Khalleedd✅

Lecture

Main Functions of the Cranial and Spinal Nerves

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The Cranial Nerves

Efferent carry motor information away from CNS represents by Brain
While Afferent carry information found all over the body toward the CNS

- The cranial nerves are consist of 12 pairs of nerves that arise from the brain.

The difference between spinal and cranial nerves is:
1. The 1st enter or exit the skull through intervertebral foreman while the 2nd enters or exit through specialized foremen in the skull
2. All of the spinal nerves are mixed contains motor sensory and may have autonomic while the cranial nerves divided to 3 groups pure motor, pure sensory, and mixed.

- They exit/enter (Motor / Efferent, Sensory / Afferent) the cranium through openings in the skull.
- The olfactory, optic and vestibulocochlear nerves are purely sensory nerves "special sensory" **(128).**
- The oculomotor (3), trochlear (4), abducent (6), accessory (11) and hypoglossal (12) nerves are purely motor nerves. 3-4-6-11-12
- The trigeminal, facial, glossopharyngeal and vagus nerves are mixed nerves **(10975).**

Cranial nerves contain autonomic fibers 10973

سؤال بيطرح نفسه انو ال ١٠ وال ٩ وال ٧ حطيناهم مع ال mixed ليش ما حطيت نيرف رقم ٣ مع ال mixed ، autonomic fibres is purly motor الجواب بكل سهولة انو ال

Supplies constrictor pupil muscle and Cilliary muscle that play a role in accommodation reflex.

Functional Modalities

Voluntary
- **Somatic:** skeletal muscle, joint, tendon, ligament, and skin.

Involuntary
- **Visceral:** smooth muscles, cardiac muscles, and glands. GIT peristalsis.
  - **Sensory "Afferent":**
    - ✓**General.** Pain sensation
    - ✓**Special.** Taste sensation
  - **Motor "Efferent":**
    - ✓**General.**
    - ✓**Special.**
- **Organic sensations:** e.g. hunger, thirst and sexual sensations **"Hypothalamic Sensations".**

The center is found in it and the receptors

Motor Functional Modalities

Efferent

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.

Found in anterior somatic horn of spinal card, give the signal via spinal nerve and supply 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).**

Involuntary motor

For internal organs

3. **The Special Visceral Efferent (SVE):** which supply muscles of the trigeminal, facial, glossopharyngeal, vagus, and cranial accessory nerves.

Do not supply smooth muscles

Supplies somatic skeletal muscles and follow the cranial nerves

special visceral efferents, which innervate striped muscles of branchial origin, and general visceral efferents, which innervate involuntary muscles and secreting glands

Sensory Functional Modalities

Afferent

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.

For touch pain proprioception temperature sensation

2. **Special Somatic Afferent (SSA): afferent nerves of the special senses,** (fibers include the optic nerve and the vestibulocochlear nerve).

For special sensation not related to GIT = hearing and vision

Vision

Hearing

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.

For sensory impulses of internal organs

Like the stretched urinary bladder sensation

Irritation from diseased or inflamed organ cause pain sensation in it

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).

For special sensation related to GIT = smell and taste

Smell

Taste

Taste sensation by 3 cranial nerves: *Facial nerve by corda tympani for ant. 2/3 *Lingual of glossopharyngeal for post. 1/3 *Vagus give superior laryngeal and has external and internal branches the internal supplies the sensation above vocal cords and give a branch for taste sensation in epiglottis.

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.** (Somatic; Visceral)
3. **Autonomic "Visceral" Functions":** via parasympathetic innervation to the visceral organs.

Salivation

Parotid gland works to secrete saliva: by tympanic nerve tympanic nerve from glossopharyngeal before it reach the gland it relay in otic ganglion

Sublingual and submandibular salivary glands works by Corda tympani nerve before that it relay in submandibular ganglion

How the tear mechanism works by GSPN greater superficial petrosal nerve before that it relay in sphenopalatine ganglion

Branch of facial nerve

Classification of the Cranial Nerves

№	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 V1 Maxillary V2 Mandibular V3	 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 C_1-C_4 AHC of SC	Jugular foramen
12	Hypoglossal	Motor	Medulla oblongata	Hypoglossal canal

Cranial Nerves

They arranged according to the enter or the exit from the brain

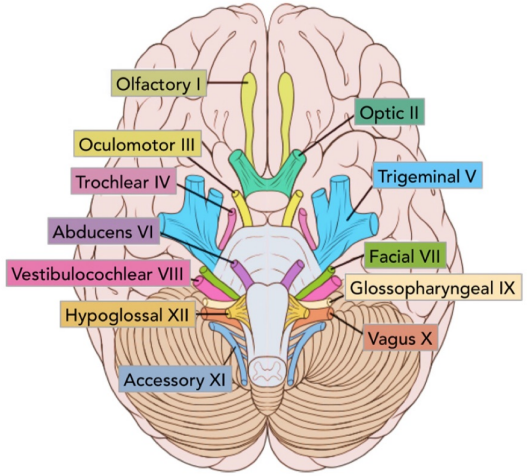
Motor → 3-4-6-11-12

Sensory → 128

Mixed → 10975

Autonomic → 10973

With exception (3) is pure motor even the autonomic fibers



Functions:

* Sensory

1 → smell

2 → vision

8 → hearing and pulse

* mixed

5

7

9

10

* motor

3

4

6

11

12

Cerebral hemispheres 2 → temporal (1) occipital (2)

Midbrain 2 → (3) + (4)

Pons 4 → (5) + (6) + (7) ((8)

Medulla oblongata 4 → (9) + (10) + (11) + (12)

With some exceptions.

Parts of trigeminal (5) nerve nucleus is found in midbrain
And parts of them descends to the spinal card.
Parts of facial (7) nerve nucleus is found in the medulla oblongata.

Accessory nerve (11) has cranial and spinal parts the
2nd is in the anterior horn of the upper cervical segment.

Opening in the skull

Olfactory → cribriform plate may arise from it olfactory groove meningioma and cause Foster-kinidy syndrome.

Optic → optic canal.

Oculomotor, Trochlear, Ophthalmic branch of Trigeminal, and Abducent → superior orbital fissure.

Maxillary → foreman rotundam

Mandibulare → foreman ovale

Facial → enter through internal acoustics meatus and exit through stylomastoid foreman.

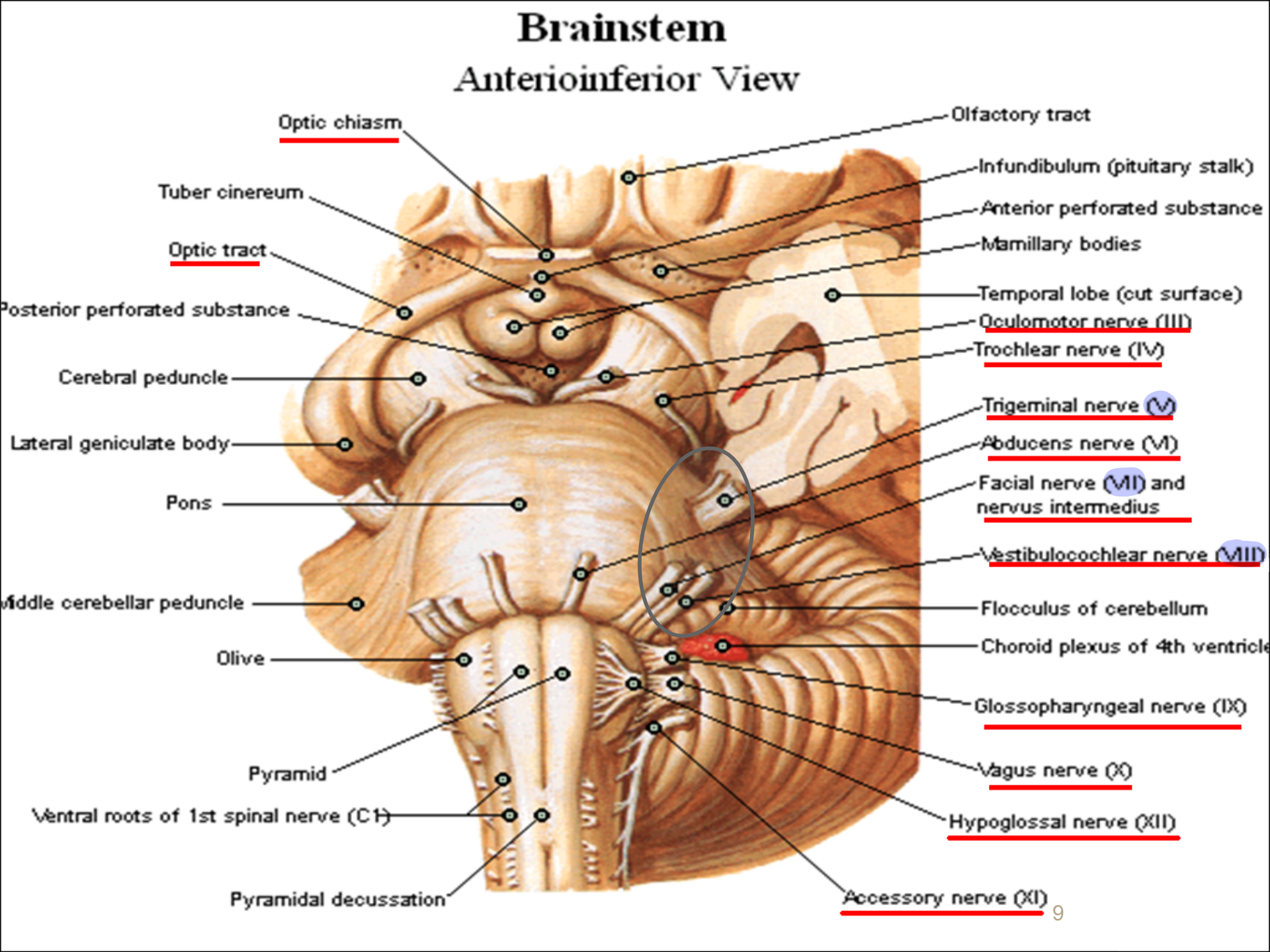
Vestibulo-cochlear → internal acoustics meatus.

Glossopharynged, vague, accessory → jugular foreman

Hypoglossal → specific canal

Brainstem

Anterioinferior View



Notes on the slides before

Oculomotor ventral surface anterior of mid brain
Trochlear dorsal surface posterior of midbrain

Trigeminal has large root sensory and small root autonomic

Facial has two roots large is motor and small sensory and parasympathetic

In cerebellum pontine angle pass 3 cranial nerves 5th 7th and 8th if damaged called CPA syndrome
اجت للدكتور حالة حكاها وكانت بتشكي من اشياء بيعملوها هدول الـ٣ نيرفز وبلش الكومبلاين بفقدان السمع ورنة في الدان وبعدها بلست اعراض النيرفين التانيين ،والدكتور شخصها انها ورم في العصب التامن وعاملة ضغط عالسابع والخامس

Accessory has 2 roots cranium part from medulla oblongata and spinal parts from spinal cord and supplied trapezius muscle and stynocledomastoid muscle

I. The Olfactory Nerve

Its not a single tract it composed of 20 filaments on each side and enters through cribriform plate on alfactory groove and deliver the signal to olfactory pulp then olfactory tract and attached to the inf. Surface of cerebellar hemisphere

The pathway

- **Olfactory Nerve:** (Latin for "to smell").
- **Function and modality:** Special visceral afferent **(smell sensation).**

Means sensory

Related to git

- **Olfactory tract** located in the anterior cranial fossa and attached to the inferior surface of frontal lobe.

So the signal reach the 2 hemispheres

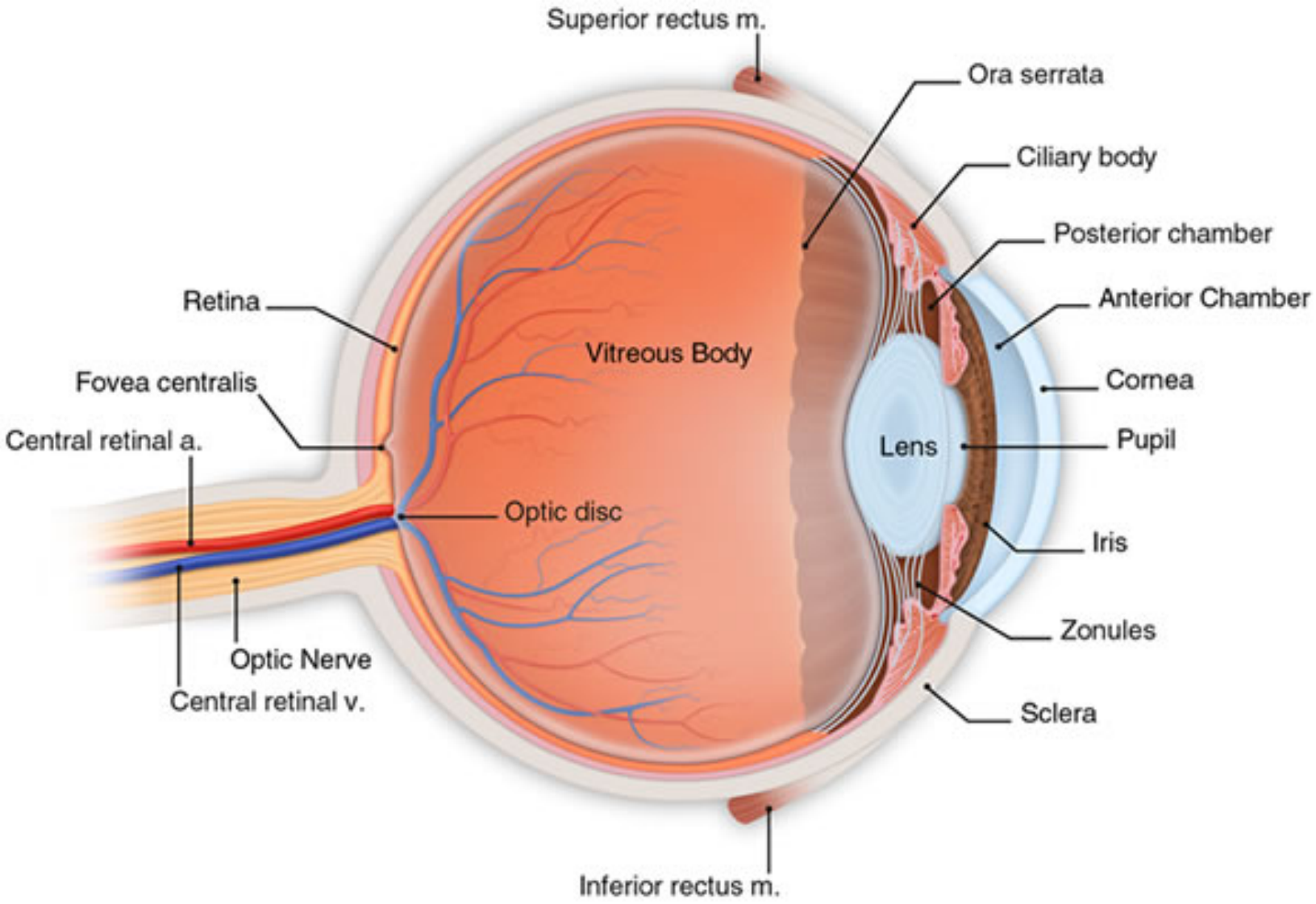
The right goes to Rt and Lt and vice verse

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. Occipital lobe for visual center
- The optic disc is the front surface of the optic nerve.

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

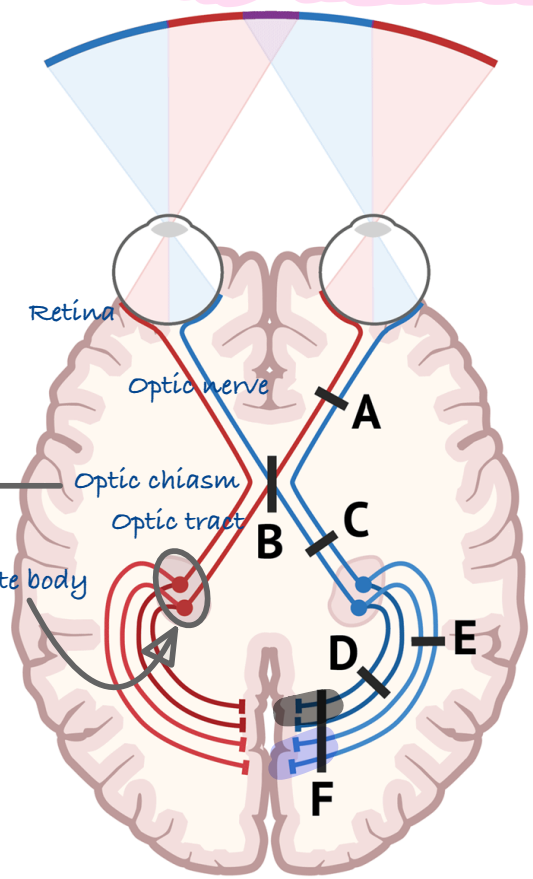

Superior rectus m.
Ora serrata
Ciliary body
Posterior chamber
Anterior Chamber
Cornea
Pupil
Iris
Zonules
Sclera
Retina
Vitreous Body
Fovea centralis
Central retinal a.
Optic disc
Lens
Optic Nerve
Central retinal v.
Inferior rectus m.

Pathway of the Vision

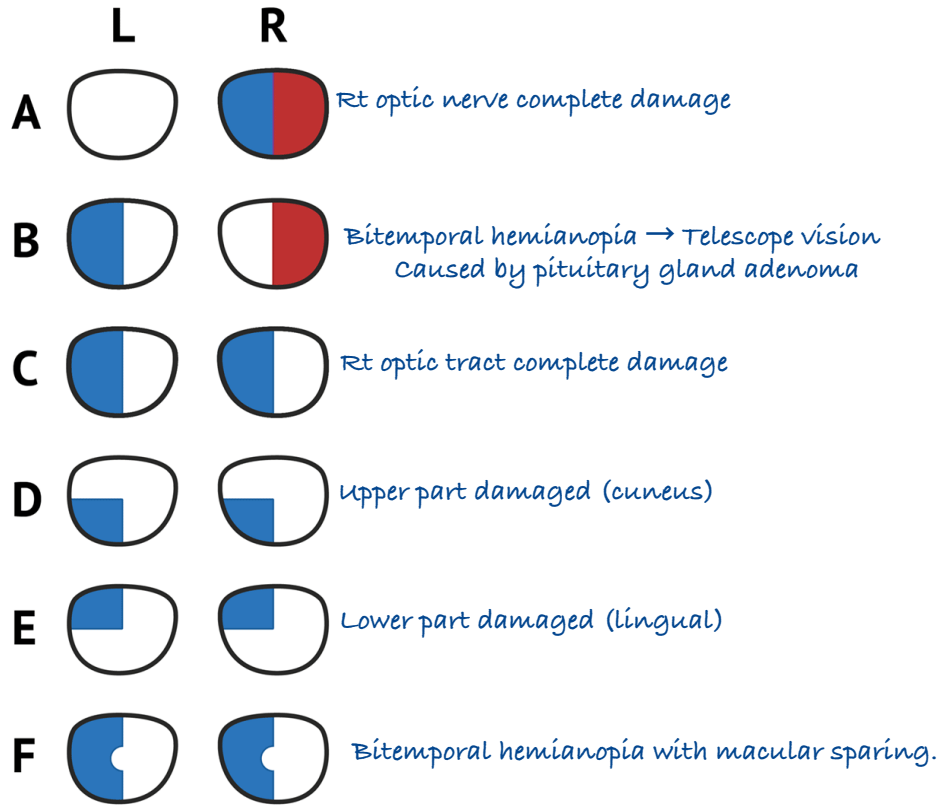
Receptors of light are **rods and cones of retina** → **optic nerve** → optic canal of the sphenoid bone → **optic chiasma** (the medial fibers decussate to the opposite optic tract, while the lateral fibers continue in the same optic tract) → **optic tract (gives fibers to Edinger-Westphale nucleus 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.**

Visual pathway field defects

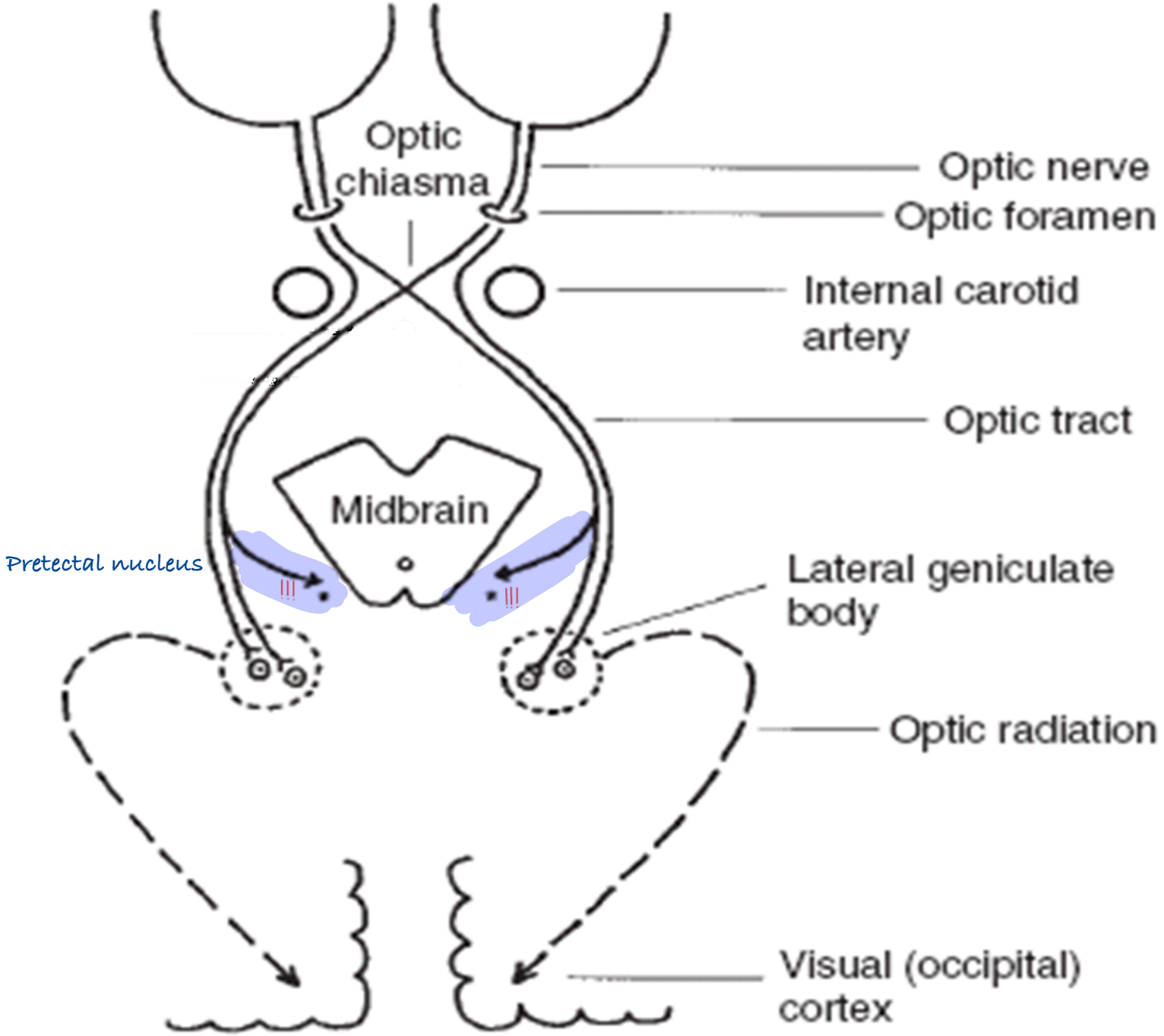
Lateral fibres see the nasal visual field while medial fibers see the temporal (lateral) visual field.



In optic chasm medial fibres crosses while lateral ones do not cross



Upper fibers for Cuneus cause inferior visual field while lower fibers for lingual cause superior visual field


Optic chiasma
Optic nerve
Optic foramen
Internal carotid artery
Optic tract
Midbrain
Pretectal nucleus
III
III
Lateral geniculate body
Optic radiation
Visual (occipital) cortex

Light reflex

Direct light reflex if we put a light in the right eye it will cause constriction to the same pupil that exposed to light

Indirect light reflex if we expose right eye to a light it will cause the left eye pupil to constricts

Pathway of vision and light reflex

Before we reach LGB some fires exit the tract and goes to pretectal nucleus which gives

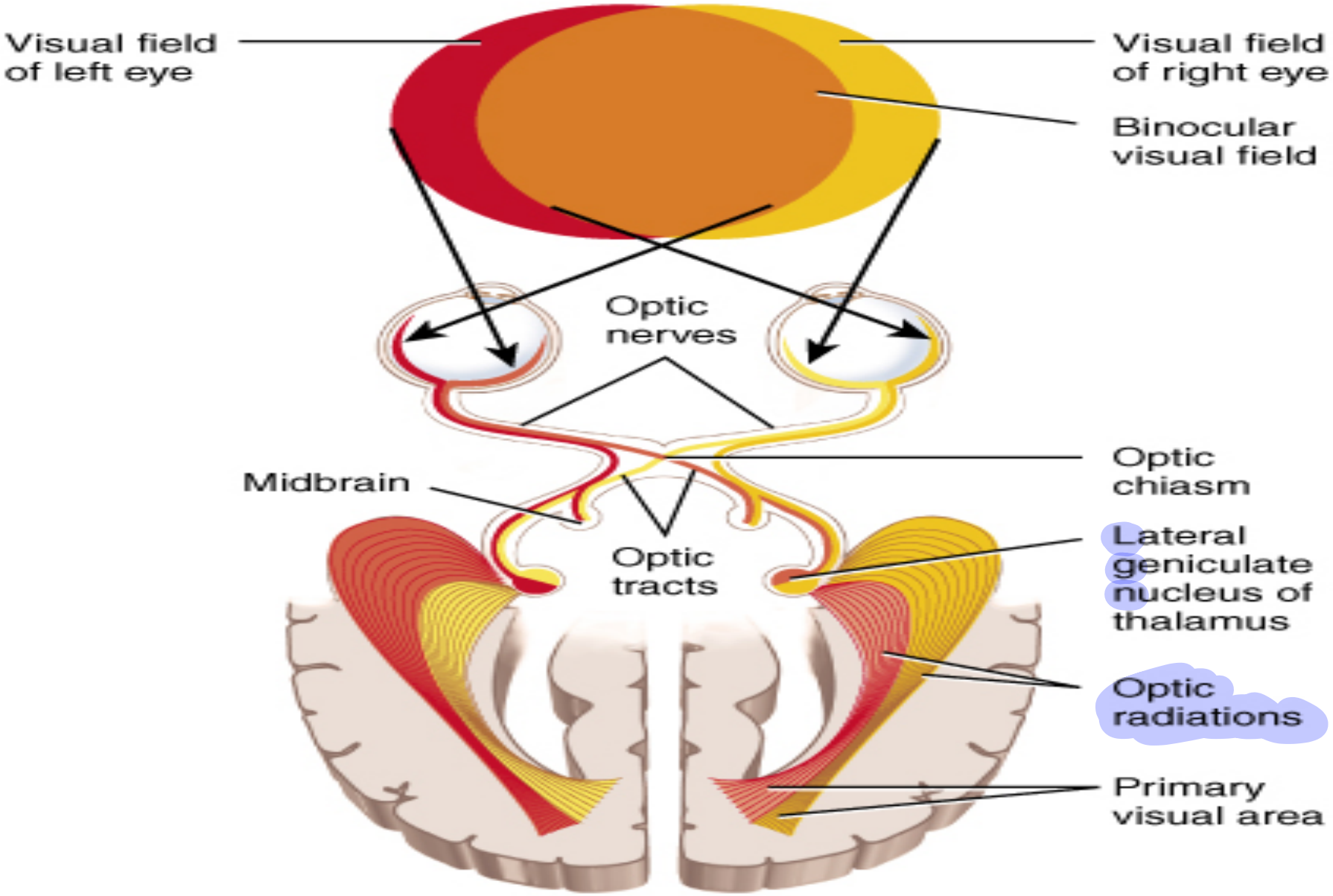
Rt and Lt Edinger westphal Nucleus then goes to oculomotor nerve (3rd) then nerve to inferior oblique muscle that give a signal to ciliary ganglion then short ciliary nerves supply 2 muscles has a relation to light reflex → sphincter pupil muscle cause miosis (constriction to the pupil)

Stimulus → Retina (cones and rods receptors) → optic nerve → optic chiasm → optic tract →→ (LGB) lateral geniculate body → internal capsule runs through temporal and parietal lobes by optic radiation to reach → occipital lobe where the visual centers found.

Sensory Motor

The nerves that responsible for it is the optic as Afferent and oculomotor as Efferent

The Visual Pathway



III. The oculomotor Nerve

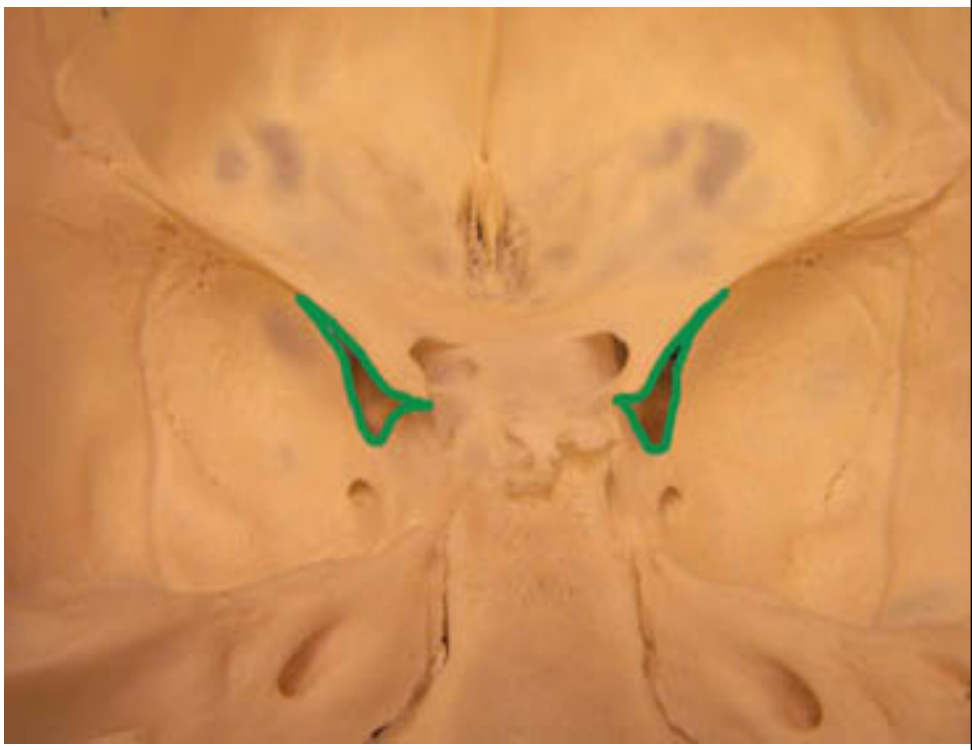
E in efferent means motor

- **Oculomotor nerve:** *(Latin for "eye" and "moving").*
- **Function and modality:**
  1. General somatic efferent: supplies extraocular "skeletal muscles" for the eye ball movement. (Voluntary)
  2. General visceral efferent: supplies intraocular smooth muscles for pupillary reaction and light reflex.

     Sphincter pupil muscle + ciliary muscle

- **Site of nucleus:** it lies in the tegmentum of midbrain.
- Emerges from the ventral (Anterior) surface of the midbrain.
- **Foramen:** superior orbital fissure **"SOF"** of the sphenoid bone.

It pass between posterior cerebral artery and superior cerebella artery is aneurysm happened and it cause pressure on the nerve it will cause occulomotor nerve palsy



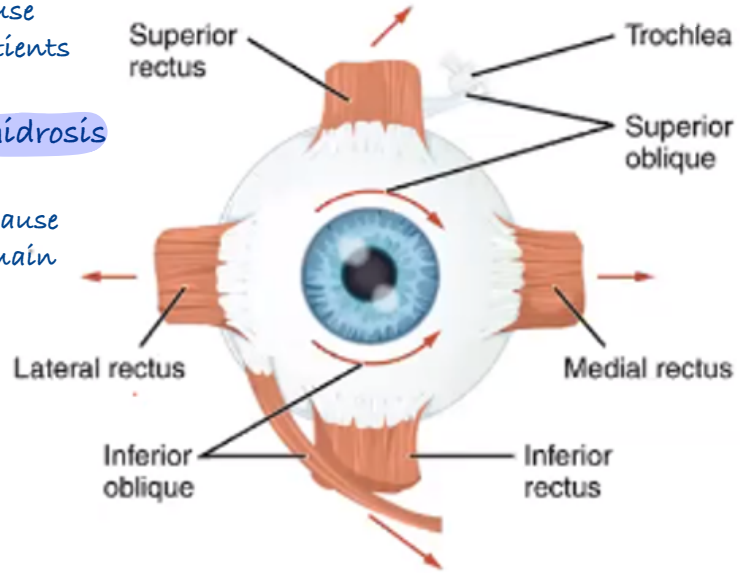
The oculomotor N. supplies all of the intra- and extraocular muscles, Except: حناخدهم كمان شوية شو بيعملو ويكيف بيحركو العين ف اعرفو هان بس انهم ما بيتغنوا بالنيرف رقم ٣ وخلص

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.

If sympathetic is damaged it will cause partial ptosis with Horner syndrome patients

Horner → ptosis, miosis, and anhidrosis

But if oculomotor is damaged it will cause complete ptosis because it supply the main muscle that responsible for.



Anterior view of the right eye

Structure of Oculomotor Nuclei

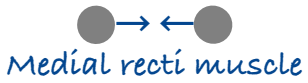
1. **The Edinger-Westphal nucleus:** parasympathetic function which supplies two intraocular muscles:
   a. Constrictor pupillae muscle → Miosis. Constriction of the pupil.
   b. Ciliary muscle → Responsible for light and accommodation reflexes.
2. **The lateral cell mass (motor function):** supplies five extra ocular muscles:
   a. Levator palpebrea superioris muscle. Elevate the eyelid and open the eye
   b. Superior rectus muscle.
   c. Medial rectus muscle.
   d. Inferior oblique muscle.
   e. Inferior rectus muscle.

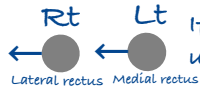
There is lateral rectus muscle supplied by abducents

There is superior oblique muscle supplied by trochlear

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.

Plus accommodation reflex by ciliary muscle





If somebody looks to the right he will be using the lateral to right and medial to left

Branches of the Oculomotor Nerve

1. **Superior** division "Somatic motor and sympathetic":

   which supplies the:

   a. **Levator palpebrae superioris** muscle.

   b. **Superior rectus** muscle.

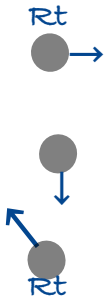
2. **Inferior** division "Somatic motor and parasympathetic":

   which supplies the:

   a. **Medial rectus** muscle.

   b. **Inferior rectus** muscle.

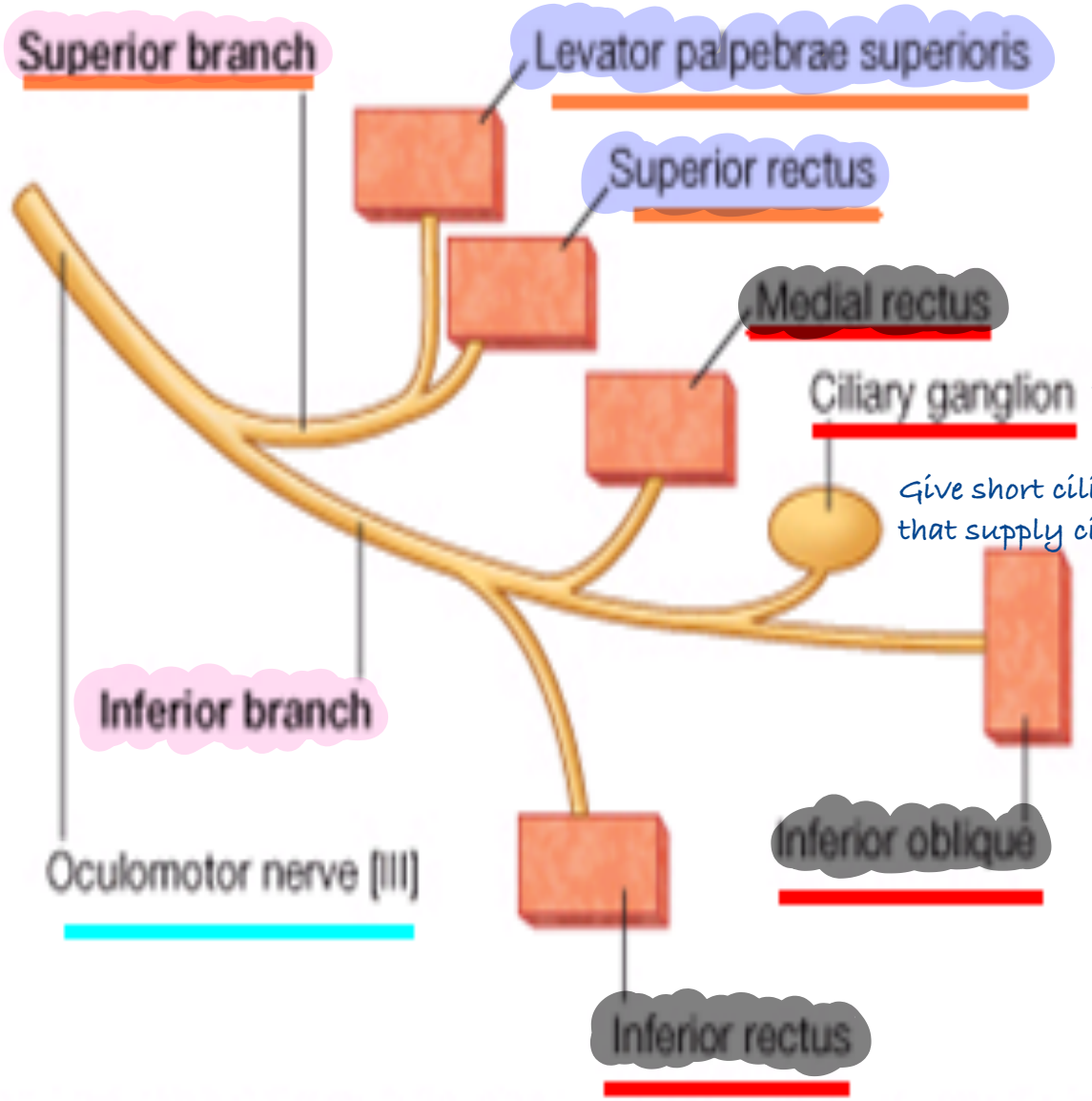
   c. **Inferior oblique** muscle.



   d. Constrictor pupillae muscle (via ciliary ganglion).

Sphincter pupil muscles

   e. Ciliary muscle (via ciliary ganglion).



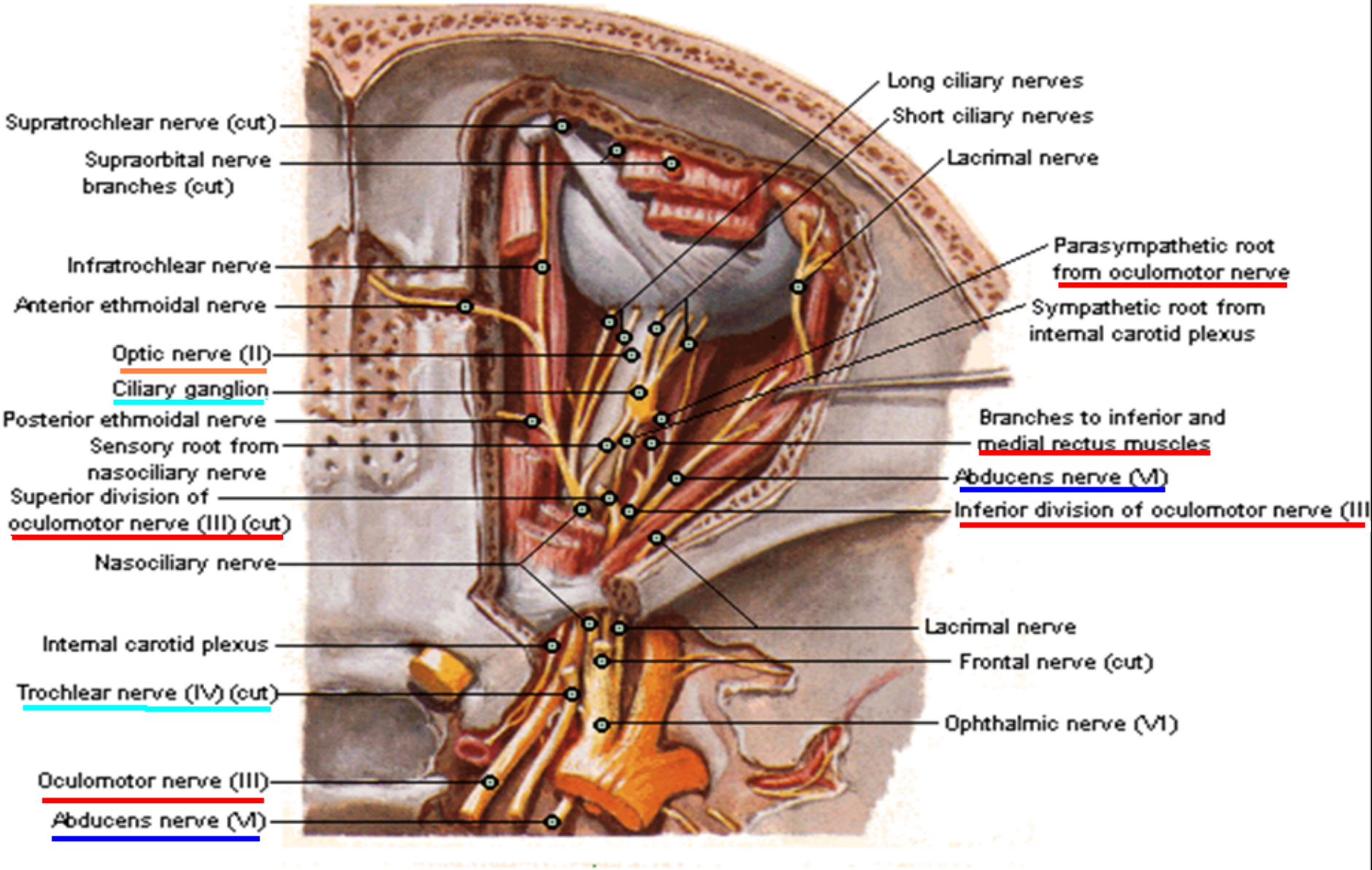
Elevate the eyelid if damaged it will cause ptosis (closure to the eye)

Parasympathetic fibers

Give short ciliary nerves that supply ciliary muscles

Nerves of Orbit - Muscles Partially Cut Away

Superior View



IV. The Trochlear Nerve

Arise from a dorsal surface (Posterior) of midbrain.

- It is purely a motor nerve and the smallest cranial nerve.
- **Function and modality:** general somatic efferent (Motor) → 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.

Oculomotor and trochlear enters to the upper lateral wall cavernous sinus then to superior orbital fissure and supply sup. Oblique muscle. While abducents nerve in the upper medial wall cavernous sinus.

VI. The Abducent Nerve

- **Abducent nerve:** *(Latin for "abduction").*
- **Function and modality:** general somatic efferent → supplies **the lateral rectus muscle.**

Motor

Then it pass in the medial wall of cavernous sinus then goes to superior orbital fissure and supply lateral rectus muscle → for abduction to eye.

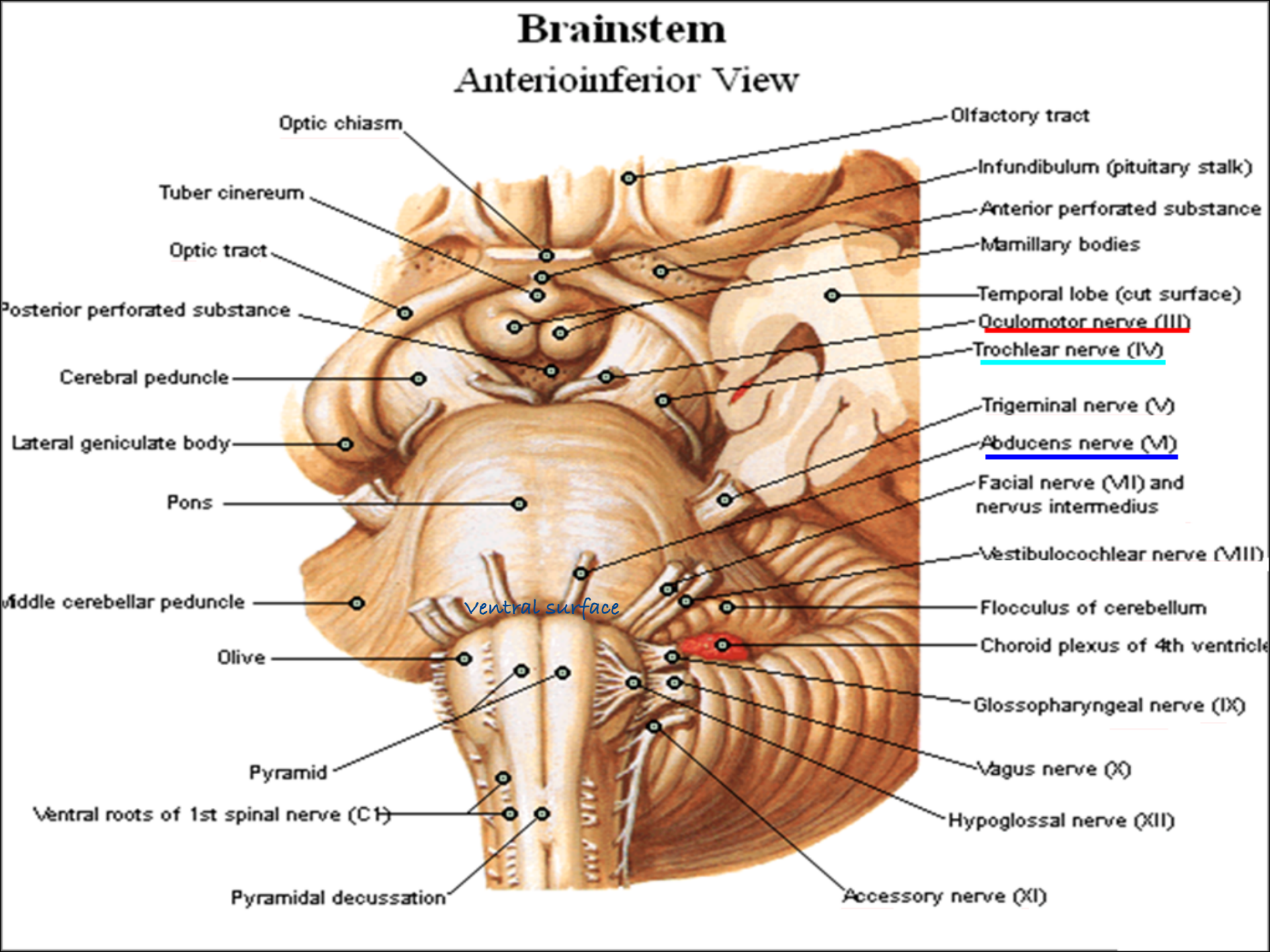
- **Site of the nucleus**: it lies in pons.

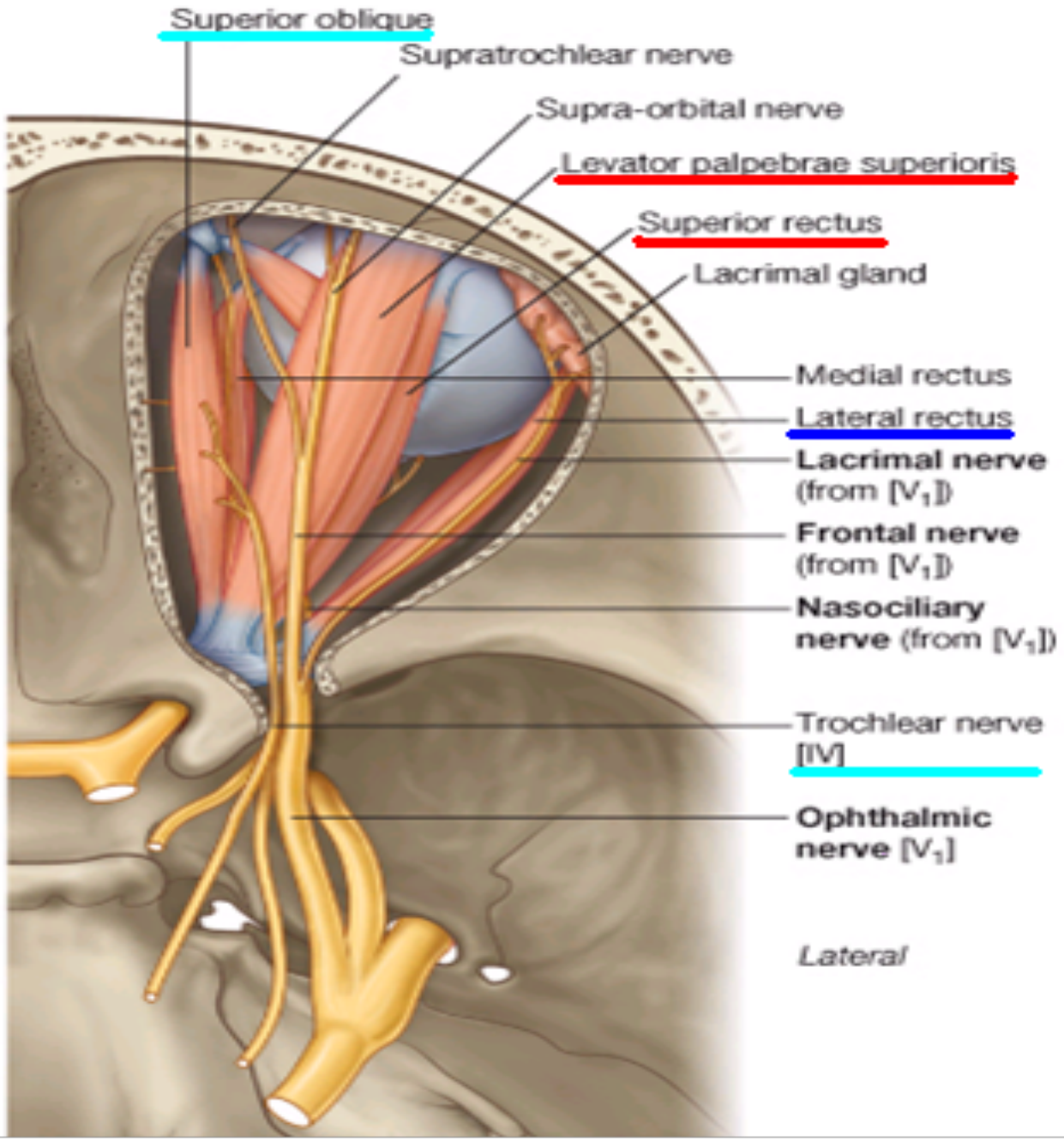
ventral surface (anterior)

- 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

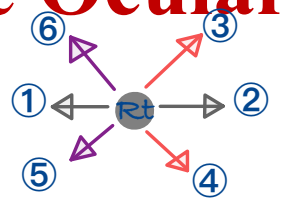
Anterioinferior View




Superior oblique
Supratrochlear nerve
Supra-orbital nerve
Levator palpebrae superioris
Superior rectus
Lacrimal gland
Medial rectus
Lateral rectus
Lacrimal nerve (from [V1])
Frontal nerve (from [V1])
Nasociliary nerve (from [V1])
Trochlear nerve [IV]
Ophthalmic nerve [V1]
Lateral

The Actions of the Ocular Muscles

كل العضلات بتمشي ع هوى الاسم ماعدا الي الها علاقة بال oblique



Rectus muscle
Superior → elevation
Inferior → depression
Lateral → abduction
Medial → addiction

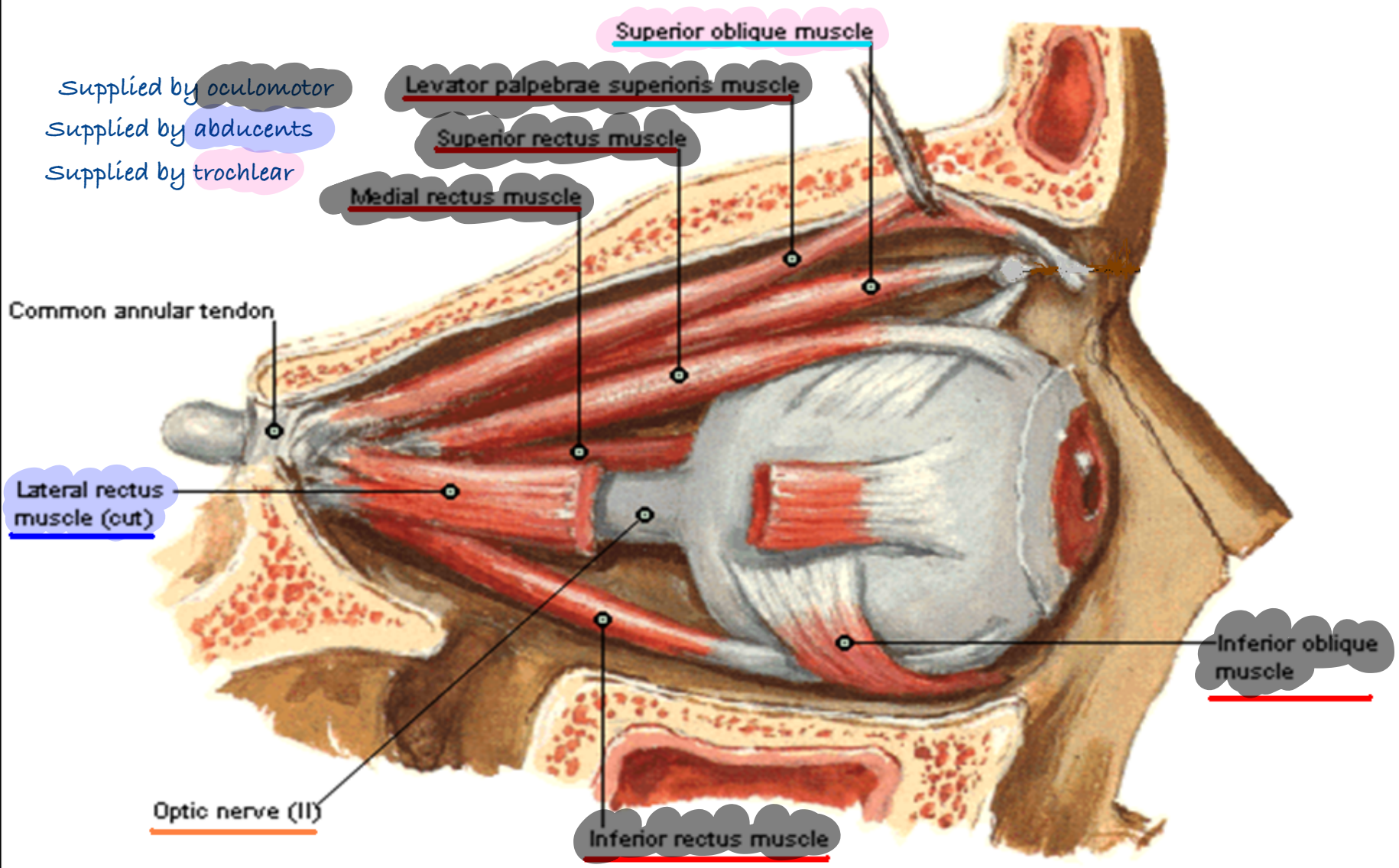
1. **Lateral Rectus Muscle:** abducts (laterally) the eye ball.
2. **Medial Rectus Muscle:** adducts (medially) the eye ball.
3. **Superior Rectus Muscle:** elevates, adducts and rotates medially.
4. **Inferior Rectus Muscle:** depresses, adducts and rotates medially.
5. **Superior Oblique Muscle:**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

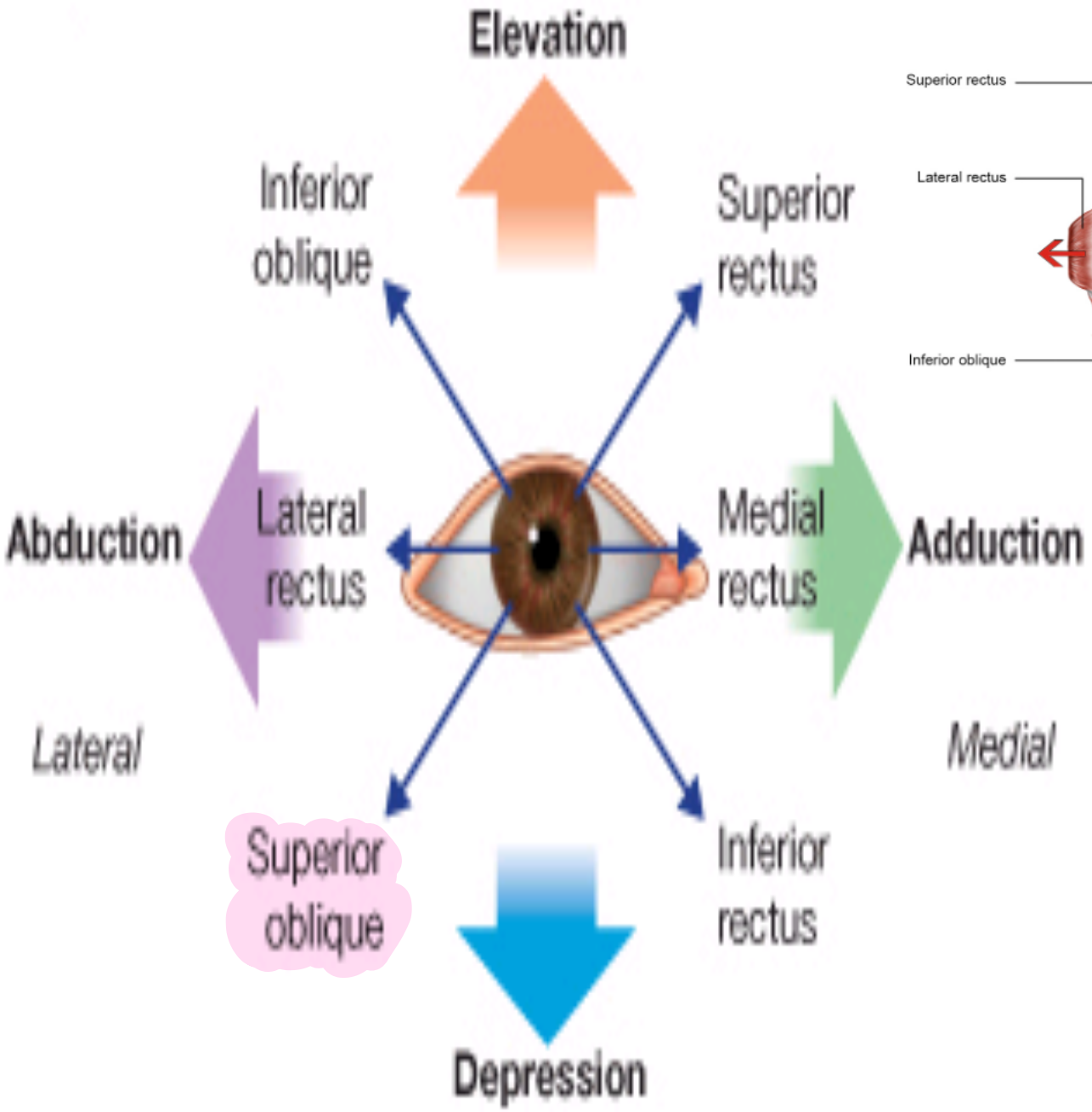
It may do addiction

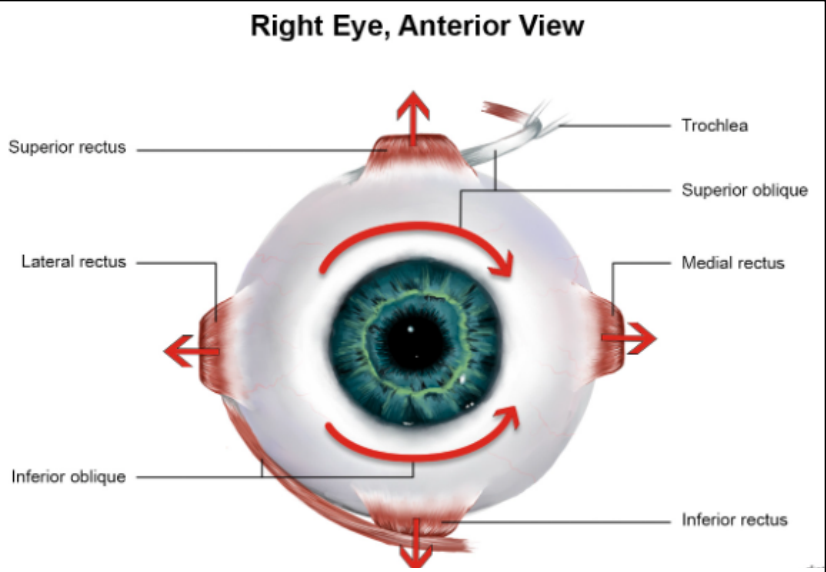
6. **Inferior Oblique Muscle:** elevates, abducts and rotates laterally.

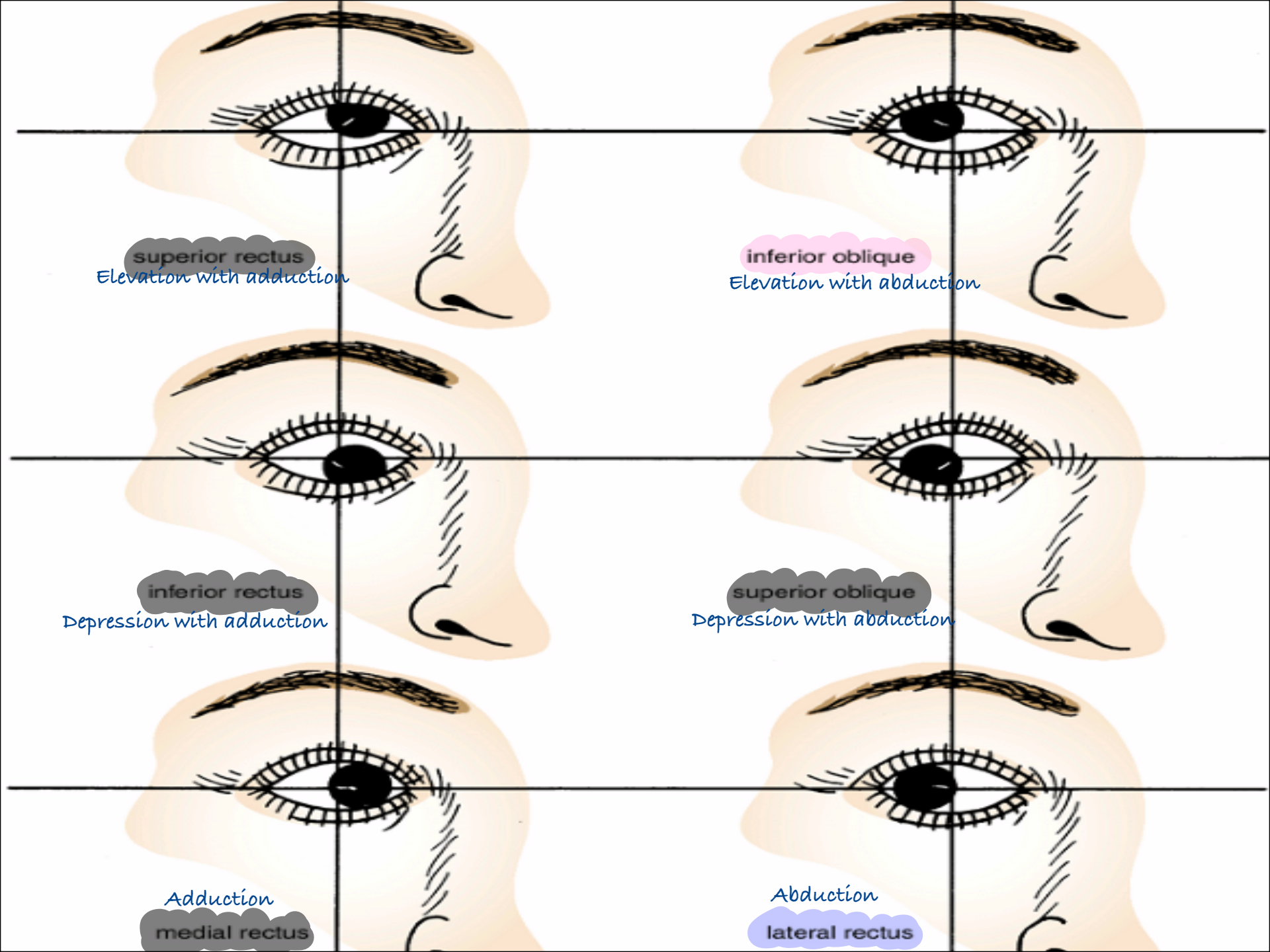
Extrinsic Eye Muscles

Right Lateral View




Elevation
Inferior oblique
Superior rectus
Abduction
Lateral rectus
Medial rectus
Adduction
Lateral
Medial
Superior oblique
Inferior rectus
Depression


Right Eye, Anterior View
Superior rectus
Trochlea
Superior oblique
Lateral rectus
Medial rectus
Inferior oblique
Inferior rectus


superior rectus
Elevation with adduction
inferior oblique
Elevation with abduction
inferior rectus
Depression with adduction
superior oblique
Depression with abduction
Adduction
medial rectus
Abduction
lateral rectus

Lesion of the Oculomotor Nerve

Main muscle for elevation of the eye and open it if paralyzed it will cause ptosis

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

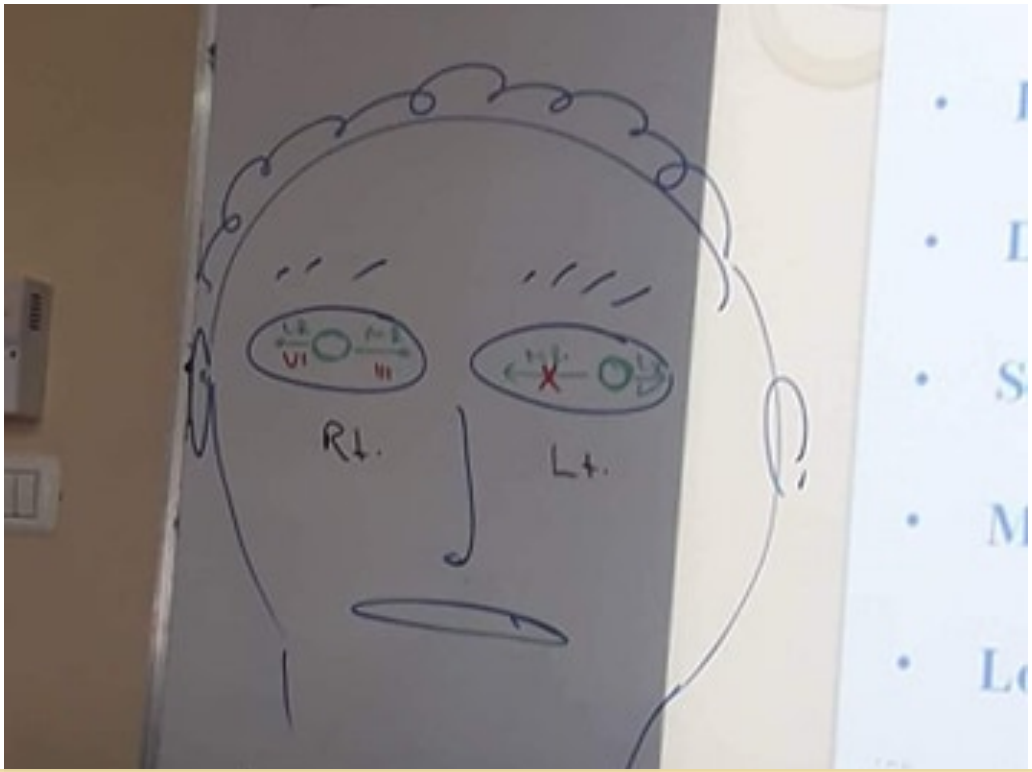
Because the constriction that caused by parasympathetic is deleted so the sympathetic is dominant so cause dilated pupil.

Cause of lateral rectus work it will cause abduction of the eye and medial rectus doesn't work so it will pull the eye laterally

If there is ptosis it will not cause diplopia

الحل مع المرضى الي عندهم diplopia اني البسهم نضارة واسكر عين وحدة وبالتناوب كل يوم عين، عشان اتخلص من ال double vision

Lesion of the Oculomotor Nerve



If a patient came with oculomotor nerve palsy either she is DM with mono neuropathy or aneurysm compression to the nerve

If case presentation with one question and pupil is intact it is believed that it is for DM that affect the axons and autonomic fibers is more external but if he has mydriasis it is believed to be compression or pressure to the nerve cause its the 1st symptom appears

According to the place of the compression:

If the problem in cavernous sinus where ophthalmic and maxillary passes it will cause painful ophthalmoplegia if it was by superior orbital fissure tumor it will cause the same because of the ophthalmic branch of trigeminal nerve

But if the nerve is just affected it will be painless

Superior oblique muscle

Lesion of the Trochlear Nerve

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

Lateral rectus

Lesion of the Abducent Nerve

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

Light Reflex Done✅

- **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

Parasympathetic

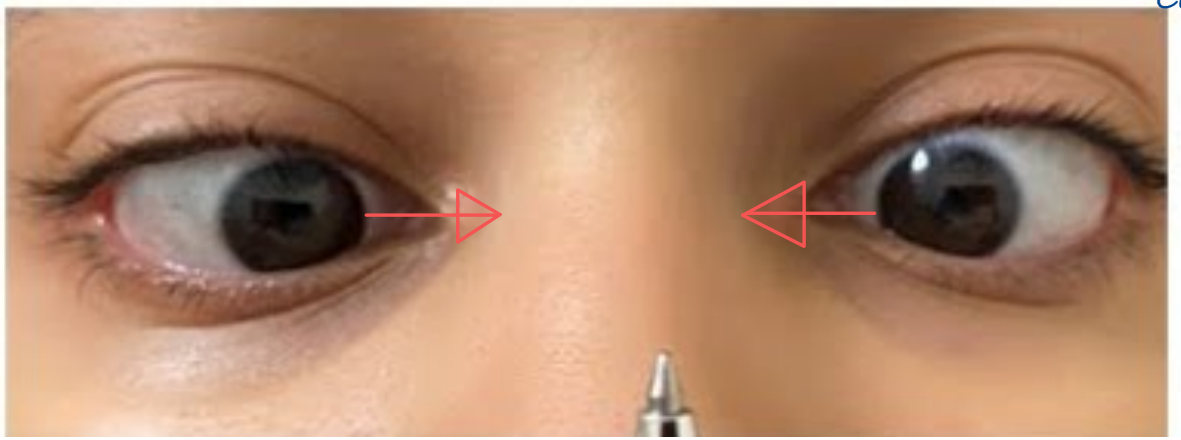
Accommodation and Convergence Reflex

Done✅

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).

Ciliary 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.

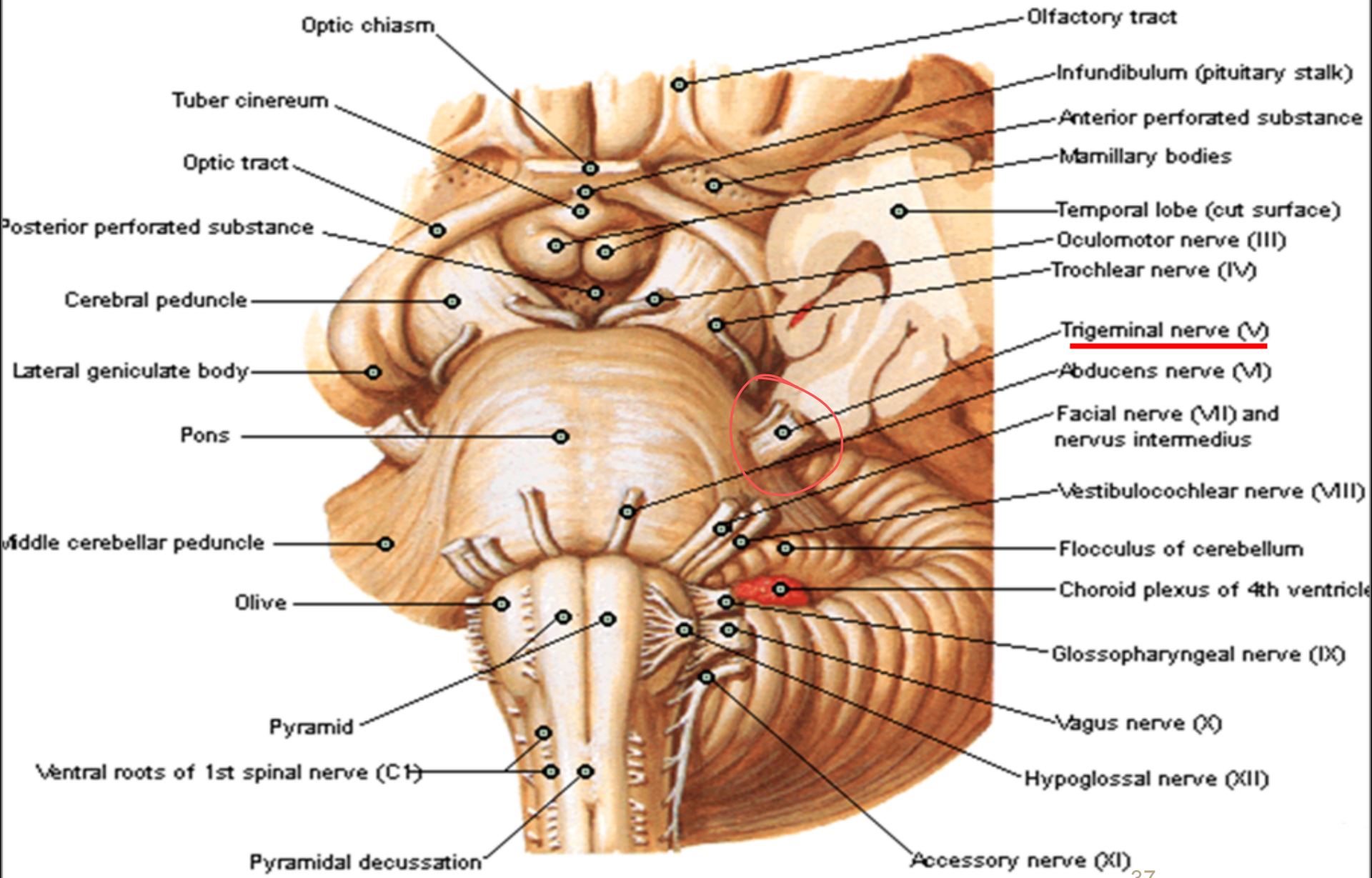
Pass through cerebello pontine angle with 7th and 8th

- The two roots are attached to the ventro-lateral aspect of the pons.

Anterolateral

Brainstem

Anterioinferior View

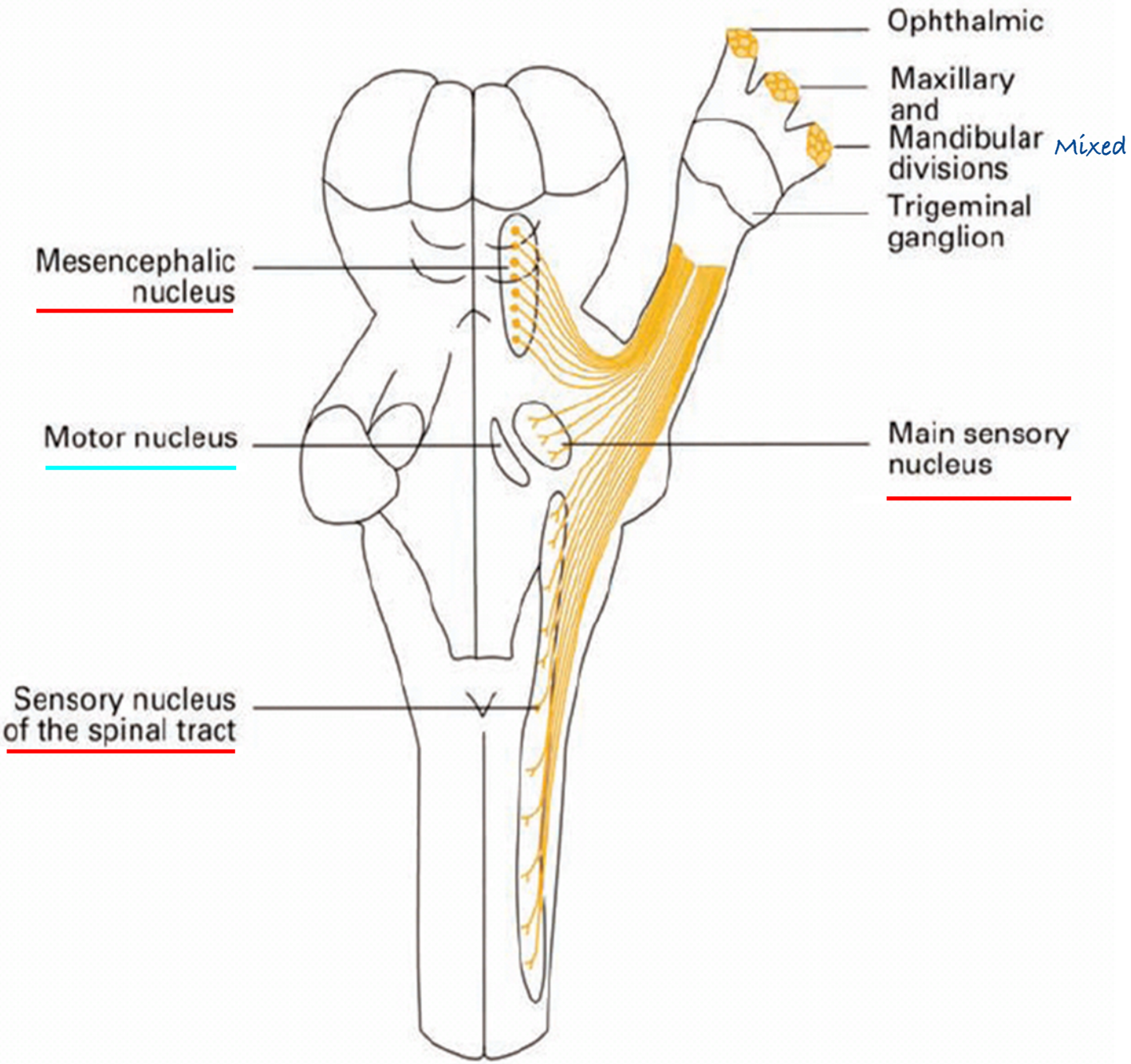


Nuclei of the Trigeminal Nerve

1. **Main Sensory Nucleus:** lies in the middle part of the pons (for touch sensation).
2. Long nucleus
   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. Exception
   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.

For 8 muscles
4 mastication and other 4 non mastication.

The only one that has motor function in 5th cranial nerve.


Ophthalmic
Maxillary and Mandibular divisions
Mixed
Trigeminal ganglion
Mesencephalic nucleus
Motor nucleus
Main sensory nucleus
Sensory nucleus of the spinal tract

Branches of the Trigeminal Nerve

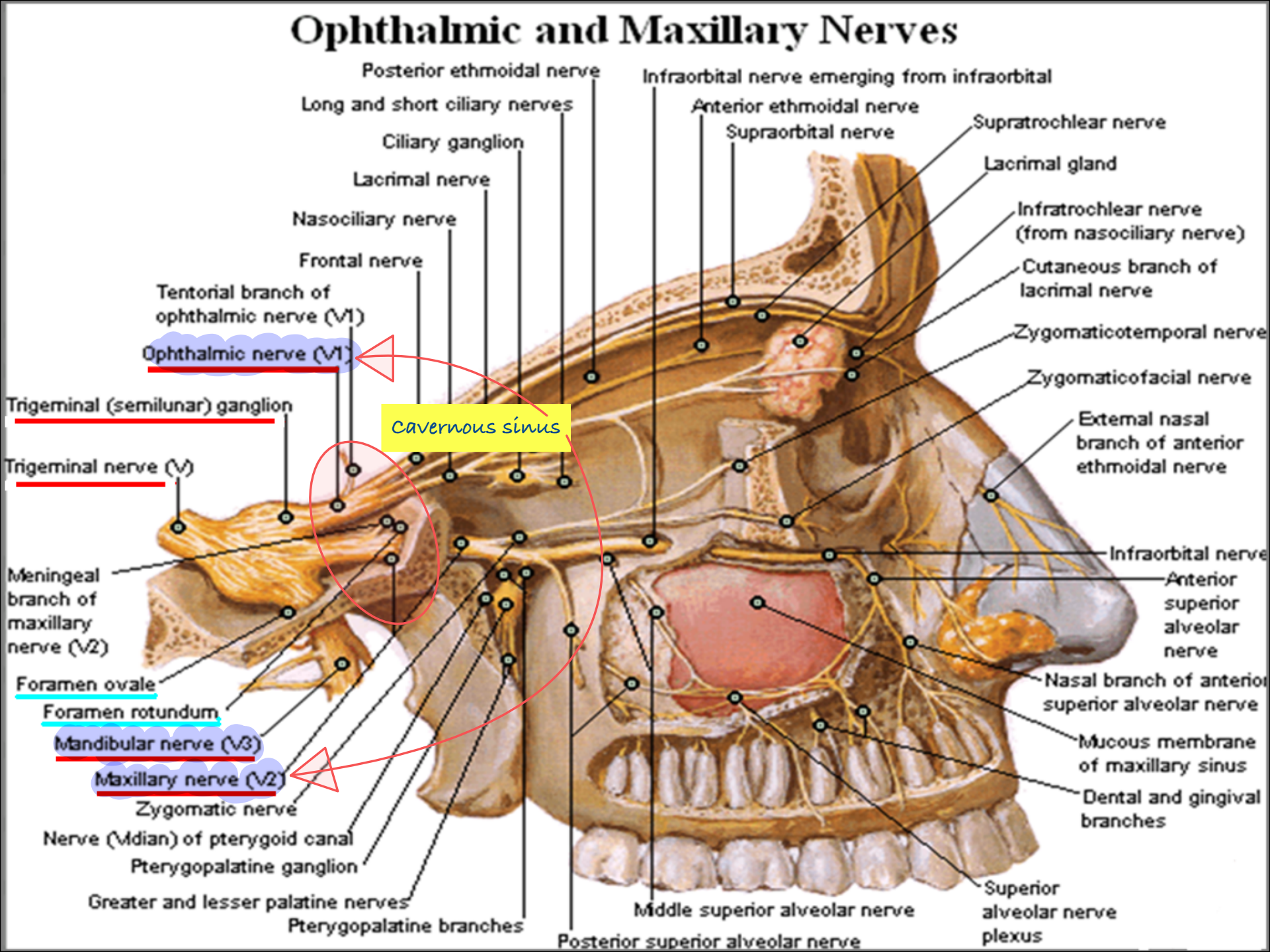
The trigeminal nerve has three branches:

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

Supplies 8 muscles

4 mastication
4 non mastication

Ophthalmic and Maxillary Nerves



The Ophthalmic Nerve (V_1)

- It is the first branch of the trigeminal nerve.
- **Function and modality:** general somatic afferent. (Sensory)
- **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. (called conjunctiva reflex)
  5. Nasal mucosa.
  6. Frontal sinus.
  7. External nose.
  8. Dura mater in the anterior cranial fossa.

لو جينا جسم غريب على سبيل المثال قطنة ومررناها على سطح العين
حتلاقي انو عينك سكرت لحالها وهادي هيّا ال corneal reflex

2 cranial nerves are responsible
sensory V1 and V2 while motor facial nerve 7th
Afferent
Efferent

The Maxillary Nerve (V_2)

- It is the second branch of the trigeminal nerve.
- **Function and modality:** general somatic afferent. (Sensory)
- **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.

Irritation of soft palat and cause elevation of it and cause involuntary swallowing

Sensory → maxillary V2 and glossopharyngeal 9th
Motor → glossopharyngeal 9th and vagal 10th

The Mandibular Nerve (V_3)

- It is the third branch of the trigeminal nerve.
- **Functions and modalities:** mixed nerve general somatic afferent (Sensory) & special visceral efferent (Motor).
- **Foramen:** rotundum foramen.
- **Origin:** it is a mixed (They joined each other) 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

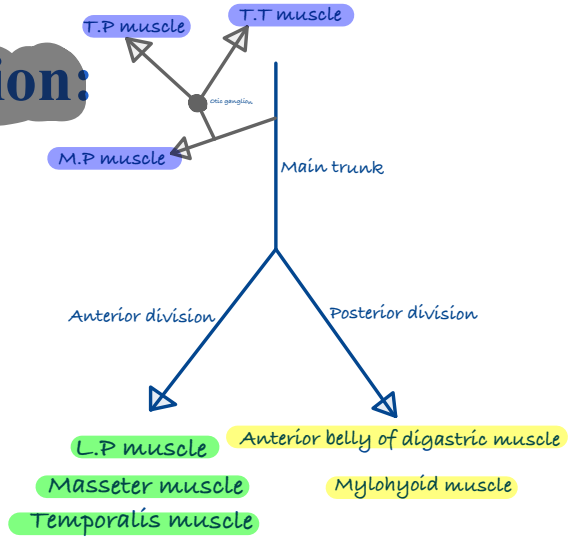
1. Motor fibers to muscles of mastication:

a. Temporalis muscle.

b. Masseter muscle.

c. Medial pterygoids muscle.

d. Lateral pterygoids muscle.



2. Motor fibers to other four muscles:

a. Mylohyoid muscle.

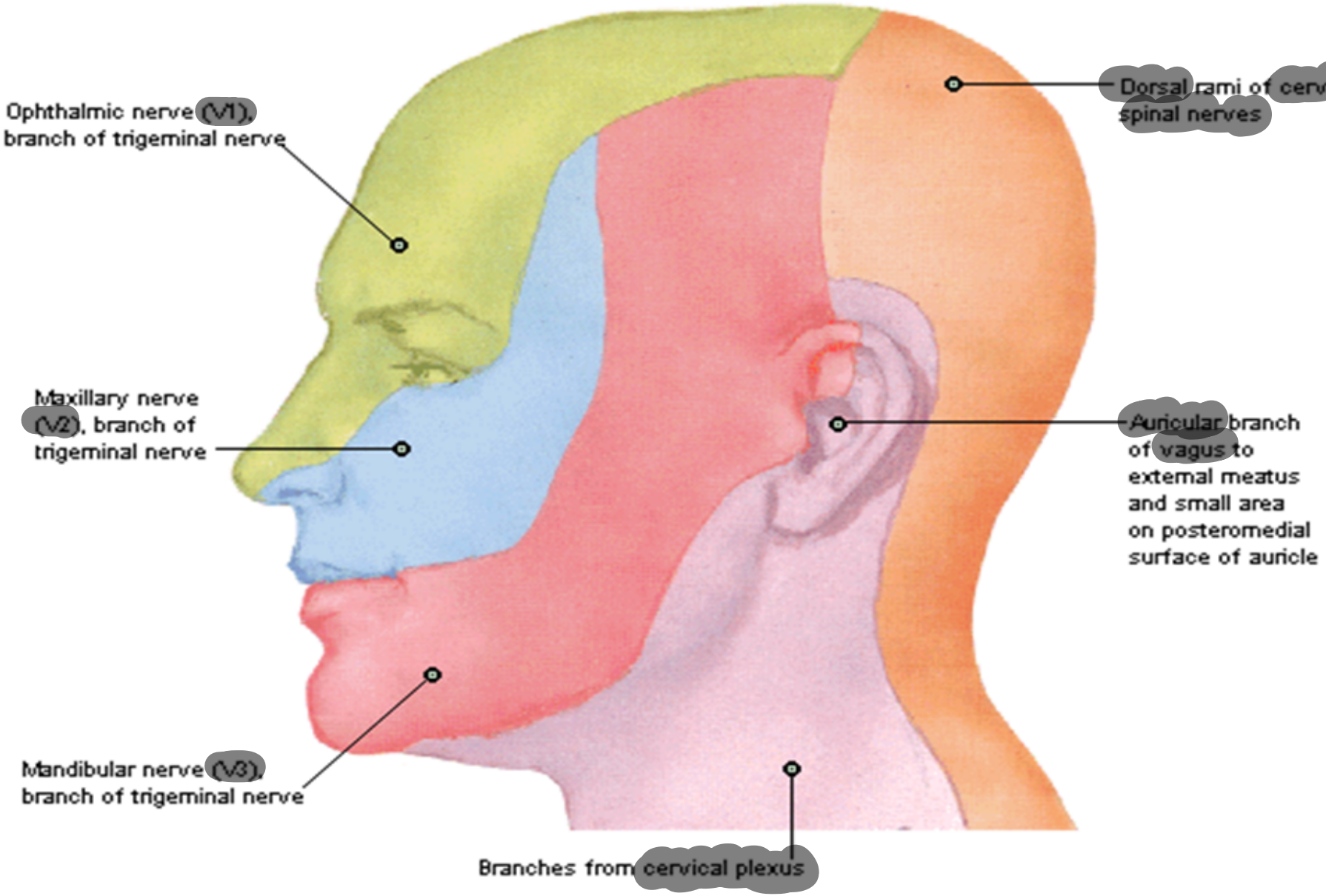
The posterior branch supplied by a branch of facial nerve

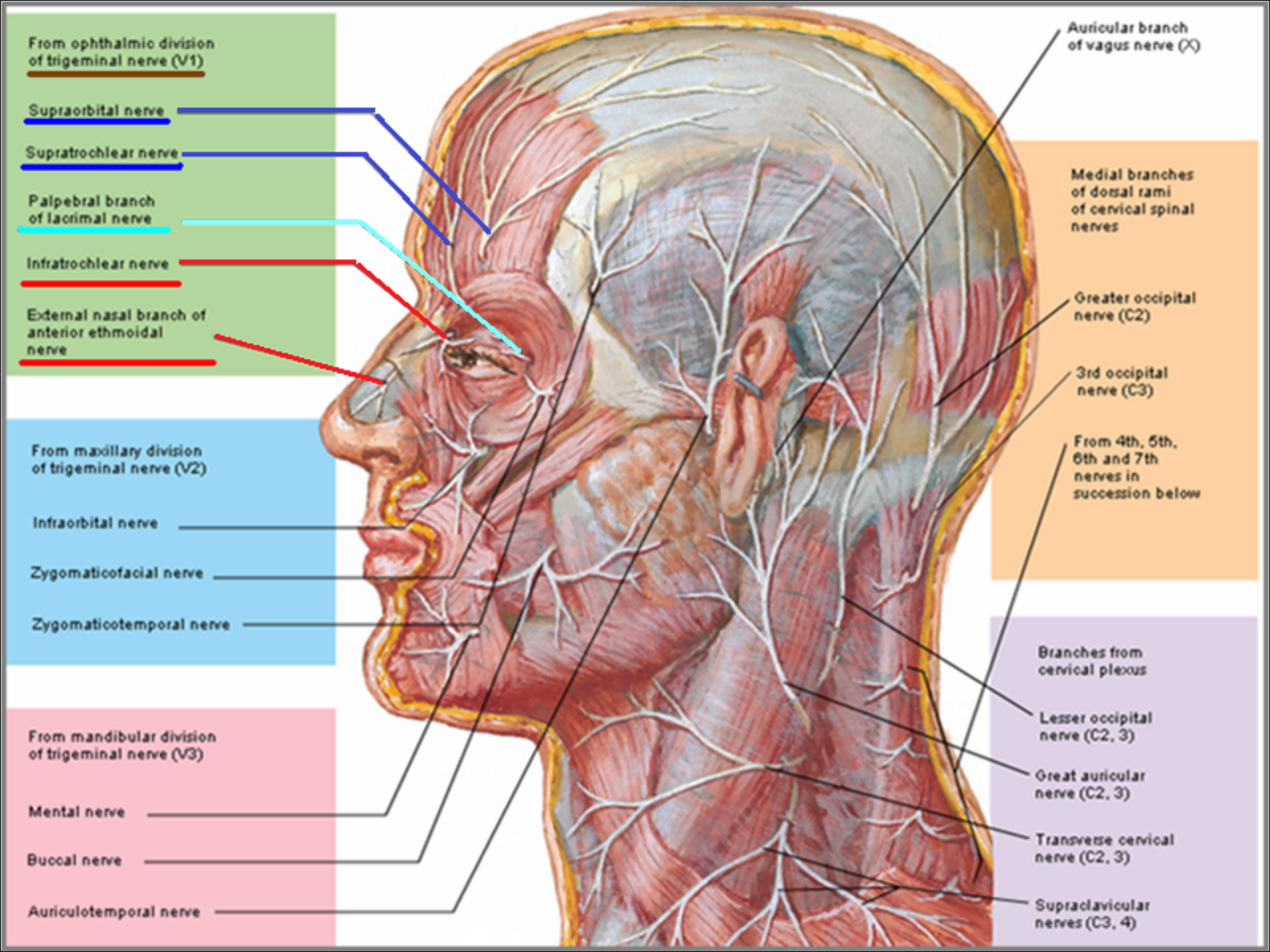
b. Anterior belly of digastric muscle.

c. Tensor palati muscle (from otic ganglion).

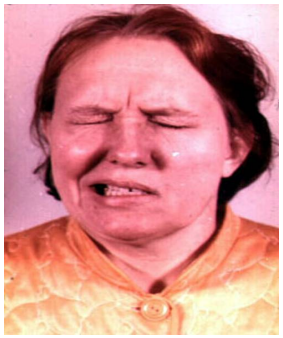
d. Tensor tympani muscle (from otic ganglion).

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 Douloureau"



- 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.

كل المرضى بييجو بنفس ال complain

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.

Motor part | Sensory part

- **Foramen:** Internal auditory meatus → Stylomastoid foramen.

① UMNL upper motor neuron lesion → C.B.T damage
② LMNL lower motor neuron lesion → nuclear or nerve legion

① If damaged result contralateral lower part paralysis
② If damaged result epsilateral hemifacial paralysis

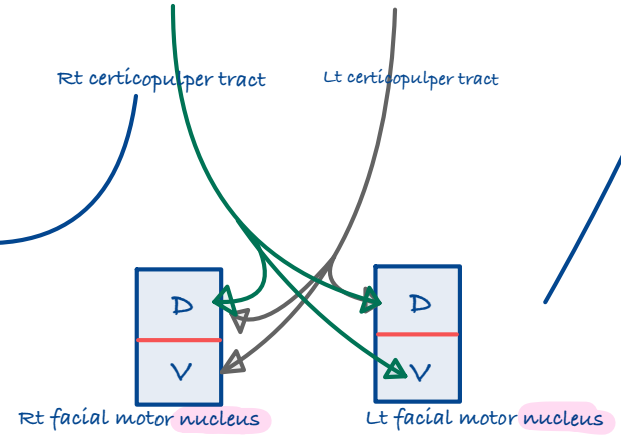
Roots of the Facial Nerve

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

In general the C.B.T gives dorsal and ventral controlateral in addition to dorsal epsilateral

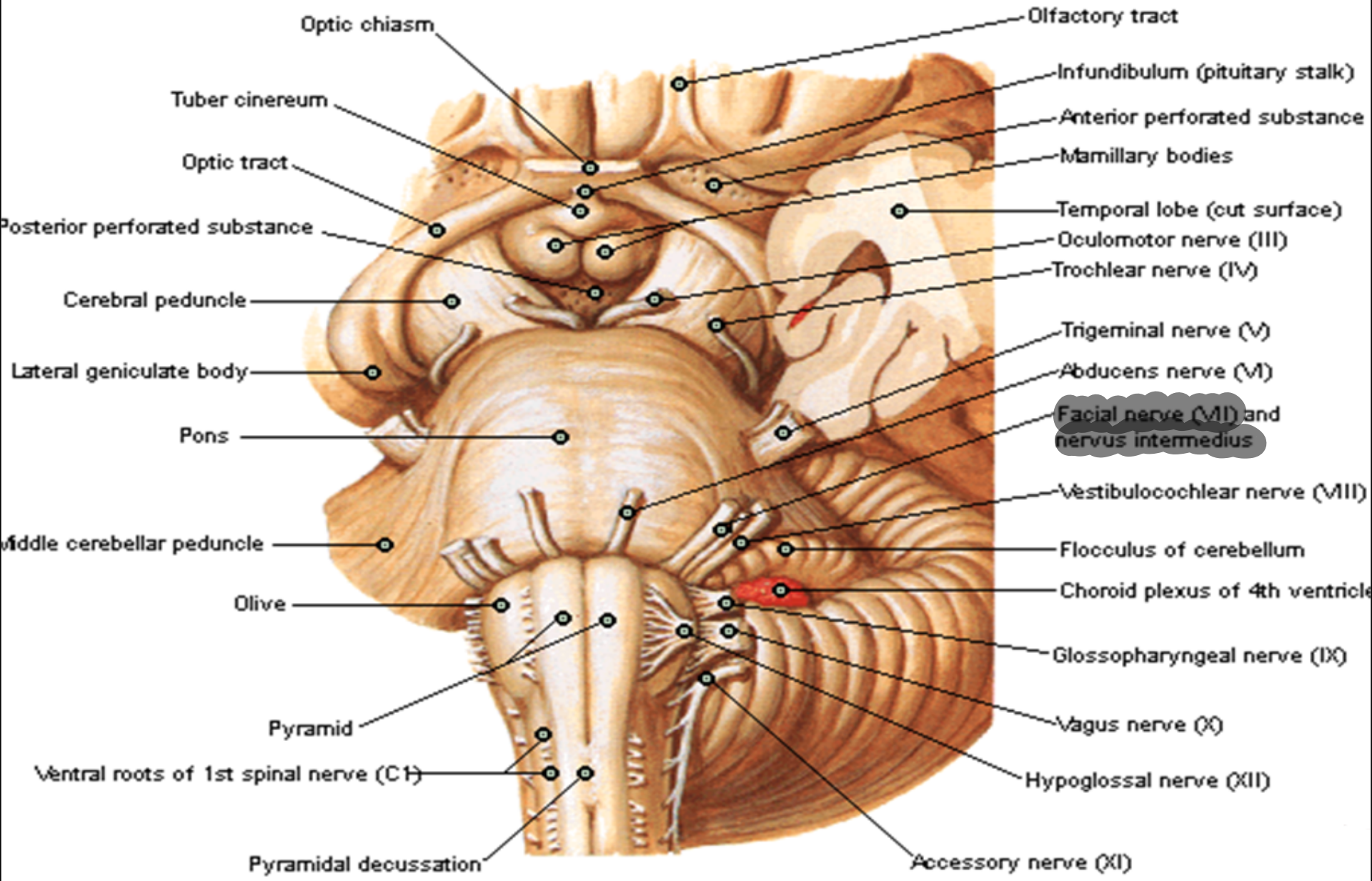
Dorsal part cause its importance for the eye has dual innervation from both cerebral hemispheres.

D→ dorsal (anterior) part of nucleus for upper part of face
V→ ventral (posterior) part of nucleus for lower part of face



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:

   All salivary glands except parotid gland supplied by glossopharyngeal 9th

   a. Submandibular and sublingual salivary glands (Chorda tympani nerve). Branch of facial

   b. Glands of the palate, nose, lacrimal glands and nasopharynx (Greater superficial petrosal nerve).
3. **Solitary nucleus:** lies in **the medulla oblongata** for:

   7th
   9th
   10th

   - 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.

called conjunctiva reflex

لو جبنا جسم غريب على سبيل المثال قطنة ومررناها على سطح العين
corneal reflex حتلاقي انو عينك سكّرت لحالها وهادي هيّا ال

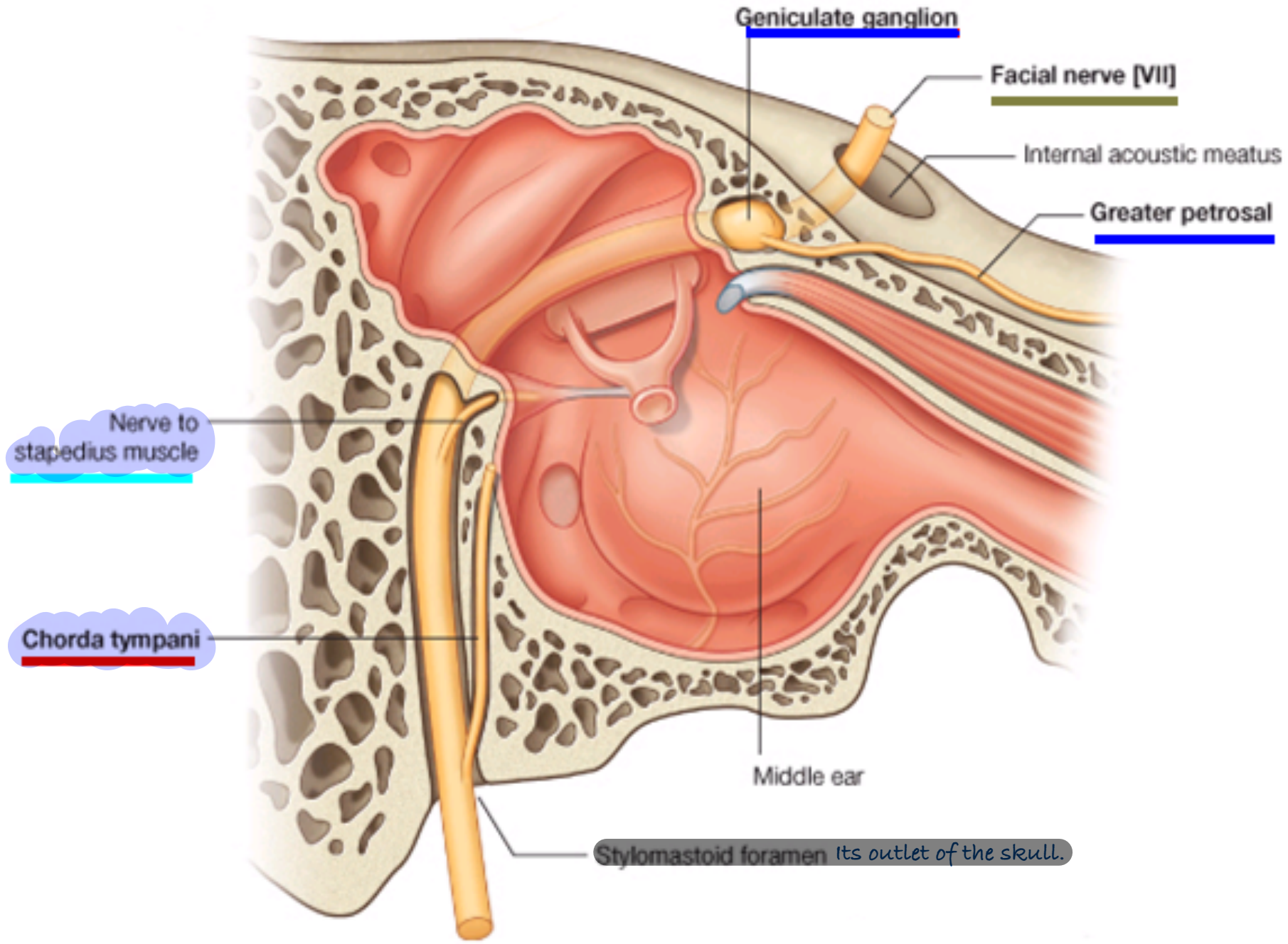
2 cranial nerves are responsible
sensory V1 and V2 while motor facial nerve 7th
Afferent
Efferent

Branches of the Facial Nerve

10 branches
3 intracanal
2 immediately after exit
5 final branches

Inside the Fallopian Canal

1. The greater superficial petrosal nerve "GSPN".
   Only parasympathetic
2. Small branch to the stapedius muscle.
   على اسم العضلة المتصلة فيها
   Only motor
   In internal ear its contraction decrease transmission of the high vibrations and sound from external ear to internal
3. The chorda tympani.
   Mixed: sensory and parasympathetic
   For taste sensation of ant. 2/3 of the tongue
   And parasympathetic fibers for submandibular ganglion for submandibular and sublingual salivary gland.


Geniculate ganglion
Facial nerve [VII]
Internal acoustic meatus
Greater petrosal
Nerve to stapedius muscle
Chorda tympani
Middle ear
Stylomastoid foramen
Its outlet of the skull.

Branches of the Facial Nerve
After it Leaves the Skull

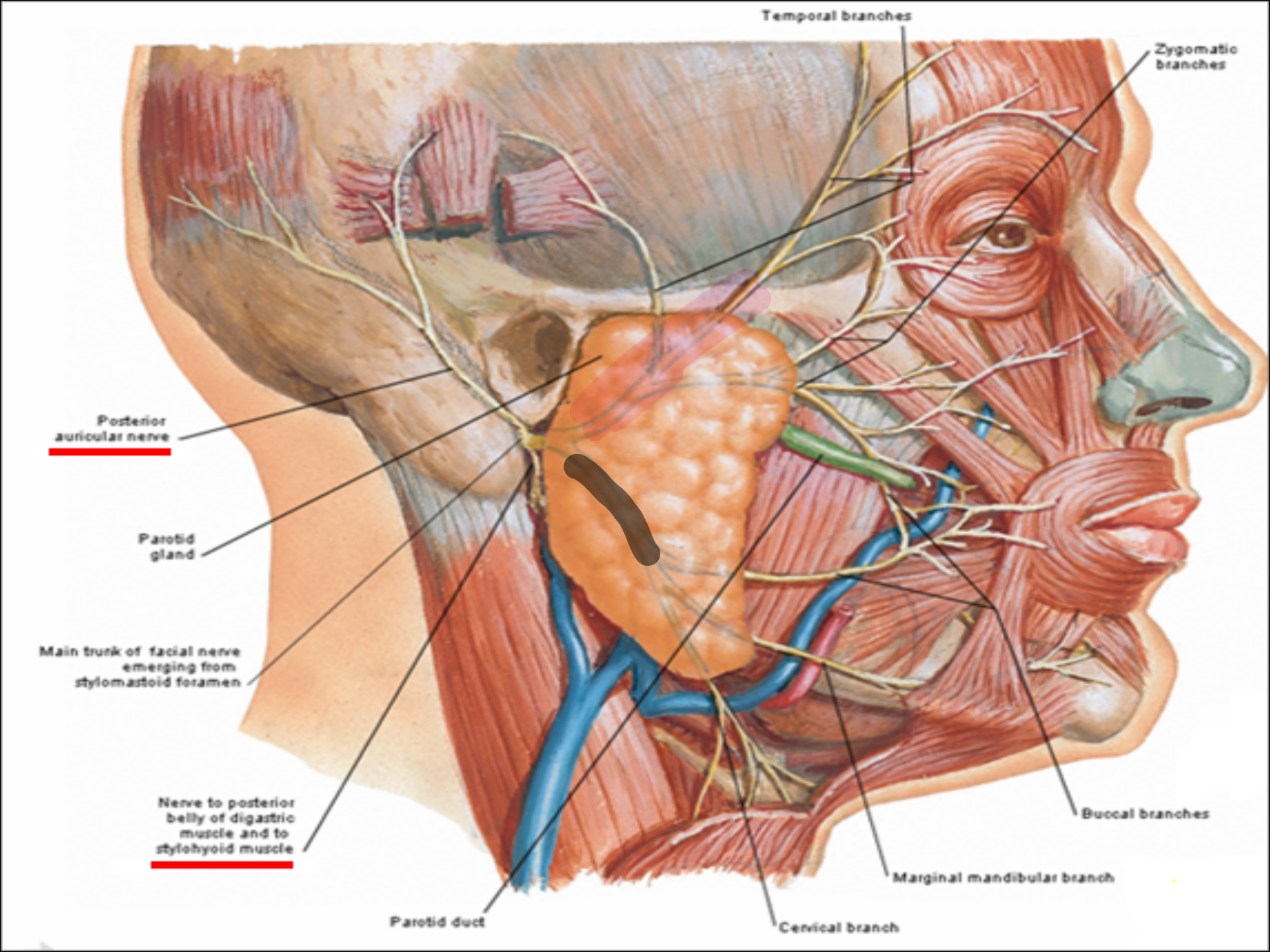
❖Immediately after it leaves the skull "2 branches":

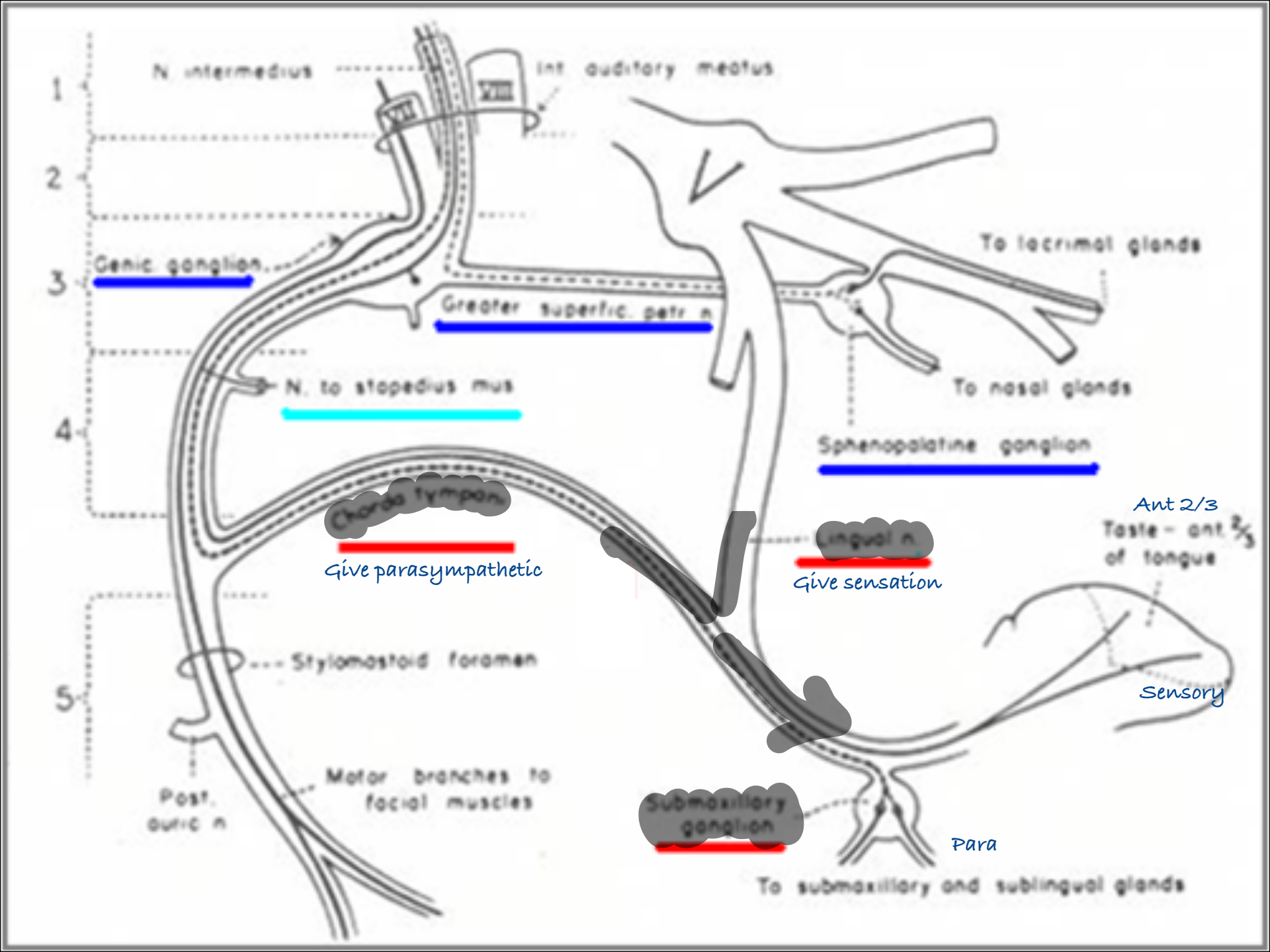
1. The posterior auricular nerve.
   Carry sensation of the auricle and supply occipital belly of occipitofrontalis muscle
2. The nerve to the posterior belly of the digastric muscle and to the stylohyoid muscle.

The nerve reach's posterior medial surface of parotid gland

❖Terminal branches of the facial nerve "5 branches":

1. Temporal nerve (from temporofacial branch).
   Upper part for orbicularis muscle for its importance has dual innervation
2. Zygomatic nerve (from temporofacial branch).
   Upper and lower → Upper and lower orbicularis oculi muscle Close the eye
   For nasal muscle and muscle between eye and mouth
3. Buccal nerve (from cervicofacial branch).
   Supply 2 muscles: orbicularis oris and buccinator
4. Marginal mandibular nerve (from cervicofacial branch).
   Supply muscle around the mandibular angle.
5. Cervical nerve (from cervicofacial branch).
   Supply latesma muscle


Temporal branches
Zygomatic branches
Posterior auricular nerve
Parotid gland
Main trunk of facial nerve emerging from stylomastoid foramen
Nerve to posterior belly of digastric muscle and to stylohyoid muscle
Parotid duct
Buccal branches
Marginal mandibular branch
Cervical branch


N. intermedius
Int. auditory meatus
VII
VIII
Genic ganglion
Greater superfic. petr. n.
To lacrimal glands
To nasal glands
N. to stapedius mus
Sphenopalatine ganglion
Chorda tympani
Give parasympathetic
Lingual n.
Give sensation
Ant 2/3 Taste - ant 2/3 of tongue
Stylomastoid foramen
Sensory
Post. auric n.
Motor branches to facial muscles
Submaxillary ganglion
Para
To submaxillary and sublingual glands
1
2
3
4
5

Idiopathic lower facial motor neuron due to inflammation of facial nerve at exit of stylomastoid foremen

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.

(12 November 1774 – 28 April 1842)

Clinical Features of Bell's Palsy

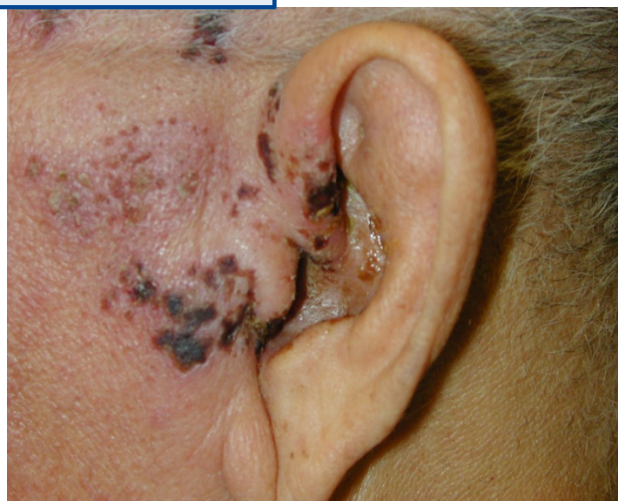
Patients with Bell's palsy typically present with sudden onset (usually over hours) of unilateral facial paralysis, common findings include:

- 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.

Intact side

Very good note: that the patient may face a problem that he is can't taste in the affected side because of affection of Chorda tympani nerve that is the most distal branch intracanal so it is close to stylomastoid foreman and it is reversable damage.

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.

Inability to close the left eye
Mouth deviated to Rt non affected side (intact side)
No forehead wrinkles on the left side
No nasolabial gold in the Lt side

Bells palsy

مراجعة للكلام عالسريع

① UMNL upper motor neuron lesion → C.B.T damage
② LMNL lower motor neuron lesion → nuclear or nerve legion

① If damaged result contralateral lower part paralysis
② If damaged result epsilateral hemifacial paralysis

In general the C.B.T gives dorsal and ventral controlateral in addition to dorsal epsilateral

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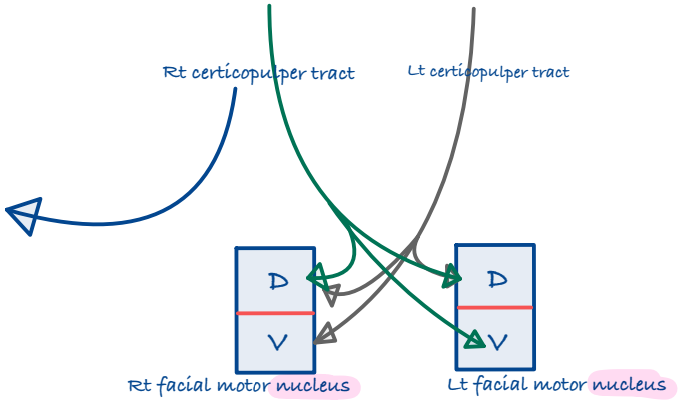


Upper motor neuron damaged at right cerebral hemisphere the defecet will be contralateral lower (ventral) part
If the nucleus damaged or the nerve it will cause epsilateral lower (ventral) part

في الحالة تبعت الـ٣ صور الي ب اخر سلايد ،بما انو التأثير جاي على نص الفيس اليسار معناها انو المشكلة بال LMNL وهاي
احنا عارفين بتيجي ب defect امّا بال nucleus or nerve السؤال الحلو انو كيف اميز بينهم ؟؟؟؟؟؟؟

Damaged Lt nucleus cause → Lt LMNL of facial nerve
Damaged Lt facial nerve → the same
How do we differ in between

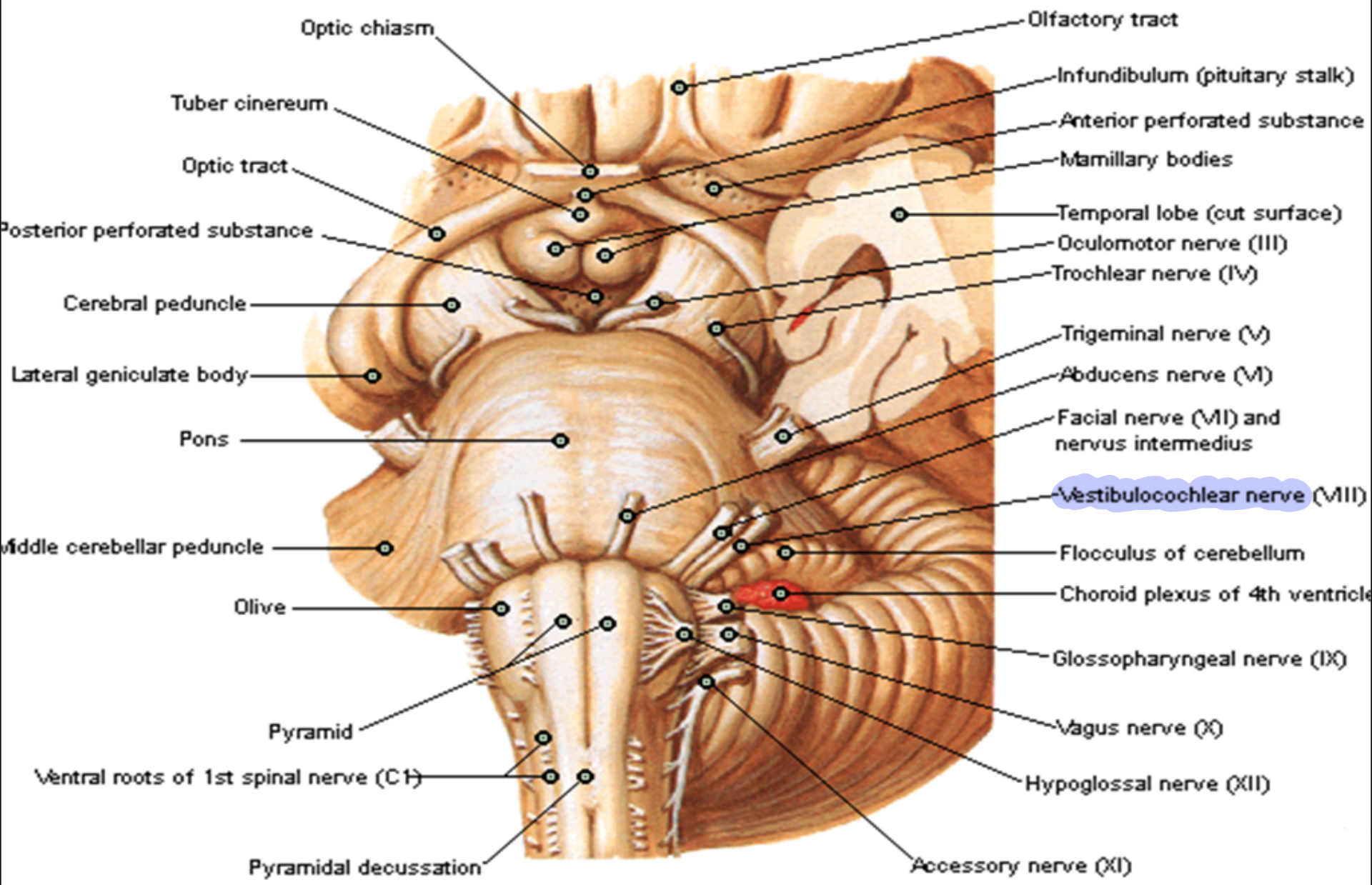
We should remember cortico spinal tract the motor tract come from Lt and at lower part of MO cross to Rt
If stroke happened at Lt pons → epsilateral facial palsy and contralateral hemiplegia
→ so Lt pontine lesion
If the nerve is damaged it will be without hemiplegia. Cuz the nerve out of brainstem

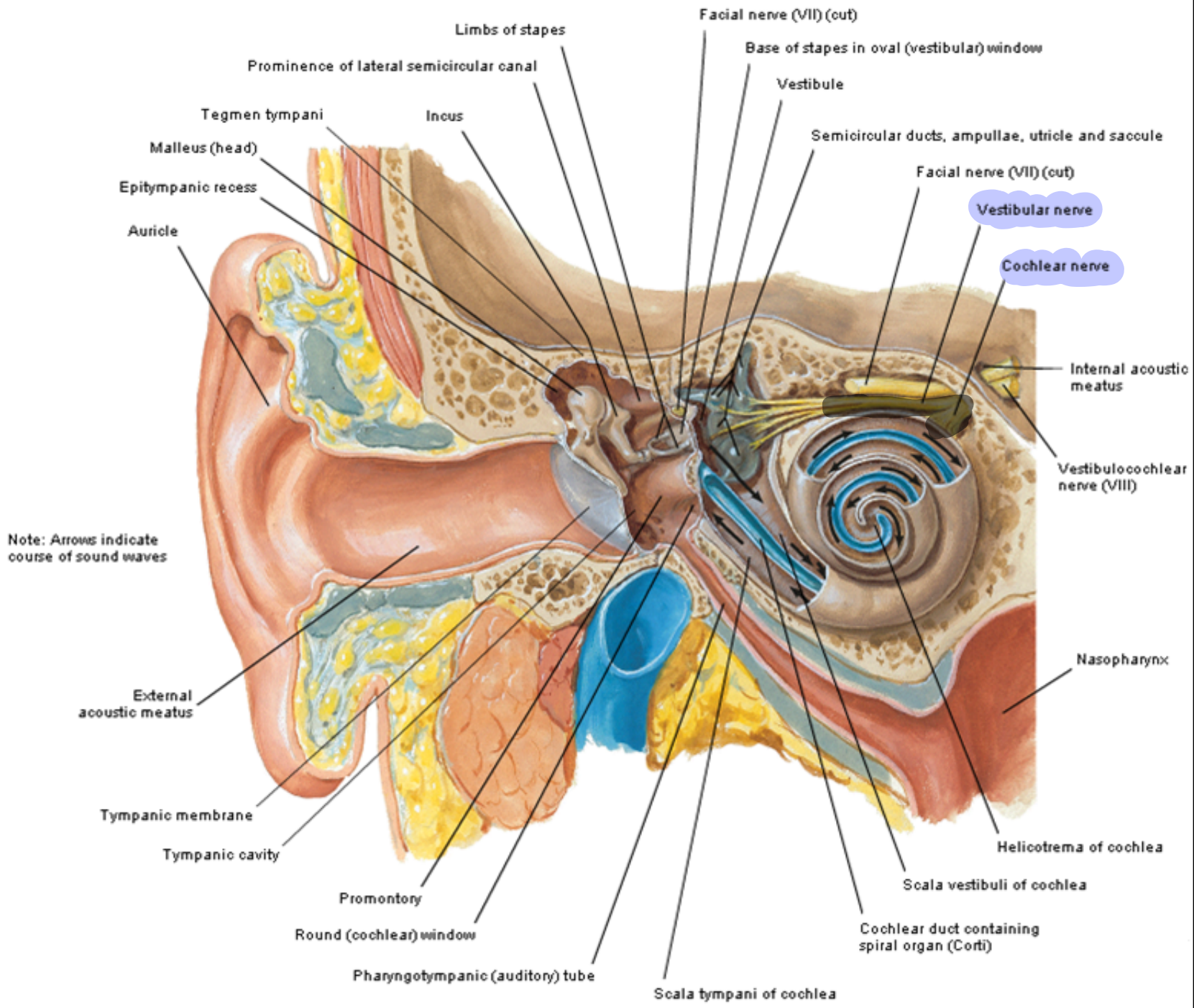
The Vestibulo-Cochlear Nerve (VIII) (Auditory or Stato-Acustic nerve)

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

Brainstem

Anterioinferior View



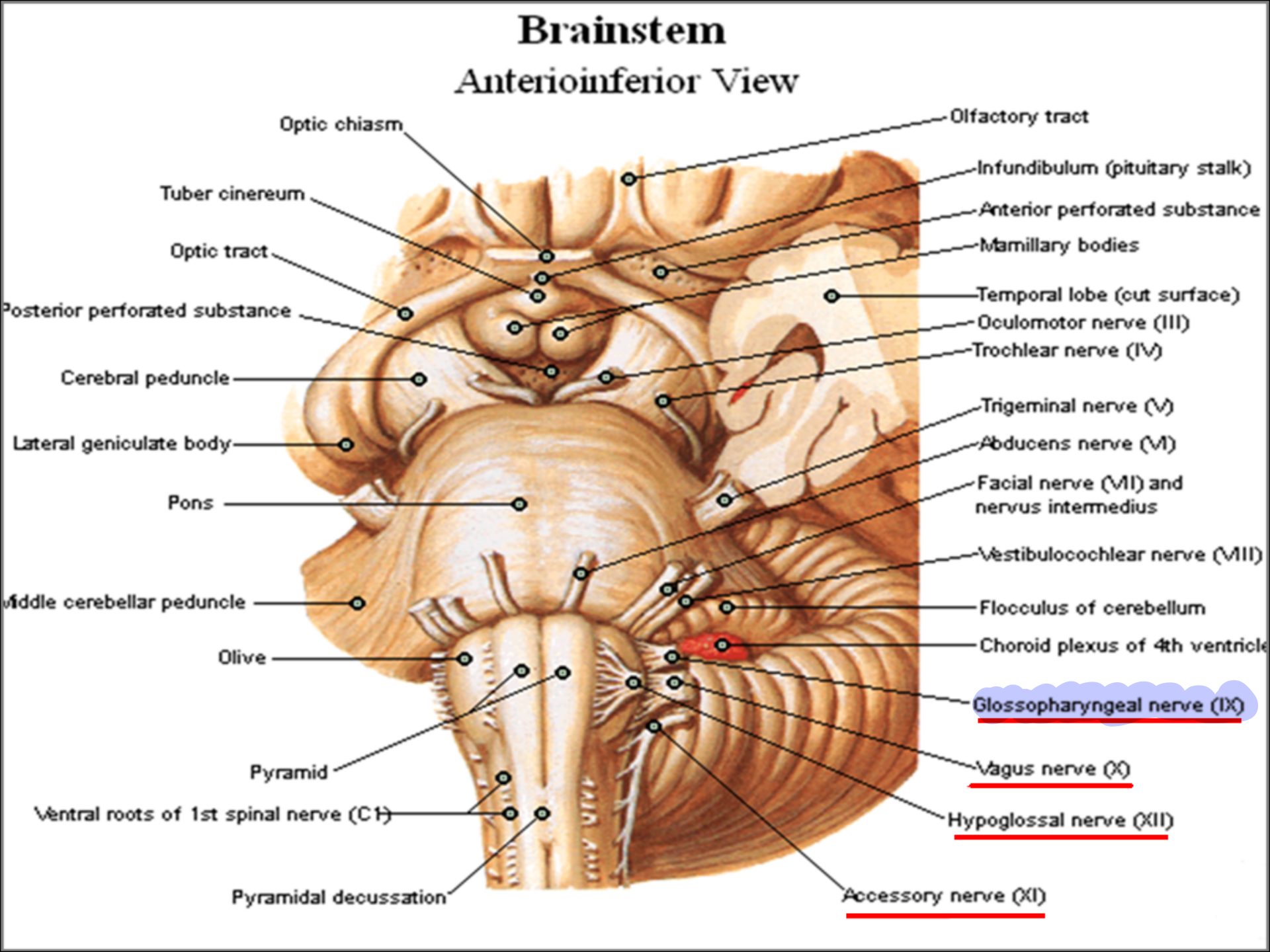

Limbs of stapes
Facial nerve (VII) (cut)
Base of stapes in oval (vestibular) window
Prominence of lateral semicircular canal
Vestibule
Tegmen tympani
Incus
Semicircular ducts, ampullae, utricle and saccule
Malleus (head)
Facial nerve (VII) (cut)
Epitympanic recess
Vestibular nerve
Auricle
Cochlear nerve
Internal acoustic meatus
Vestibulocochlear nerve (VIII)
Note: Arrows indicate course of sound waves
Nasopharynx
External acoustic meatus
Tympanic membrane
Helicotrema of cochlea
Tympanic cavity
Scala vestibuli of cochlea
Promontory
Round (cochlear) window
Cochlear duct containing spiral organ (Corti)
Pharyngotympanic (auditory) tube
Scala tympani of cochlea

The Glossopharyngeal Nerve (IX)

- **The glossopharyngeal N. is a mixed nerve containing:** 10975
  a. Sensory fibers. Palat palatine tonsil pharynx carotid (body and sinus) post 1/3 of the tongue
  b. Parasympathetic fibers. Give a branch for otic ganglion that supplies parotid gland
  c. Motor fibers. Supplies one muscle: stylopharyngeous muscle
- It is more important as mainly sensory than as a motor nerve.
- **Origin:** from posterolateral sulcus of medulla.
- **Modalities: GVE, SVE, GSA, & SVA.**
- **Foramen:** Jugular foramen.✓

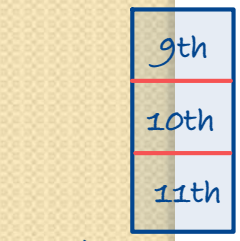
Brainstem

Anterioinferior View



Nuclei of the Glossopharyngeal Nerve

It has three nuclei:

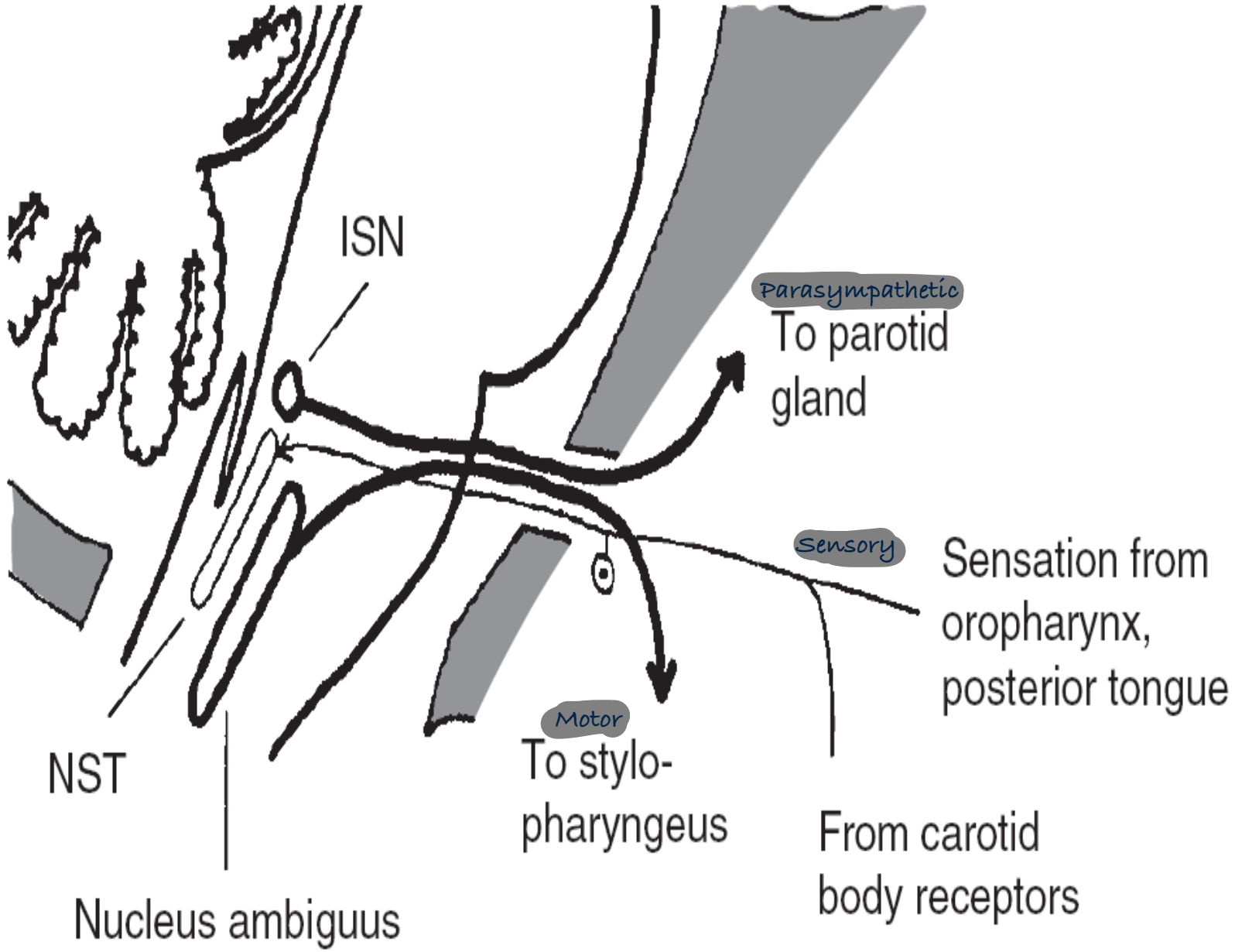


مشتركة بين 3 نيرفز

1. **The upper part of nucleus ambiguous:** it lies in the medulla **(motor function).**

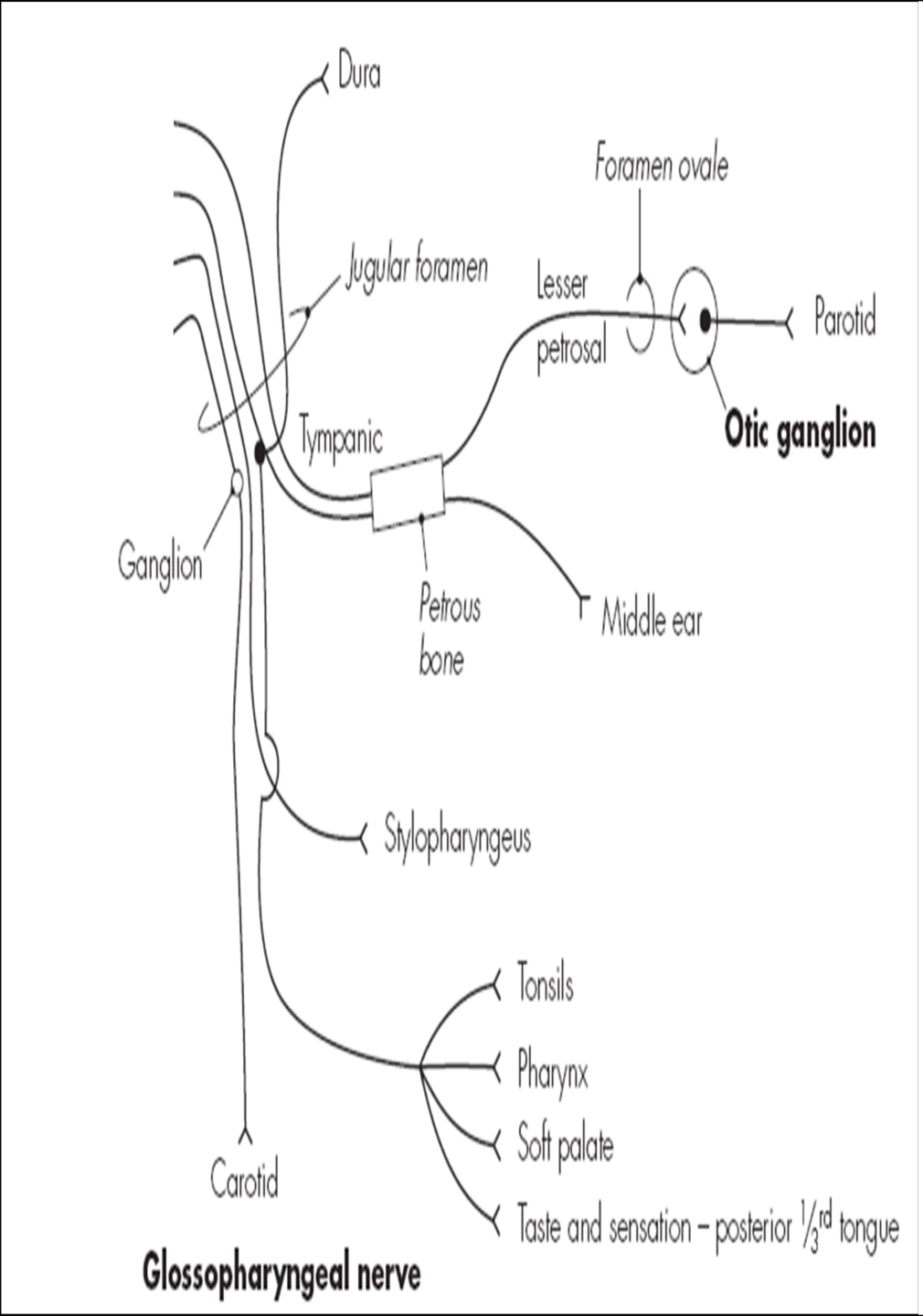
2. **The inferior salivary nucleus:** it lies in the medulla **(parasympathetic function).** For parotid gland

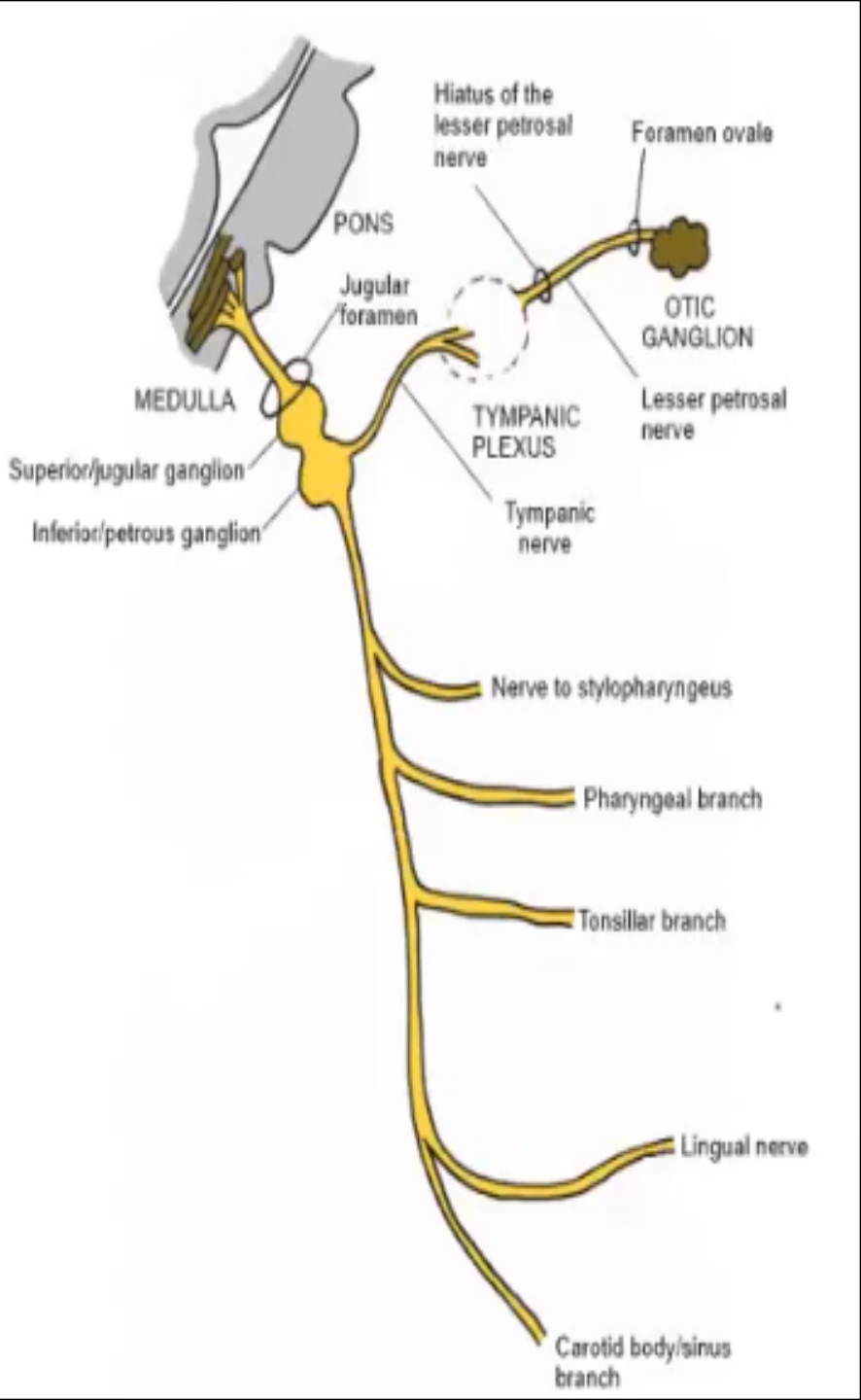
3. **The solitary nucleus:** it lies in the medulla **(sensory function).** Mentioned before


ISN
Parasympathetic
To parotid gland
Sensory
Sensation from oropharynx, posterior tongue
Motor
To stylo-pharyngeus
NST
Nucleus ambiguus
From carotid body receptors

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.


Dura
Foramen ovale
Jugular foramen
Lesser petrosal
Parotid
Tympanic
Otic ganglion
Ganglion
Petrous bone
Middle ear
Stylopharyngeus
Tonsils
Pharynx
Soft palate
Carotid
Taste and sensation – posterior 1/3rd tongue
Glossopharyngeal nerve


Hiatus of the lesser petrosal nerve
Foramen ovale
PONS
Jugular foramen
OTIC GANGLION
MEDULLA
TYMPANIC PLEXUS
Lesser petrosal nerve
Superior/jugular ganglion
Inferior/petrous ganglion
Tympanic nerve
Nerve to stylopharyngeus
Pharyngeal branch
Tonsillar branch
Lingual nerve
Carotid body/sinus branch

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).

If we touch its back it will cause gag reflex.

Gag reflex

Efferent (motor) vagus and cranial accessory
Afferent (sensory) glossopharynged

Evoked by touching the root of the mouth back of the tongue and prepare you for vomiting

Not complete cause it just supply one muscle
→ stylophoryngeous muscle

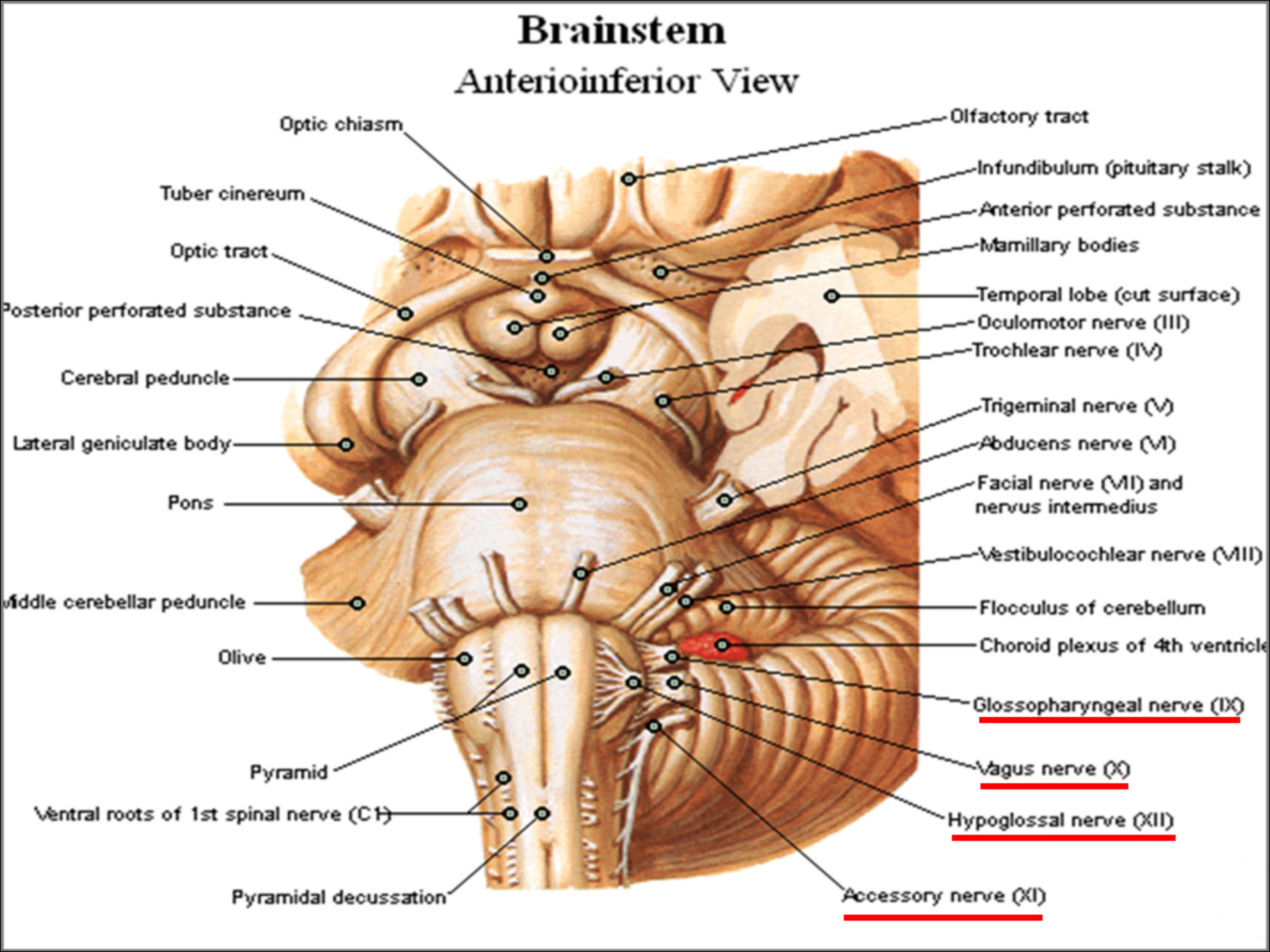
2 types of dysphasia:
Neurogenic and obstructive called solid
1st → difficulty in fluid
2nd → difficulty in solid matters

The Vagus Nerve (X)

- The vagus nerve is the longest of the cranial nerve.
- **Origin:** from the posterolateral sulcus of the medulla. Lower to 9th and lateral to 12th
- **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. The main parasympathetic nucleus in the body

   Dorsal motor nucleus of vagus "Parasympathatic":

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

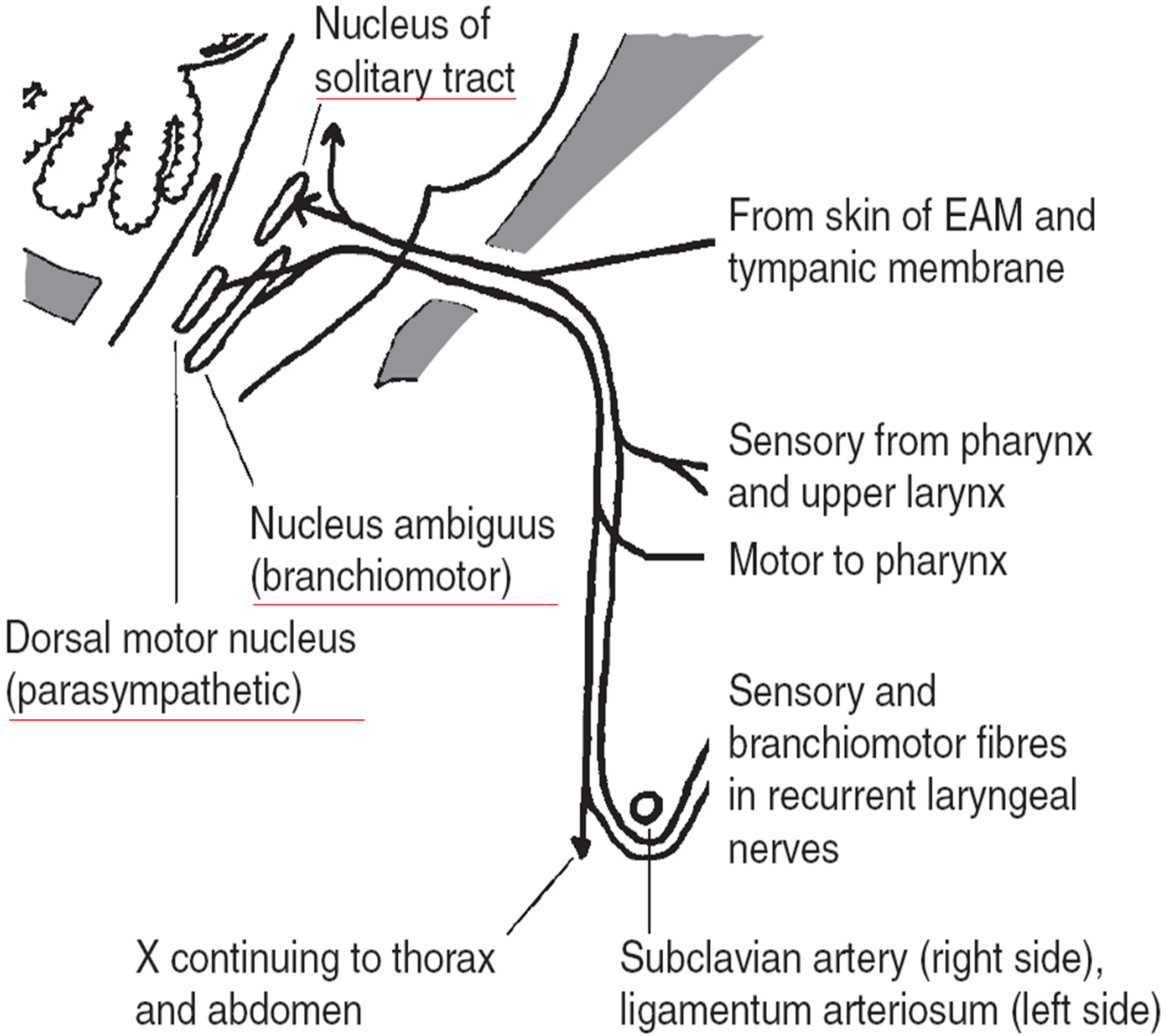
   In GIT system all the system take from vagus until it reach the junction between proximal 2/3 of transverse colon and distal 1/3 and the distal to the junction is innervated by sacral

2. **Main part of nucleus ambiguous "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.


Nucleus of solitary tract
From skin of EAM and tympanic membrane
Sensory from pharynx and upper larynx
Motor to pharynx
Nucleus ambiguus (branchiomotor)
Dorsal motor nucleus (parasympathetic)
Sensory and branchiomotor fibres in recurrent laryngeal nerves
X continuing to thorax and abdomen
Subclavian artery (right side), ligamentum arteriosum (left side)

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.

Glosssopharyngeal

c. All the muscles of the palate except the tensor palati muscle.

Otic ganglion by mandibular branch of 5th nerve

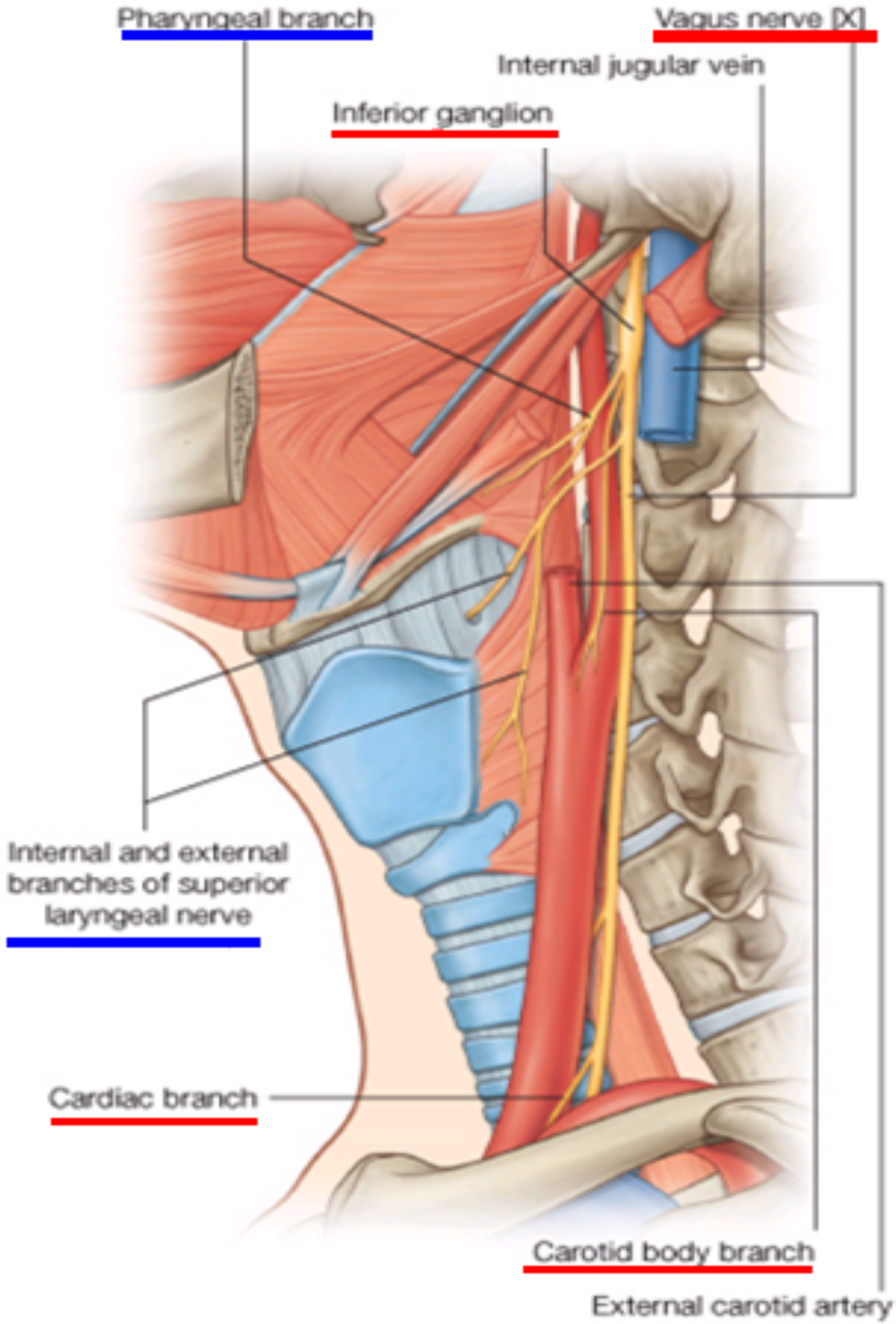
3. The sensory fibers:

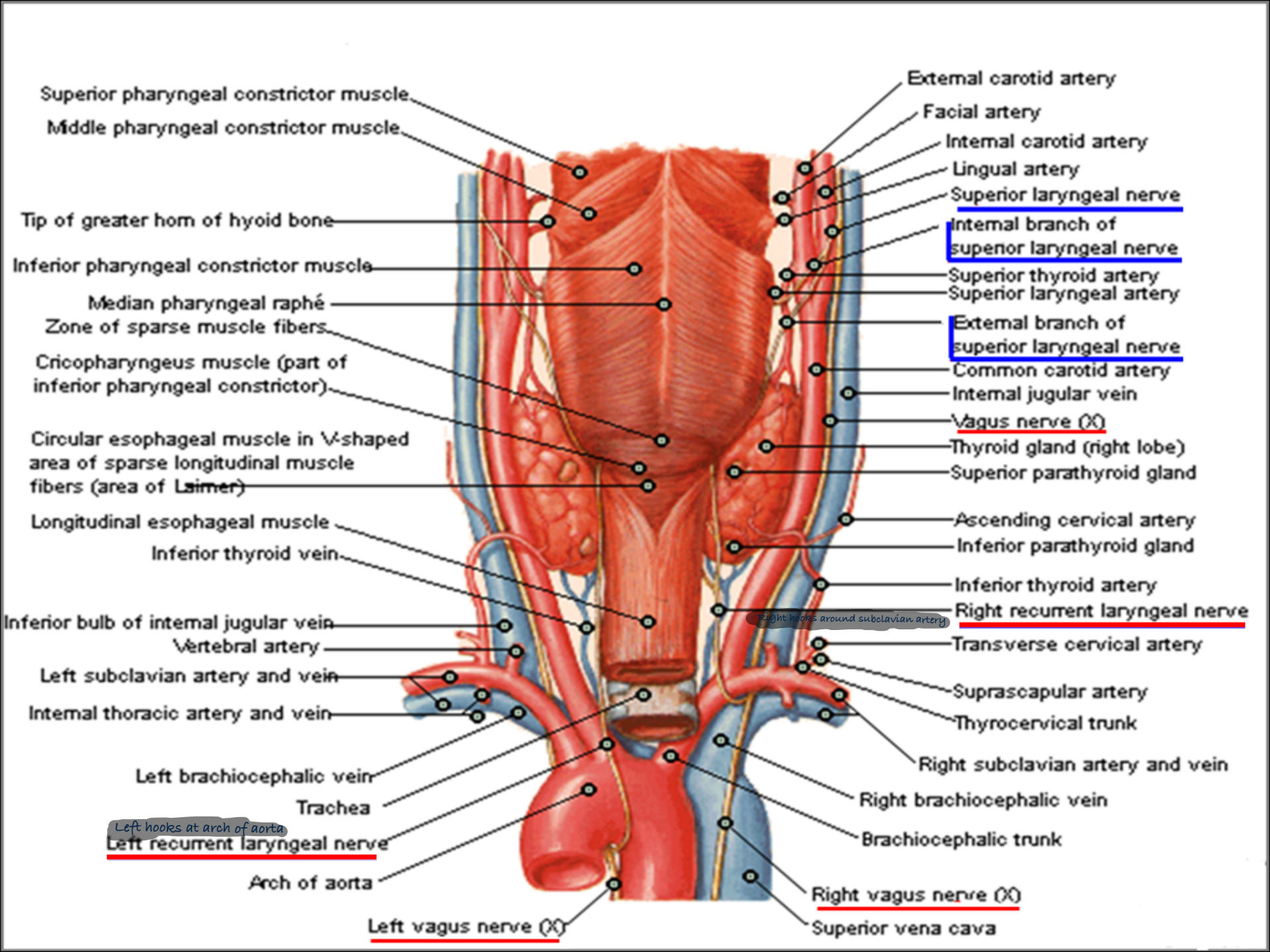
a. Receive sensation from the mucous membrane of the respiratory and digestive system mainly.

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.


Pharyngeal branch
Vagus nerve [X]
Internal jugular vein
Inferior ganglion
Internal and external branches of superior laryngeal nerve
Cardiac branch
Carotid body branch
External carotid artery


Superior pharyngeal constrictor muscle
Middle pharyngeal constrictor muscle
Tip of greater horn of hyoid bone
Inferior pharyngeal constrictor muscle
Median pharyngeal raphé
Zone of sparse muscle fibers
Cricopharyngeus muscle (part of inferior pharyngeal constrictor)
Circular esophageal muscle in V-shaped area of sparse longitudinal muscle fibers (area of Laimer)
Longitudinal esophageal muscle
Inferior thyroid vein
Inferior bulb of internal jugular vein
Vertebral artery
Left subclavian artery and vein
Internal thoracic artery and vein
Left brachiocephalic vein
Trachea
Left hooks at arch of aorta
Left recurrent laryngeal nerve
Arch of aorta
Left vagus nerve (X)
External carotid artery
Facial artery
Internal carotid artery
Lingual artery
Superior laryngeal nerve
Internal branch of superior laryngeal nerve
Superior thyroid artery
Superior laryngeal artery
External branch of superior laryngeal nerve
Common carotid artery
Internal jugular vein
Vagus nerve (X)
Thyroid gland (right lobe)
Superior parathyroid gland
Ascending cervical artery
Inferior parathyroid gland
Inferior thyroid artery
Right recurrent laryngeal nerve
Right hooks around subclavian artery
Transverse cervical artery
Suprascapular artery
Thyrocervical trunk
Right subclavian artery and vein
Right brachiocephalic vein
Brachiocephalic trunk
Right vagus nerve (X)
Superior vena cava

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.

Sympathetic effect

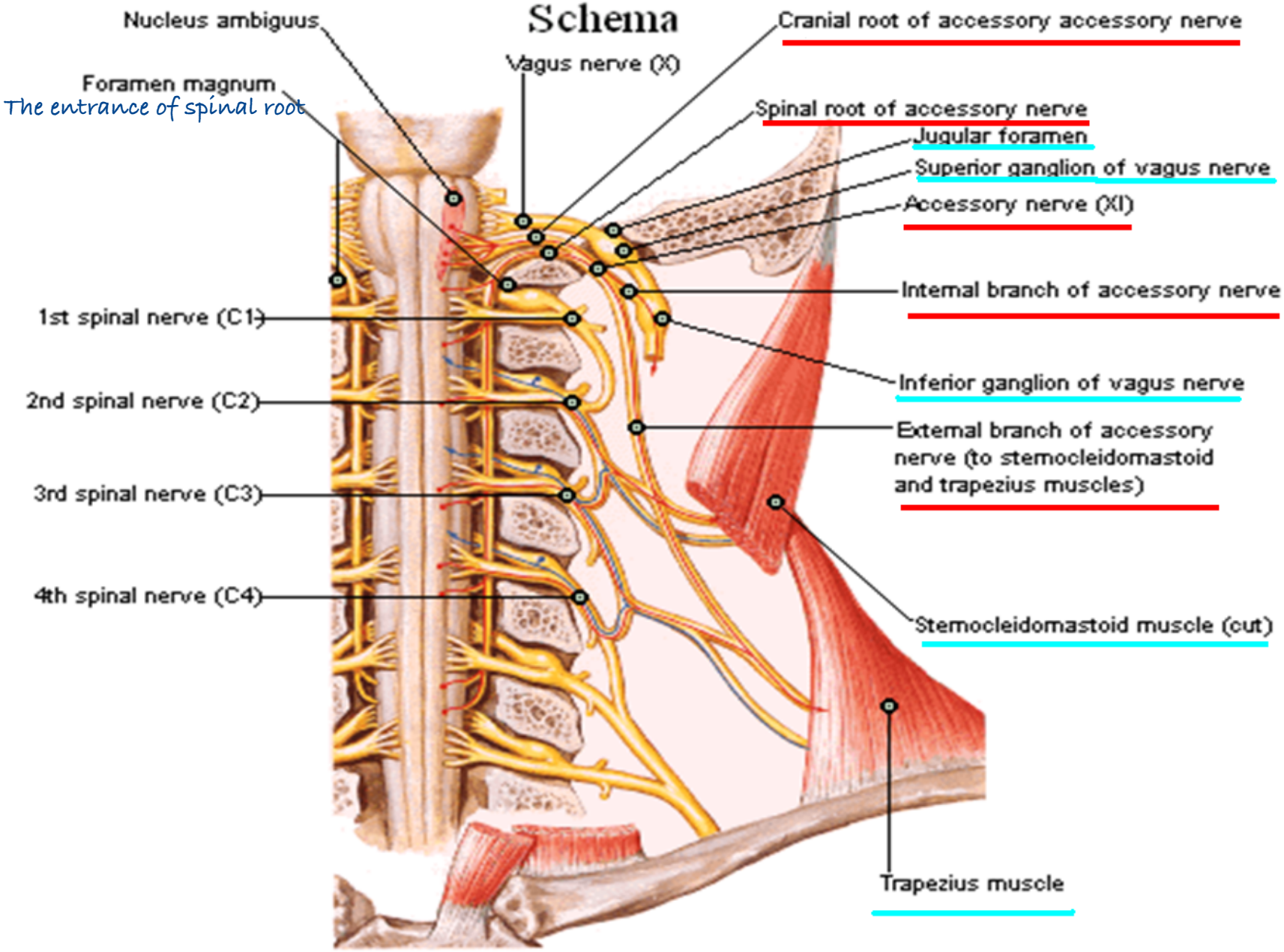
The Accessory Nerve (XI)

- **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. Anterior horn cells
- **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.

After they pass the foremen they divided another time to spinal and cranial the 1st supplies 2 muscles and the 2nd give vagus nerve.

Accessory Nerve

Schema



Cause the cranial mentioned in motor branch of the vagus

Lesion of the Spinal Accessory Nerve

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

The Hypoglossal Nerve (XII)
(The motor nerve of the tongue)

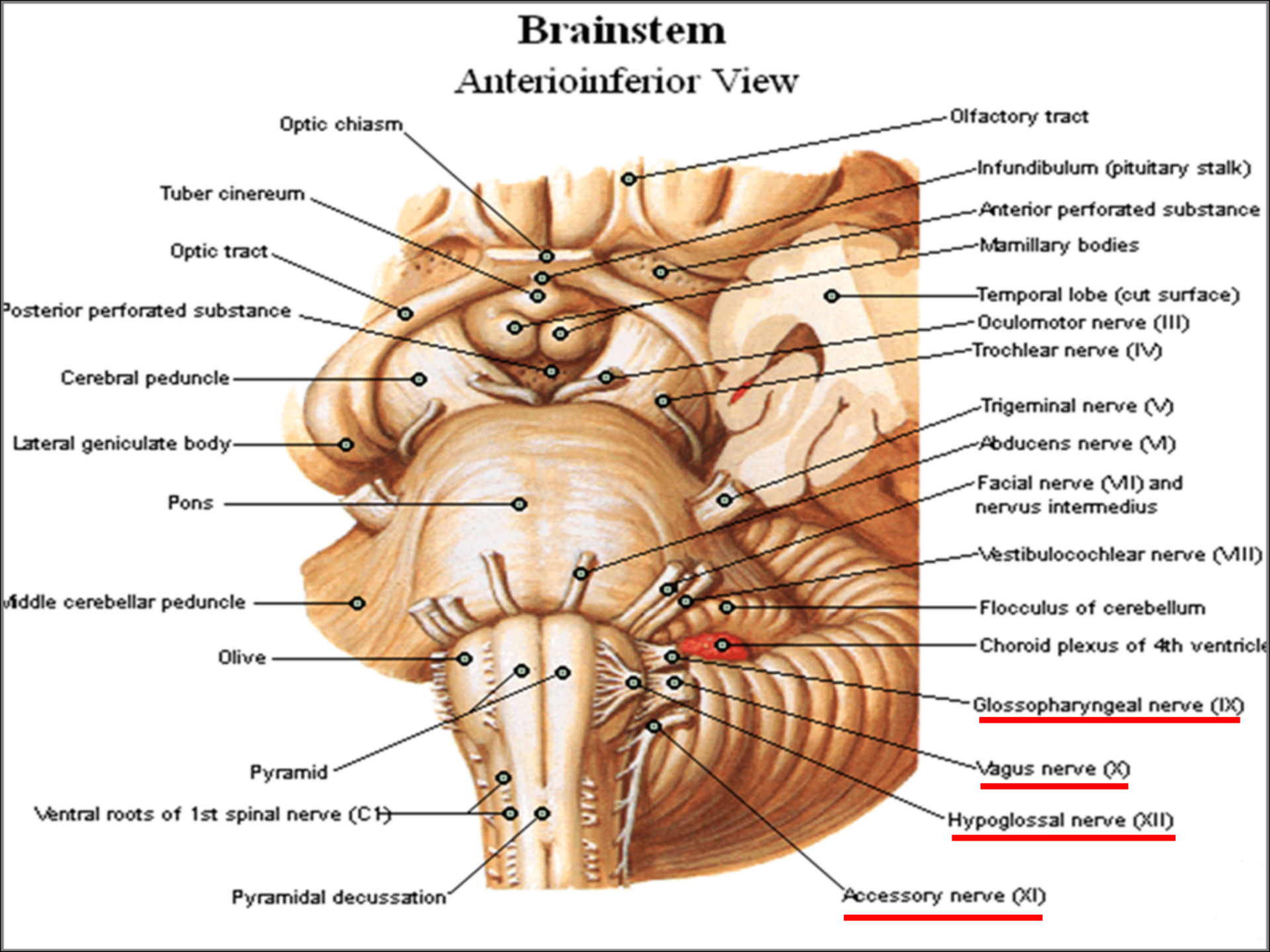
Supplies geniohyoid thyrohyoid and give branch to ansa cervicalis that connect it wit C2 + C3

- **Origin:** from the anterolateral sulcus of medulla oblongata. It receives a communicating branch from C1.
- **Modality:** General somatic efferent. (Motor)
- **Foramen:** Hypoglossal canal. (Specific foreman)
- **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).

(Vagus and cranial accessory)

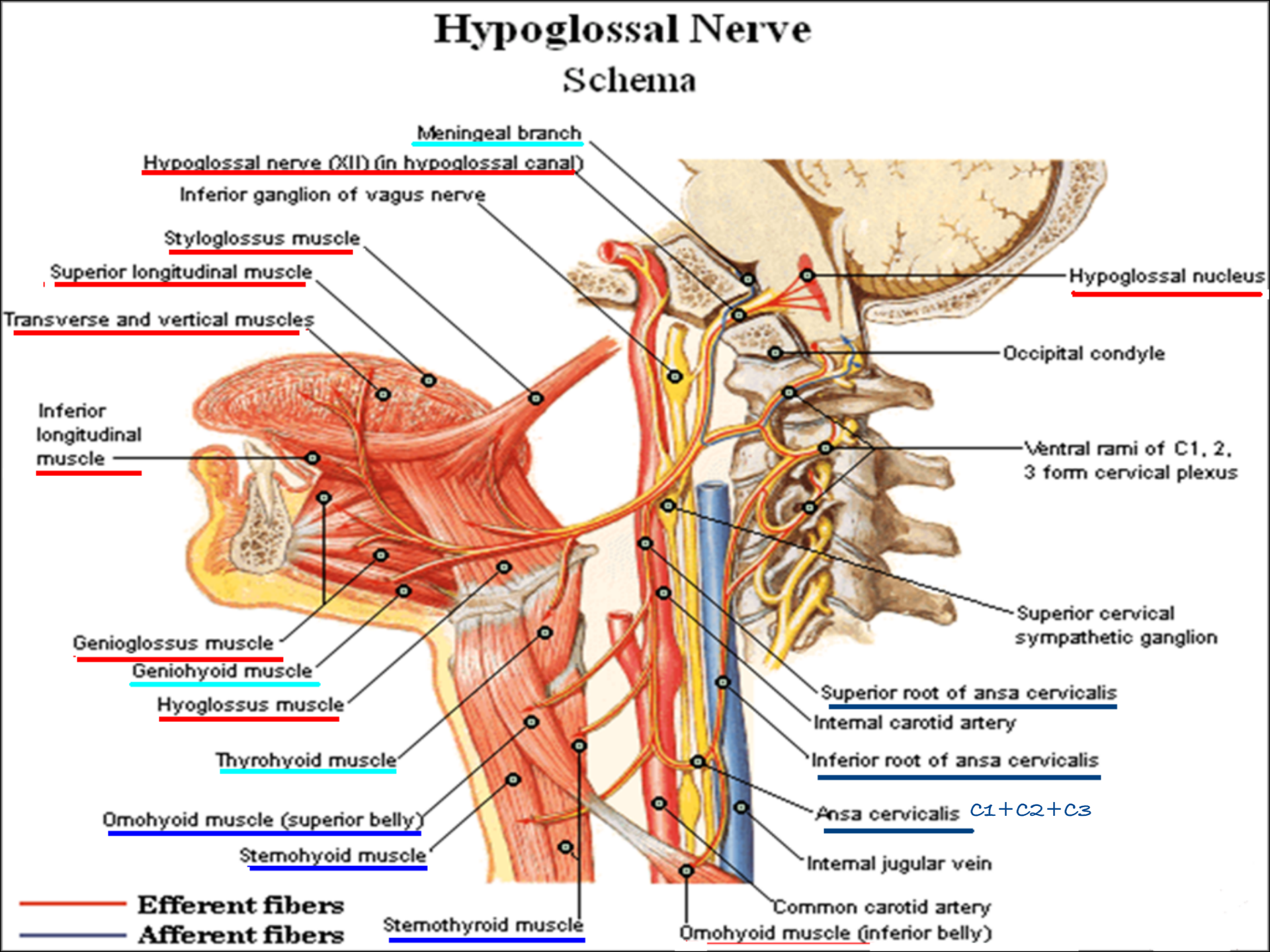
Brainstem

Anterioinferior View



Hypoglossal Nerve

Schema



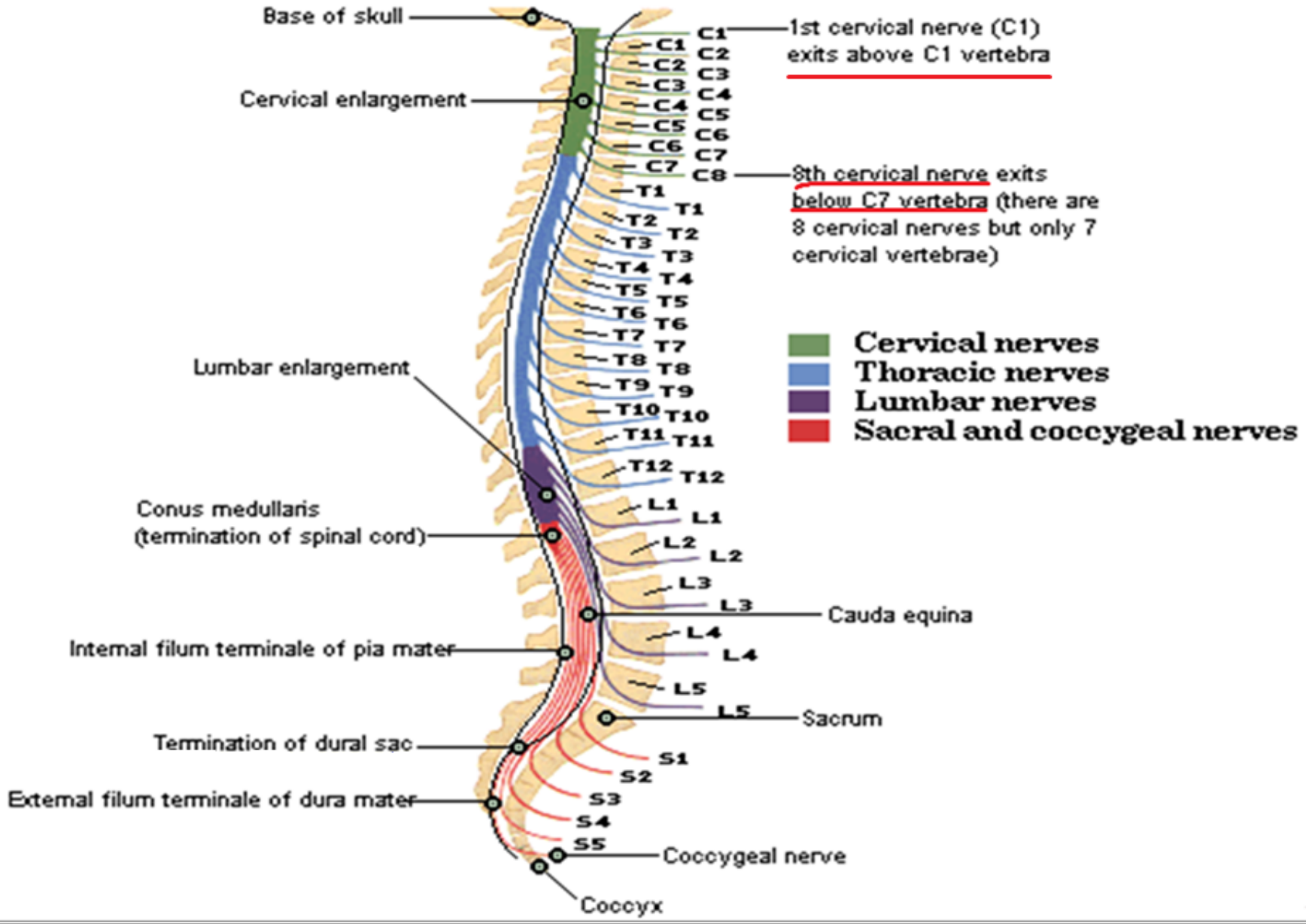
The Spinal Roots and Nerves

- **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 C_1- C_7 pass above their vertebra.
- C_8 pass below C_7 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.**

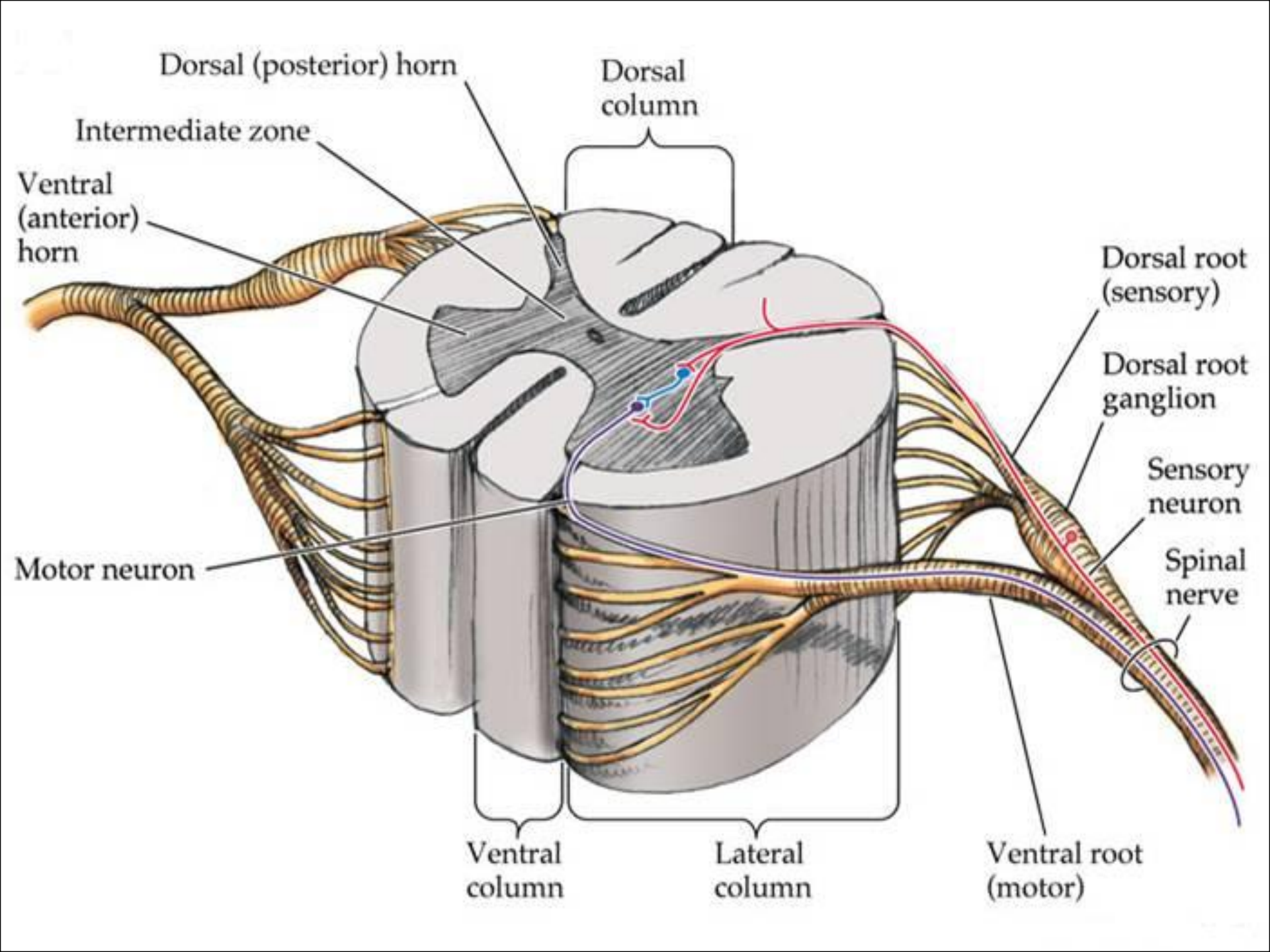
The Spinal Nerve Rami

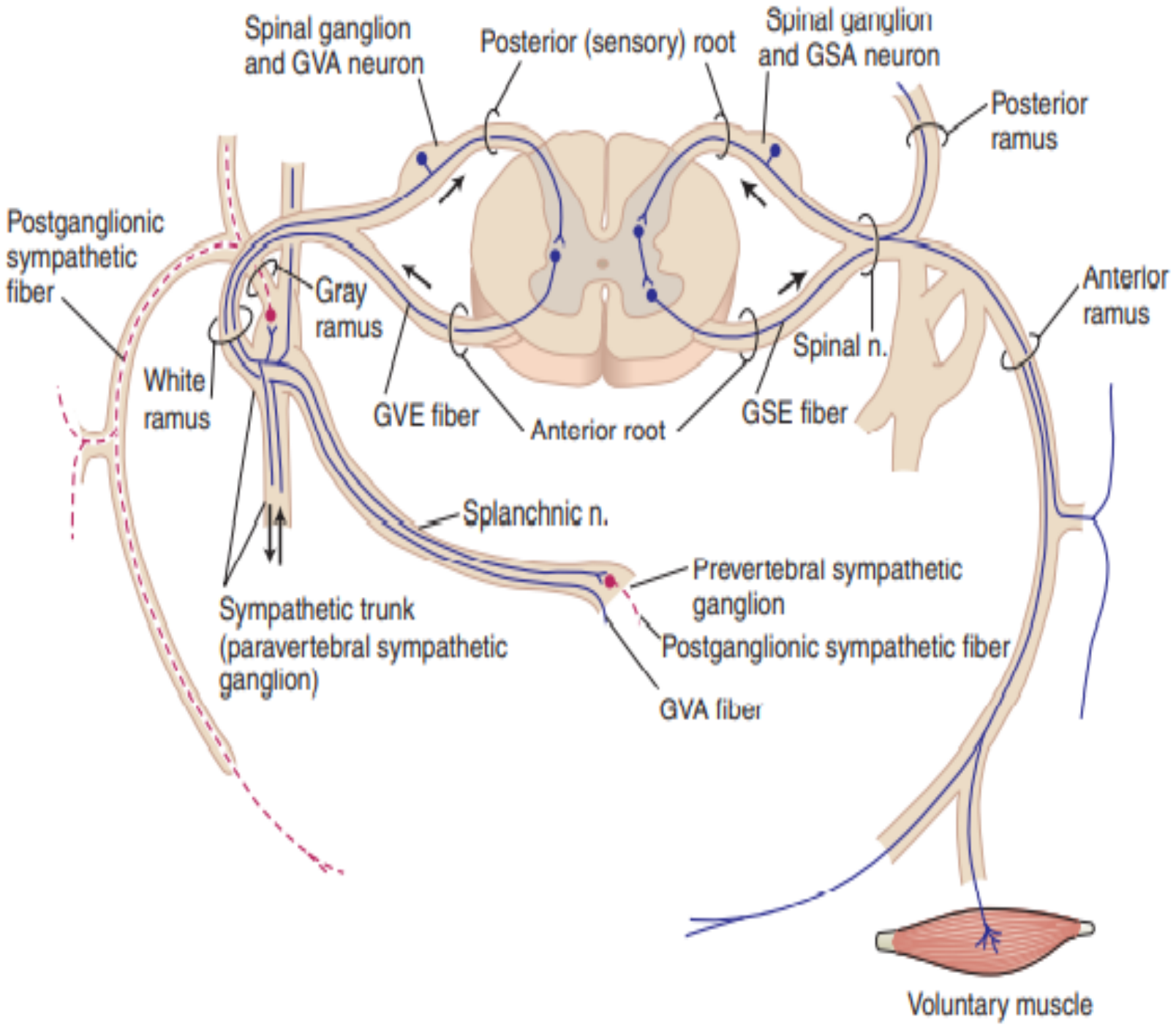
- **Posterior ramus:** innervates the skin and muscles of the back.
- **Anterior ramus:** innervates the anterior and lateral muscles and skin of the trunk, extremities, and visceral organs.
- **Meningeal ramus:** innervates the meninges and vertebral column.
- **White communicating rami:** contain myelinated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


Dorsal (posterior) horn
Dorsal column
Intermediate zone
Ventral (anterior) horn
Dorsal root (sensory)
Dorsal root ganglion
Sensory neuron
Motor neuron
Spinal nerve
Ventral column
Lateral column
Ventral root (motor)


Spinal ganglion and GVA neuron
Posterior (sensory) root
Spinal ganglion and GSA neuron
Posterior ramus
Postganglionic sympathetic fiber
Gray ramus
White ramus
GVE fiber
Anterior root
GSE fiber
Spinal n.
Anterior ramus
Splanchnic n.
Prevertebral sympathetic ganglion
Sympathetic trunk (paravertebral sympathetic ganglion)
Postganglionic sympathetic fiber
GVA fiber
Voluntary muscle

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