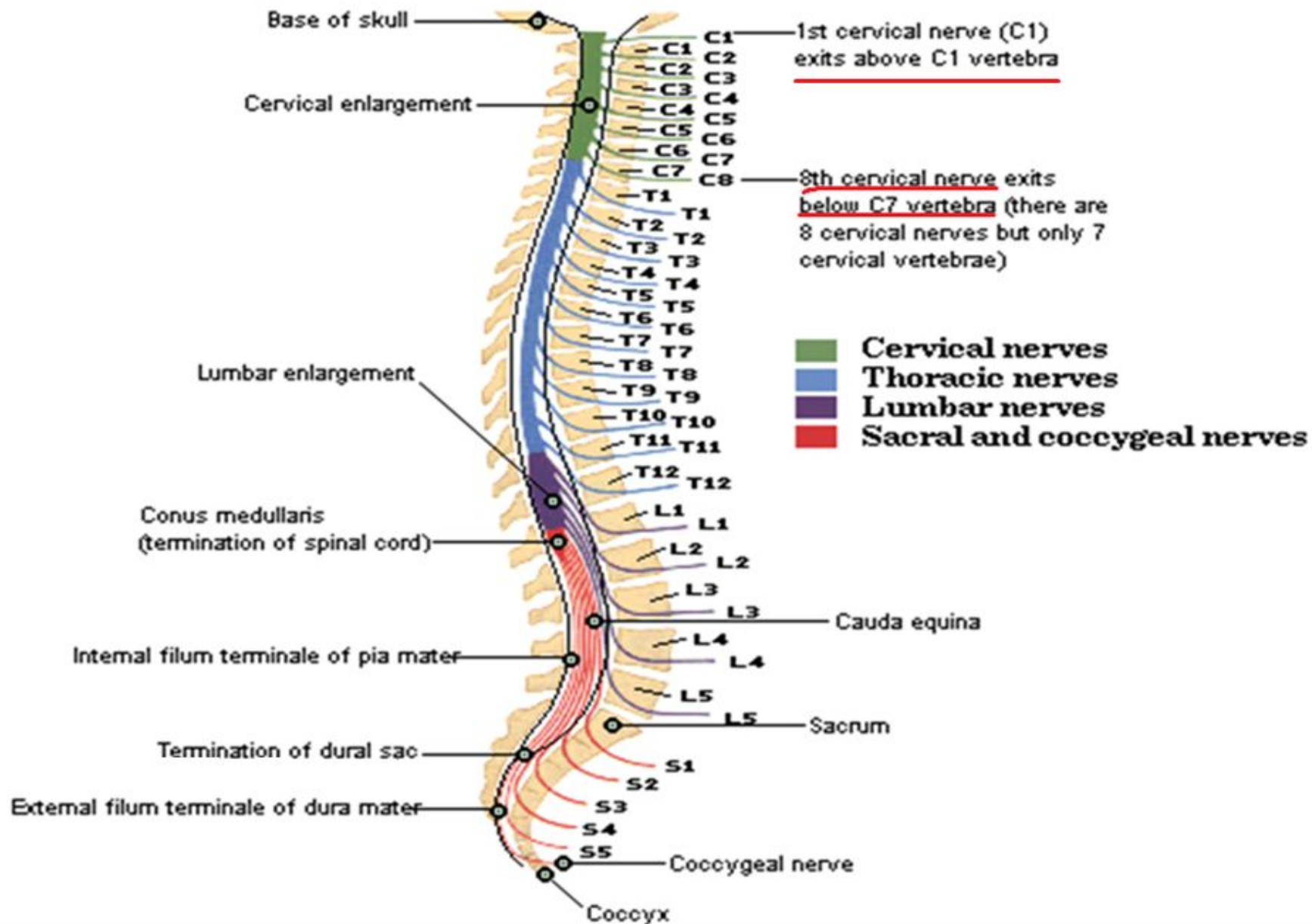
□ The anterior and posterior roots will join to form a single mixed nerve called **the spinal nerve** → consist of 31 pairs of spinal nerves (8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal).

□ Each spinal nerve emerges from the intervertebral foramen.

The Exit of Spinal Nerve Roots

- ❖ Through the intervertebral foramina.
- ❖ Roots C₁- C₇ pass **above** their vertebra.
- ❖ C₈ pass **below** C₇ vertebra.
- ❖ Thoracic, lumbar and sacral nerves pass **below** corresponding vertebra.
- ❖ Lower lumbar, sacral and coccygeal nerves descend vertically as **cauda equina** pass below corresponding vertebra.

Relation of Spinal Nerve Roots to Vertebrae



Special Considerations of the Spinal nerve Roots

- **The first cervical nerve** and the **coccygeal nerve** usually have neither the posterior (sensory) roots nor the corresponding dermatomes.
- **The first cervical nerve** passes between the atlas and the skull.
- **The second cervical nerve** passes between the atlas and the axis.

Components and Branches of Spinal Nerves

- **The spinal nerve:** is formed by the union of posterior and anterior roots within the intervertebral foramen, resulting in a mixed nerve.
- **Posterior root.**
- **Spinal ganglion:** located within the posterior root and contains pseudounipolar neurons “First order neuron for somatic sensations”.
- **Anterior root.**
- **Spinal nerve rami.**

The Spinal Nerve Rami

- **Posterior ramus:** innervates the skin and muscles of the back.
- **Anterior ramus:** innervates the anterior and lateral muscles and skin of the trunk, extremities, and visceral organs.
- **Meningeal ramus:** innervates the meninges and vertebral column.
- **White communicating rami:** contain myelinated preganglionic autonomic fibers.
- **Gray communicating rami:** contain unmyelinated postganglionic autonomic fibers.

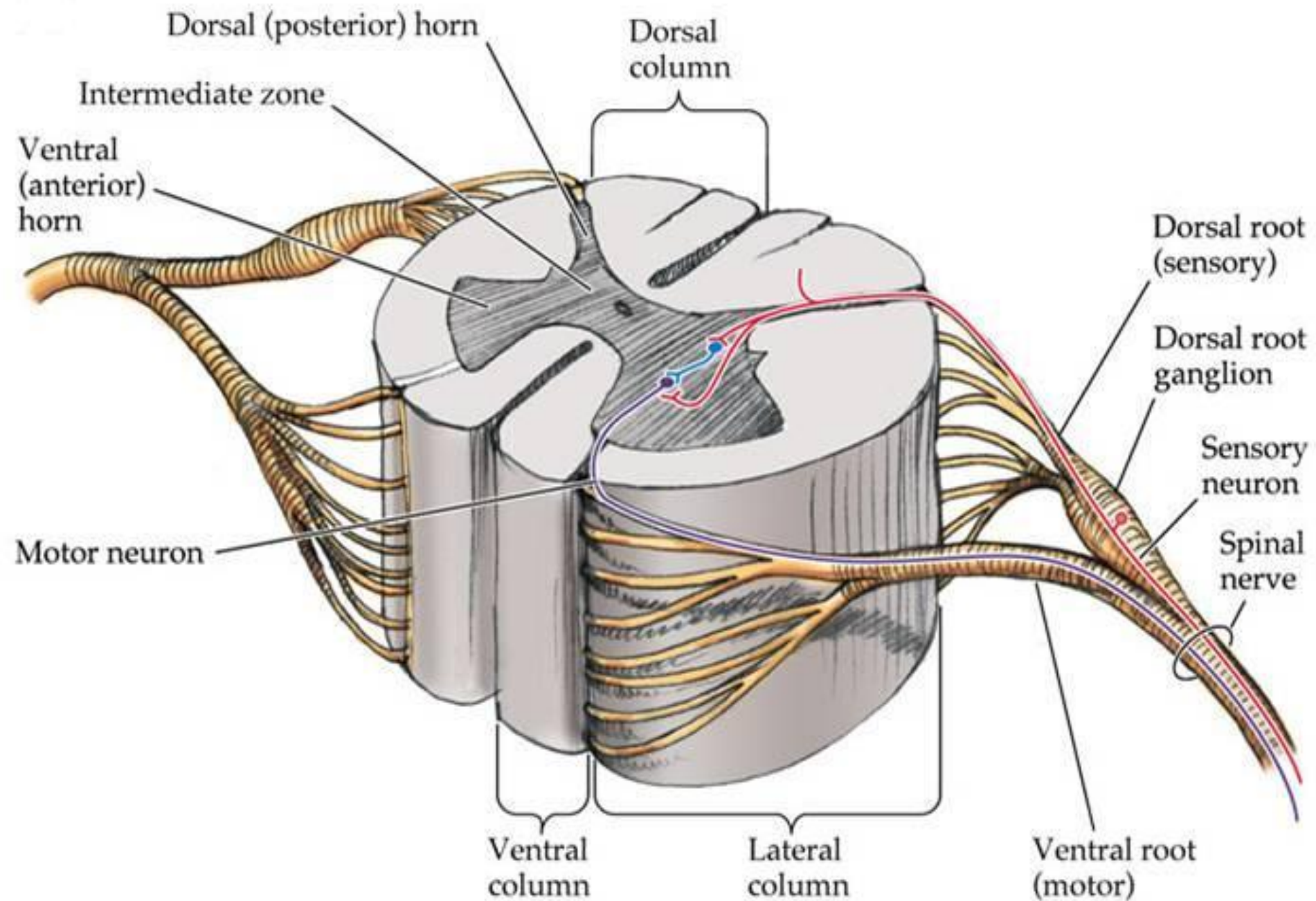
Functional Components of Spinal Nerve Fibers

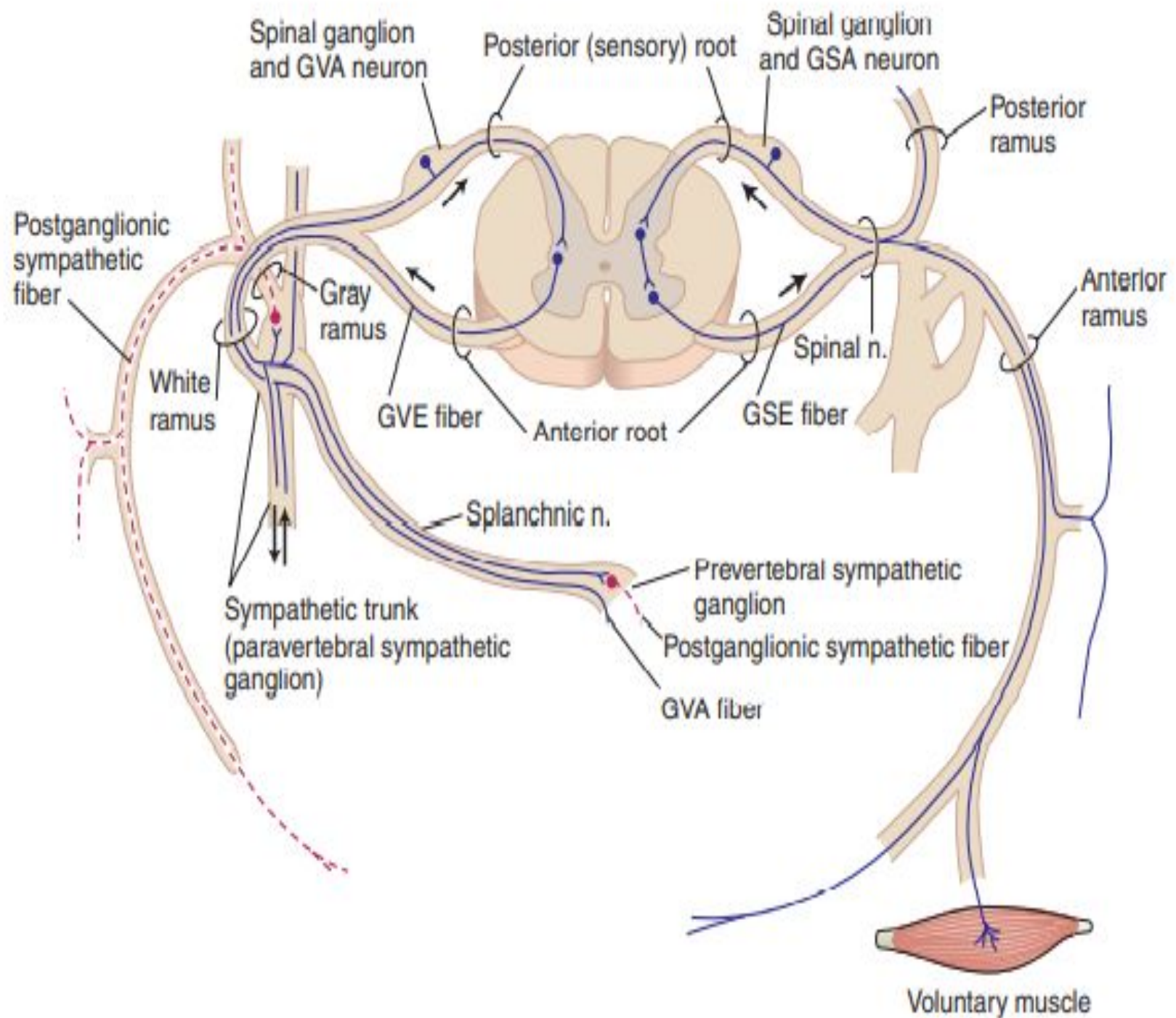
1. Afferent Fibers:

- A. General Somatic Afferent (GSA) Fibers:** Convey **sensory input** from skin, muscle, bone, and joints to the central nervous system (CNS).
- B. General Visceral Afferent (GVA) Fibers:** Convey **sensory input** from visceral organs to the CNS.

2. Efferent Fibers:

- A. General Somatic Efferent (GSE) Fibers:** Convey **motor output** from anterior horn motor neuron to skeletal muscle.
- B. General Visceral Efferent (GVE) Fibers:**
 - Convey **motor output** to glands, smooth muscle, and visceral and pelvic organs.





Visceral Nervous System

- 1. Visceral components of the spinal nerves:** are not present at all levels: they are associated mainly with T1-T2 and S2-S4 regions
- 2. Sympathetic Nervous System:** located within the lateral horns of T1-L2 segments of the spinal cord.
- 3. Sacral Parasympathetic Nervous System:** located within the anterior horns of S2-S4 segments of the spinal cord.

Spinal Nerve Innervation

1. **Dermatome:** consists of a **cutaneous** area innervated by the fibers of **one spinal nerve**.
2. **Myotome:** consists of **muscles** innervated by the fibers of **one spinal nerve**.
3. **Sclerotome:** consists of **bones and ligaments** innervated by the fibers of **one spinal nerve**.

Thank You

