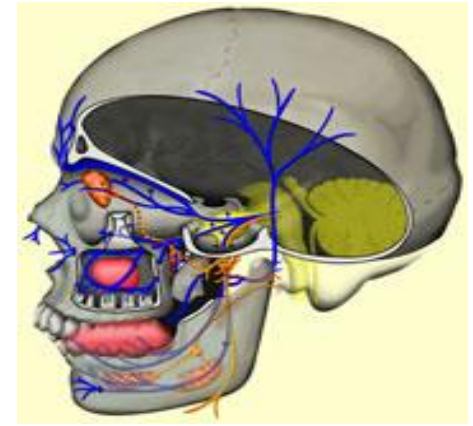


Lecture: 9



Anatomy and Physiology of the Trigeminal Nerve

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

الرجاء تحويل الجوال إلى وضع
الصامت مع الشكر



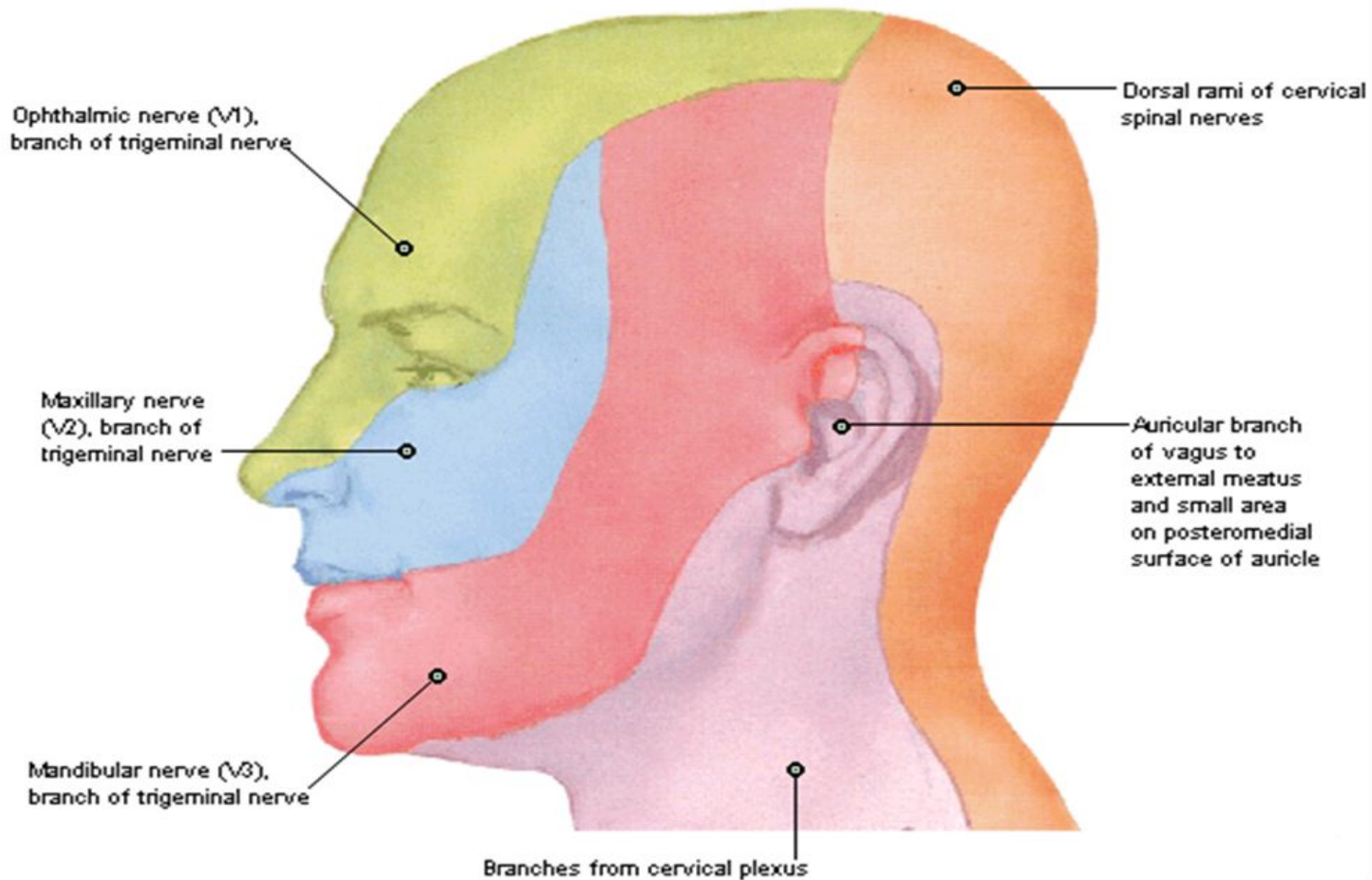
Nerve Supply of the Face

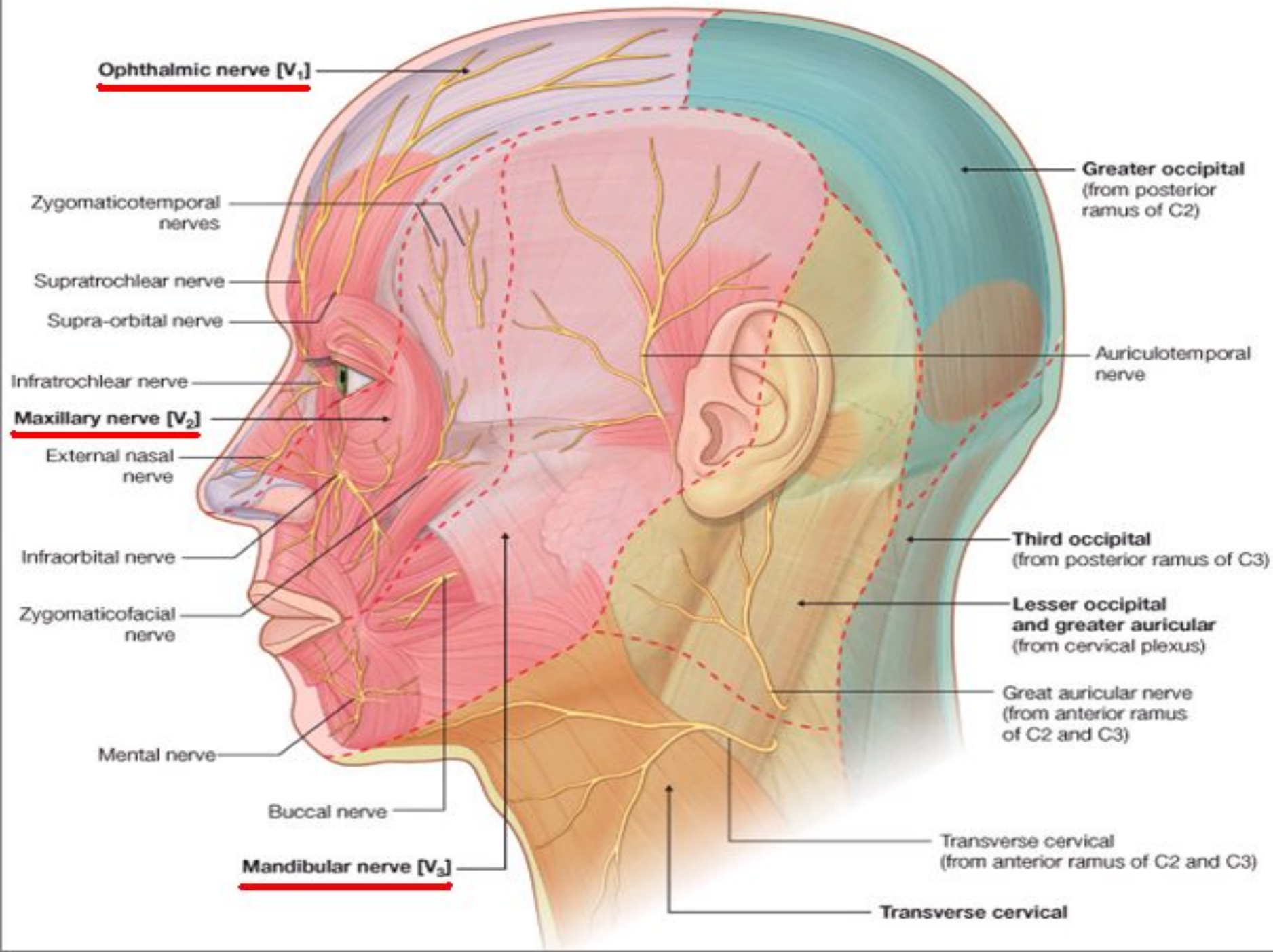
1. Sensory (to skin of the face):

- a. **Trigeminal Nerve:** supplies most of the face skin.
- b. **Great Auricular Nerve (C2,3):** supplies the skin covering the angle of mandible and parotid gland.
- c. **Posterior auricular nerve (CN VII):**
supplies the skin of external auricle.

2. Motor (to facial muscles): by branches of the facial nerve.

Dermatomes of Head and Neck



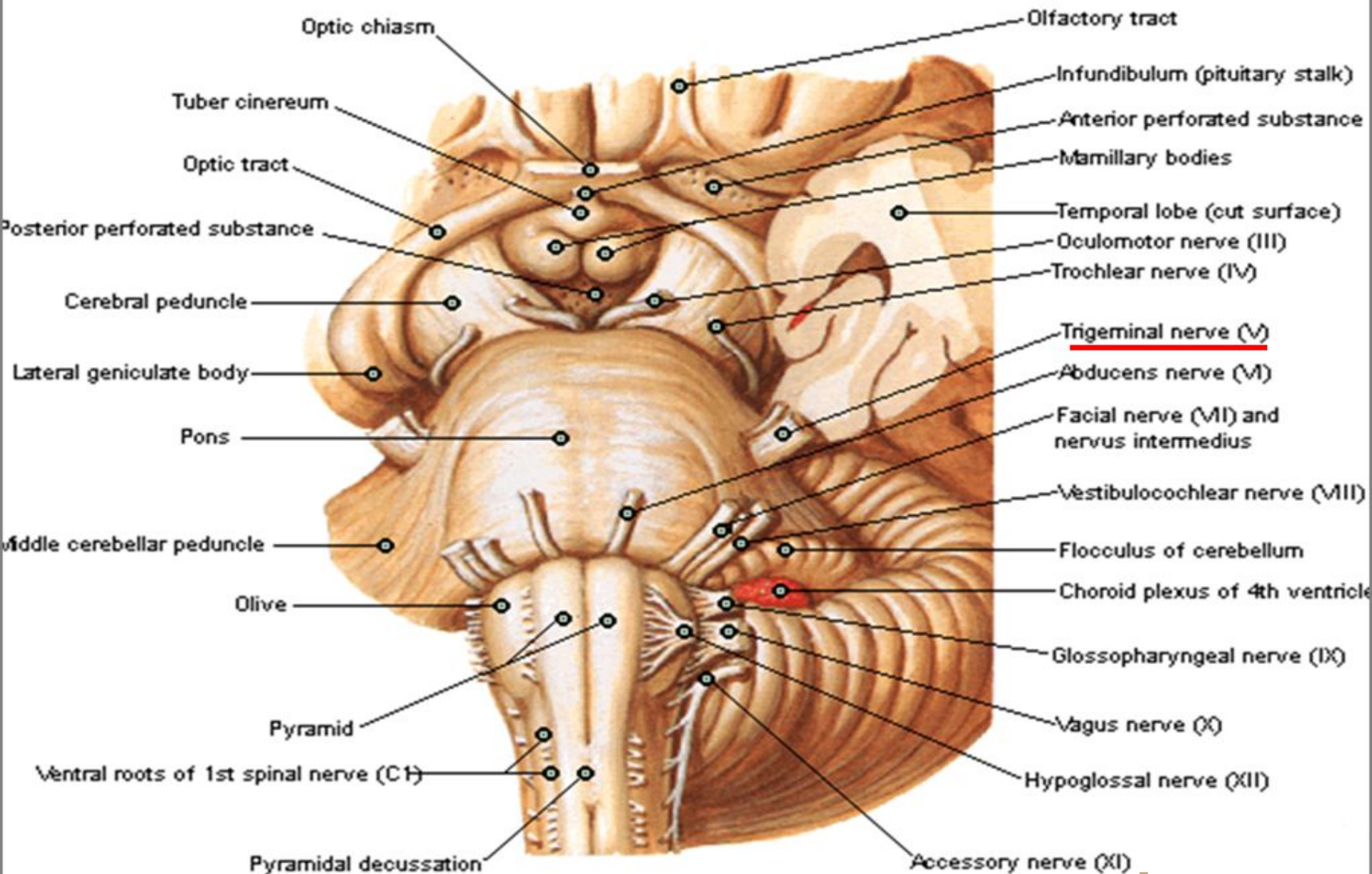


The Trigeminal Nerve (V)

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

Brainstem

Anterioinferior View



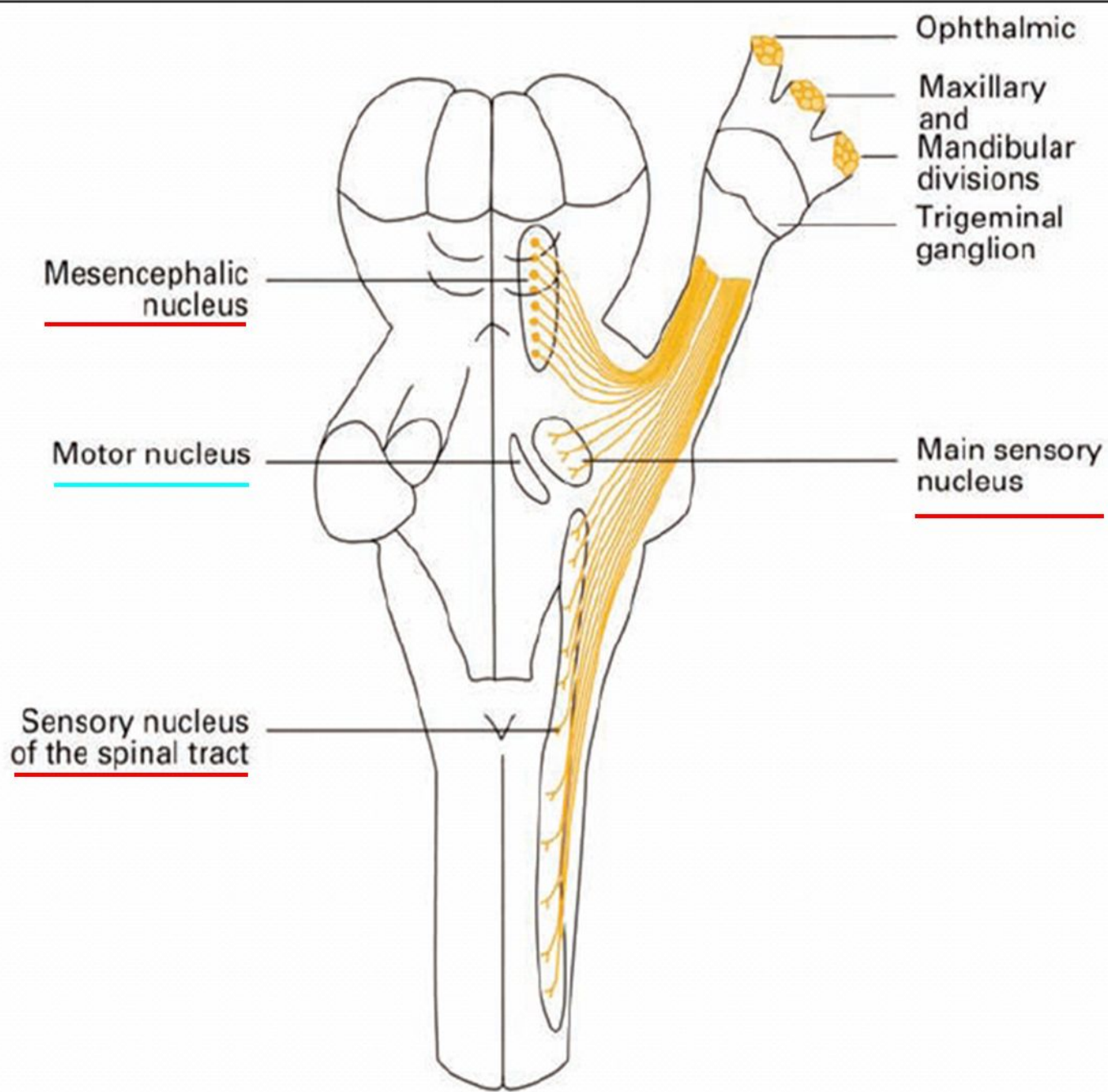
Nuclei of the Trigeminal Nerve

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

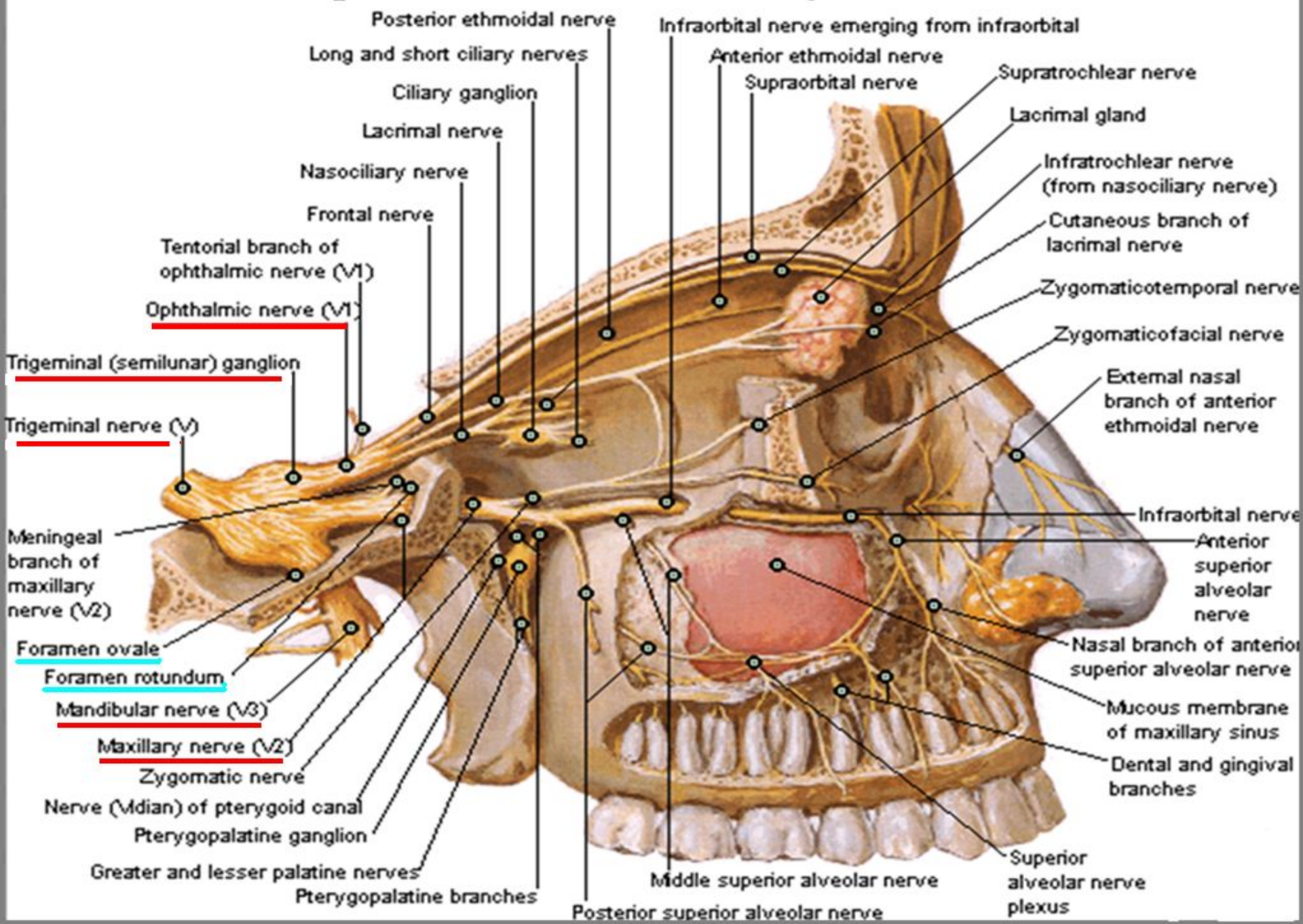
Branches of the Trigeminal Nerve (V)

The trigeminal nerve has three branches:

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



Ophthalmic and Maxillary Nerves



The Ophthalmic Nerve (V_1)

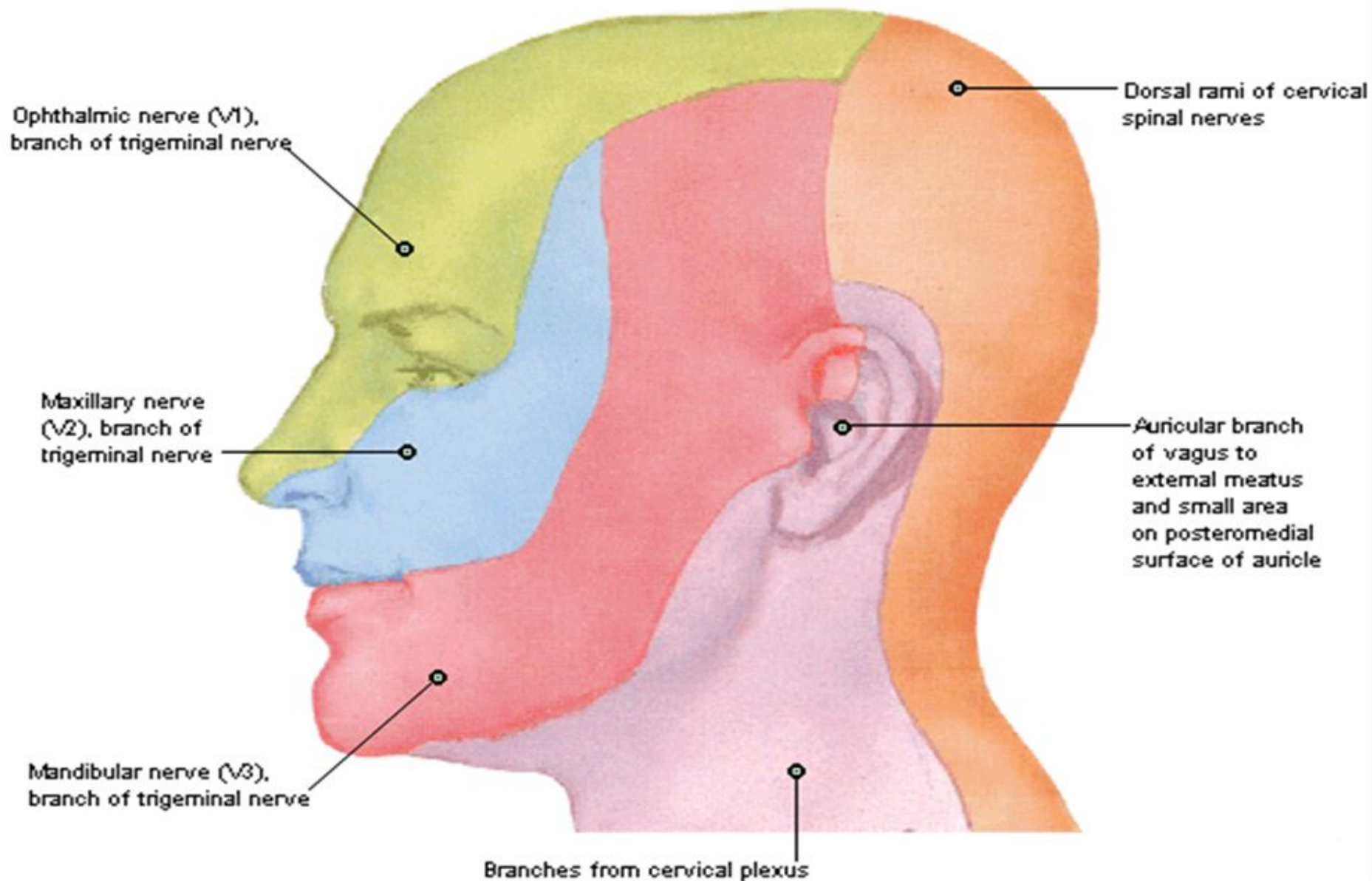
It is the first branch of the trigeminal nerve.

Functions: it is a sensory nerve.

It supplies the:

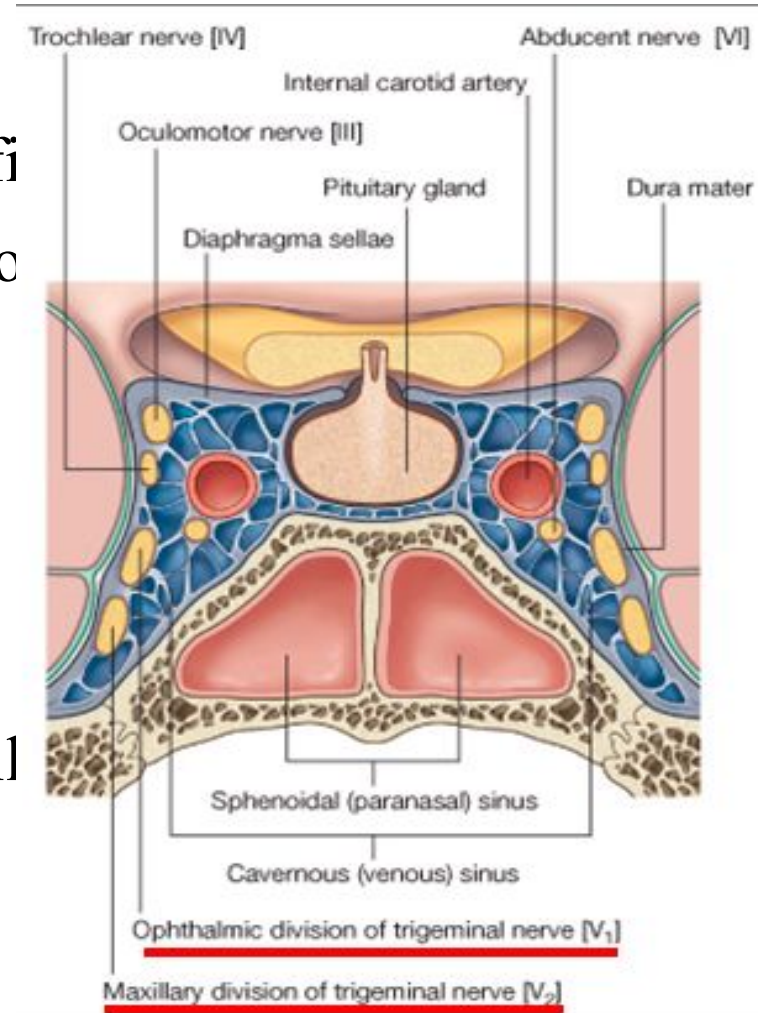
1. Skin over forehead.
2. Skin over upper eyelid.
3. Eyeball, conjunctiva, & lacrimal gland.
4. Nasal mucosa.
5. Frontal sinus.
6. External nose.
7. Dura mater in the anterior cranial fossa.

Dermatomes of Head and Neck



Course and Relation of Ophthalmic Nerve

1. It arises inside the skull as the first branch of the trigeminal ganglion
2. It passes forwards in the lower lateral wall of cavernous sinus with the maxillary nerve.
3. Then it divides into **three branches**, which leave the skull through **the superior orbital fissure** → to enter orbit.



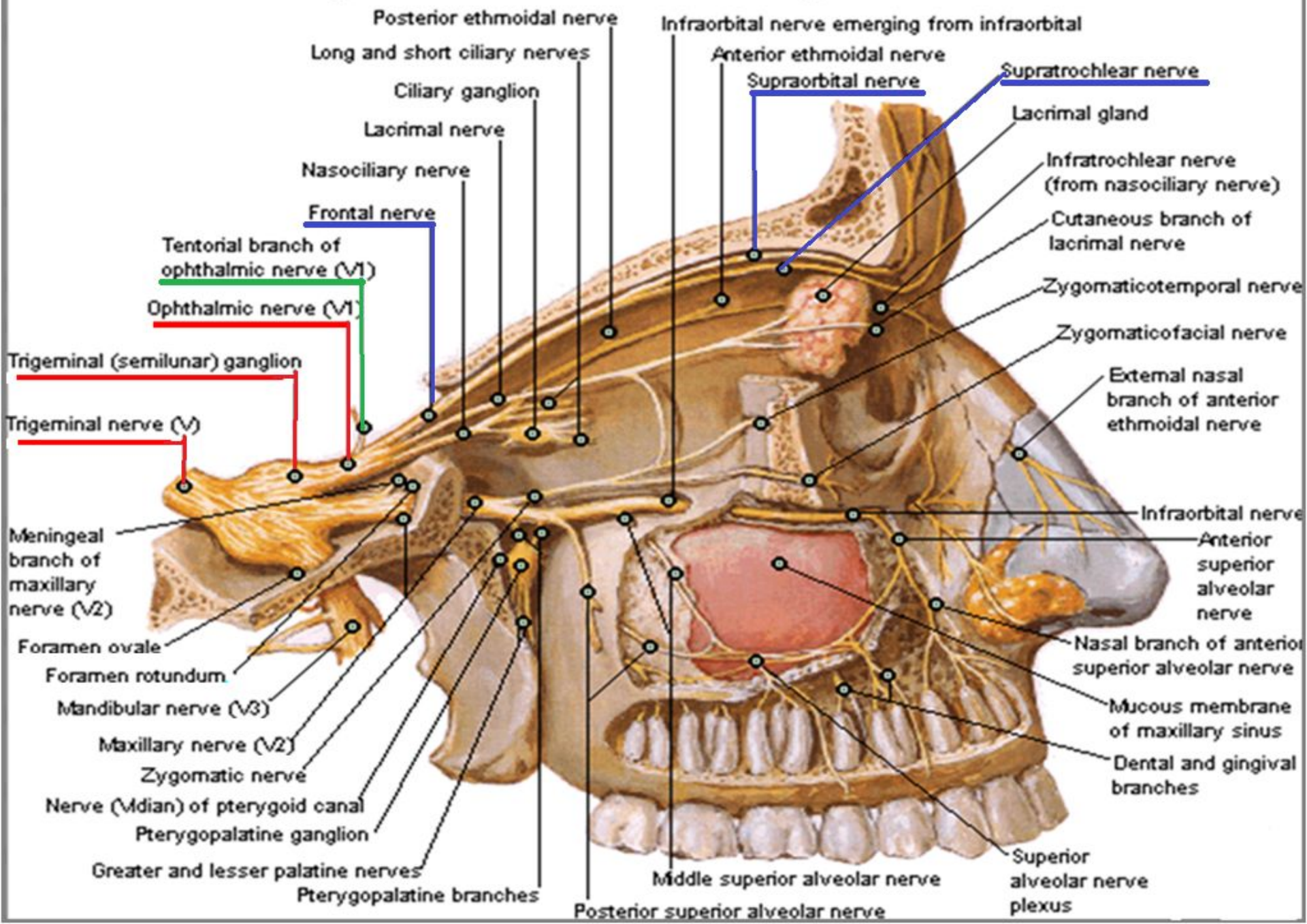
Branches of the Ophthalmic Nerve

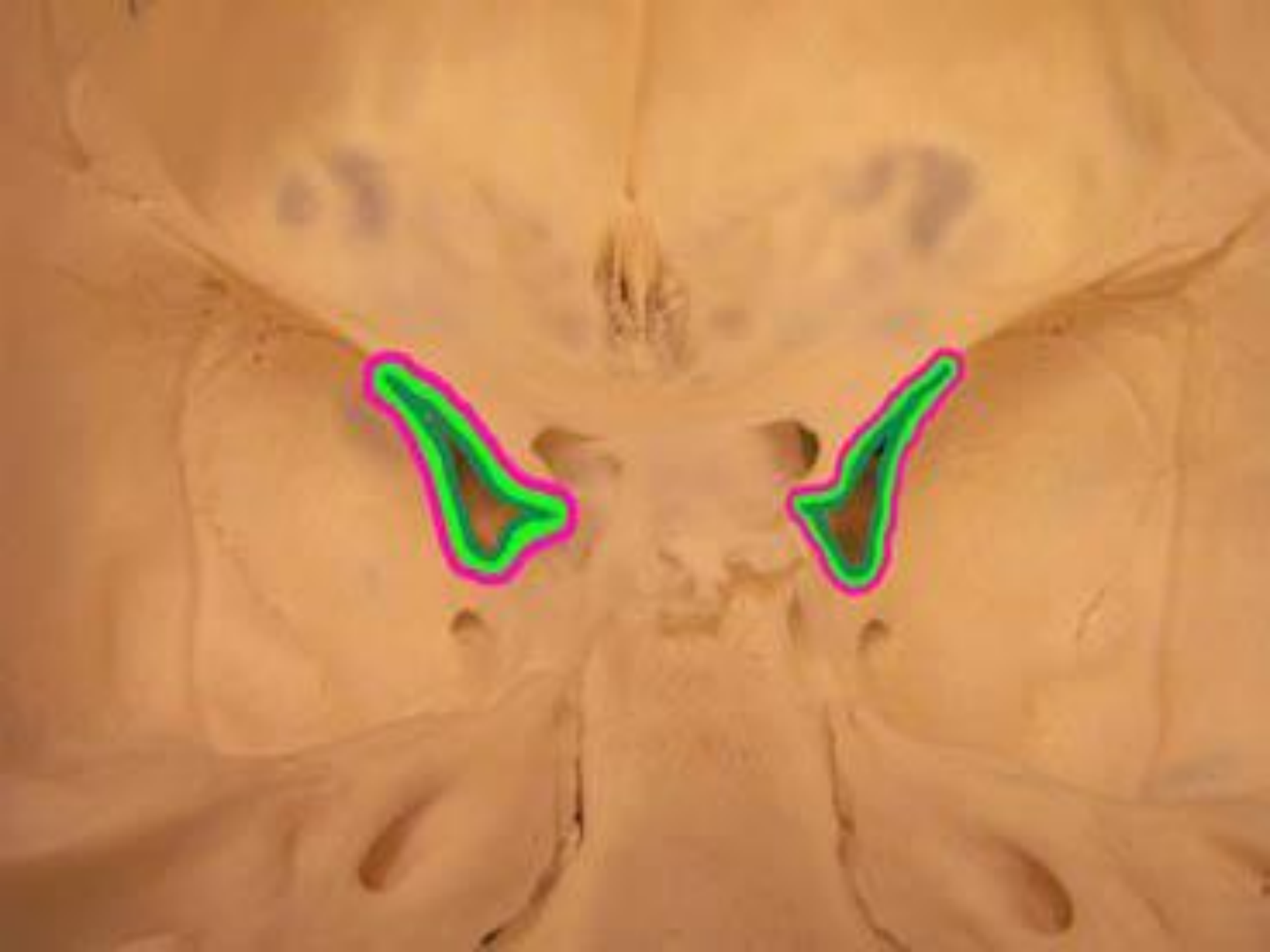
❖ On reaching the superior orbital fissure, it divides into **three main branches:**

1. **Frontal nerve.**
2. **Nasociliary nerve.**
3. **Lacrimal nerve.**

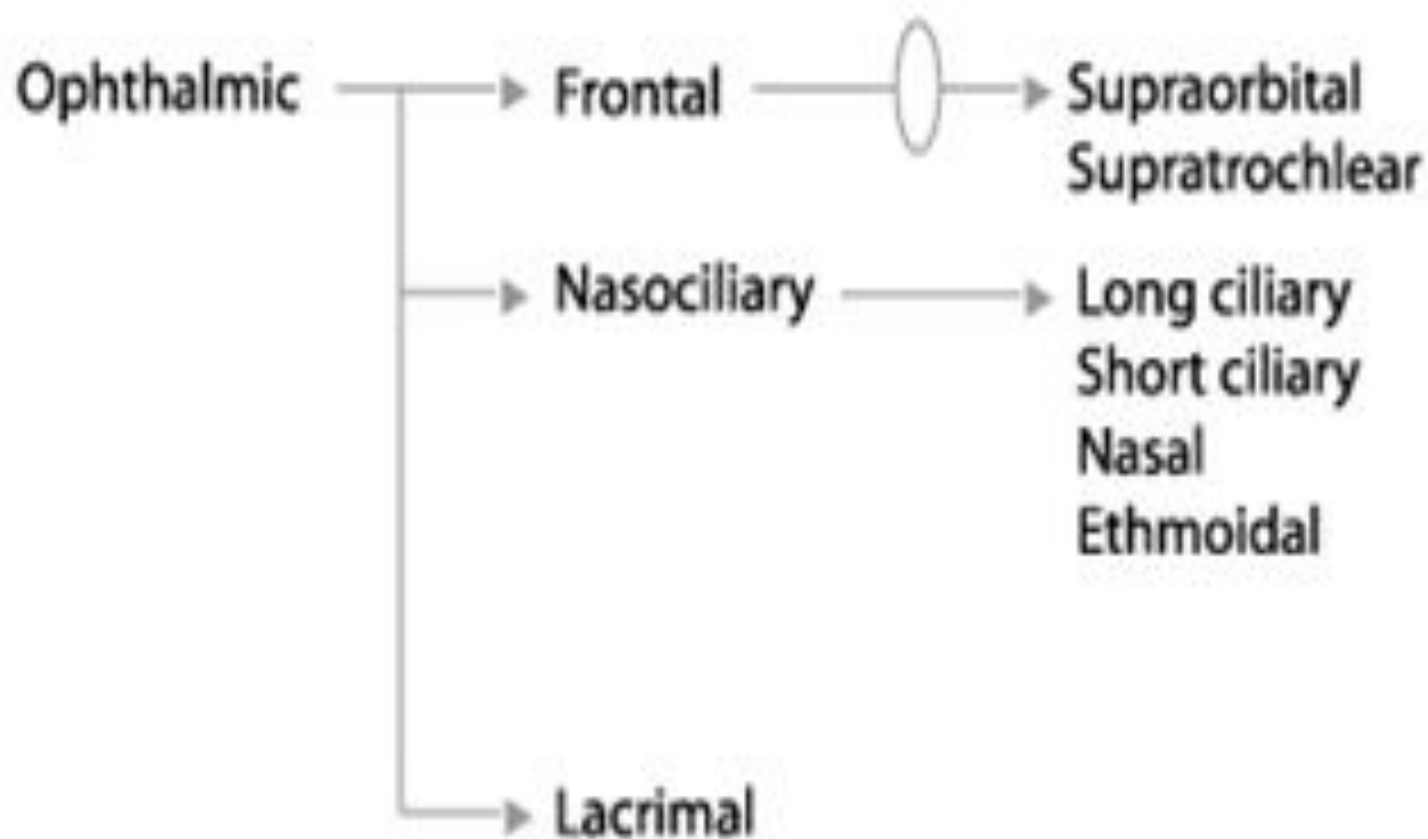
*****Tentorial nerve:** supplies the meninges in the anterior cranial fossa.

Ophthalmic and Maxillary Nerves





Supraorbital



1. The Frontal Nerve

- It enters the orbit through the upper part of the superior orbital fissure.
- It is the main branch of the ophthalmic nerve.

Branches of the Frontal Nerve

- 1. Supraorbital nerve (Lateral branch):** it exits the orbit through **supraorbital foramen**. It supplies the skin over forehead (as far back as the parieto-occipital fissure) and the middle part of the upper eyelid.
- 2. Supratrochlear (Medial branch):** it supplies the skin over forehead (small area) and the medial part of the upper eyelid.

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

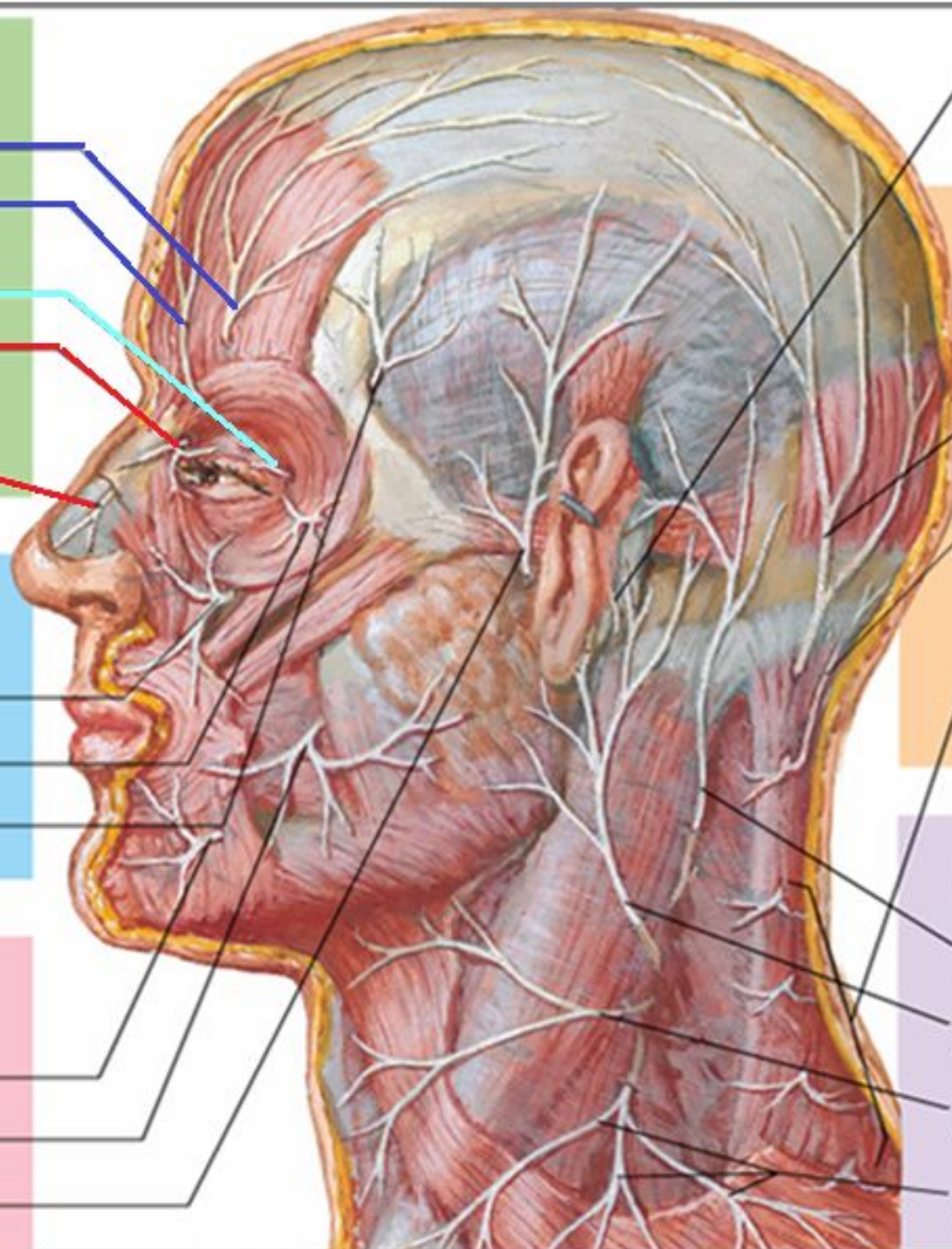
Branches from
cervical plexus

Lesser occipital
nerve (C2, 3)

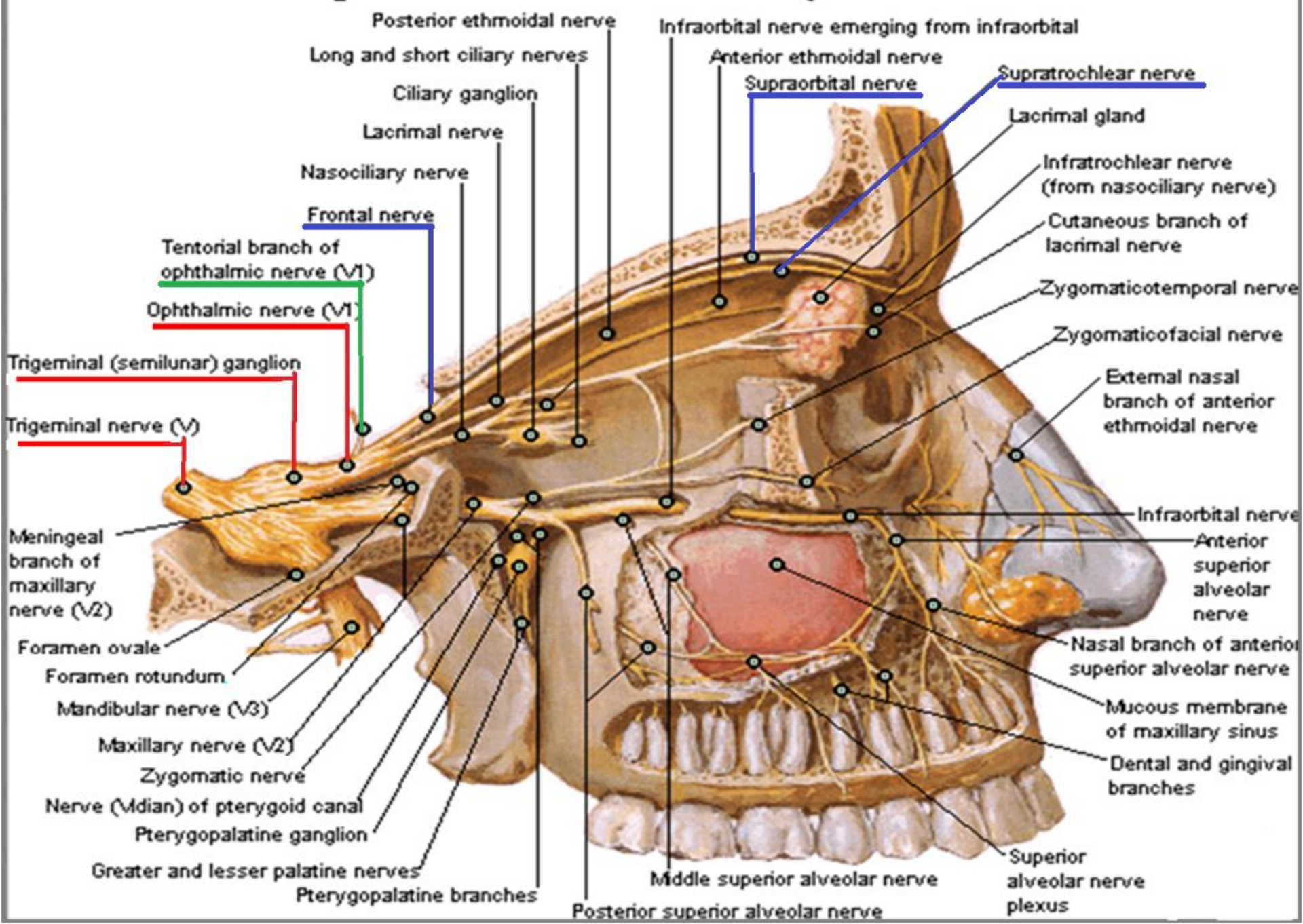
Great auricular
nerve (C2, 3)

Transverse cervical
nerve (C2, 3)

Supraclavicular
nerves (C3, 4)



Ophthalmic and Maxillary Nerves



2. The Nasociliary Nerve

- ❖ It enters the orbit through the lower part of the superior orbital fissure.

Branches of the Nasociliary Nerve:

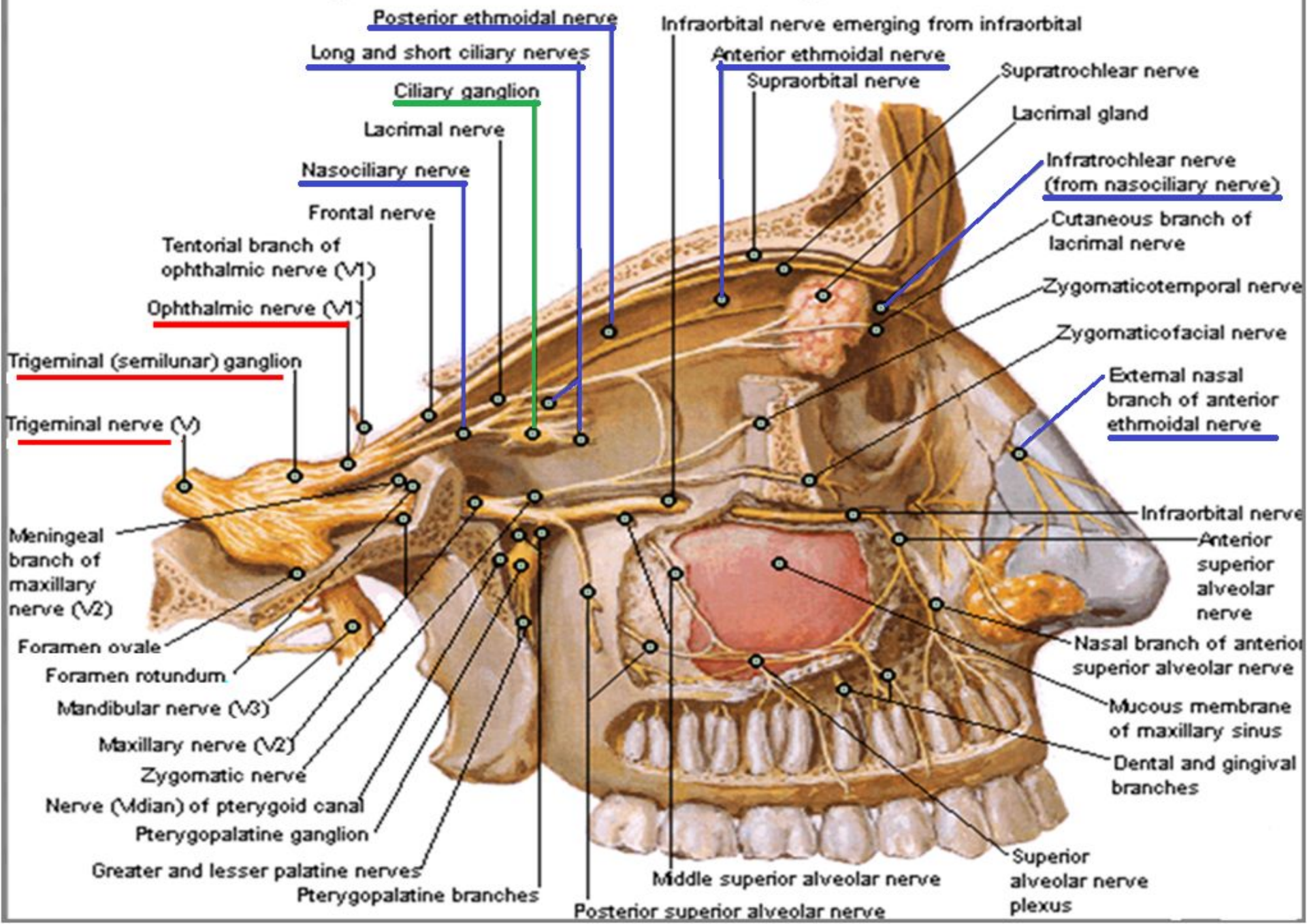
- 1. Communicating branch to the ciliary ganglion:** is a sensory nerve.
- 2. Two long ciliary nerves:** contains sympathetic fibers to supply the dilator pupillae muscle.
- 3. Posterior ethmoid nerve:** supplies the ethmoidal and sphenoidal sinuses.



5. Anterior ethmoid nerve: it enters the nasal cavity and after supplying an area of mucous membrane, it appears on the face as the **external nasal branch** at the lower border of the nasal bone, and supplies the skin of the nose down as far as the tip.

6. Infratrochlear nerve: **terminal branch of the nasociliary nerve**, supplies the skin over medial aspect of the upper and lower eyelid and the upper lateral part of the nose.

Ophthalmic and Maxillary Nerves



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

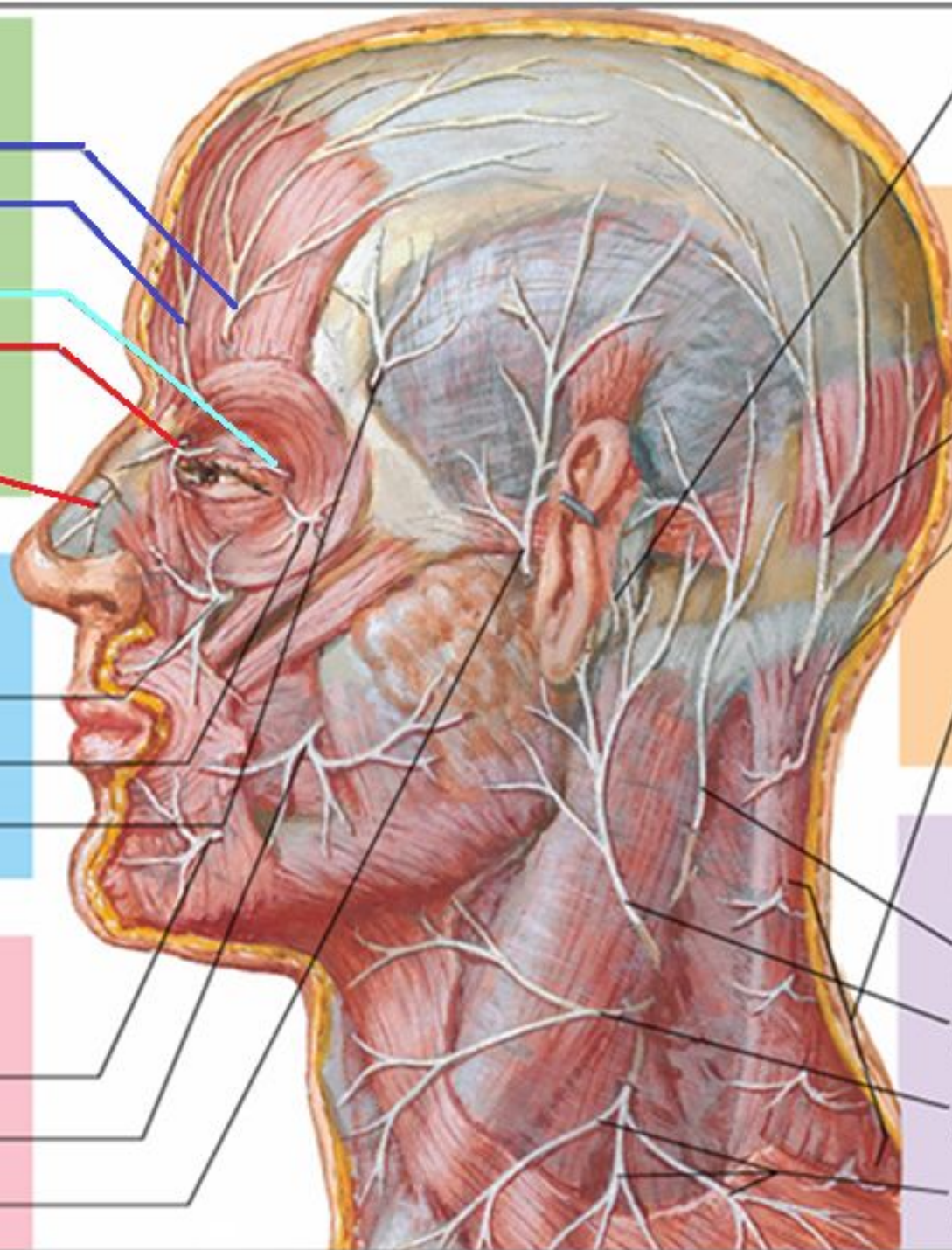
Branches from
cervical plexus

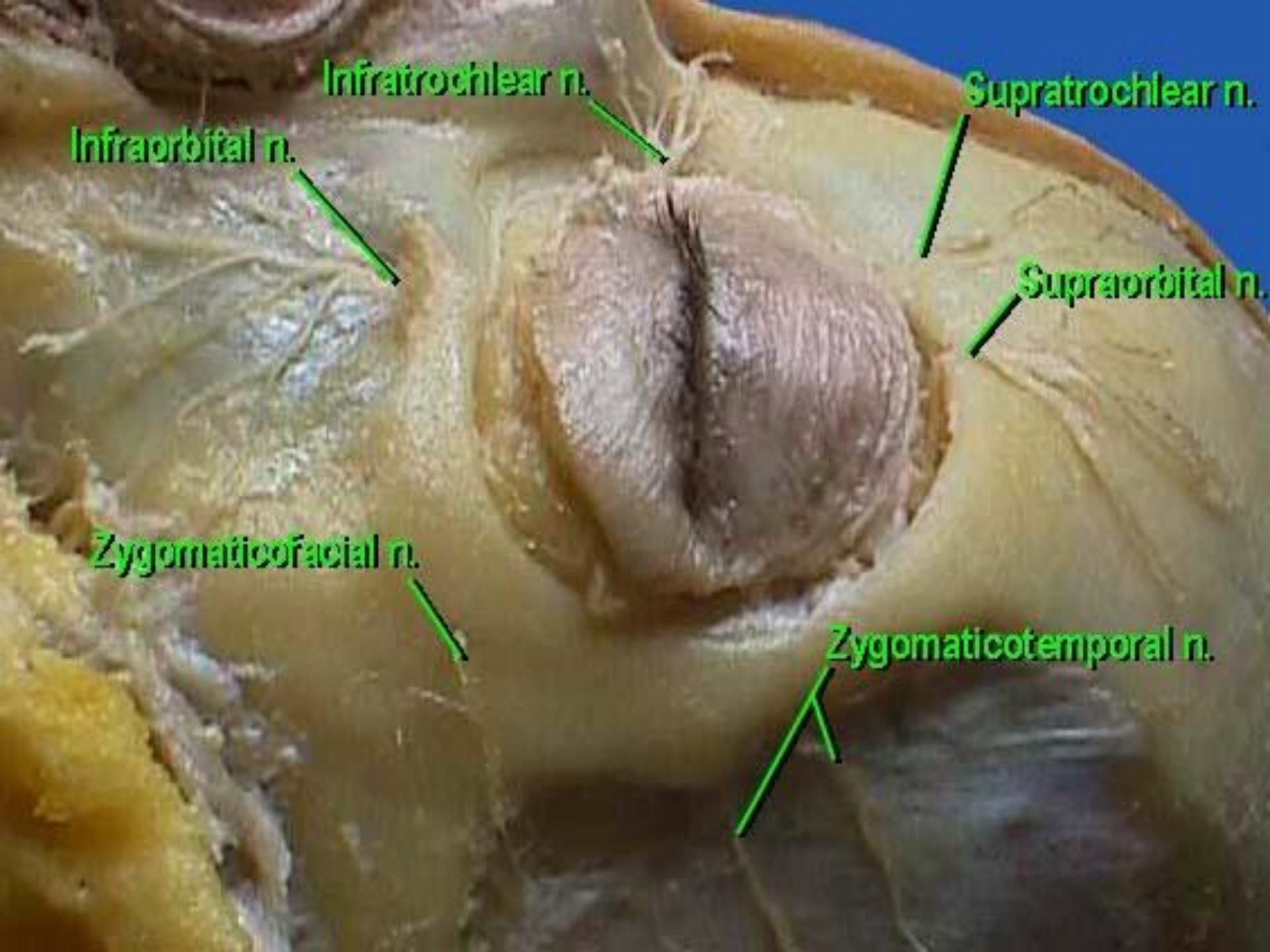
Lesser occipital
nerve (C2, 3)

Great auricular
nerve (C2, 3)

Transverse cervical
nerve (C2, 3)

Supraclavicular
nerves (C3, 4)





Infratrochlear n.

Supratrochlear n.

Infraorbital n.

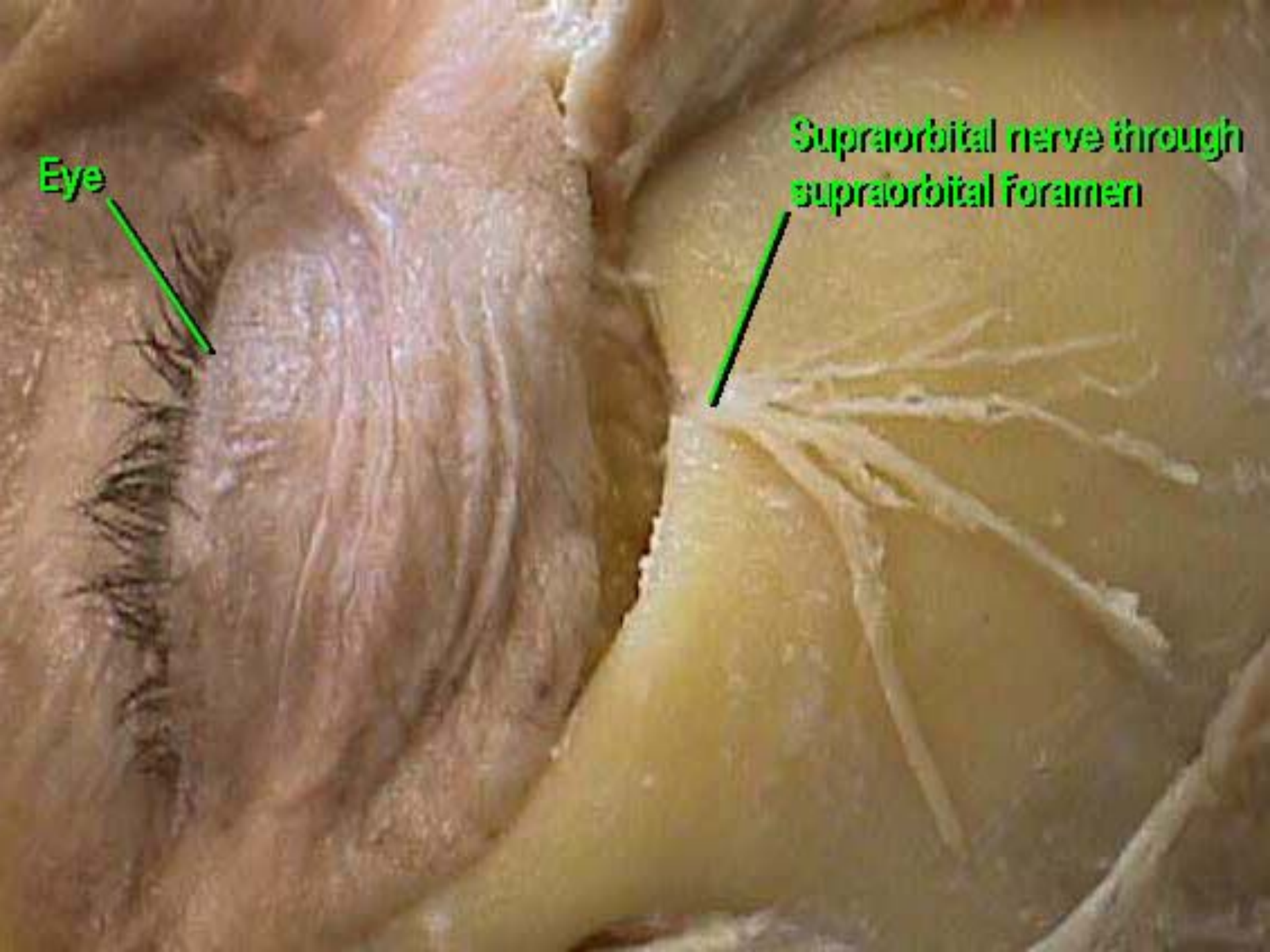
Supraorbital n.

Zygomaticofacial n.

Zygomaticotemporal n.

Eye

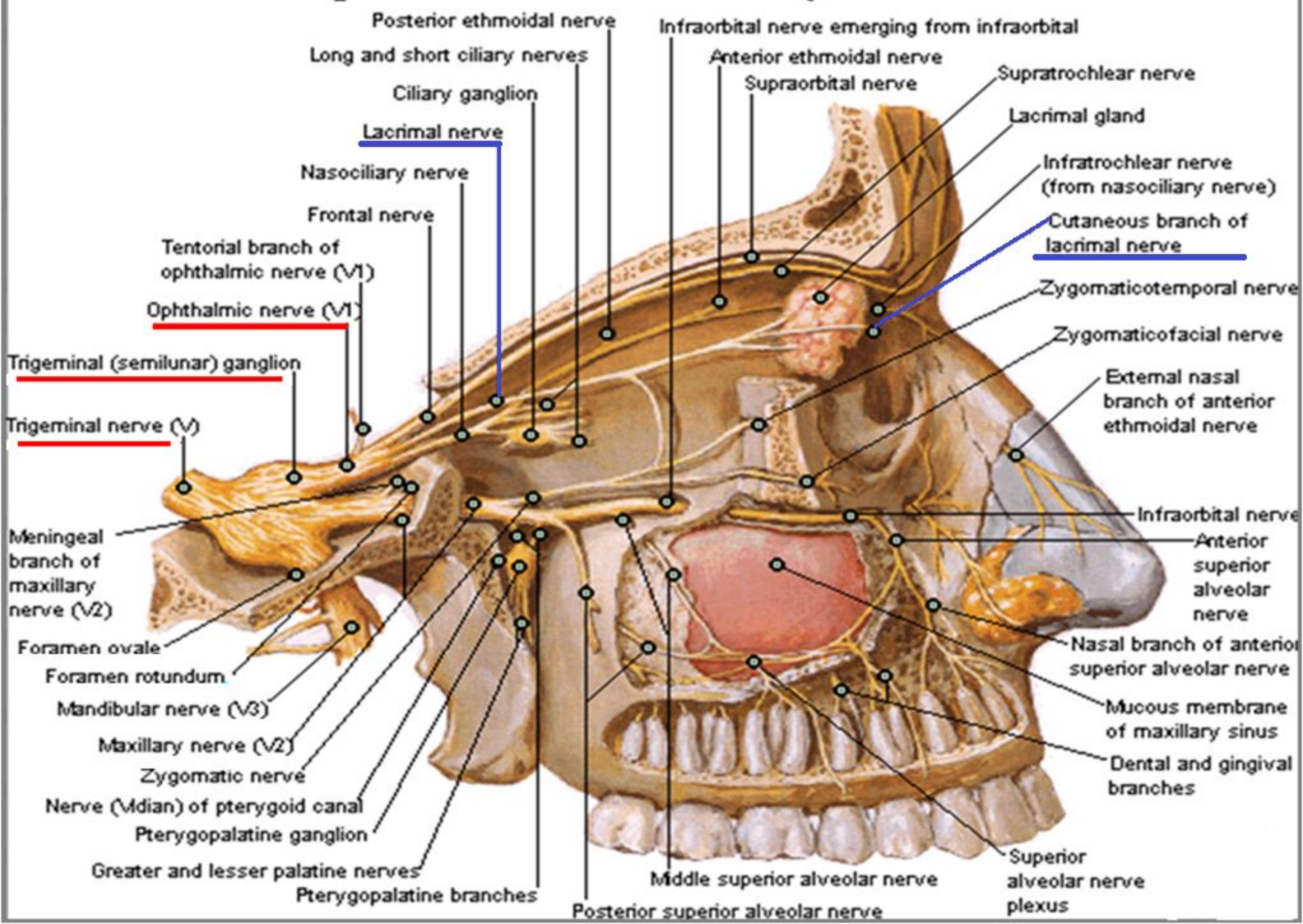
Supraorbital nerve through
supraorbital foramen



3. The Lacrimal Nerve

- It is a branch of the ophthalmic nerve.
- It enters the orbit through the upper part of superior orbital fissure.
- Supplies the lacrimal gland “sensation”, and it gives **Palpebral branch**, which supplies the skin over the lateral part of the upper eyelid.
- Carries parasympathetic secretomotor fibers from sphenopalatine ganglion “from the greater superficial petrosal branch of facial nerve.

Ophthalmic and Maxillary Nerves



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

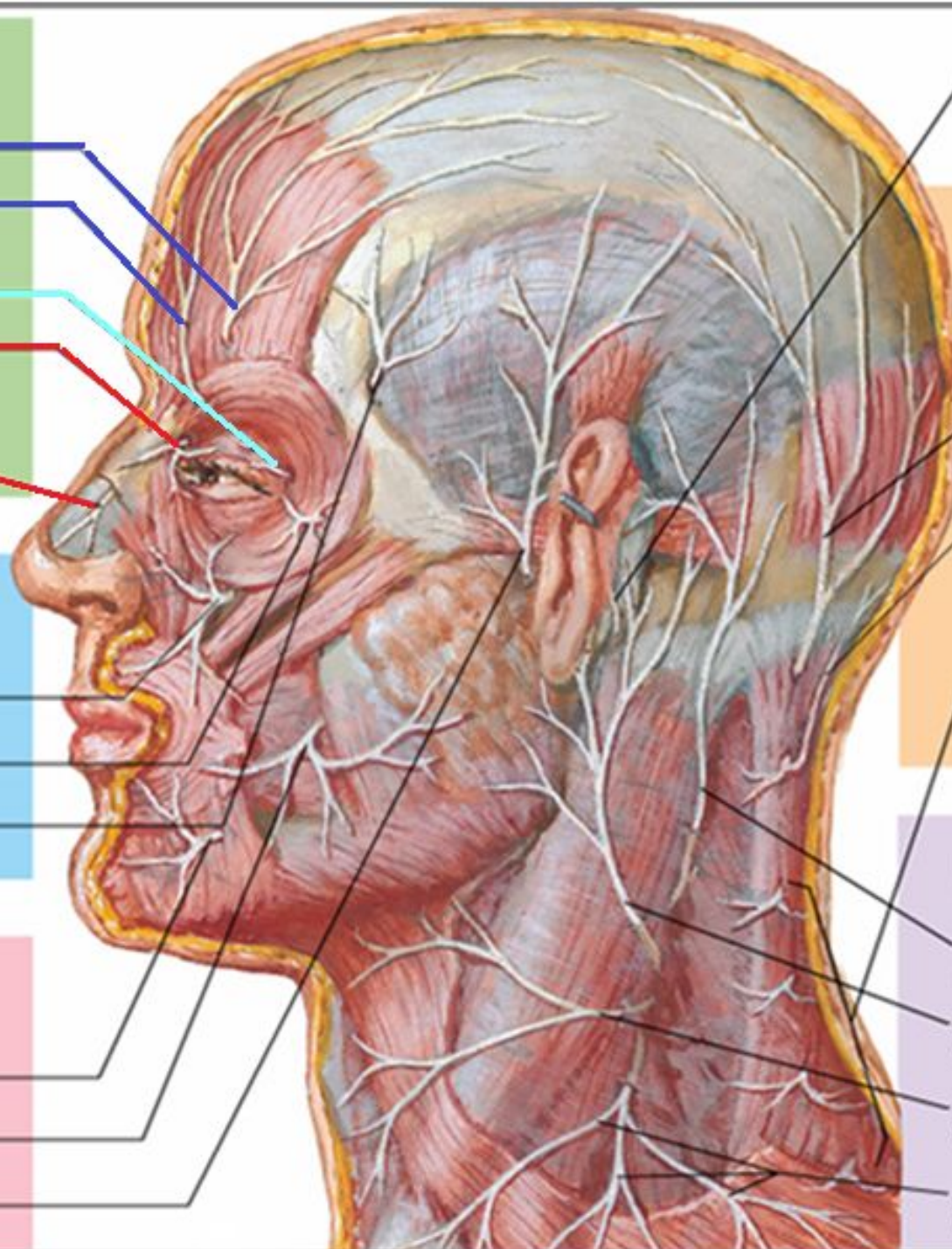
Branches from
cervical plexus

Lesser occipital
nerve (C2, 3)

Great auricular
nerve (C2, 3)

Transverse cervical
nerve (C2, 3)

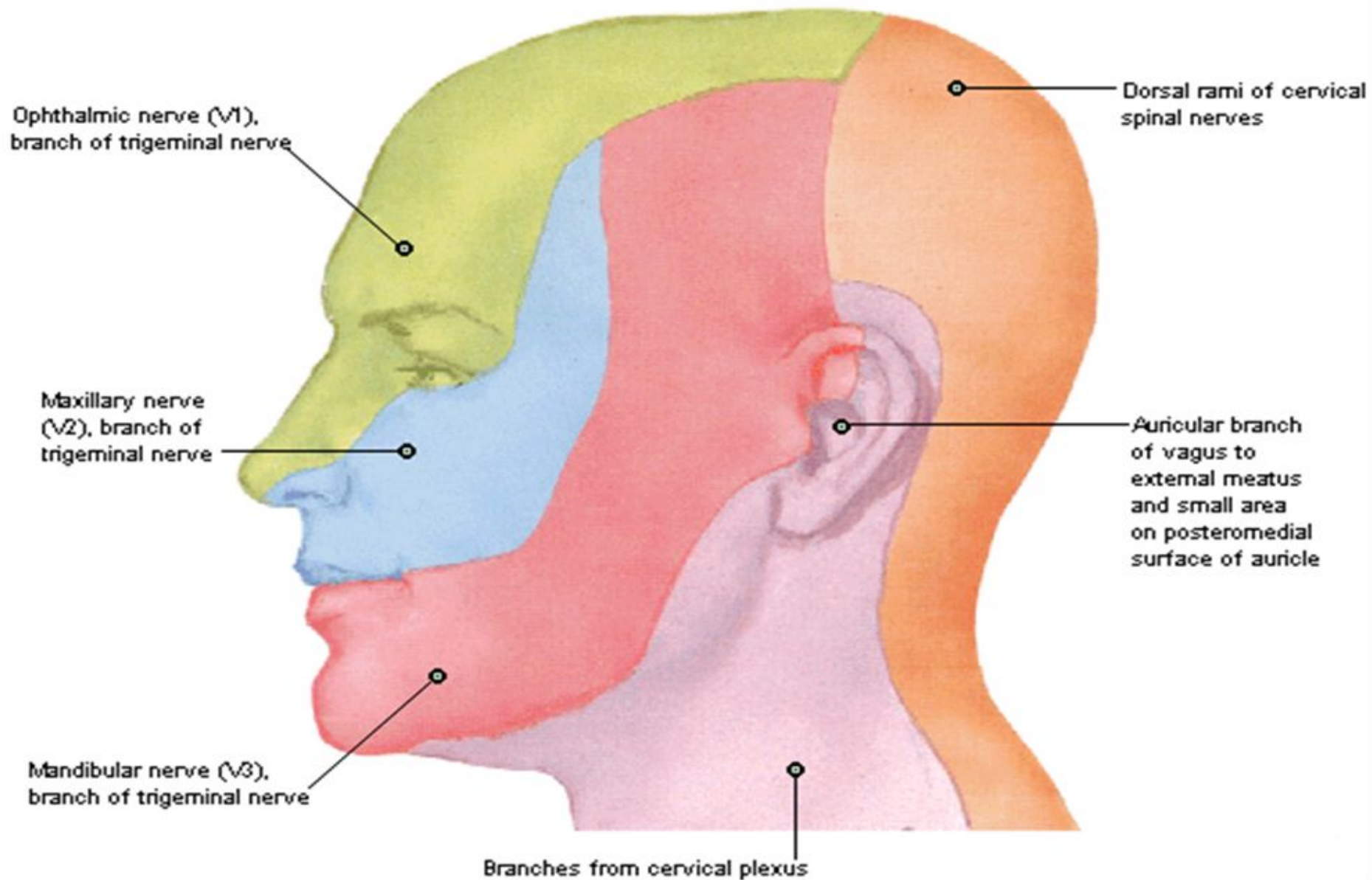
Supraclavicular
nerves (C3, 4)



The Maxillary Nerve (V₂)

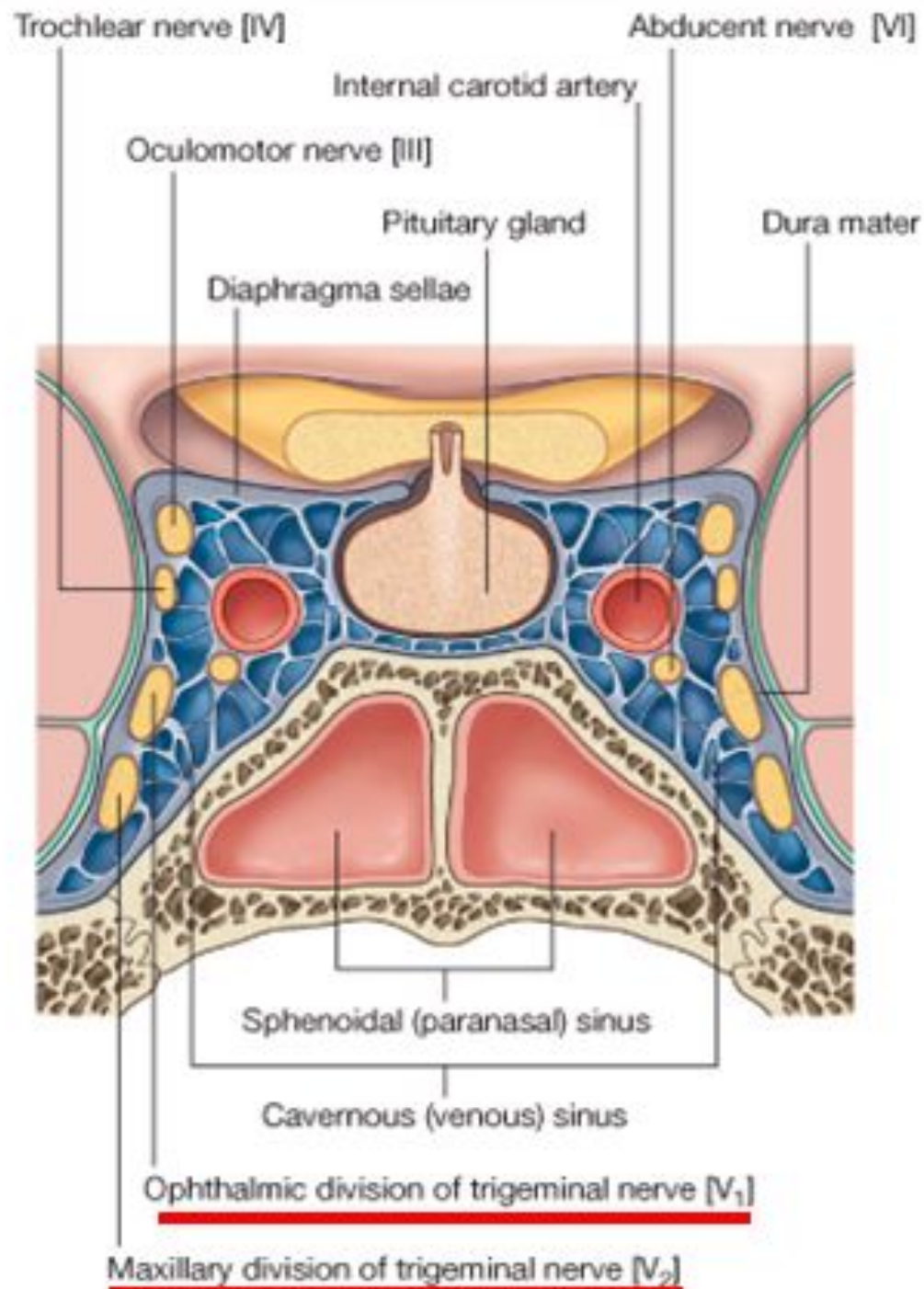
- ❖ It is the second branch of the trigeminal nerve.
- ❖ **Function:** it is a sensory nerve.
- ❖ **It supplies the:**
 - Maxillary area of skin of the face.
 - Maxillary teeth (of the upper jaw).
 - Mucosa membrane related to maxilla.
 - Maxillary sinus.
 - Dura matter in the middle cranial fossa.

Dermatomes of Head and Neck



Course and Relation of the Maxillary Nerve

1. It arises inside the skull as the second branch of the trigeminal ganglion.
2. It passes forwards in the **lower lateral wall of cavernous sinus** with the ophthalmic nerve.
3. Then it leaves the skull through the **foramen rotundum**.
4. It reaches the pterygopalatine fossa → to enter orbit through the inferior orbital fissure → infraorbital canal → infraorbital foramen as **the infraorbital nerve**.





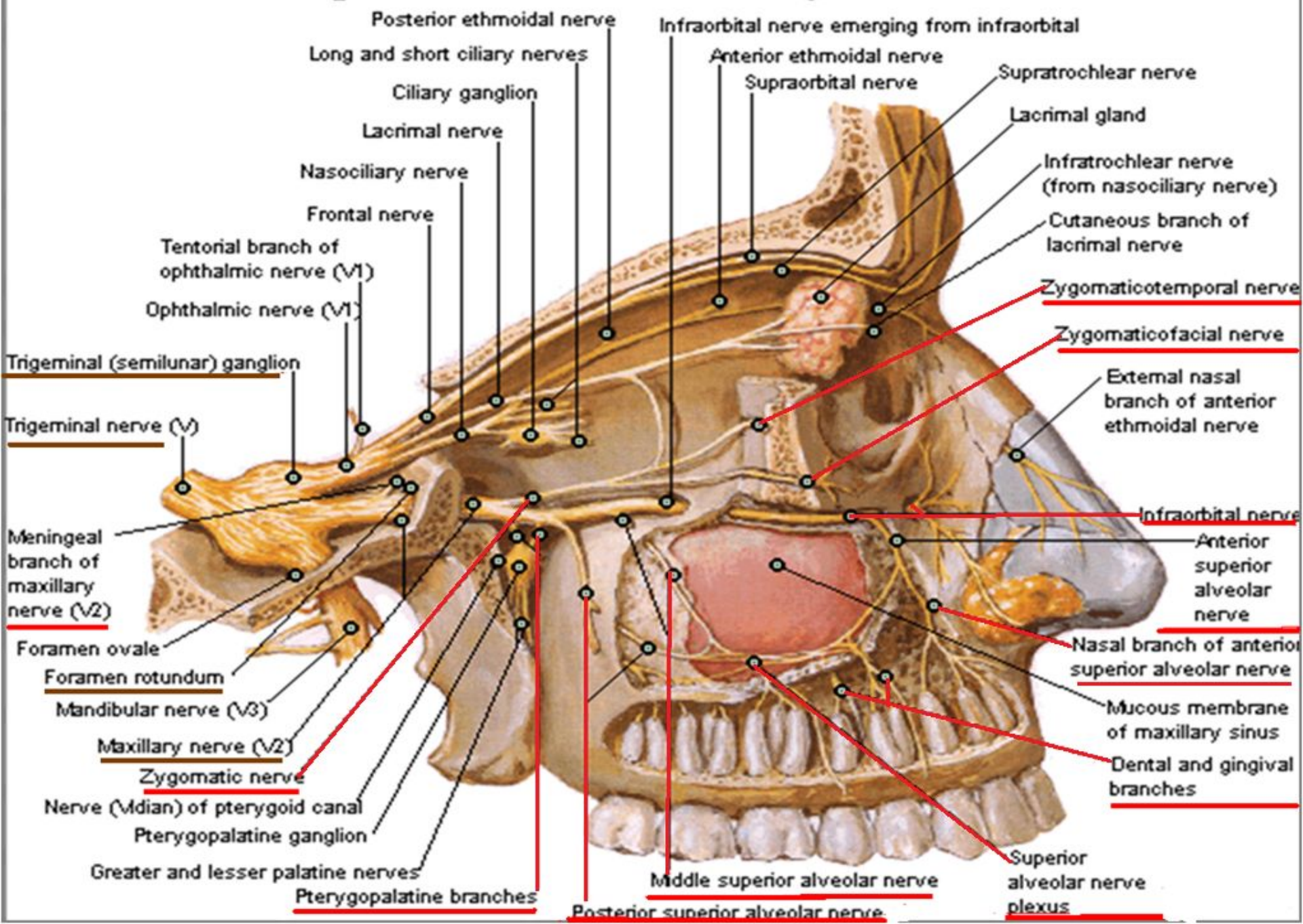
Foramen rotundum (V2)



Branches of Maxillary Nerve

1. **The meningeal branch:** arises in the cranial cavity to supply the dura mater in the middle cranial fossa.
2. **Pterygopalatine branches:** arise in the pterygopalatine fossa. It carry sensory fibers to the pterygopalatine ganglion.
3. **Two branches before it enters the orbit:**
 - a. The posterior superior dental (alveolar) nerve.
 - b. The zygomatic nerve:
 - Zygomaticotemporal nerve.
 - Zygomaticofacial nerve.
3. **The middle superior dental (alveolar) nerve.**
4. **The anterior superior dental (alveolar) nerve.**
5. **Infraorbital nerve:**
 - a. Palpebral nerve.
 - b. Nasal nerve.
 - c. Labial nerve.

Ophthalmic and Maxillary Nerves



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

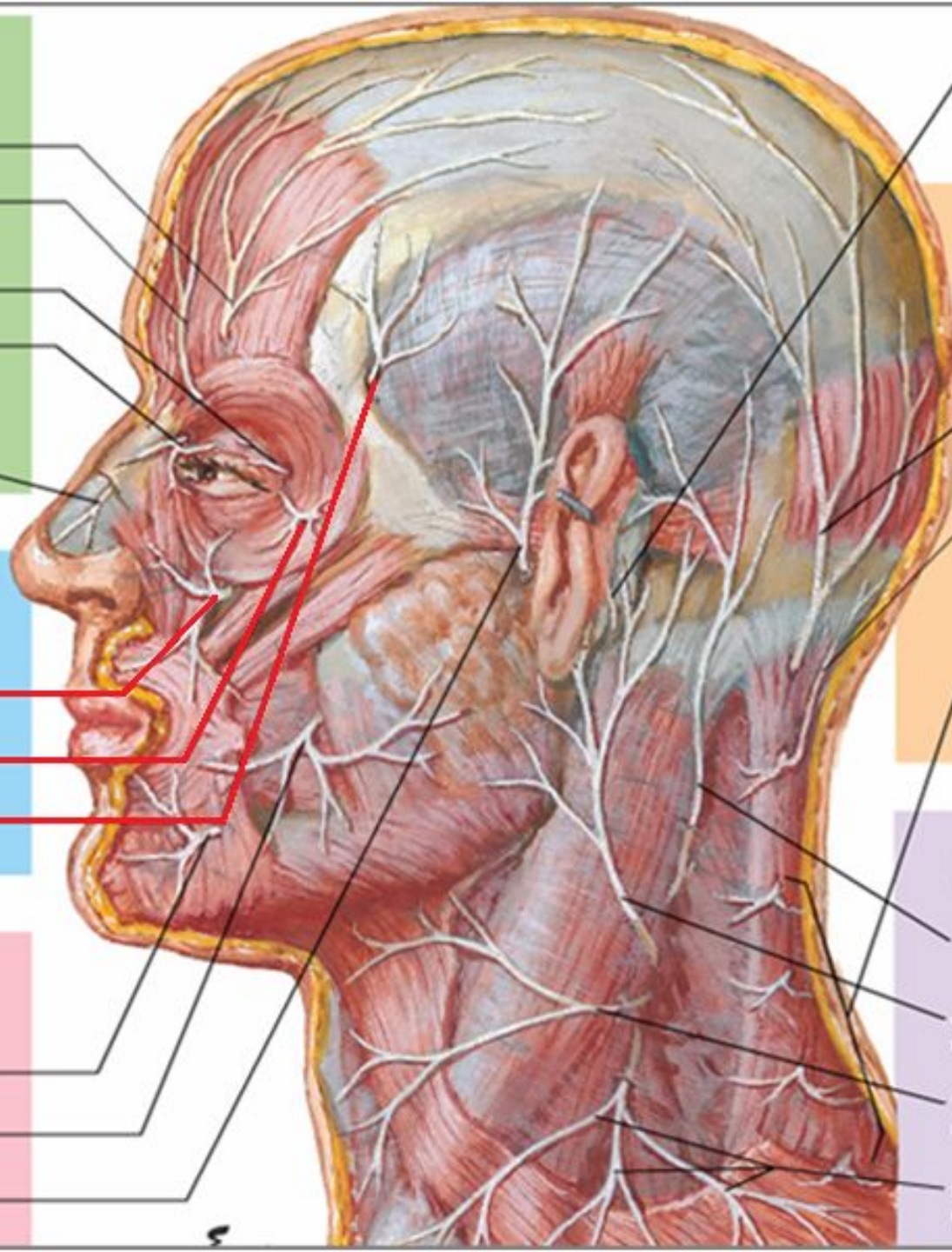
Branches from
cervical plexus

Lesser occipital
nerve (C2, 3)

Great auricular
nerve (C2, 3)

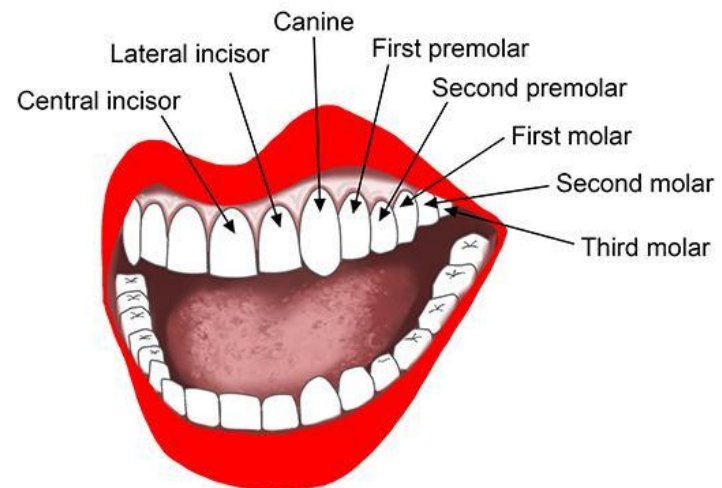
Transverse cervical
nerve (C2, 3)

Supraclavicular
nerves (C3, 4)

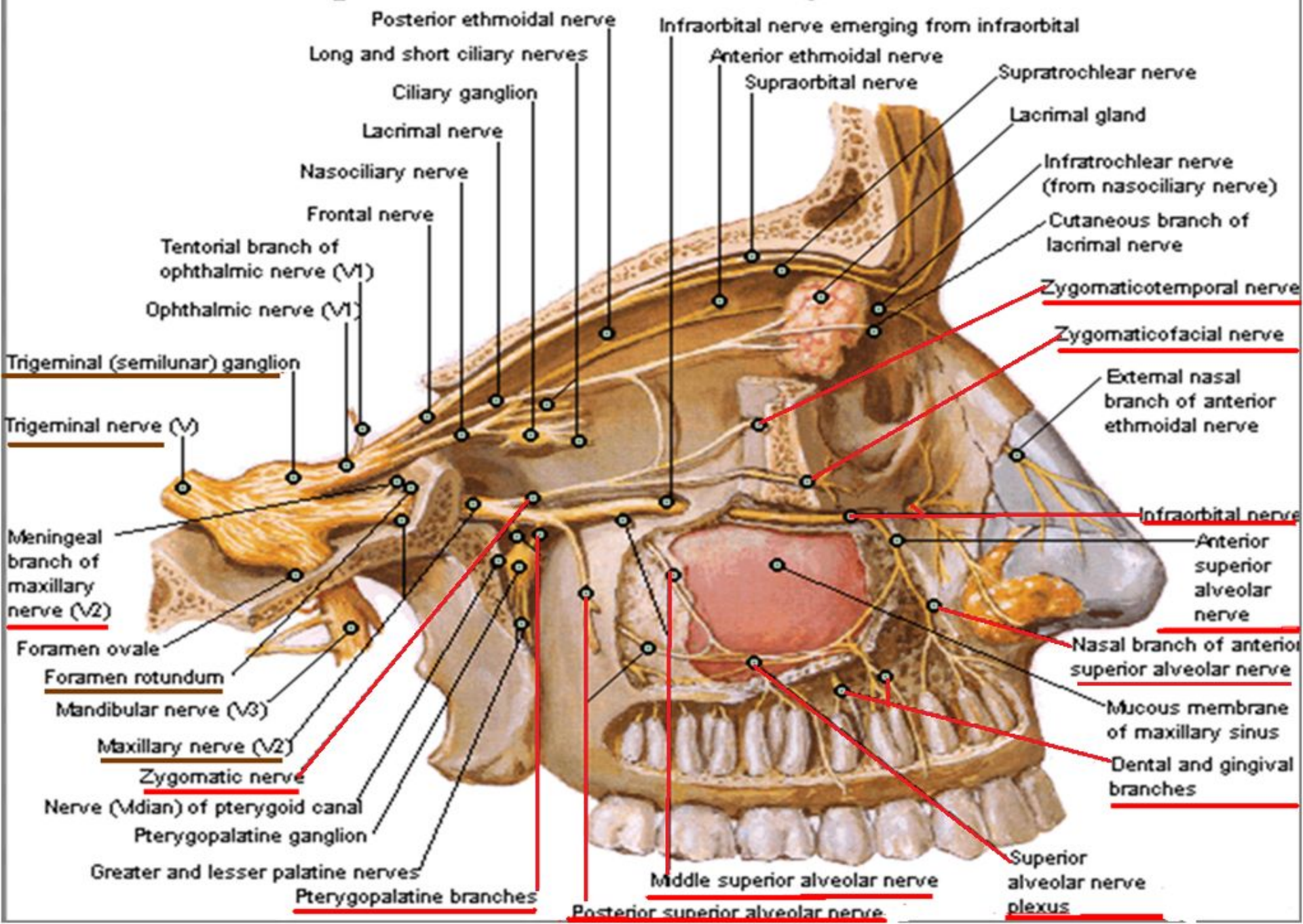


The Posterior Superior Dental (Alveolar) Nerve

- Arises in the pterygopalatine fossa then passes through the **pterygomaxillary fissure**.
- It enters the **posterior superior alveolar foramen** in the posterior surface of the maxilla.
- It supplies the **upper three molar teeth, gum and maxillary air sinus**.



Ophthalmic and Maxillary Nerves



The Zygomatic Nerve

- ❖ Arises in the pterygopalatine fossa.
- ❖ It enters the orbit through the **inferior orbital fissure** and ascends on its lateral wall (in a canal in the zygomatic bone) where it divides into two branches for innervation of the skin over the zygoma (cheek bone):

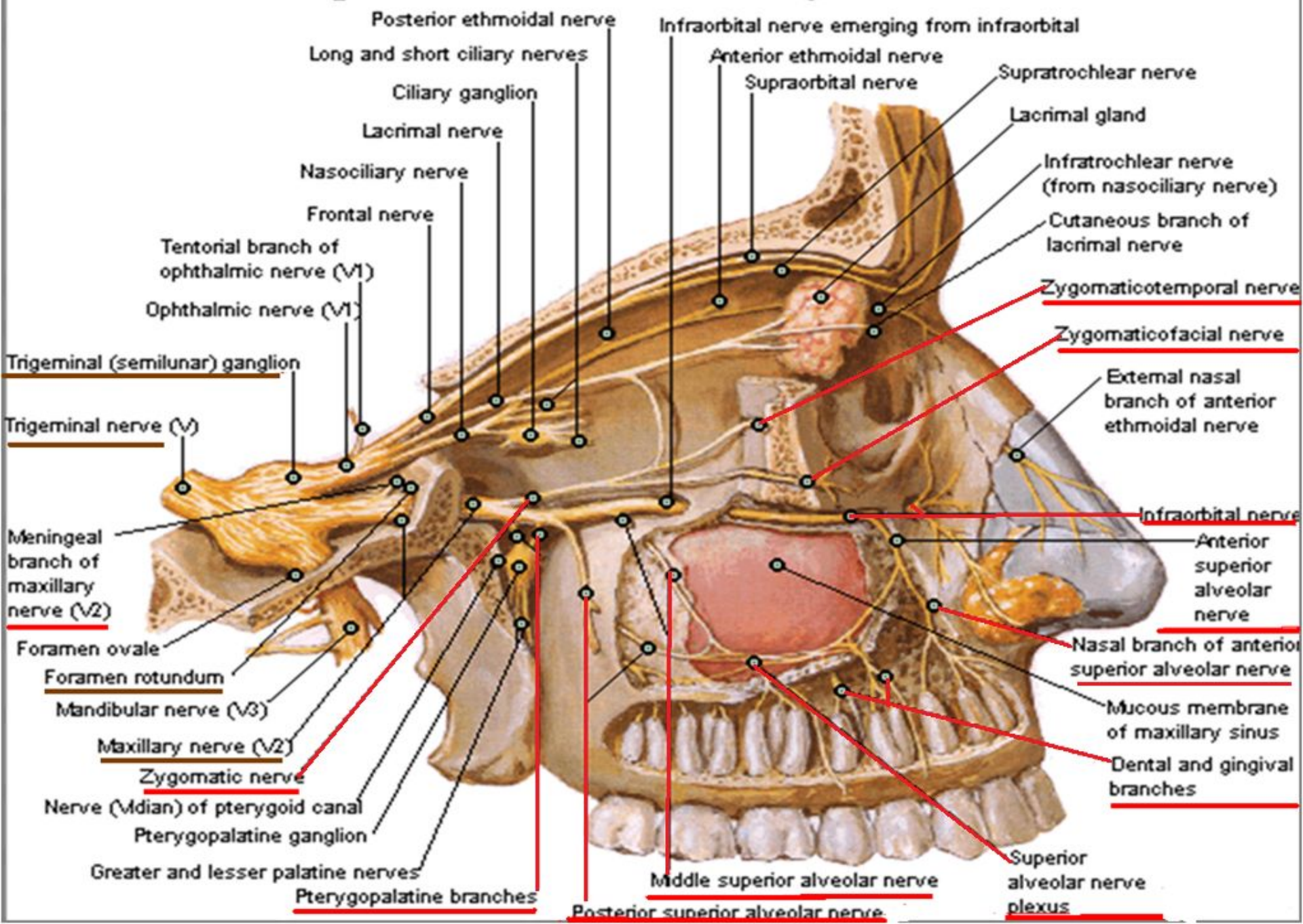
1. Zygomaticotemporal nerve:

- Emerges in the temporal fossa through a small foramen on the **posterior surface** of the zygomatic bone.
- It supplies the skin over the anterolateral temporal area.
- Carries postganglionic parasympathetic and sympathetic fibers from the sphenopalatine ganglion to lacrimal gland.

2. Zygomaticofacial nerve:

- Passes into the face through a small foramen on the **lateral side** of the zygomatic bone.
- It supplies the skin over the prominence of the cheek.

Ophthalmic and Maxillary Nerves



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

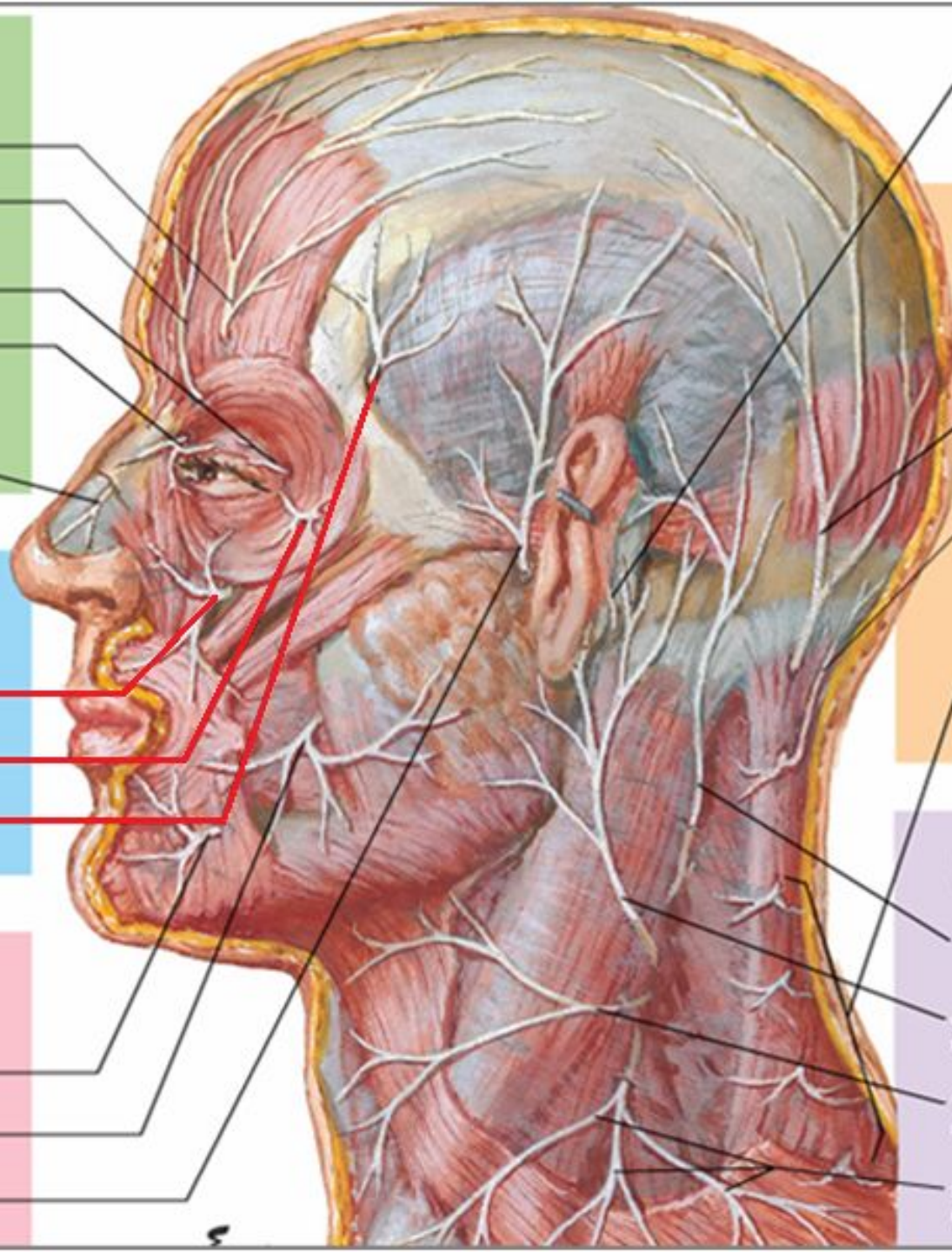
Branches from
cervical plexus

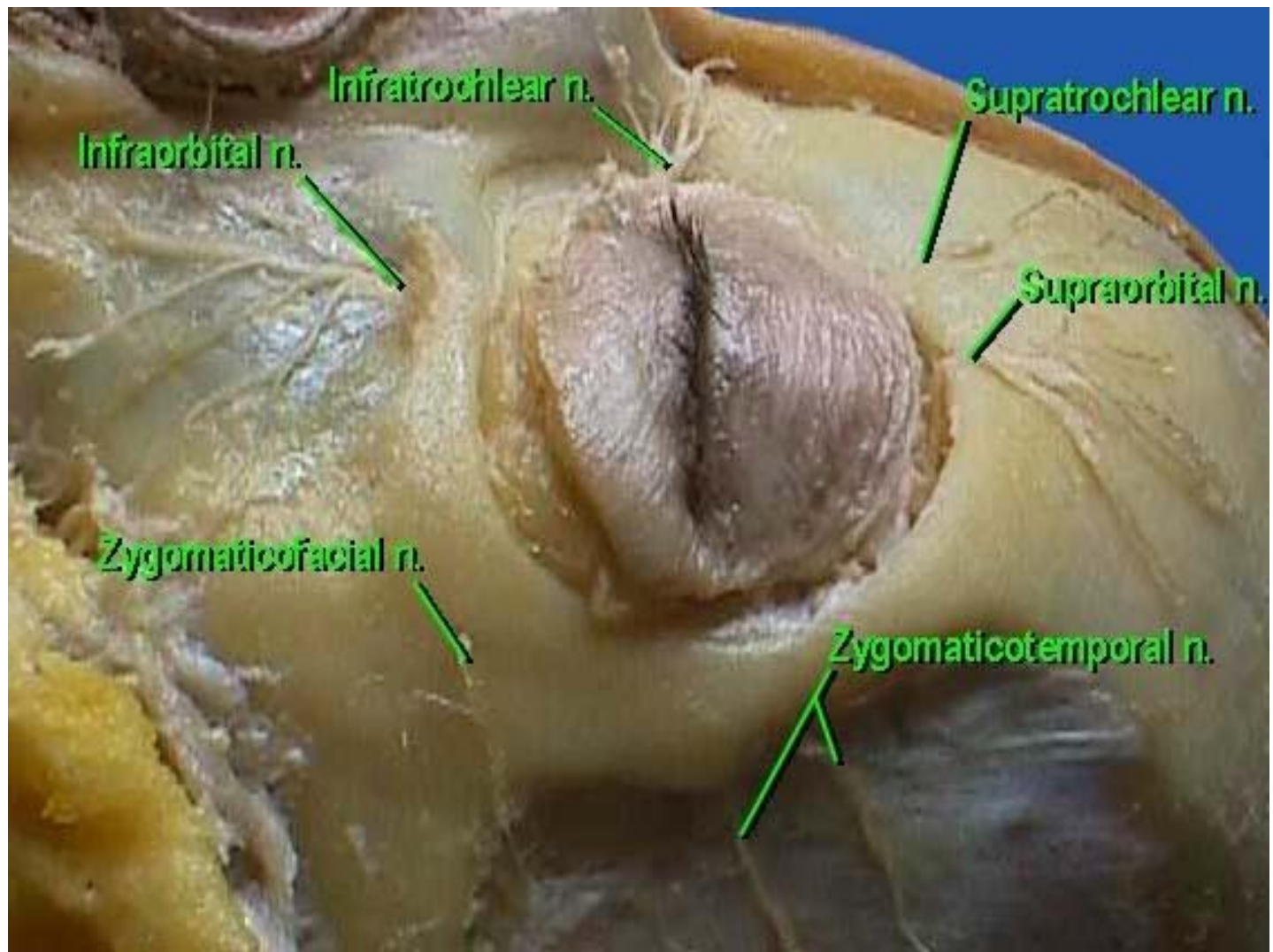
Lesser occipital
nerve (C2, 3)

Great auricular
nerve (C2, 3)

Transverse cervical
nerve (C2, 3)

Supraclavicular
nerves (C3, 4)



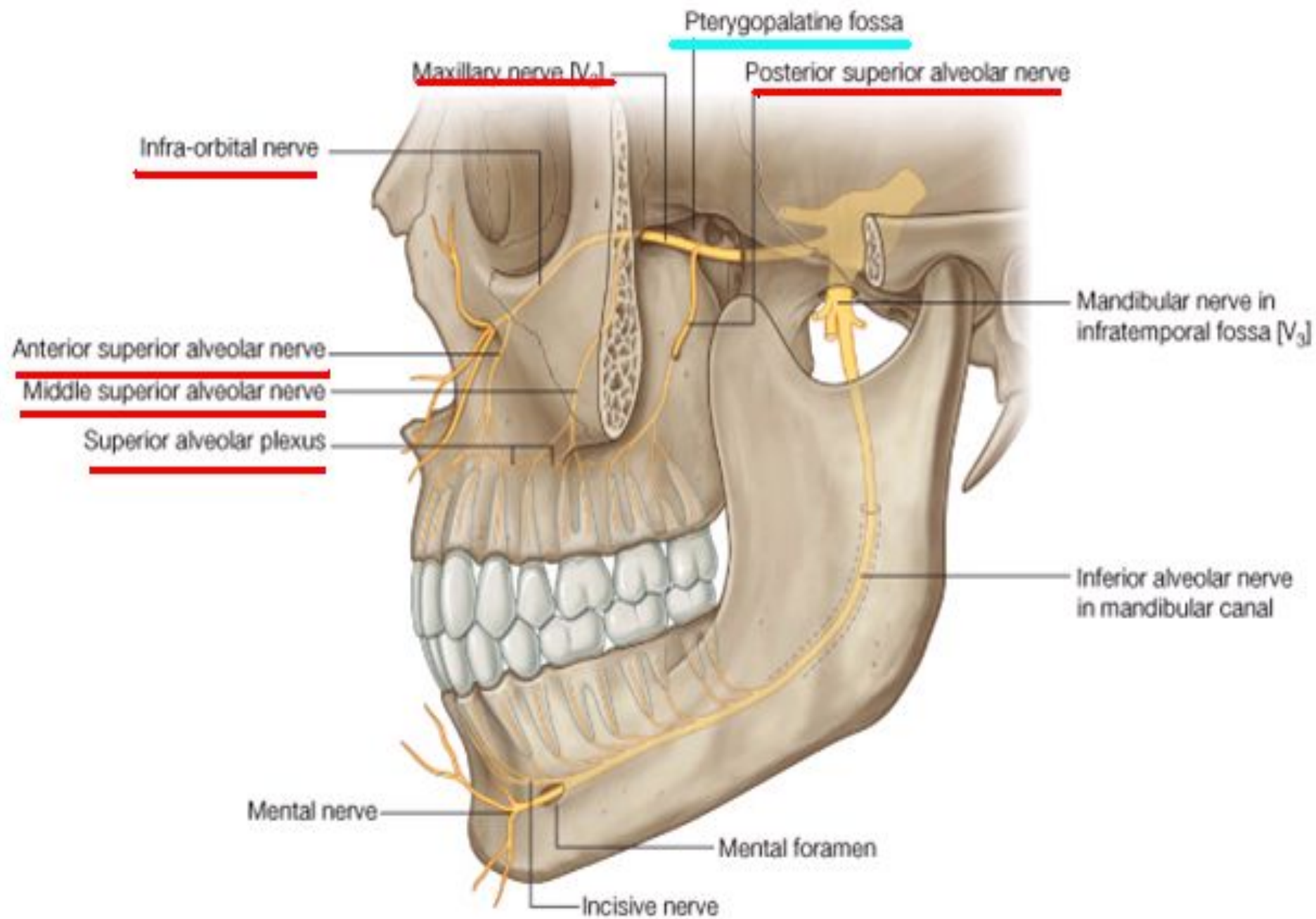


The Middle Superior Dental (Alveolar) Nerve

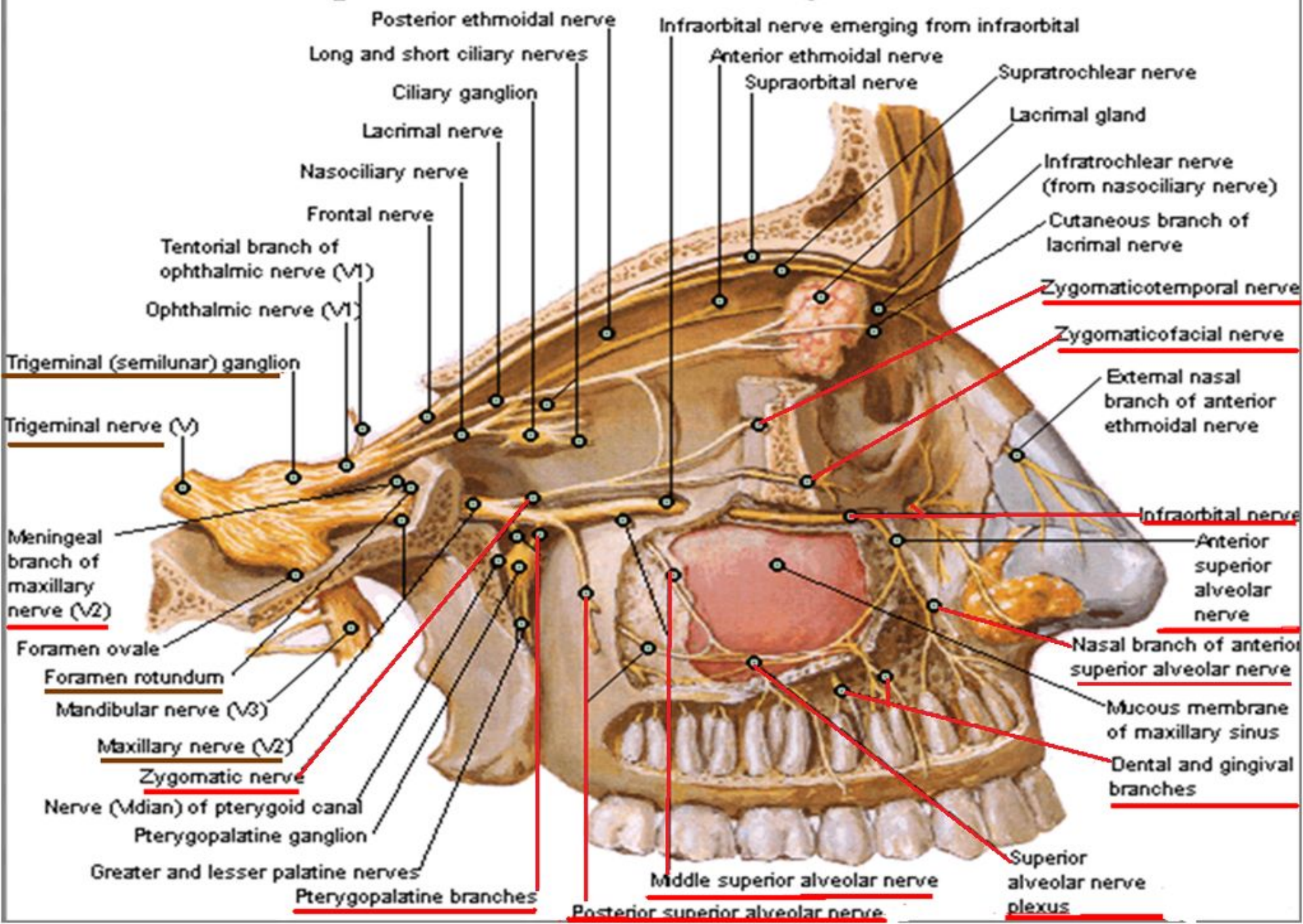
- ❑ Arises in the infraorbital groove.
- ❑ It descends along **the lateral wall** of the maxillary sinus, runs in a small bony canal to supply **the upper first molar and upper two premolar teeth and gum.**

The Anterior Superior Dental (Alveolar) Nerve

- ❑ Arises in the infraorbital canal.
- ❑ It descends along **the anterior wall** of the maxillary sinus, runs in a small bony canal to supply **the upper two incisor, canine teeth and the gum.**



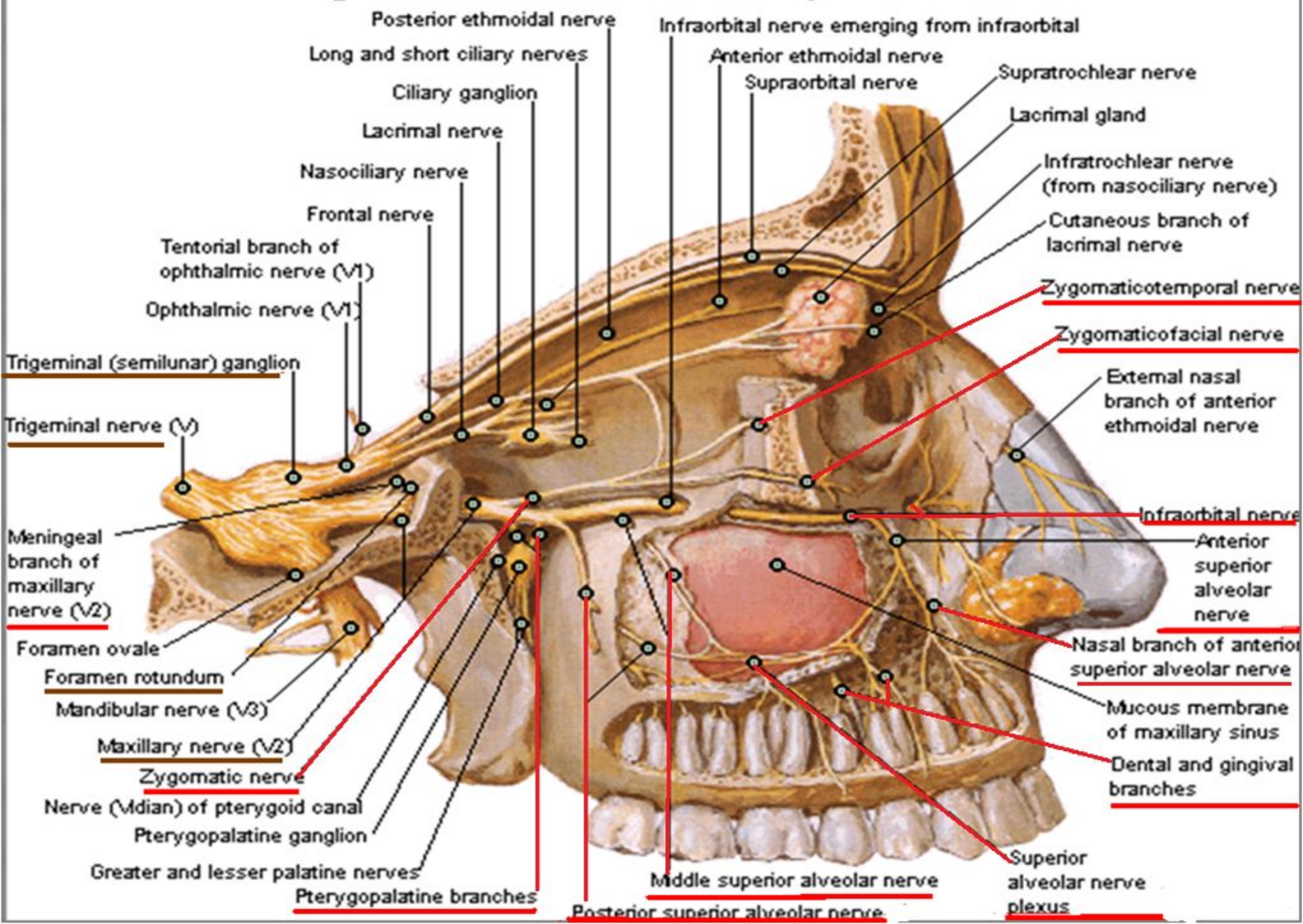
Ophthalmic and Maxillary Nerves

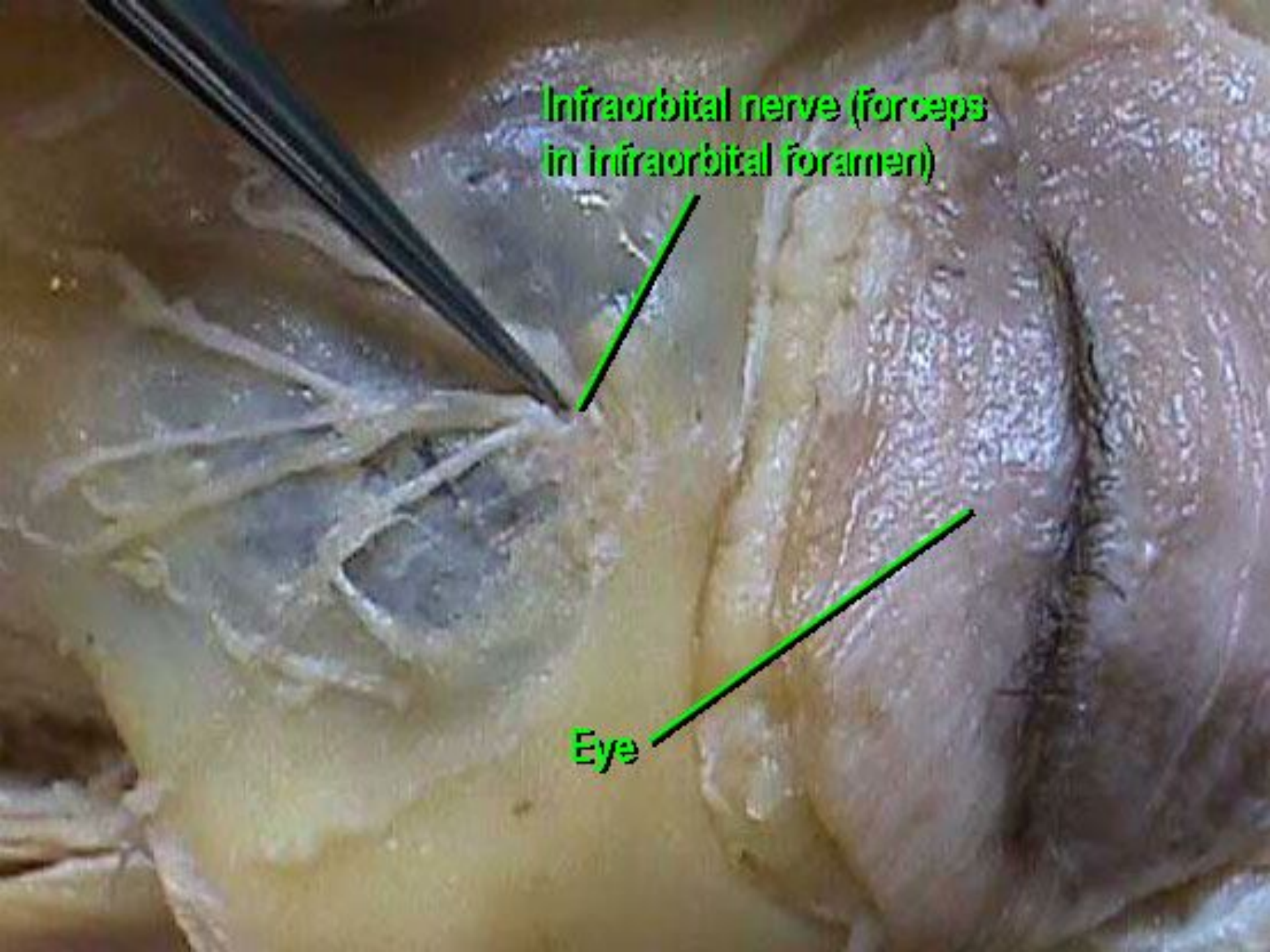


The Infraorbital Nerve

- It is **the terminal branch** of the maxillary nerve.
- It reaches the face through the infraorbital foramen (on the face), where it divides into three branches:
 - a. **Palpebral nerve:** to supply the lower eyelid.
 - b. **Nasal nerve:** to supply the posterior part of the side of the nose.
 - c. **Labial nerve:** to supply the upper lip.

Ophthalmic and Maxillary Nerves





This is a close-up photograph of a rat's head during an anatomical dissection. The skin has been removed from the snout and cheek area, revealing the underlying structures. A pair of black forceps is positioned to grasp the infraorbital nerve as it passes through the infraorbital foramen. The eye is visible on the right side of the image. Green text labels with leader lines identify the 'Infraorbital nerve (forceps in infraorbital foramen)' and the 'Eye'.

Infraorbital nerve (forceps
in infraorbital foramen)

Eye

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

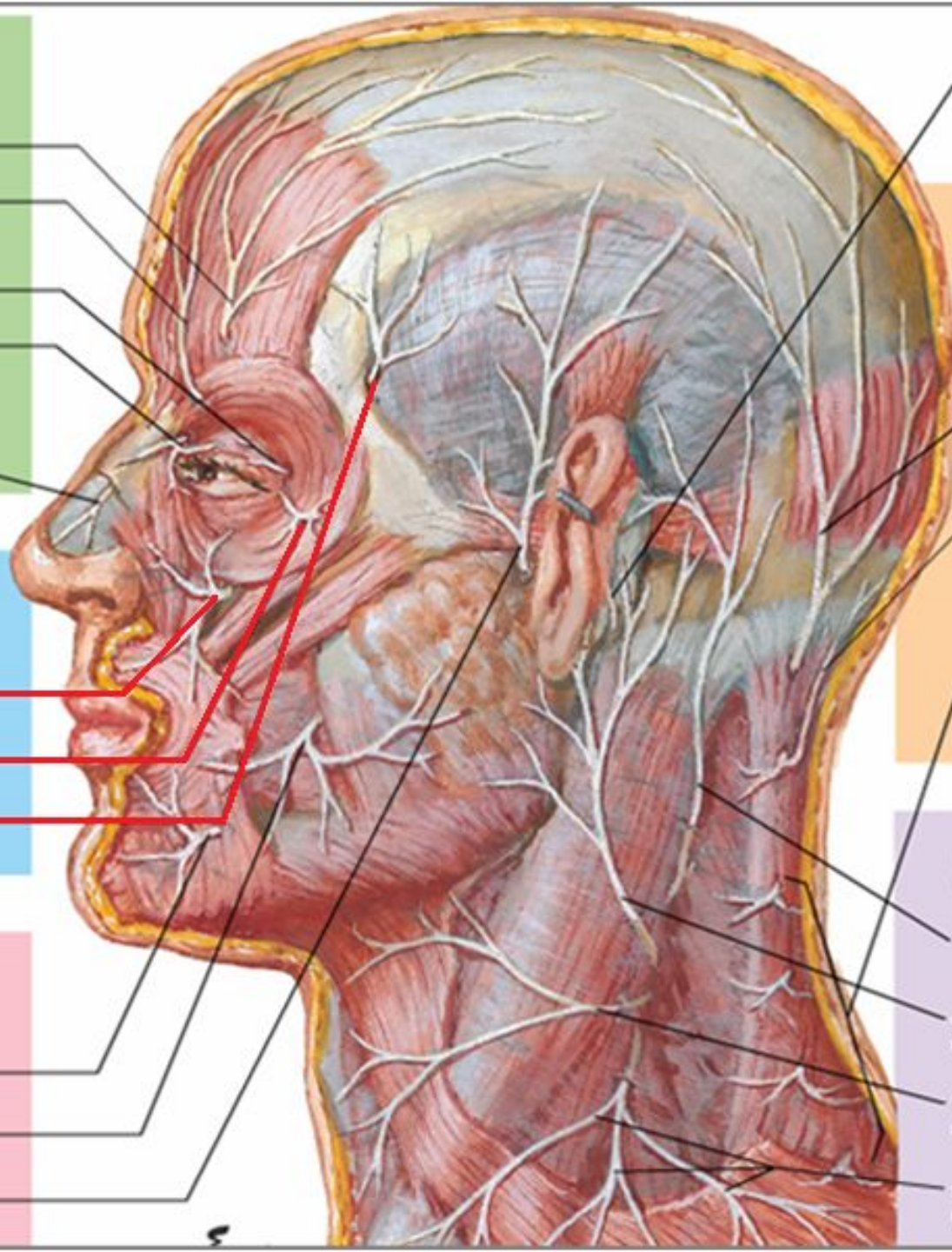
Branches from
cervical plexus

Lesser occipital
nerve (C2, 3)

Great auricular
nerve (C2, 3)

Transverse cervical
nerve (C2, 3)

Supraclavicular
nerves (C3, 4)



The Mandibular Nerve (V_3)

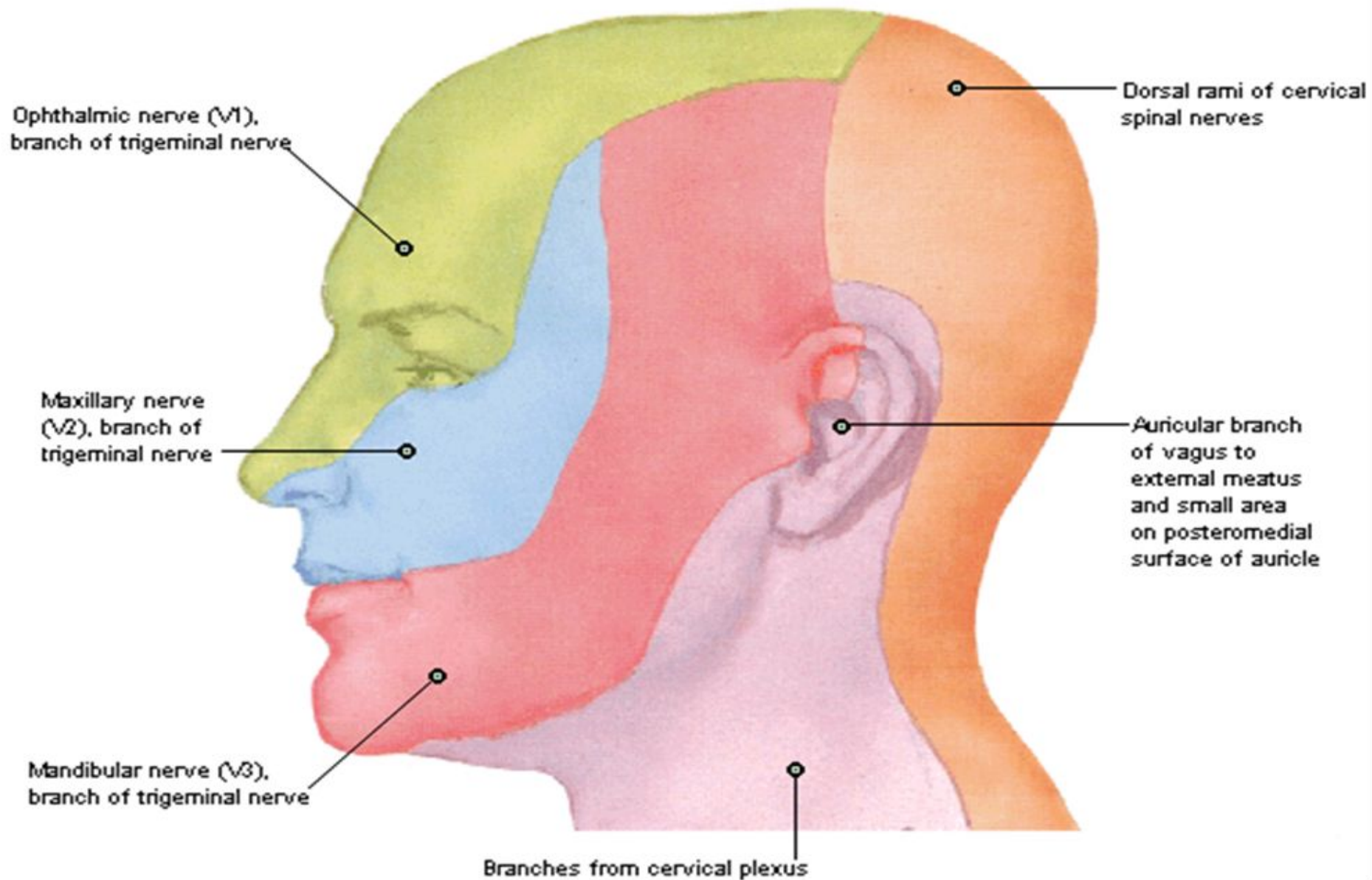
Origin: it is a mixed nerve formed of two roots:

- 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. Side of the head and scalp.
 6. Meninges of the middle cranial fossa.

Dermatomes of Head and Neck



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:

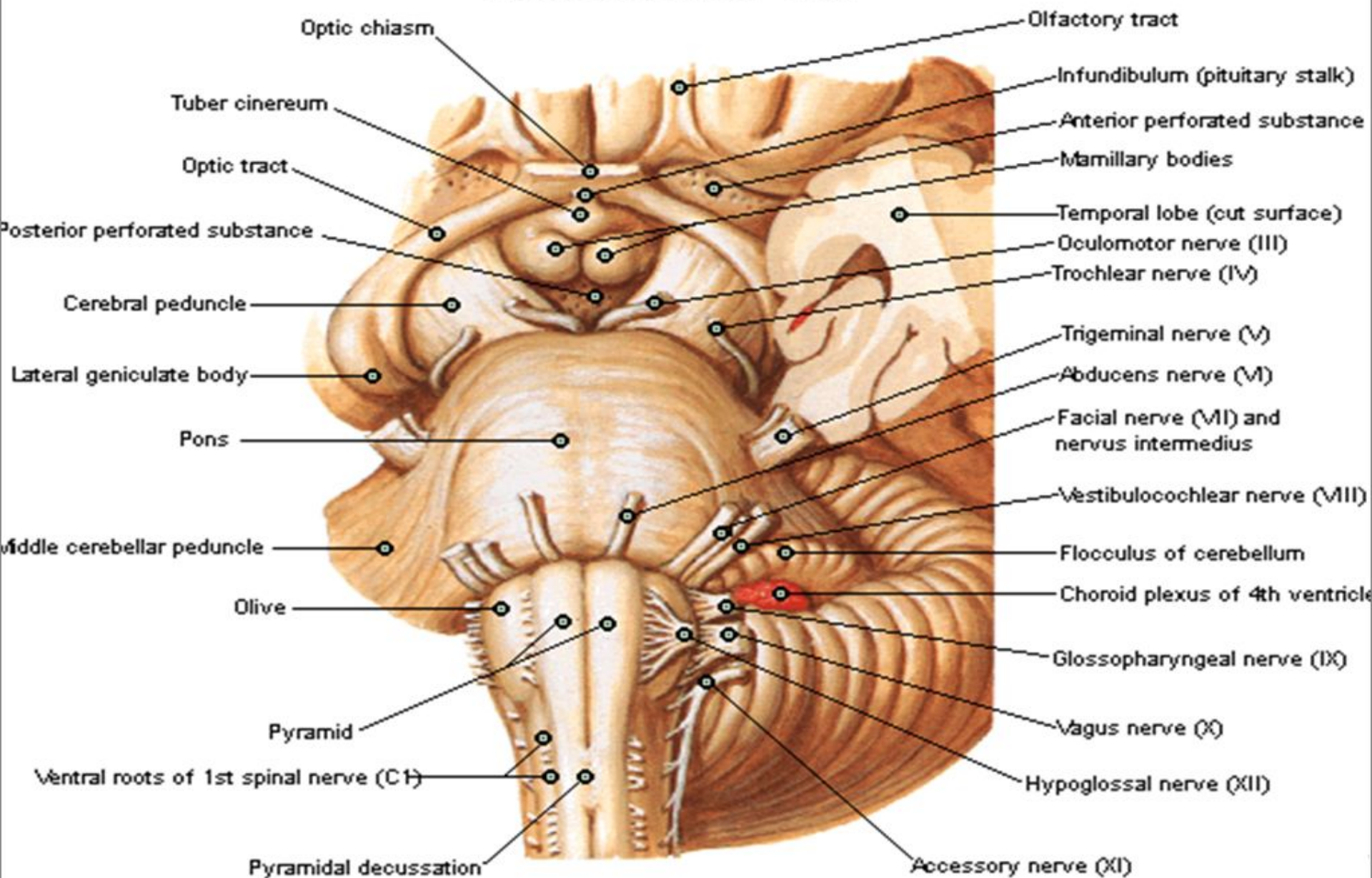
- e. Mylohyoid muscle.
- f. Anterior belly of digastric muscle.
- g. Tensor palati muscle (from otic ganglion).
- h. Tensor tympani muscle (from otic ganglion).

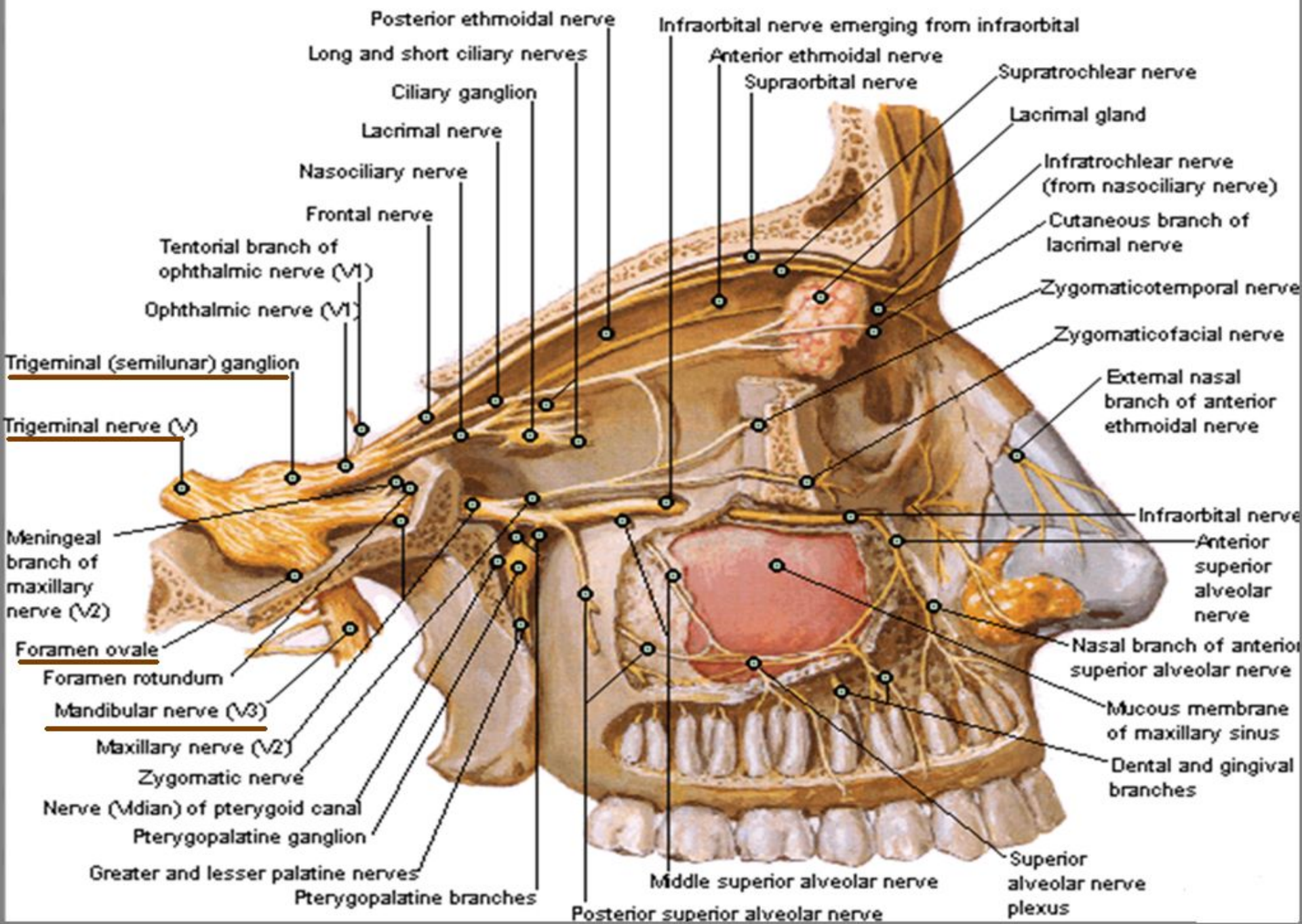
Course and Relation of the Mandibular

1. The sensory and motor fibers unite together in the foramen ovale to form the main trunk of the mandibular nerve **(mixed)**.
2. When it is inside the cranial cavity the mandibular nerve is **sensory** but in the infratemporal fossa, and after joining the motor root, it becomes **mixed nerve**.
3. The main trunk descends through the foramen ovale to reach the infratemporal fossa where it lies deep to the lateral pterygoid muscle & superficial to tensor palati muscle and the otic ganglion.
4. The main trunk give two branches **(spinosus nerve and nerve to medial pterygoid muscle)**, then divides into two divisions (anterior and posterior).

Brainstem

Anterioinferior View





Divisions of the Mandibular Nerve

1. **The anterior division (a smaller):** it is mainly motor and it has only one sensory branch **(the buccal nerve)**.
2. **The posterior division (a larger):** it is mainly sensory and has only one motor branch **(the mylohyoid nerve)**.

Branches of the Mandibular Nerve

1. Two branches arise from the main trunk:

- a. Spinous nerve.
- b. Nerve to medial pterygoid.

2. Branches from the anterior division:

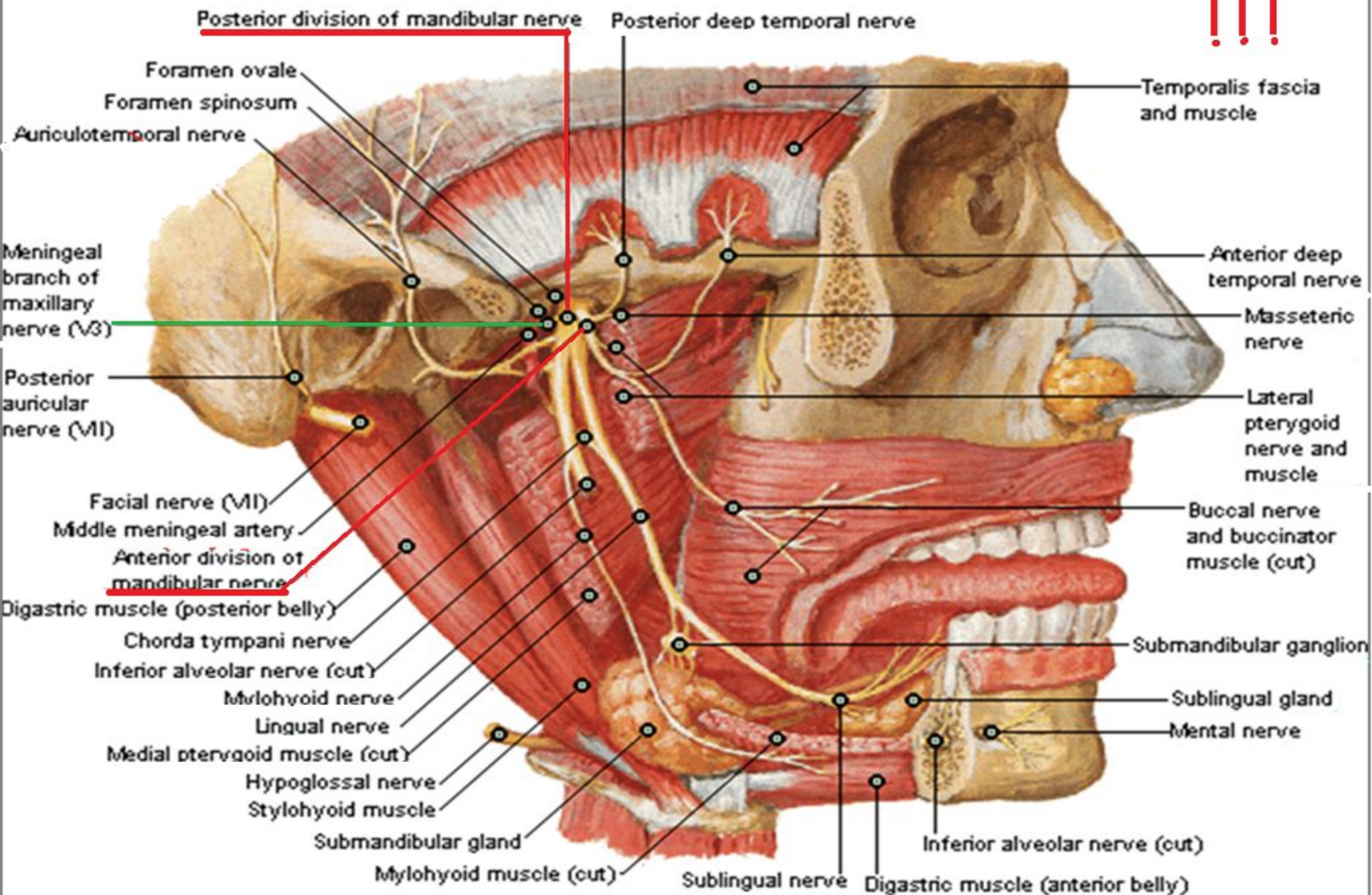
- a. Nerves to the other three muscles of mastication.
- b. The buccal nerve: **sensory**.

3. Branches from the posterior division:

- a. The auriculotemporal nerve.
- b. The lingual nerve.
- c. The inferior alveolar nerve:
 - **Mental nerve**.
 - **Incisive nerve**.
- d. Nerve to mylohyoid muscle: **motor**.

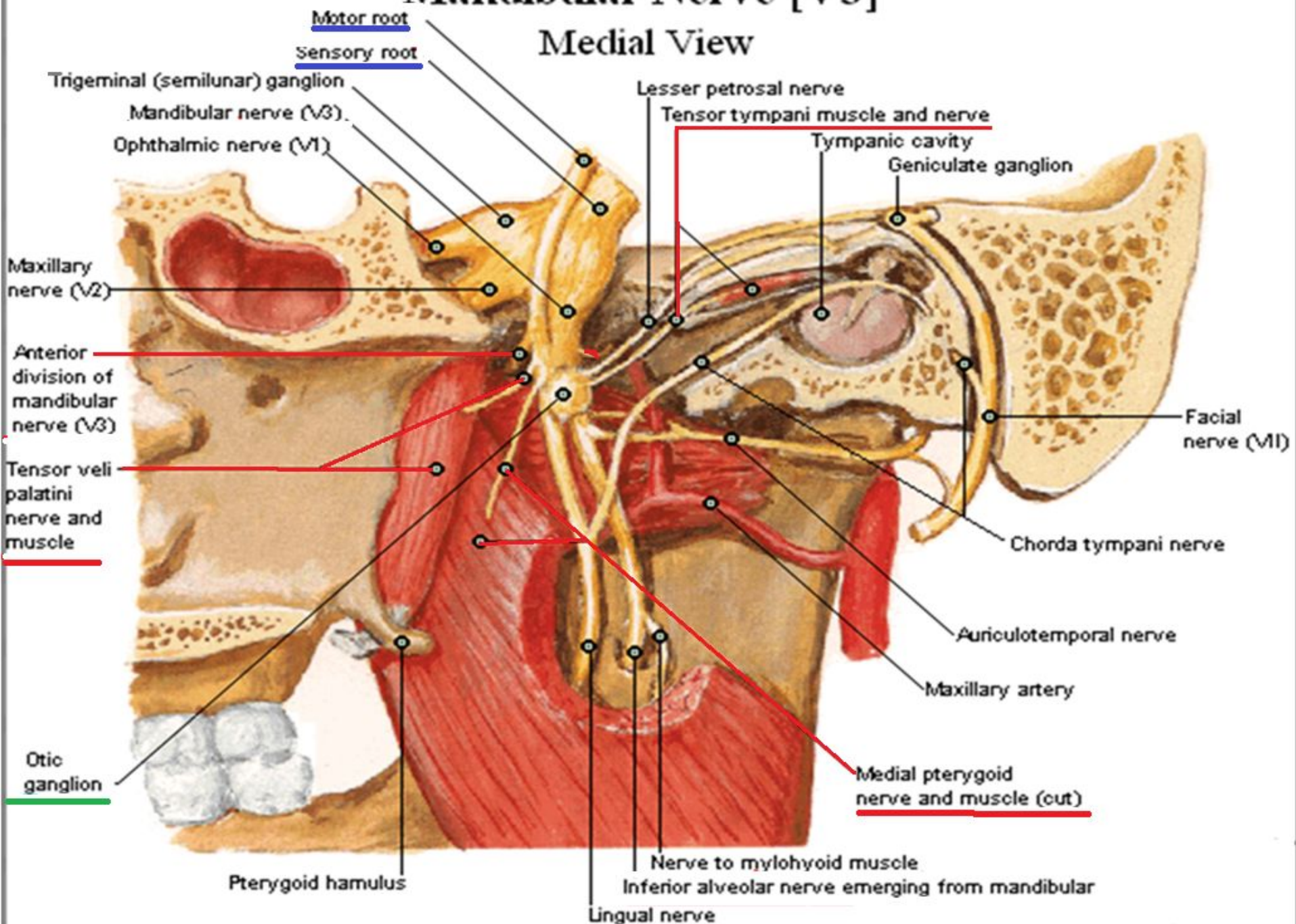
Mandibular Nerve [V3]

Lateral View



Mandibular Nerve [V3]

Medial View

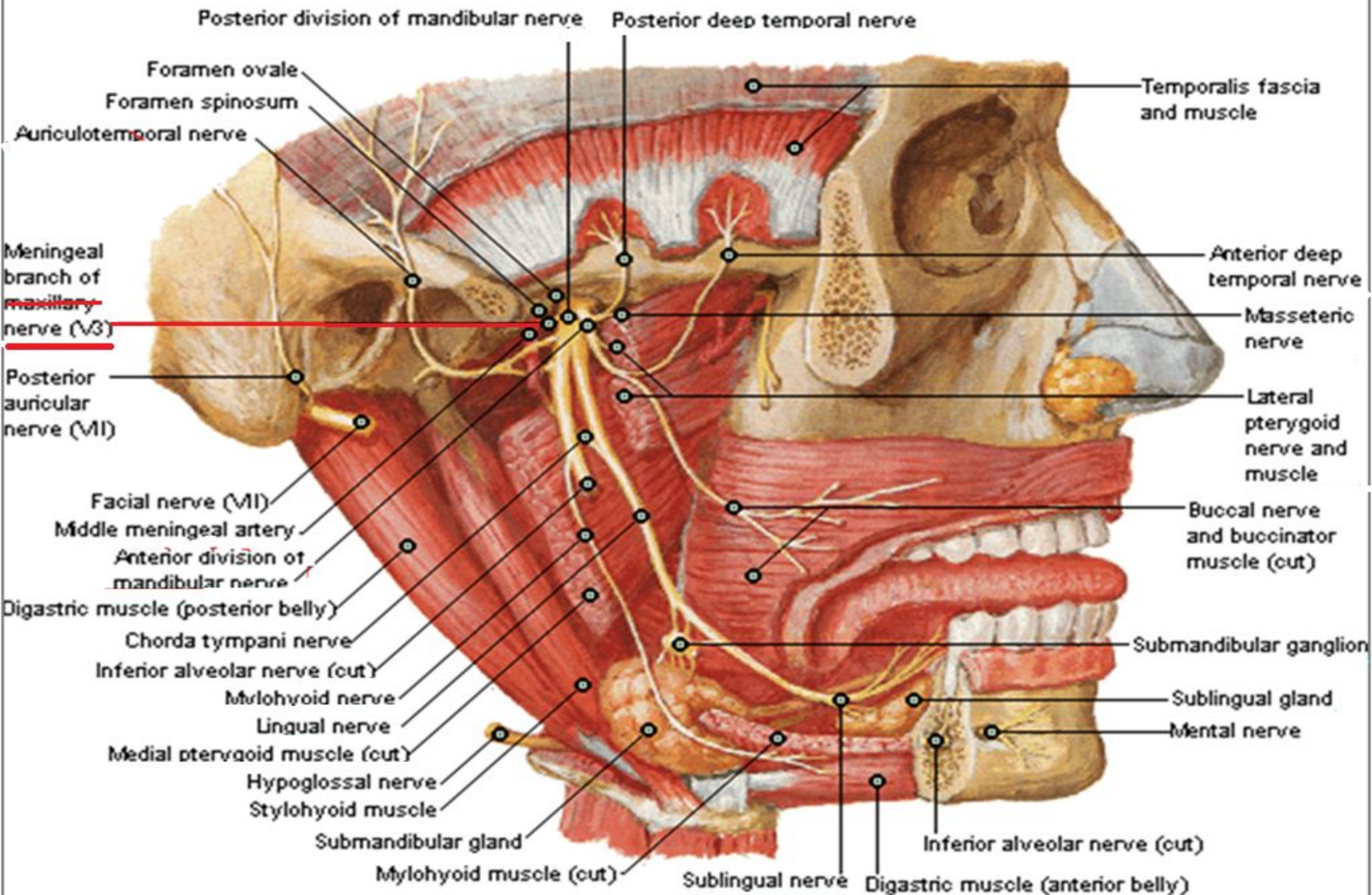


Branches Arise from the Main Trunk of the Mandibular Nerve

1. **Spinosus nerve (sensory):** which enters the skull through the foramen spinosum (with the middle meningeal artery) to supply the dura mater in the middle cranial fossa.
2. **Nerve to medial pterygoid (motor):** which supplies:
 - a. The medial pterygoid muscle.
 - b. Gives branch to the otic ganglion: supplies the:
 - Tensor palati muscle.
 - Tensor tympani muscle.

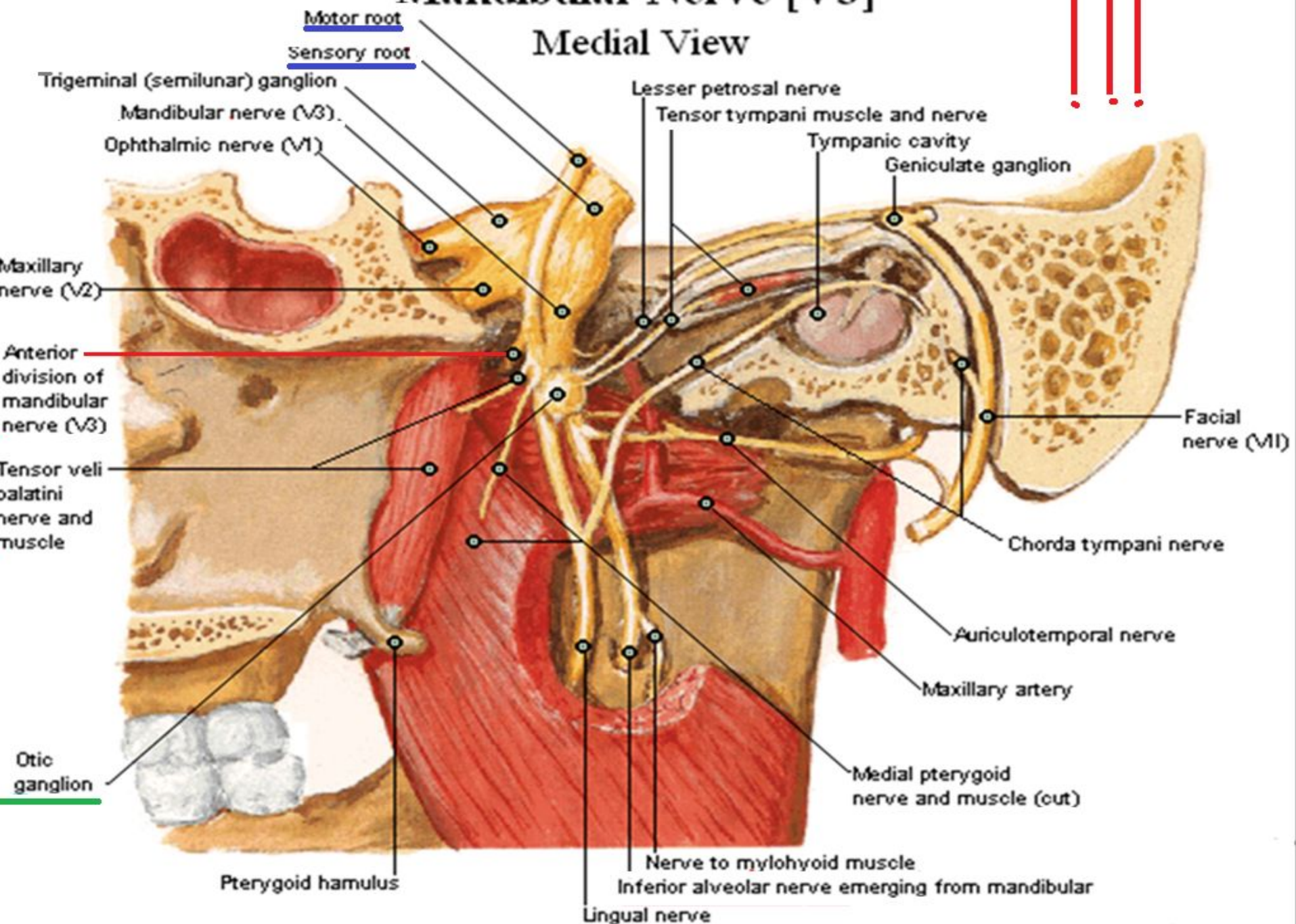
Mandibular Nerve [V3]

Lateral View



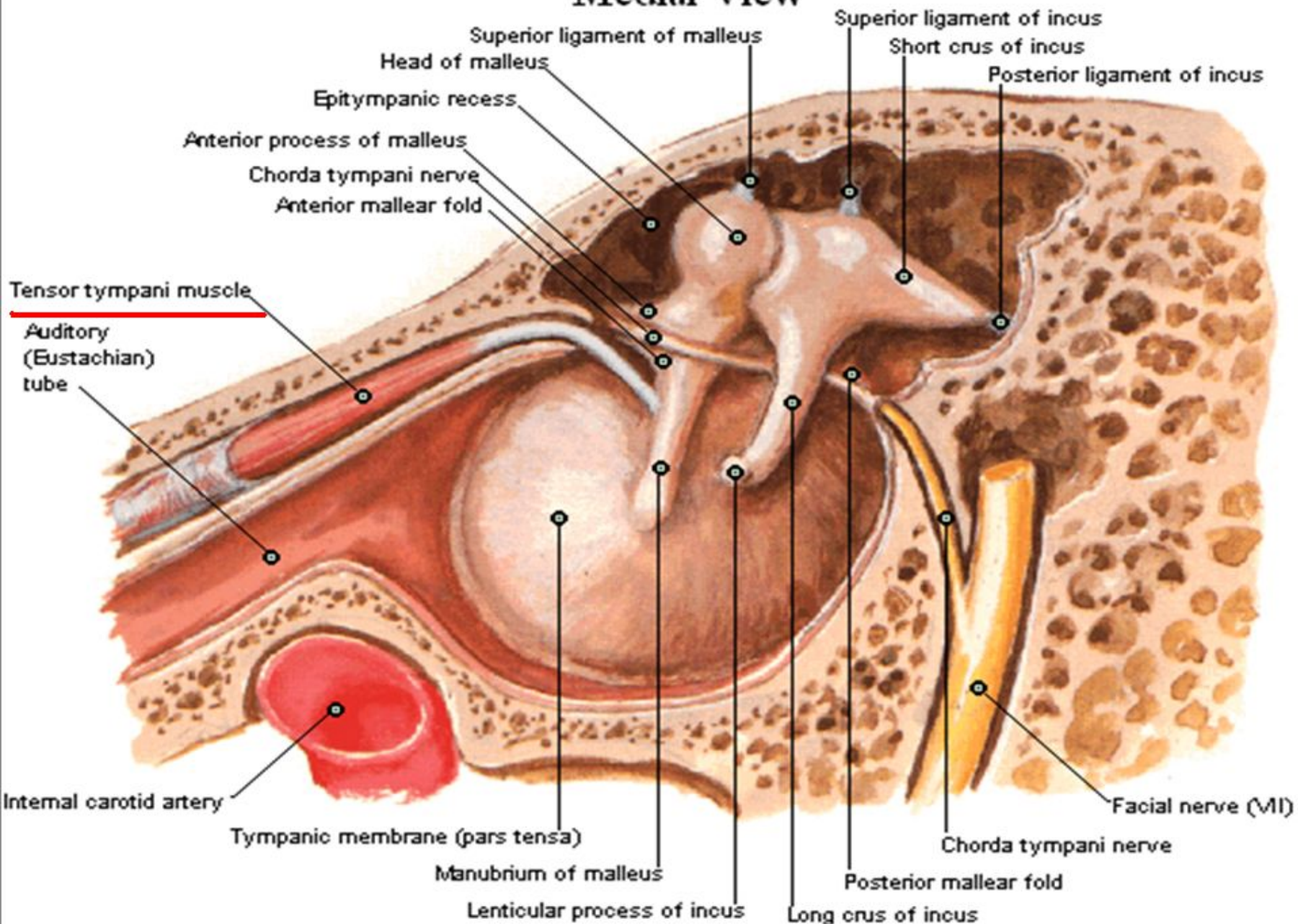
Mandibular Nerve [V3]

Medial View



Tympanic Cavity - Lateral Wall

Medial View



Branches from the Anterior Division of the Mandibular Nerve

1. Nerves to the other three muscles of mastication:

masseter, temporalis and lateral pterygoid muscles (motor nerves):

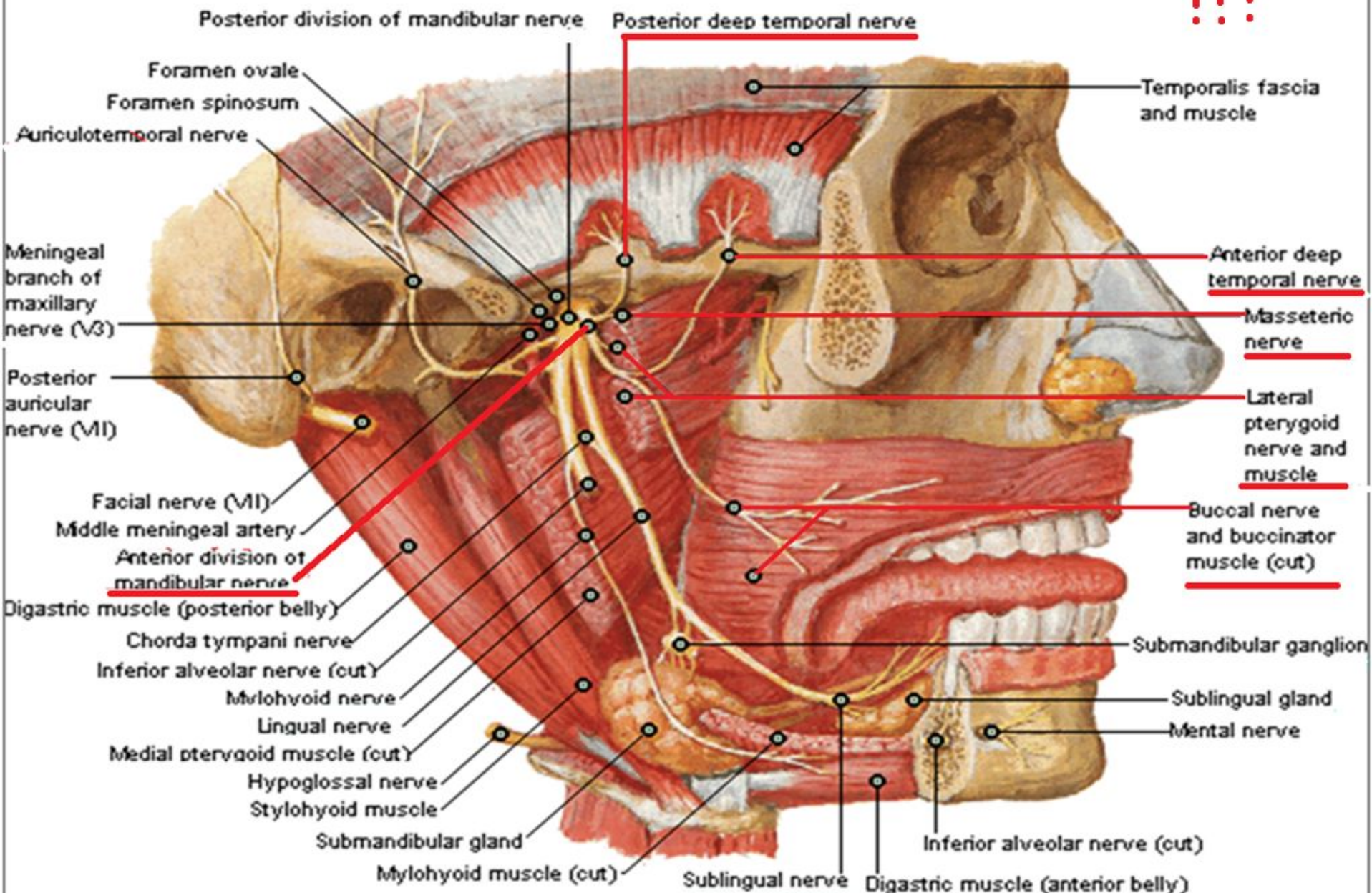
- a. Two deep temporalis nerves.
- b. The nerve to masseter muscle.
- c. The nerve to lateral pterygoid muscle.

2. The buccal nerve (sensory): which supplies the skin and mucous membrane of the cheek.

❑ The trigeminal buccal nerve does not supply the buccinator and orbicularis oris muscles (which are supplied by the facial buccal nerve).

Mandibular Nerve [V3]

Lateral View



Branches from Posterior Division of the Mandibular Nerve

- a. Auriculo-temporal nerve.
- b. Lingual nerve.
- c. Inferior alveolar nerve.
 - Mental nerve.
 - Incisive nerve.
- d. Nerve to Mylohyoid muscle.

The Auriculo-temporal Nerve

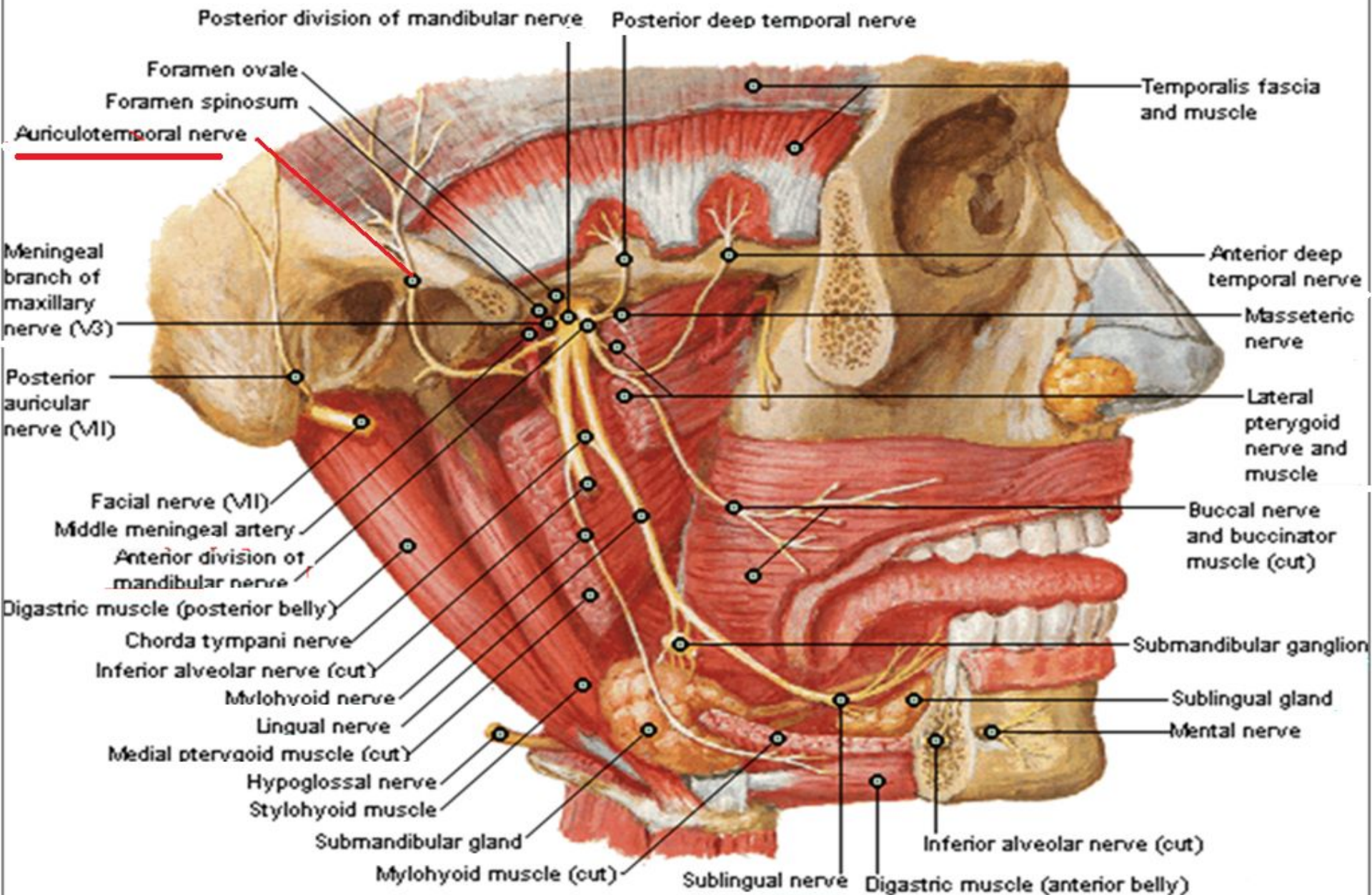
- It is a branch from the posterior division of the mandibular nerve.
- It passes backwards deep to the neck of mandible.
- Then it passes upwards deep to the parotid gland.
- Finally it appears at the upper end of parotid gland behind the superficial temporalis vessels.

□ It supplies the:

1. Skin of the upper 2/3 of lateral surface of the auricle.
2. Skin of the external auditory meatus.
3. Skin over the tempo-mandibular joint.
4. Parotid glands (sensory).
5. It carries also postganglionic parasympathetic and sympathetic fibers from the otic ganglion to the parotid gland.

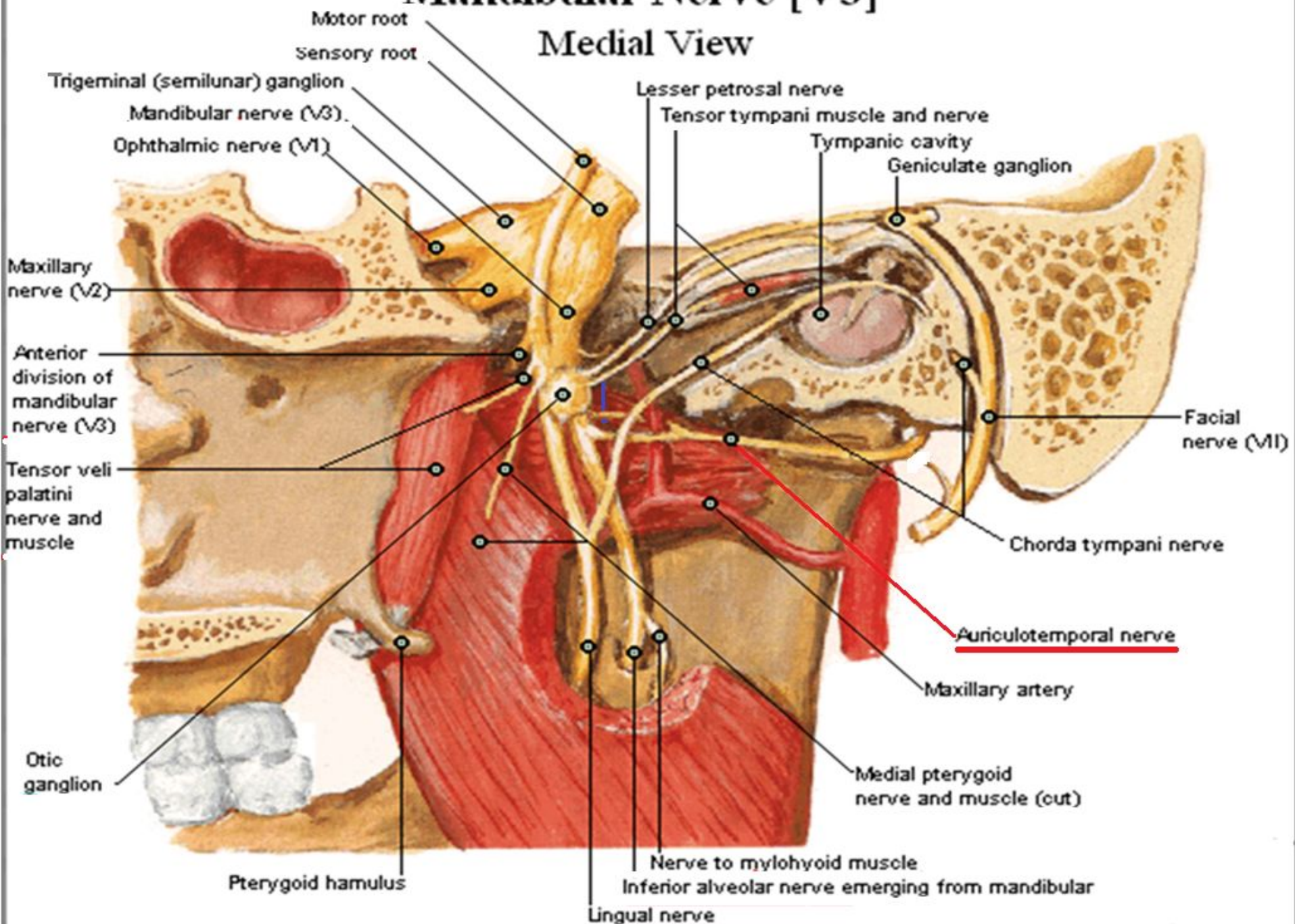
Mandibular Nerve [V3]

Lateral View



Mandibular Nerve [V3]

Medial View



The Lingual Nerve

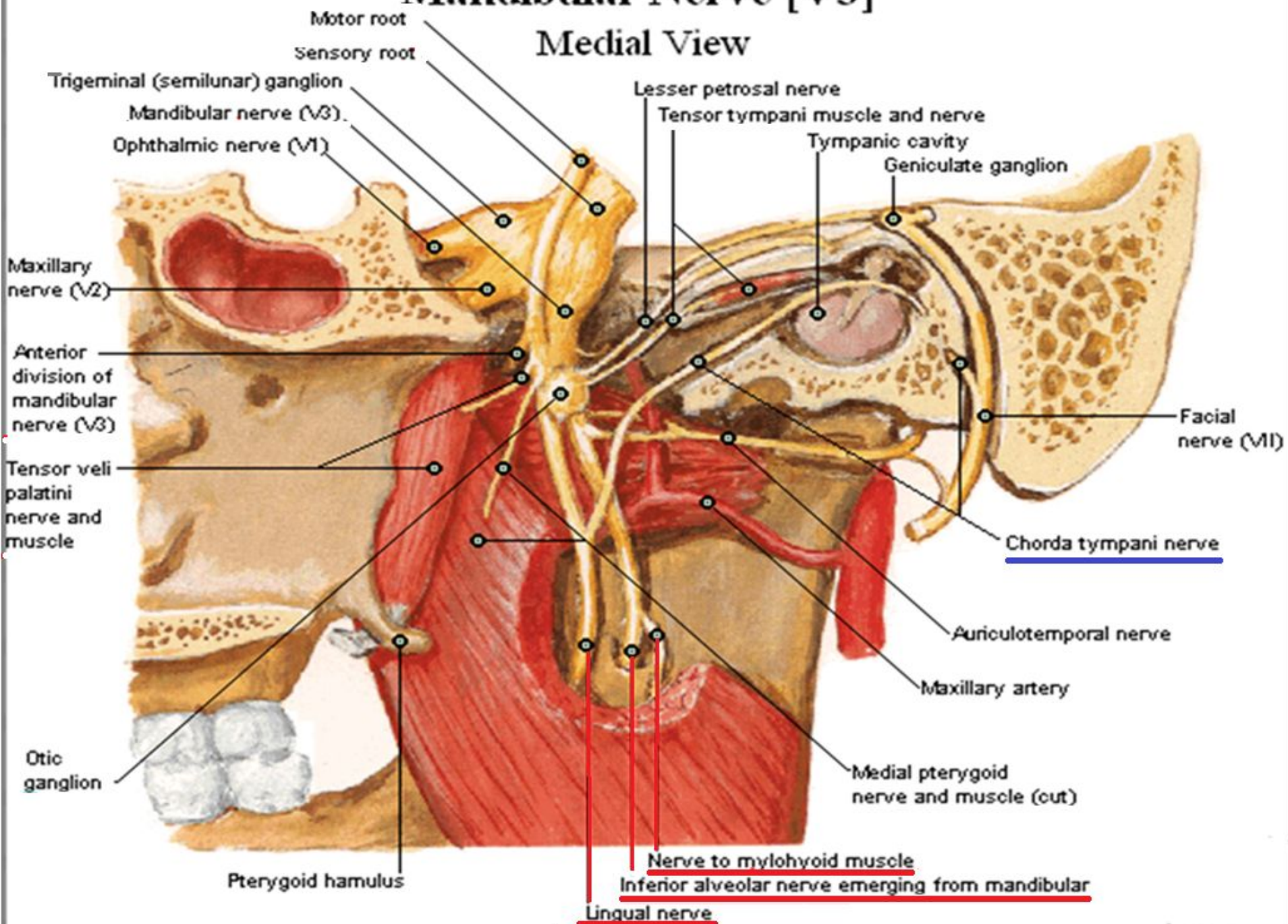
- It is a branch from the posterior division of the mandibular nerve.
- It is sensory nerve to the mucous membrane of the anterior 2/3 rd of the tongue.
- It joined by the chorda tympani nerve (branch of facial nerve).
- The lingual nerve may be injured during tooth extraction, as it lies below and behind the last molar tooth.

The Lingual Nerve

- ✓ **The lingual nerve supplies:**
- ✓ Pain, temperature and touch sensation to the mucous membrane of the anterior 2/3 of the tongue as well as to the mucous membrane of the corresponding part of the floor of the mouth and the gums.
- ✓ Submandibular and sublingual glands via **submandibular ganglion**.
- ✓ The taste impulses from anterior 2/3 of the tongue are carried by **the chorda tympani branch of the facial nerve**.

Mandibular Nerve [V3]

Medial View



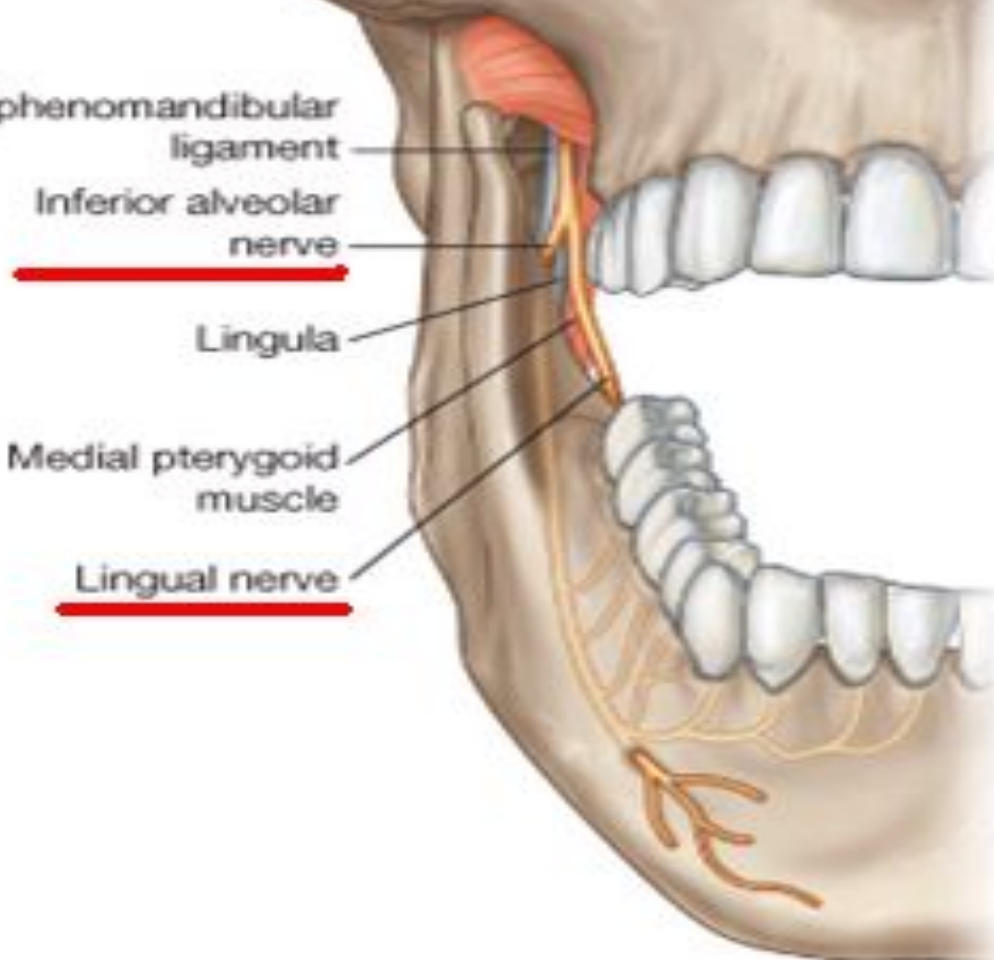
Sphenomandibular
ligament

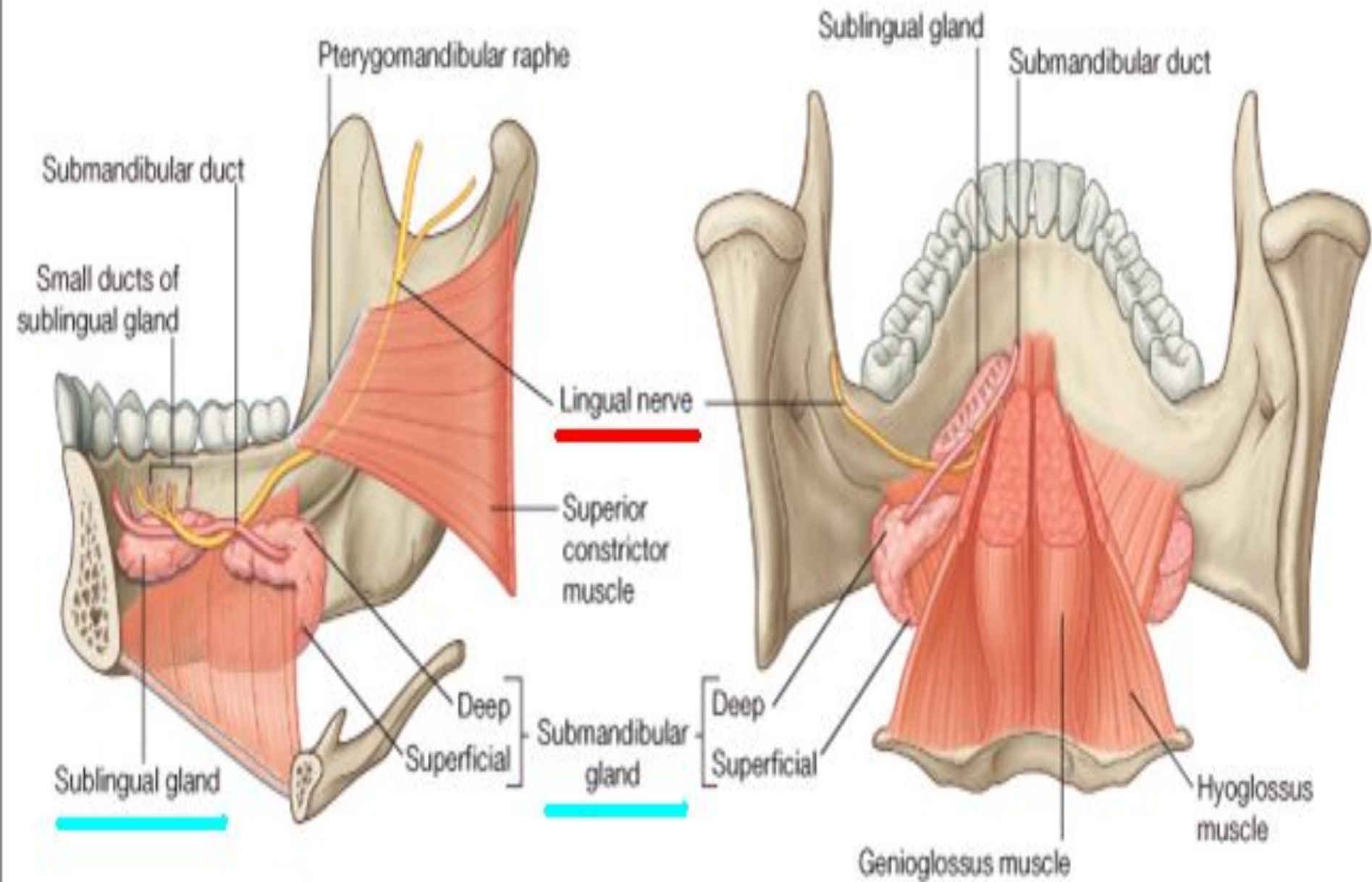
Inferior alveolar
nerve

Lingula

Medial pterygoid
muscle

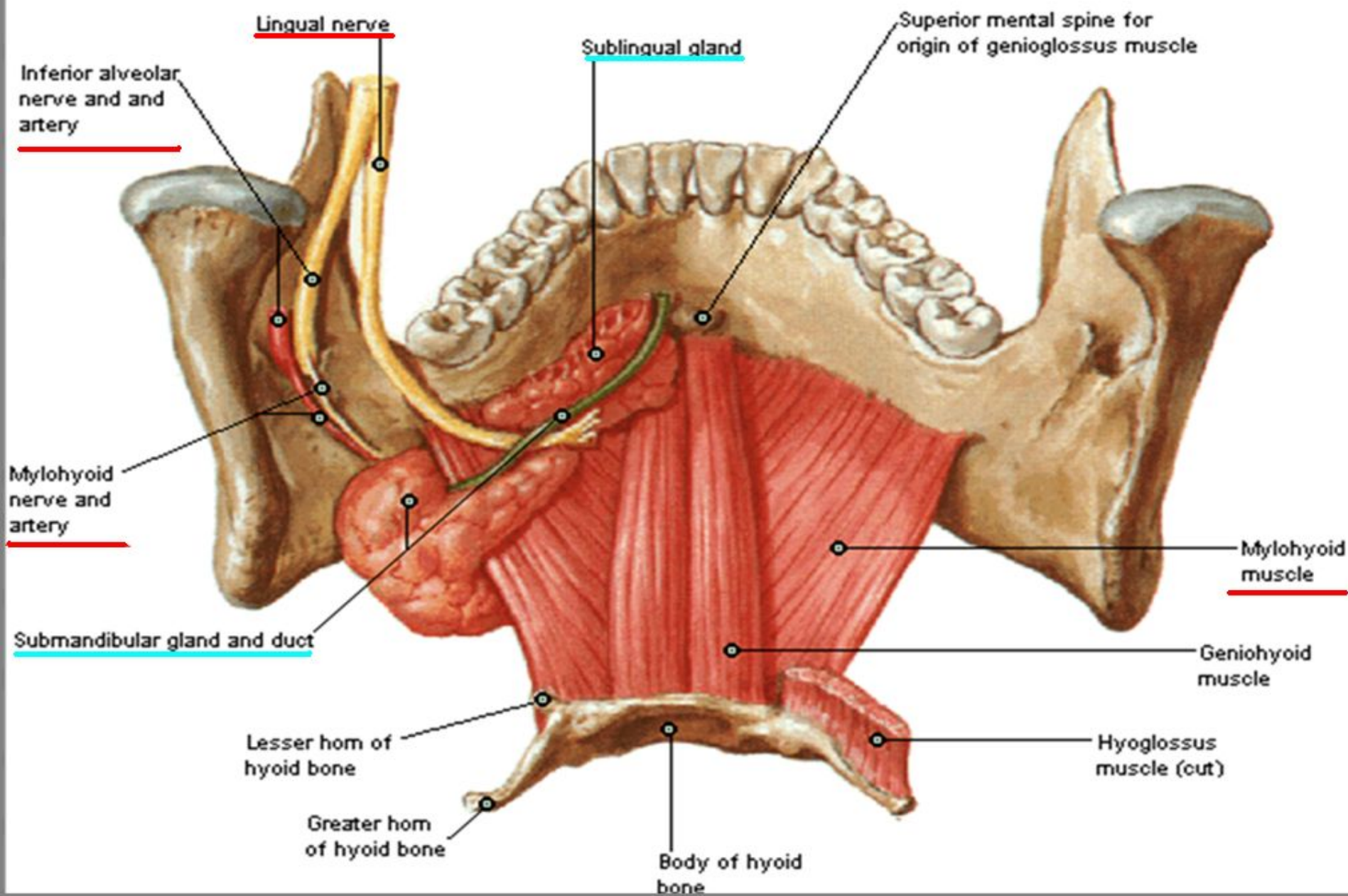
Lingual nerve





Floor of Mouth - Musculature

Posterosuperior View



The Inferior Alveolar Nerve

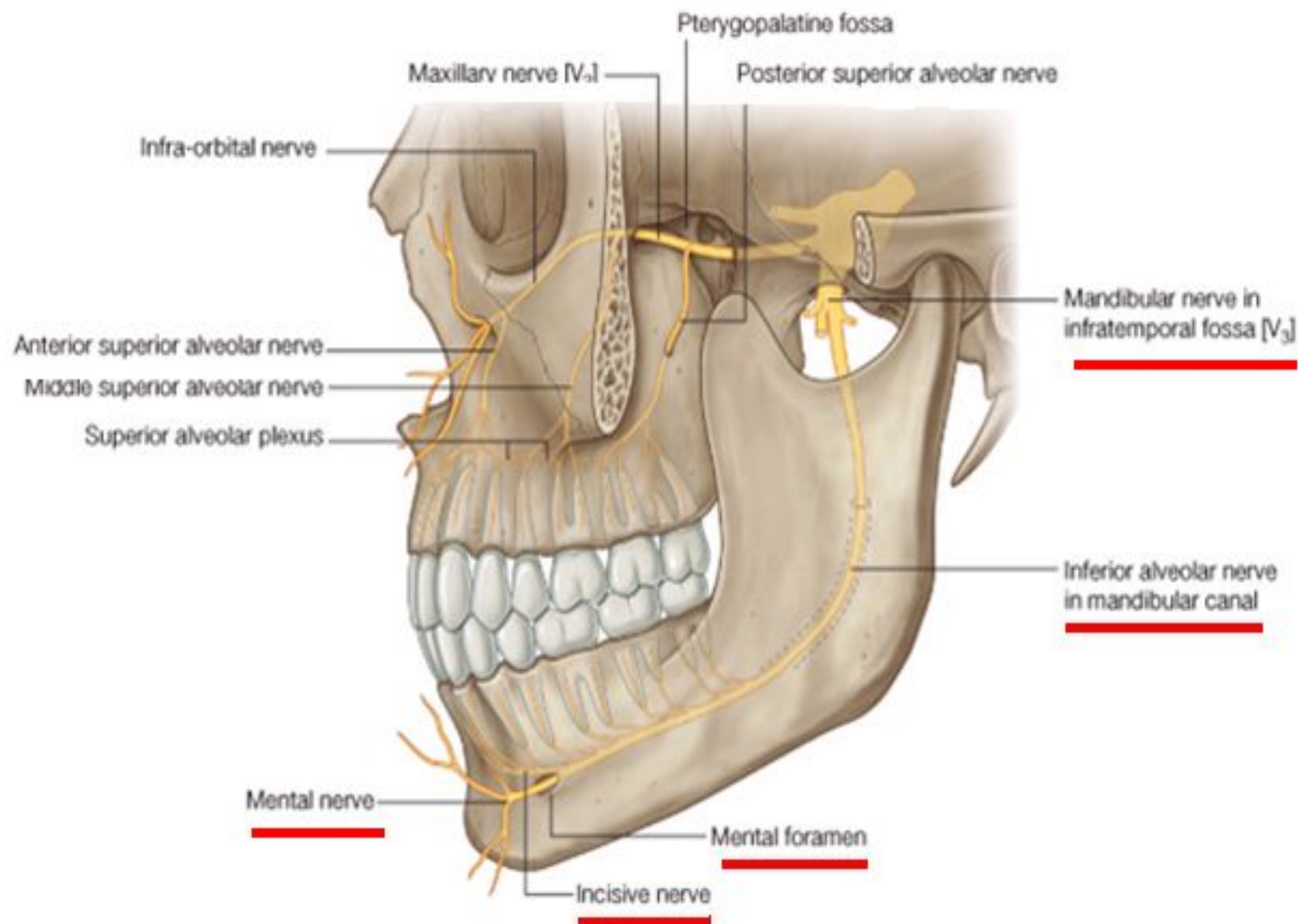
- It is a largest branch of the posterior division of the mandibular nerve.
- It is mainly sensory nerve but contains a small number of motor fibers (which form **the mylohyoid motor branch** of the inferior alveolar nerve).

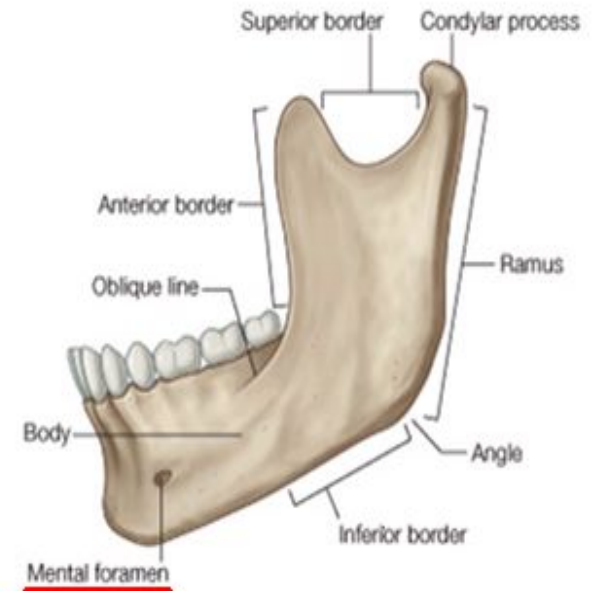
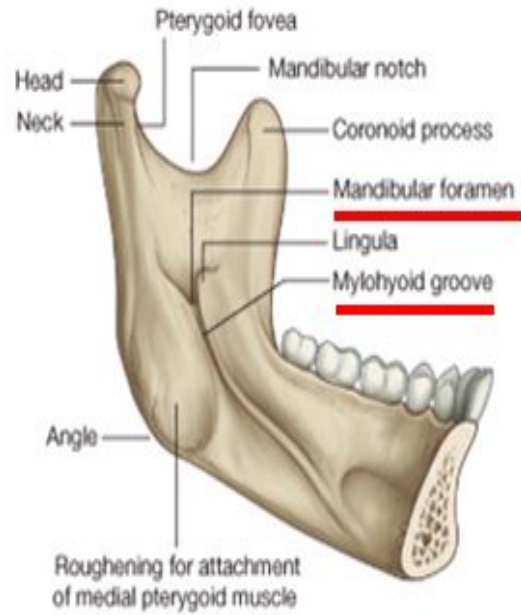
Course and Relation of the inferior alveolar nerve:

- It begins deep to the lateral pterygoid muscle.
- It descends between the ramus of the mandible (**laterally**) and the medial pterygoid muscle (**medially**).
- Before it enters the mandible it gives off its **mylohyoid (motor) branch**.
- Then it enters the mandibular foramen and runs downwards in the mandibular canal supplying **the molar and premolar teeth** of the lower jaw.
- It ends opposite the mental foramen by dividing into two branches:
 - a. Mental nerve:** come out of the mental foramen supplying the chin.
 - b. Incisive nerve:** continues inside the mandible to supply the **lower canine and incisor teeth**.

Nerve to Mylohyoid Muscle

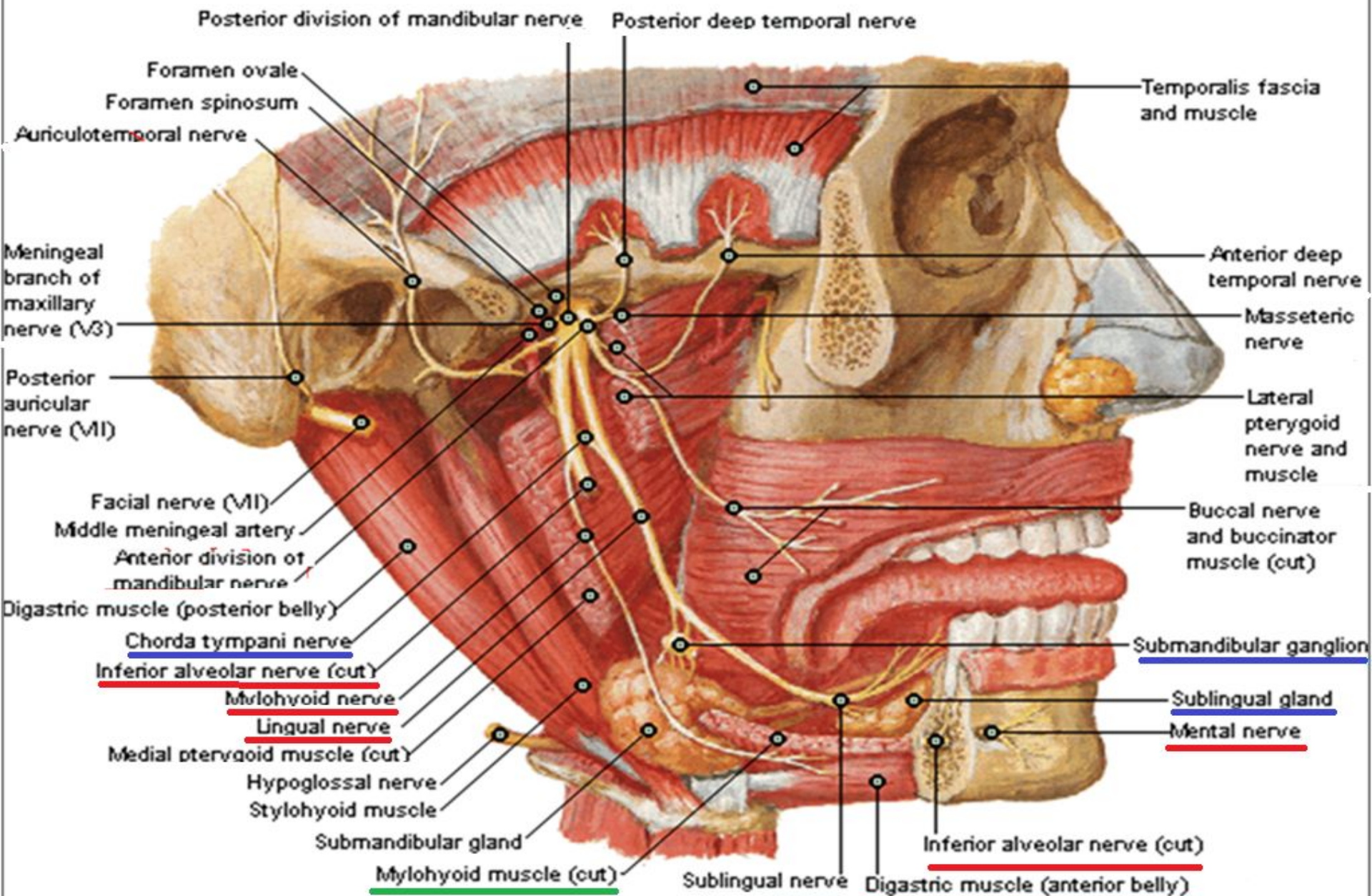
- It is a branch from the posterior division of the mandibular nerve.
- It arises as a branch from the inferior alveolar nerve **before** it enters the mandibular foramen.
- It runs in the mylohyoid groove of the mandible.
- It supplies the:
 - a. Mylohyoid muscle.**
 - b. Anterior belly of digastric muscle.**





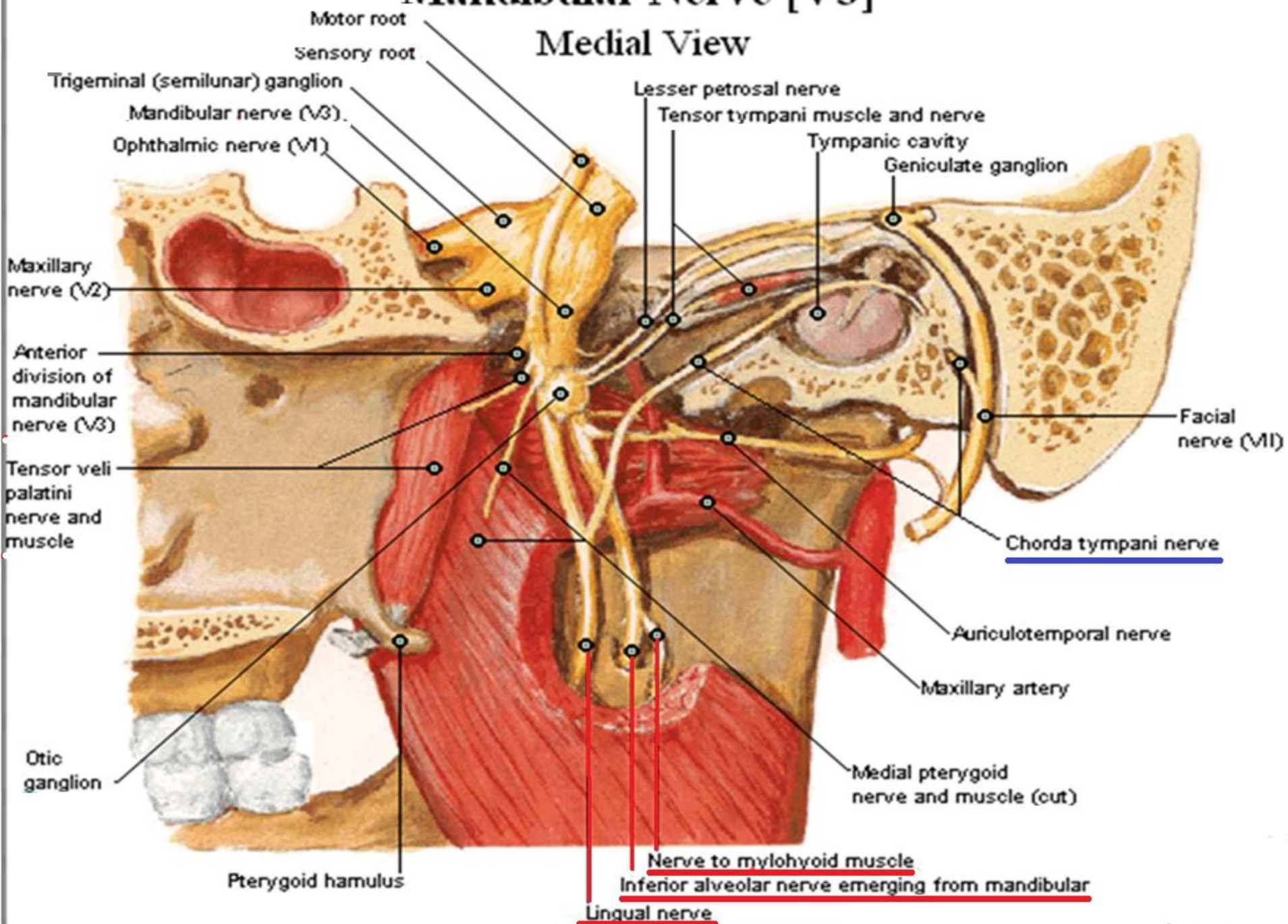
Mandibular Nerve [V3]

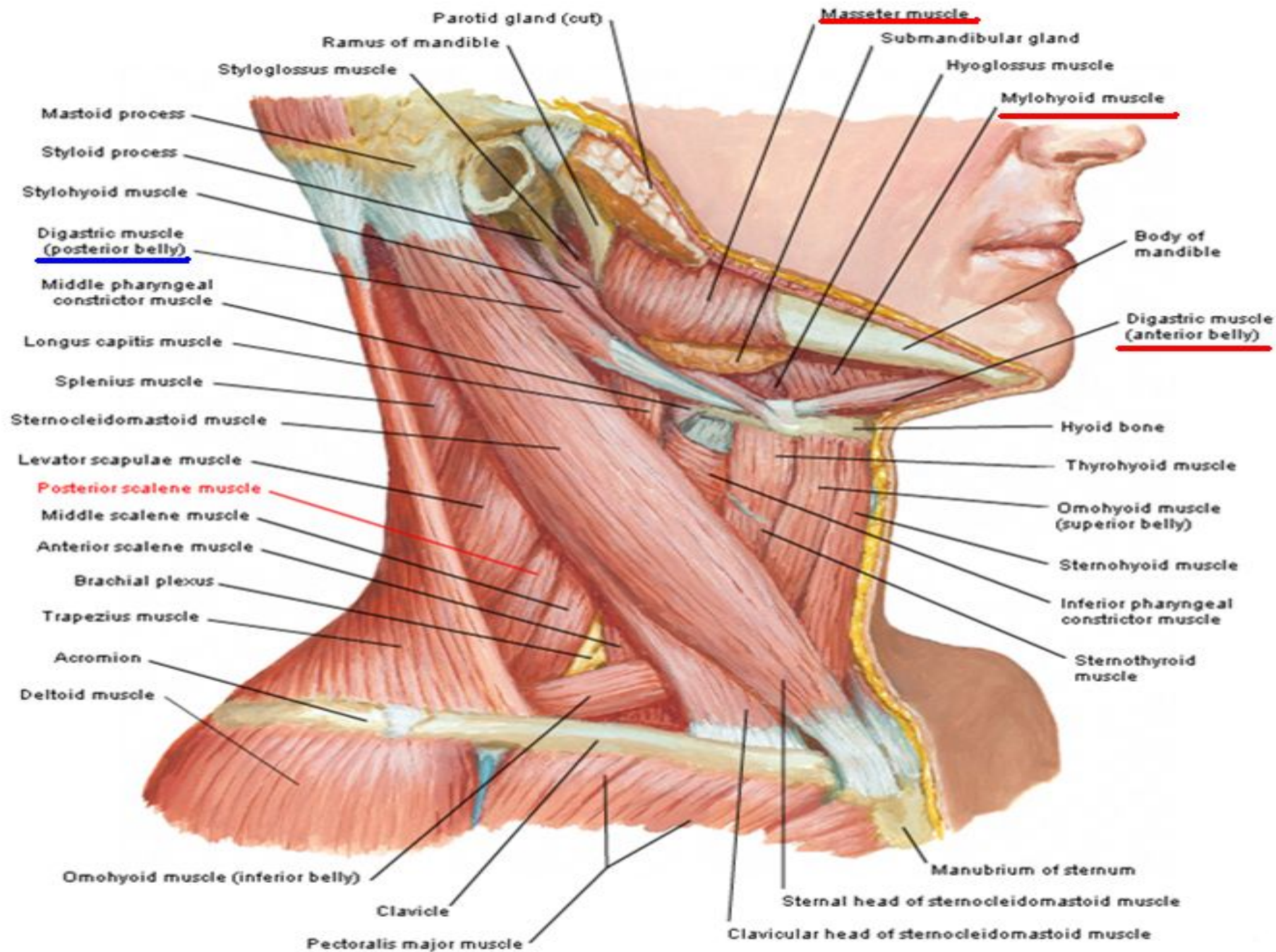
Lateral View

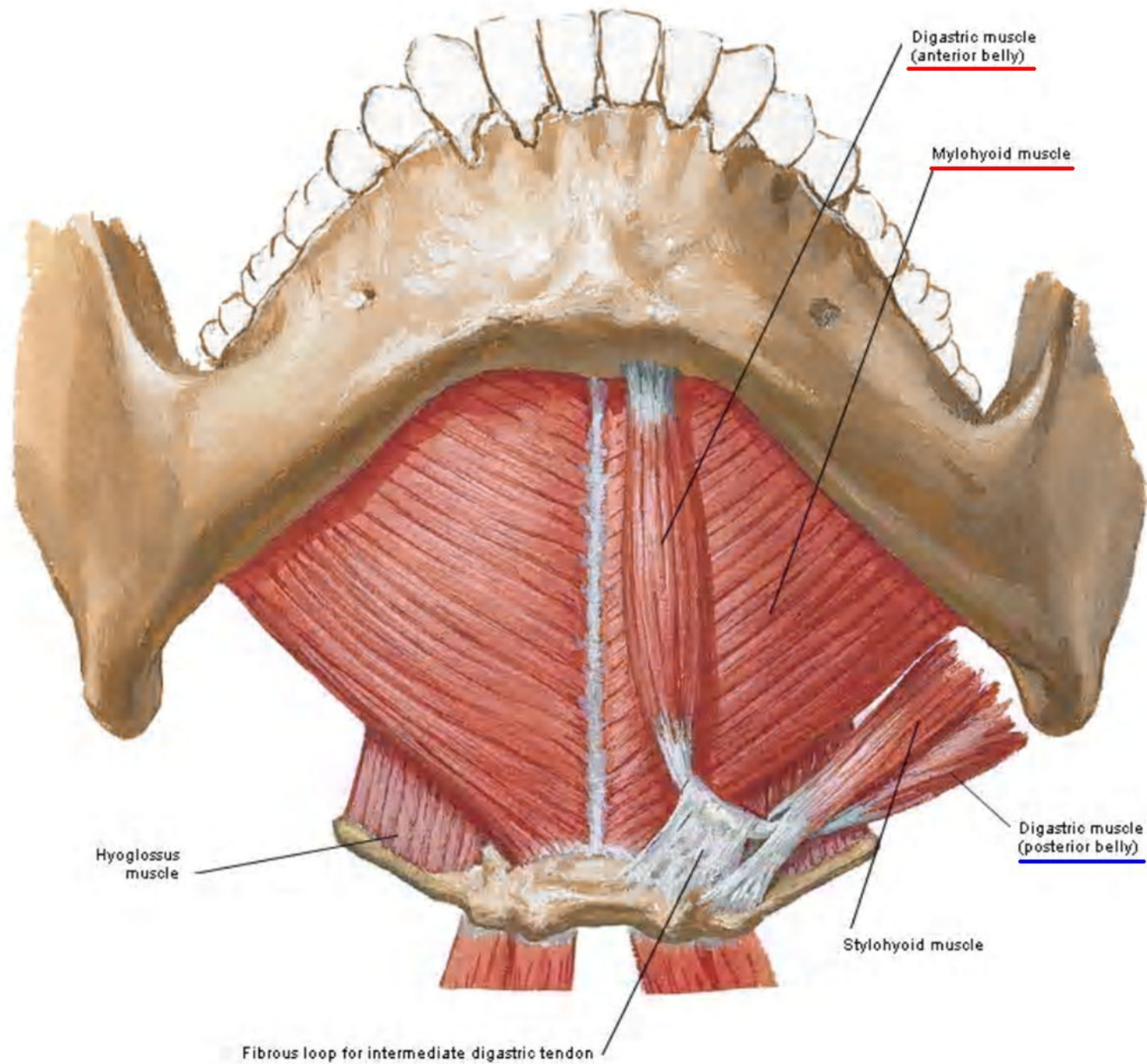


Mandibular Nerve [V3]

Medial View







Thank You

