Peripheral Nervous Syst. Module

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Trigeminal Nerve

Lecture objectives

- **By the end of this session, you should be able to:**

1. Know a brief introduction to the trigeminal nerve
2. Recognize Trigeminal nuclei and its functional components
3. Visualize the course & distribution and locate the Trigeminal ganglion and its components
4. Enumerate divisions of trigeminal nerve and their applied anatomy

Introduction

The **largest** cranial nerve

It is **mixed nerve** (sensory and motor)

Sensory to: Skin of face, mucosa of cranial viscera, except base of tongue and pharynx

Motor to: Muscles of Mastication (Tensor palati, Tensor tympany, Anterior belly of digastric, Mylohyoid)

Trigeminal Nuclei

- A **cranial nerve nucleus** is a collection of neurons (gray matter) in the brain stem that is associated with one or more cranial nerves.

- Axons carrying information to and from the cranial nerves form a synapse at these nuclei.

Trigeminal Nuclei

- ***Sensory Nuclei:***

1. ***Mesencephalic Nucleus:***

1. Cell body of Pseudounipolar neuron
2. Relay ***proprioception*** from ***muscles*** of ***mastication***, ***extra ocular*** muscles, ***facial*** muscles.
3. Situated in midbrain just lateral to aqueduct ***(at the level of the superior colliculus***).

Trigeminal Nuclei

- ***Sensory Nuclei:***

2. ***Main Sensory Nucleus:***

- Lies in **pons** lateral to motor nucleus

- Relays ***touch*** sensation

Trigeminal Nuclei

- ***Sensory Nuclei:***

3. ***Spinal Nucleus:***

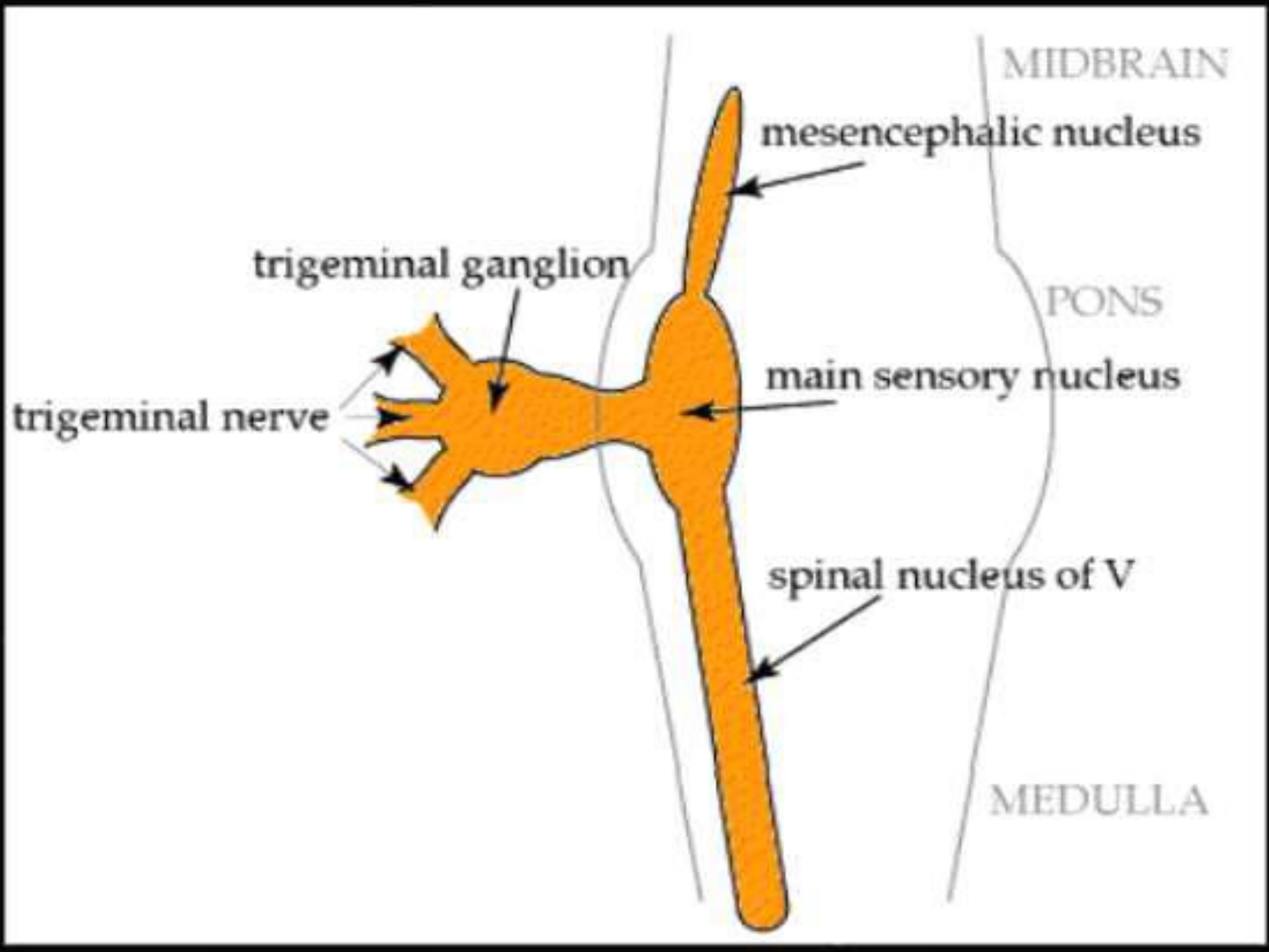
- Extends from caudal end of principal sensory nucleus in pons to 2nd or 3rd spinal segment

- It relays ***Pain*** and ***Temperature***

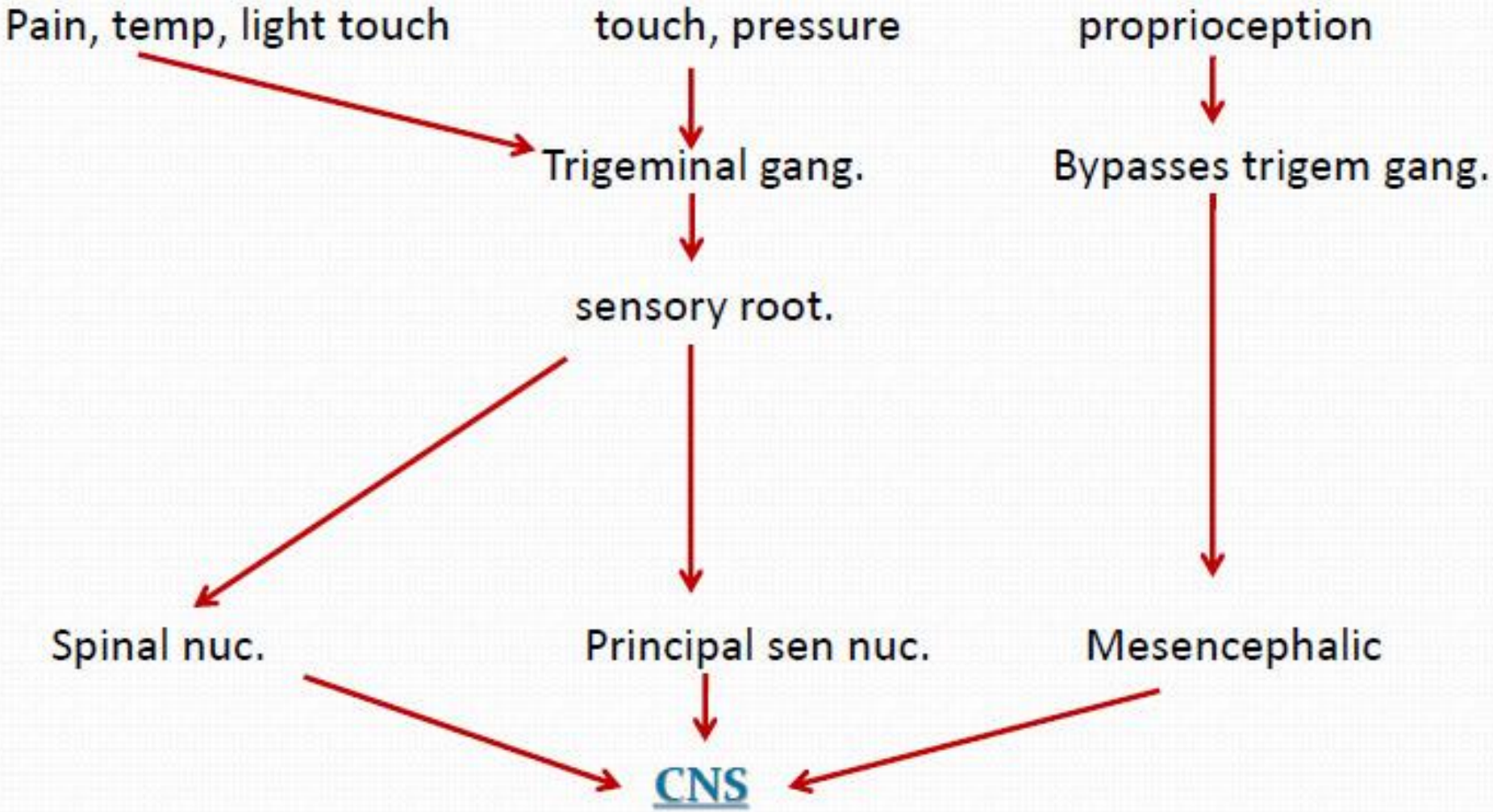
Trigeminal Nuclei

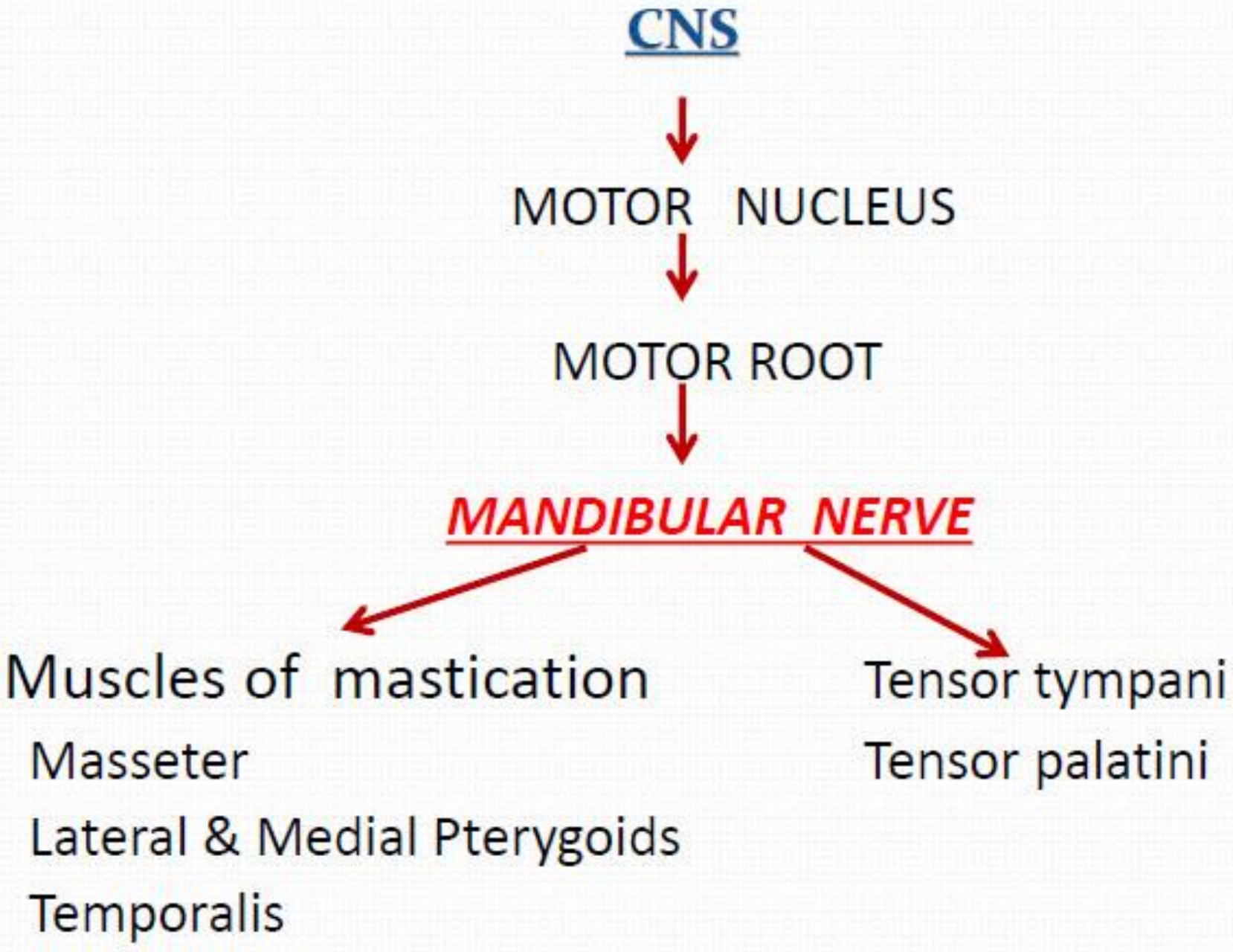
- ***Motor Nucleus:***

1. Innervates **muscles of mastication** and **tensor tympani and tensor palati**
2. Derived from ***first branchial arch.***
3. Located in pons medial to principle sensory nucleus.


MIDBRAIN
mesencephalic nucleus
trigeminal ganglion
PONS
main sensory nucleus
trigeminal nerve
spinal nucleus of V
MEDULLA

GENERAL SOMATIC AFFERENTS- Face, Scalp, Teeth, Gingiva, Oral, Nasal, Cavities, Para nasal sinus, Conjunctiva and Cornea.

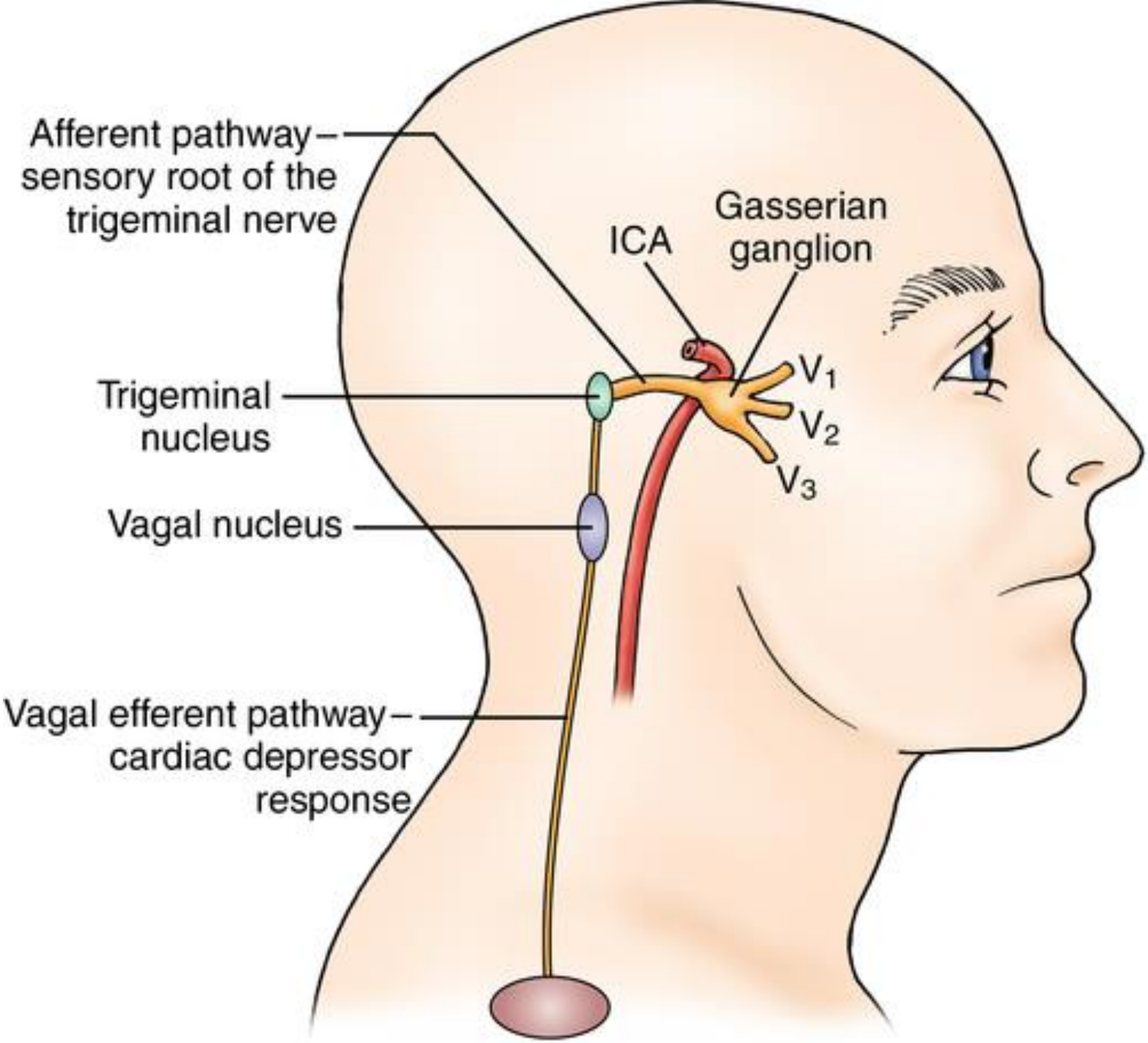



CNS
MOTOR NUCLEUS
MOTOR ROOT
MANDIBULAR NERVE
Muscles of mastication
Masseter
Lateral & Medial Pterygoids
Temporalis
Tensor tympani
Tensor palatini

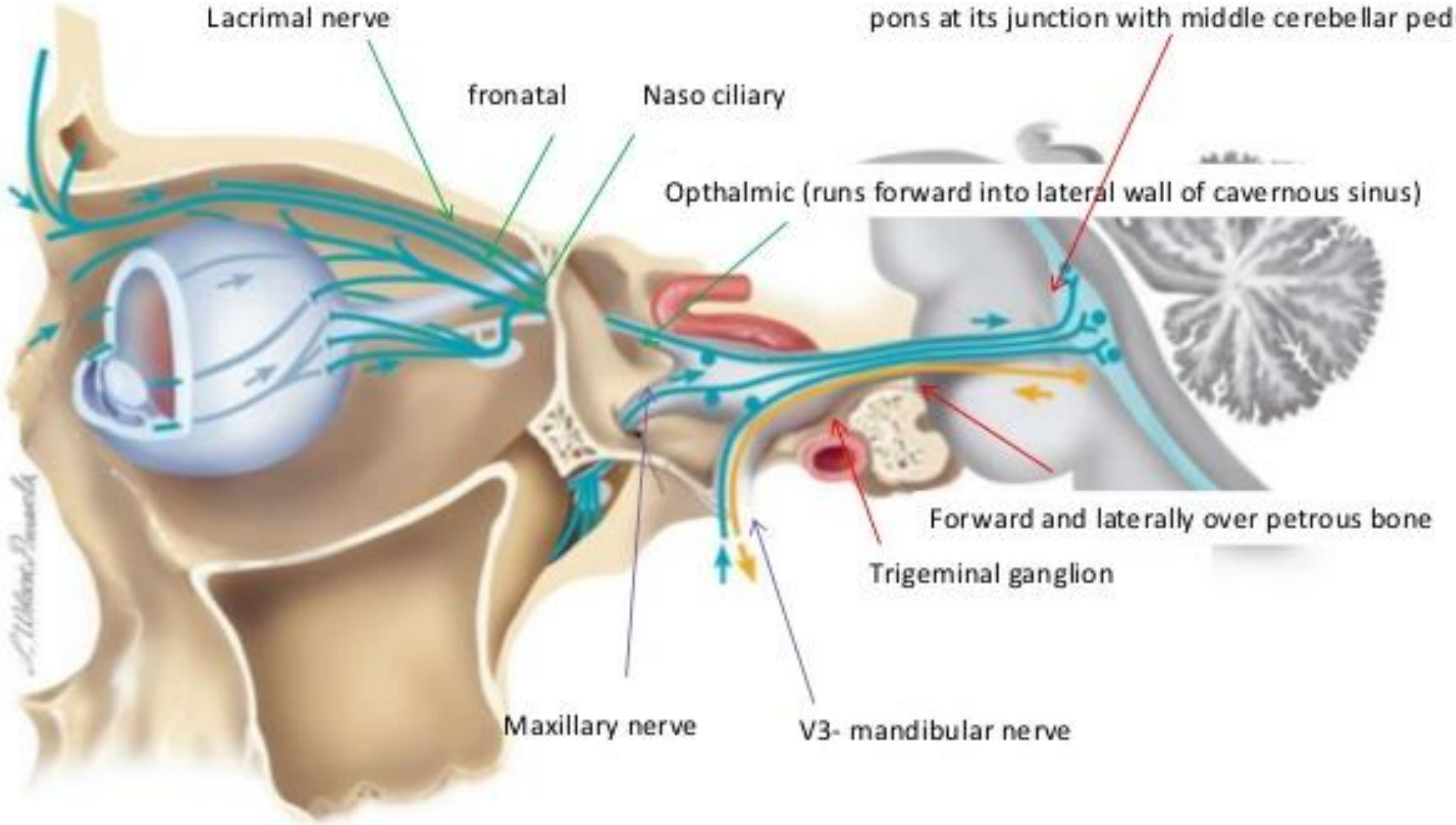
Course and Distribution

- Both **motor** and **sensory root** are attached **ventrally** to **junction** of **pons** and **middle cerebellar peduncle** with motor root lying ventromedially to the sensory root.

- Pass anteriorly in middle cranial fossa to lie below tentorium cerebelli in ***trigeminal cave***, here ***motor root*** lies ***inferior*** to ***sensory root***.


Afferent pathway – sensory root of the trigeminal nerve
ICA
Gasserian ganglion
Trigeminal nucleus
V1
V2
V3
Vagal nucleus
Vagal efferent pathway – cardiac depressor response

Course and branches



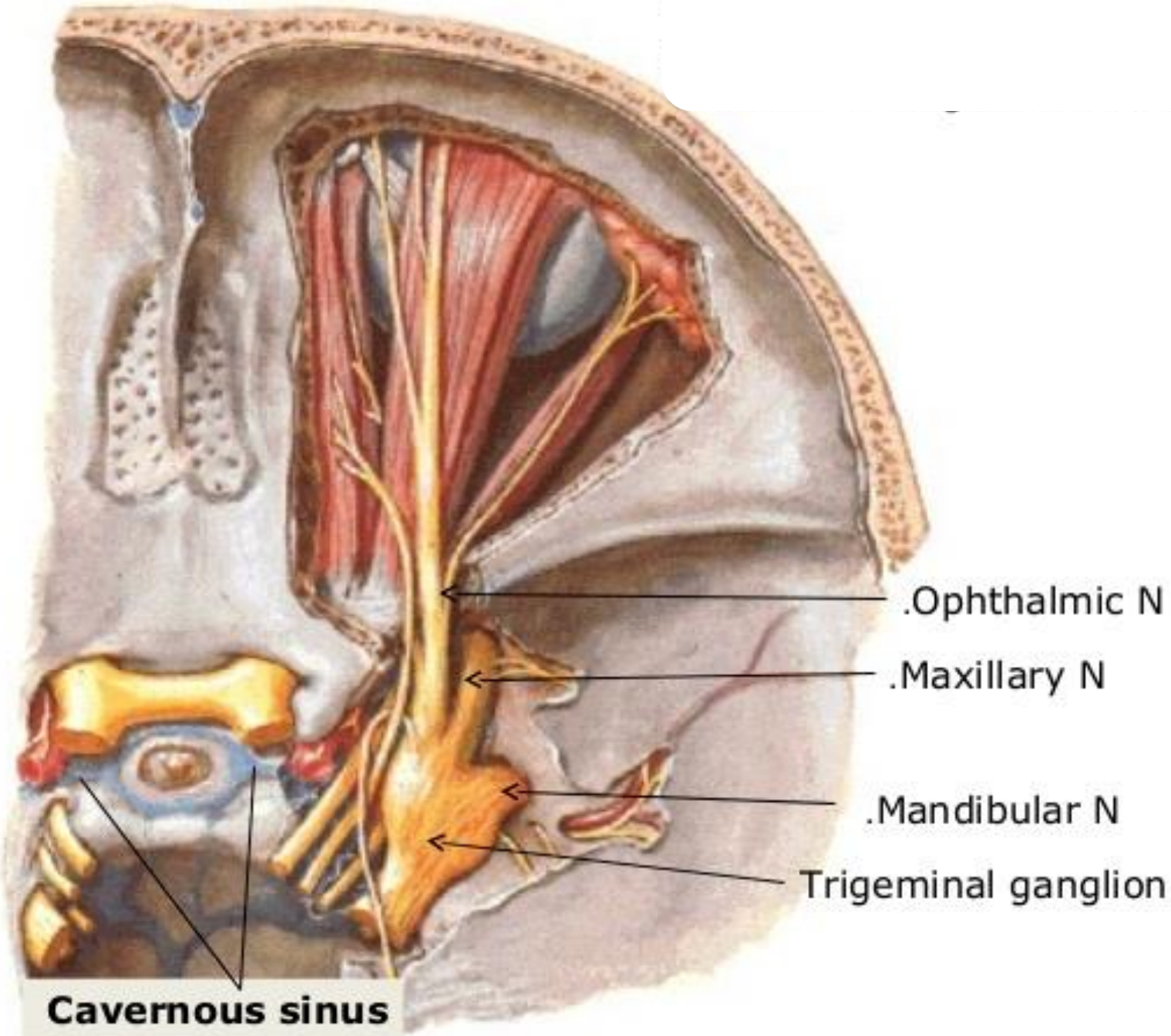
Course and Distribution

- ***Motor root*** turns further inferior with sensory component of V3 (***Mandibular N.***) to ***emerge*** out of ***foramen ovale*** as mandibular nerve.

- ***Ophthalmic*** and ***maxillary*** division ***emerges*** through ***superior orbital*** fissure and ***foramen rotundum*** respectively.

Trigeminal Ganglion

- Called ***Semilunar*** or ***Gasserian*** ganglion.
- ***Cresentric*** in shape with ***convexity anterolaterally***.
- Contains cell bodies of ***pseudounipolar*** neurons.
- ***LOCATION:*** lies in a bony fossa at ***apex*** of the ***petrous temporal bone*** on floor of middle cranial fossa, just lateral to posterior part of lateral wall of the cavernous sinus.

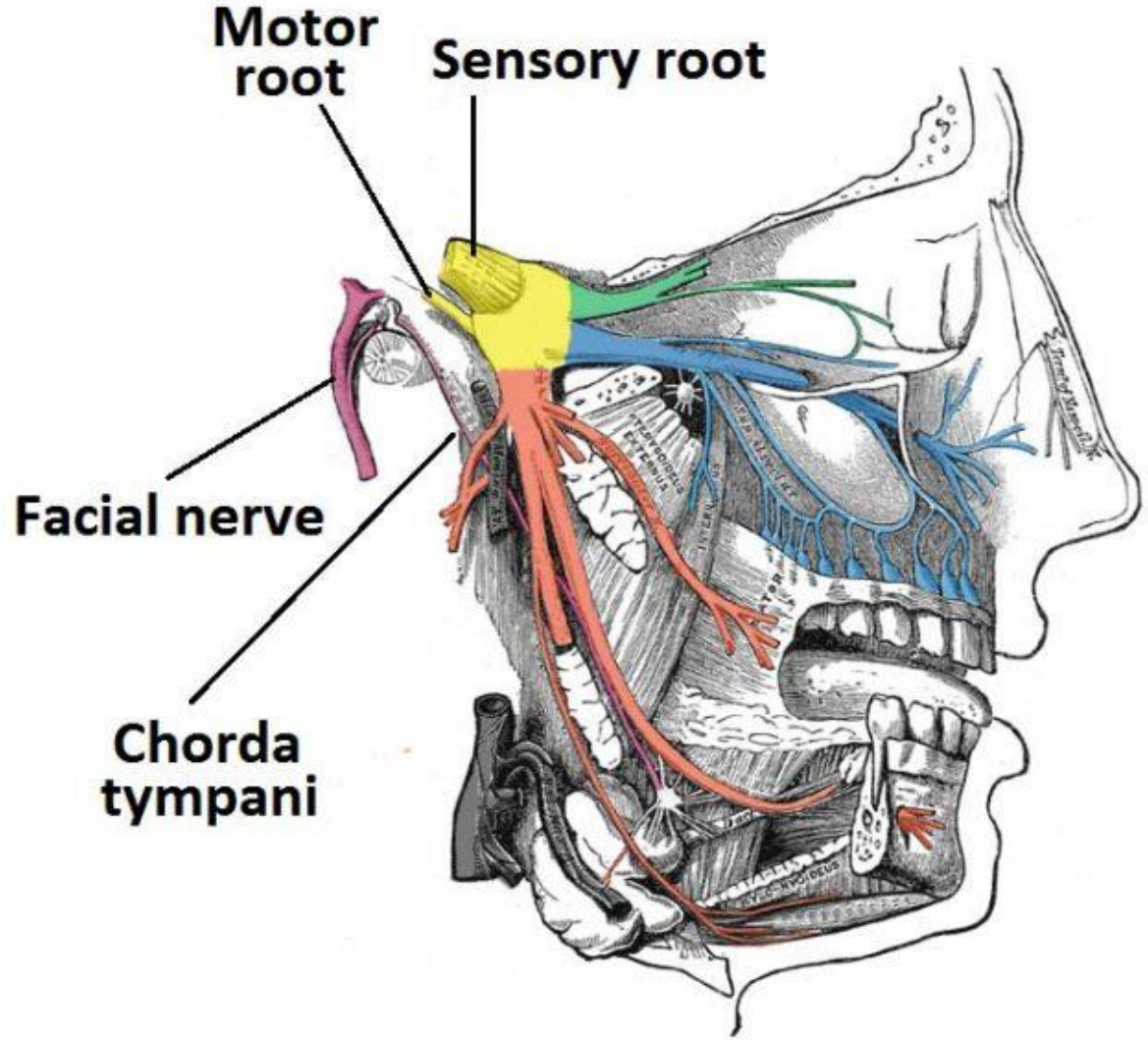

.Ophthalmic N
.Maxillary N
.Mandibular N
Trigeminal ganglion
Cavernous sinus

Trigeminal Ganglion

- ***Coverings:*** covered by dural pouch forming trigeminal cave lined by pia and arachnoid, thus the **ganglion is bathed in CSF.**

- ***Arterial Supply:*** Ganglionic branches of internal carotid artery, middle meningeal artery and accessory meningeal artery.

Divisions

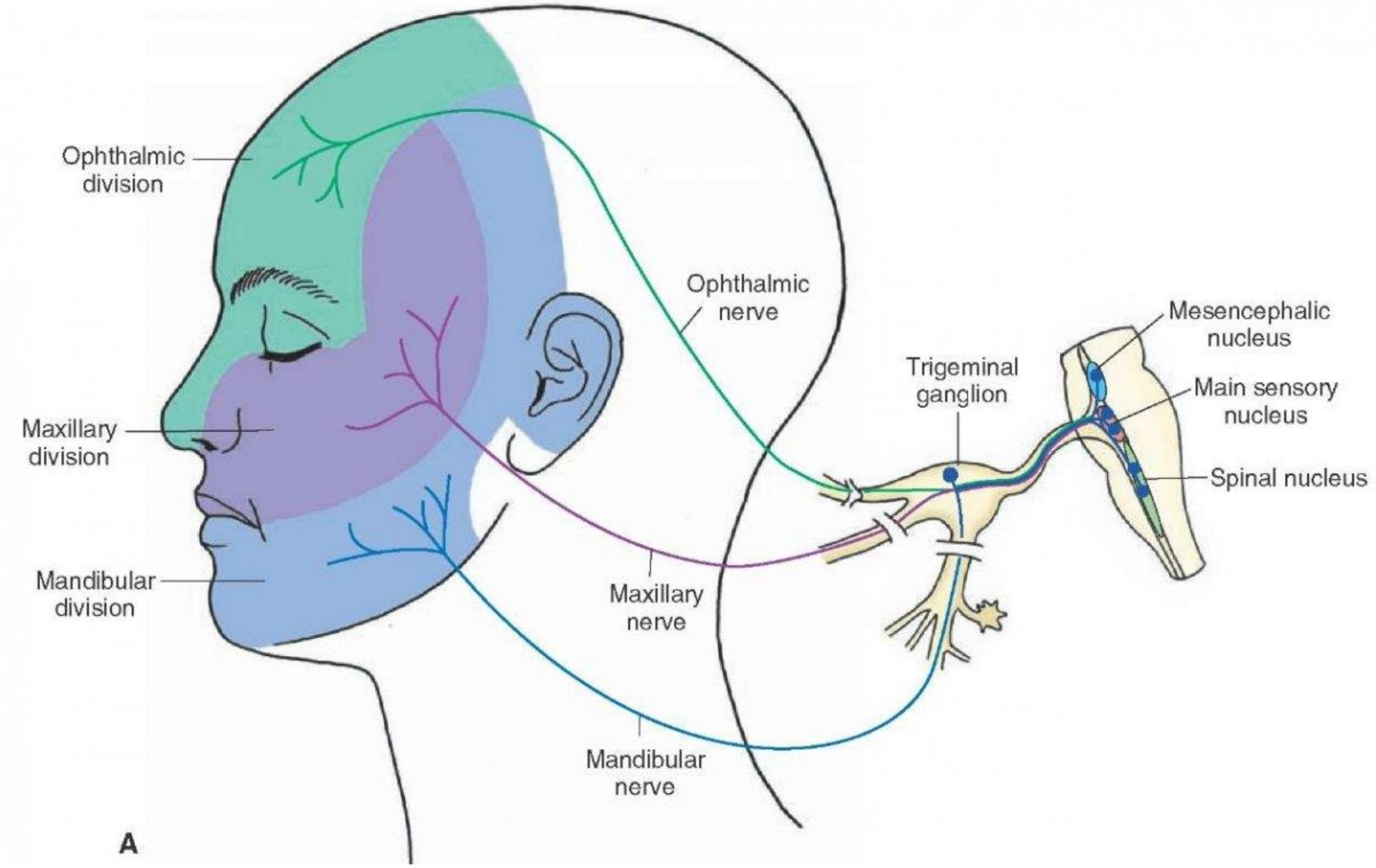


- Opthalmic (V1)
- Maxillary (V2)
- Mandibular (V3)

Divisions

Ophthalmic nerve

1. **Smallest** division.
2. **Sensory only**
3. ***Supplies:*** eyeballs, conjunctiva, lacrimal gland, mucosa of nose and paranasal sinus, skin of forehead eyelid and nose

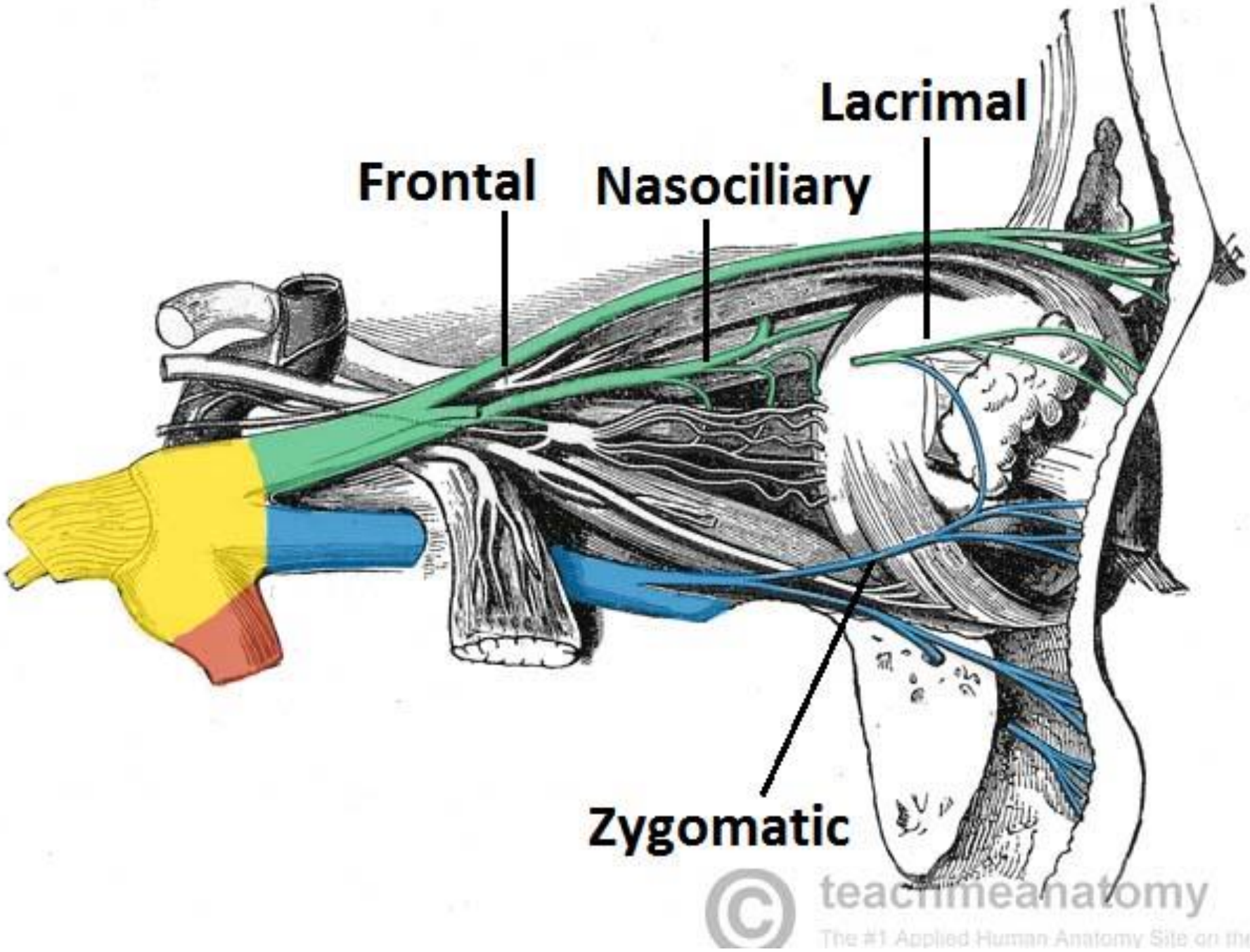

Ophthalmic division
Maxillary division
Mandibular division
Ophthalmic nerve
Maxillary nerve
Mandibular nerve
Trigeminal ganglion
Mesencephalic nucleus
Main sensory nucleus
Spinal nucleus
A

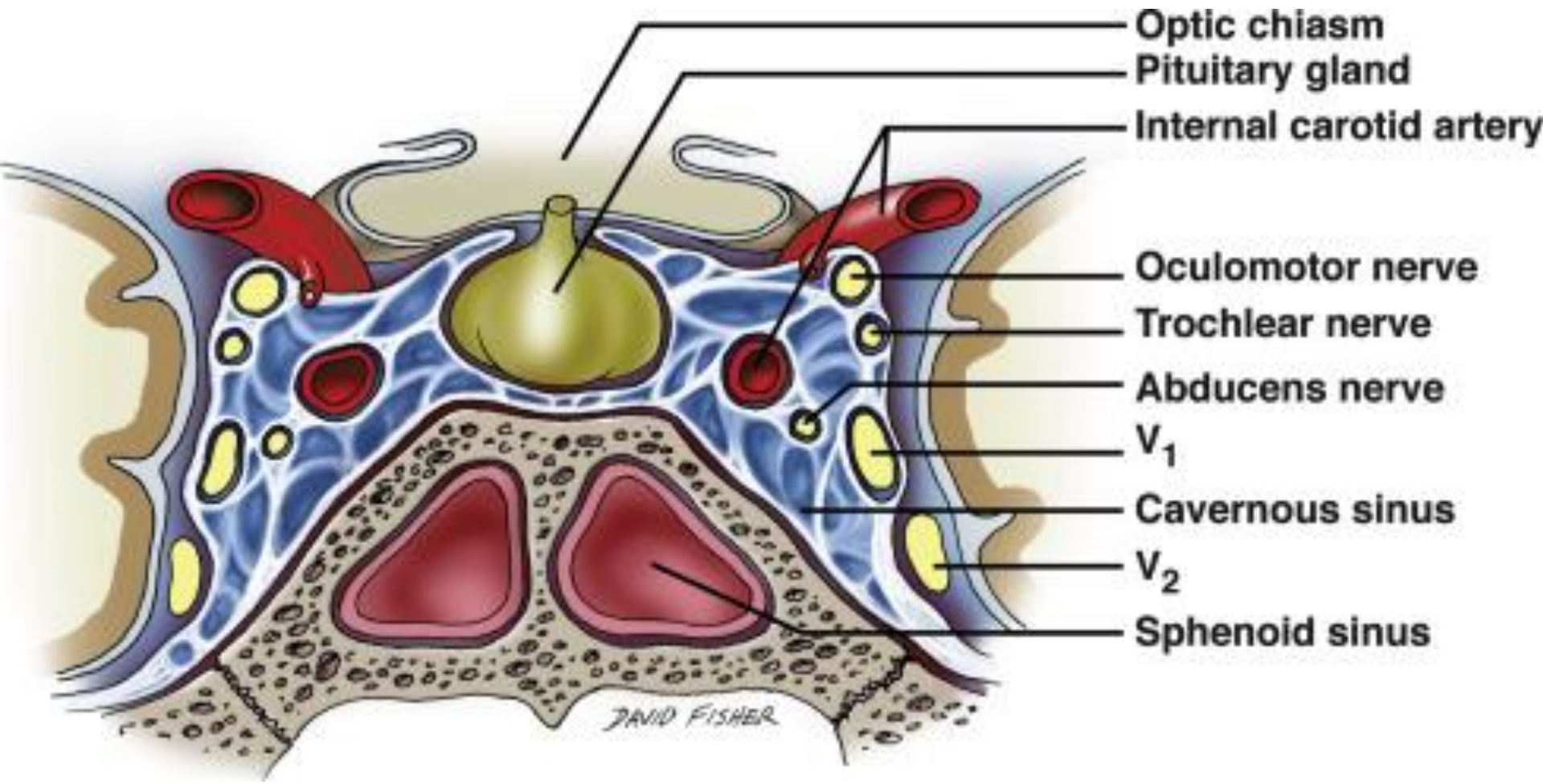
Ophthalmic Nerve

- ***Course:*** emerges from the trigeminal ganglion, passes ***through*** the ***lateral wall*** of the ***cavernous sinus***, divides into 3 branches in the anterior part of the cavernous sinus

1. **Lacrimal**
2. **Frontal**
3. **Nasocilliary**

- All enter the orbit through the ***superior orbital fissure***



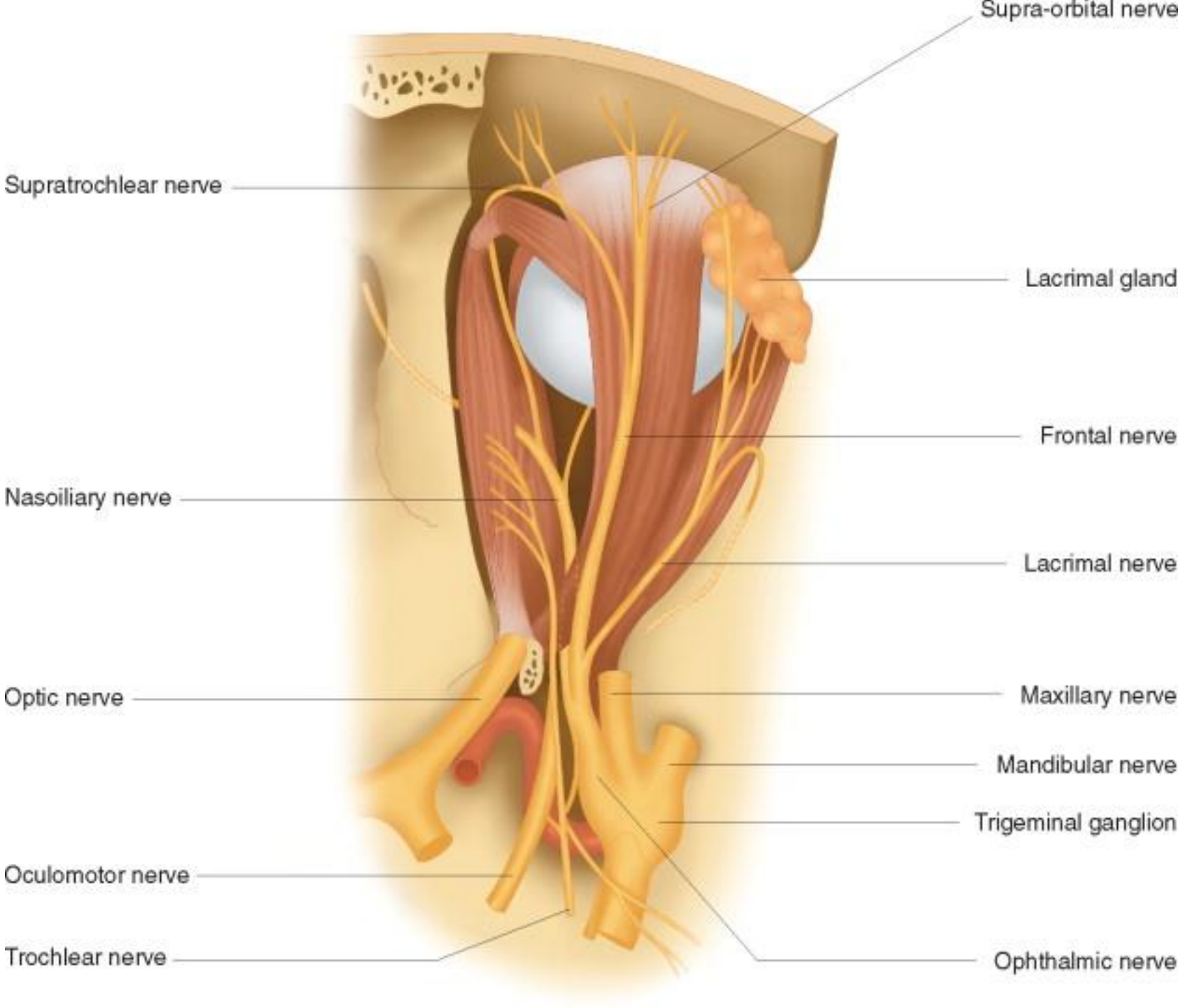

Optic chiasm
Pituitary gland
Internal carotid artery
Oculomotor nerve
Trochlear nerve
Abducens nerve
V1
Cavernous sinus
V2
Sphenoid sinus
DAVID FISHER

Ophthalmic Nerve

- ***Lacrimal Nerve:***

- Passes into orbit through lateral compartment of the ***Superior orbital fissure*** **outside** ***the tendinous ring***.

- In the orbit it runs along the ***upper border of the lateral rectus***, with the lacrimal artery, It enters the lacrimal gland and gives off several filaments, which supply the gland.


Supra-orbital nerve
Supratrochlear nerve
Lacrimal gland
Frontal nerve
Nasoiliary nerve
Lacrimal nerve
Optic nerve
Maxillary nerve
Mandibular nerve
Trigeminal ganglion
Oculomotor nerve
Trochlear nerve
Ophthalmic nerve

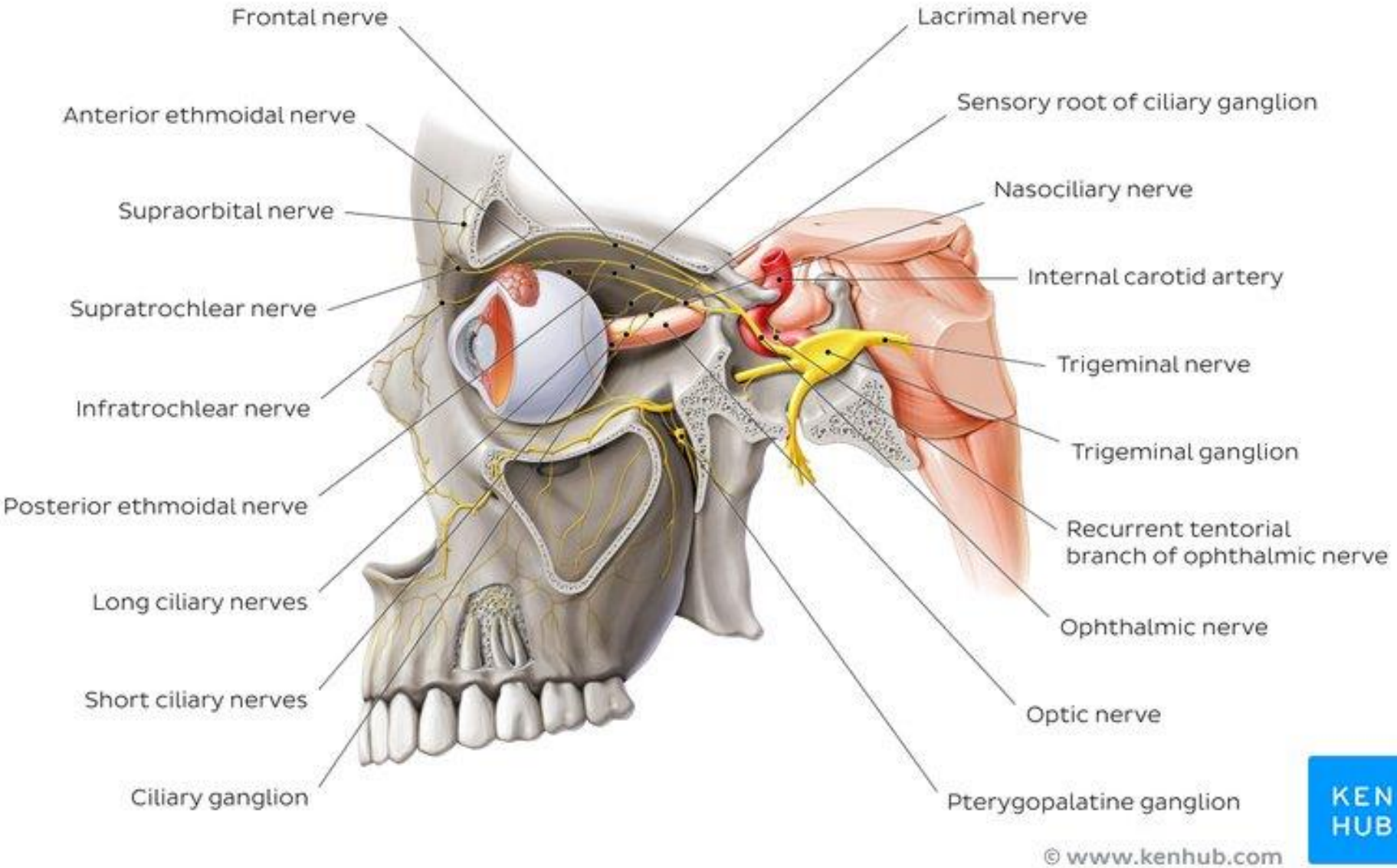
Lacrimal Nerve

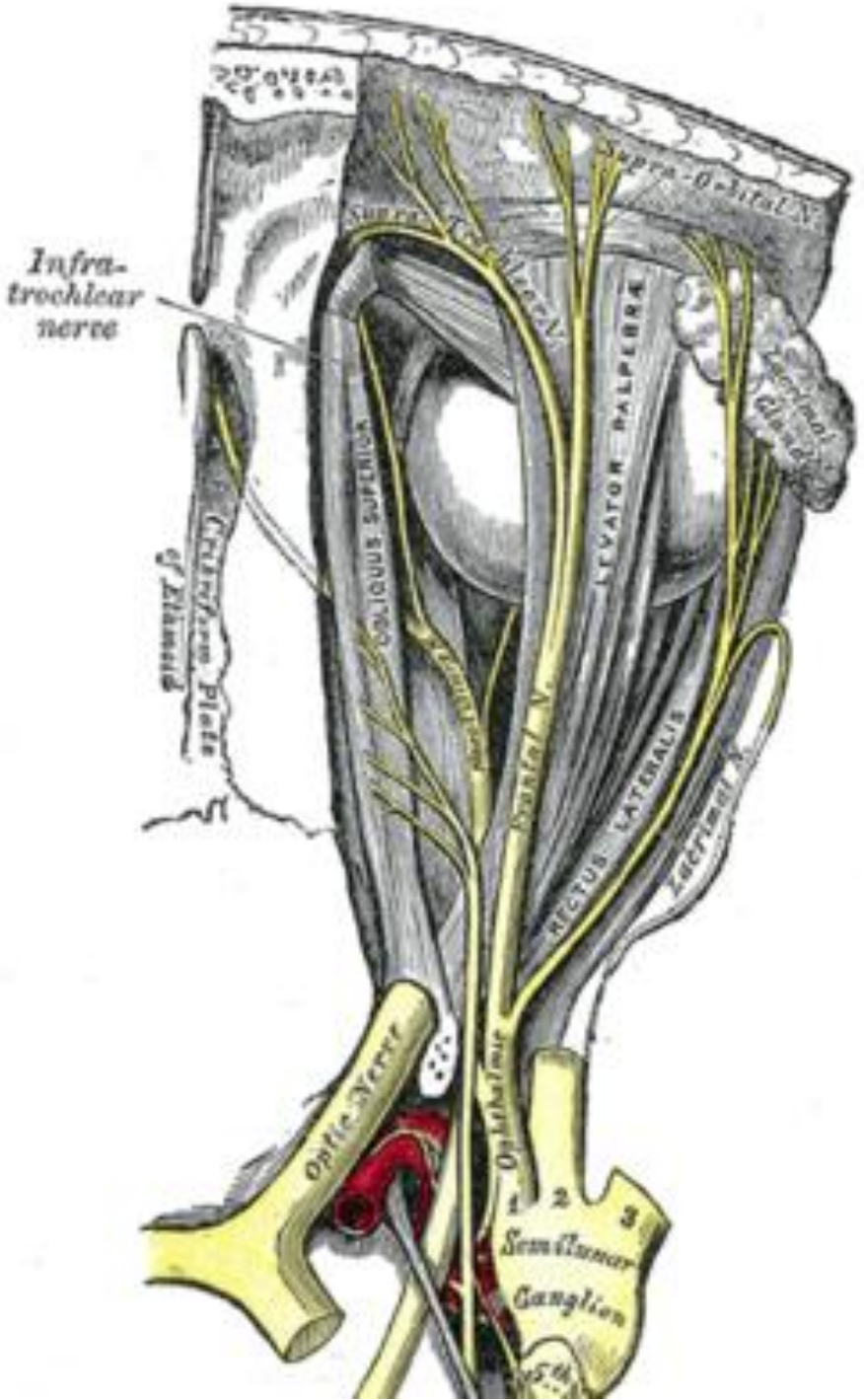
- Finally it pierces the orbital septum giving ***Sensory supply*** to lateral ***conjunctiva, upper Lid, lacrimal gland***

- In addition to post synaptic ***parasympathetic*** fibers from ***pterygopalatine ganglion*** to ***lacrimal gland*** (parasym. ***secretomotor***).

Frontal Nerve

- **Largest** of the ophthalmic N. branches
- ***Enters orbit*** through lateral part of ***superior orbital fissure*** **outside** ***tendinous ring***
- Passes forward between roof of orbit and levator palpebral superioris
- Divides midway of its course into **supratrochlear** and **supraorbital nerves**



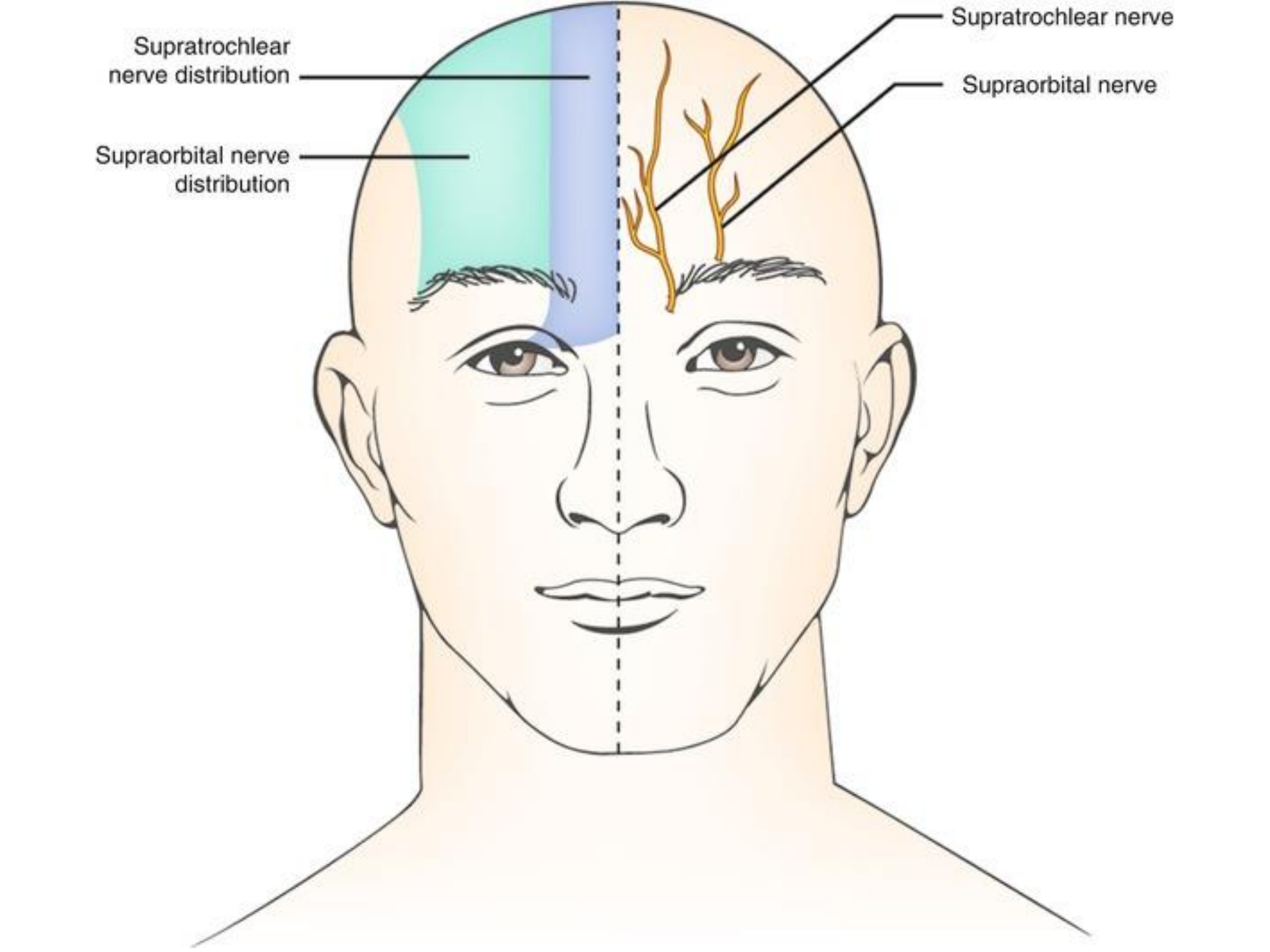

Infra-trochlear nerve
Levator palpebræ
Rectus lateralis
Optic Nerve
Semilunar Ganglion

Frontal Nerve

Supratrochlear Nerve:

- ***Smaller*** nerve, ***medial branch***

- Curves around superomedial margin of orbit suppling the ***skin*** of the ***lower*** part of the ***forehead*** close to the middle line and sends filaments to the ***conjunctiva*** and ***skin*** of the ***upper eyelid***

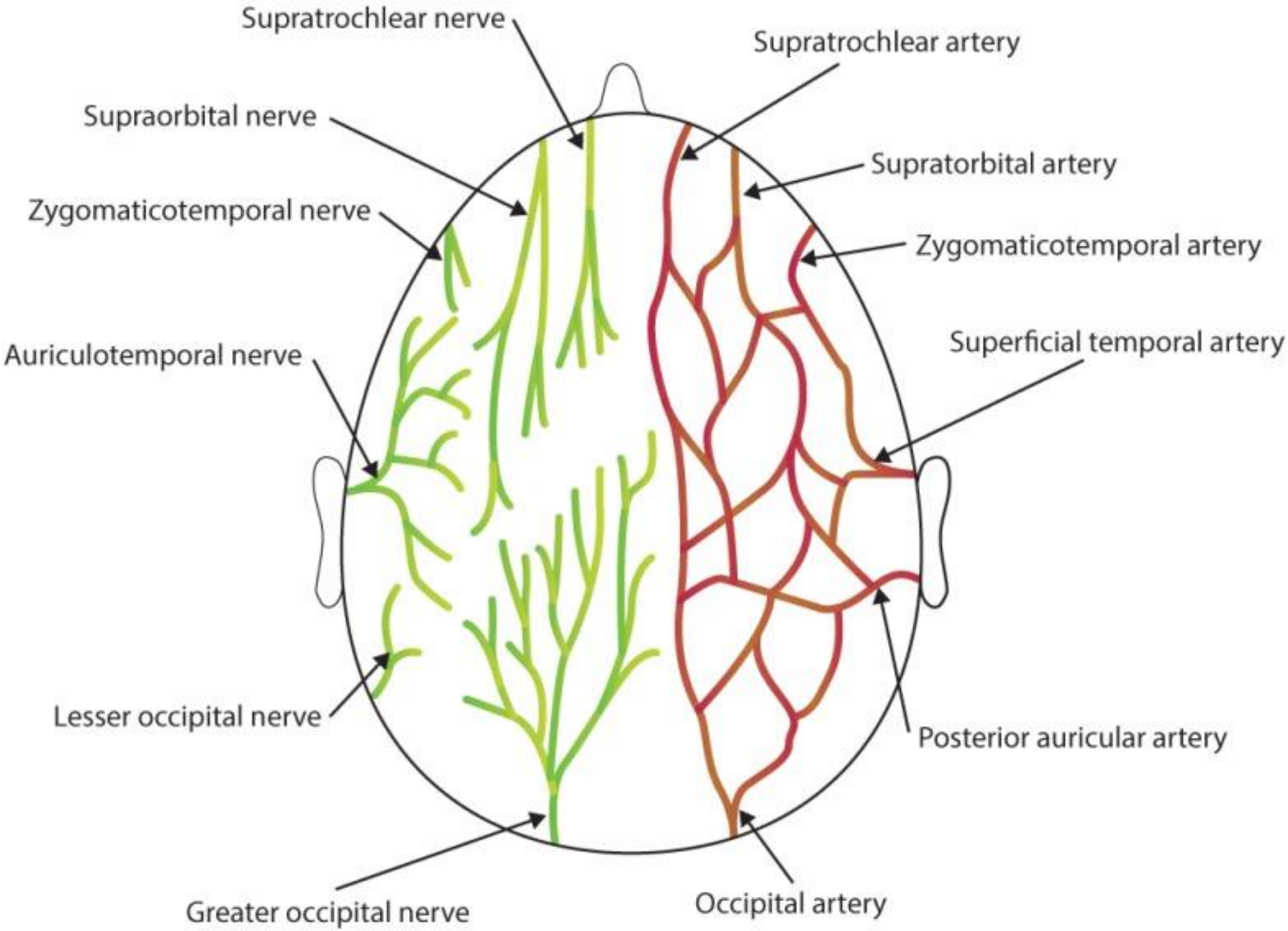

Supratrochlear nerve distribution
Supraorbital nerve distribution
Supratrochlear nerve
Supraorbital nerve

Frontal Nerve

Supraorbital Nerve:

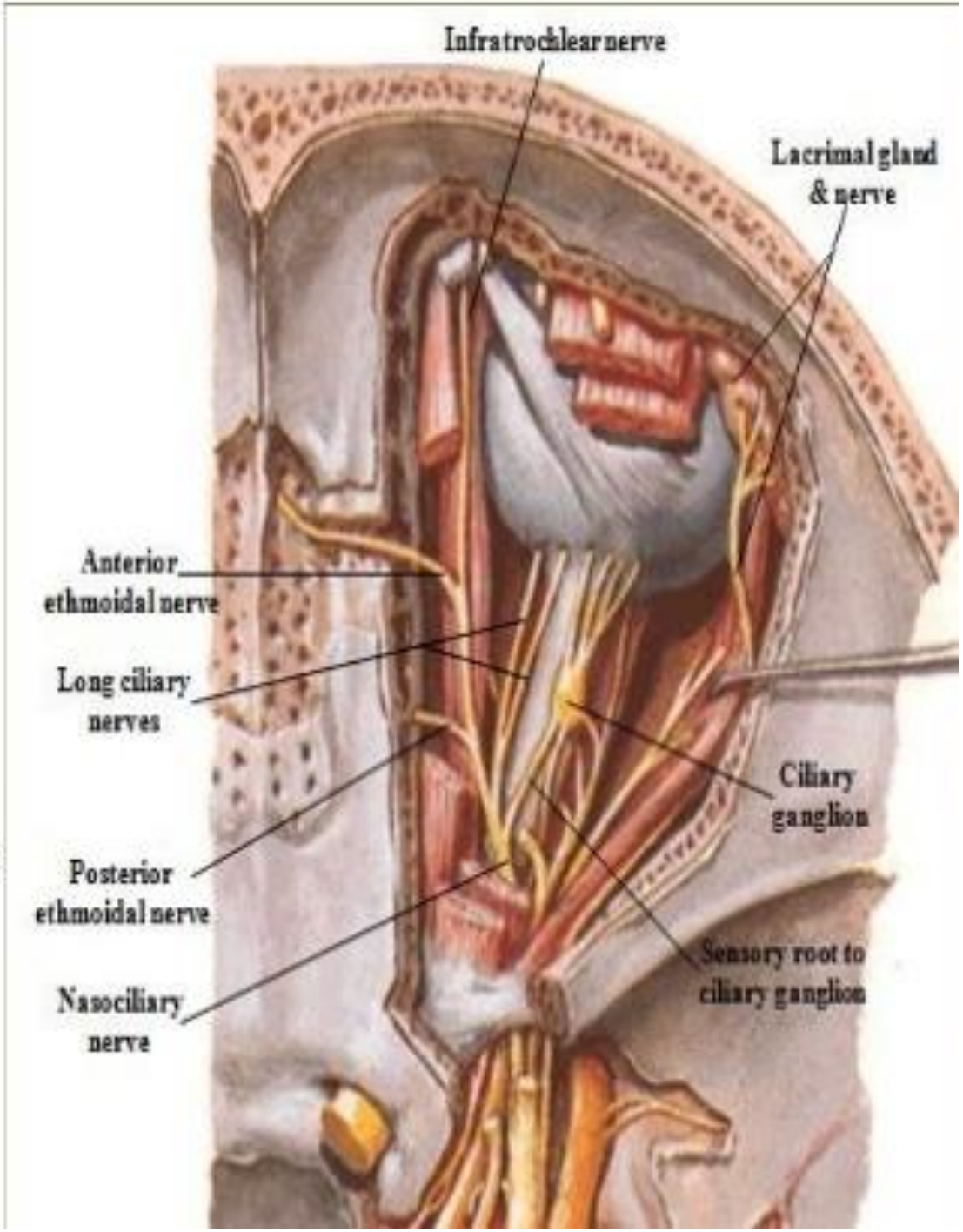
- ***Larger*** nerve, ***lateral branch***

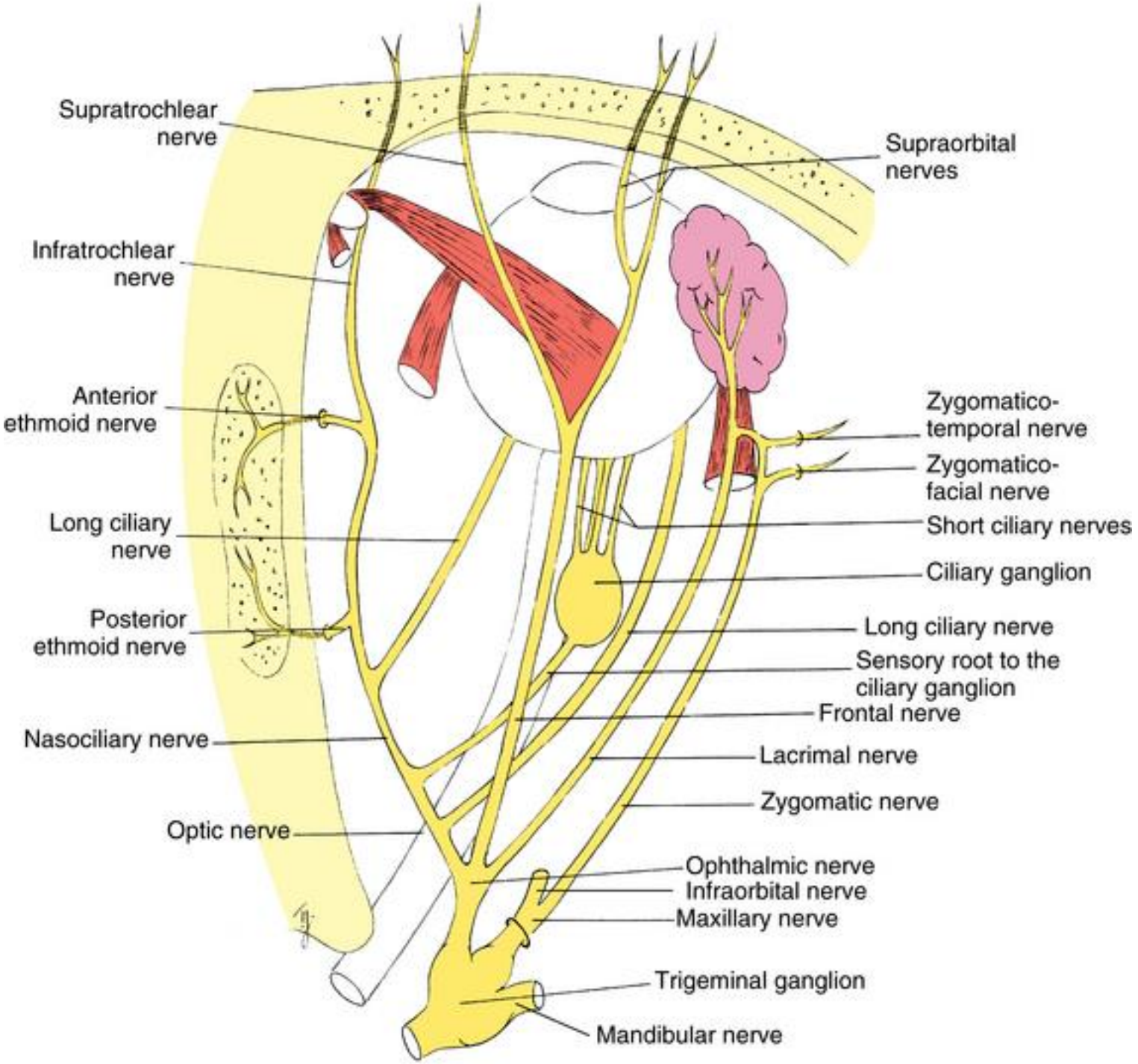
- Divides in medial and lateral branches supplying the ***skin*** of the ***scalp***, reaching nearly ***as far*** back as the ***lambdoidal suture***.


Supratrochlear nerve
Supratrochlear artery
Supraorbital nerve
Supratorbital artery
Zygomaticotemporal nerve
Zygomaticotemporal artery
Auriculotemporal nerve
Superficial temporal artery
Lesser occipital nerve
Posterior auricular artery
Greater occipital nerve
Occipital artery

Nasociliary Nerve

- Purely ***Sensory***
- Passes through middle part of ***superior orbital fissure*** **within** the ***tendenious ring***.
- **Runs** along **medial wall** of **orbit** between superior oblique and medial rectus
- Ends by dividing into ***Anterior Ethmoidal*** and ***External Nasal*** and gives 5 orbital branches


Infratrochlear nerve
Lacrimal gland & nerve
Anterior ethmoidal nerve
Long ciliary nerves
Ciliary ganglion
Posterior ethmoidal nerve
Sensory root to ciliary ganglion
Nasociliary nerve


Supratrochlear nerve
Supraorbital nerves
Infratrochlear nerve
Anterior ethmoid nerve
Zygomatico-temporal nerve
Zygomatico-facial nerve
Long ciliary nerve
Short ciliary nerves
Ciliary ganglion
Posterior ethmoid nerve
Long ciliary nerve
Sensory root to the ciliary ganglion
Frontal nerve
Nasociliary nerve
Lacrimal nerve
Zygomatic nerve
Optic nerve
Ophthalmic nerve
Infraorbital nerve
Maxillary nerve
Trigeminal ganglion
Mandibular nerve

Nasociliary Nerve

Branches:

1. ***Short Ciliary Nerves:*** Fibers reaches eyeball and contains fibers from Ciliary Ganglion

2. ***Long Ciliary Nerves:*** 2 or 3 in no. supply to Iris and Cornea.

Nasociliary Nerve

Branches:

3. ***Post Ethmoidal Nerve:*** passes through posterior ethmoidal foramen to supply the Ethmoid and Sphenoid sinuses.

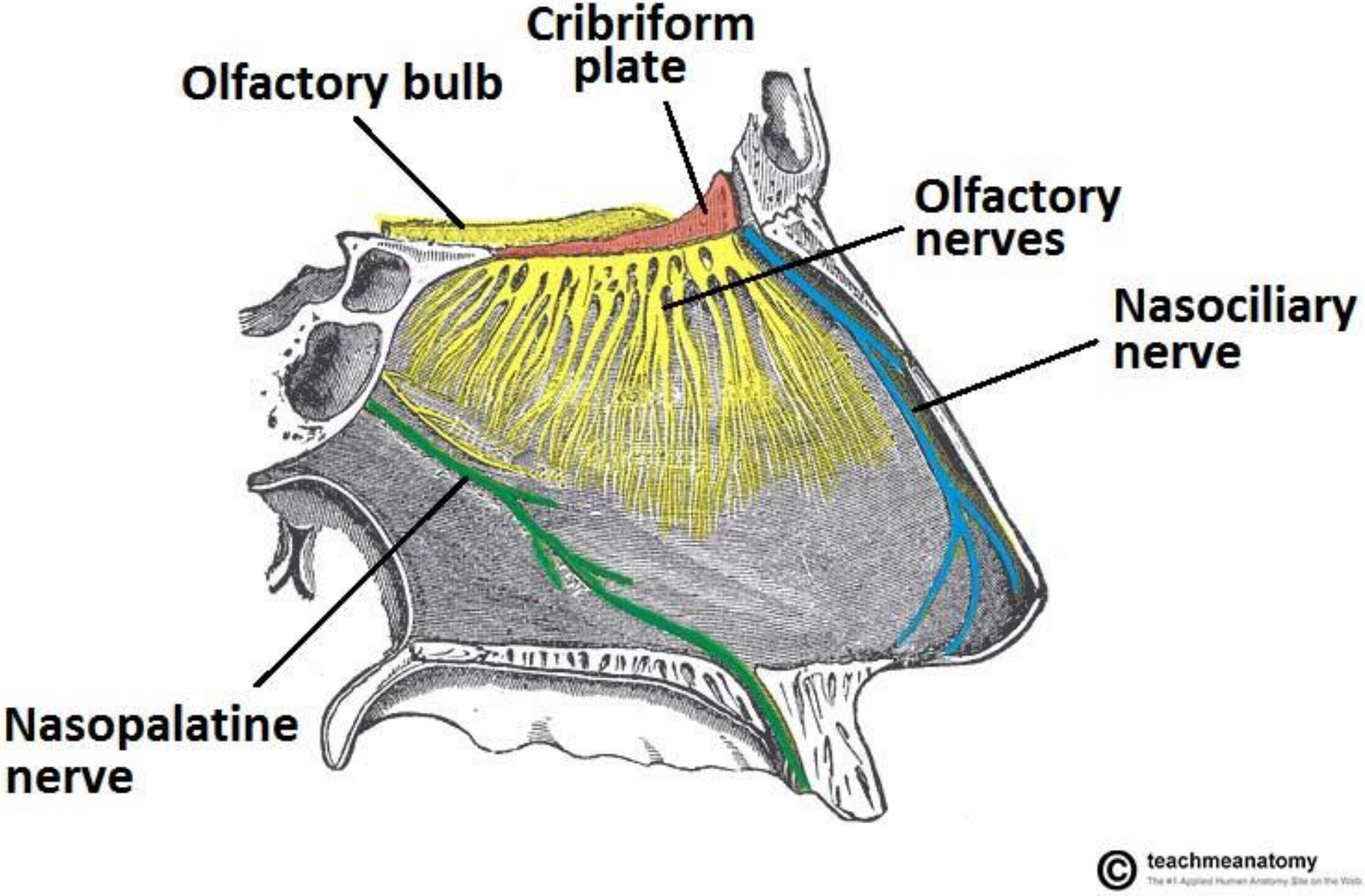
4. ***Infratrochlear Nerve:*** appears on face above med. angle the eye. Supplies to skin of lacrimal sac and caruncle.

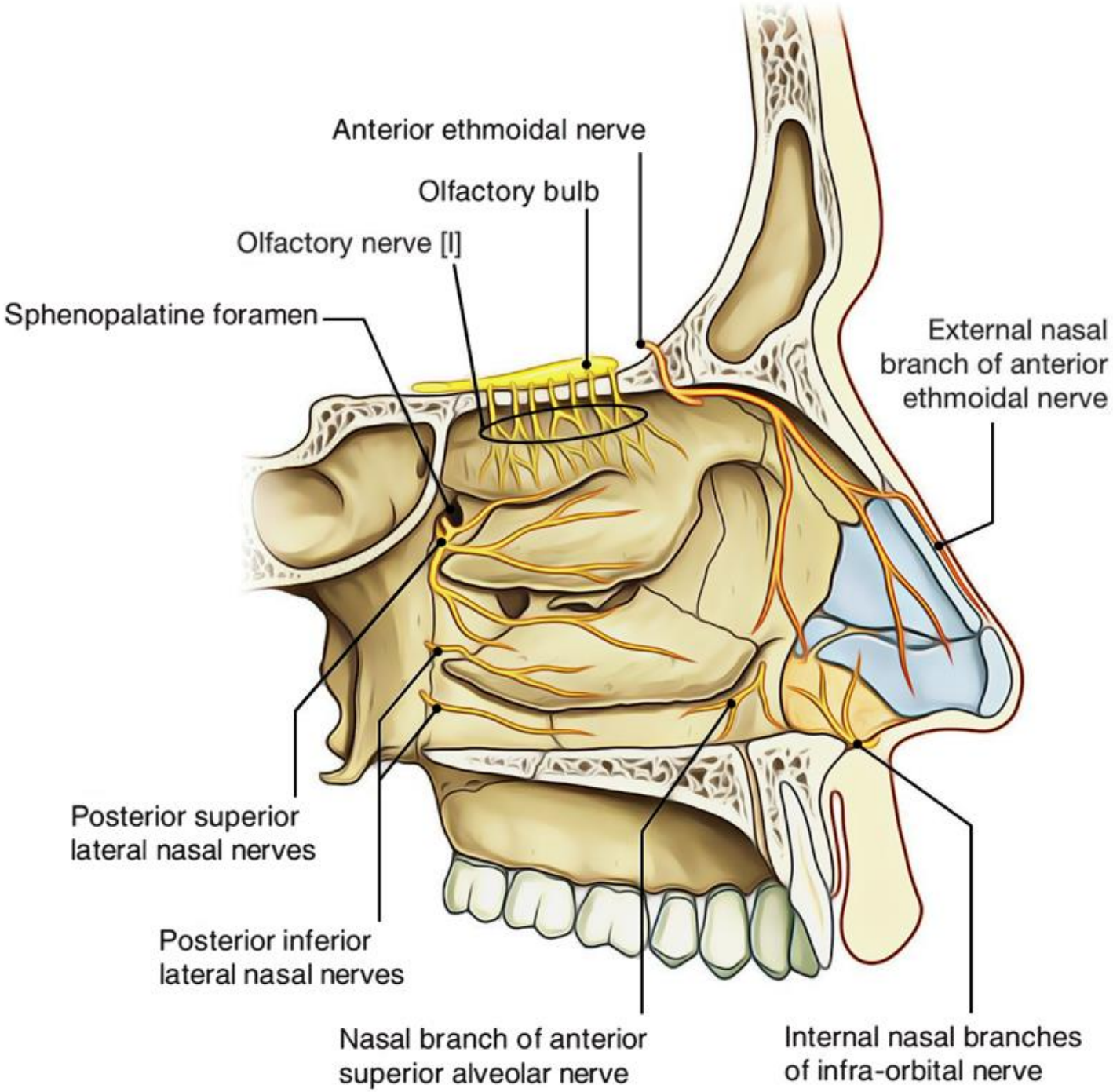
Nasociliary Nerve

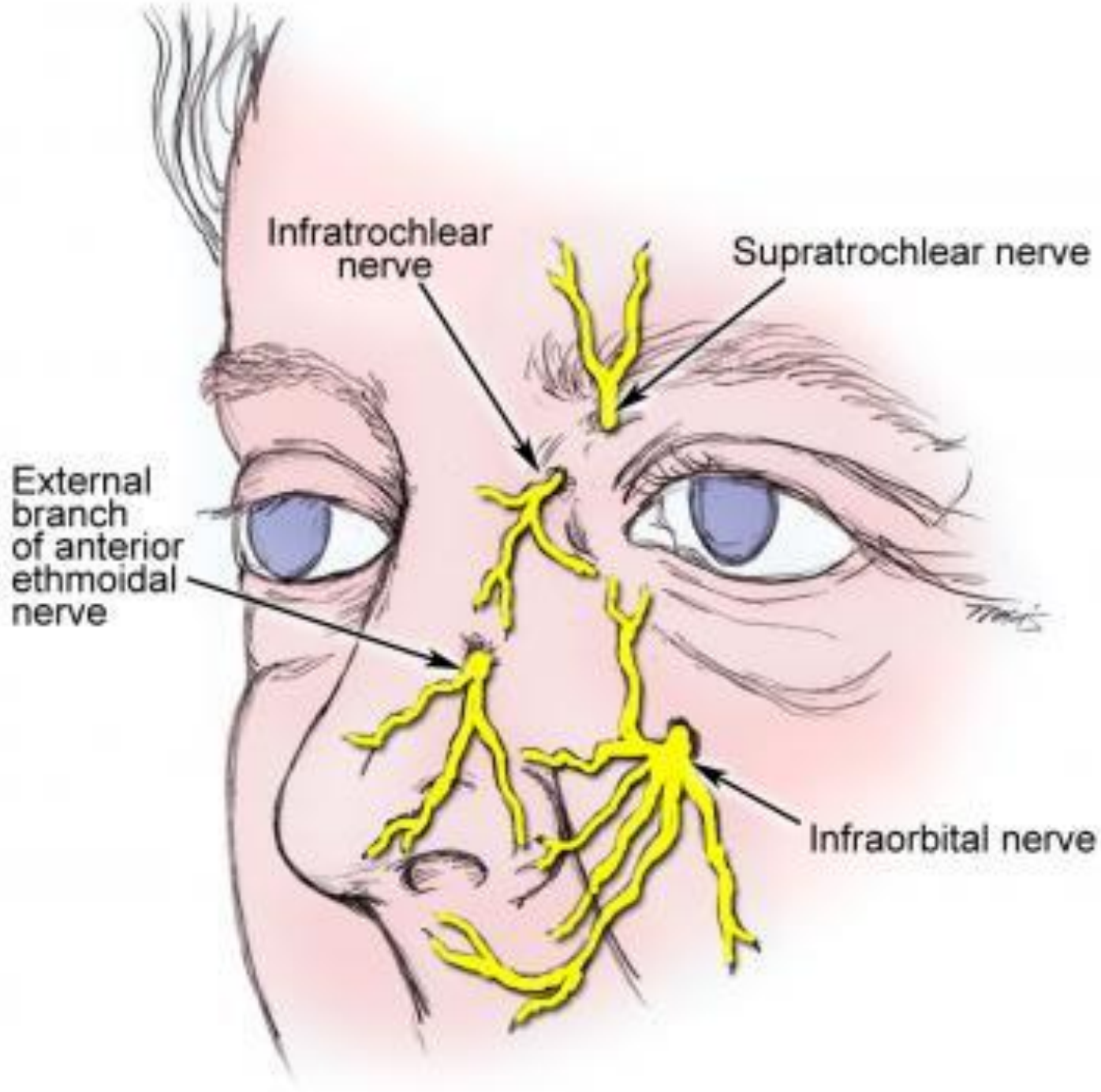
5. ***Anterior Ethmoidal Nerve:***

- Larger terminal branch, goes through anterior ethmoidal foramen and then into anterior cranial fossa then back into nasal cavity

- Ends by splitting into ***medial internal nasal*** branch, to the ***anterior nasal septum*** and ***lateral internal nasal*** branch to the ***lateral nasal cavity*** then emerges outside as ***external nasal*** nerve to skin of ***ala***, ***vestibule*** and ***tip*** of ***nose***




Anterior ethmoidal nerve
Olfactory bulb
Olfactory nerve [I]
Sphenopalatine foramen
External nasal branch of anterior ethmoidal nerve
Posterior superior lateral nasal nerves
Posterior inferior lateral nasal nerves
Nasal branch of anterior superior alveolar nerve
Internal nasal branches of infra-orbital nerve


Infratrochlear nerve
Supratrochlear nerve
External branch of anterior ethmoidal nerve
Infraorbital nerve

Maxillary Nerve

- ***Second*** division of trigeminal nerve

- Pure ***sensory***

Course:

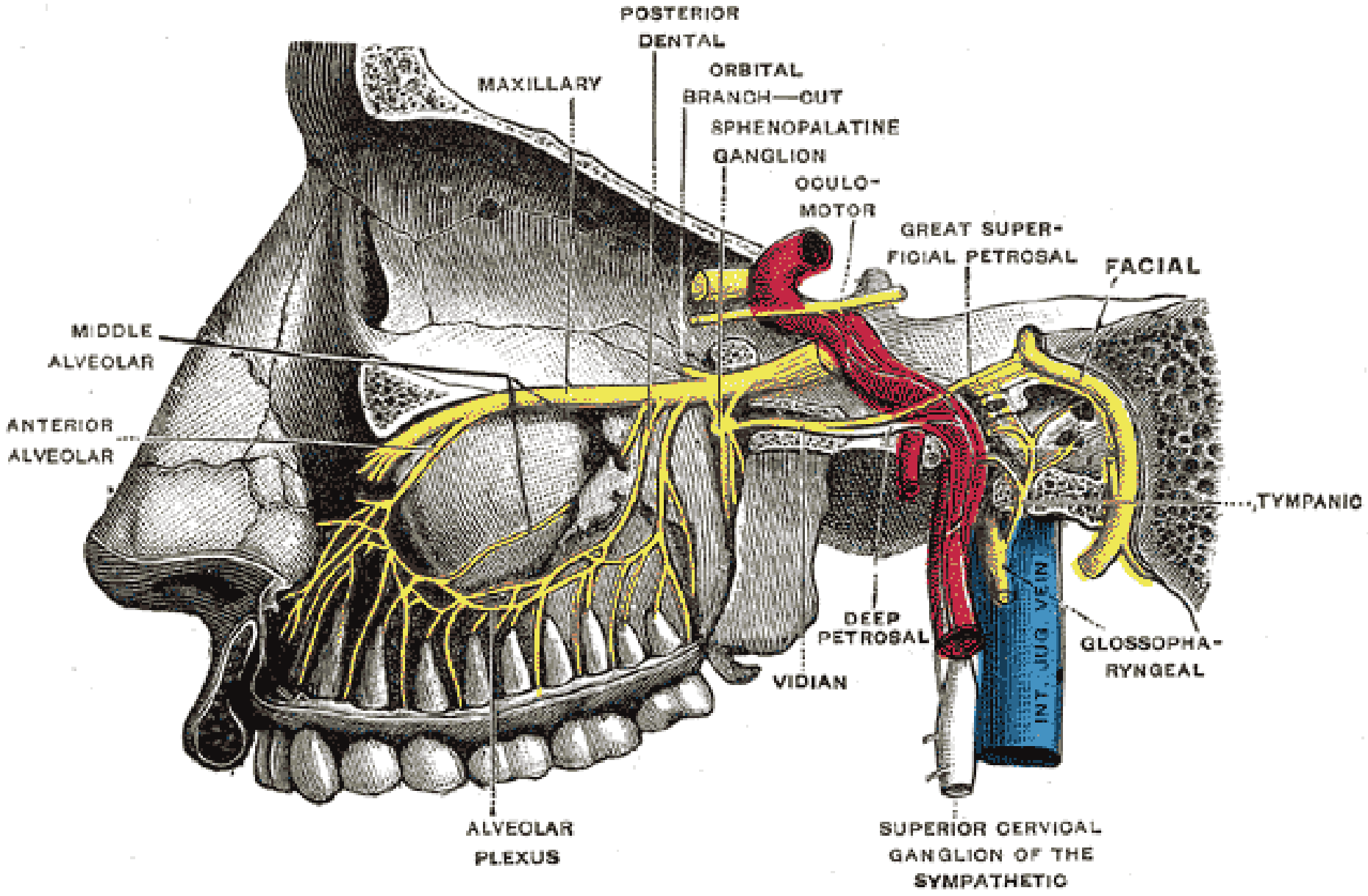
- Passes ***from*** the ***trigeminal ganglion*** in the middle cranial fossa, ***to*** the ***lateral wall*** of ***cavernous sinus***

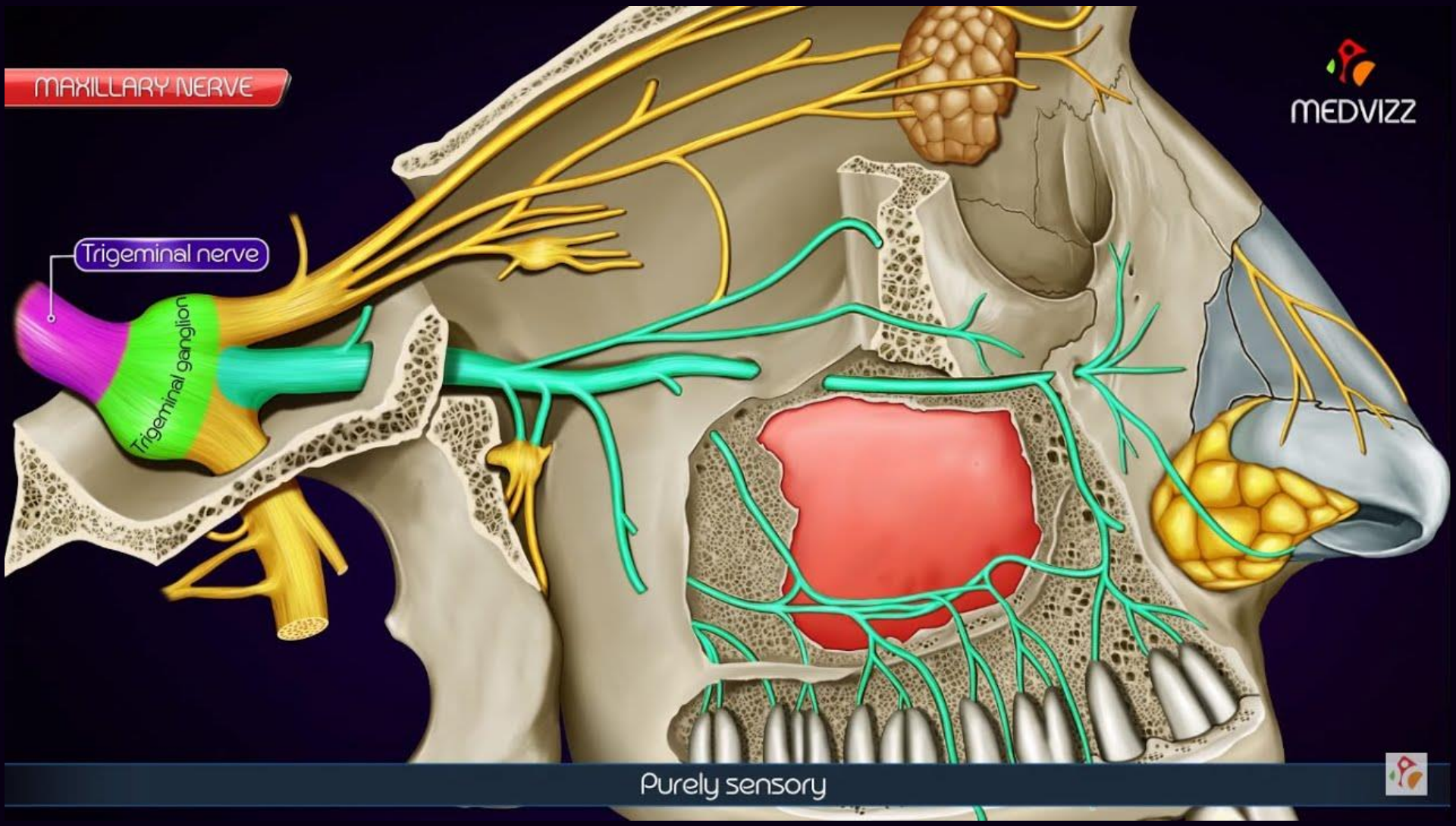
Maxillary Nerve

Course Cont.:

- From the sinus wall it ***leaves*** the ***middle cranial fossa*** through the ***Foramen rotundum*** towards the ***Pterygopalatine fossa***

- Then **passes in** a **groove** on posterior surface **of maxilla**, through inferior orbital fissure into orbit and moves through ***infra orbital groove*** where it is called as ***infraorbital nerve*** that exits on the face from infra orbital foramen.


POSTERIOR
DENTAL
ORBITAL
BRANCH—CUT
SPHENOPALATINE
GANGLION
MAXILLARY
OCULO-
MOTOR
GREAT SUPER-
FICIAL PETROSAL
FACIAL
MIDDLE
ALVEOLAR
ANTERIOR
ALVEOLAR
TYMPANIC
DEEP
PETROSAL
VIDIAN
GLOSSOPHA-
RYNGEAL
INT. JUG.
ALVEOLAR
PLEXUS
SUPERIOR CERVICAL
GANGLION OF THE
SYMPATHETIC


MAXILLARY NERVE
MEDVIZZ
Trigeminal nerve
Trigeminal ganglion
Purely sensory

Maxillary Nerve

Branches:

1. ***Meningeal branch:*** in middle cranial fossa, provides sensory innervation to cranial dura matter.

Maxillary Nerve

- ***In Pterygopalatine Fossa:***

1. ***Zygomatic:*** **Zygomaticofacial** nerve suppling skin on prominence of cheek, **Zygomaticotemporal** nerve, supplies skin of temporal region after piercing temporal fascia 2 cm above zygoma, giving branch to lacrimal N suppling parasymp. ***Secretomotor fibers to lacrimal gland***

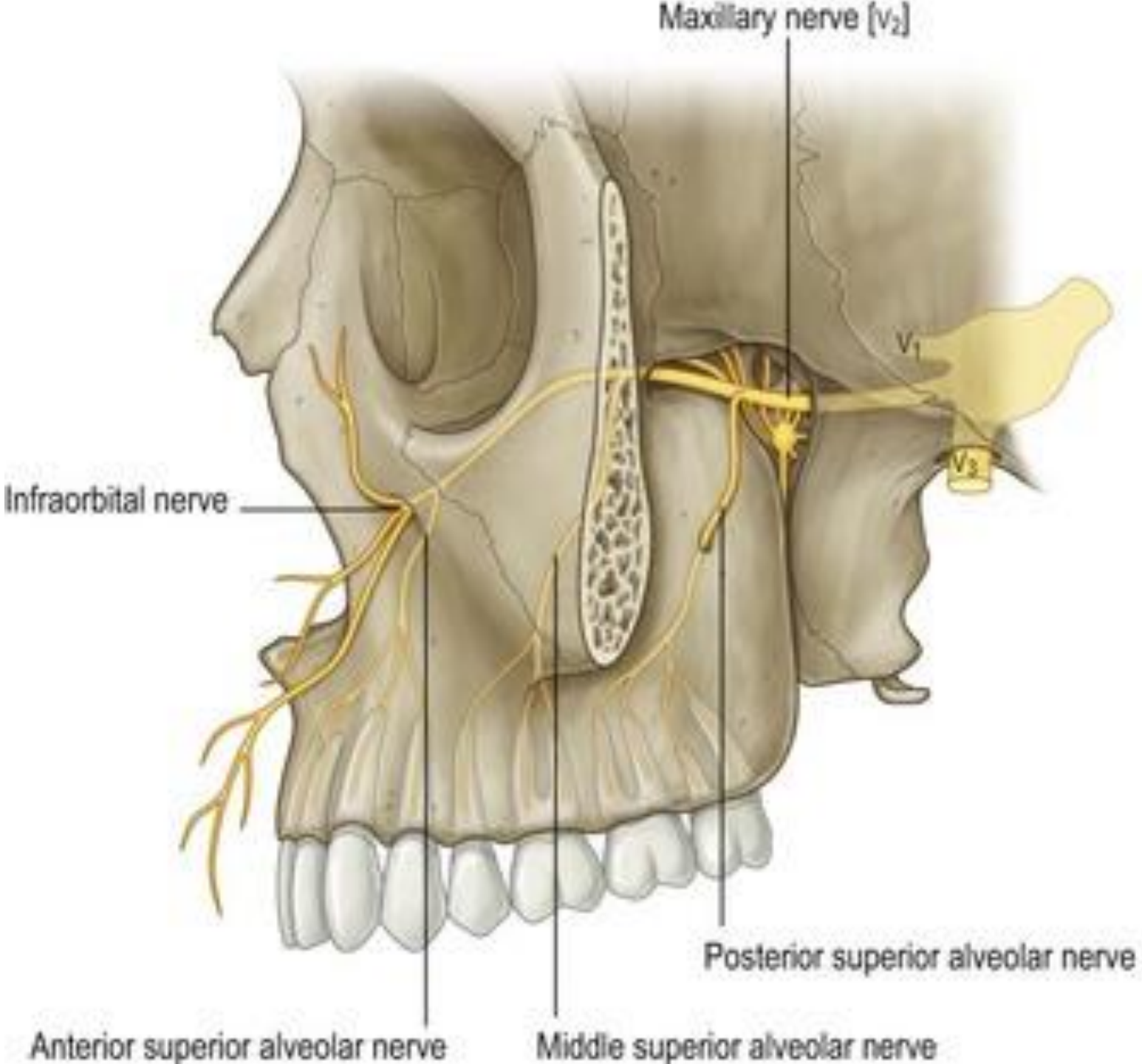
2. **Sphenopalatine.**

Maxillary Nerve

- ***In Pterygopalatine Fossa:***

3. ***Posterior superior alveolar:*** arises just before it enters the infraorbital groove, give off several twigs to the gums and neighboring parts of the mucous membrane of the cheek and **roots of the teeth.**

4. ***Ganglionic branches carrying the pterygopalatine ganglion***


Maxillary nerve [V2]
V1
V2
Infraorbital nerve
Posterior superior alveolar nerve
Anterior superior alveolar nerve
Middle superior alveolar nerve

Maxillary Nerve

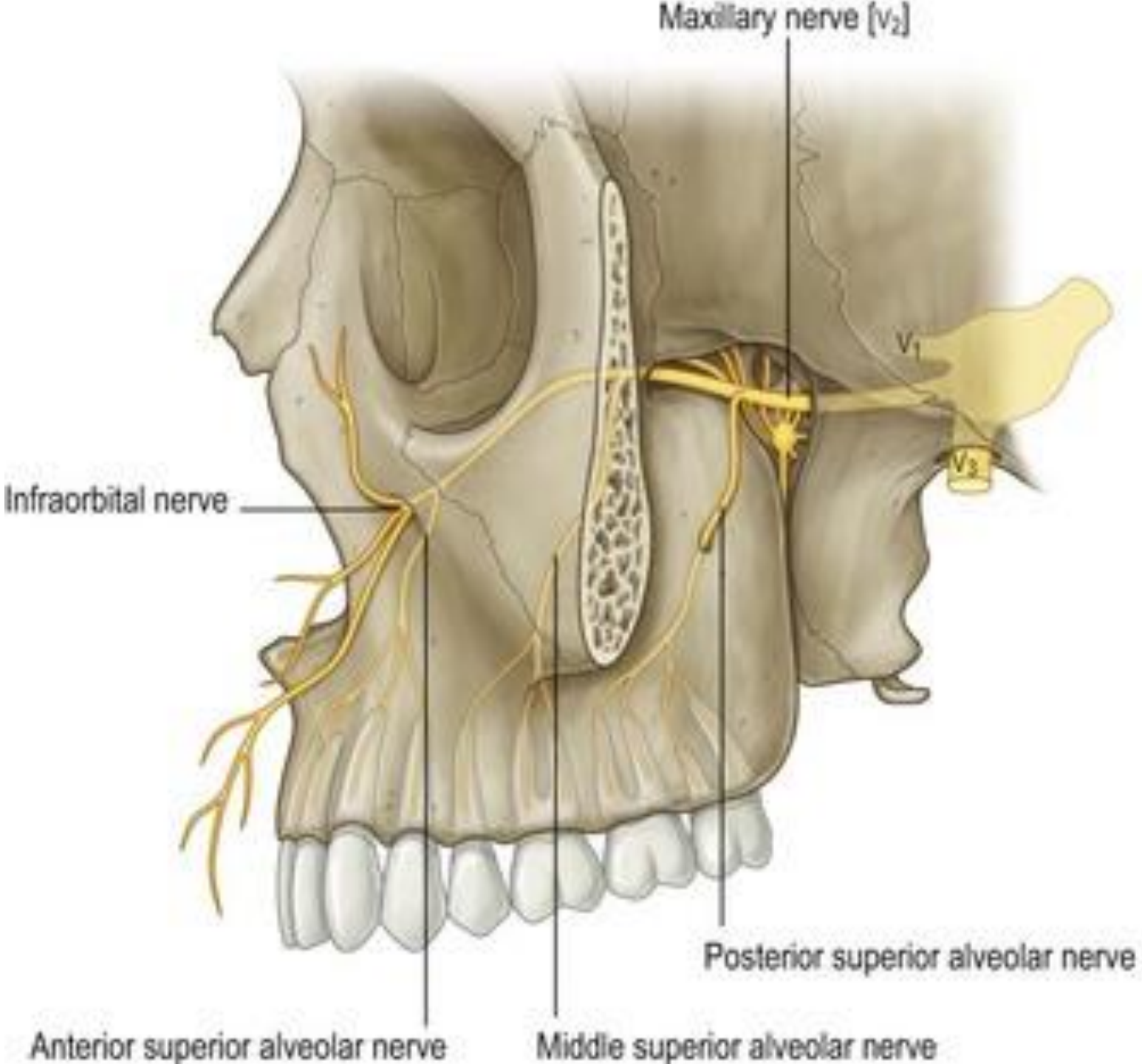
- ***In the Infraorbital Canal:***

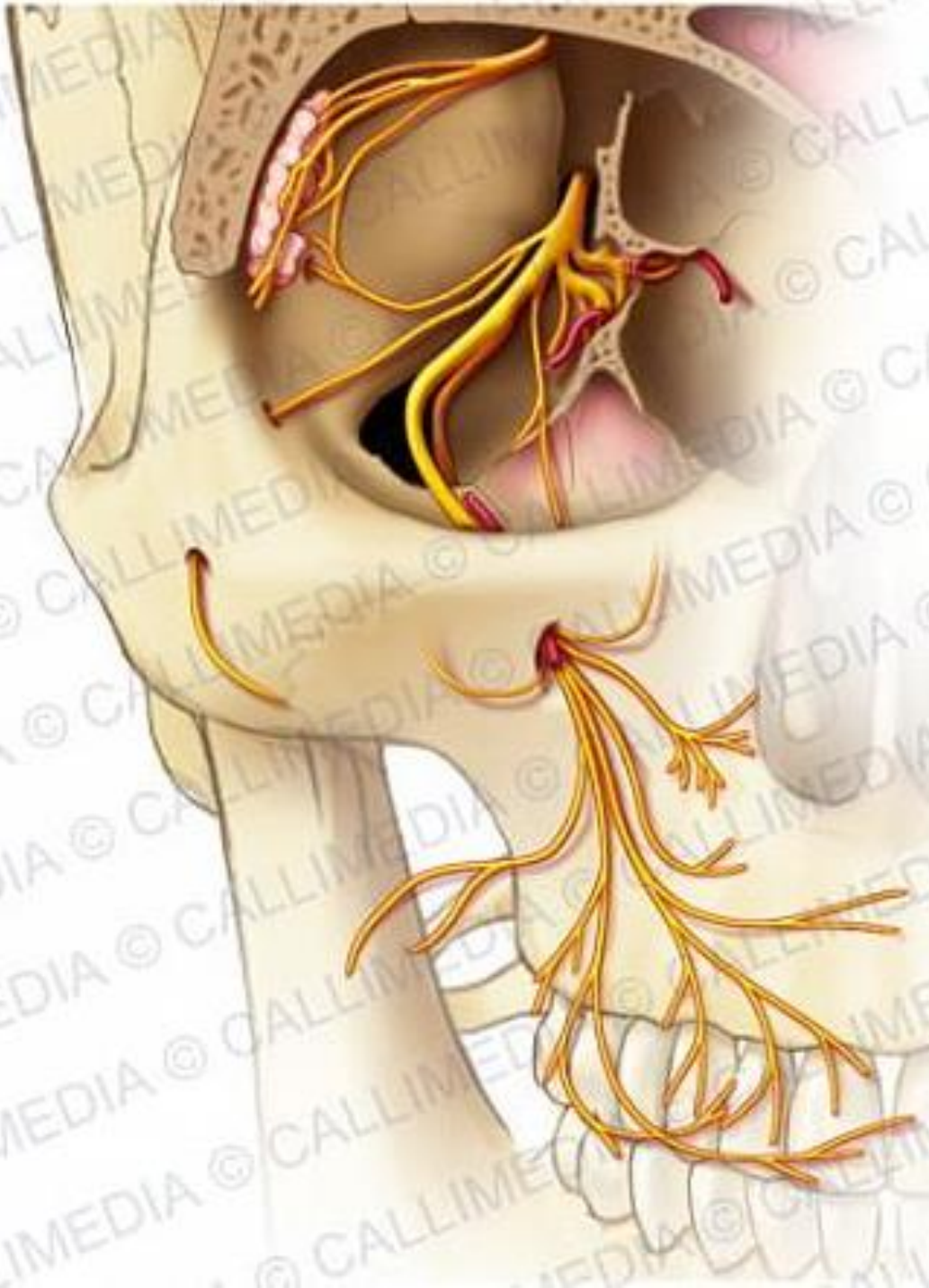
1. Anterior superior alveolar.
2. Middle superior alveolar.

- ***Both to maxillary sinus walls and roots of the teeth while anterior alveolar supply lateral nasal wall below inf. meatus***

- ***On the Face (Infraorbital Nerve):***

1. Inferior palpebral.
2. External nasal.
3. Superior labial.


Maxillary nerve [V2]
V1
V2
Infraorbital nerve
Posterior superior alveolar nerve
Anterior superior alveolar nerve
Middle superior alveolar nerve



Maxillary Nerve

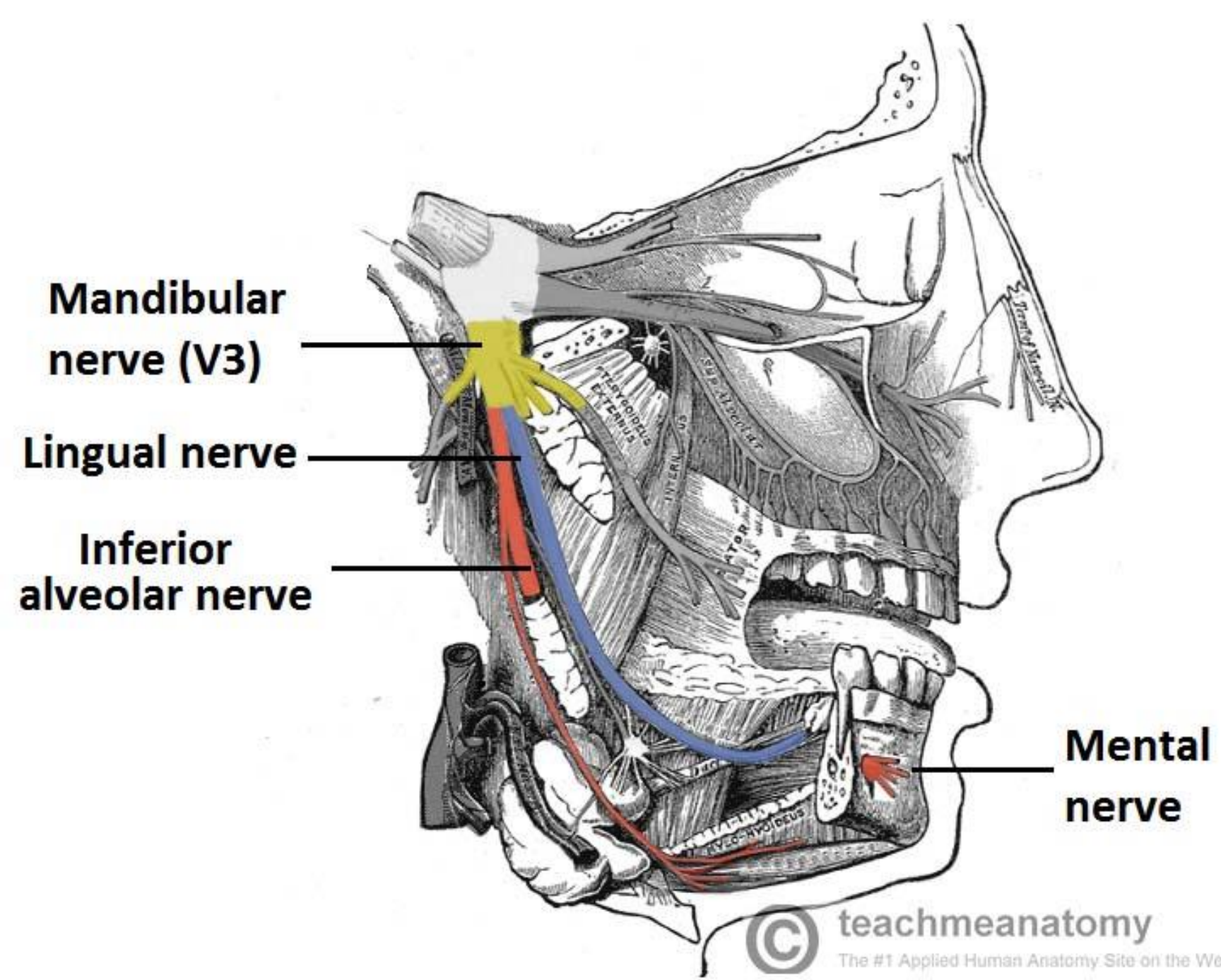
In Summary:

It receives sensations from:

- **Dura in ant. & middle cranial fossae, nasopharynx, palate, nasal cavity (*through branches of pterygopalatine ganglion*), teeth of upper jaw, maxillary sinus, skin covering side of nose, lower eyelids, cheeks & upper lip**

Mandibular Nerve

- Leaves cranial cavity through **foramen ovale**
- **Mixed nerve, largest, Nerve of the 1st branchial arch**
- Has a ***large sensory root & a small motor root*** which join each other inside foramen ovale to form the n. trunk which is very short & ***divides*** into ***small ant***. & ***large post***. ***divisions***



Mandibular Nerve

Branches

- ***Trunk (undivided)***

1. Nervous Spinosus re-enters cranial cavity through foramen spinosus

2. ***Nerve*** to ***medial Pterygoid***: Supplies medial pterygoid and through otic ganglion without interruption to supply ***tensor tympani*** & ***tensor palati***

Mandibular Nerve

Branches

- ***Anterior Division (Muscular to Ms of mastication)***

1. Massetric Nerve (***supplies TMJ***).
2. Deep temporal Nerve.
3. Nerve to lateral Pterygoid
4. Buccal Nerve (***only sensory br.***).

- ***Posterior Division***

1. Auriculo-temporal Nerve
2. Inferior. Alveolar Nerve
3. Lingual Nerve.

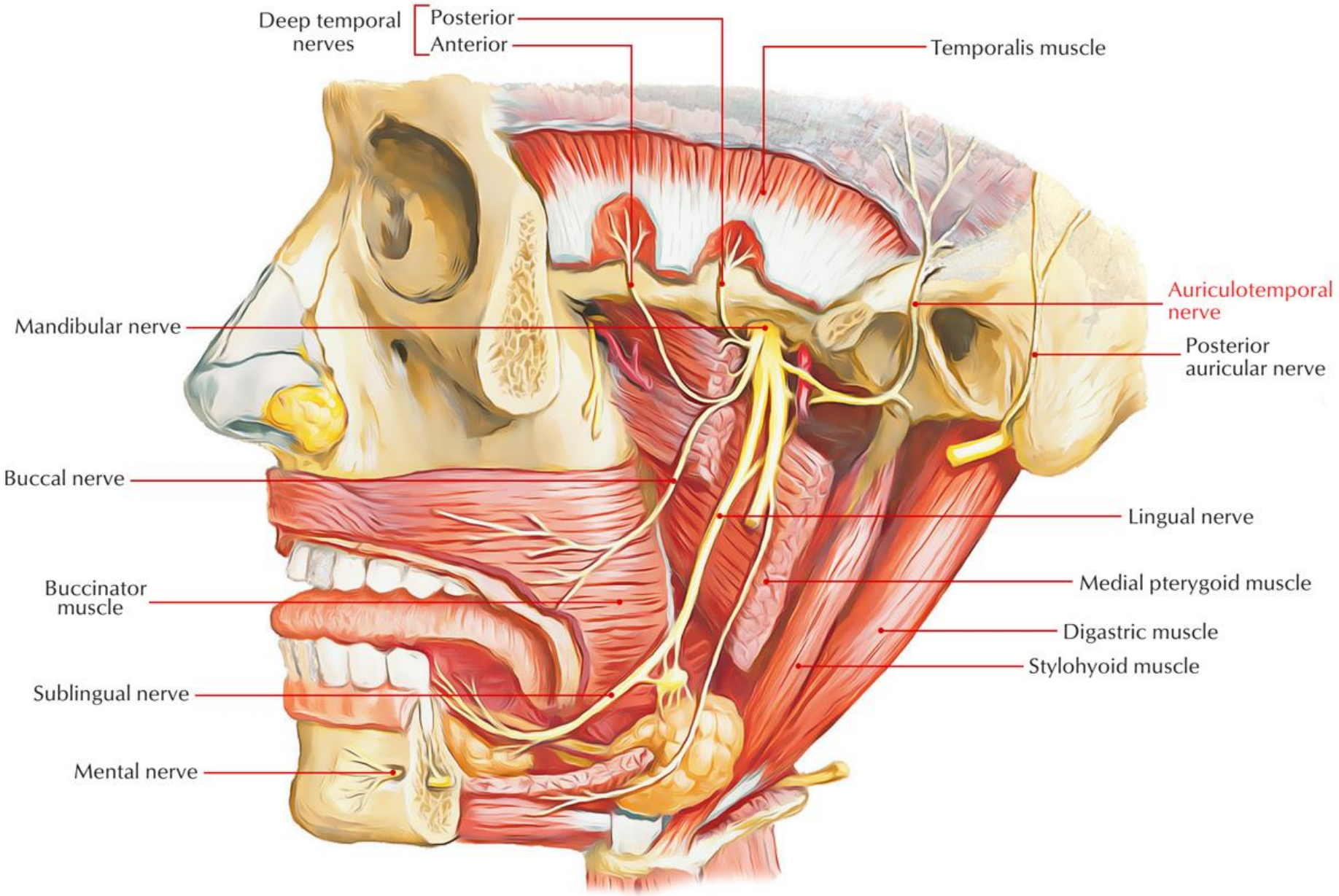
Mandibular Nerve

- ***Auriculotemporal Nerve:***

- Arises from 2 roots which run backwards and encircle the middle meningeal artery and form single trunk.

- Lies **behind** the **TMJ** close to the parotid

- Ascends behind superficial temporal vessels and then in temporal region divides into superficial temporal branches

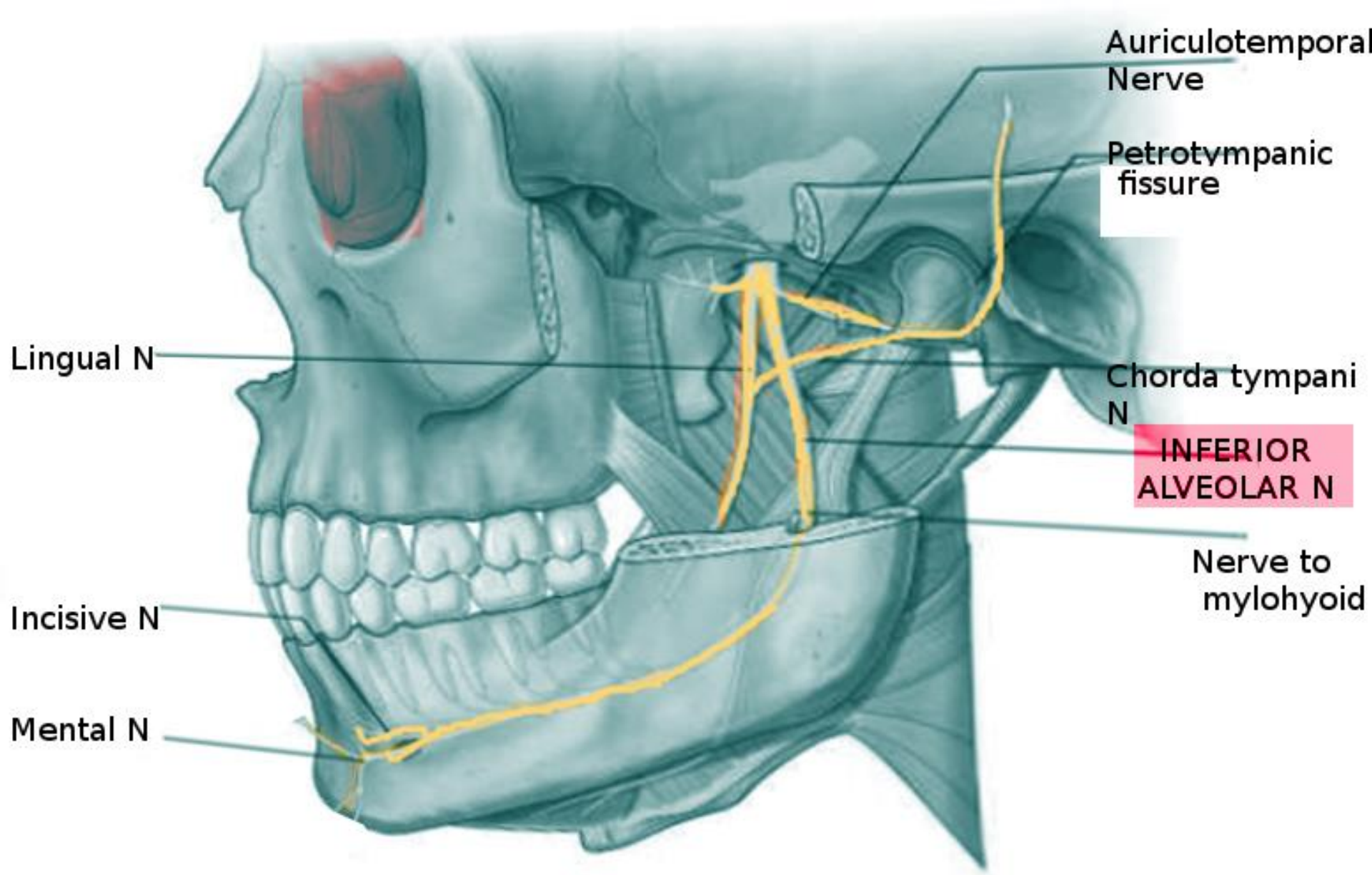

Deep temporal nerves
Posterior
Anterior
Temporalis muscle
Auriculotemporal nerve
Mandibular nerve
Posterior auricular nerve
Buccal nerve
Lingual nerve
Buccinator muscle
Medial pterygoid muscle
Digastric muscle
Stylohyoid muscle
Sublingual nerve
Mental nerve

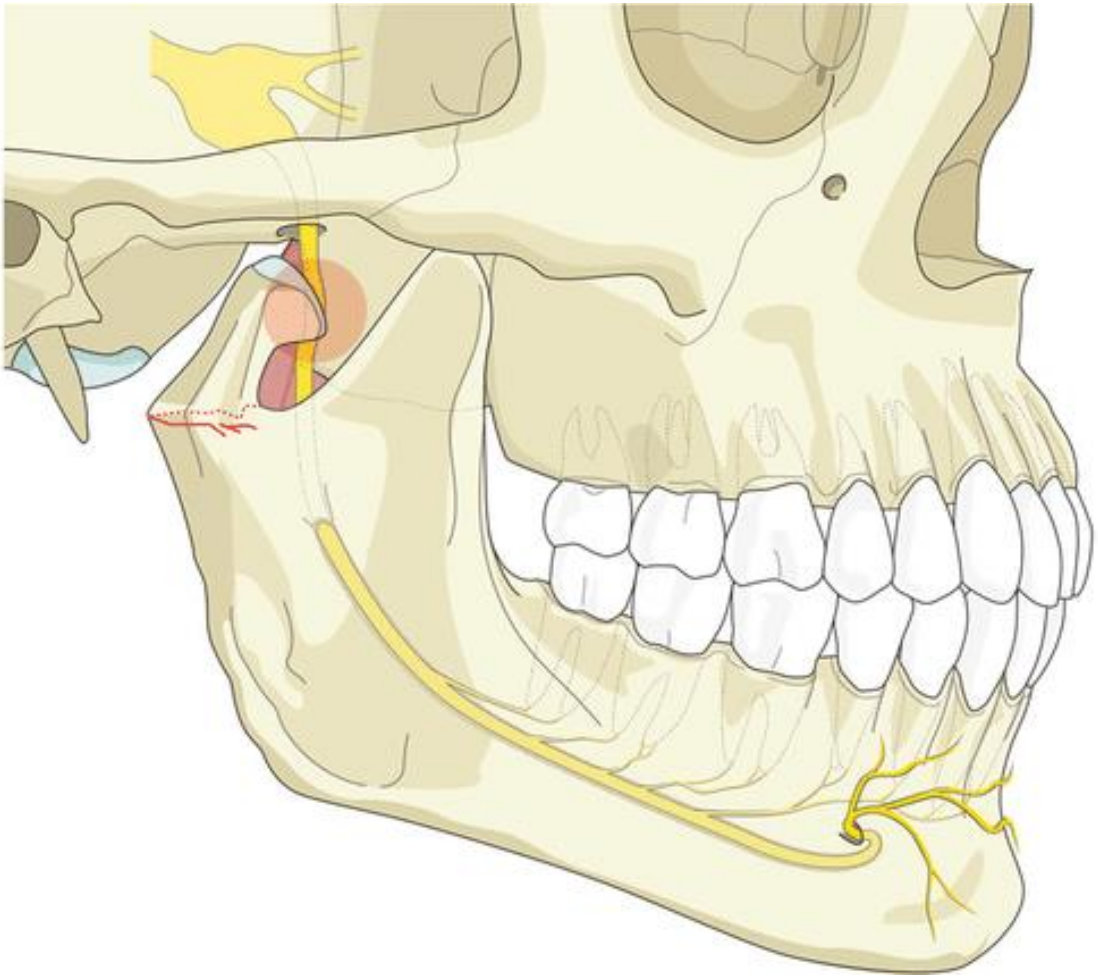
Mandibular Nerve

- ***Auriculotemporal Nerve (Branches):***
- Auricular branches to the **ear**
- Superficial temporal branches, **supply** **skin** of **temple**
- It also supply sensory and secretomotor to **parotid**.
- Articular branches, supply the **TMJ**.

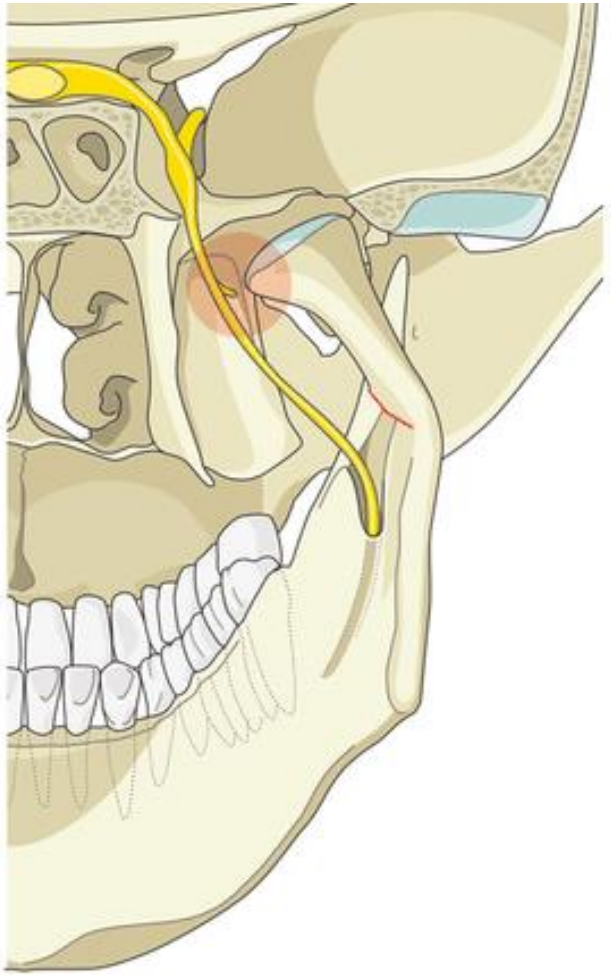
Mandibular Nerve

- ***Inferior Alveolar Nerve:***
- Is ***mixed nerve***
- Runs vertically downwards medial to lateral pterygoid and latero-posterior to lingual nerve.
- Enters mandible through mandibular foramen to run in a bony canal below the teeth


Auriculotemporal Nerve
Petrotympanic fissure
Lingual N
Chorda tympani N
INFERIOR ALVEOLAR N
Nerve to mylohyoid
Incisive N
Mental N



a



b

Mandibular Nerve

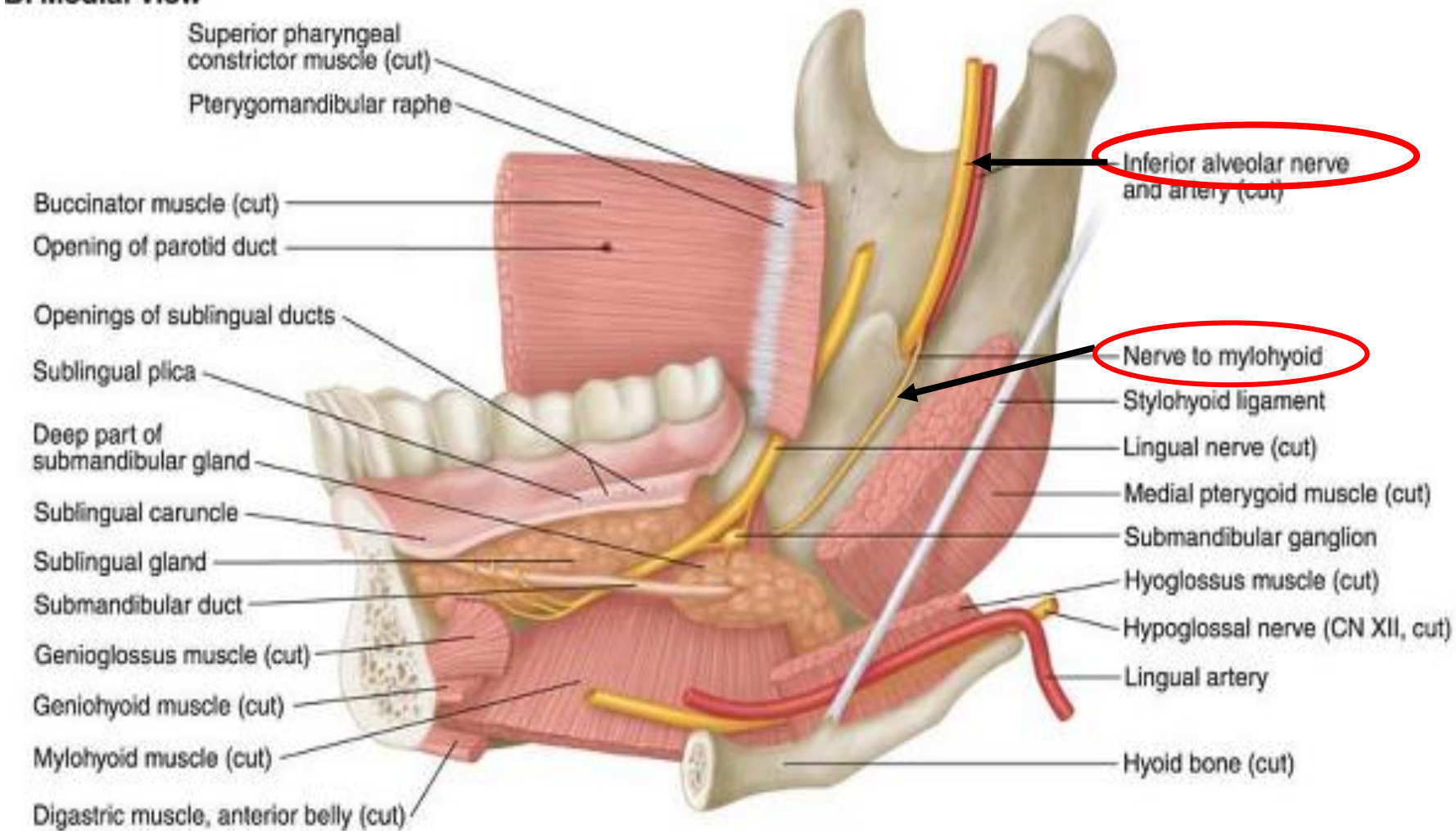
- ***Branches:***

1. ***Mylohyoid N.:*** through mylohyoid groove to mylohyoid & ant. belly of digastric Ms.

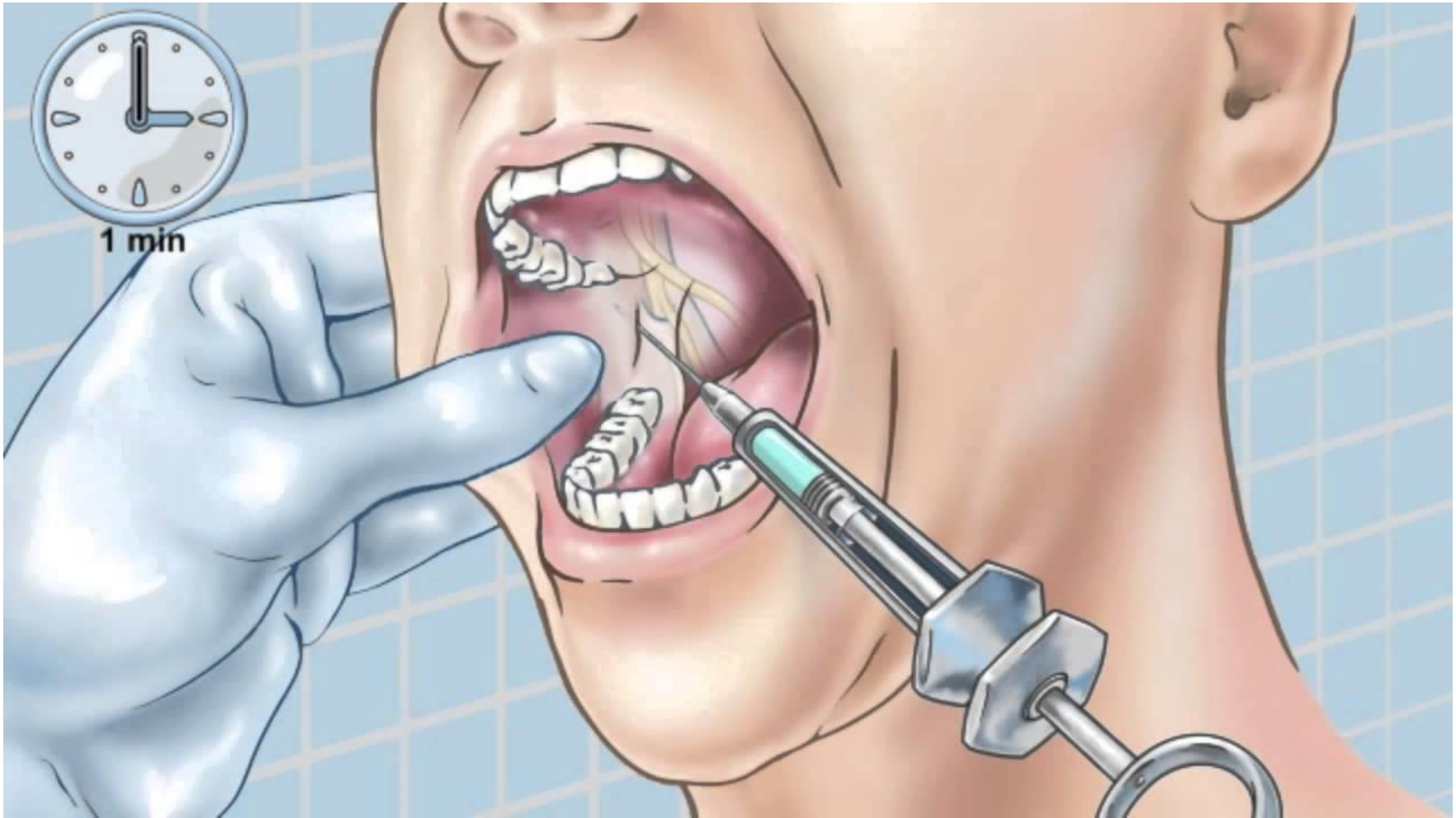
2. Branches to ***all teeth of the mandible***

3. Terminal mental & incisive n (***mental N.*** → mental foramen for ***skin*** over ***chin of mandible*** & ***incisive N.*** for ***incisor teeth***)

B. Medial view



Inferior Alveolar N. Block



Anesthesia of inferior alveolar n. is widely practiced by most DENTISTS.

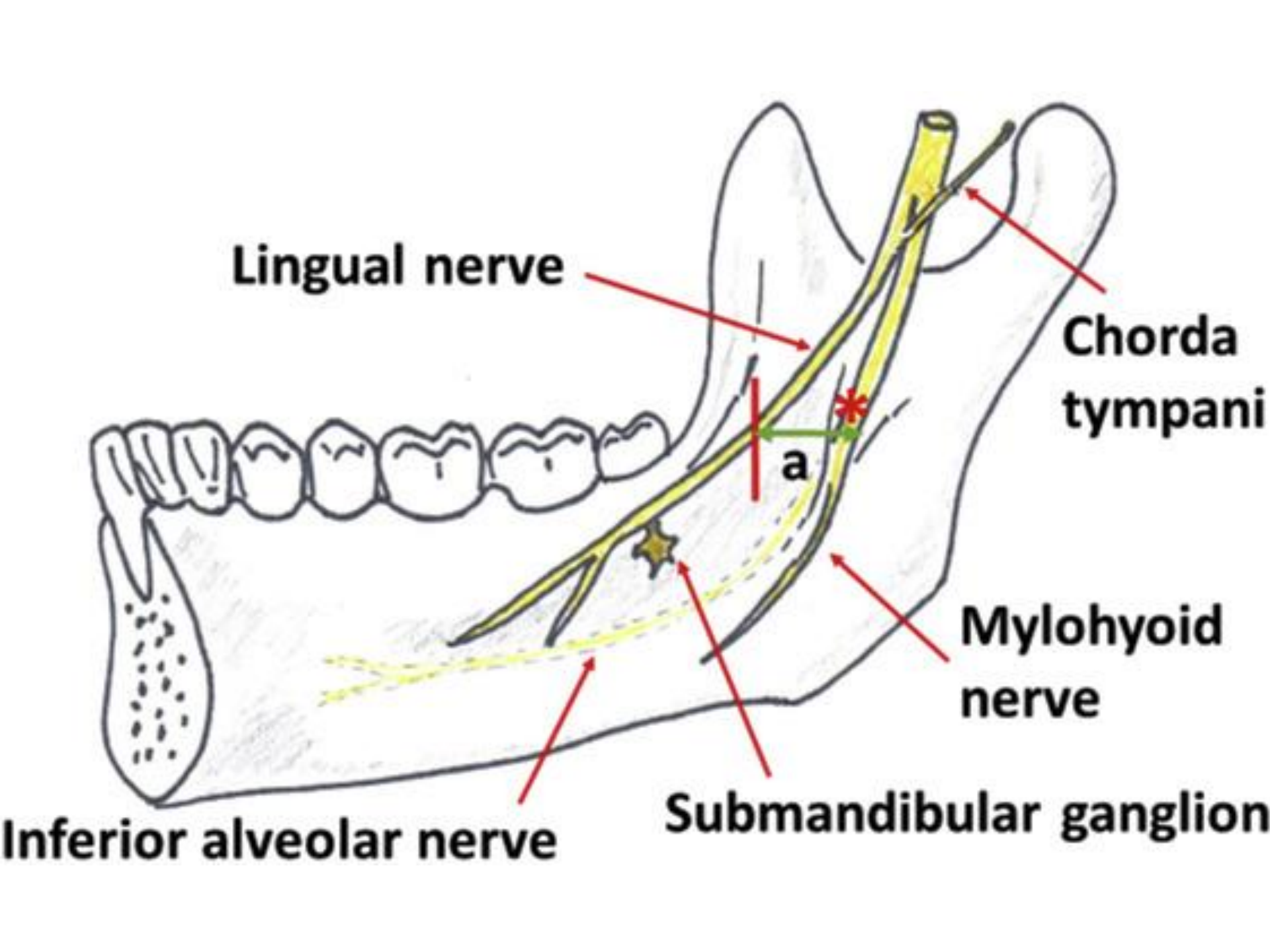
Needle is placed lateral to anterior arch in the buccal cavity

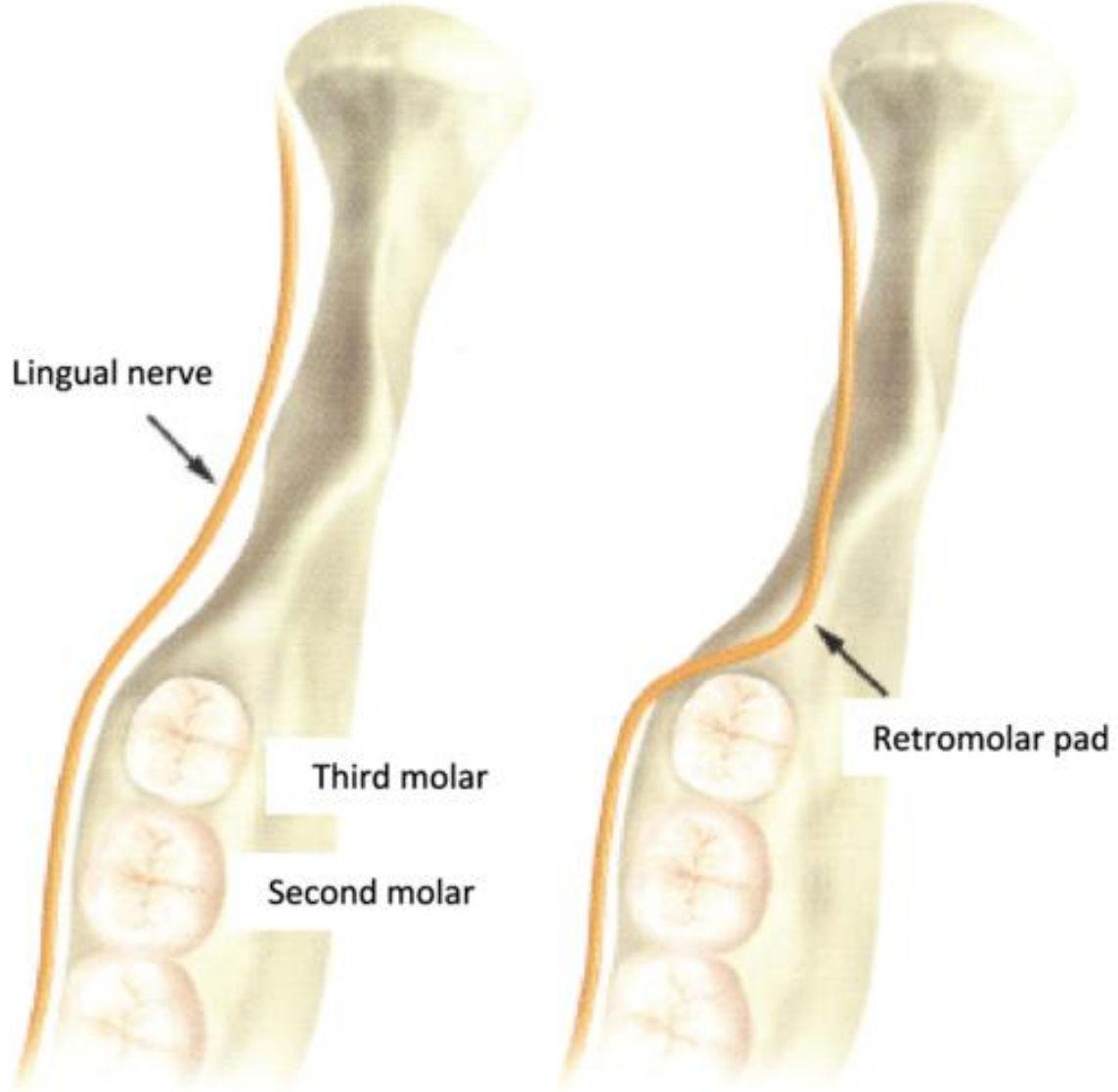
Mandibular Nerve

- ***Lingual Nerve:***

- It runs partly in infratemporal fossa & partly in submandibular region

- Reach to side of **base of tongue 1 cm below and behind 3rd molar** just below mucous membrane of lateral lingual sulcus (**Dangerous Area**)


Lingual nerve
Chorda tympani
a
Mylohyoid nerve
Submandibular ganglion
Inferior alveolar nerve


Lingual nerve
Third molar
Second molar
Retromolar pad
Normal Pathway
Abnormal Pathway

Mandibular Nerve

- ***Lingual Nerve:***

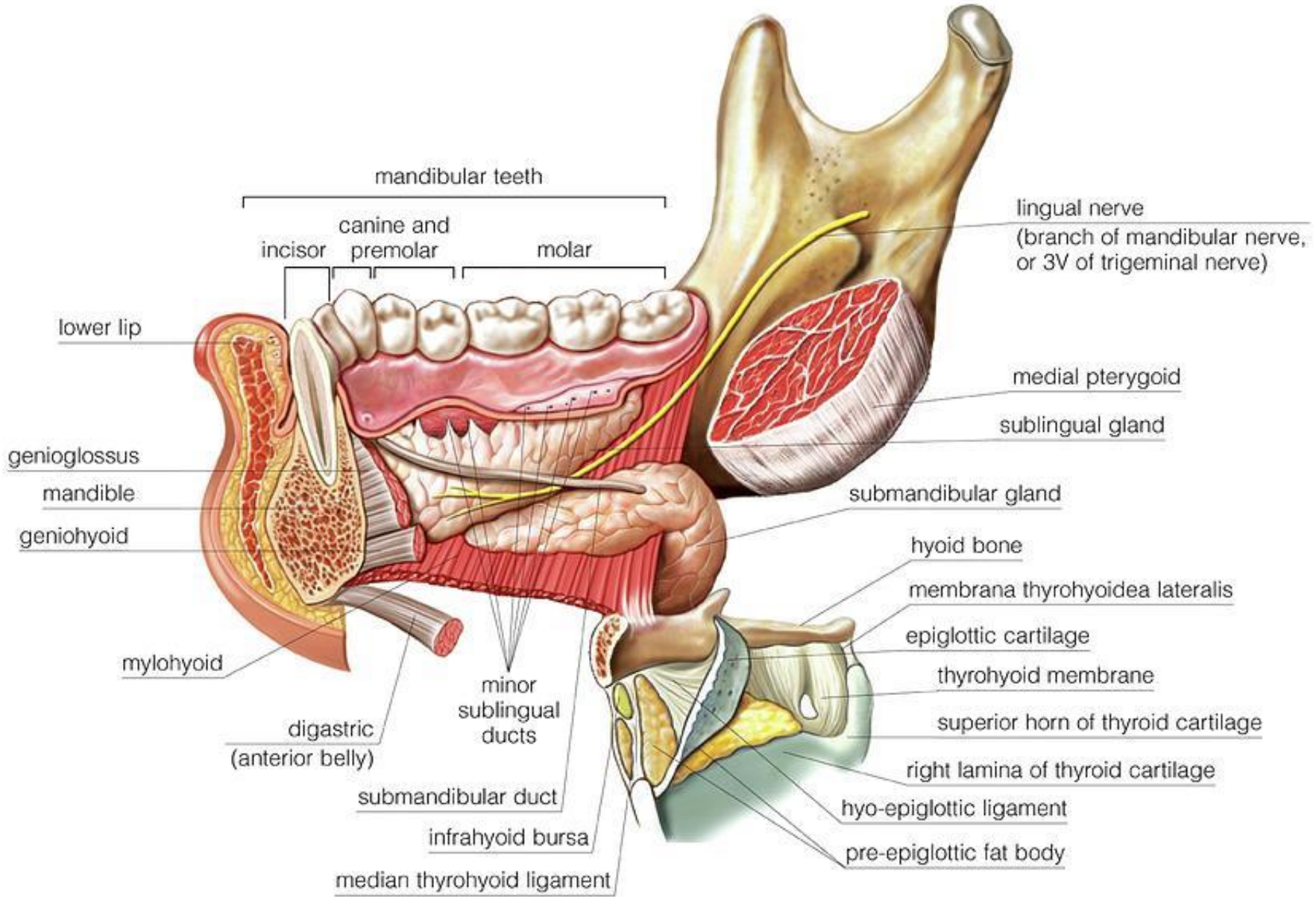
- In submandibular region, lingual nerve crosses the posterior end of mylohyoid line just behind the 3rd molar teeth. It supplies the mucous membrane of ant 2/3 of tongue (general sensations)

Mandibular Nerve

- ***Lingual Nerve:***

- Then proceeds anteriorly across the muscles of tongue ,looping medially and downwards to submandibular duct to deep surface of submandibular gland where it break in terminal branches

- In ***infratemporal fossa,*** lingual N. is joined by ***chorda tympani*** (br. of facial n) which carries taste fibers from ant 2/3 of tongue & parasympathetic fibers to **submandibular** & **sublingual salivary glands**


mandibular teeth
incisor
canine and premolar
molar
lingual nerve
(branch of mandibular nerve, or 3V of trigeminal nerve)
lower lip
medial pterygoid
sublingual gland
genioglossus
mandible
submandibular gland
geniohyoid
hyoid bone
membrana thyrohyoidea lateralis
epiglottic cartilage
thyrohyoid membrane
mylohyoid
minor sublingual ducts
superior horn of thyroid cartilage
digastric (anterior belly)
right lamina of thyroid cartilage
submandibular duct
hyo-epiglottic ligament
infrahyoid bursa
pre-epiglottic fat body
median thyrohyoid ligament

Trigeminal in the Face

- Each half of face is supplied by 13 cutaneous nerves: **1 motor and 12 sensory**

Of 12 sensory:

1. **11 are from trigeminal nerve**
2. **Last is C2 greater auricular nerve**

Trigeminal in the Face

- **Branches of trigeminal nerve:**

1. **5 from ophthalmic:**

i. Lacrimal
ii. Supraorbital
iii. Supratrocheal
iv. Infratrochlear
v. External nasal

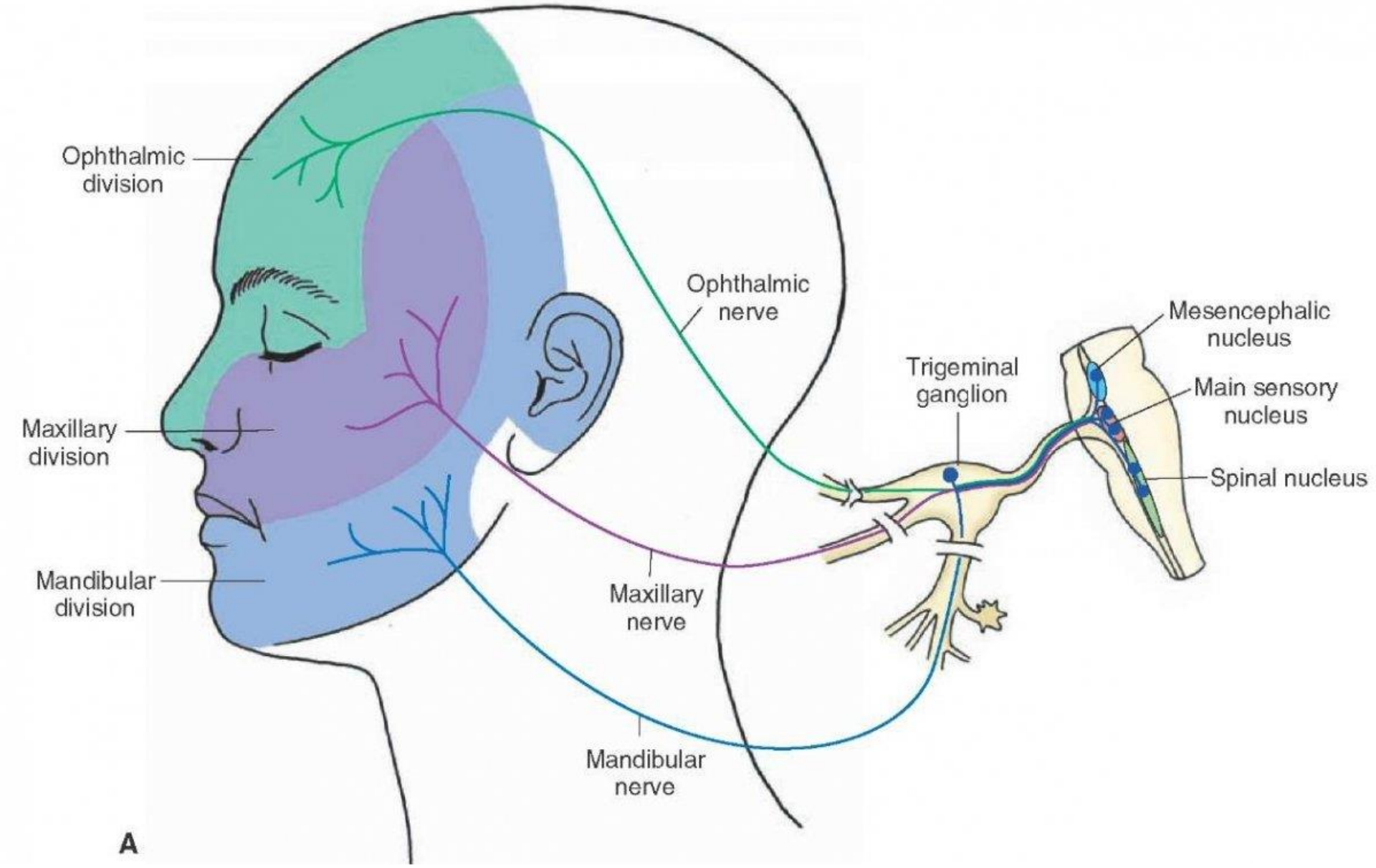
Trigeminal in the Face

2. ***3 from maxillary N:***

i. Infra orbital nerve
ii. Zygomaticofacial nerve
iii. Zygomaticotemporal nerve

3. ***3 from mandibular nerve:***

i. Buccal nerve
ii. Auriculotemporal nerve
iii. Mental nerve


Ophthalmic division
Maxillary division
Mandibular division
Ophthalmic nerve
Maxillary nerve
Mandibular nerve
Trigeminal ganglion
Mesencephalic nucleus
Main sensory nucleus
Spinal nucleus
A

- For further inquiries ***PLZ*** feel free to contact at any time through email

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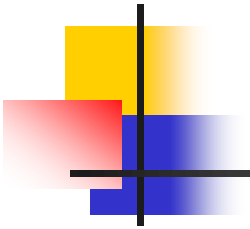

Thank You