

# Lecture

## **Main Functions of the Cranial and Spinal Nerves**

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الرجاء تحويل الجوال إلى وضع  
الصامت مع  
الشكر



nerves of spinal nerve → mixed

# The Cranial Nerves

pure sensory  
pure motor  
mixed

□ 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).

skull  
بکھ دافل دی  
ase nding

□ The oculomotor, trochlear, abducent, accessory and hypoglossal nerves are purely motor nerves.

desending  
skull  
فارج مہ

□ The trigeminal, facial, glossopharyngeal and vagus nerves are mixed nerves (10975).



Locus Coeruleus

autonomic system

Sympathetic

Parasympathetic

- **Somatic:** skeletal muscle, joint, tendon, ligament, and skin.
  - **Visceral:** smooth muscles, cardiac muscles, and glands.
- nerves*
- **Sensory “Afferent”:**
    - ✓ **General.**
    - ✓ **Special.** *test, vision, smell*
  - **Motor “Efferent”:**
    - ✓ **General.**
    - ✓ **Special.**
- parasympathetic*
- **Organic <sup>or systemic sensation</sup> 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 ventral horns of the gray matter within the spinal cord. They exit the spinal cord through the ventral roots, carrying motor impulses to skeletal muscle. <sup>تفني</sup>
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). <sup>تفني</sup>
3. **The Special Visceral Efferent (SVE):** which supply muscles which derived from the branchial arches (the trigeminal, facial, glossopharyngeal, vagus, and cranial accessory nerves).  
9      10      11

cranial n. 3-12

R

# Sensory Functional Modalities

posterior spinal root ganglion → like: pain, touch, muscle sensation, Proprioception<sup>خبر</sup>, joint sensation

## 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.

*Cardiac infarction ←*

## 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).

بالأثر عكسي  
autonomic n. system

# **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.

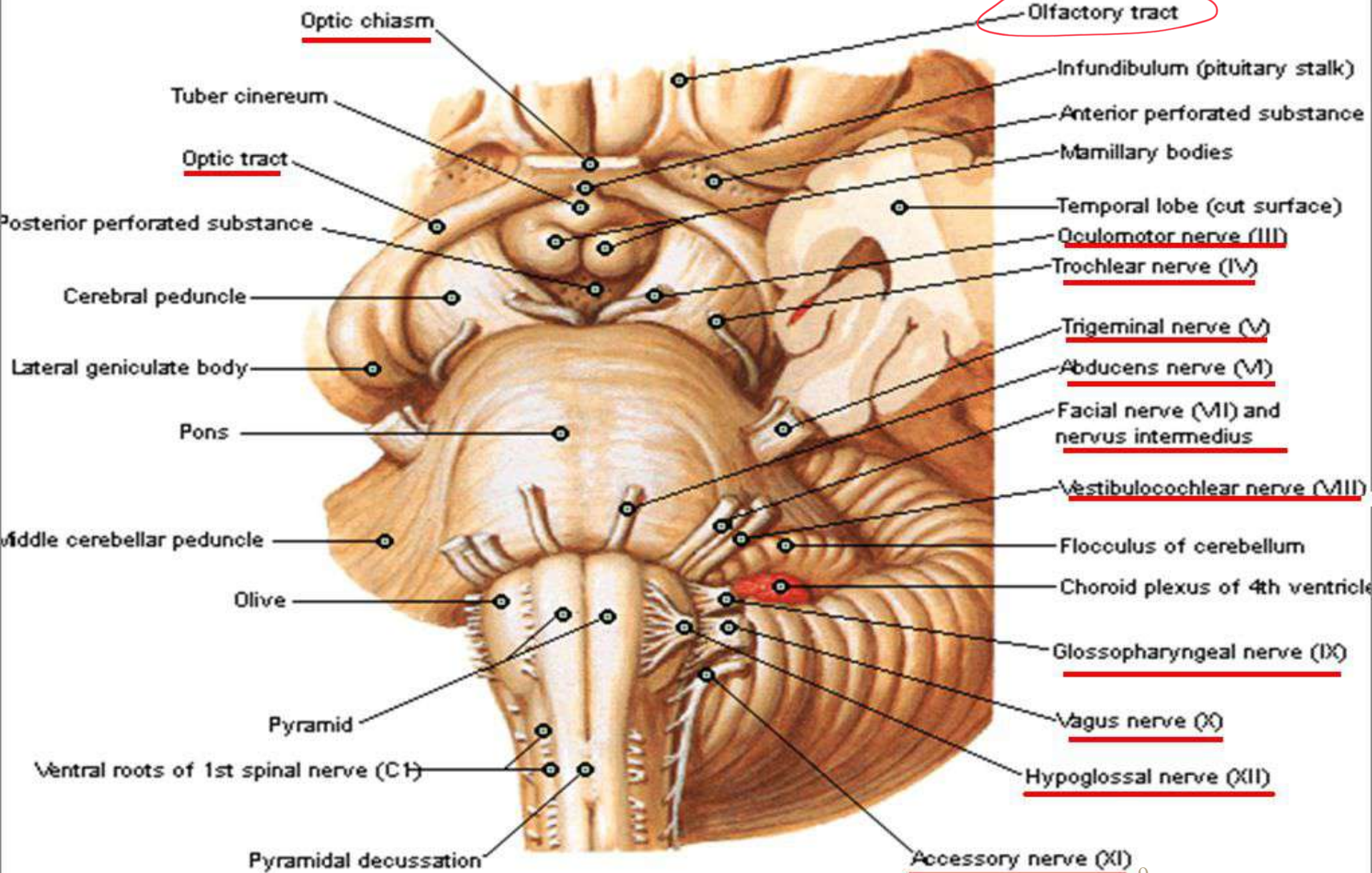


# Classification of the Cranial Nerves

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

# 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.

if injured

Cause →

anosmia

Insomnia → 6-8





## II. The Optic Nerve

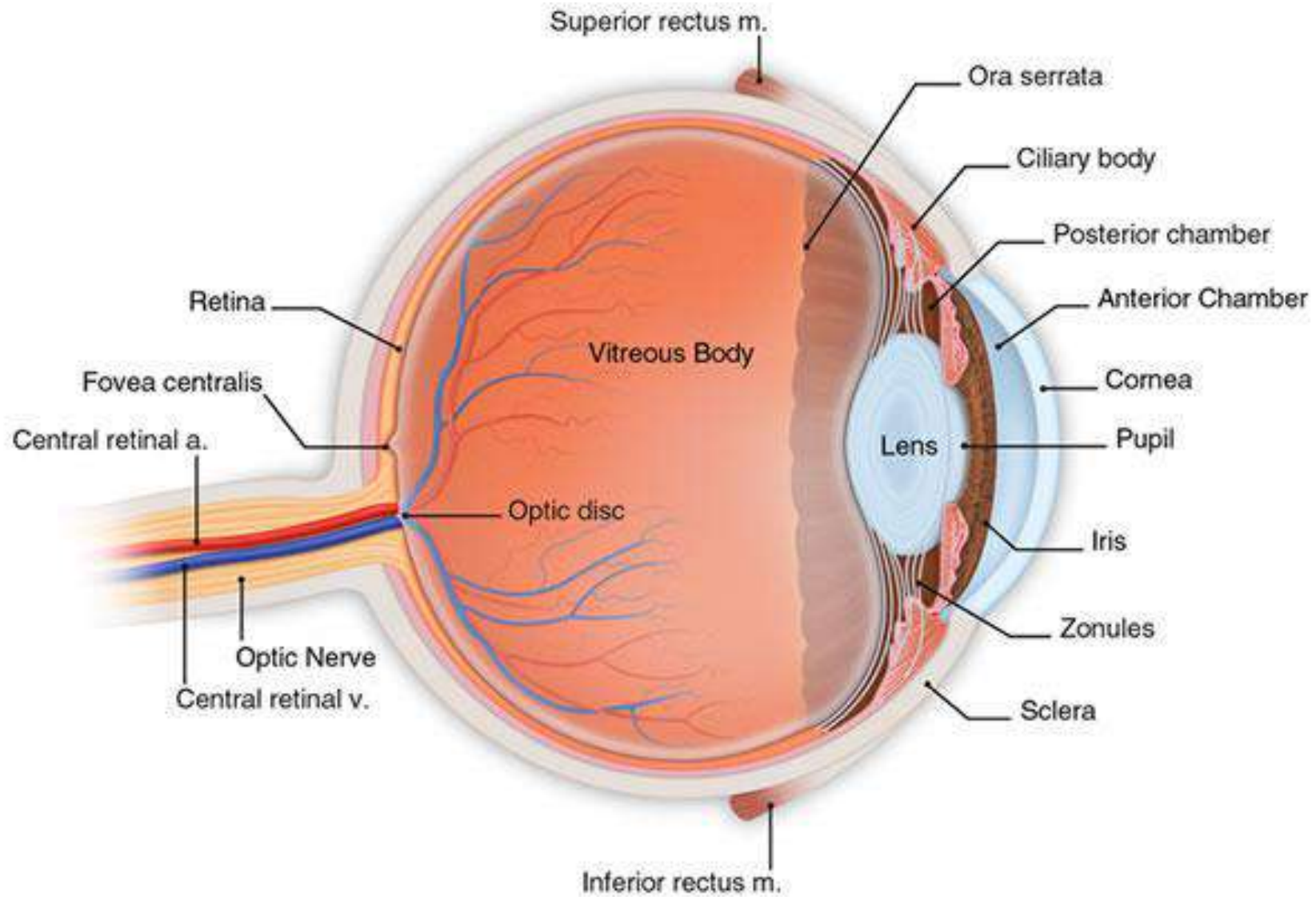
### ◆ Optic Nerve: (Latin for "to see").

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

### ◆ Function and modality: special somatic afferent

(sense of vision) and pupillary light reflex.



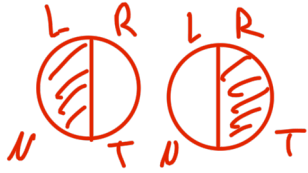


# Pathway of the Vision

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.**

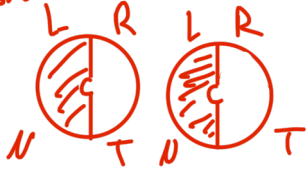
X optic tract

bi temporal hemianopia → heteronymous

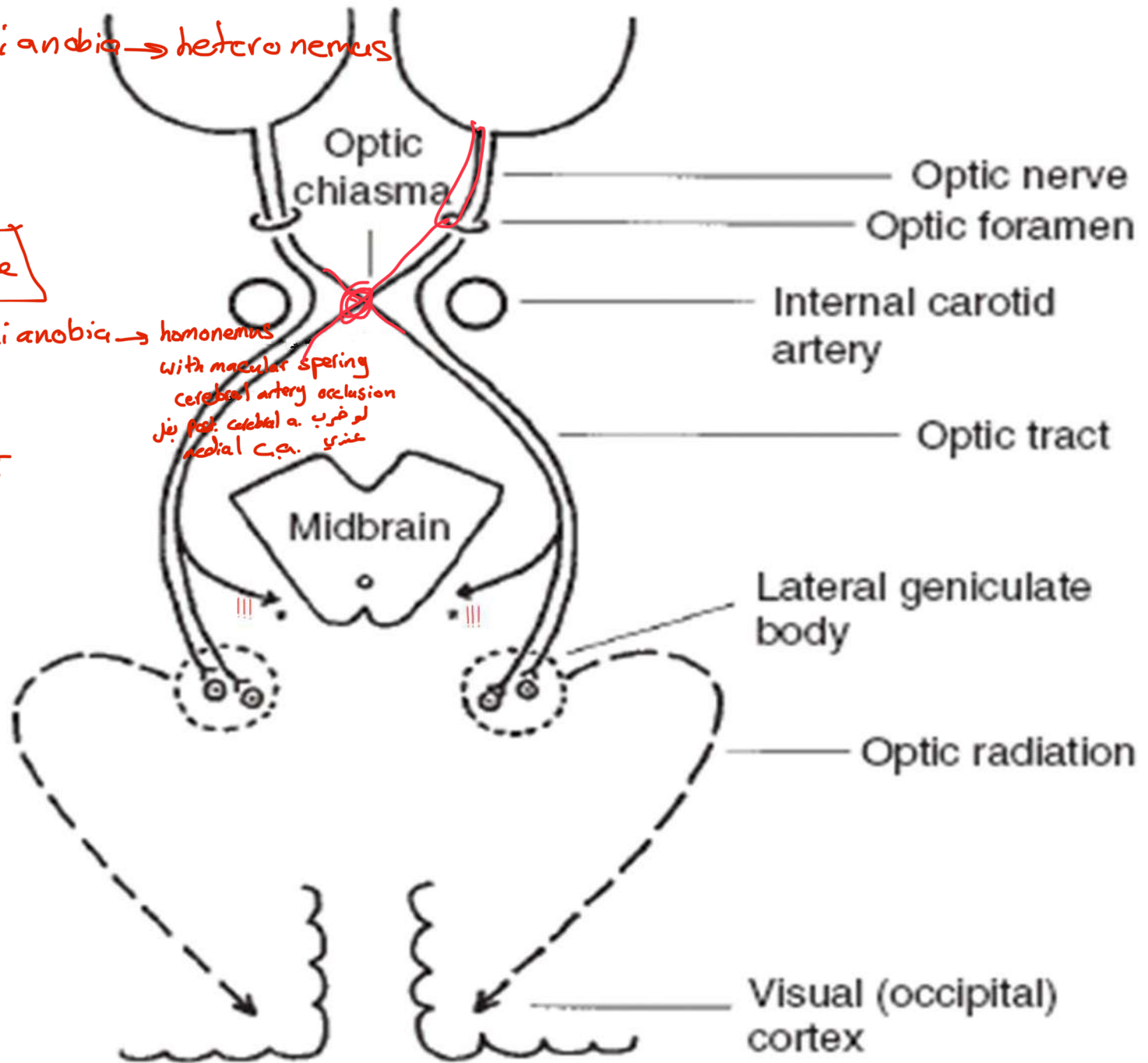


X occipital lobe

Central lateral hemianopia → homonymous

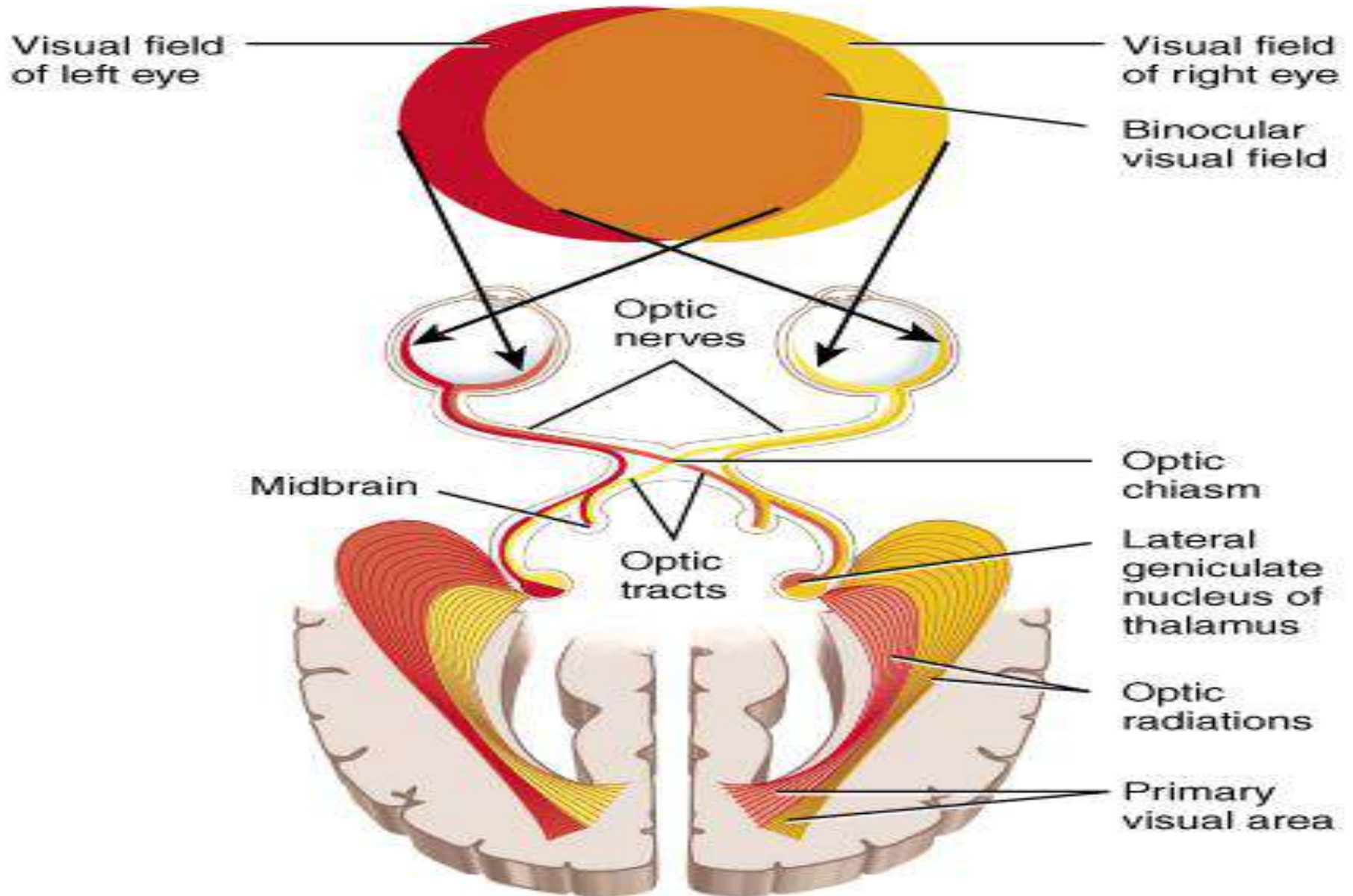


with macular sparing  
cerebral artery occlusion  
لوفروب cerebral a. بيل  
medial C.A. عذري





# The Visual Pathway

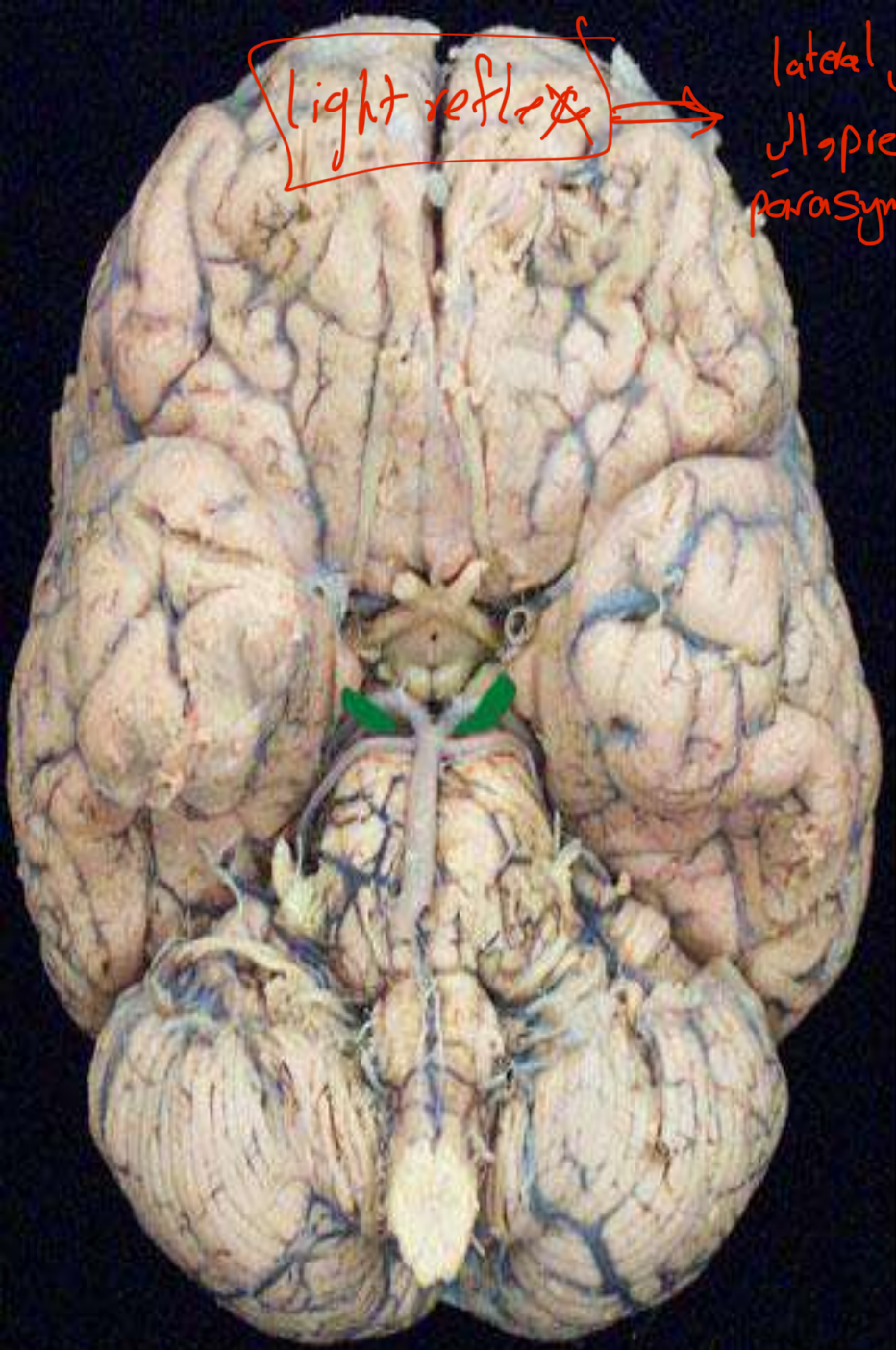


light reflex → A → II  
                          E → III

### III. The oculomotor Nerve

هذا الزعيم يغذي أكثر من كل extra, intra muscle in eye فاعداً في خلاصة

- **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.  
بقدرة شئ اتحكم في pupil
- **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.



light reflex

في lateral junculat body جـ بـ مـ fibers from optic tract  
 تتجه الى pretectal nucleus mid brain  
 الجـ تـ وصل الى لـ و لـ رة paraSympathatic nucleus of oculomotor  
 الجـ تـ وصل الى لـ و لـ رة other side of, side  
 direct light reflex  
 indirect light reflex





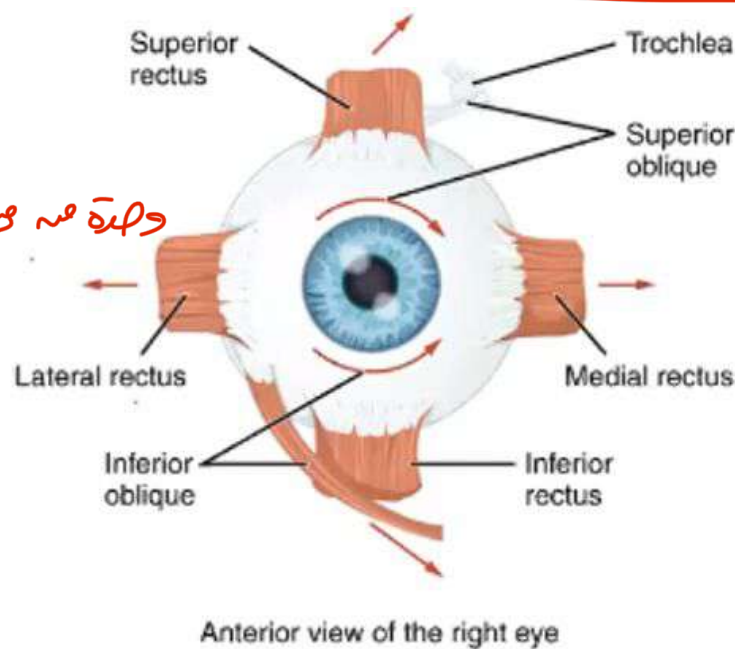
**The oculomotor N. supplies all of the intra- and extraocular muscles, Except:**

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.

بتساهم في رفع الجفنة

بتعطي horner syndrome

أو partial ptosis ← symptoms من sympathosis





# 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.

لو نقصونا oculomotor  
بصير عندي  
complete ptosis

الحفلة الكبيرة التي بتربغ عضلة العين



# Branches of the Oculomotor Nerve

## **1. Superior division “Somatic motor and sympathetic”:**

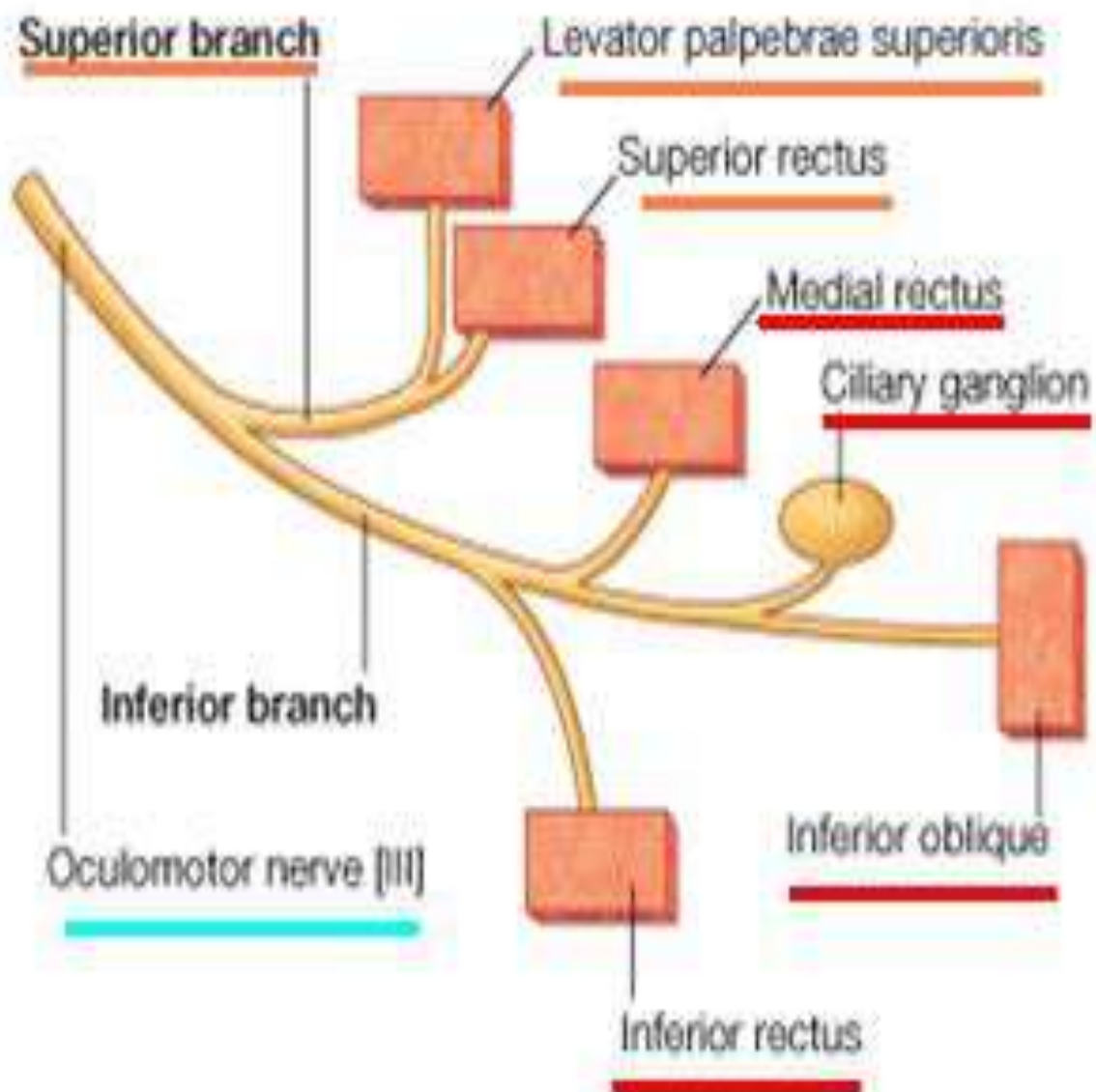
**which supplies the:**

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

## **2. Inferior division “Somatic motor and parasympathetic”:**

**which supplies the:**

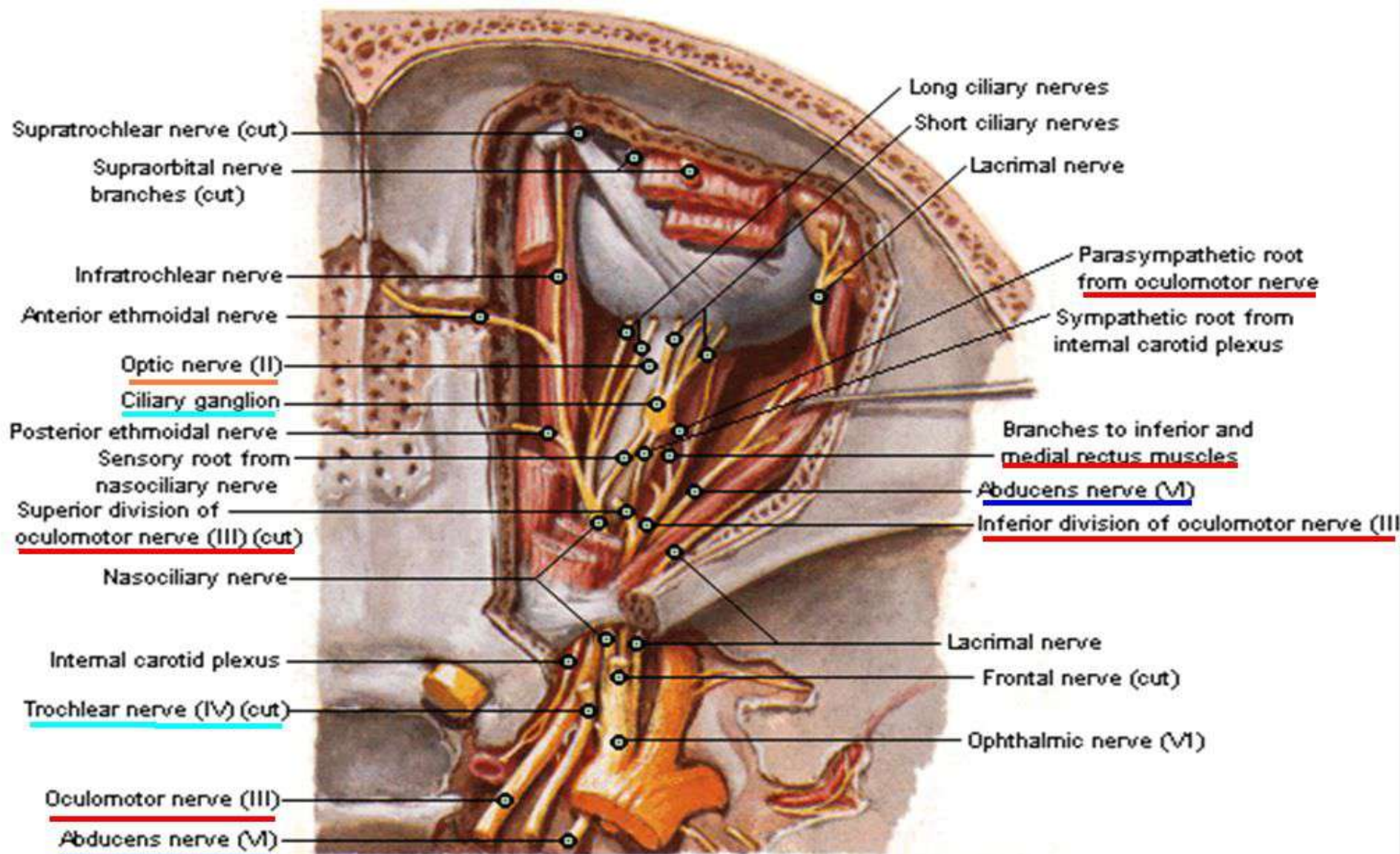
- a. Medial rectus muscle.**
- b. Inferior rectus muscle.**
- c. Inferior oblique muscle.**
- d. Constrictor pupillae muscle (via ciliary ganglion).**
- e. Ciliary muscle (via ciliary ganglion).**





# 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.

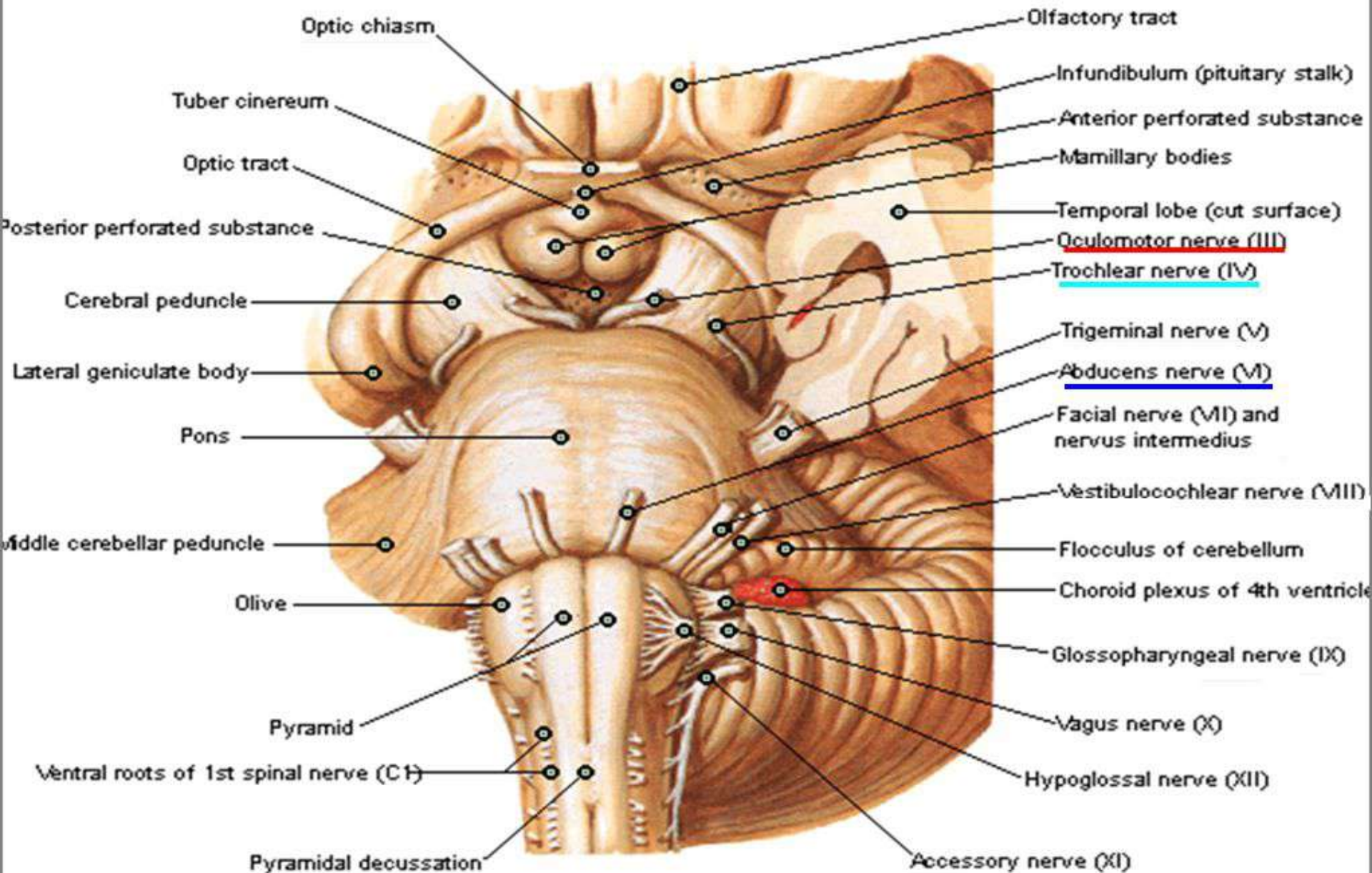
## VI. The Abducent Nerve

- **Abducent nerve:** *(Latin for "abduction")*.
- **Function and modality:** general somatic efferent → supplies <sup>lateral</sup> ~~the superior~~ <sup>retus</sup> ~~oblique~~ 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



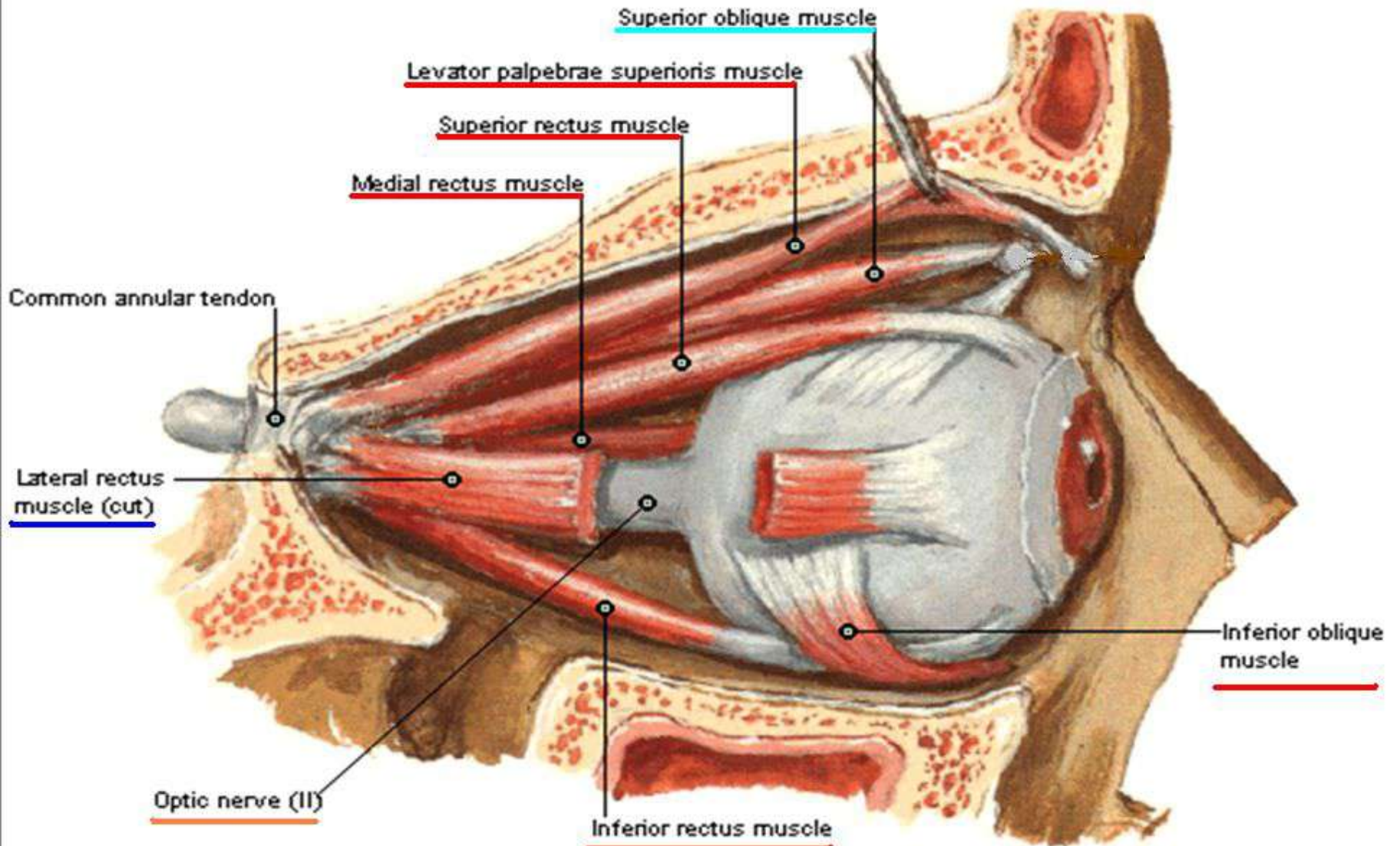


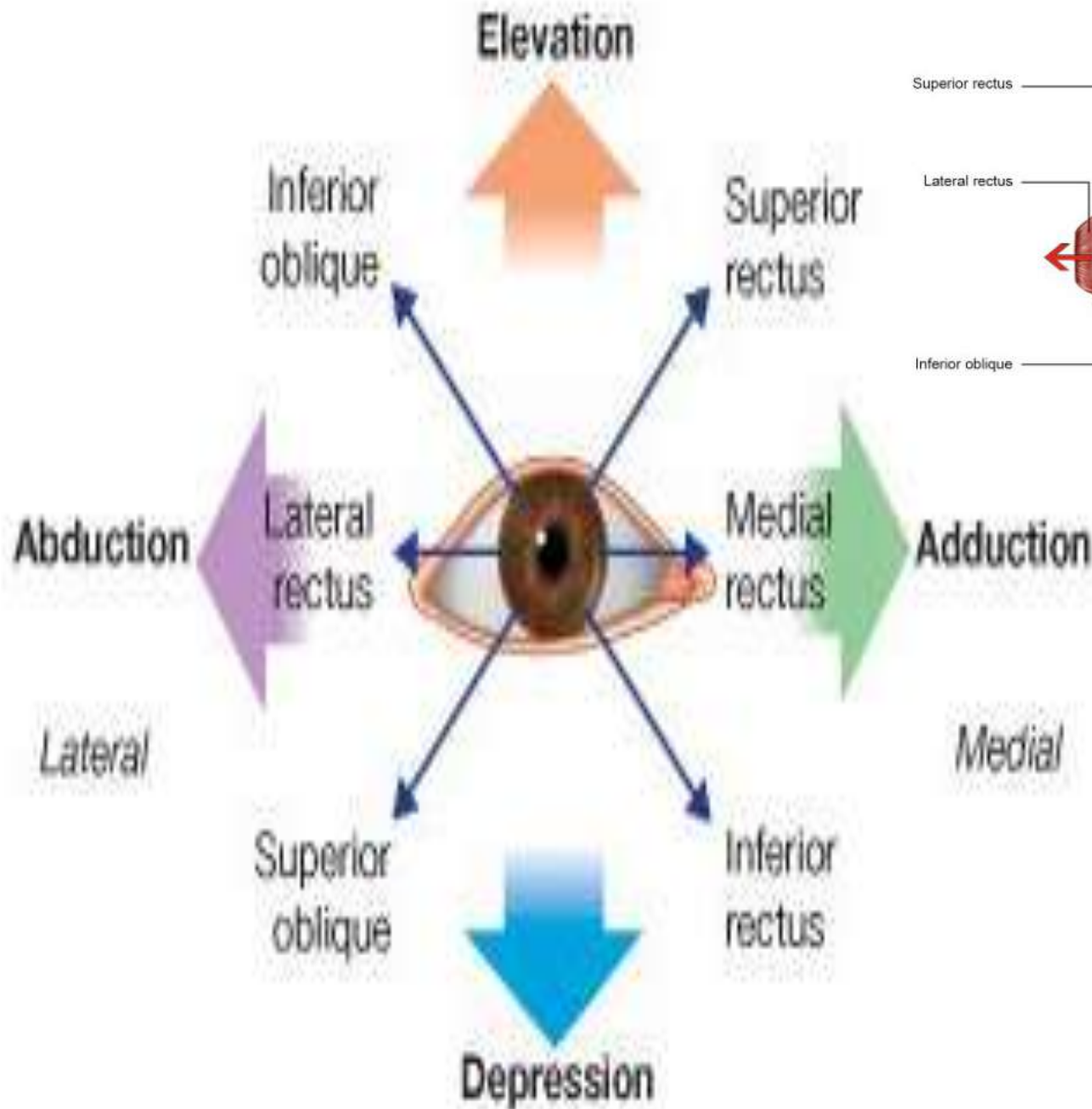
# The Actions of the Ocular Muscles

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.

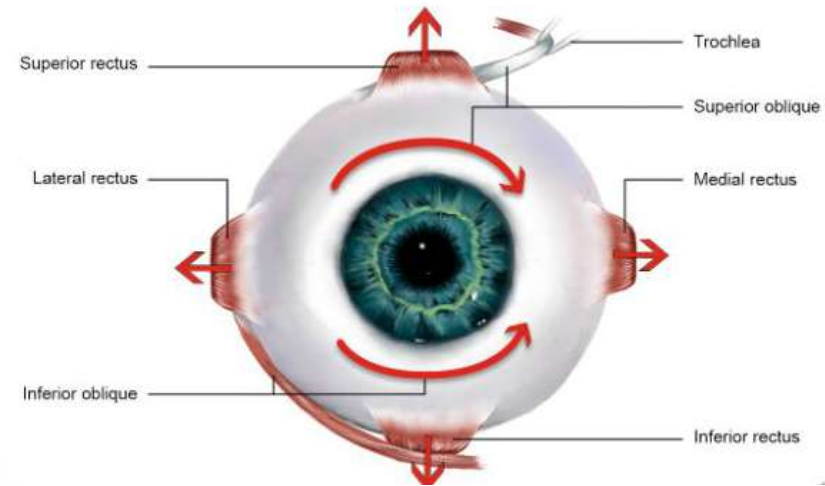
# Extrinsic Eye Muscles

## Right Lateral View

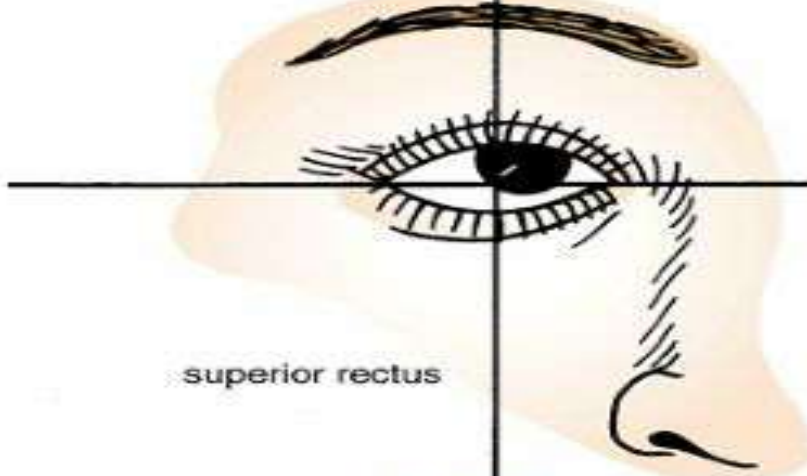




**Right Eye, Anterior View**

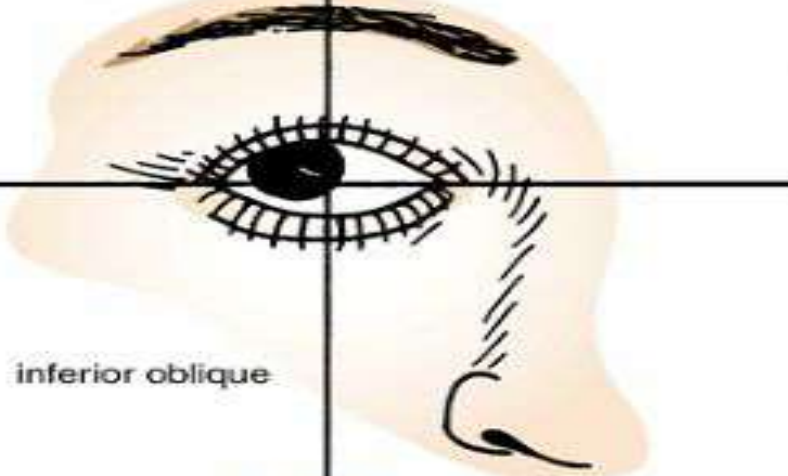






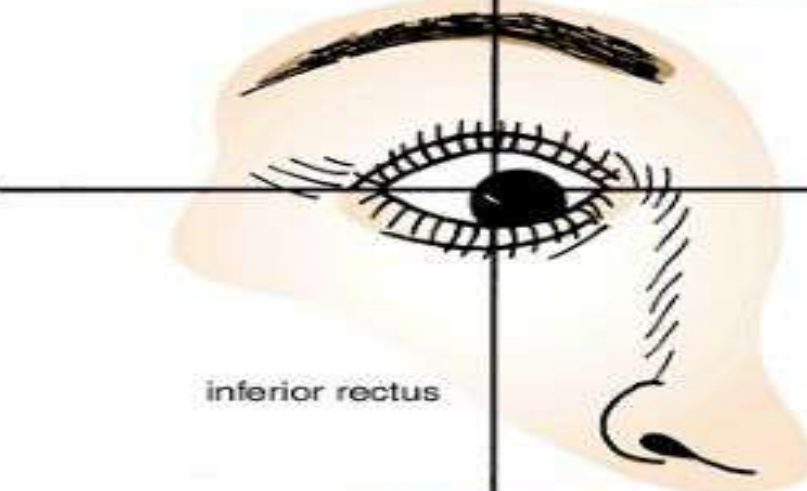
superior rectus

This diagram shows a lateral view of a human head with the eye looking straight ahead. A vertical line passes through the center of the eye, and a horizontal line passes through the pupil. The superior rectus muscle is highlighted in a light tan color, extending from the upper eyelid down to the eye. The muscle fibers are shown as a series of parallel lines, indicating its orientation.



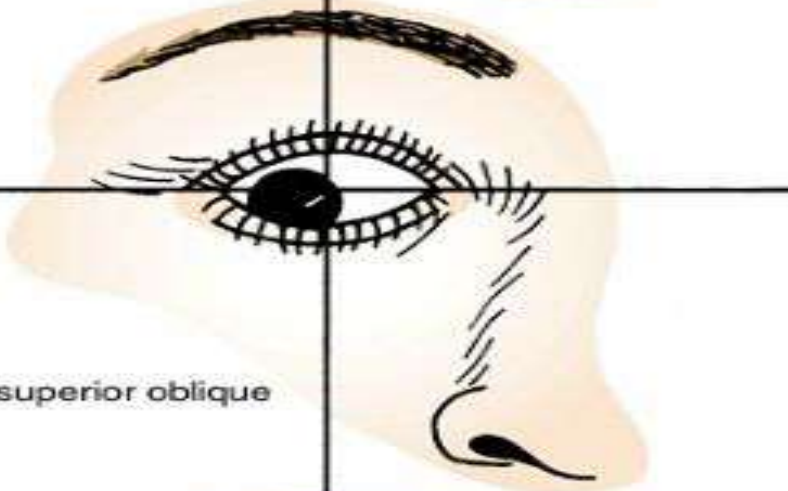
inferior oblique

This diagram shows a lateral view of a human head with the eye looking straight ahead. A vertical line passes through the center of the eye, and a horizontal line passes through the pupil. The inferior oblique muscle is highlighted in a light tan color, extending from the lower eyelid up to the eye. The muscle fibers are shown as a series of parallel lines, indicating its orientation.



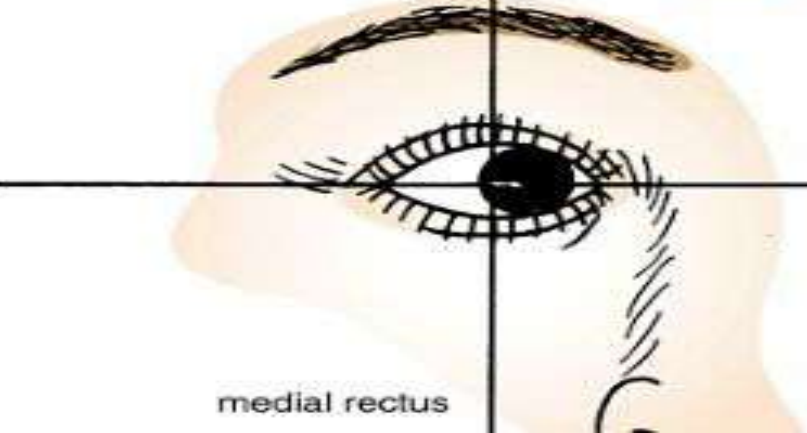
inferior rectus

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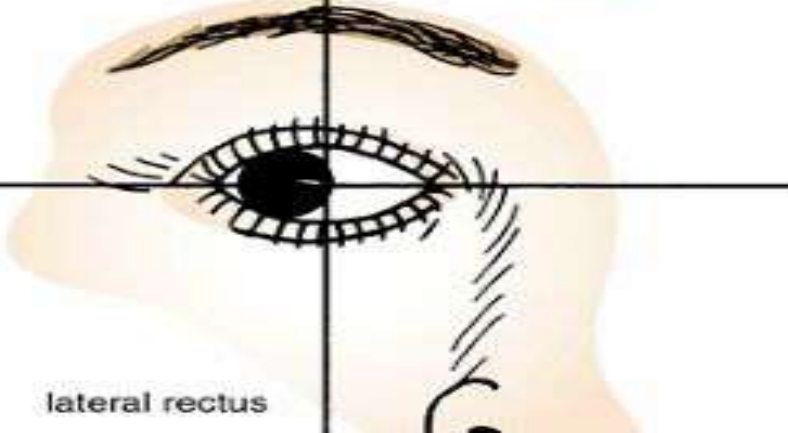
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medial rectus

This diagram shows a lateral view of a human head with the eye looking straight ahead. A vertical line passes through the center of the eye, and a horizontal line passes through the pupil. The medial rectus muscle is highlighted in a light tan color, extending from the inner corner of the eye towards the nose. The muscle fibers are shown as a series of parallel lines, indicating its orientation.



lateral rectus

This diagram shows a lateral view of a human head with the eye looking straight ahead. A vertical line passes through the center of the eye, and a horizontal line passes through the pupil. The lateral rectus muscle is highlighted in a light tan color, extending from the outer corner of the eye towards the temple. The muscle fibers are shown as a series of parallel lines, indicating its orientation.

# Lesion of the Oculomotor Nerve

- **Ptosis:** paresis of the levator palpebrae superioris muscle.

- **Diplopia:** occurs only on elevation of eye lid. →

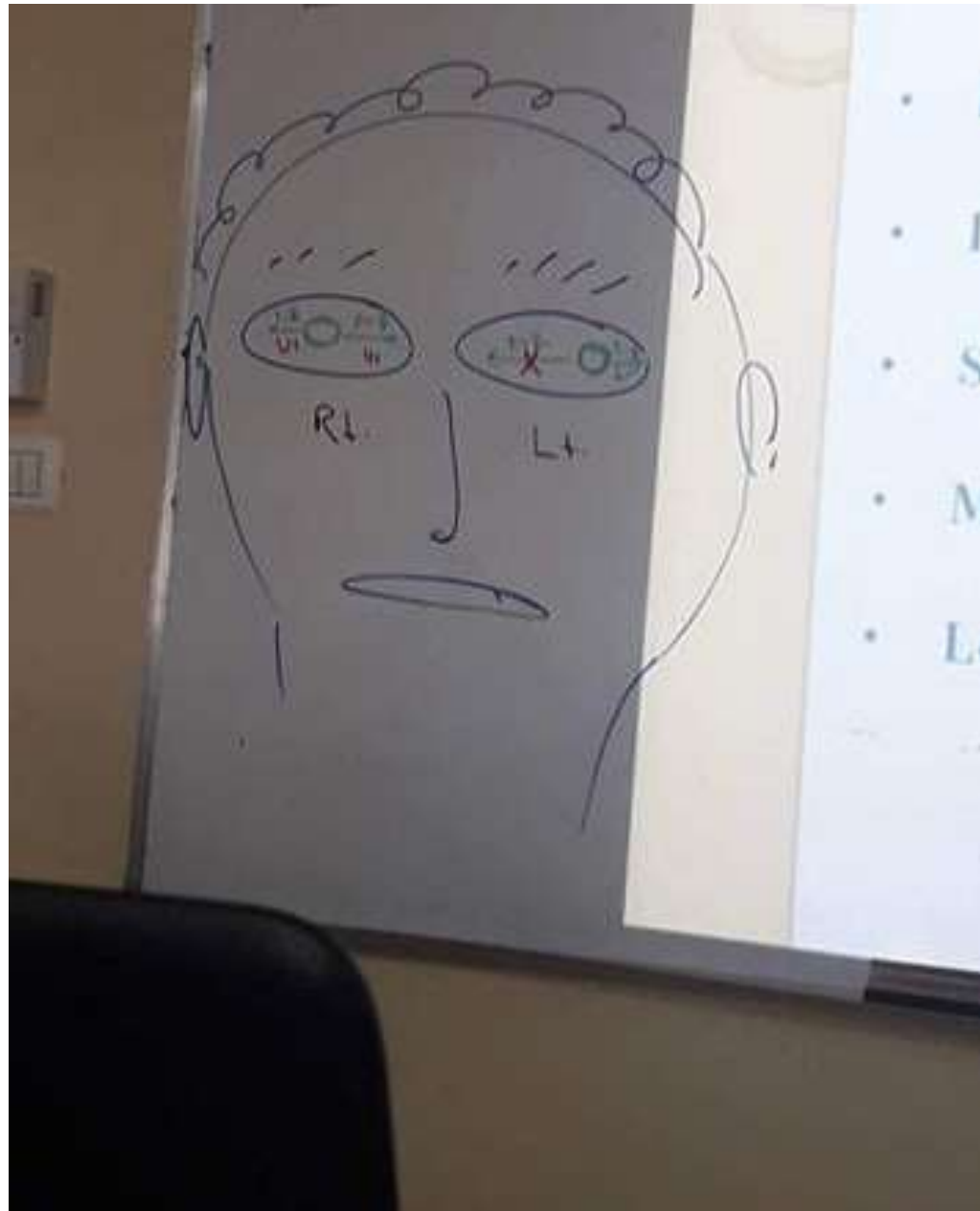
- **Squint:** divergent paralytic.

- **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

*Afferent* → 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

*Efferent* →



# 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).





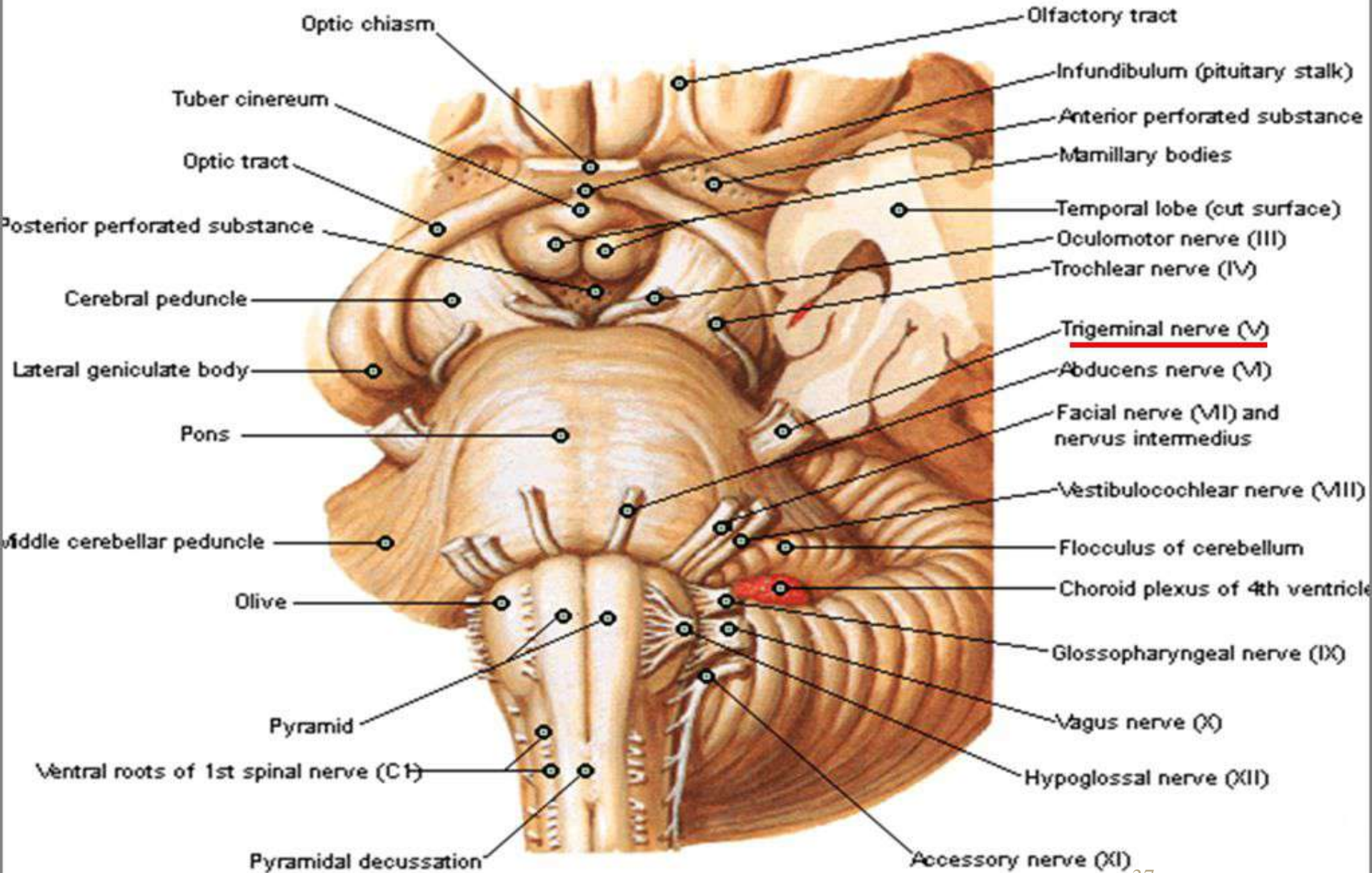
## V. The Trigeminal Nerve

يعني ٨ عصب

- The trigeminal nerve is **mixed nerve** (motor and sensory fibers). *Carry sympathetic and parasympathetic trigeminal n. نكه في عصبه*
- 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. *Cerebellar lobulation angle*
  - b. **Small Motor Root:** motor function. *٥, ٧, ٨ n بردافيه*
- The two roots are attached to the ventro-lateral aspect of the pons.

# Brainstem

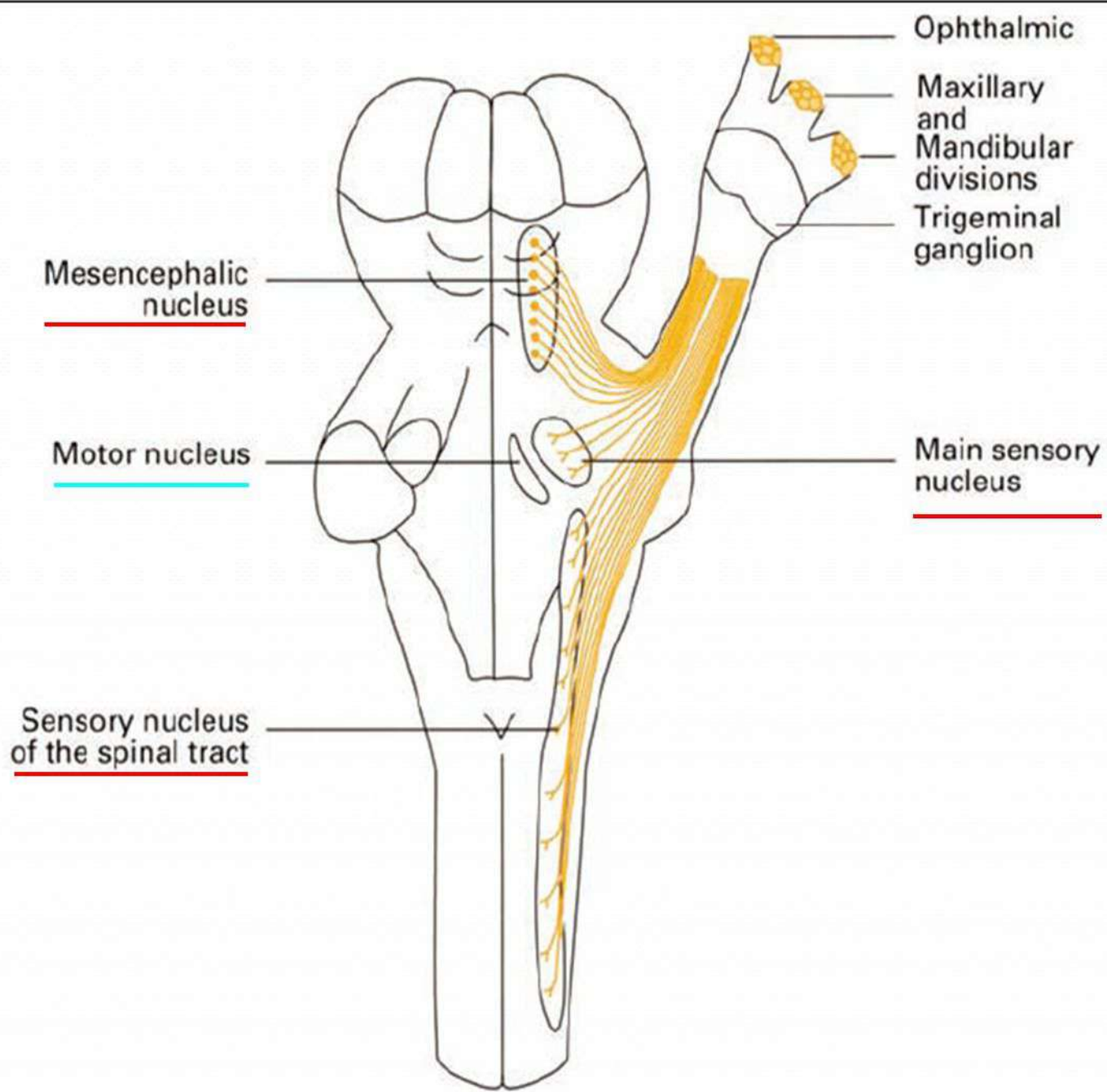
## Anterioinferior View



# Nuclei of the Trigeminal Nerve

1. **Main Sensory Nucleus:** lies in the middle part of the pons (for touch sensation).  
*upper molar maxillary v.*
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).  
*C<sub>2</sub> - C<sub>4</sub>*  
*ophthalmic*  
*mandibular*
3. **Mesencephalic Nucleus:** lies in the midbrain and upper part of the pons (deep sensation).  
*الفصل prep. section*
4. **Motor Nucleus (motor function):** lies in the middle of the pons. It give motor fibers that joins with the mandibular nerve.  
*الى بتفني 8 حقلات*



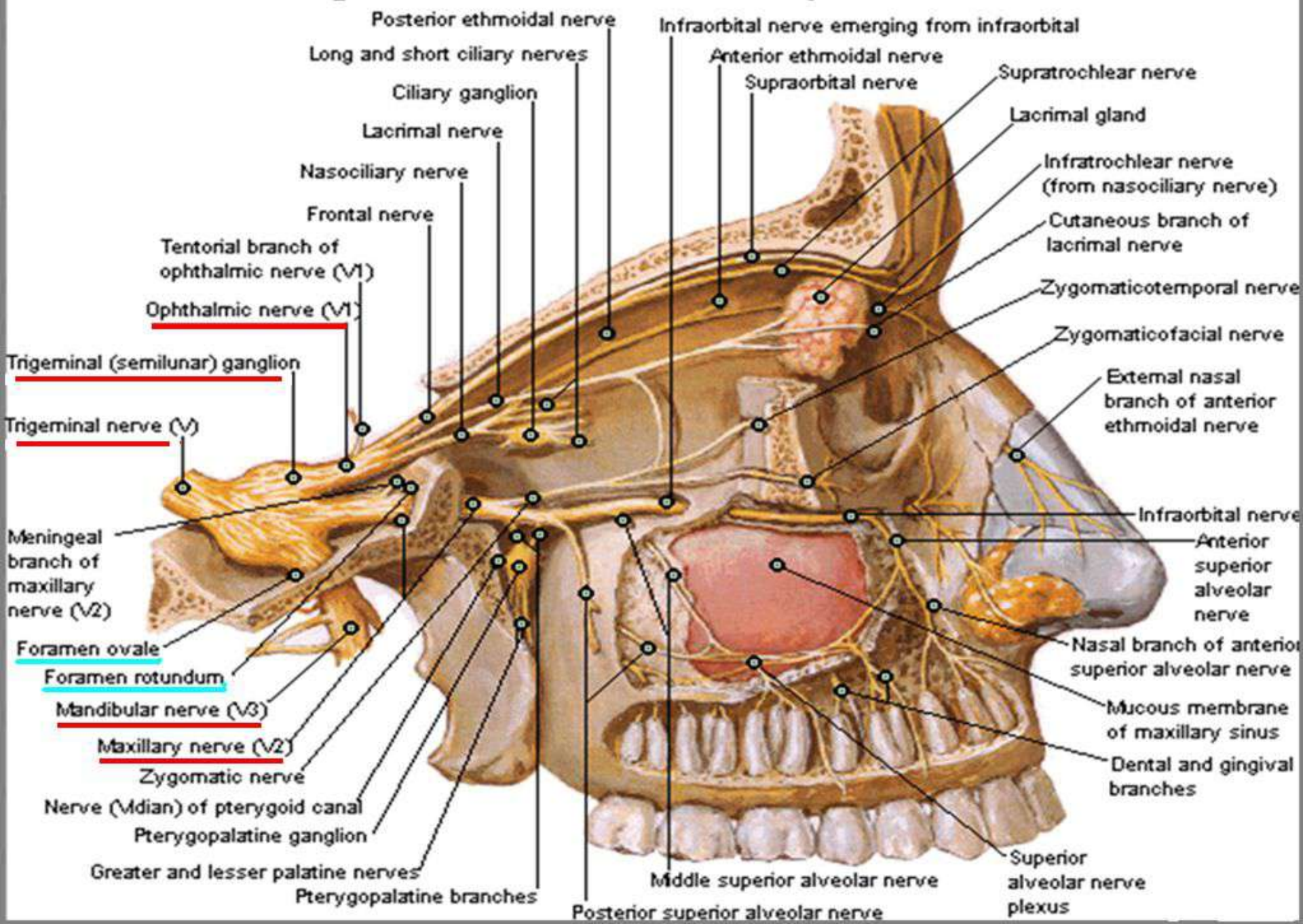


# Branches of the Trigeminal Nerve

The trigeminal nerve has three branches:

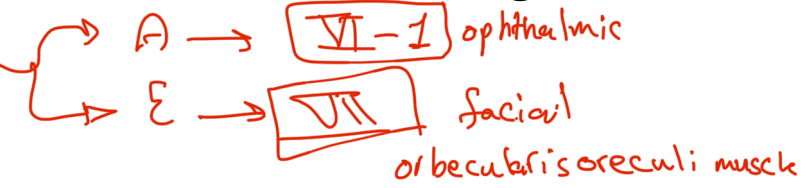
1. Ophthalmic Nerve (V1): **sensory.**
2. Maxillary Nerve (V2): **sensory.**
3. Mandibular Nerve (V3): **mixed.**

# Ophthalmic and Maxillary Nerves





# The Ophthalmic Nerve (V<sub>1</sub>)

- 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 (V<sub>2</sub>)

- 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.

A → V 2 + IX  
E → IX and Cr II

# The Mandibular Nerve (V<sub>3</sub>)

- 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.

اعض لسانى -  
بارد و سخنه -  
general sensation  
taste ← طعم و حلو  
temporal n. from facial

# Motor Functions of the Mandibular Nerve

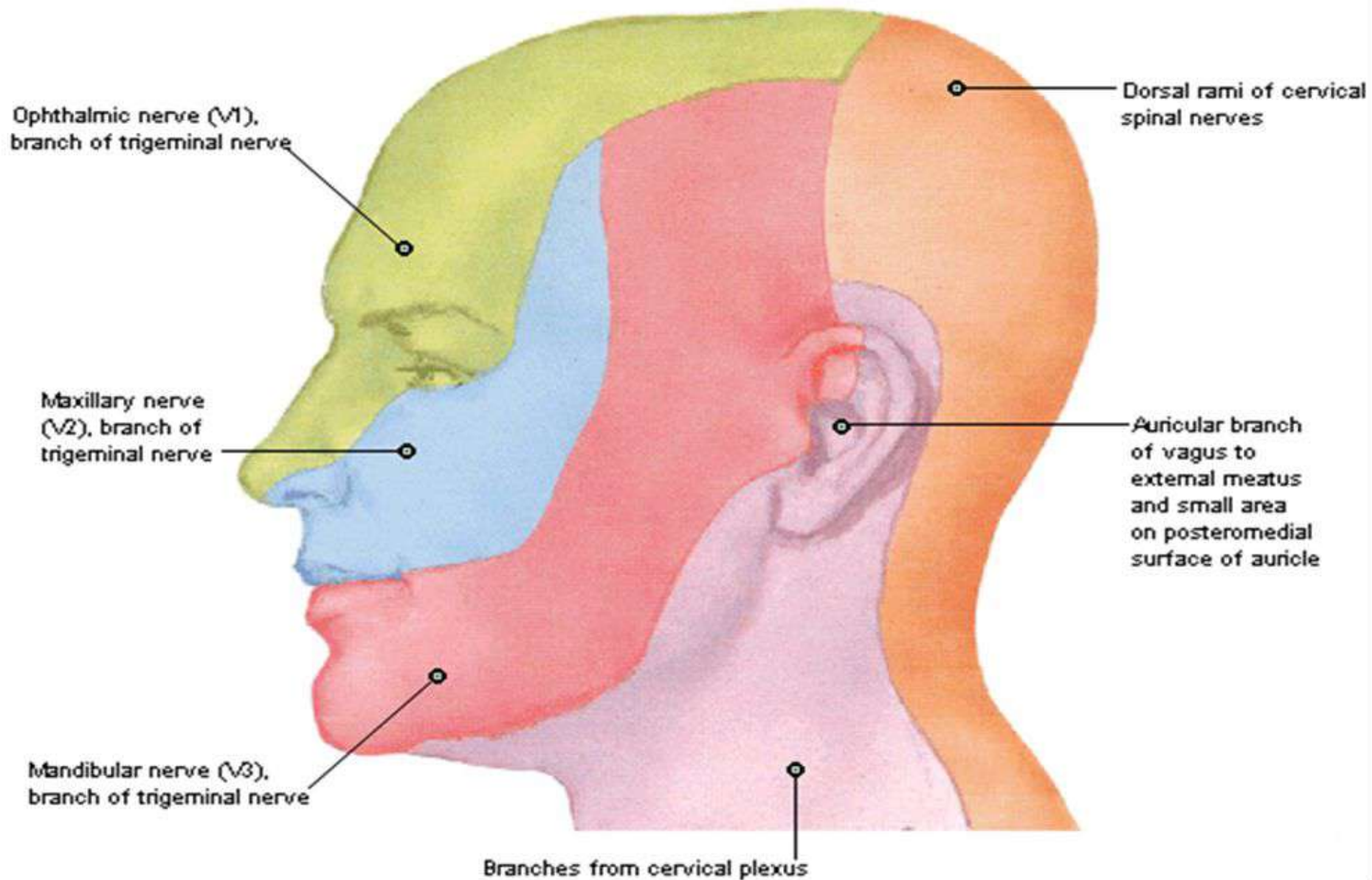
## 1. Motor fibers to muscles of mastication:

- 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

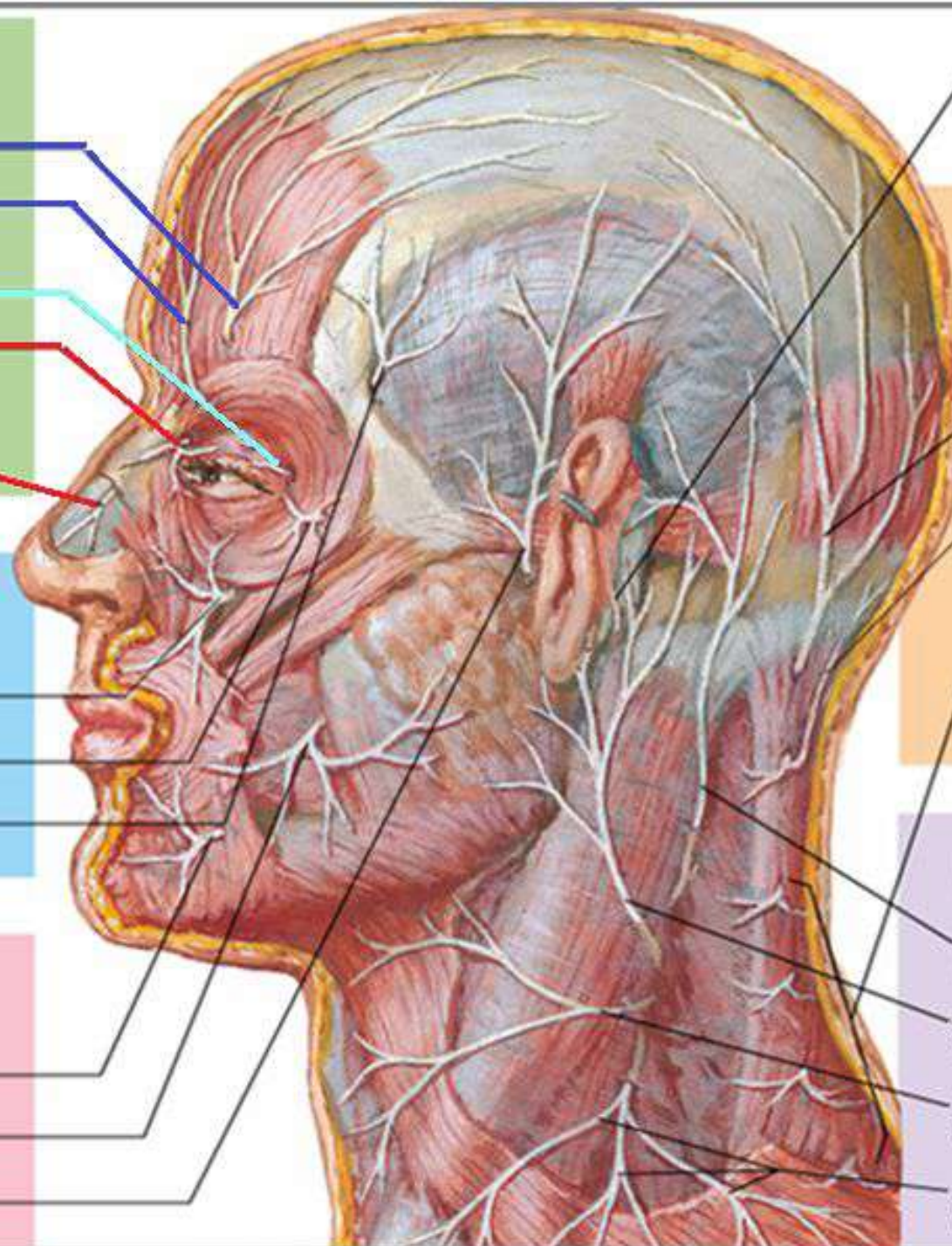
Branches from  
cervical plexus

Lesser occipital  
nerve (C2, 3)

Great auricular  
nerve (C2, 3)

Transverse cervical  
nerve (C2, 3)

Supraclavicular  
nerves (C3, 4)



# Trigeminal Neuralgia (TN)

## ”Tic Doloureux“



نوبات / على نفس الوتيرة

- 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.

نسي الحواس

في

- neck  
- thigh  
- foot

## 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.



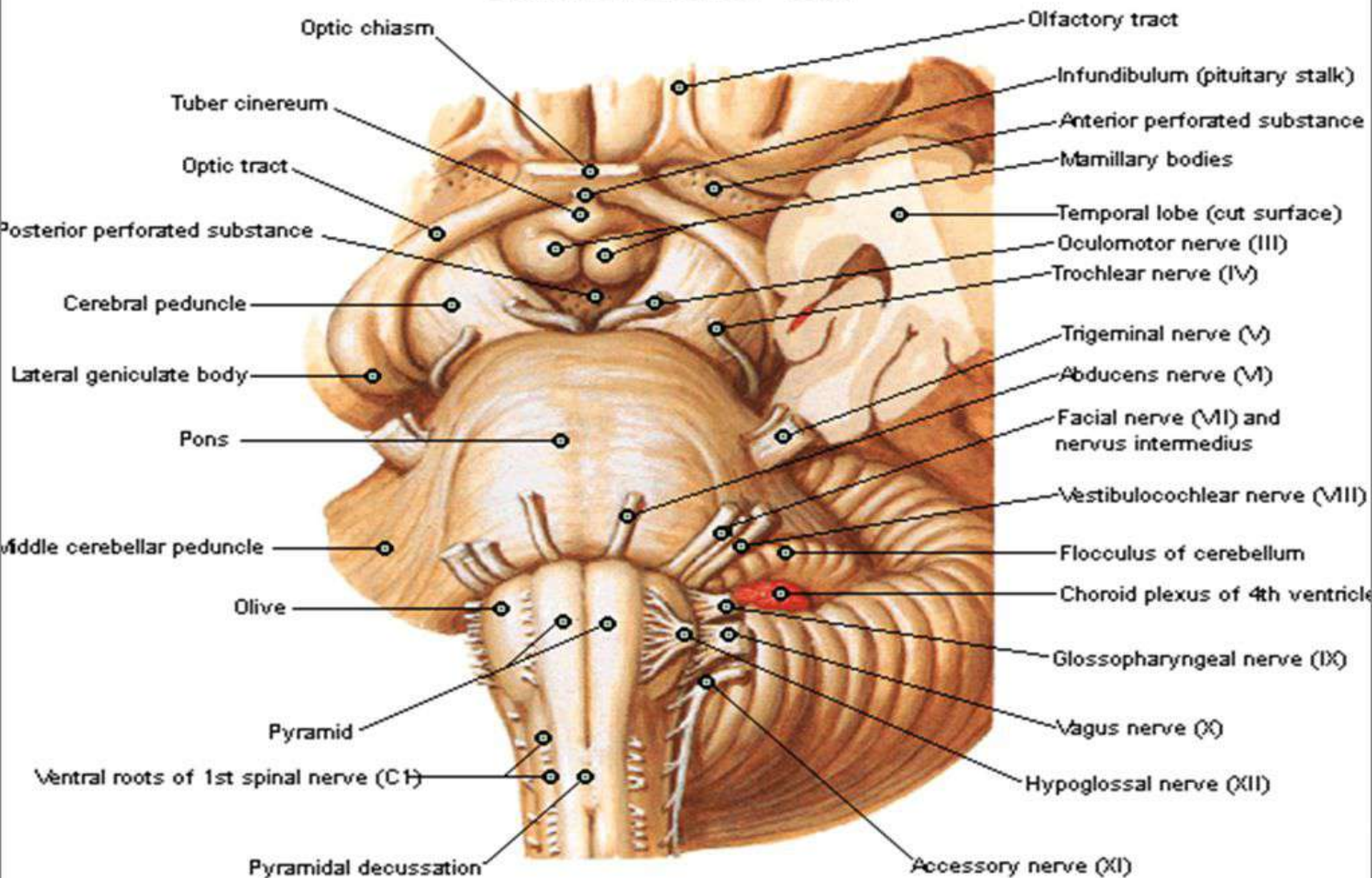
# Roots of the Facial Nerve

- **Facial Nerve (motor nerve):** <sup>large root</sup> is a purely motor nerve supplies all the muscles of face expression.
- **Nerve Intermedius:** <sup>small root</sup> consists of sensory and parasympathetic fibers.



# Brainstem

## Anterioinferior View

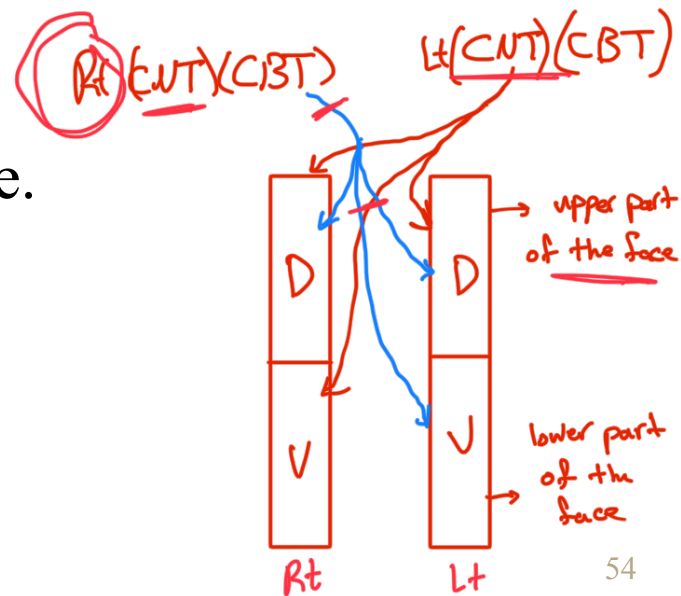


# Nuclei of the Facial Nerve

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**). *GSPN*
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. *Chorda tympani nerve*



1. Motor function to muscles of facial expression.  
*Stapedius muscle* بطني
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  $\frac{2}{3}$  of the tongue.
5. Corneal reflex.





10 branches  
إليه  
3 في

## Branches of the Facial Nerve Inside the Fallopian Canal

1. The greater superficial petrosal nerve "GSPN".  
↳ Parasympathetic

2. Small branch to the stapedius muscle.

↳ ينقل قوة الصوت دلو

3. The chorda tympani.

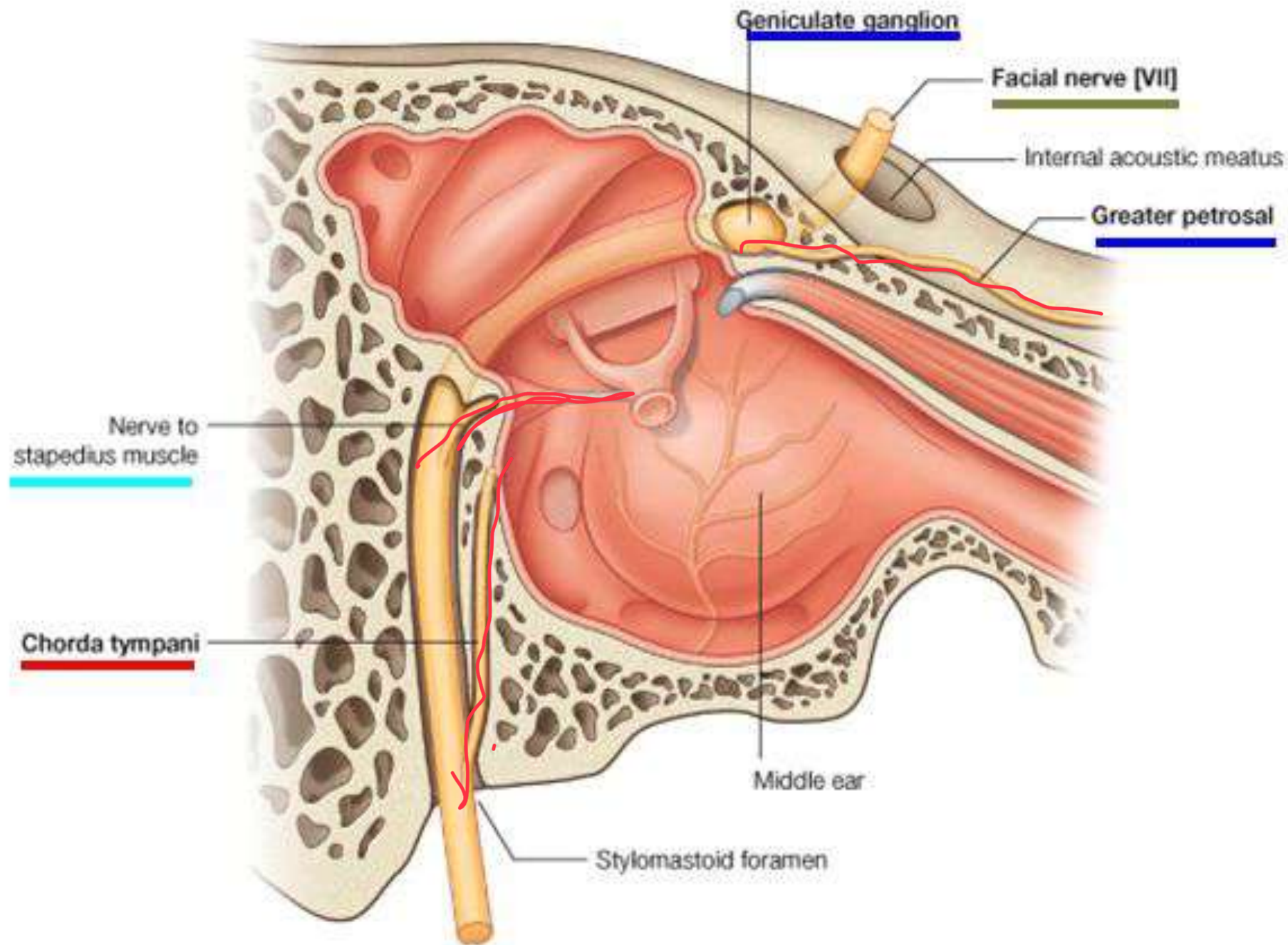
↳ taste sensation of anterior  $\frac{2}{3}$  of the tongue

Submandibular  
Sublingual  
Salivary  
gland

postganglionic fibers (ألياف ما بعد العصبية)، Submandibular ganglionic

preganglionic (ألياف ما قبل العصبية)، Parasympathetic fibers of chorda tympani n.





# 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”:

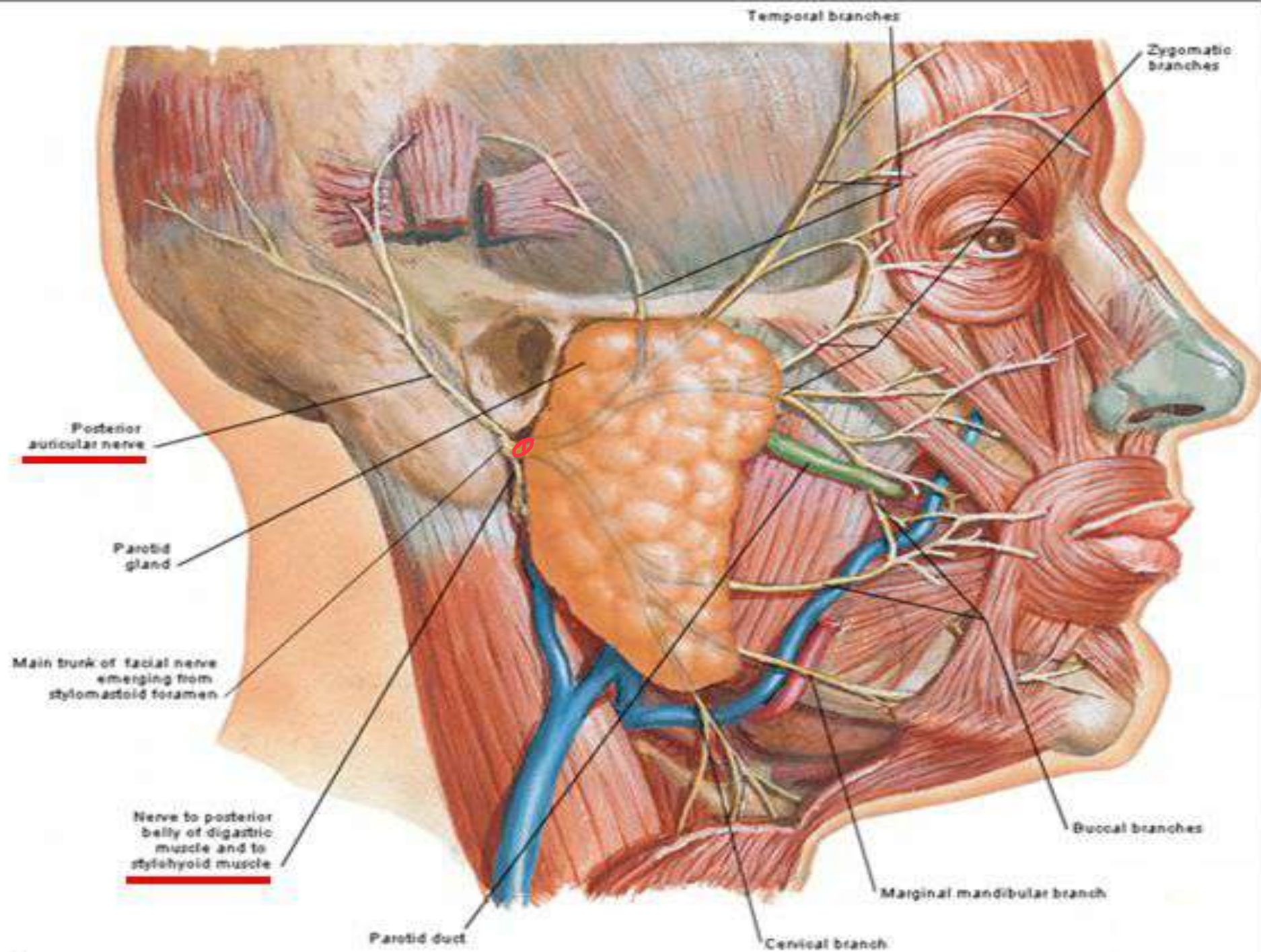
1. Temporal nerve (from temporofacial branch).
2. Zygomatic nerve (from temporofacial branch).
3. Buccal nerve (from cervicofacial branch). *motor*
4. Marginal mandibular nerve (from cervicofacial branch). *muscle around angle of the mouth*
5. Cervical nerve (from cervicofacial branch).

posterior  
medial surface  
of parotid gland  
temporo  
facial  
cervico  
facial

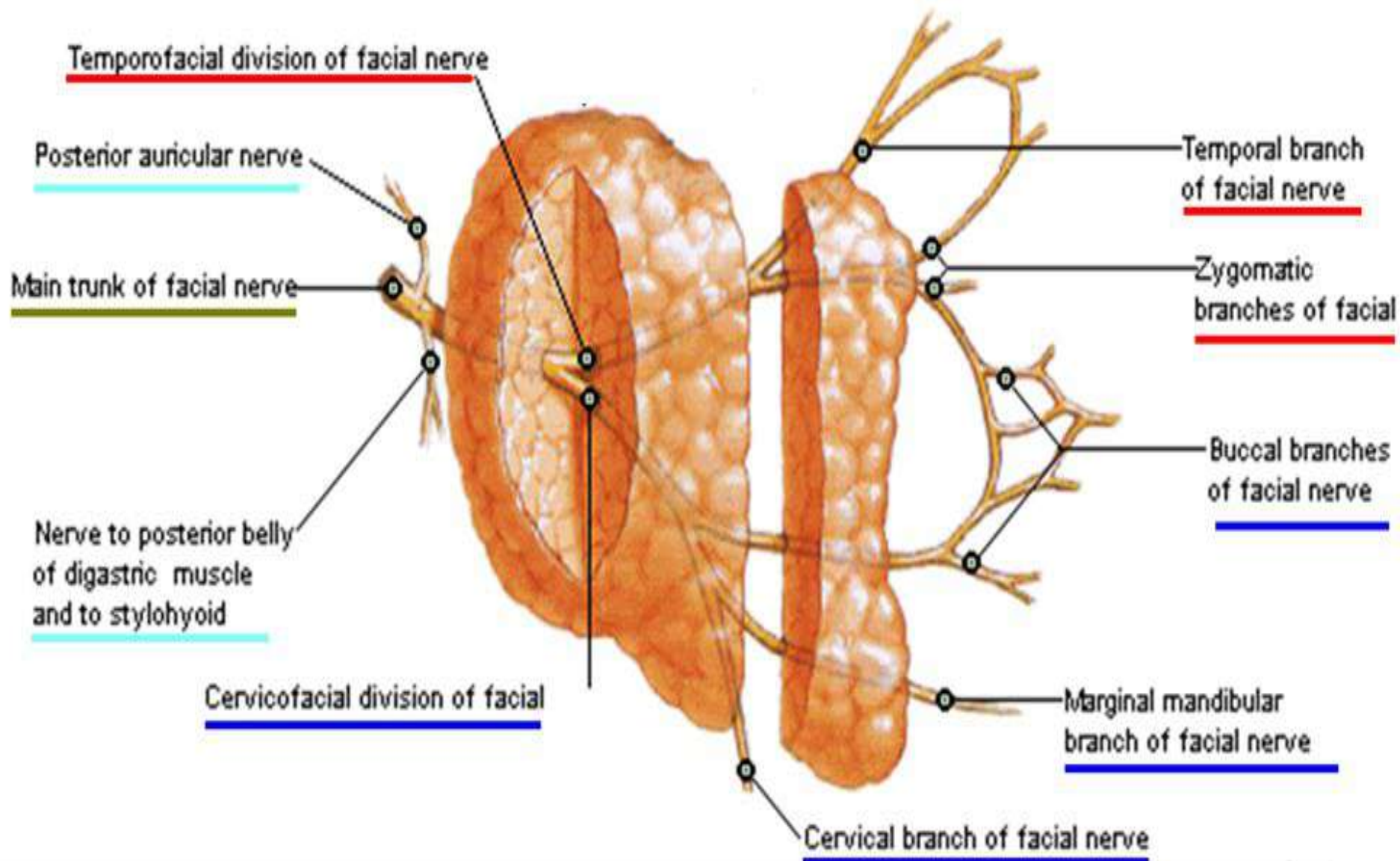
lower  
↓  
m. between eye  
and mouth  
upper  
↓  
orbicularis  
ocularis  
m.

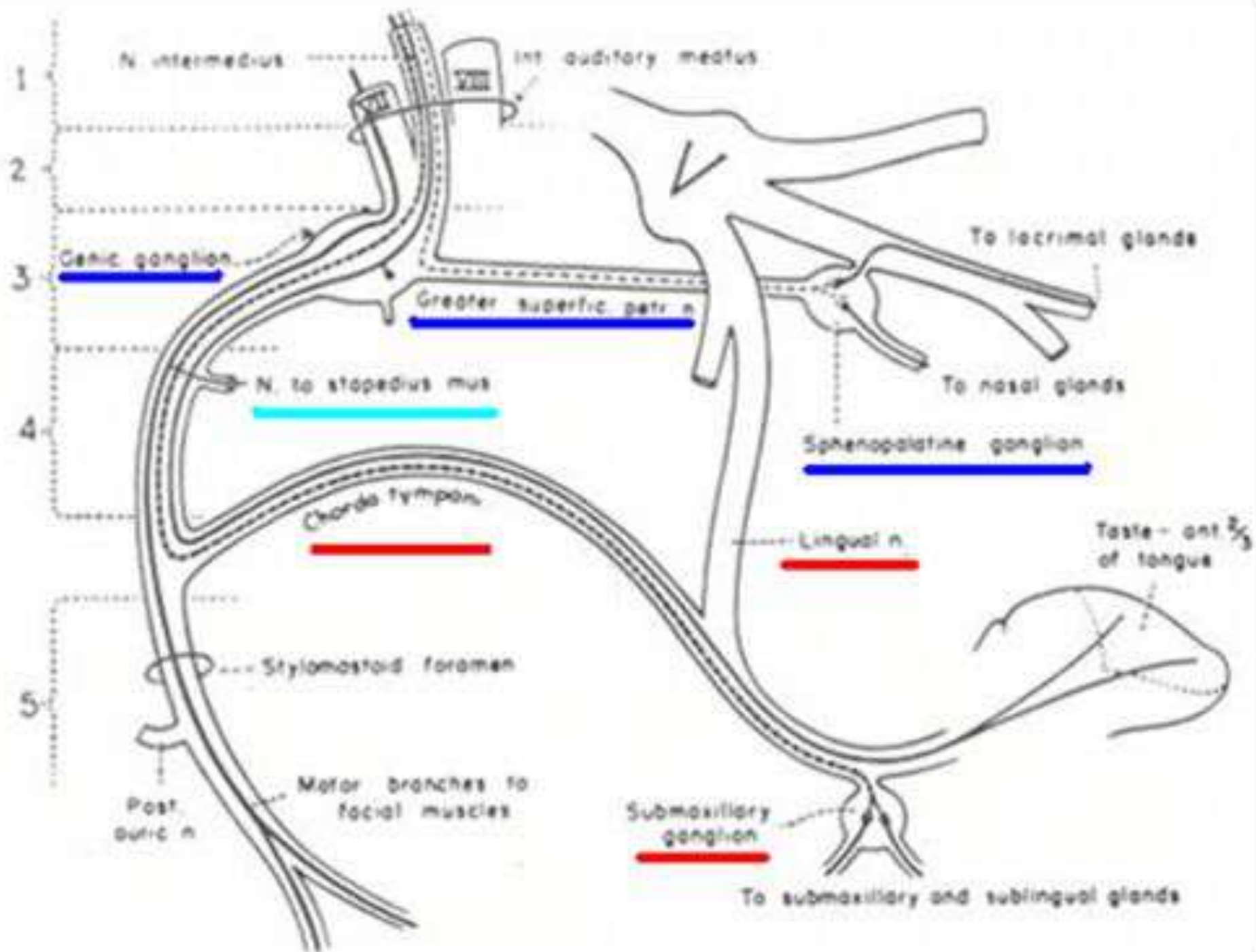
orbicularis oris muscle + buccinator m.







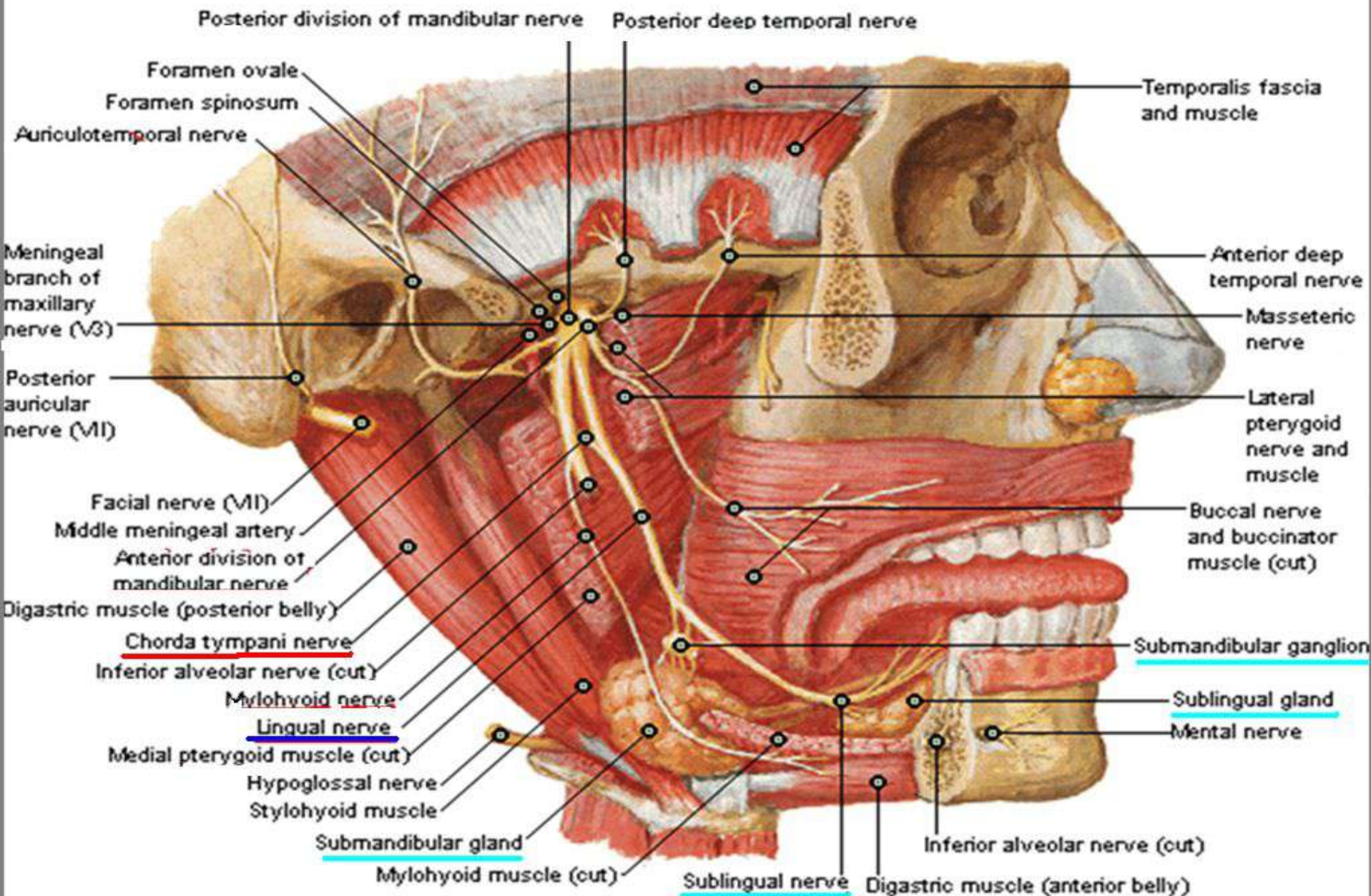




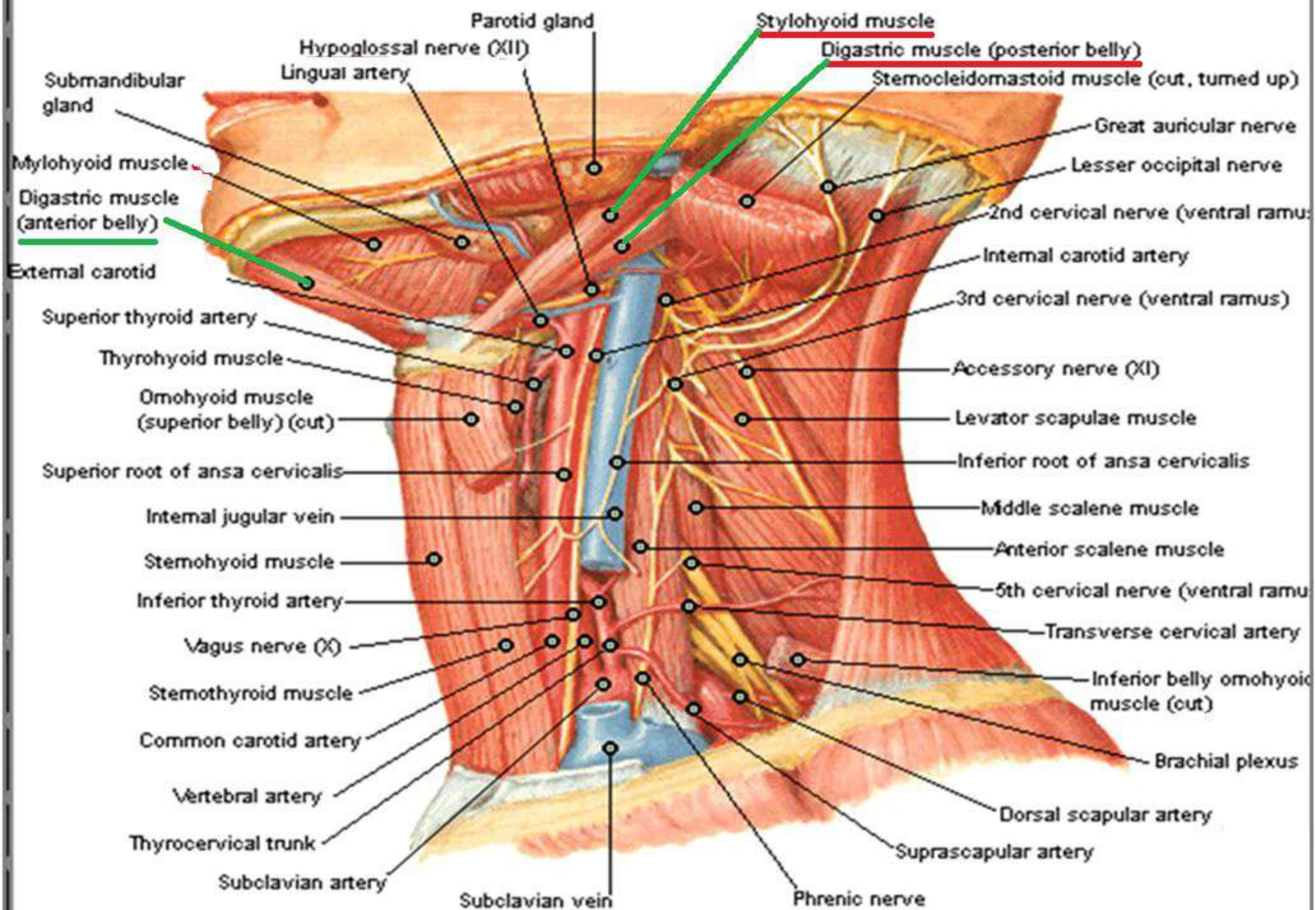


# Mandibular Nerve [V3]

## Lateral View







# *file* 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

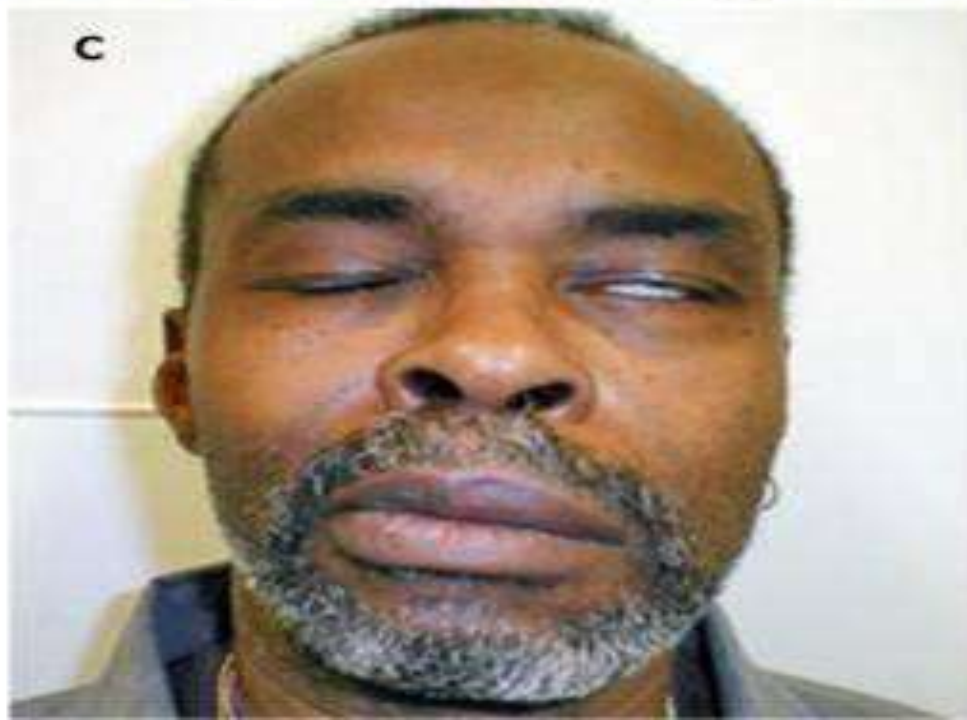
**Ramsay Hunt syndrome:** acute peripheral facial neuropathy associated with erythematous vesicular rash of the skin of the ear canal.

**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.





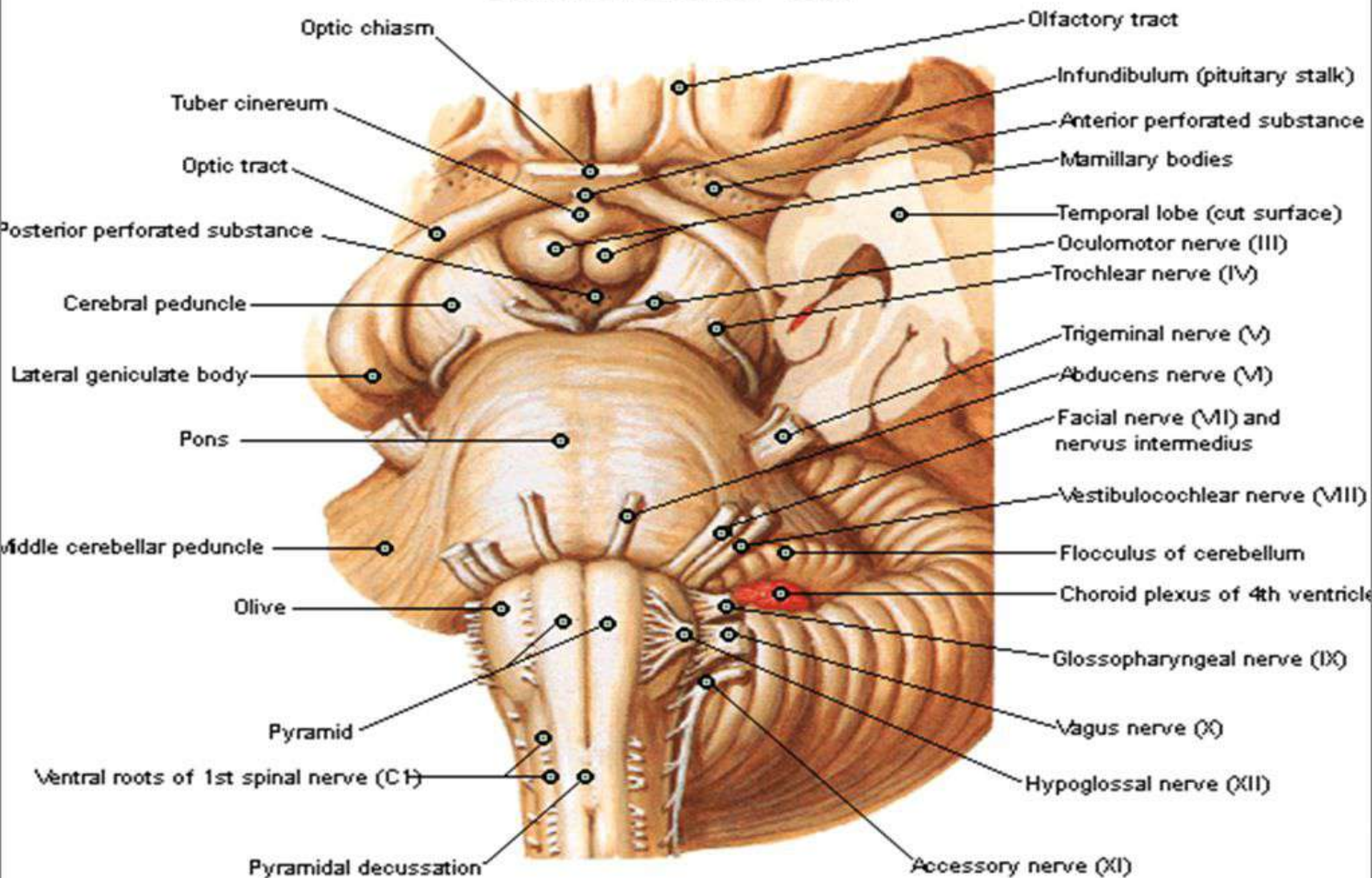
# The Vestibulo-Cochlear Nerve (VIII) (Auditory or Stato-Acoustic nerve)

- 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. + labritin artery
- It has two divisions:
  - **Cochlear division.** → hearing —
  - **Vestibular division.** → balance ✓

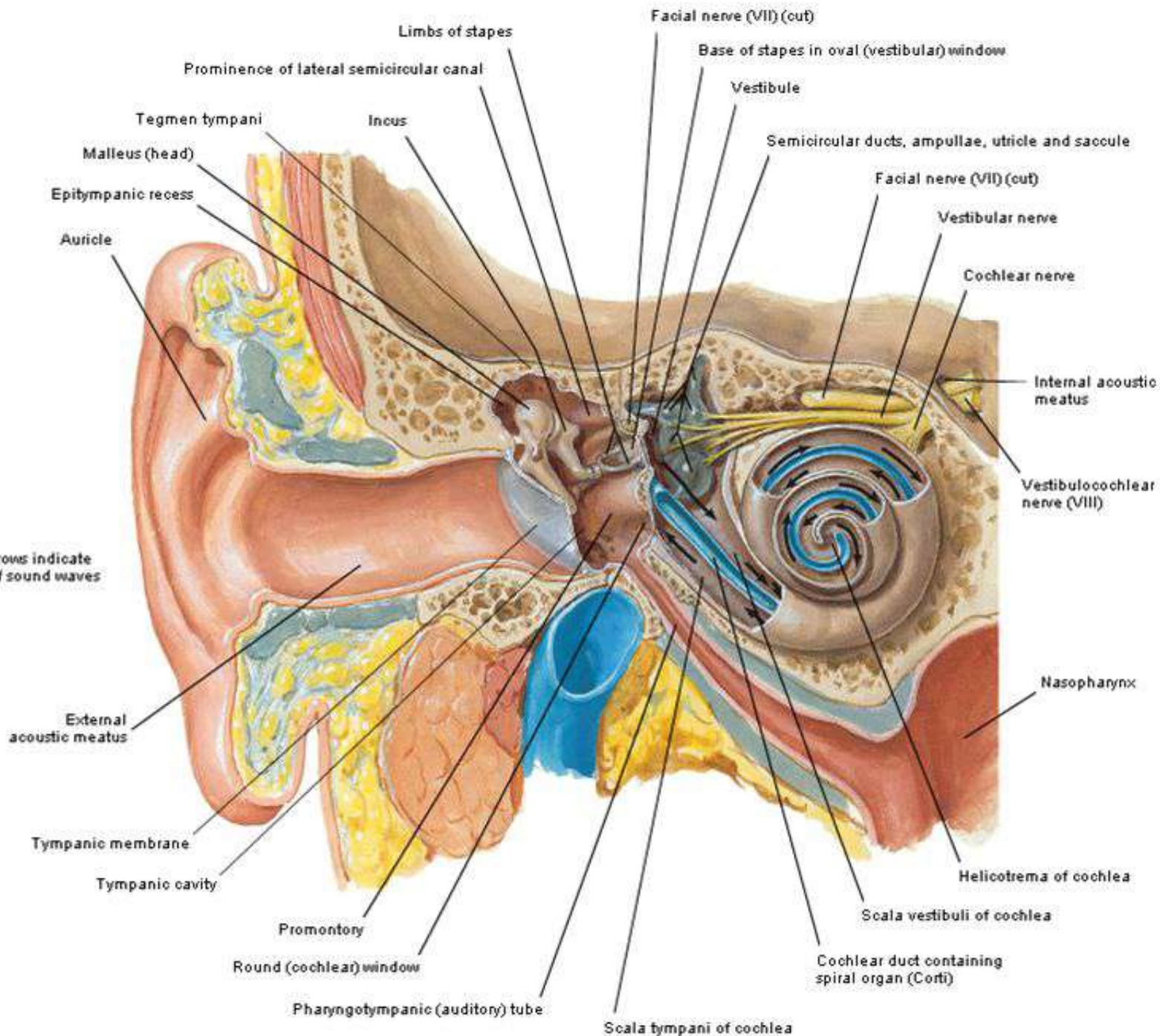


# Brainstem

## 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.

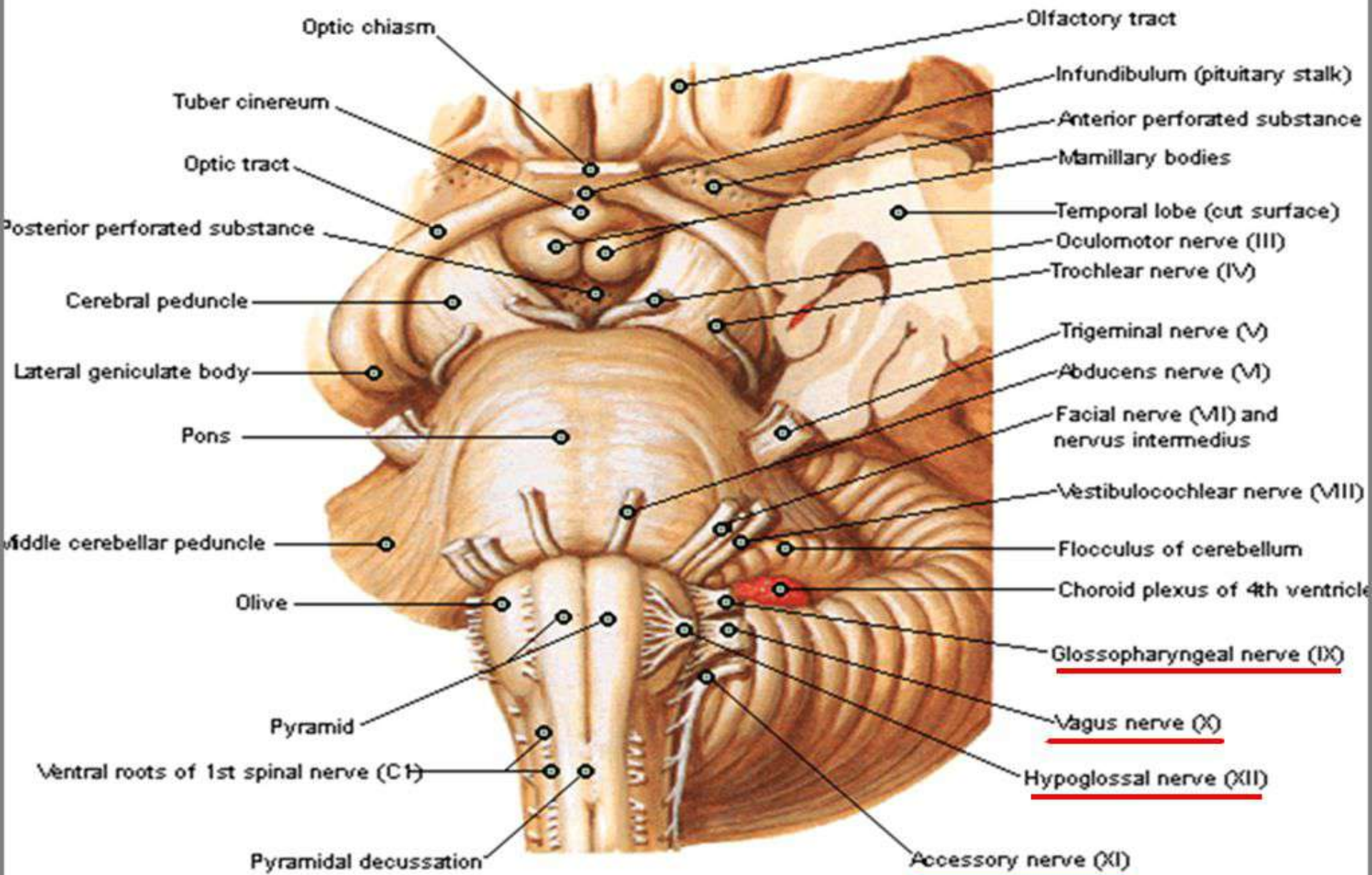
□ **Modalities:** GVE, SVE, GSA, & SVA.

□ **Foramen:** Jugular foramen.



# Brainstem

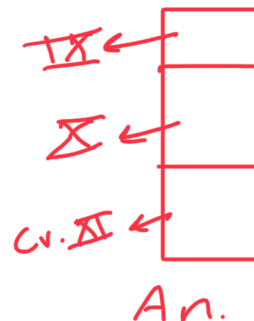
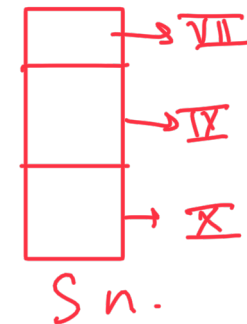
## Anterioinferior View

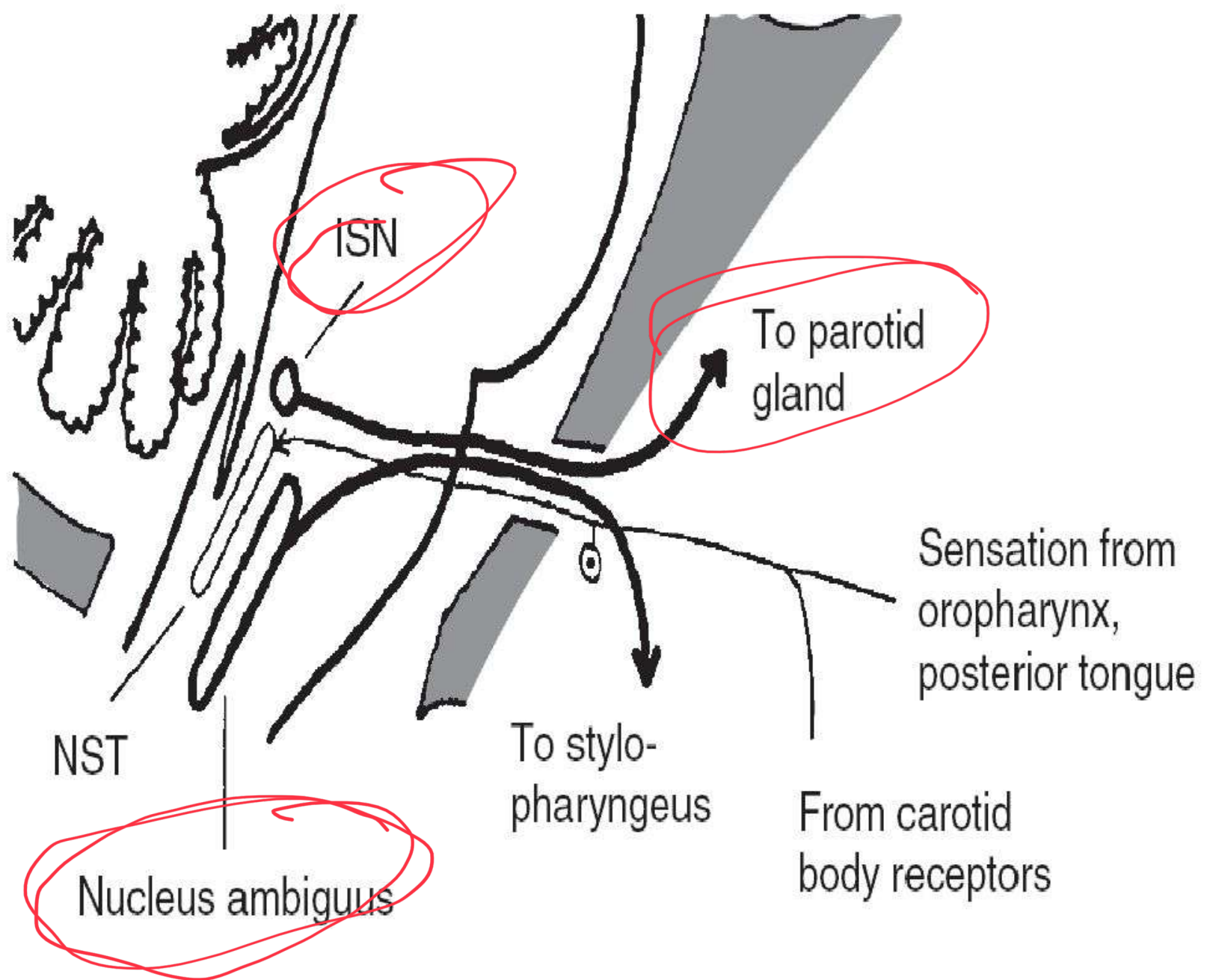


# Nuclei of the Glossopharyngeal Nerve

It has three nuclei:

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







# Functions of the Glossopharyngeal Nerve

1. **Sensory function:** supplies the:

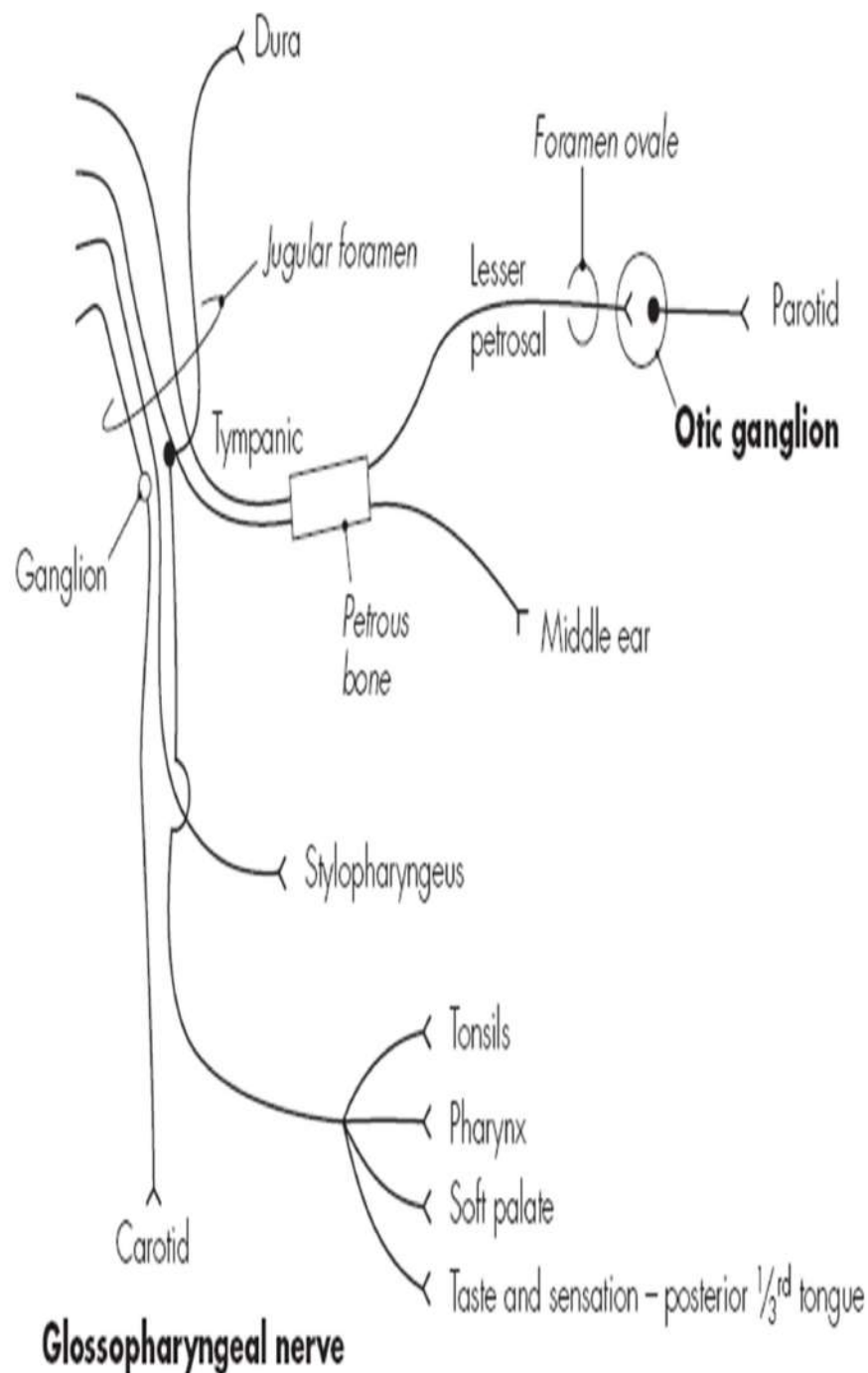
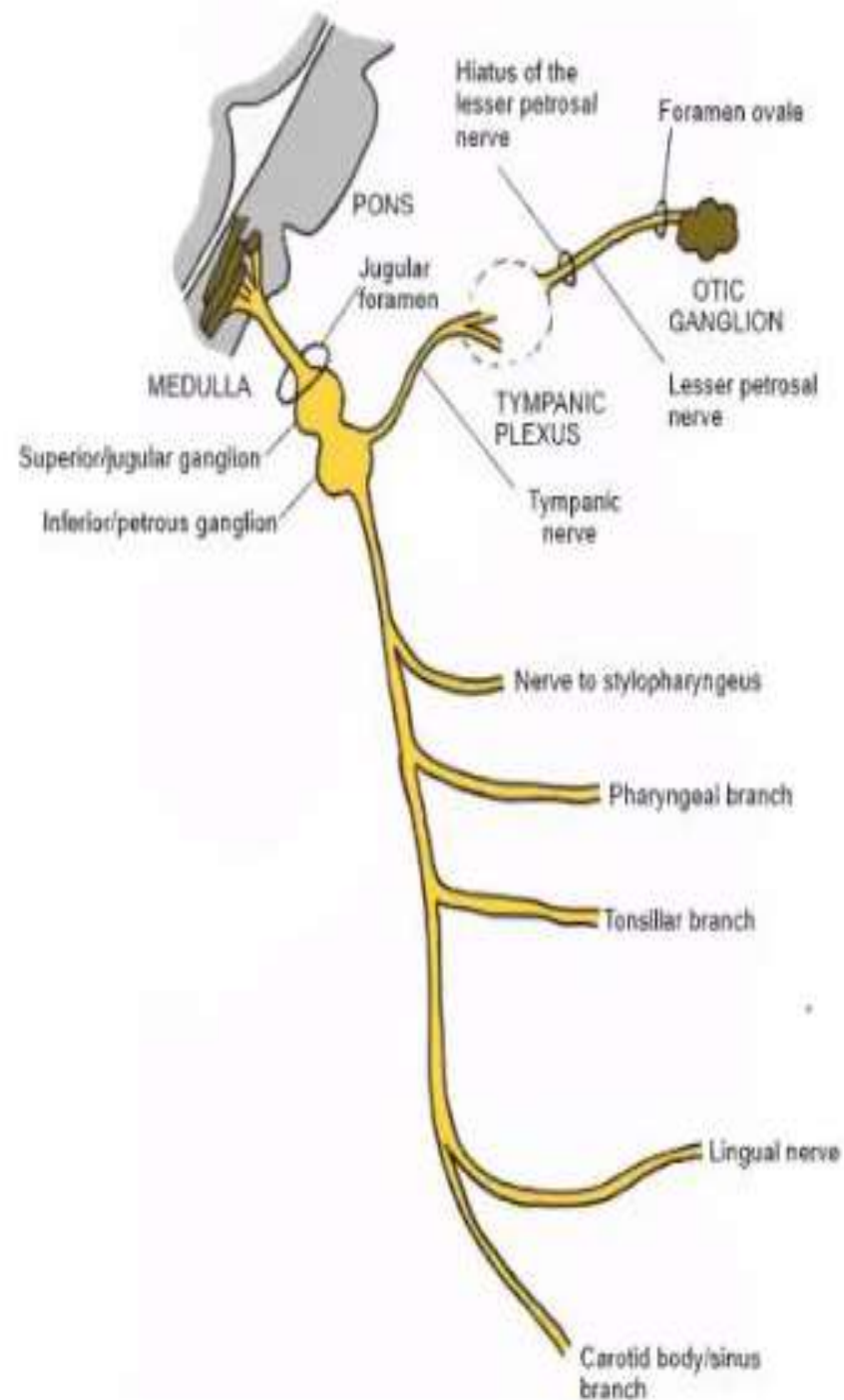
- a. Posterior 1/3 rd of the tongue (taste and general sensation).
- b. Mucous membrane of the pharynx and tonsil.
- c. Carotid sinus and carotid body.

2. **Parasympathetic function:** supplies the parotid gland.

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

# Branches of the Glossopharyngeal Nerve

1. **Meningeal branch (sensory):** Supplies meninges of posterior cranial fossa.
2. **Tympanic branch or Jacobson's nerve (parasympathetic nerve):** 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.

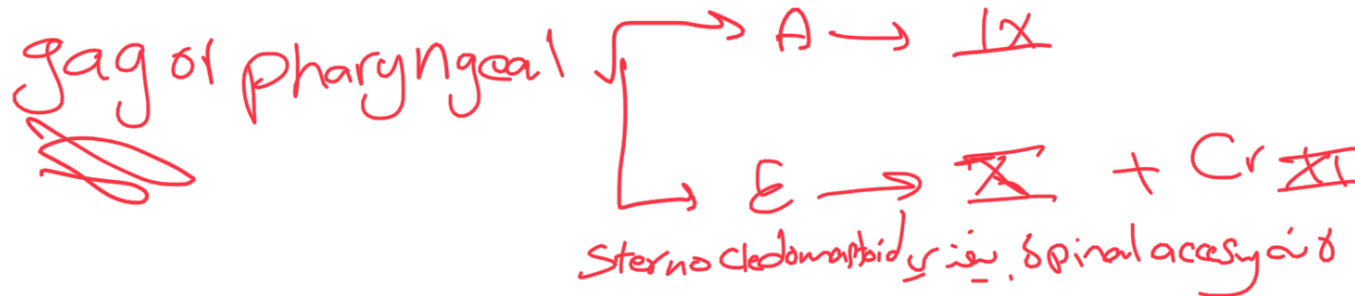




# Lesion of the Glossopharyngeal Nerve

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).

air, taste, vision



# 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.

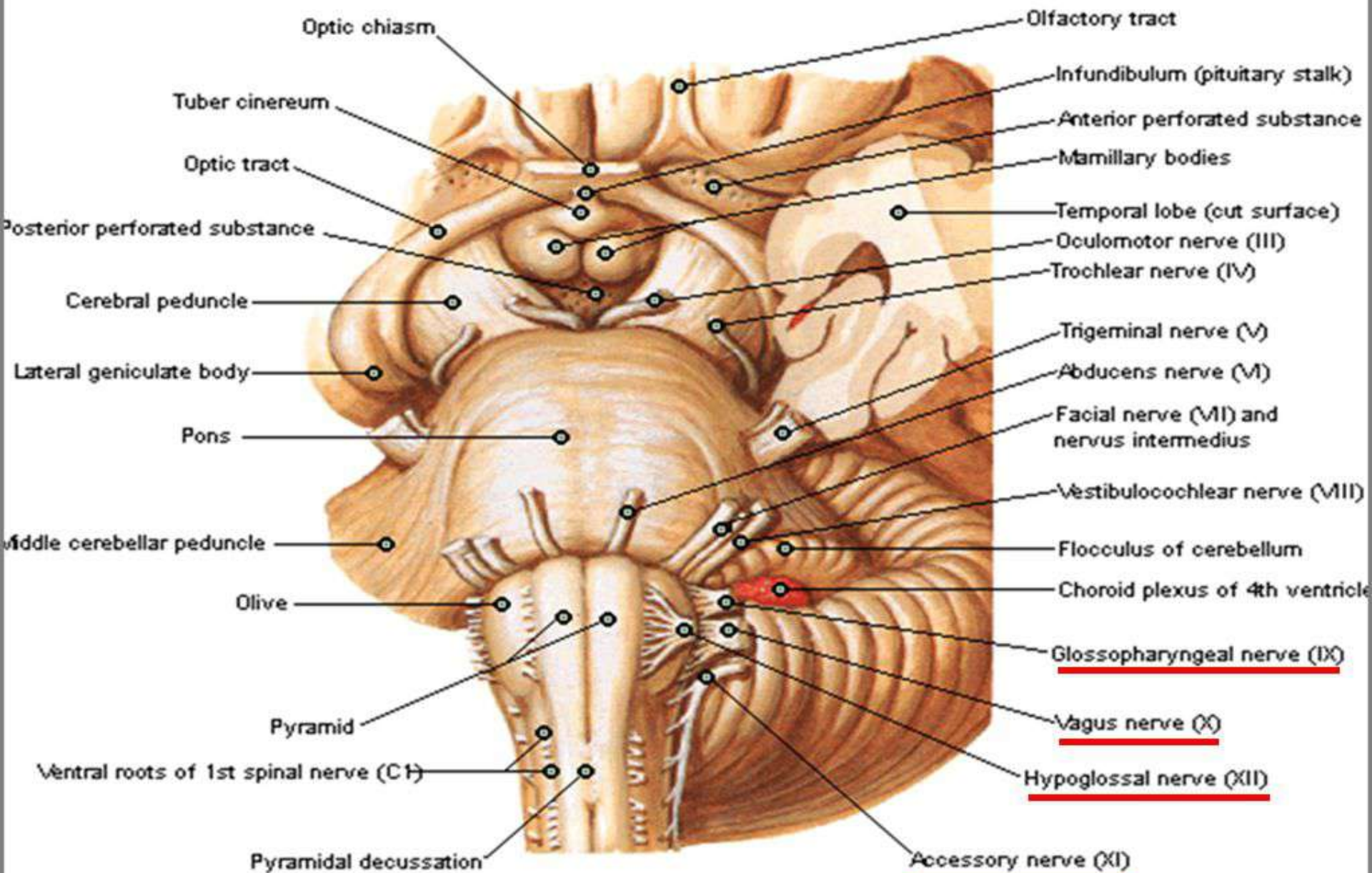
◆ It is the most important parasympathetic nerve in the  
□ body.

□ **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**”:

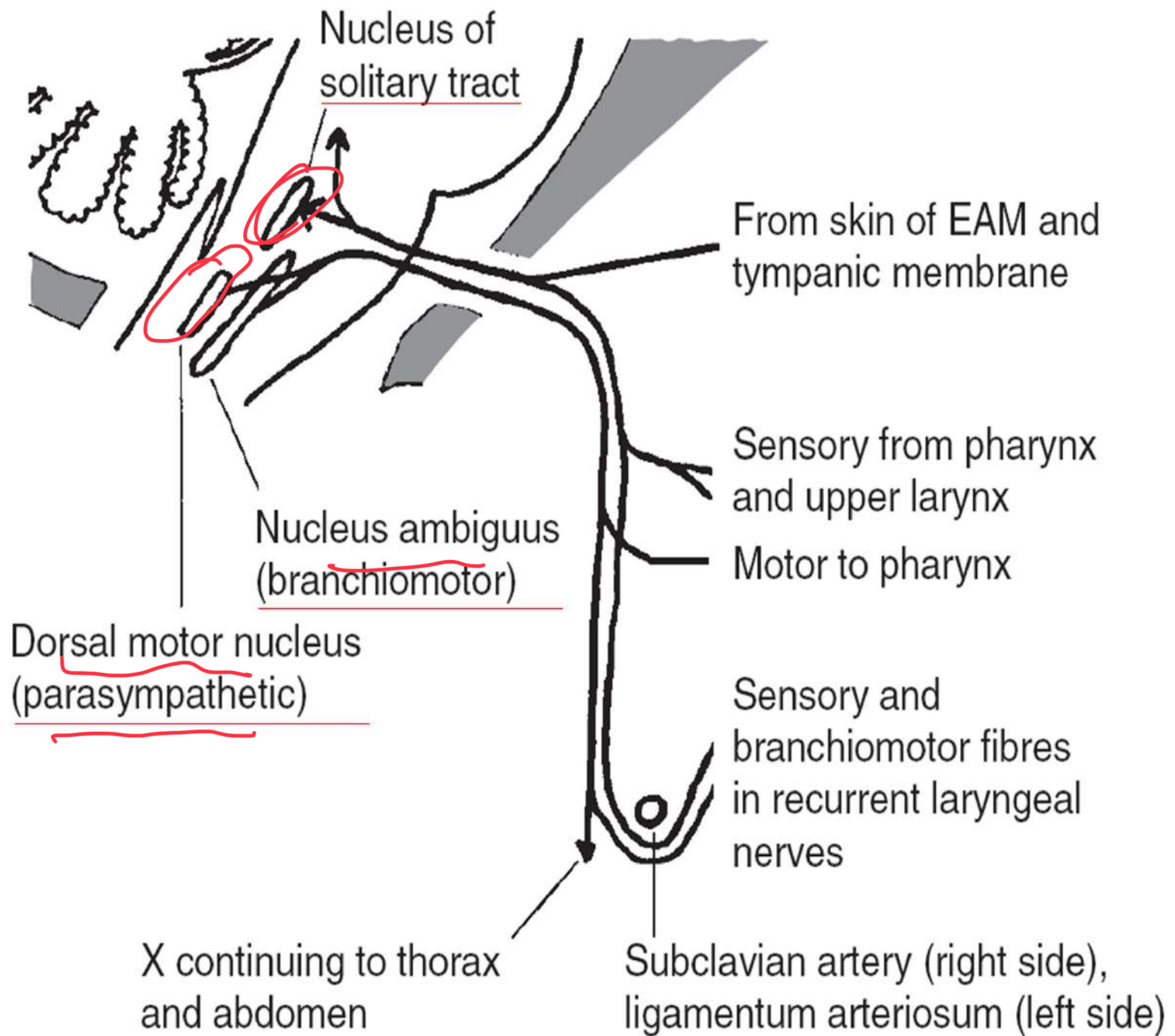
Gives parasympathetic fibers to respiratory system,  
digestive tract and the heart.

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:

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

## 2. The motor fibers supply:

- All the muscles of the larynx.
- All the muscles of the pharynx except the stylopharyngeus M.
- All the muscles of the palate except the tensor palati muscle.

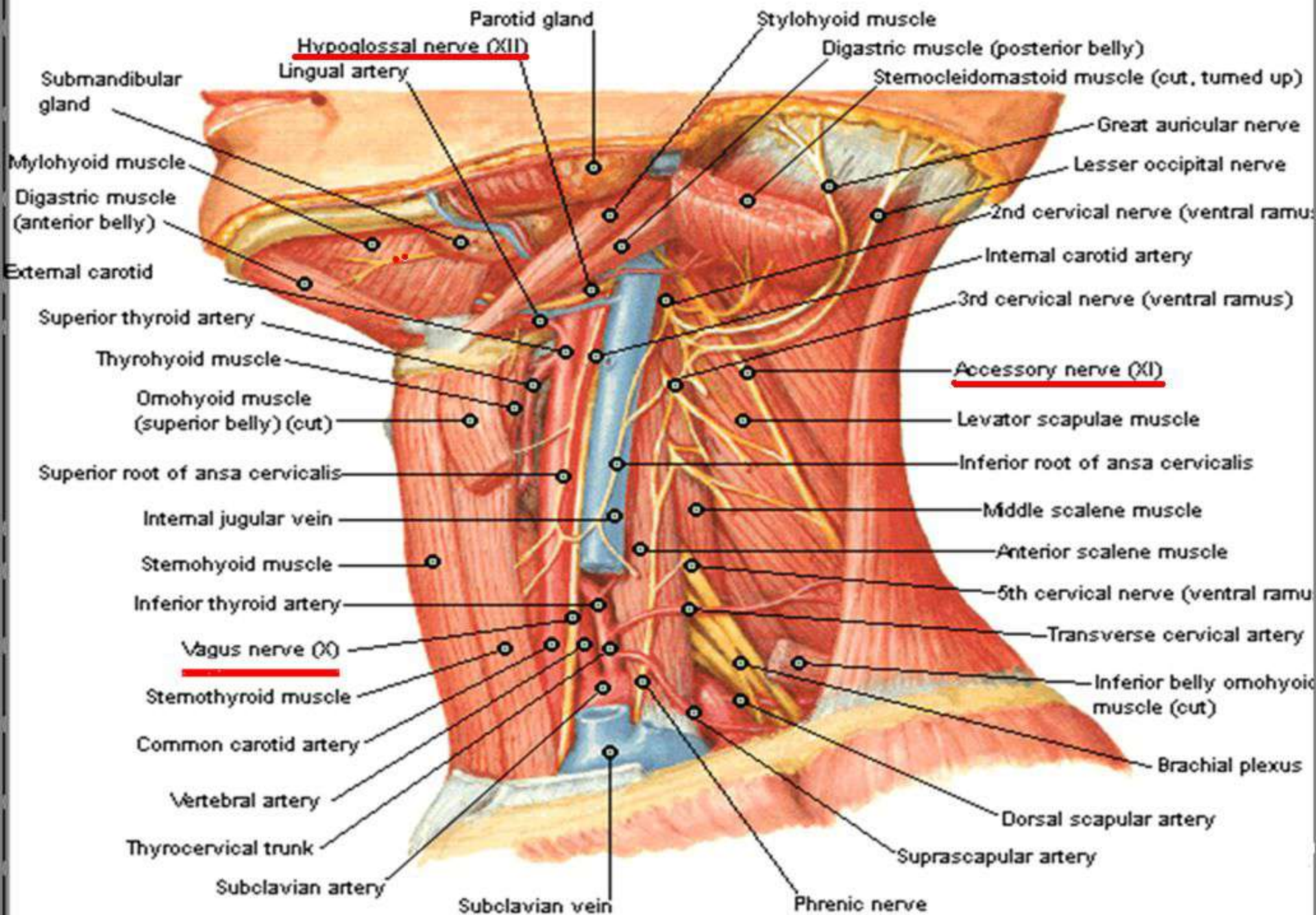
↳ by glossopharyngeus

↳ main branch of mandibular (facial)

## 3. The sensory fibers:

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





# Branches of the Vagus Nerve

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.
3. **Pharyngeal branch:** <sup>motor</sup> its fibers mostly derived from the cranial accessory nerve. Supply all pharyngeal muscles except the stylopharyngeus and all muscles of the soft palate except the tensor palati muscle.
4. **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.
5. **Carotid body branch.**



**6. Upper and lower cardiac nerve.**

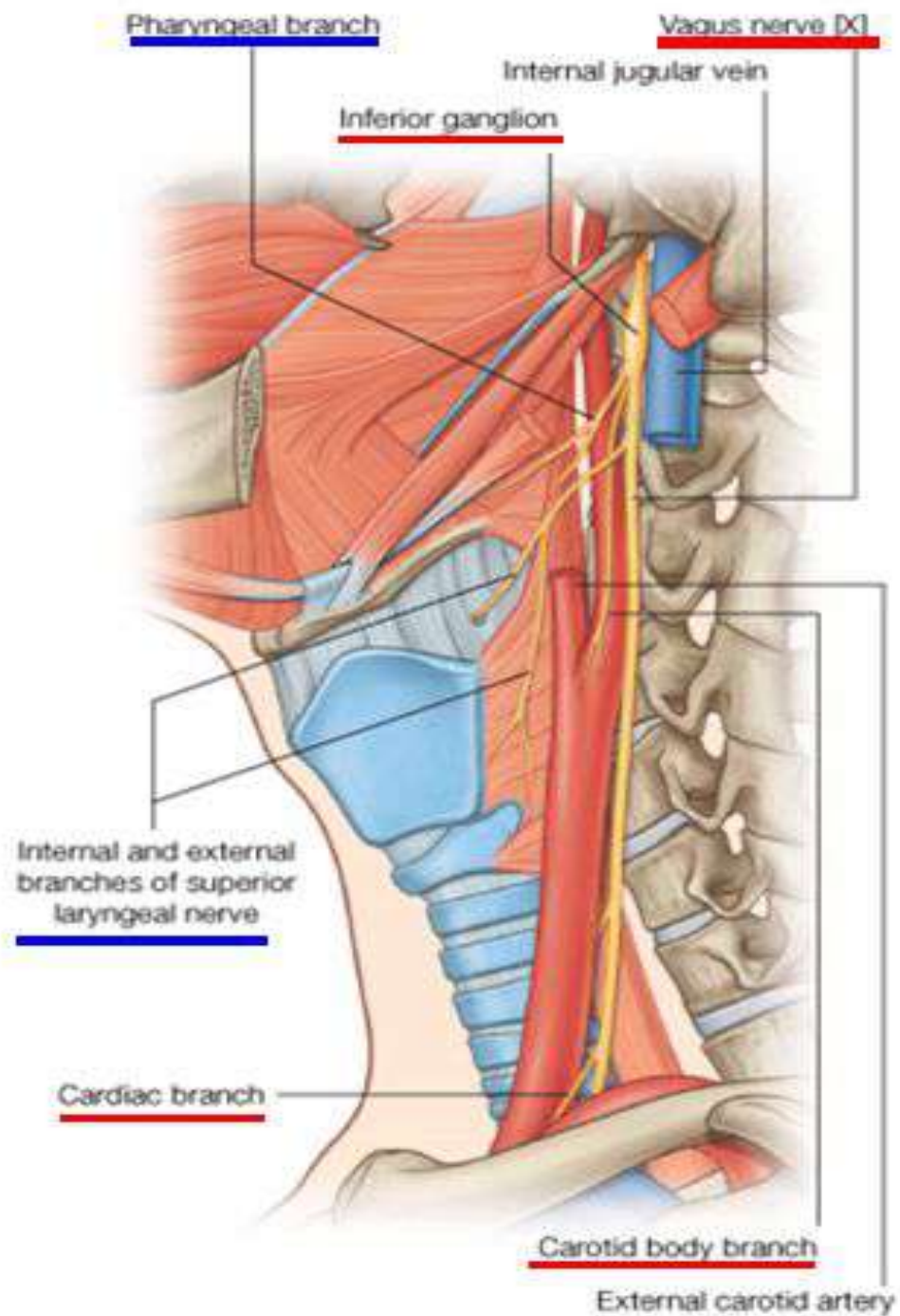
**7. Recurrent laryngeal nerve.**

**8. Pulmonary branches.**

**9. Esophageal branches.**

**10. Abdominal branches.**





## Recurrent Laryngeal Nerves (motor & sensory)

### a. Right Recurrent laryngeal nerve:

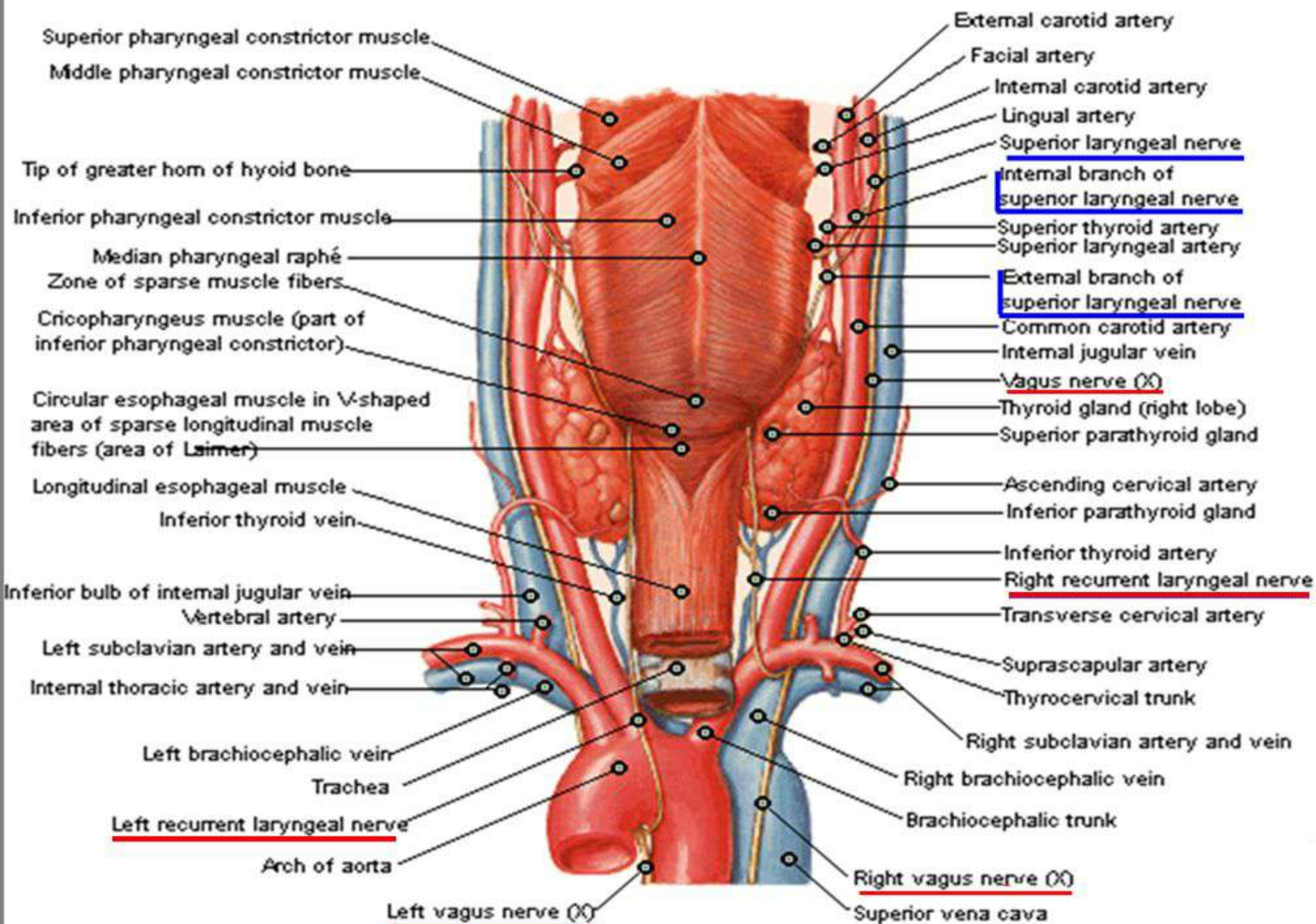
- Arises from the right vagus nerve in front of the first part of subclavian artery. Then it hooks below then behind the subclavian artery.
- It ascends along the right groove between the trachea and esophagus closely related to medial surface of thyroid gland.

### 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. خفيف
- b. Drop of palatal arch on paralyzed side and shift uvula to opposite side.
- c. Fluid regurge. بتخلع السوائل من فم
- d. Loss of palatal reflexes.

## 2. Pharyngeal paralysis:

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

لسوائل  
بمنطقة البلعوم  
من فم

## 3. Laryngeal paralysis: hoarseness of the voice.

**Others:** tachycardia and constipation.

dyphonia

Somatic motor

- origin:-  
amblygon nucleus

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

resikerni mutor

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

d with its <sup>supply:-</sup>  
palatine M, pharyngeal M  
laryngeal M.

← origin.

segments of the spinal cord from the AHCs.

↳ anterior horn cell

- **Supplies two muscles:**

↳ in the neck

5. trapezius ↓ leads to shoulder-medulla. drop

- **Origin:** from the posterolateral sulcus of the medulla.

- **Modality:** General somatic efferent.

- **Foramen:** Jugular foramen. →

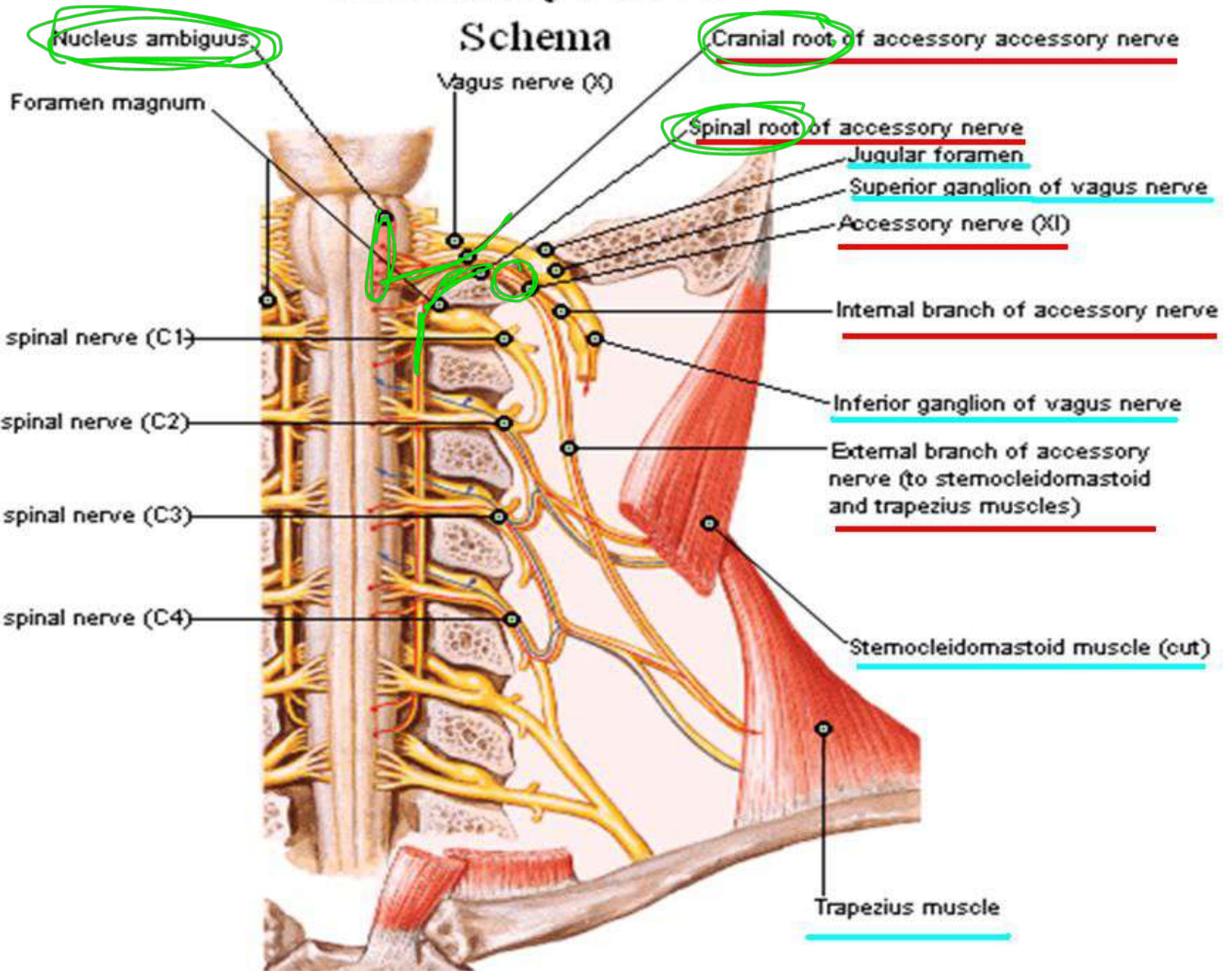
ner. → <sup>2 root 1, 12, 13, 14, 15</sup>  
cranial + vagus      spinal

ascend and enter foramen magnum and join to the cranial root forming accessory nerve

# Accessory Nerve

## Schema

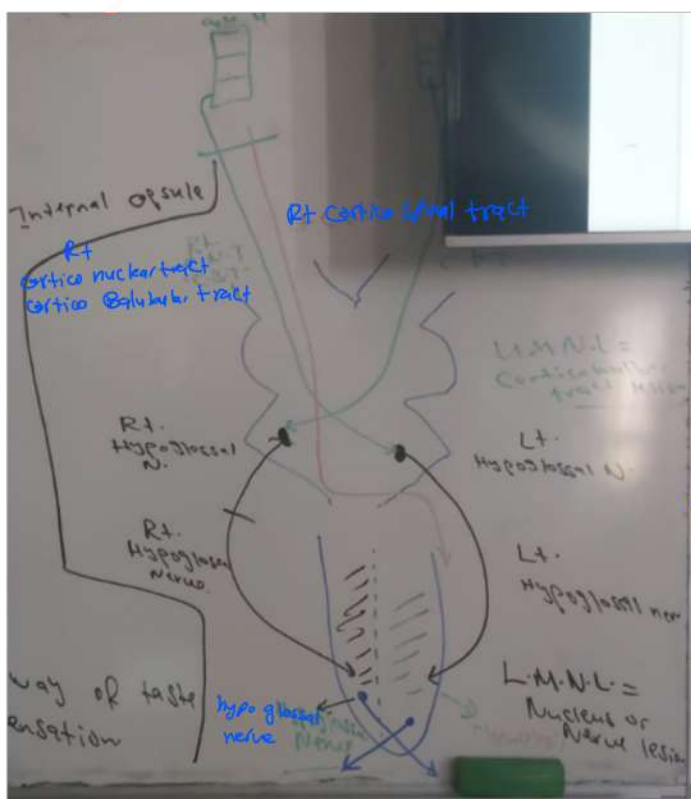
upper cervical





# 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). *drop to the shoulder ipsilateral..*



Bilateral cerebral ← motor 1, 2, 3, 4, 5, 6 Cranial nerve of  
 hemispheric innervation from → Corticobulbar  
 ventral nucleus of 12 → Corticobulbar  
 facial only from opposite side and the hypo-  
 glossal nucleus from 1, 2.

of the Rt part of the tongue supply by the Rt part of hypo-  
 glossal nucleus. [Rt hypoglossal nerve and nucleus...]  
 1, 2, 3, 4, 5, 6 ← Rt part of hypoglossal (12) is  
 if side of the tongue. منه

→ after the crossing [symptoms ipsilateral]

→ lower motor neuron lesion [LMNL] → damage in the hypoglossal nerve or the hypoglossal nucleus  
 ↳ so the tongue deviated ipsilateral at the same side of the lesion.

\* the Rt [CNT or CBT] → supply the Lt nucleus, Lt nerve, Lt tongue.. and the signal  
 from lower 1/3 of precentral gyrus [area 4]

\* if there is damage in Rt [CNT or CBT] the tongue deviated to the opposite side

↳ upper motor neuron lesion. [tongue deviation CL]

note  
 اليمين ← اليمين

[UMNL] → above the crossing. so the symptoms CL

# The Hypoglossal Nerve (XII)

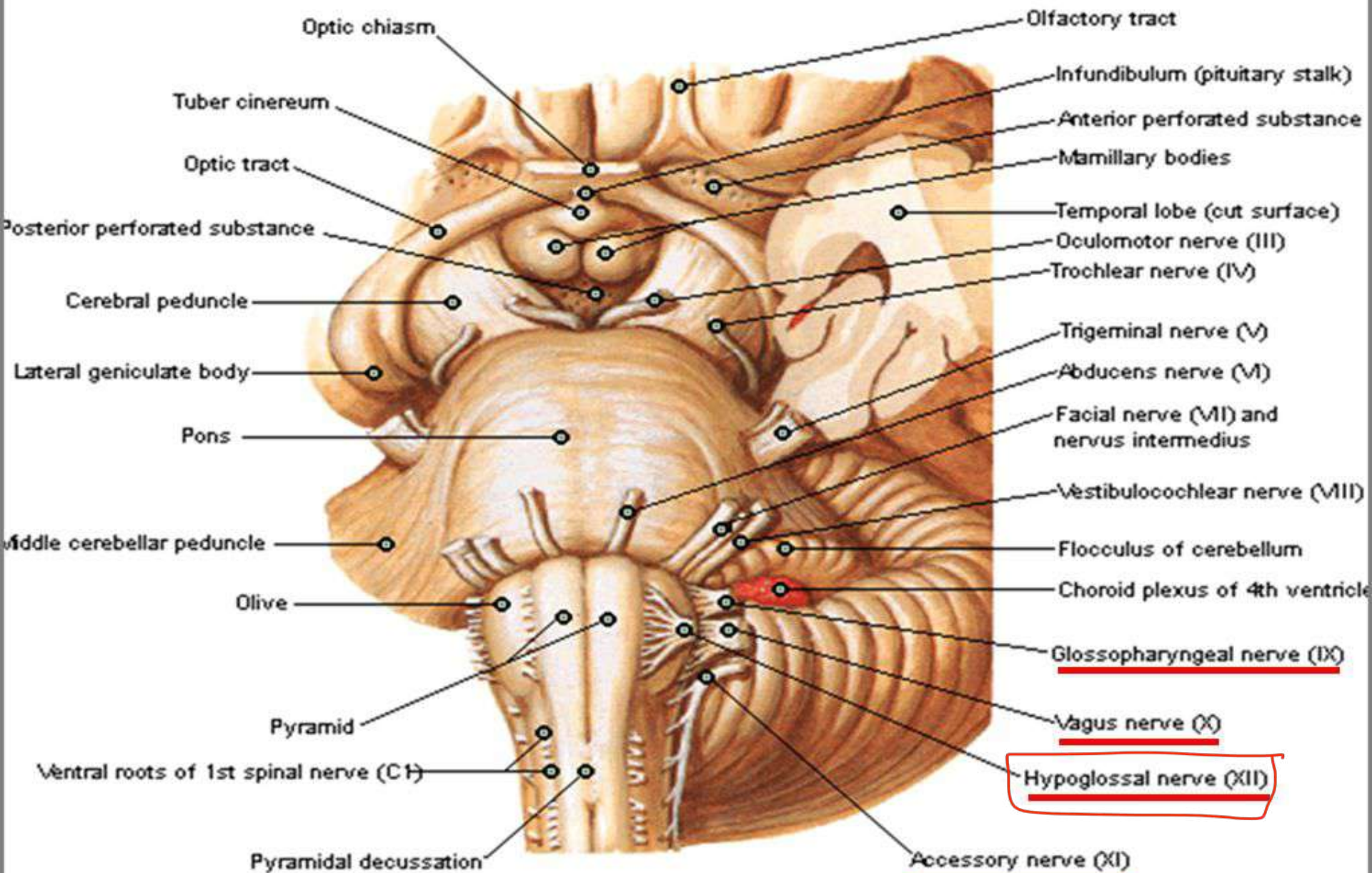
## (The motor nerve of the tongue)

- **Origin:** from the anterolateral sulcus of medulla oblongata. It receives a communicating branch from C1.
- **Modality:** General somatic efferent. *motor*
- **Foramen:** Hypoglossal canal. *GSE*
- **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). *of vagus and CN XI nerve*

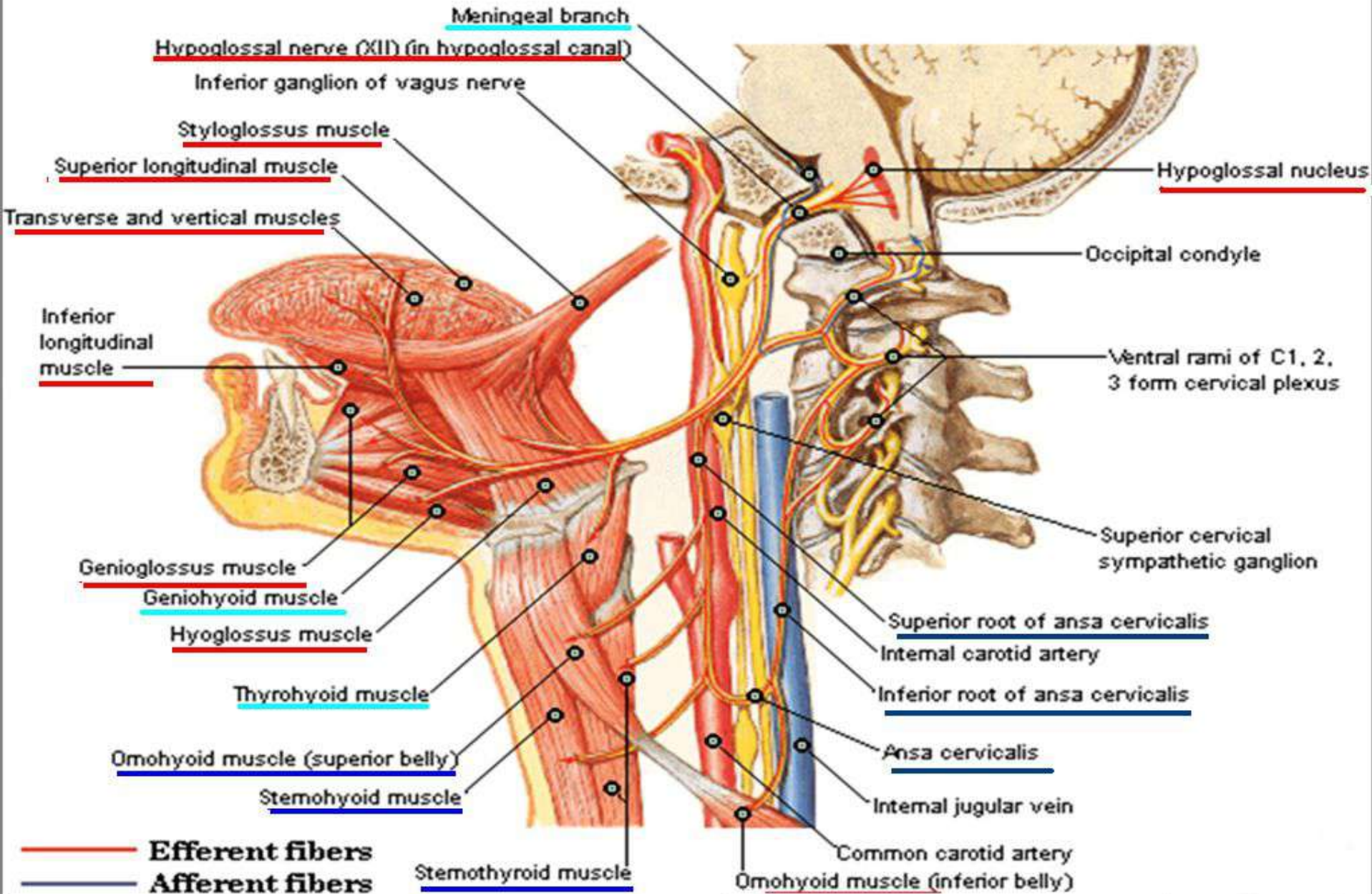


# Brainstem

## Anterioinferior View



# Hypoglossal Nerve Schema





# The Spinal Roots and Nerves

□ Each segment has **four roots**: <sup>2 R + 1 2 L</sup> 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).

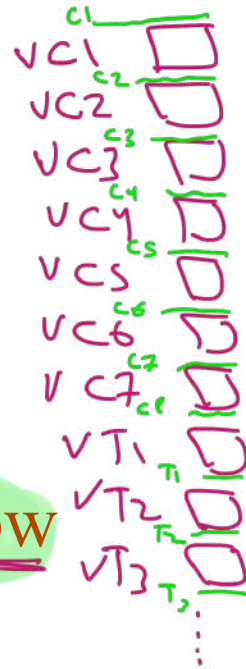
□ Each spinal nerve emerges from the intervertebral foramen.

<sup>and has Ant. , post branch.</sup>  
[pre ganglionic] white ramus - [post ganglionic] gray ramus ← عصب

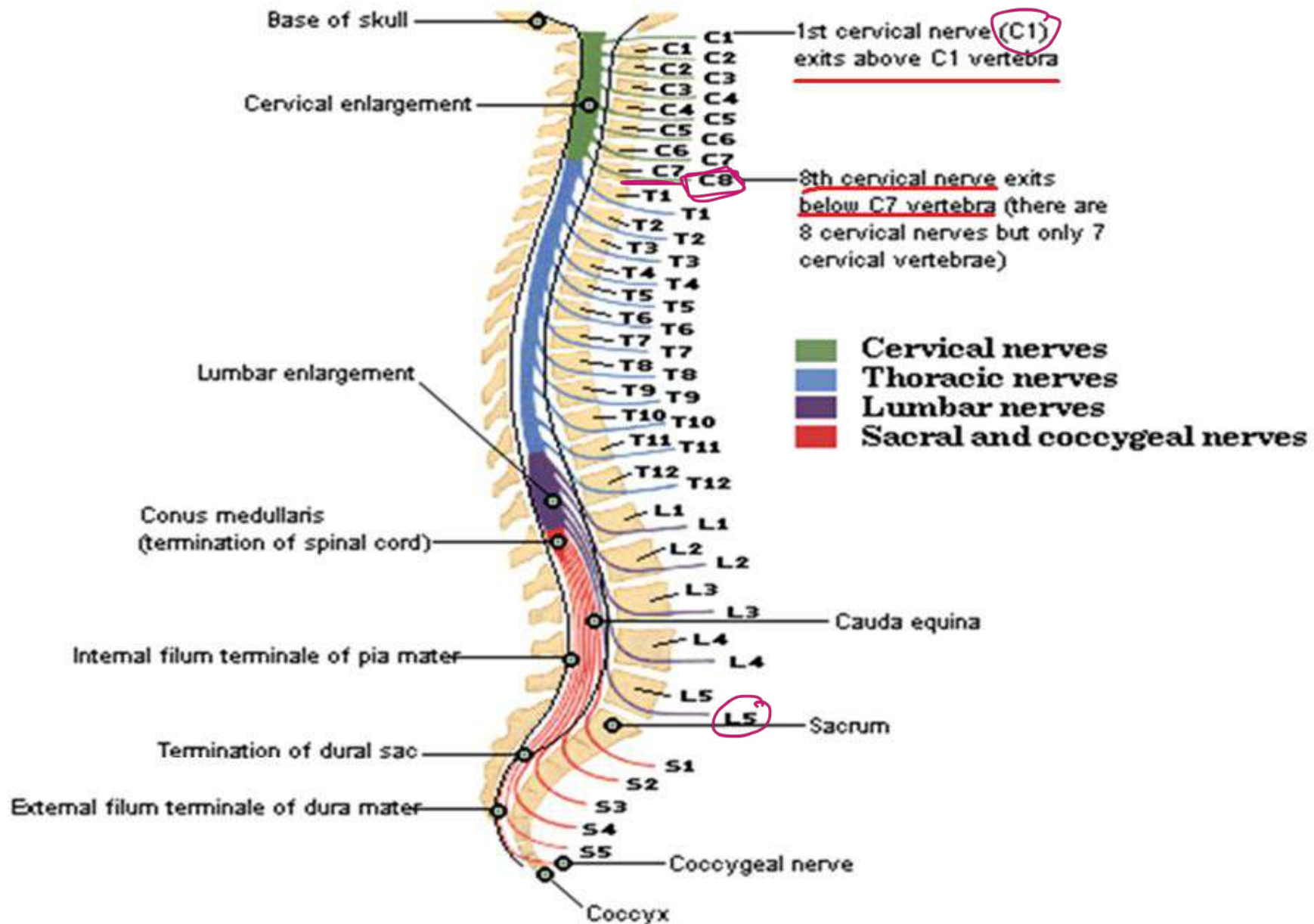


# The Exit of Spinal Nerve Roots

- ❖ Through the intervertebral foramina.
- ❖ Roots C<sub>1</sub>- C<sub>7</sub> pass above their vertebra.
- ❖ C<sub>8</sub> pass below C<sub>7</sub> vertebra. or above T<sub>1</sub>
- ❖ Thoracic, lumbar and sacral nerves pass below corresponding vertebra.
- ❖ Lower lumbar, sacral and coccygeal nerves descend vertically as cauda equina pass below corresponding vertebra.   
↳ PNS collection of root below the level of spinal cord termination..



# Relation of Spinal Nerve Roots to Vertebrae



# Special Considerations of the Spinal nerve Roots

- The first cervical nerve and the coccygeal nerve <sup>doesn't has dermatoms in the skin..</sup> usually have neither the posterior (sensory) roots nor the corresponding dermatomes.
- The first cervical nerve passes between the atlas <sup>above</sup> and the skull <sup>below</sup>.
- The second cervical nerve passes between the atlas <sup>below</sup> and the axis <sup>above</sup>.



# Components and Branches of Spinal Nerves

- **The spinal nerve:** is formed by the union of <sup>dorsal</sup> posterior and <sup>ventral</sup> anterior roots within the intervertebral foramen, resulting in a mixed nerve.
  - motor
  - sensory
  - autonomic
- **Posterior root.**
  - sensory
- **Spinal ganglion:** located within the posterior root and contains pseudounipolar neurons “First order neuron for somatic sensations”.
  - helps control the in/out, in
  - in face forming Ramsay Hunt syndrome
- **Anterior root.**
- **Spinal nerve rami.**

# The Spinal Nerve Rami

- **Posterior ramus:** innervates the <sup>sensory</sup> skin and muscles of the <sup>motor</sup> back.
- **Anterior ramus:** innervates the anterior and lateral muscles and skin of the trunk, extremities, and <sup>internal organs</sup> visceral organs.
- **Meningeal ramus:** innervates the meninges and vertebral column.
- **White communicating rami:** contain myelinated preganglionic sympathetic fibers. <sup>relay in the ganglion → give gray branch (non myelinated)</sup>
- **Gray communicating rami:** contain unmyelinated postganglionic sympathetic 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.

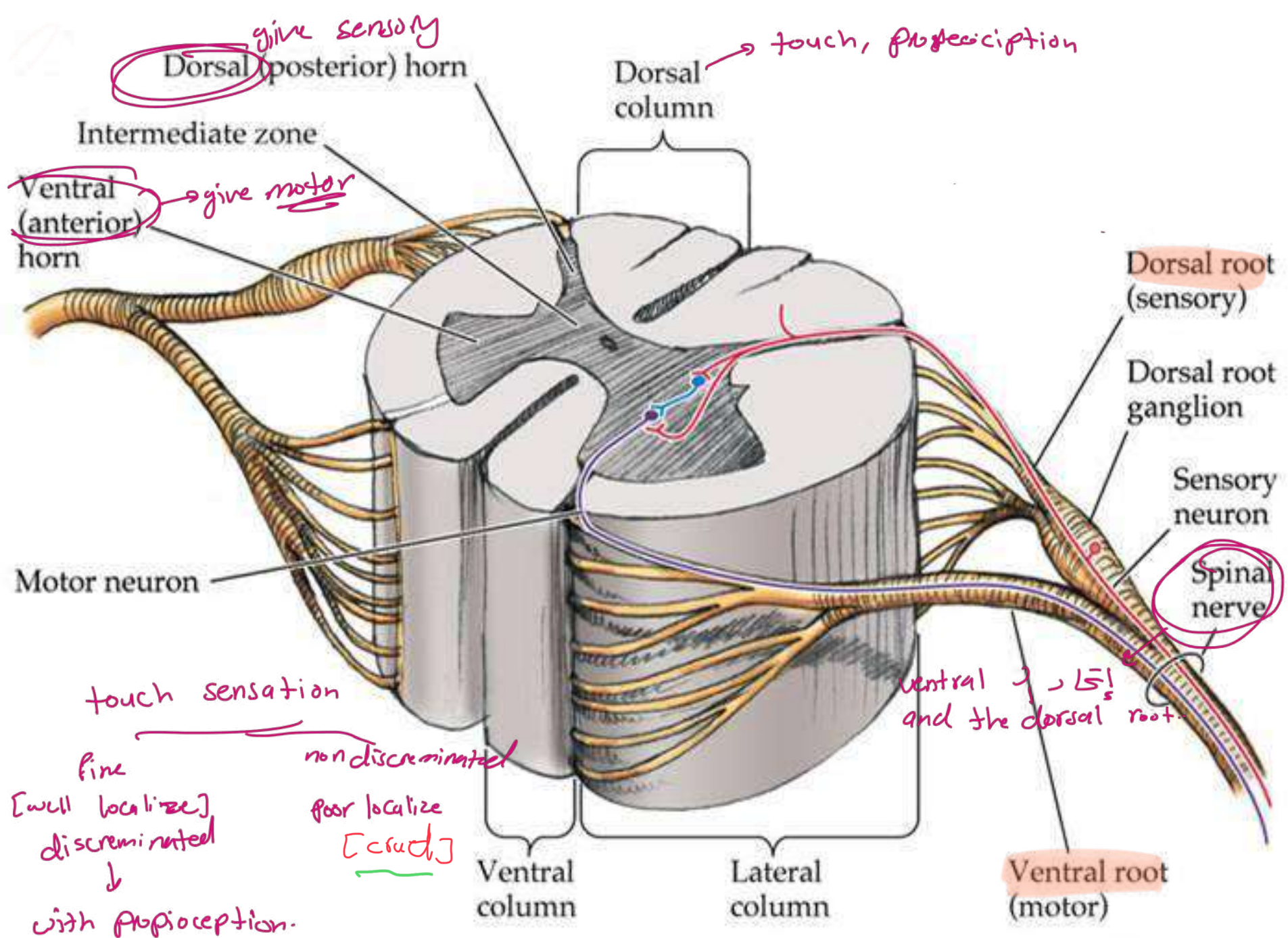
**B. General Visceral Efferent (GVE) Fibers:**

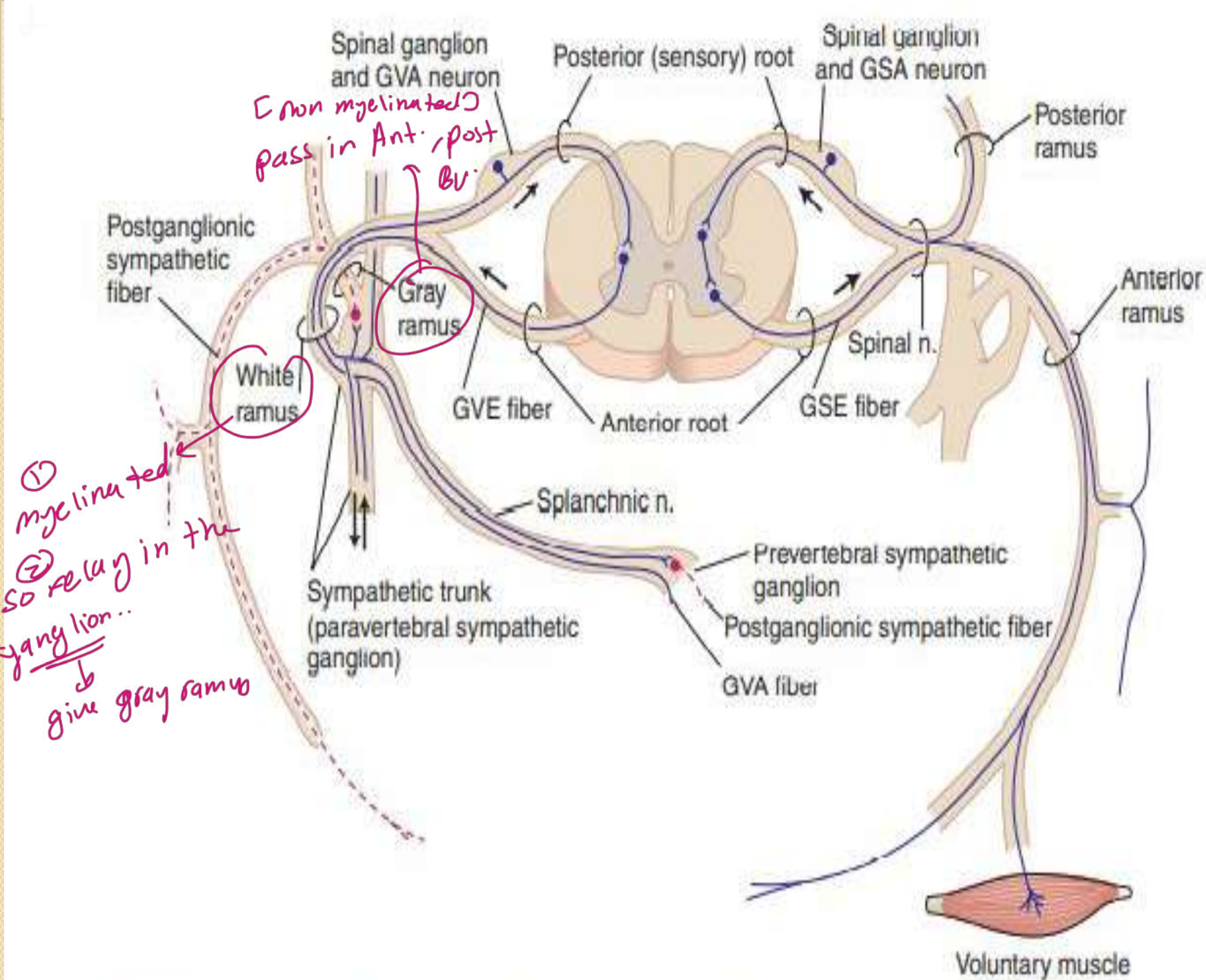
- Convey **motor output** to glands, smooth muscle, and visceral and pelvic organs.

+ cardiac muscle

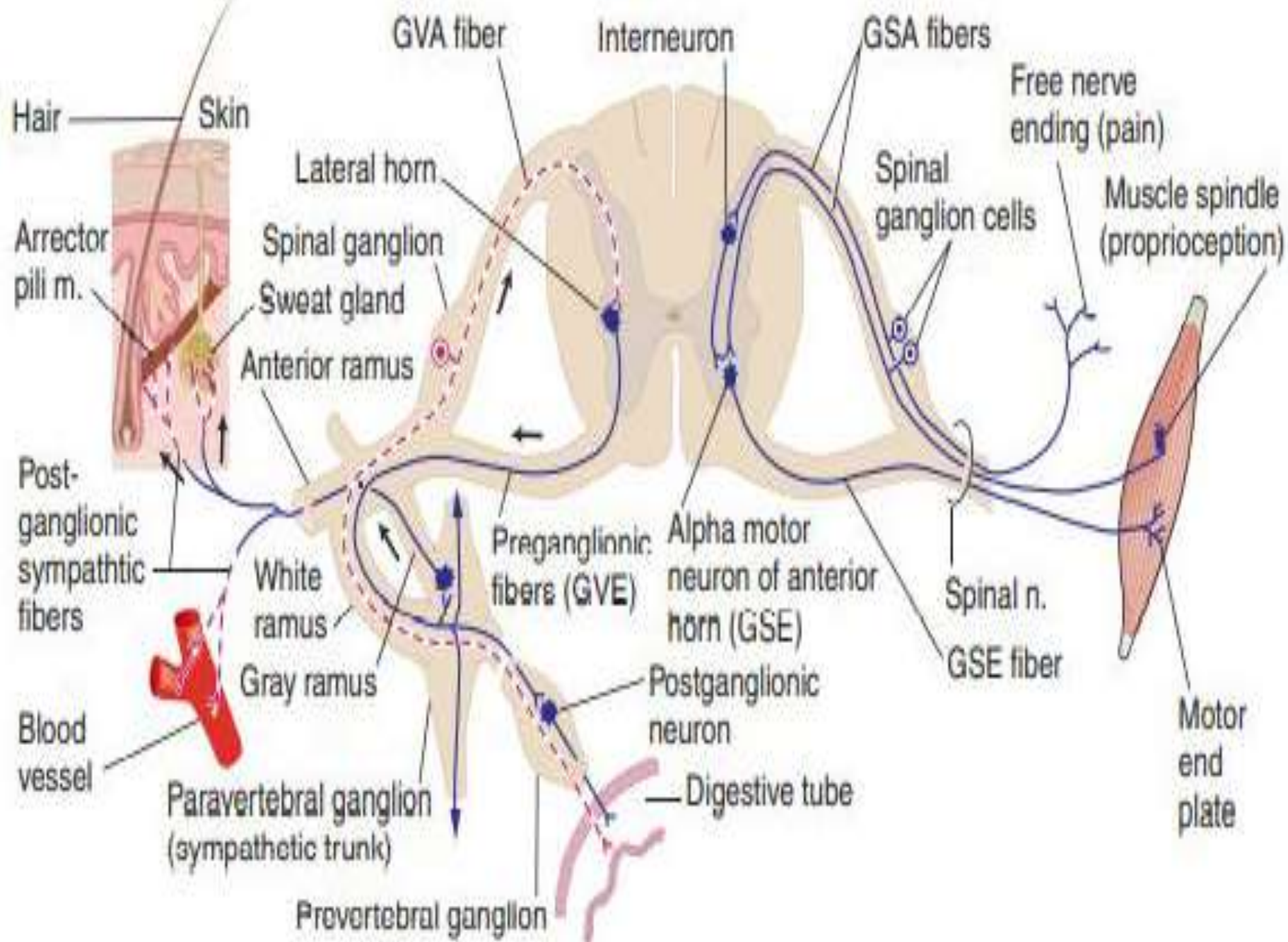
pass to gracile  
locate tract  
\*medial [LL]  
\*lateral [UL]









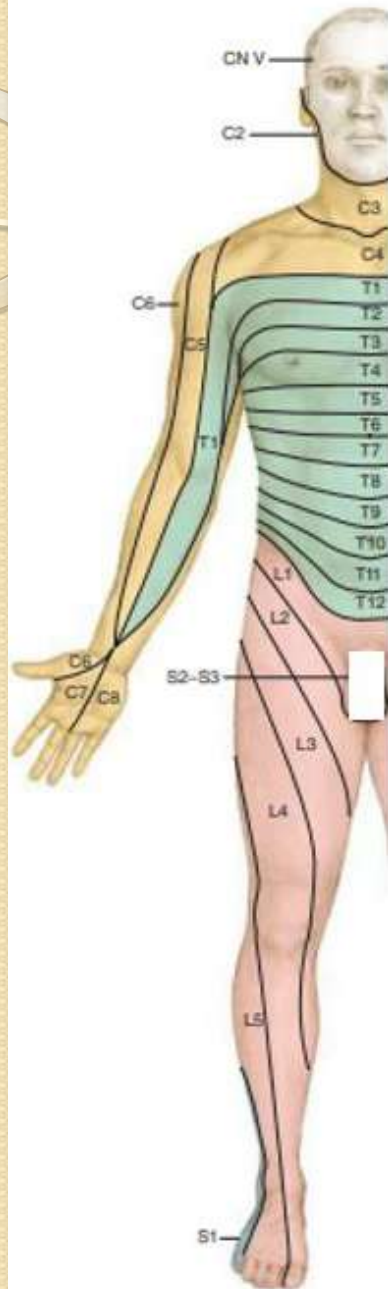
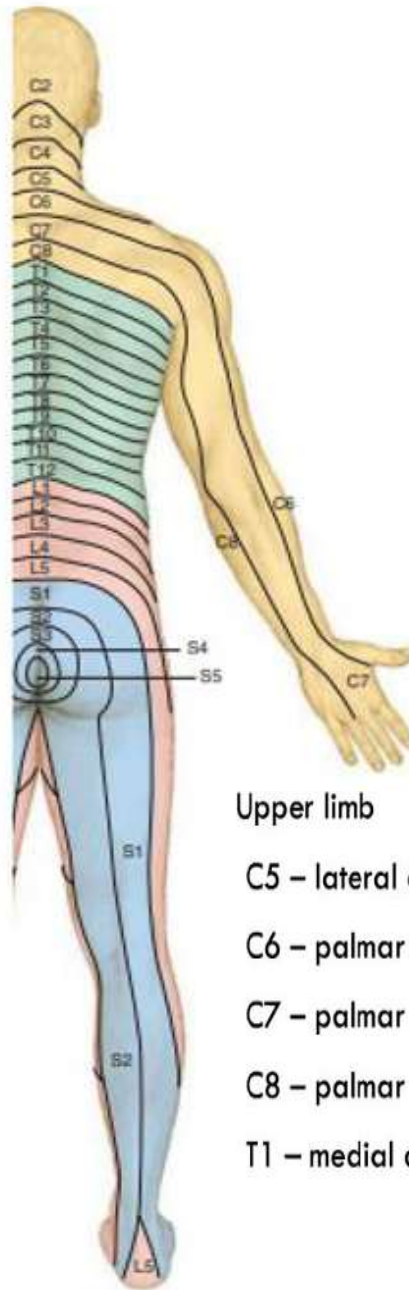




# Visceral Nervous System

- 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. *+ thoracolumbar [sympth.]*
- 3. Parasympathetic Nervous System:** located within the anterior horns of S2-S4 segments of the spinal cord. *[Para-symp]*

# Cutaneous distribution of spinal nerves, the dermatomes



## Upper limb

C5 – lateral arm 'regimental badge'

C6 – palmar side of thumb

C7 – palmar side of middle finger

C8 – palmar side of little finger

T1 – medial aspect of antecubital fossa

## Lower limb

L2 – mid thigh

L3 – knee

L4 – medial malleolus

L5 – big toe

S1 – sole of foot

# Myotomes of the Upper and Lower Limbs

## Upper limb

- C<sub>6</sub>** - Shoulder adduction.
- C<sub>5</sub>** - Elbow flexion.
- C<sub>6</sub>** - Wrist extension.
- C<sub>7</sub>** - Elbow extension.
- C<sub>8</sub>** - Fingers flexion.
- T<sub>1</sub>** - Finger abduction and adduction.

## Lower Limb

- L<sub>2,3</sub>** - Hip flexors.
- L<sub>3,4</sub>** - Knee extensors.
- L<sub>5</sub> – S<sub>1</sub>** - Knee flexion.
- L<sub>4,5</sub>** - Ankle dorsiflexion.
- S<sub>1,2</sub>** - Ankle plantar flexion.



11 *هذه*

## Motor Testing – Upper Extremity

| <u>Nerve Root</u> | <u>Muscle Action</u>                          | <u>Muscles</u>   | <u>Peripheral Nerves</u> |
|-------------------|-----------------------------------------------|------------------|--------------------------|
| <u>C5</u>         | <i>elevation</i><br><u>Shoulder Abduction</u> | <u>Deltoid</u>   | <u>Axillary</u>          |
| C5                | Elbow Flexion                                 | Biceps           | <u>Musculocutaneous</u>  |
| C6                | Wrist Extension                               | Wrist Extensors  | Radial                   |
| C7                | Elbow Extension                               | Triceps          | Radial                   |
| C7                | Wrist Flexion                                 | Wrist Flexors    | Median/Ulnar             |
| C7                | Finger Extension                              | Finger Extensors | Radial                   |
| C8                | Finger Flexion                                | Finger Flexors   | Median/Ulnar             |
| T1                | Finger AB & ADduction                         | Interossei       | Ulnar                    |

# Motor Testing – Lower Extremity

| Muscle                                           | Main Root          | Peripheral Nerve      | Main Action              |
|--------------------------------------------------|--------------------|-----------------------|--------------------------|
| Iliopsoas                                        | L2, L3             | Femoral               | Hip flexion              |
| <u>Quadriceps femoris</u>                        | <u>L3, L4</u> root | <u>Femoral nerve.</u> | <u>Knee extension</u>    |
| Adductors                                        | L2, L3, L4         | Obturator             | Adduction of thigh       |
| Gluteus maximus                                  | L5, S1, S2         | Inferior gluteal      | <u>Hip extension</u>     |
| Gluteus medius and minimus, tensor fasciae latae | L4, L5, S1         | Superior gluteal      | Hip abduction            |
| Hamstrings                                       | L5, S1             | Sciatic               | Knee flexion             |
| Tibialis anterior                                | L4, L5             | Fibular (Peroneal)    | Dorsiflexion of ankle    |
| Extensor digitorum longus                        | L5, S1             | Fibular (Peroneal)    | Dorsiflexion of toes     |
| Extensor digitorum brevis                        | S1                 | Fibular (Peroneal)    | Dorsiflexion of toes     |
| Peronei                                          | L5, S1             | Fibular (Peroneal)    | Eversion of foot         |
| Tibialis posterior                               | L4                 | Tibial                | Inversion of foot        |
| Gastrocnemius                                    | S1, S2             | Tibial                | Plantar flexion of ankle |
| Soleus                                           | S1, S2             | Tibial                | Plantar flexion of ankle |



# Thank You





\* if there is early muscle atrophy + fasciculation in the tongue seen in LMNL

\* if th nucleus damaged → so the problem in the Rt MO → tongue deviated ipsilateral [Rt]

Brainstem / 15. 1st nerve 1 - 8 without hemiplegia . - : nerve lesion ①

د. ق. 1st CST, is medial medullary syndrome / 1st IL tongue deviation / 1st hemiplegia: medullary lesion ②  
crossing 1 above

- hemiplegia Lt
- tongue deviation Rt

[Rt medullary lesion]

tongue dev. Lt  
Rt hemiplegia

[Lt medullary syndrome]

symptoms 1 elid below the crossing

hypoglossal nucleus ③

ipsilateral 1st

\* stroke in the Rt cerebral hemisphere: - damage the CUT/CBT/CST above the crossing  
tongue dev. Lt / Lt hemiplegia - opposite side 1 & 1st symptoms 1 elid crossing

↳ damage above the Rt MO  
+ damage Rt hemisphere.

called/ alternating hypoglossal syndrome or medial medullary syndrome  
↓  
in cerebral hemisphere lesion.  
MO

↓  
in medullary lesion

\* C1 root supply the thyrohyoid M., geniohyoid M.

↳ give upper limb forming Ansa cervicalis join with C2/C3

\* C2, C3 join with upper limb of C1 forming ansa cervicalis...  
supply the thyrohyoid M. and sternohyoid M.  
sternothyroid M.

\* but the geniohyoid and thyrohyoid  $\rightarrow$  supply by C1 + hypoglossal n. [XII]

\* hyoglossus, genioglossus, styloglossus supplied by XII n.

• Palate glossus supplied by vagus + cranial accessory. N.