
بسم اللہ الرحمٰن الرحیم
شروع اللہ کے نام سے جو بڑا مہربان نہایت رحم والا ہے۔
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Anatomy of Trigeminal Nerve
&
Trigeminal Neuralgia

By

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INTRODUCTION

- Trigeminal nerve is the largest and thick cranial nerve.

  It is a mixed nerve.

  Composed of a small motor root and a considerably larger sensory root.

  The sensory root contains 170000 fibres and the motor root contains 7700 fibres.

Function

- The sensory function of the trigeminal nerve is to provide the tactile, proprioceptive, and nociceptive afference of the face and mouth.

- The motor function activates the muscles of the mastication, the tensor tympani, tensor veli palatini, mylohyoid, and anterior belly of the digastric.

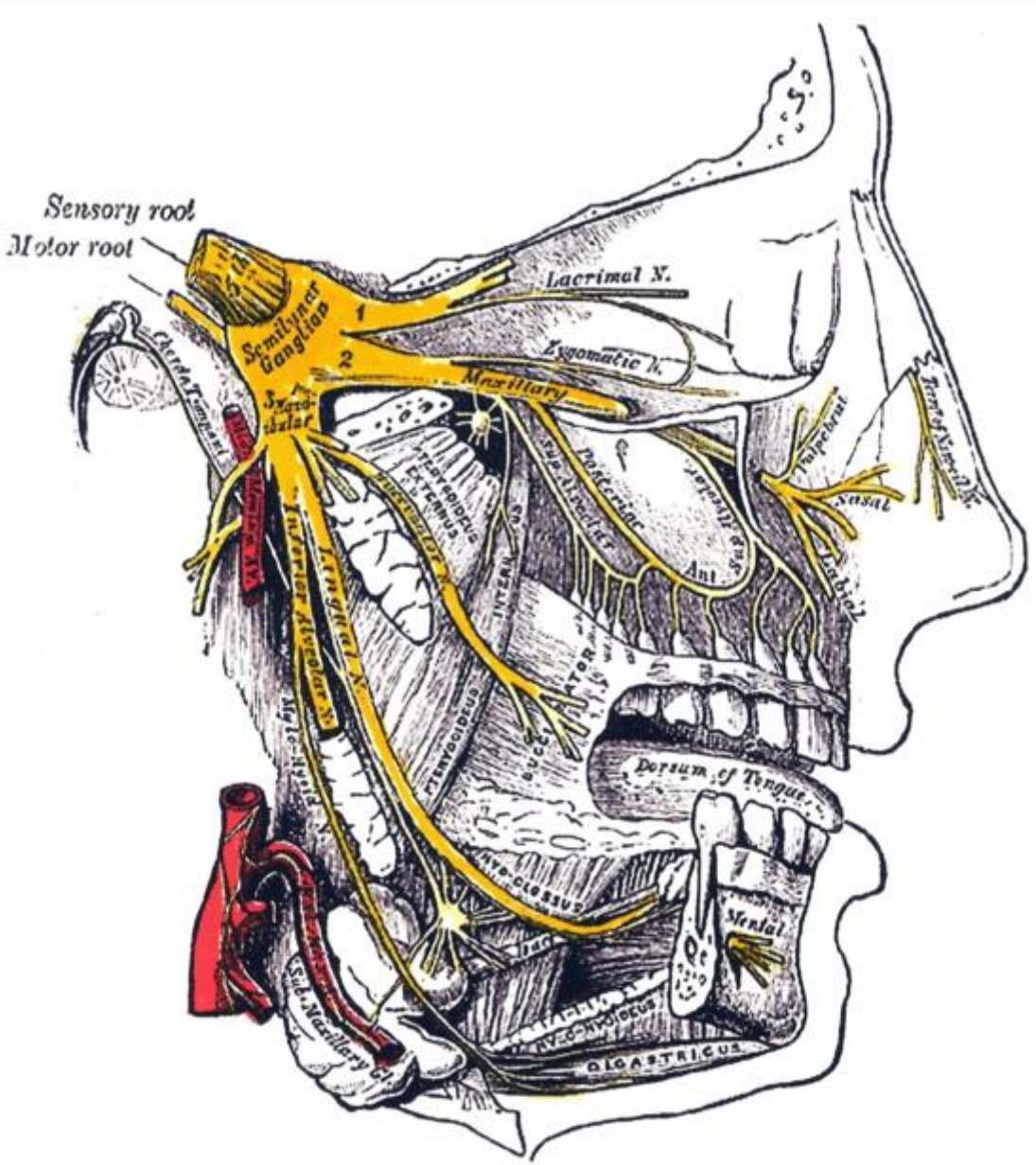
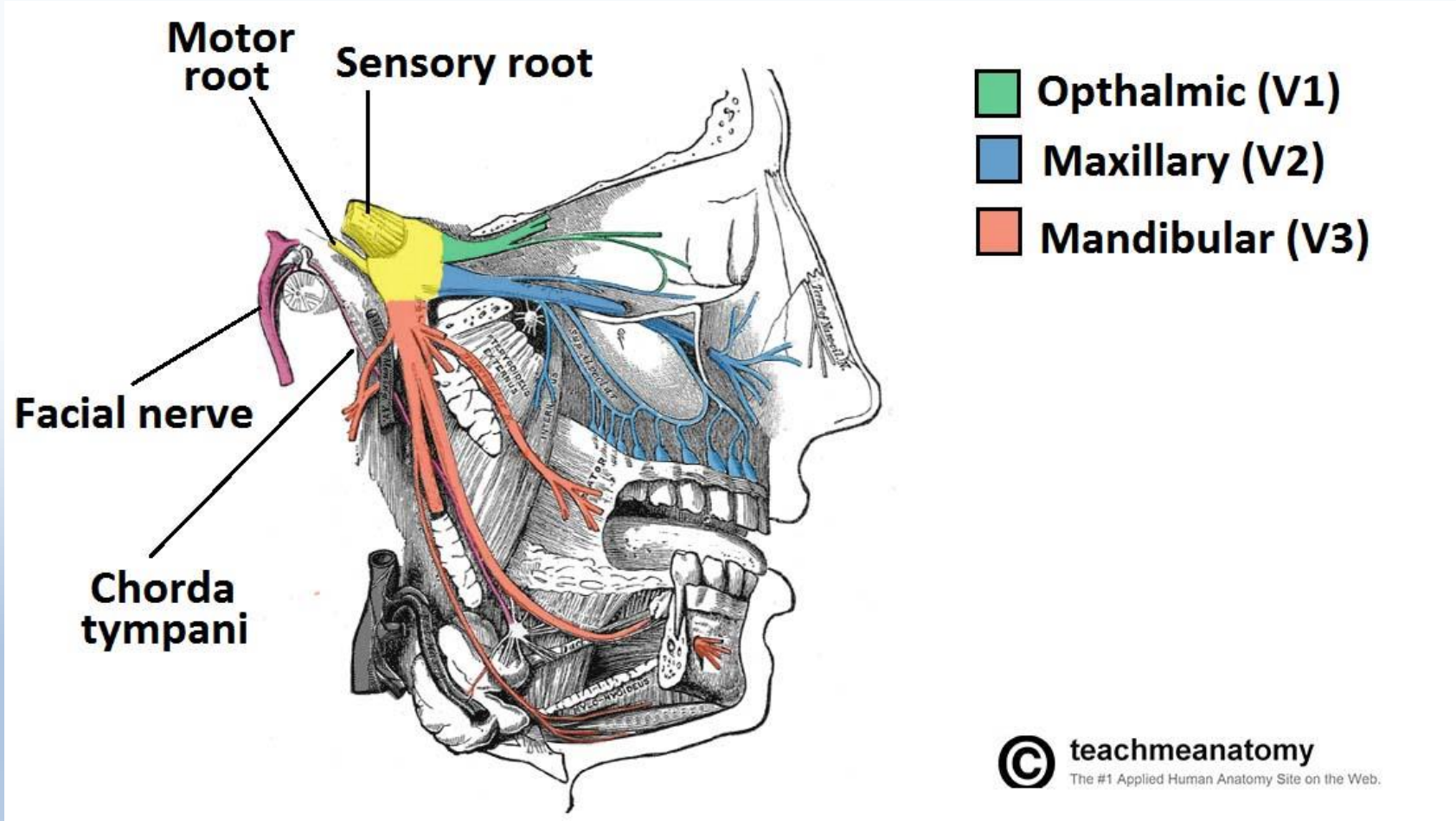


Fig 2 – Overview of the deep distribution of the trigeminal nerve and its terminal branches.



Nuclei of trigeminal nerve:-

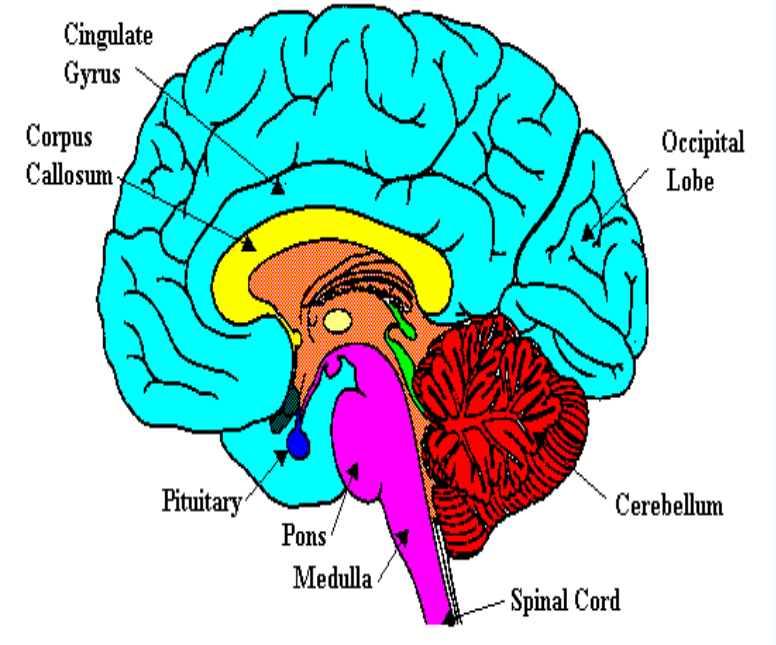
It has got 4 nuclei :

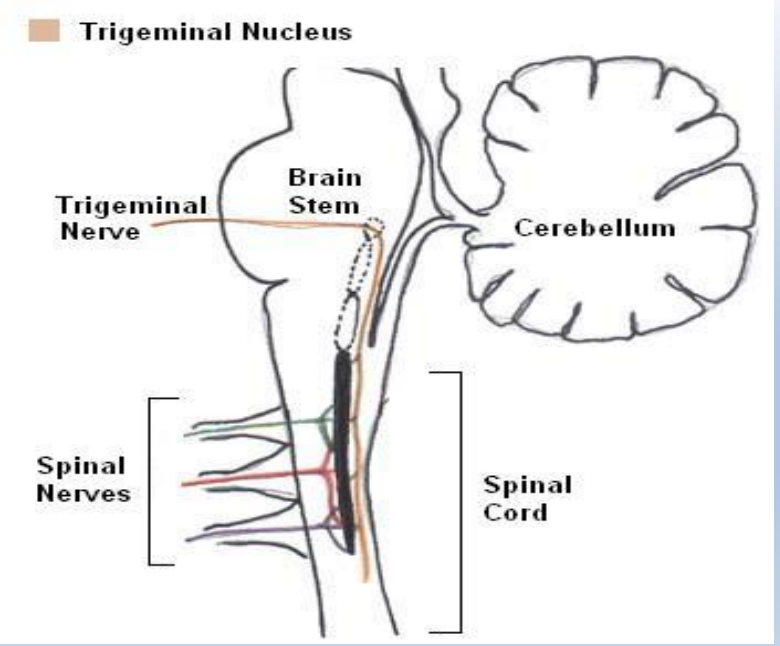
1) Main sensory nuclei

2) Spinal nuclei

3) Mesencephalic nuclei

4) Motor nuclei



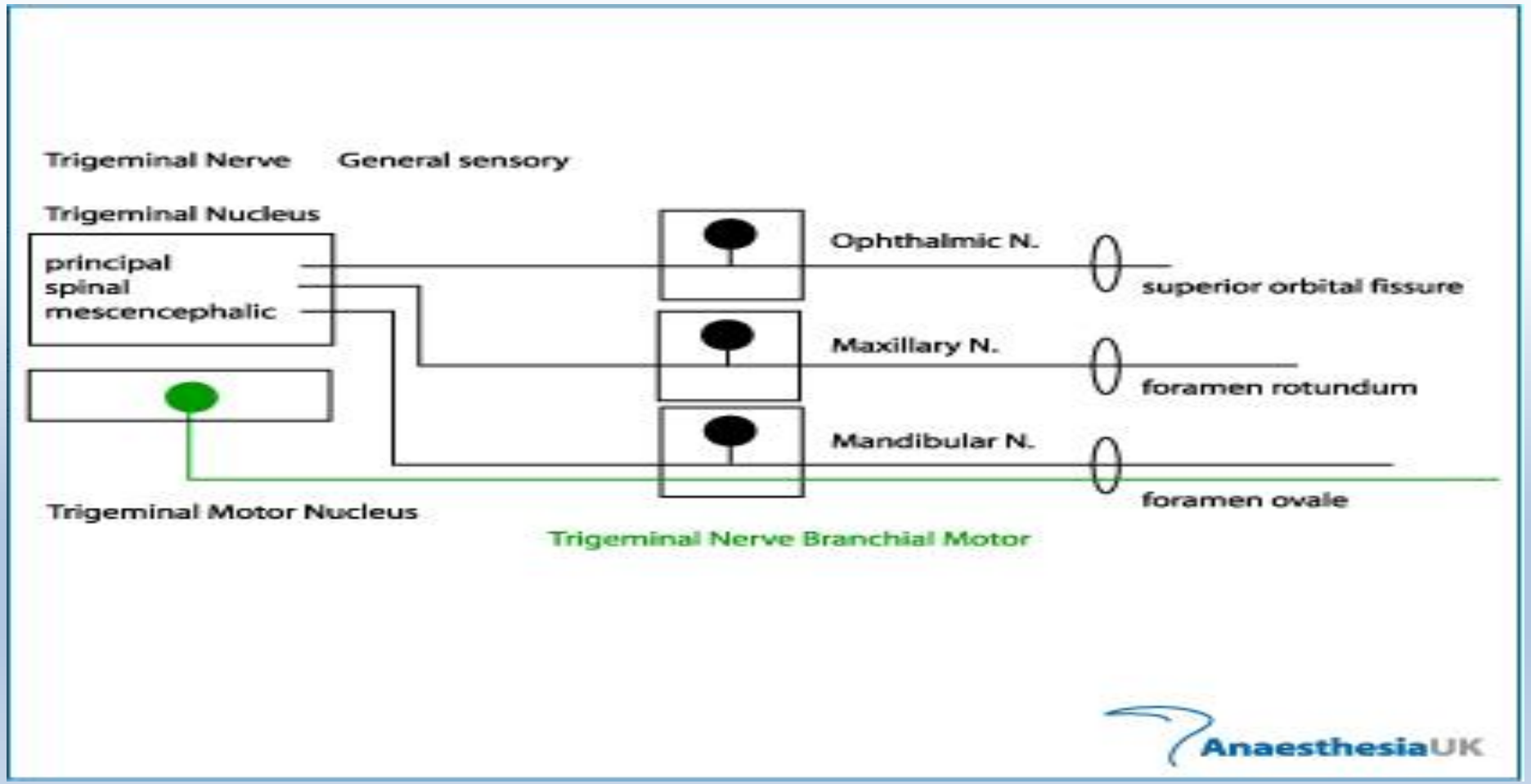


1. Mesencephalic nuclues in midbrain.

2.Main sensory nucleus situated in upper pons.

3.Spinal nuclues in upper pons to C2 segment of spinal cord.

4.Motor nucleus situated in upper pons.



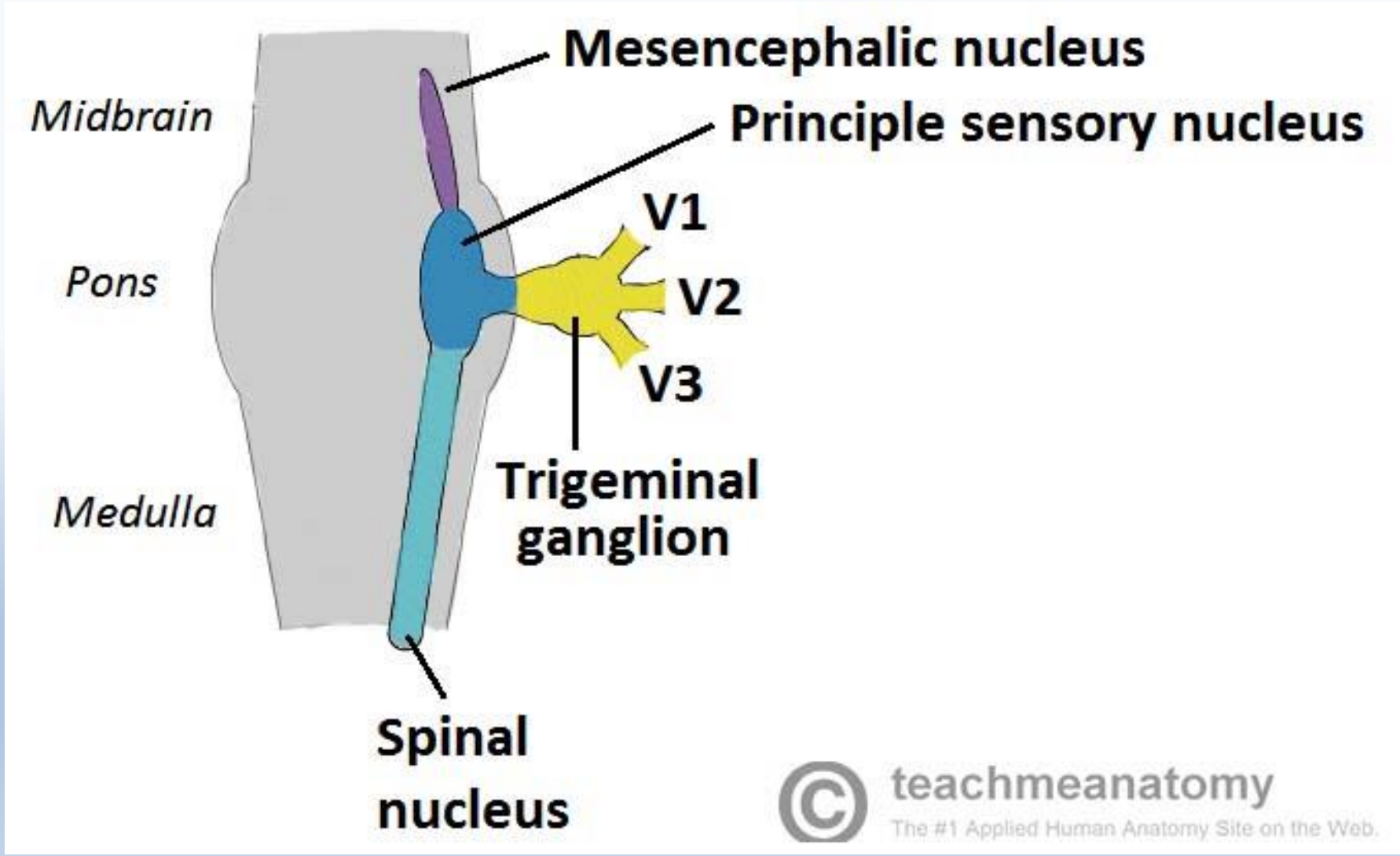
ASSOCIATED ROOTS AND BRANCHES:-

The **central processes** of the ganglion cells form the large sensory root of the trigeminal nerve ,which is attached to pons at its junction with the

1.Middle cerebellar peduncle.

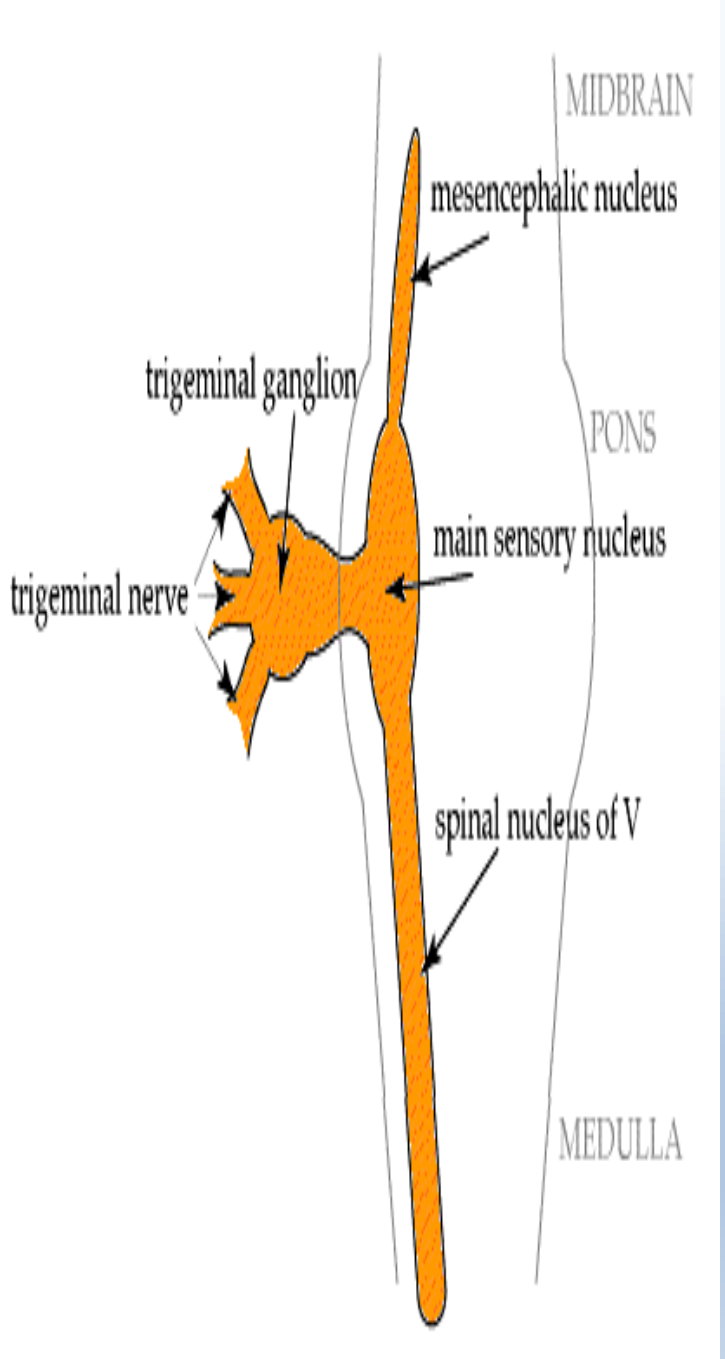
2. The **peripheral processes** form the three divisions of the trigeminal nerve.

The origin of the sensory aspect of the trigeminal nerve. Note that the nuclei are situated within in the CNS, and the ganglia outside the CNS.



- **SENSORY NUCLEI :**

  1.Mesencephalic nucleus.
  Situated in midbrain.
- First order sensory nucleus.
- Cell body of pseudounipolar neurons.
- Recieves general somatic afferent fibres.
- Relay proprioception from :
  -muscles of mastication
  -facial muscles
  -eye

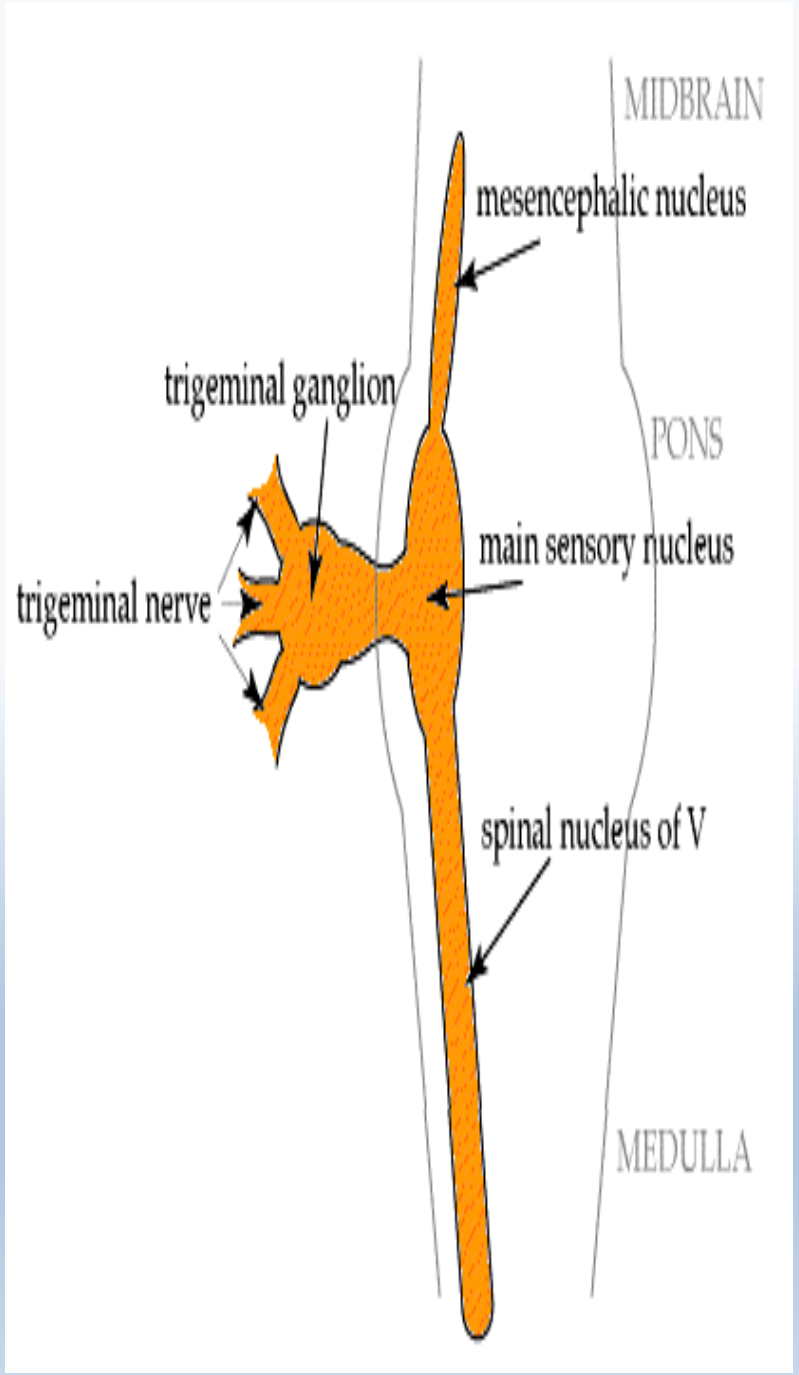


- ***2.PRIMARY SENSORY NUCLEUS***

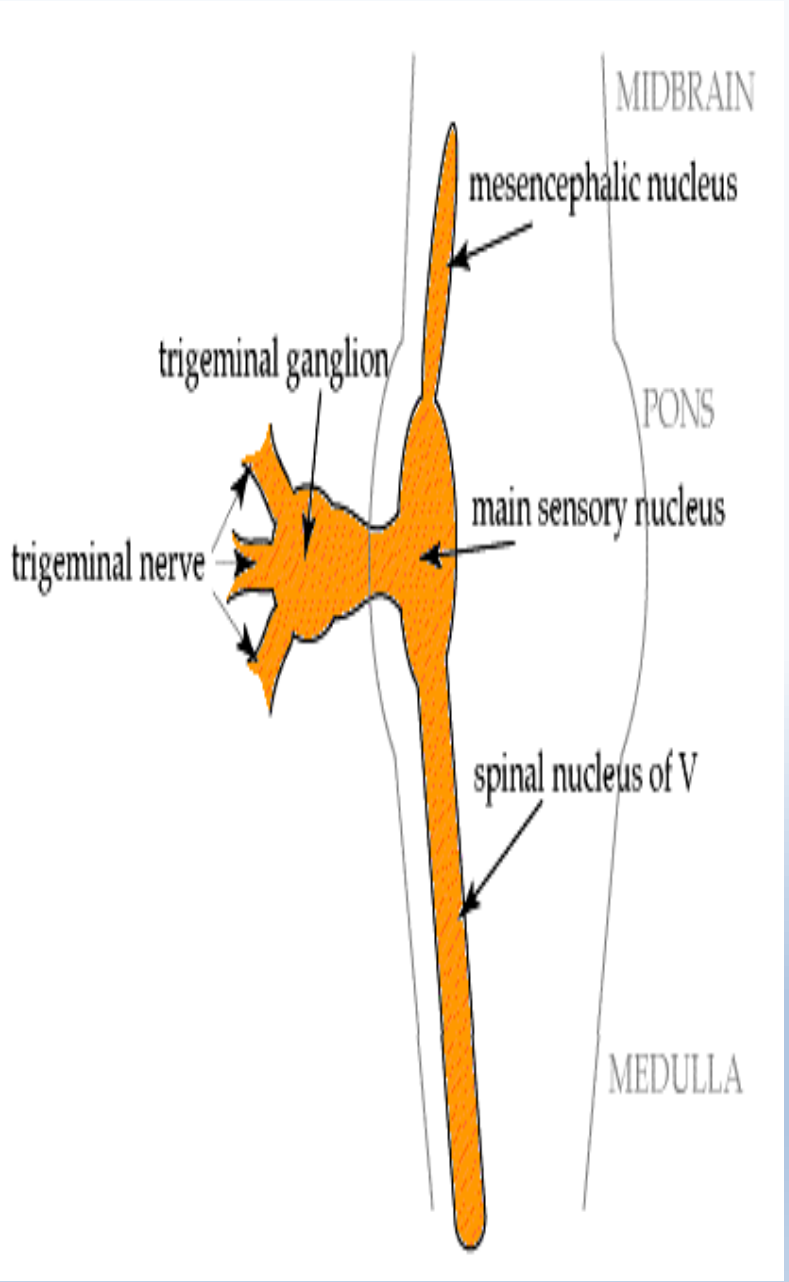
  Situated in upper part of pons lateral to motor nucleus.

  Recieves general somatic afferent fibres.

  Relays impulses of touch and pressure from skin and mucous membrane of facial region.



- ***3.The spinal nucleus*:**
  it extends from caudal end of principal sensory
  nucleus in pons to 2nd or 3rd spinal segment where it
  continues with Sub. Gelatinosa
  Divided into three parts :-
  1. Subnucleus oralis
  2. Subnucleus interpolaris
  3. Subnucleus caudalis
  It receives general somatic afferent fibres
  Relays the impulses of pain and temperature of face



1.THE MOTOR NUCLUES

It is situated in upper pons medial to principal sensory nucleus

Contains efferent fibres

.

Innervates muscles of mastication and tensor tympani and tensor palatini.

COURSE OF V NERVE

- The trigeminal nerve exits from the anterolateral surface of the pons as a large sensory root and a small motor root.
- These roots continue forward out of the posterior cranial fossa and into the middle cranial fossa by passing over the medial tip of the petrous part of the temporal bone

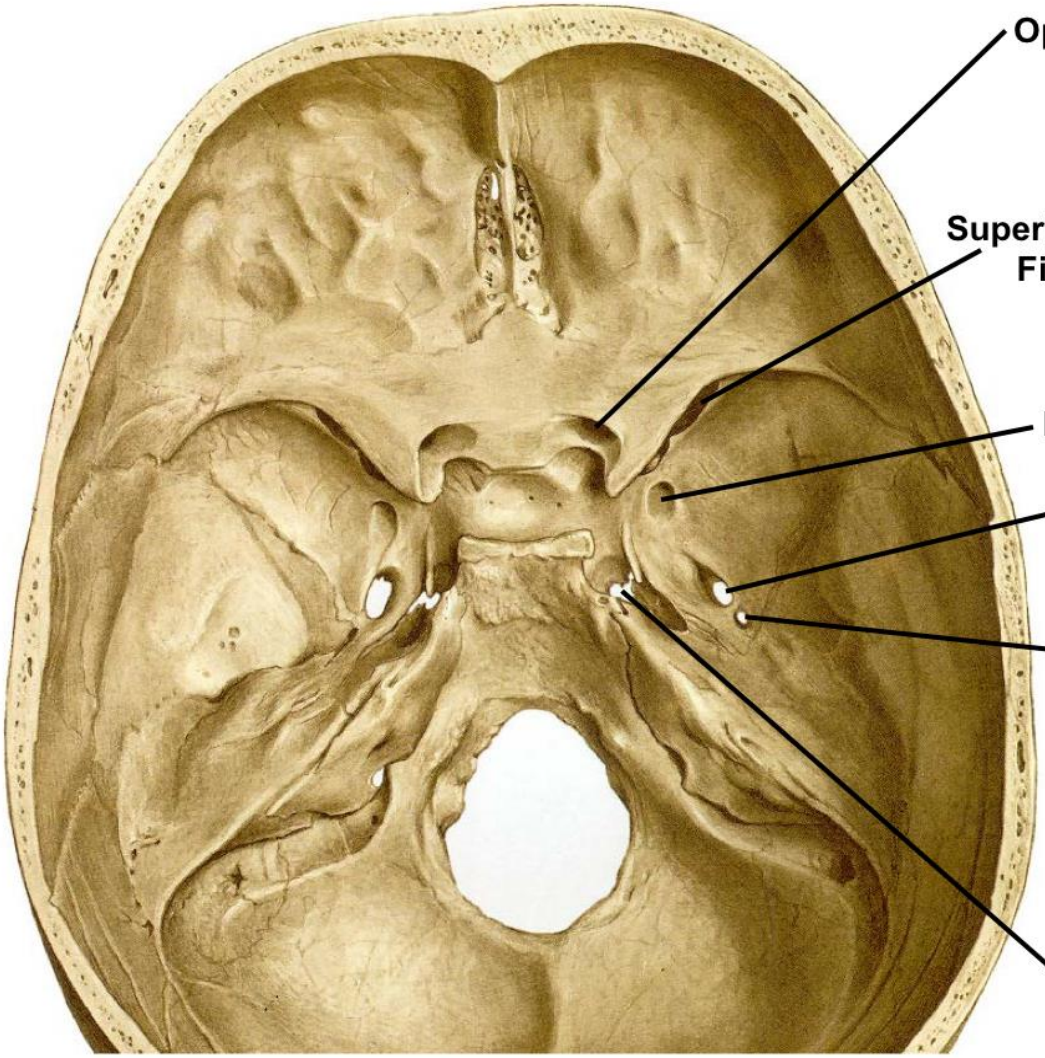
CONT.....

- In the middle cranial fossa the sensory root expands into the trigeminal ganglion. The ganglion is in a depression (the trigeminal depression) on the anterior surface of the petrous part of the temporal bone, in a dural cave (the trigeminal cave).
- The motor root is below and completely separate from the sensory root at this point.

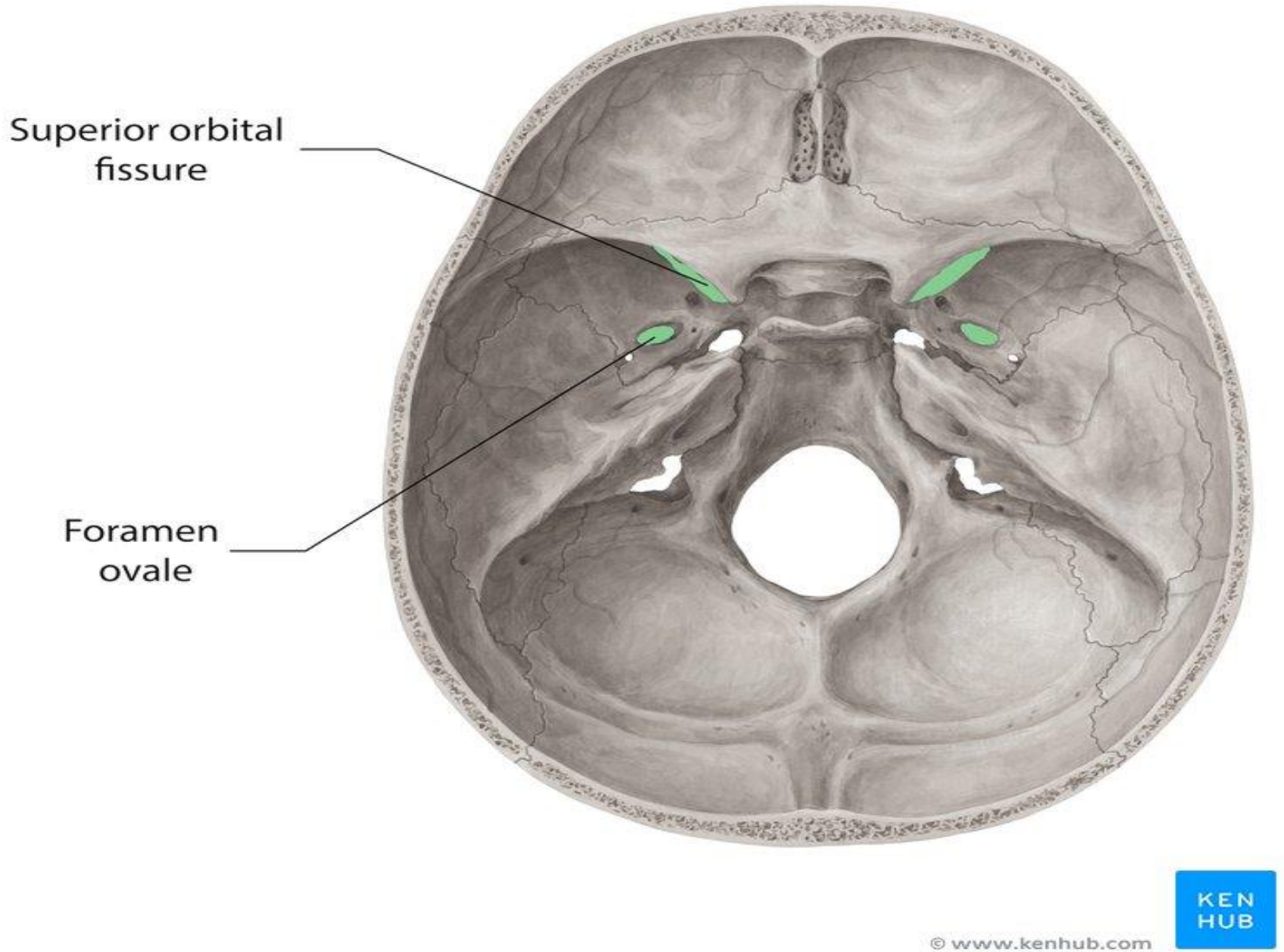
- Arising from the anterior border of the trigeminal ganglion are the three terminal divisions of the trigeminal nerve, which in descending order are:
- Ophthalmic (V_1), Maxillary (V_2), and Mandibular (V_3)

- Fibers run from the face to the pons via the superior orbital fissure (V_1),
- the foramen rotundum (V_2),
- and the foramen ovale (V_3)
- The mnemonic *"Standing Room Only"* can help you in quick recall of this.

Foramina of Middle Cranial Fossa



- **Optic Canal**
  - CN II (Optic Nerve)
  - Ophthalmic Artery
- **Superior Orbital Fissure**
  - CN III (Oculomotor Nerve)
  - CN IV (Trochlear Nerve)
  - CN V^1 (Ophthalmic Nerve)
  - CN VI (Abducens Nerve)
  - Ophthalmic Veins
- **Foramen Rotundum-** CN V^2 (Maxillary Nerve)
- **Foramen Ovale-** CN V^3 (Mandibular Nerve)
- **Foramen Spinosum**
  - Middle Meningeal A.
  - Meningeal N. (V^3)
- **Foramen Lacerum**
  (Covered by Cartilage)


Superior orbital fissure
Foramen ovale
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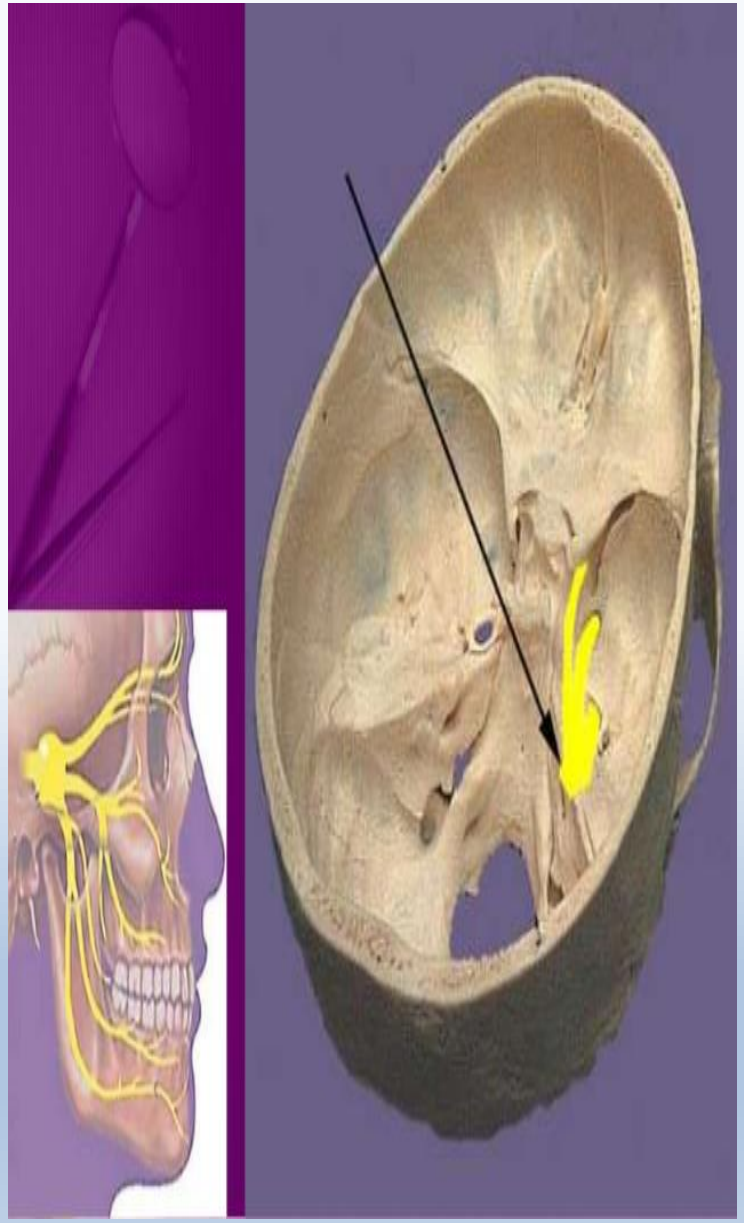
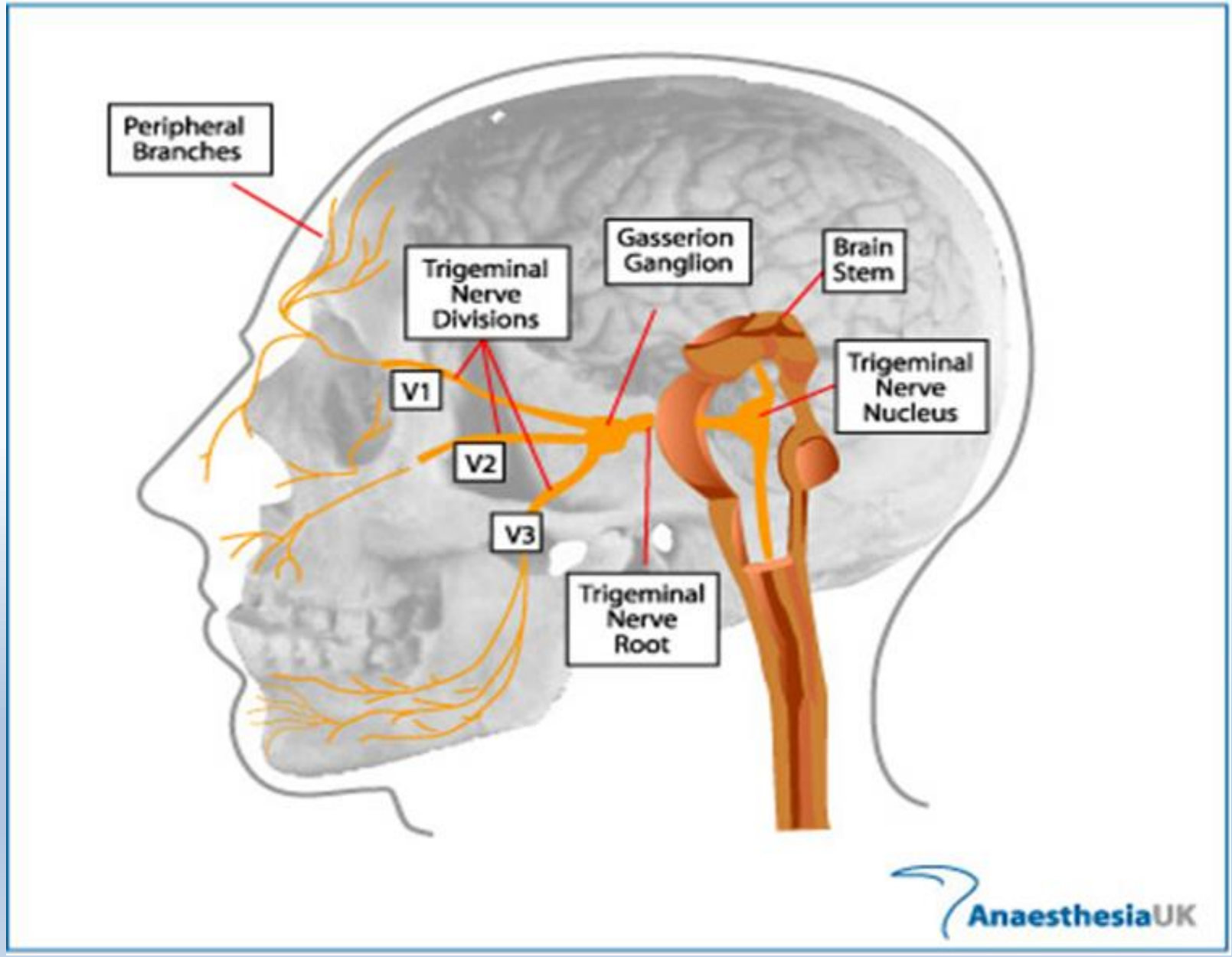
- Conveys sensory impulses from various areas of the face (V_1) and (V_2),
- and supplies motor fibers (V_3) for mastication

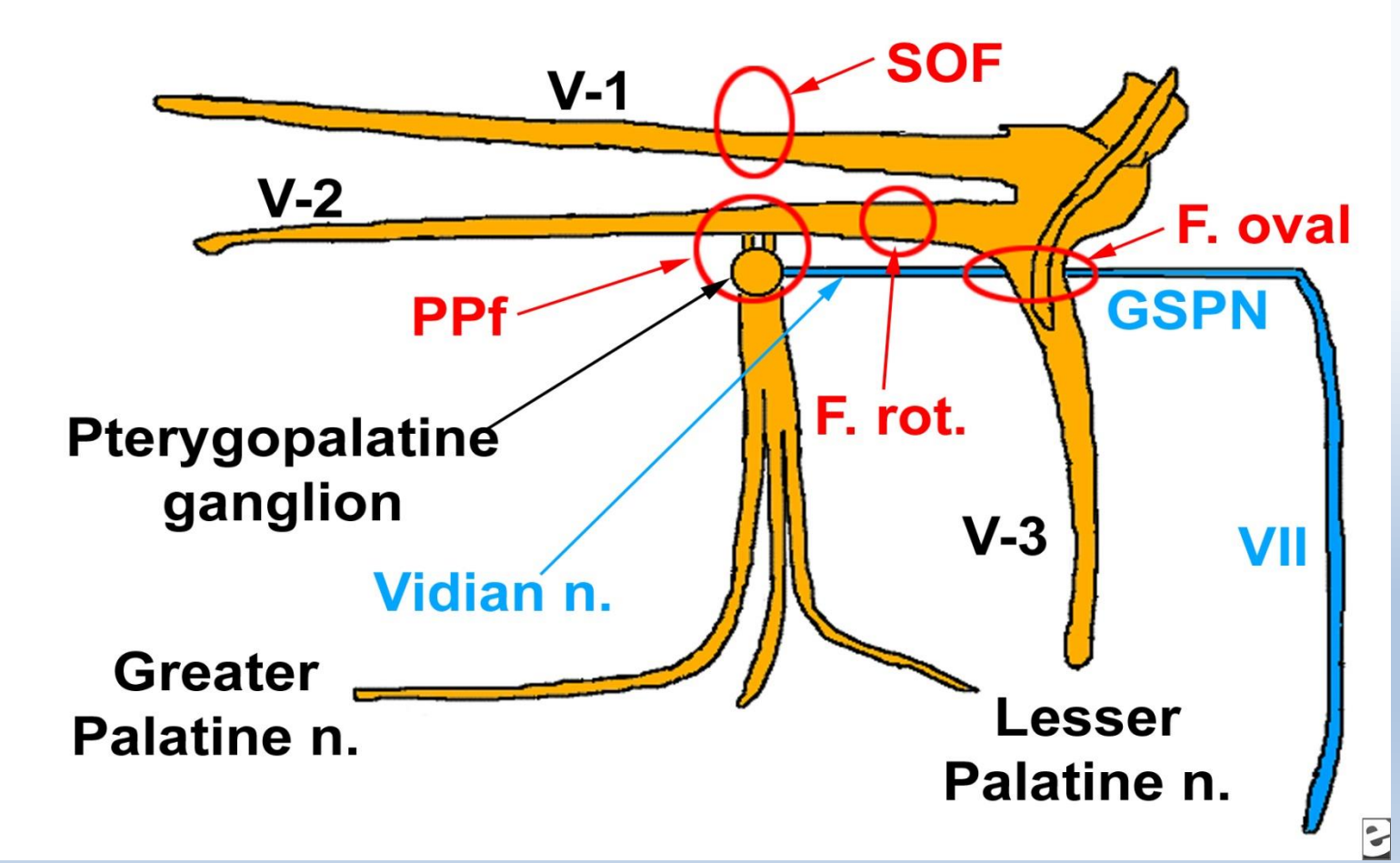
THE TRIGEMINAL GANGLION

Also known as Gasserian ganglion, or semilunar ganglion, is a sensory ganglion of the trigeminal nerve that occupies a cavity (Meckel's cave) in the dura mater, covering the trigeminal impression near the apex of the petrous part of the temporal bone.



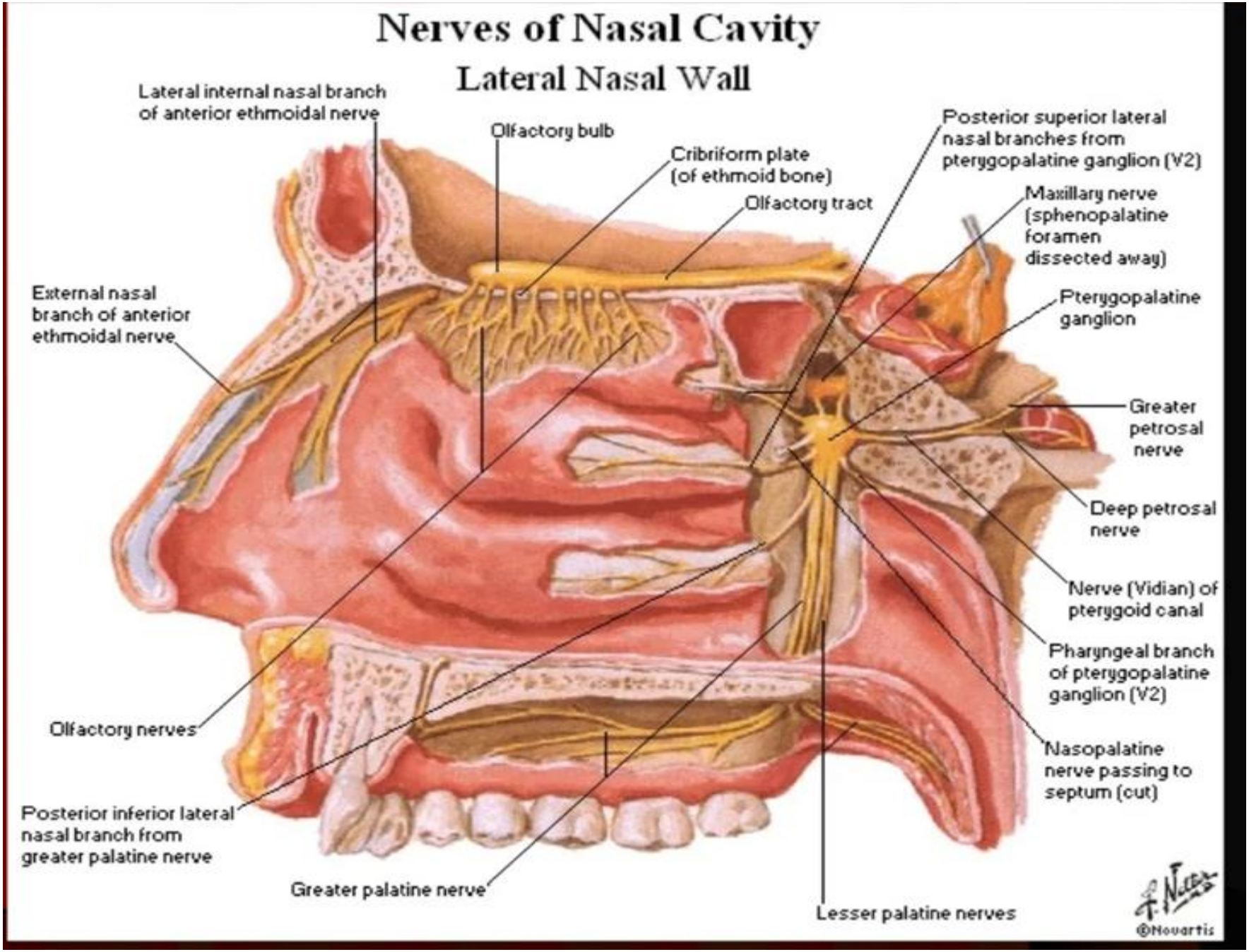

Peripheral Branches
Trigeminal Nerve Divisions
Gasserion Ganglion
Brain Stem
Trigeminal Nerve Nucleus
V1
V2
V3
Trigeminal Nerve Root
AnaesthesiaUK

THE TRIGEMINAL NERVE



Nerves of Nasal Cavity

Lateral Nasal Wall



OPTHALMIC DIVISION

- **The Ophthalmic division:-**

  Superior and smallest division.

  Sensory Nerve

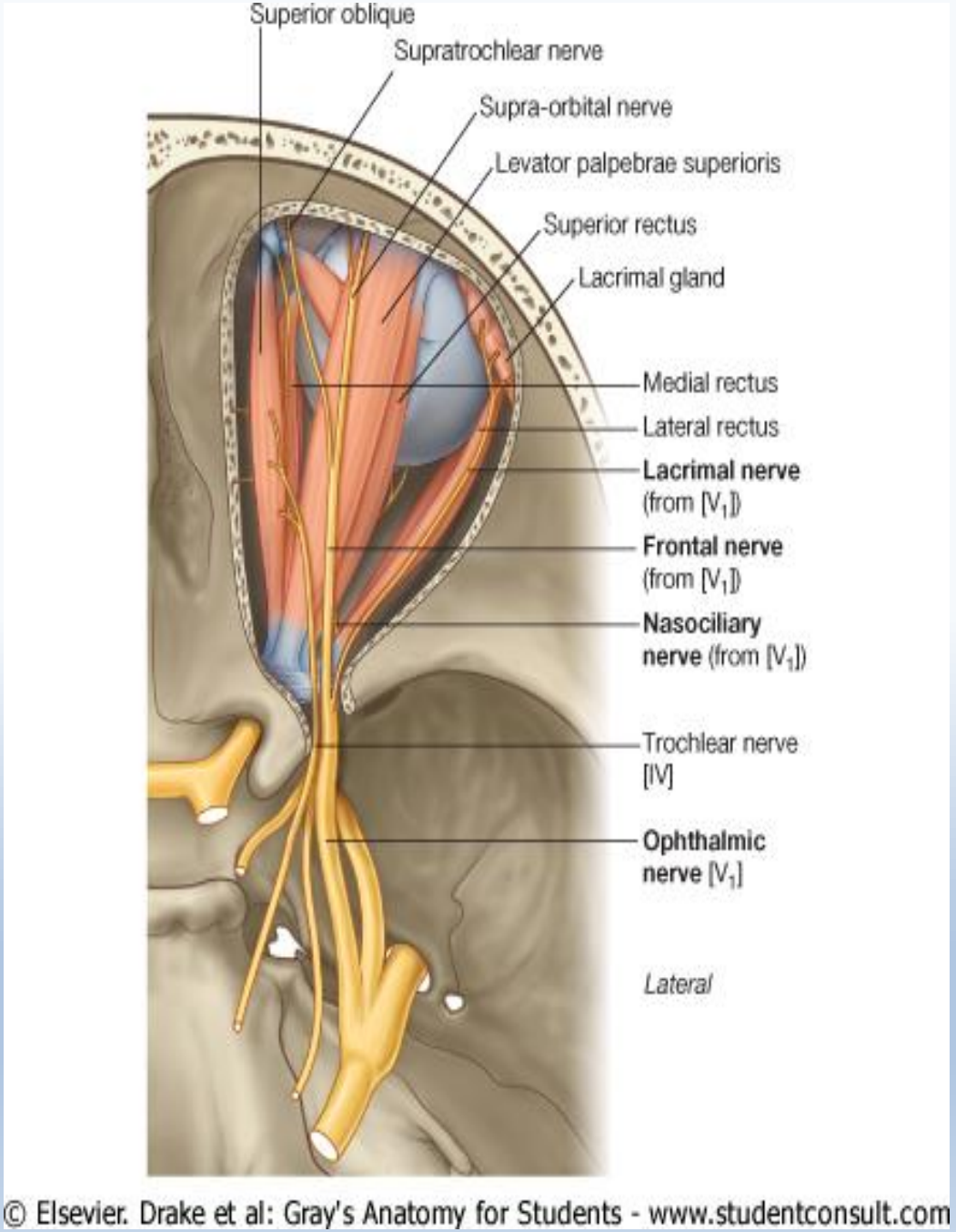
  Arises from the anteriomedial end of trigeminal ganglion as a flat band,2.5cm long.

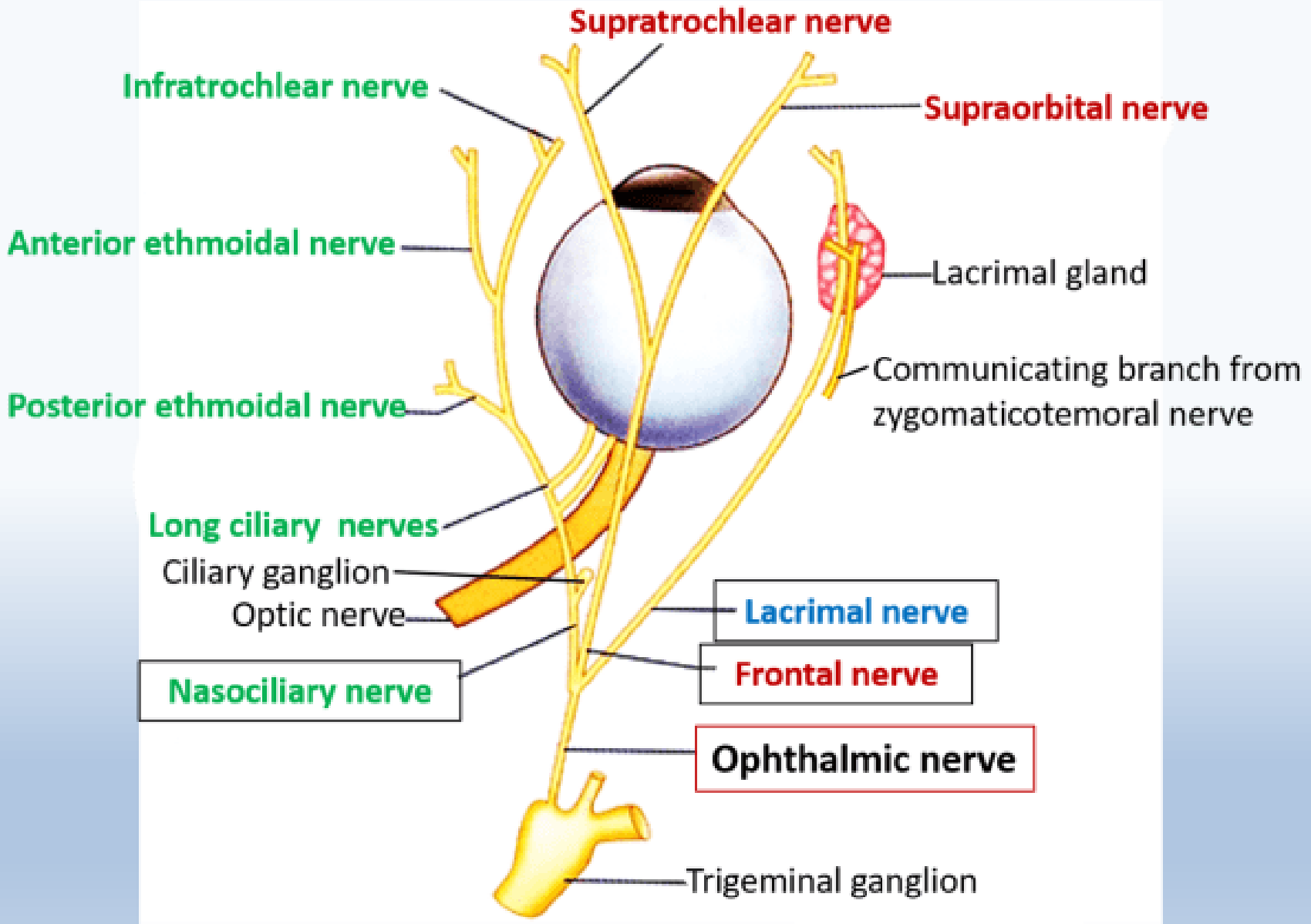
  Passes forward in the lateral wall of the cavernous sinus, below the oculomotor and trochlear nerves

Nerve is joined by the filaments from the internal carotid sympathetic plexus.

It communicates with the oculomotor,trochlear and abducent nerve.

The latter communication may be the route by which proprioceptive fibres from extraocular muscles enter the trigeminal nuclear complex.




Supratrochlear nerve
Infratrochlear nerve
Supraorbital nerve
Anterior ethmoidal nerve
Lacrimal gland
Communicating branch from zygomaticotemoral nerve
Posterior ethmoidal nerve
Long ciliary nerves
Ciliary ganglion
Optic nerve
Lacrimal nerve
Frontal nerve
Nasociliary nerve
Ophthalmic nerve
Trigeminal ganglion

KEY FACTS ABOUT THE OPHTHALMIC BRANCH OF THE TRIGEMINAL NERVE (CN V1)	
Branches	Nasociliary nerve Frontal nerve Lacrimal nerve
Supply	Eyes, conjunctiva, lacrimal gland, nasal cavity, frontal sinus, ethmoidal cells, falx cerebri, dura mater of anterior cranial fossa, superior parts of tentorium cerebelli, upper eyelid, dorsum of nose, anterior part of the scalp

The Maxillary Nerve:

It is intermediate division of trigeminal nerve.

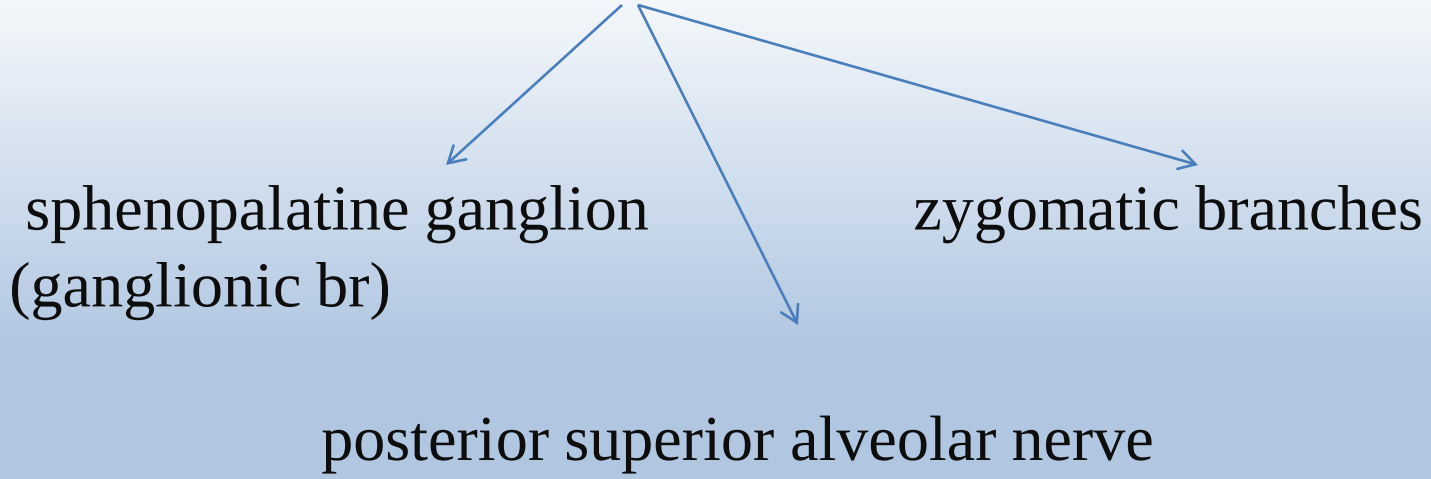
Whole sensory.

- ORIGIN:
  It leaves the trigeminal ganglion between the ophthalmic and mandibular divisions as a flat plexiform band

  Passes slightly medial to lateral wall of cavernous sinus

  Leaves the cranium through foraman rotandum, which is located in the greater wing of sphenoid bone.

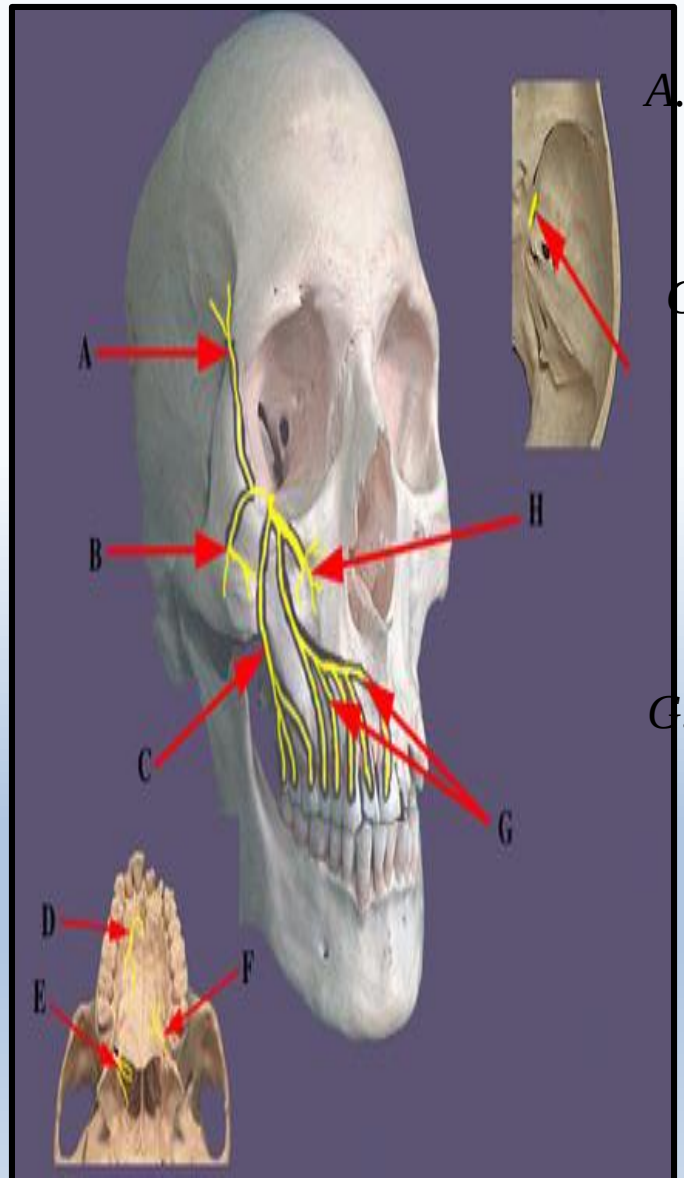
- Once outside the cranium, it crosses the uppermost part of the pterygopalatine fossa, between the pterygoid plates of sphenoid bone and the palatine bone
  As it crosses the pterygopalatine fossa it gives of branches



- It then angles laterally in a groove on the posterior surface of the maxilla,entering the orbit through the inferior orbital fissure.

  Within the orbit it occupies the infraorbital groove and becomes the infraorbital nerve,which courses anteriorly into the infraorbital canal.

  The maxillary division emerges on the anterior surface of face through the infraorbital foramen, where it divides into its terminal branches, supplying the skin of the face, nose, lower eyelid and upper lip.



A. Zygoticaticotemporal

B. Zygomaticofacial

C. Post. Sup. Alveolar

D. Nasopalatine

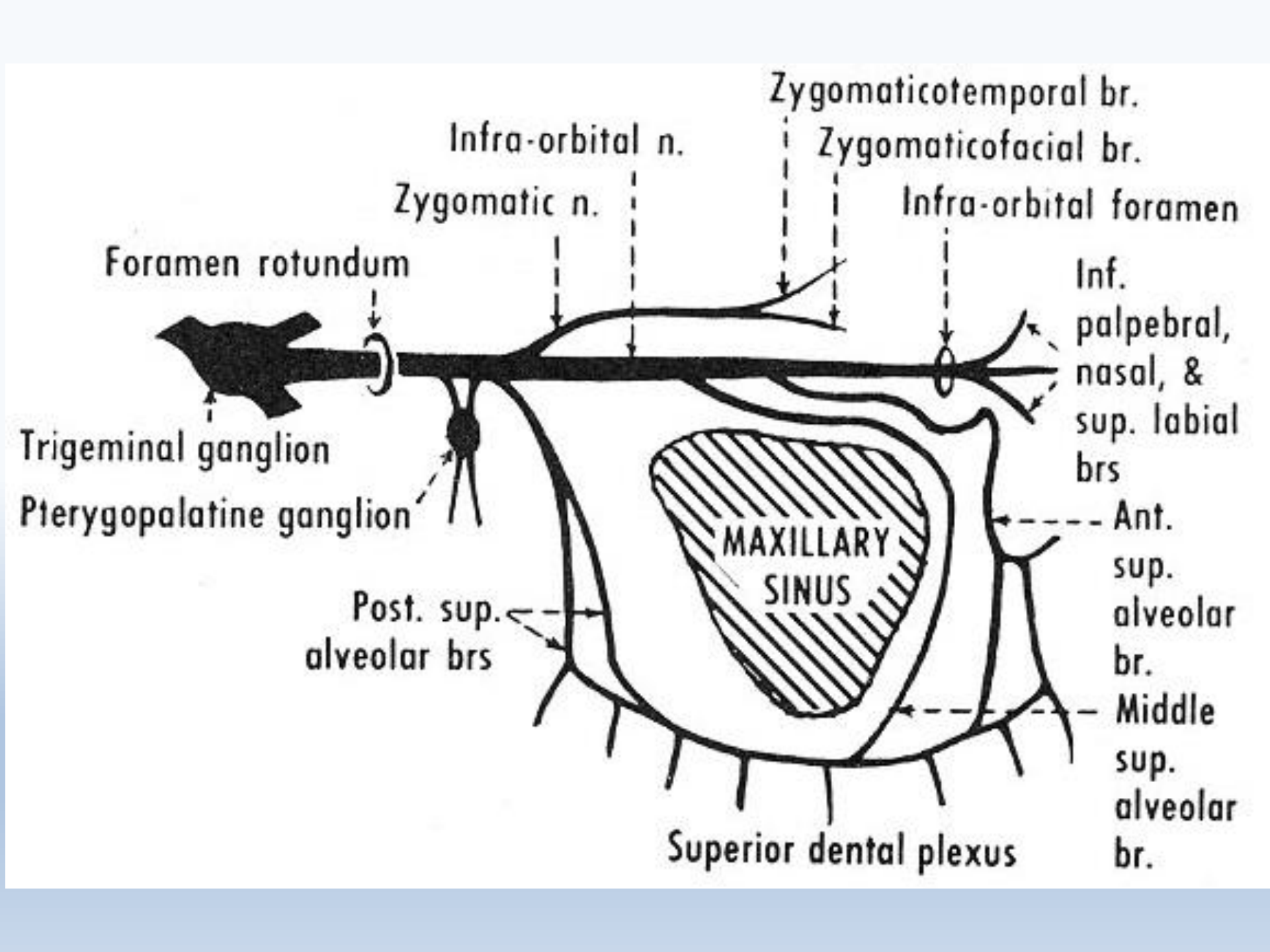
E. Greater Palatine

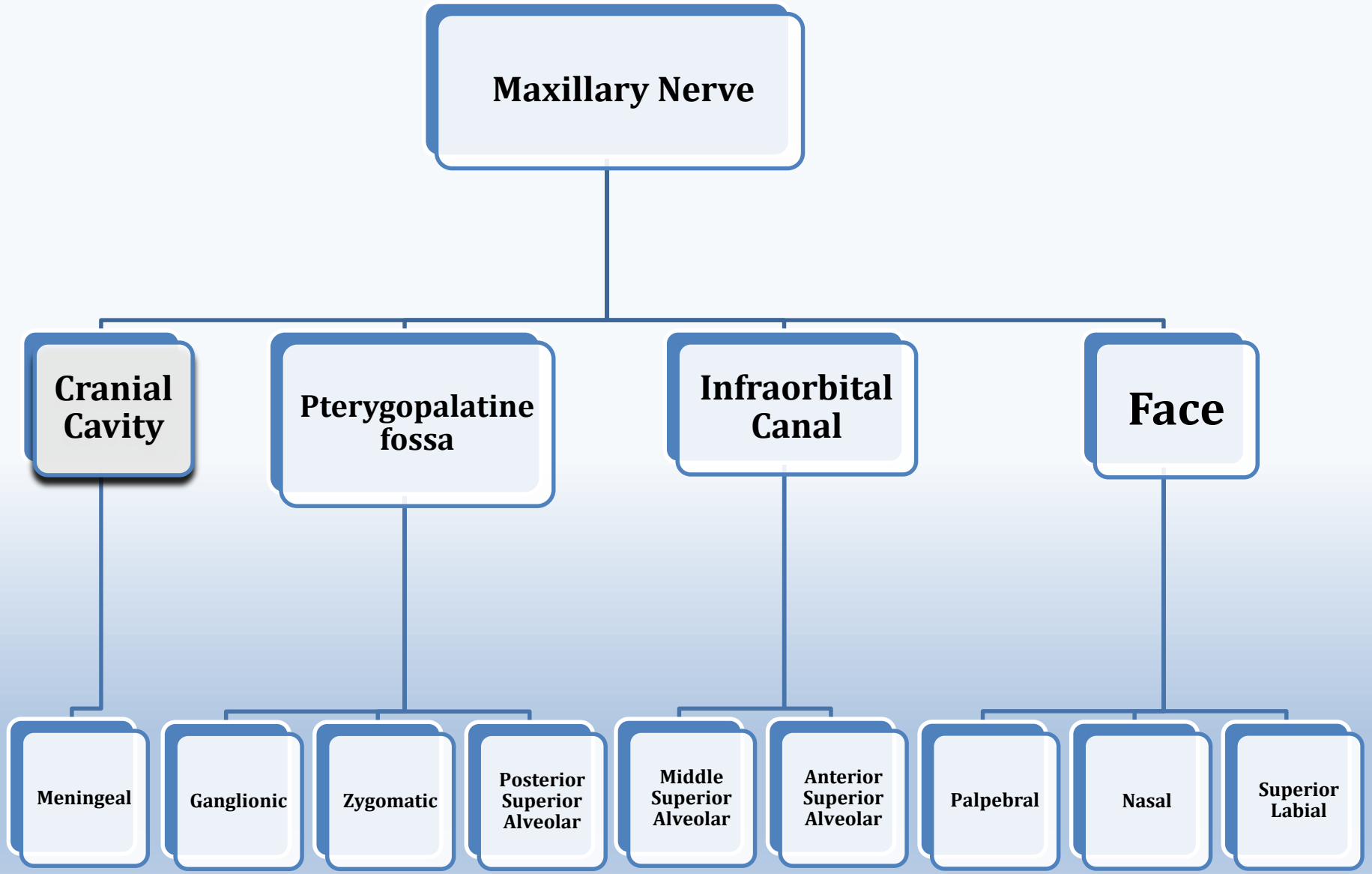
F. Lesser Palatine

G. Mid. & Ant. Alveolar

H. Infraorbital

KEY FACTS ABOUT THE MAXILLARY DIVISION OF THE TRIGEMINAL NERVE (CN V2)	
Branches	Middle meningeal nerve Zygomatic nerve Pterygopalatine nerves Branches for the nasal cavity Palatine nerves Posterior superior alveolar nerves Infraorbital nerve
Supply	Dura mater of the middle cranial fossa; mucosa of the nasopharynx, palate, nasal cavity, and nasopharynx; teeth and upper jaw; skin over the side of the nose, lower eyelid, cheek, and upper lip


Zygomaticotemporal br.
Infra-orbital n.
Zygomaticofacial br.
Zygomatic n.
Infra-orbital foramen
Foramen rotundum
Inf. palpebral, nasal, & sup. labial brs
Trigeminal ganglion
Pterygopalatine ganglion
MAXILLARY SINUS
Ant. sup. alveolar br.
Post. sup. alveolar brs
Middle sup. alveolar br.
Superior dental plexus


Maxillary Nerve
Cranial Cavity
Pterygopalatine fossa
Infraorbital Canal
Face
Meningeal
Ganglionic
Zygomatic
Posterior Superior Alveolar
Middle Superior Alveolar
Anterior Superior Alveolar
Palpebral
Nasal
Superior Labial

Within pterigopalatine fossa

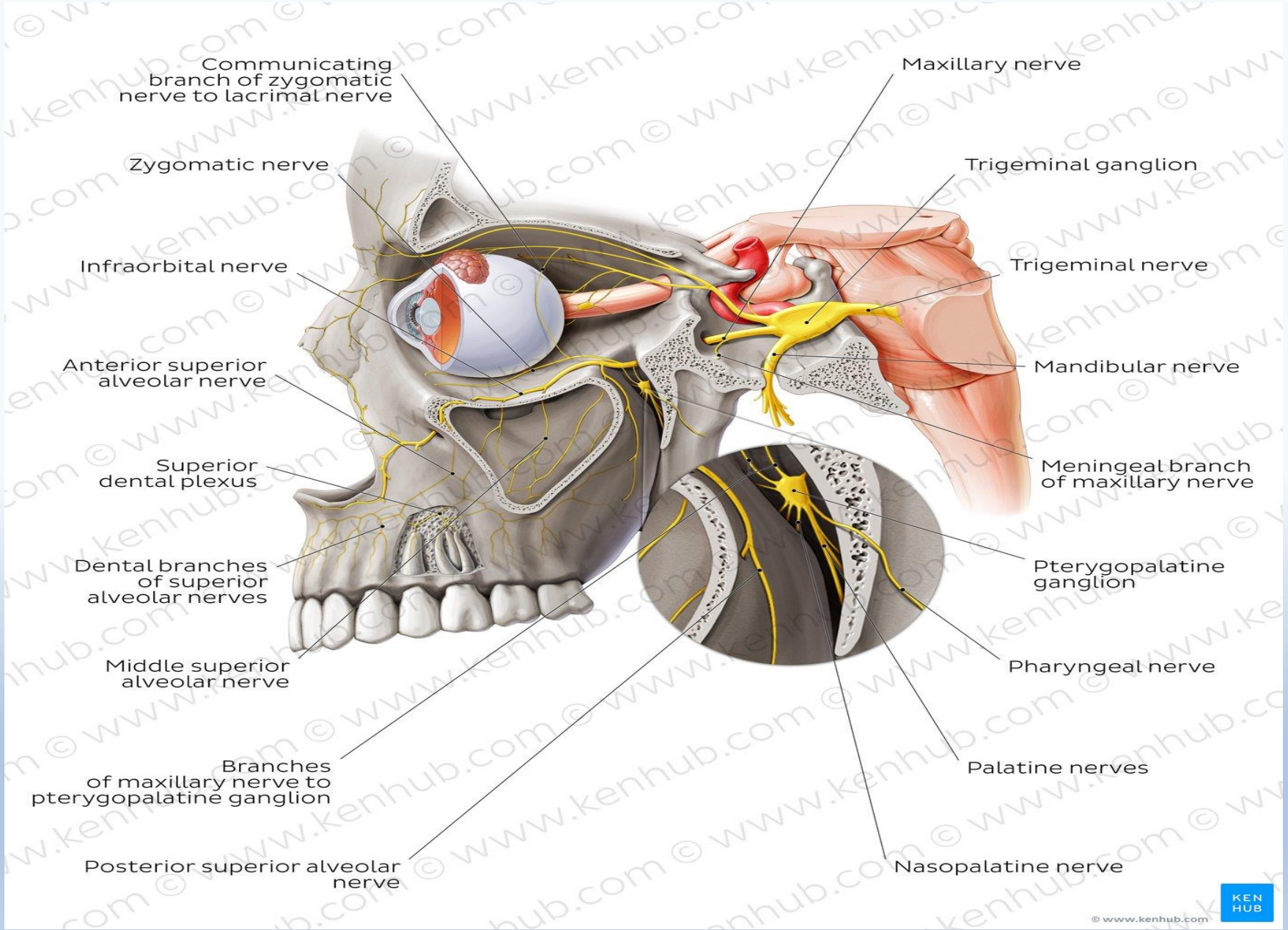
Zygomatic — pterygopalatine nerve

inferior.orbital fissure — pterygopalatine ganglion

Zygomatico temporal → Skin of forehead

zygomatico facial → to skin of cheek

Orbital	nasal/nasopalatine	palatine	pharyngeal
Periosteum of orbit	roof of nasal cavity, mucous memb.&ant. Part of nasal septum, incisive canal → incisive foramen → rt.&lt. nasopalatine nerve supplies hard palate -1 to 3	greater palatine nerve → g.p.foramen → runs muco periosteum & hard palate supplies soft tissues ant. to 1st PM Lesser palatine nerve → lesser palatine foramen &supplies mucous memb. Of soft palate &	pharyngial canal supplies to nasal part of pharynx


Communicating branch of zygomatic nerve to lacrimal nerve
Zygomatic nerve
Infraorbital nerve
Anterior superior alveolar nerve
Superior dental plexus
Dental branches of superior alveolar nerves
Middle superior alveolar nerve
Branches of maxillary nerve to pterygopalatine ganglion
Posterior superior alveolar nerve
Maxillary nerve
Trigeminal ganglion
Trigeminal nerve
Mandibular nerve
Meningeal branch of maxillary nerve
Pterygopalatine ganglion
Pharyngeal nerve
Palatine nerves
Nasopalatine nerve
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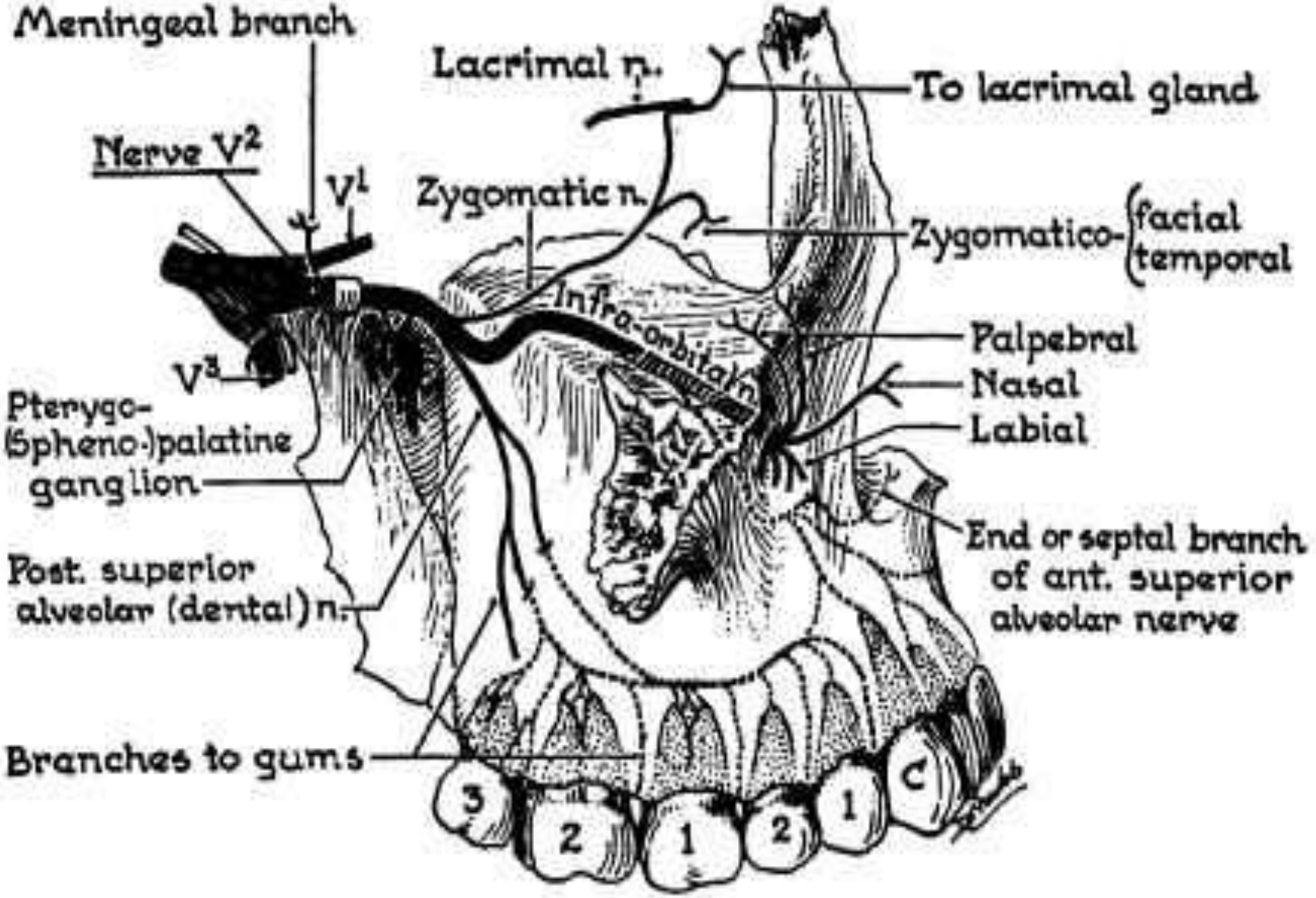
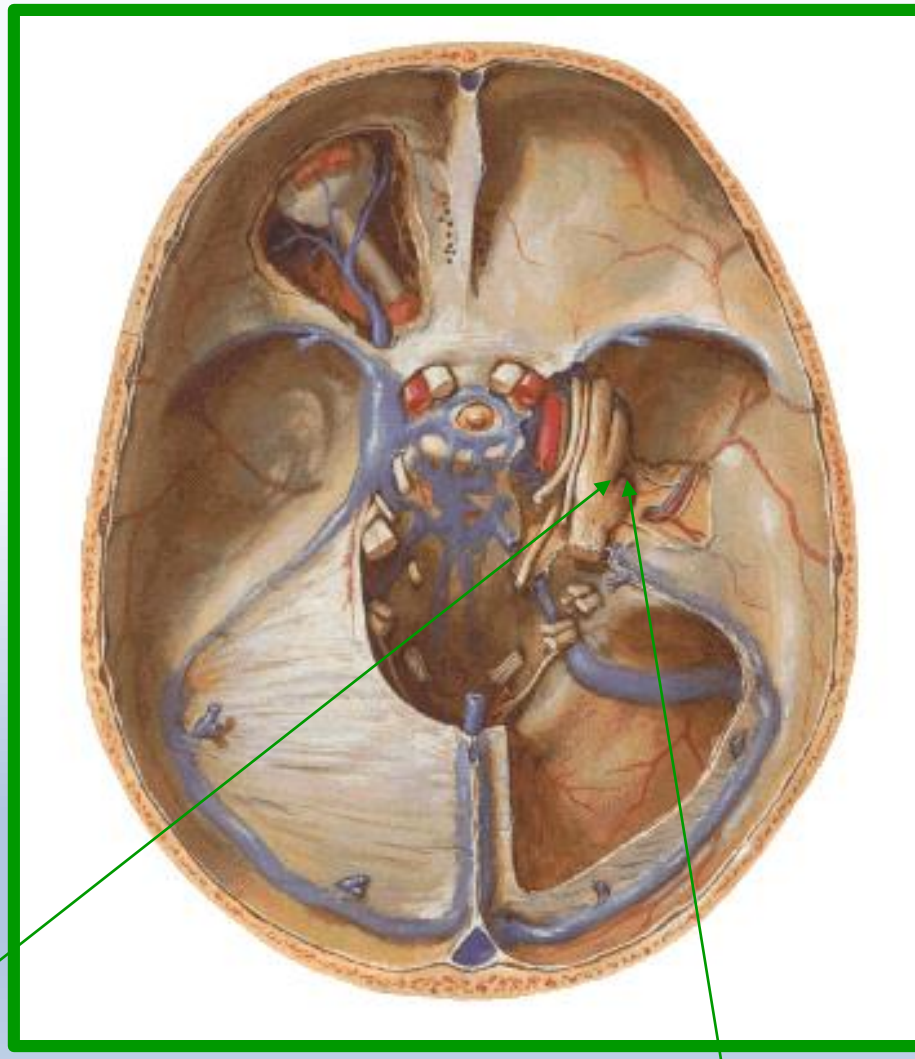


FIG. 795. Distribution of the maxillary (V^2) nerve

Mandibular nerve:
Origin and course

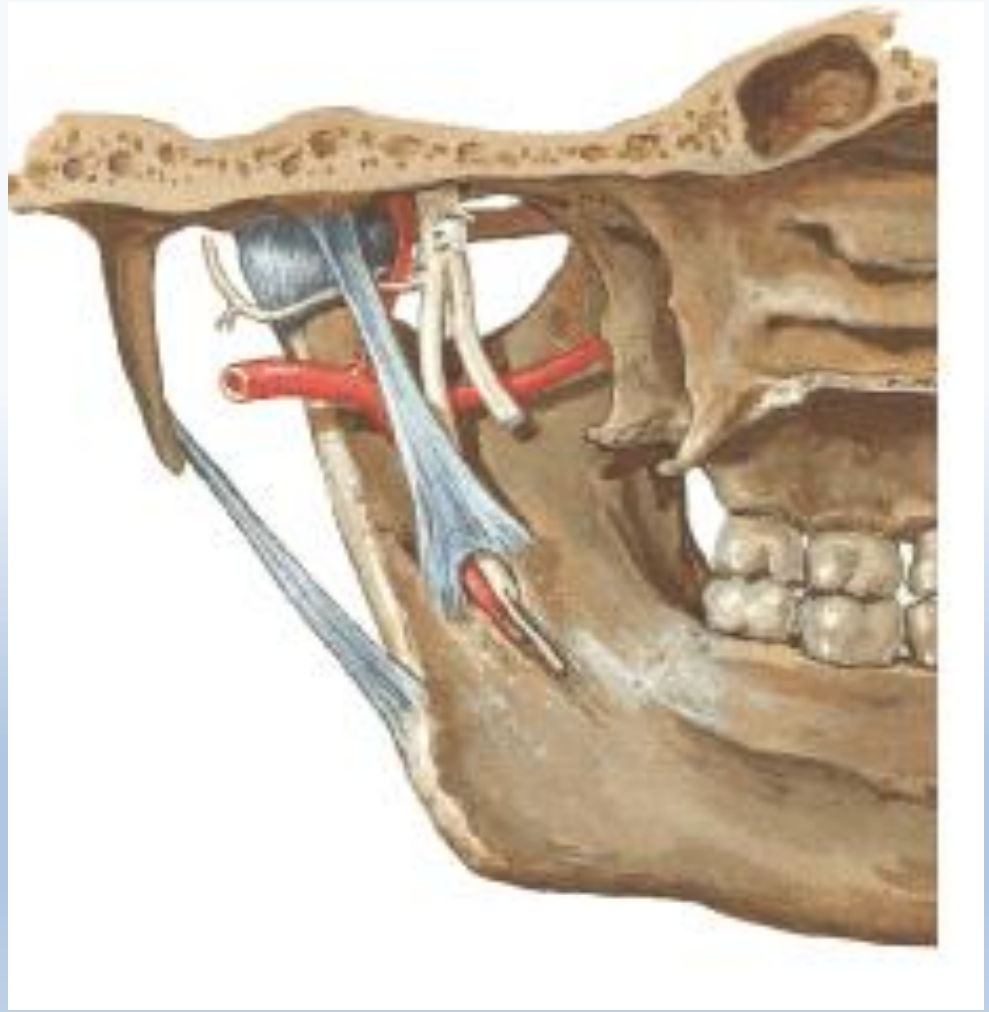
- Branch of trigeminal (V cranial) nerve. It Has
- **A small motor root** : which passes under the ganglion to unite with the sensory root just outside the skull.
- **A Large Sensory root:** Arises from lateral part of trigeminal ganglia in middle cranial fossa



Mandibular nerve

Passes through foramen ovale to infratemporal fossa

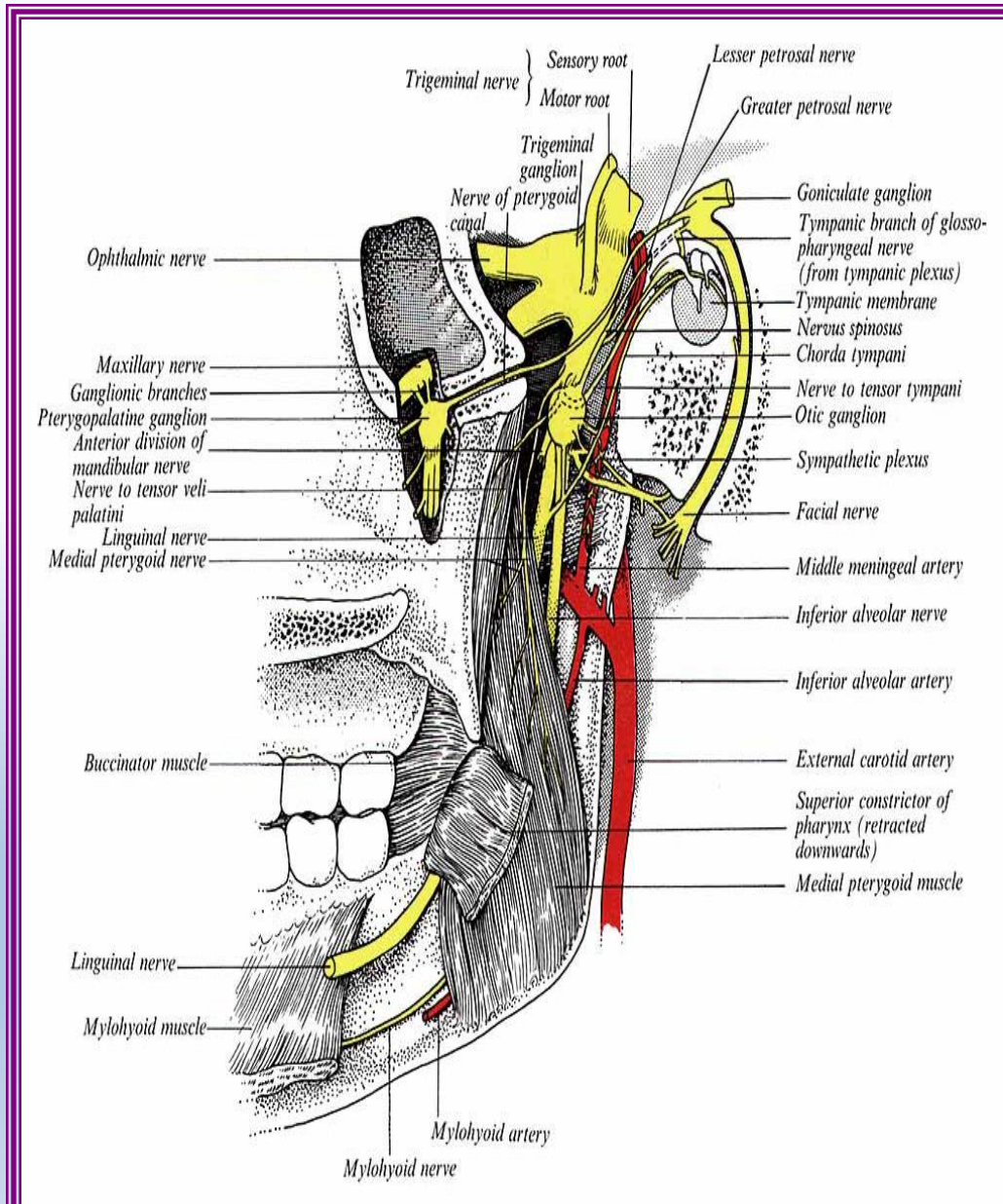
- Near exiting, it gives a meningeal br called as nervesus spinosum which exit through f.spinosum



MANDIBULAR NERVE

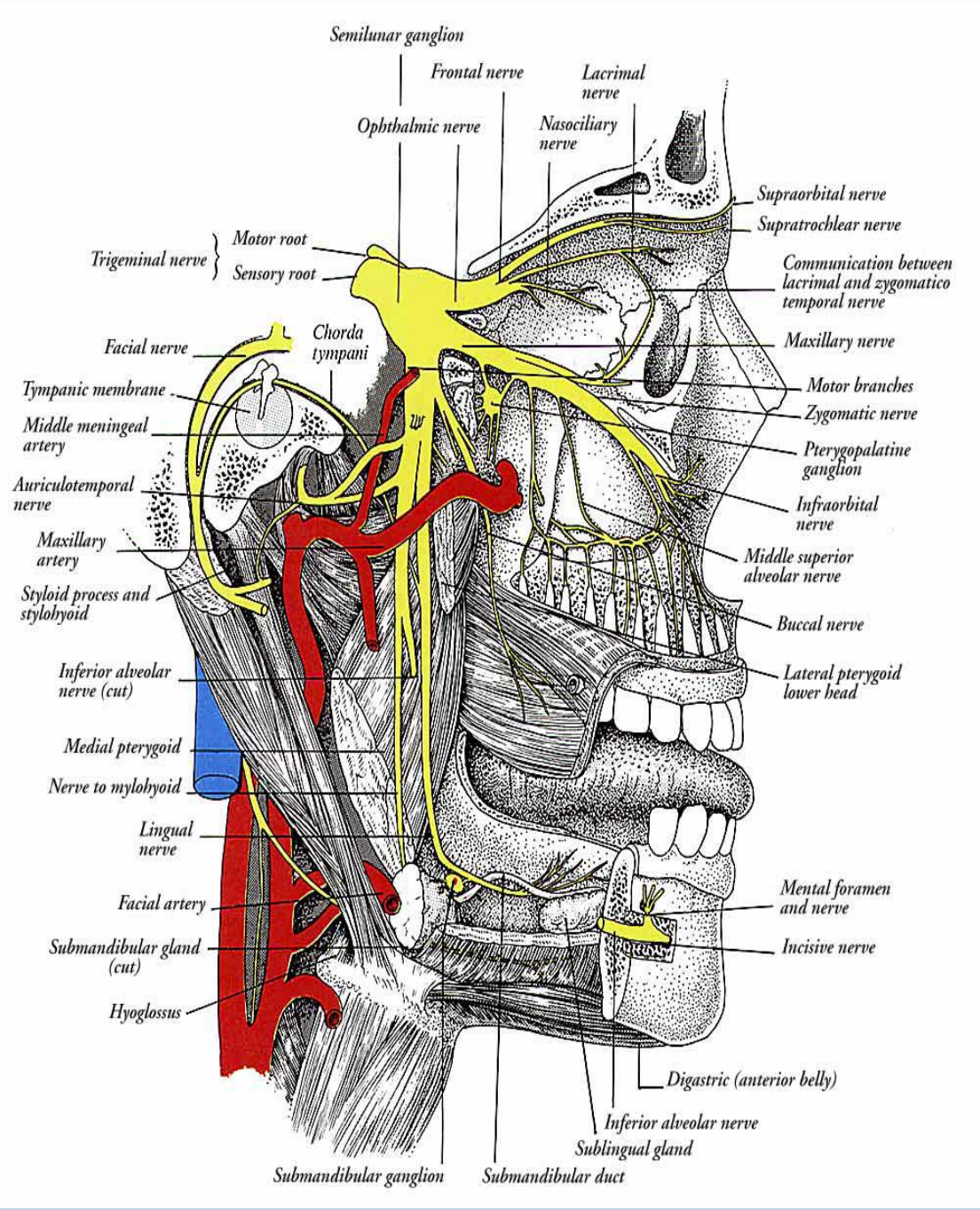
- Just beyond this junction a meningeal branch and the nerve to the medial pterygoid leaves the medial side of the nerve.

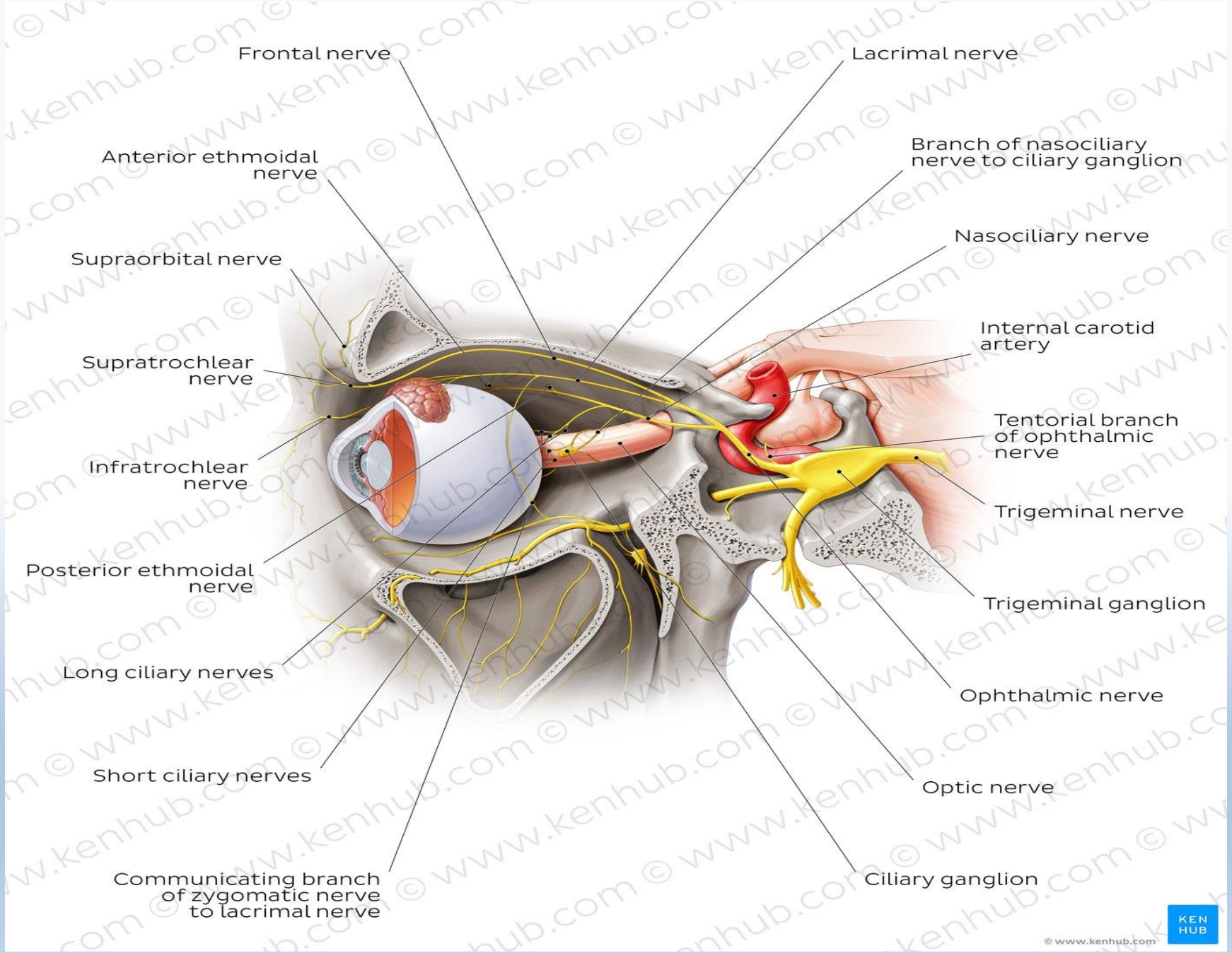
- The nerve then divides into a small anterior and large posterior trunk.



KEY FACTS ABOUT THE MANDIBULAR DIVISION OF THE TRIGEMINAL NERVE (CN V3)	
Branches	Deep temporal nerve Nerve to the medial pterygoid muscle Nerve to the lateral pterygoid muscle Masseteric nerve Nerve to the tensor veli palatini muscle,tensor tympani
Supply	Buccal skin, anterior two-thirds of the tongue, temporal region; mastication muscles, mylohyoid muscle and anterior belly of the digastric muscle

- As it descends from the foramen ovale, the nerve is about 4 cm from the surface and a little anterior to the neck of the mandible.




Frontal nerve
Lacrimal nerve
Anterior ethmoidal nerve
Branch of nasociliary nerve to ciliary ganglion
Supraorbital nerve
Nasociliary nerve
Internal carotid artery
Supratrochlear nerve
Tentorial branch of ophthalmic nerve
Infratrochlear nerve
Trigeminal nerve
Posterior ethmoidal nerve
Trigeminal ganglion
Long ciliary nerves
Ophthalmic nerve
Short ciliary nerves
Optic nerve
Communicating branch of zygomatic nerve to lacrimal nerve
Ciliary ganglion
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Mandibular Nerve
(in infratemporal fossa)

Branches:

From trunk:

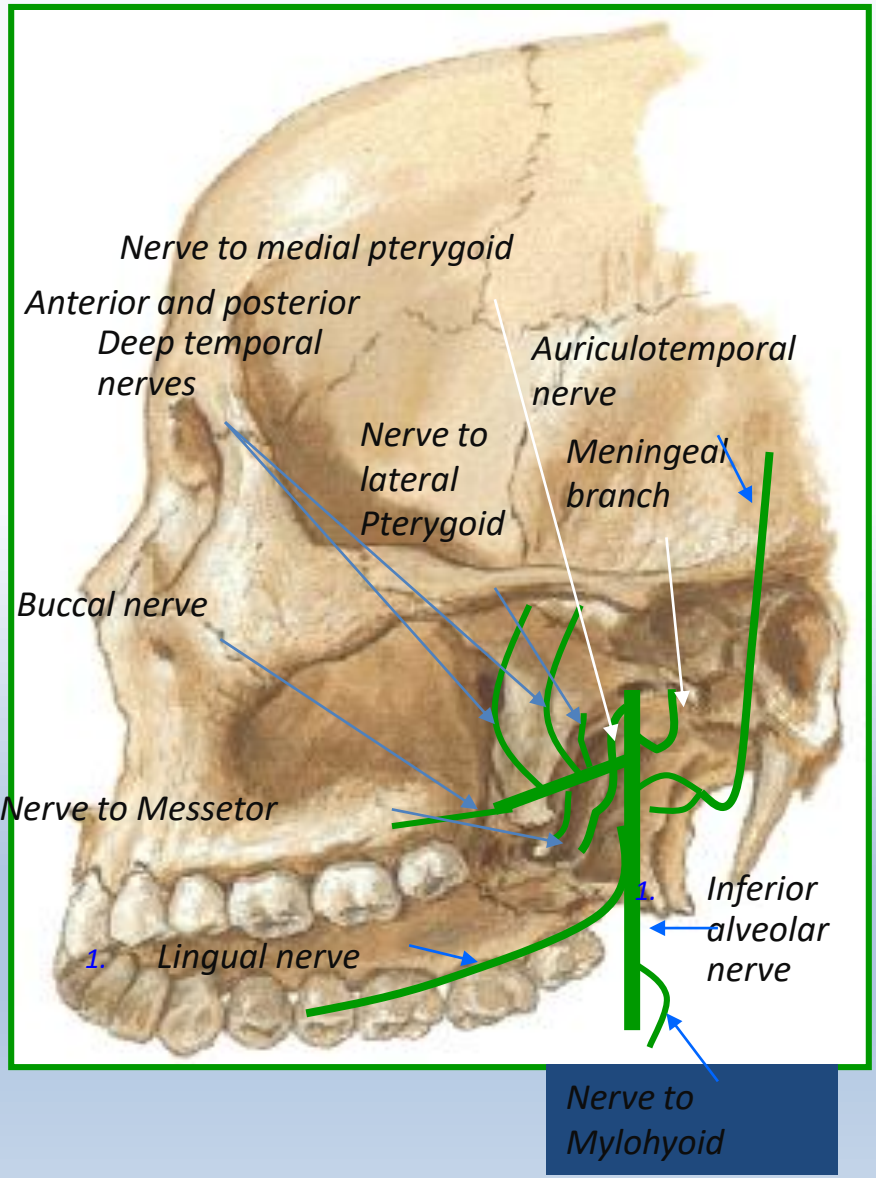
1. Meningeal branch
2. Nerve to medial pterygoid muscle

From Anterior Division:

1. Anterior and posterior Deep temporal nerves
2. Nerve to lateral Pterygoid muscle
3. Nerve to Messeter muscle
4. Buccal nerve (only sensory nerve)

From Posterior Division:

1. Auriculotemporal nerve
2. Lingual nerve
3. Inferior alveolar nerve



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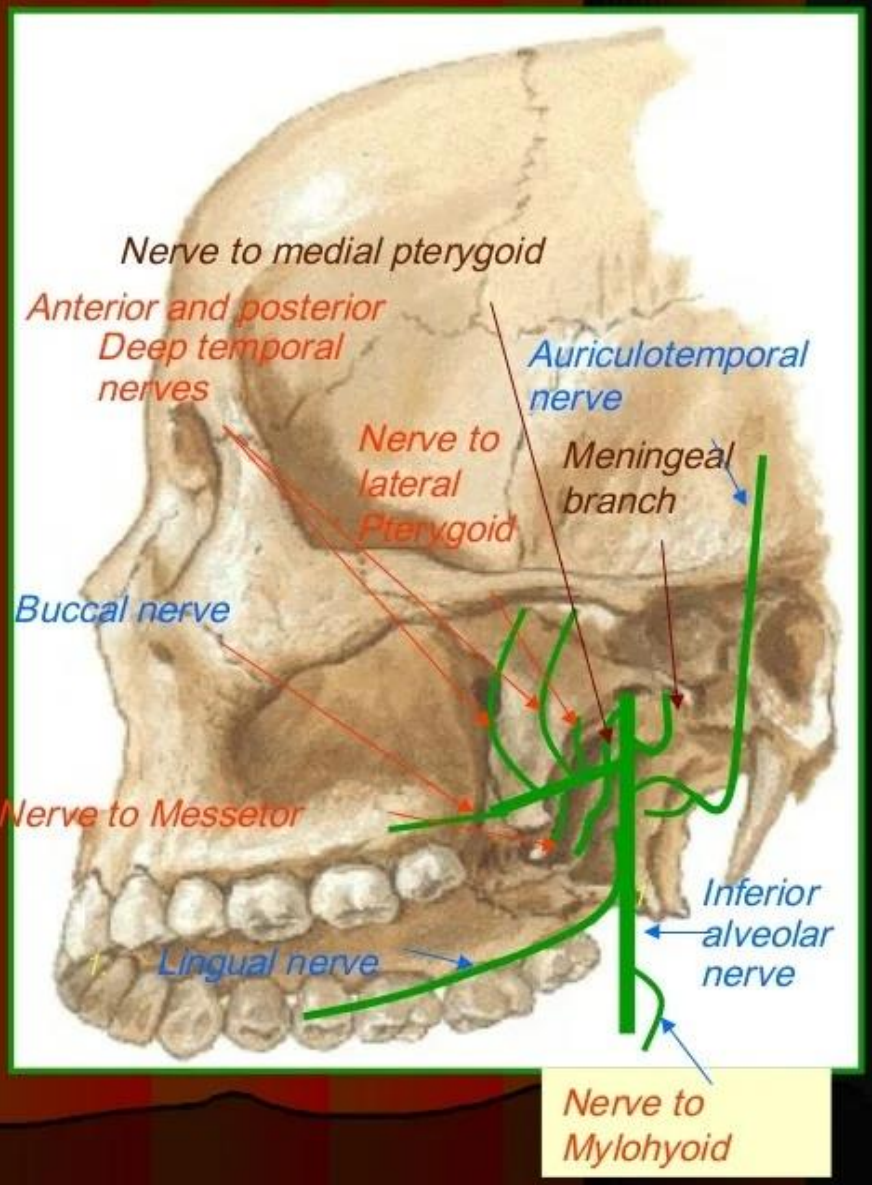
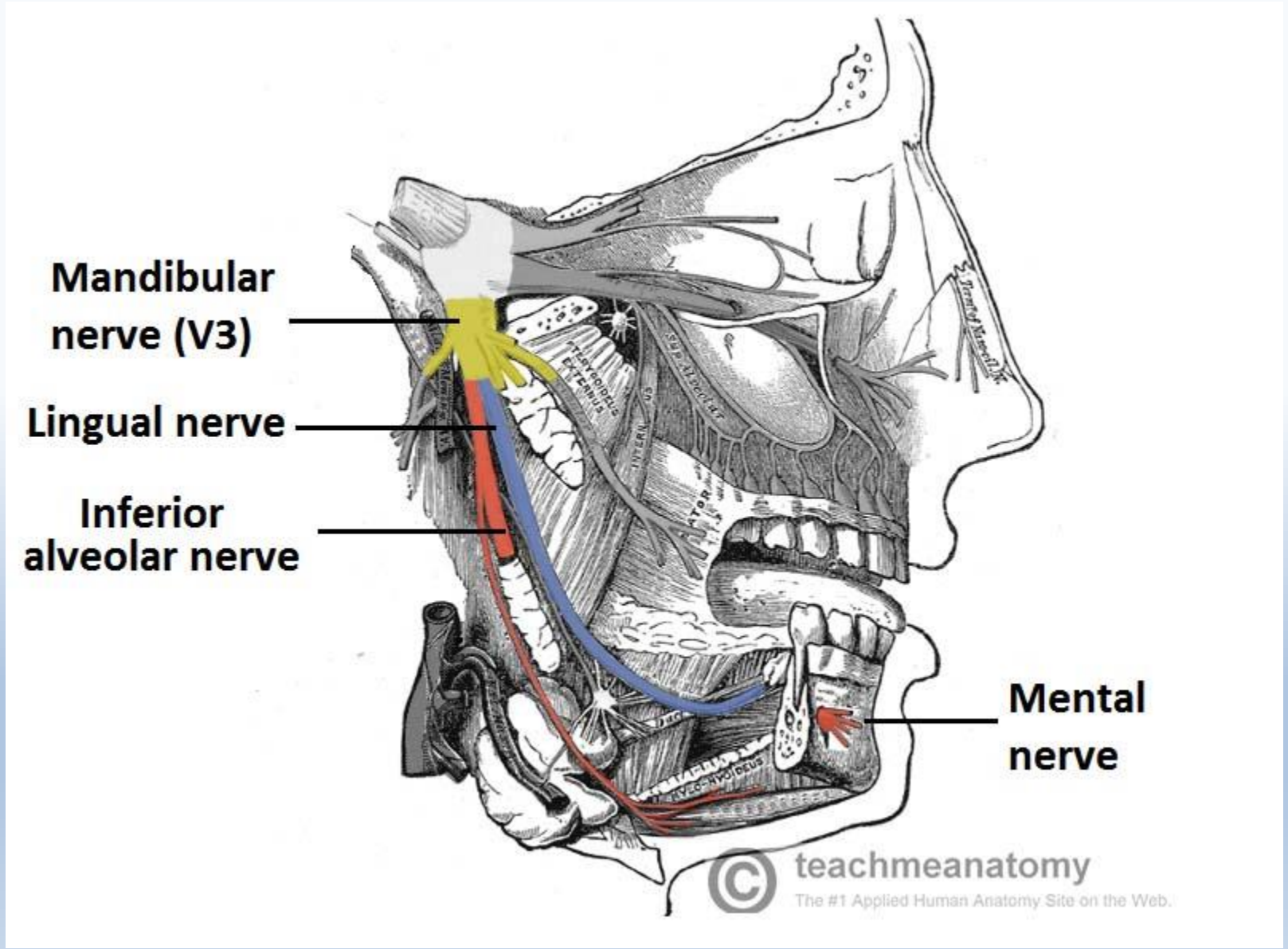
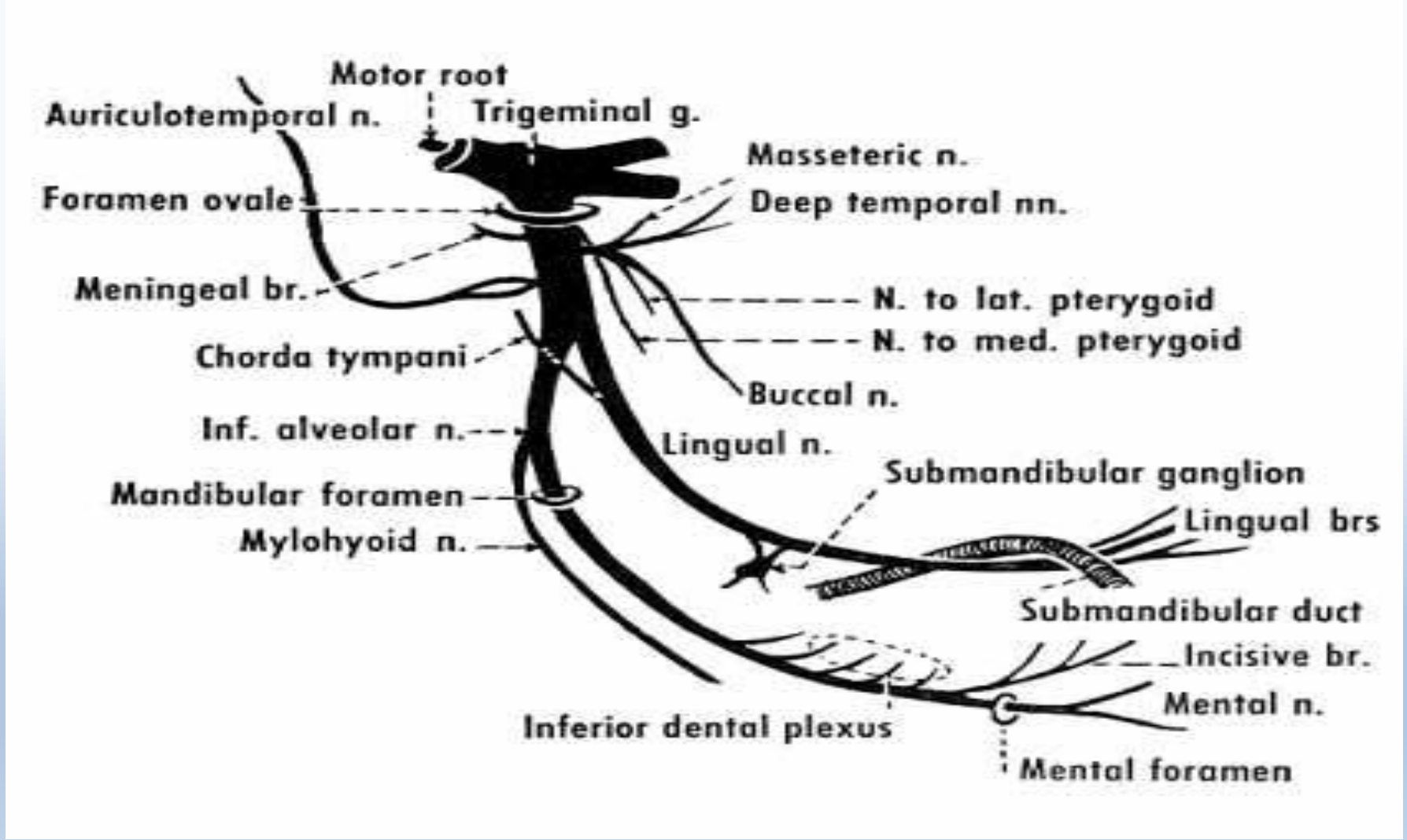


Anatomical course of the inferior alveolar and lingual nerves. Note the close proximity of the two nerves. The portion of the inferior alveolar nerve that runs through the mandibular canal has been removed.



THE MANDIBULAR NERVE



PARASYMPATHETIC ASSOCIATIONS

- While the trigeminal nerve does not have parasympathetic innate parasympathetic fibers, it is associated with several parasympathetic ganglia along its course. These ganglia are:

1. The ciliary ganglion
2. The otic ganglion
3. the submandibular ganglion
4. the pterygopalatine (sphenopalatine) ganglion

Parasympathetic Supply:

- **Lacrimal gland**: Post ganglionic fibres from the pterygopalatine ganglion (derived from the facial nerve), travel **with** the zygomatic branch of V2 and then join the lacrimal branch of V1. The fibres supply parasympathetic innervation to the lacrimal gland.
- **Nasal glands**: Parasympathetic fibres are also carried to the mucous glands of the nasal mucosa. Post-ganglionic fibres travel with the nasopalatine and greater palatine nerves (branches of V2)

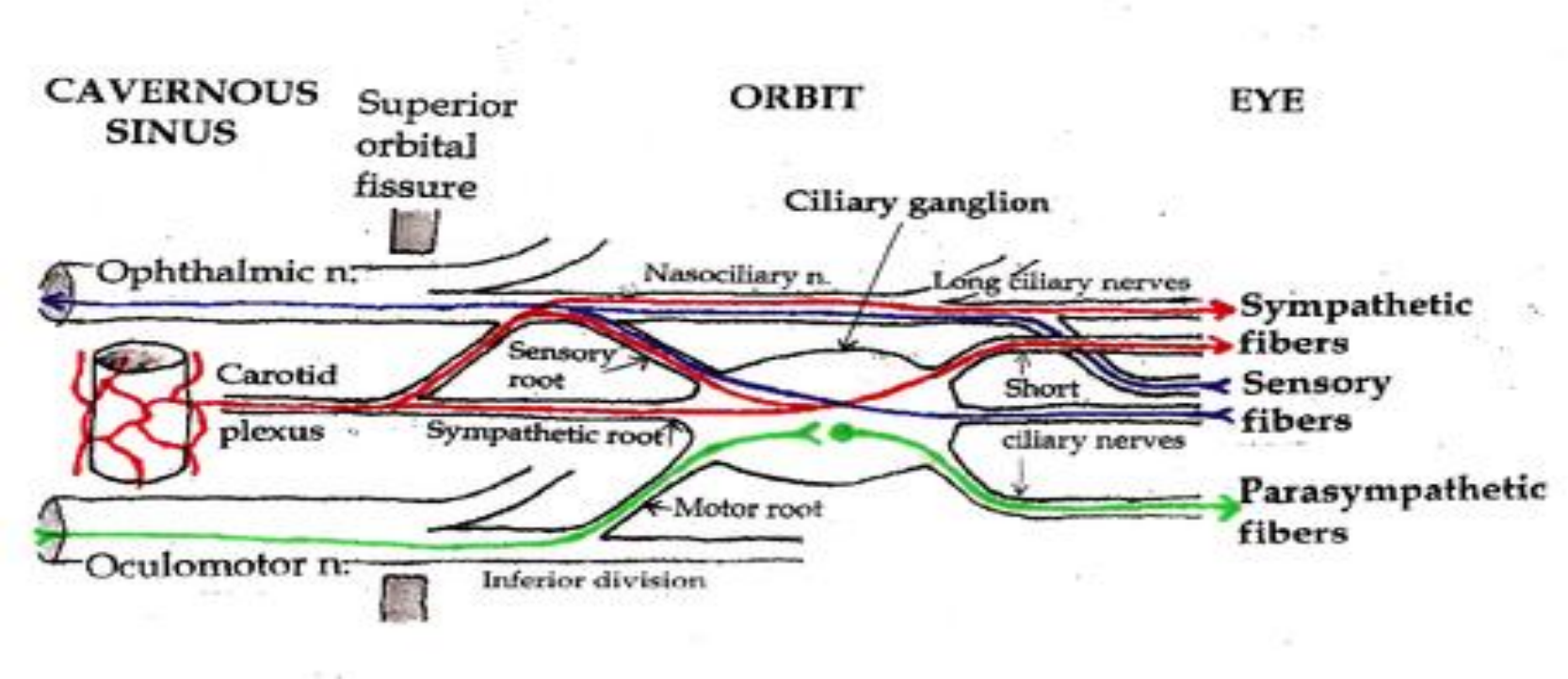
Parasympathetic Supply:

- **Submandibular and Sublingual glands:** Post-ganglionic fibres from the submandibular ganglion (derived from the facial nerve), travel with the lingual nerve to innervate these glands.
- **Parotid gland:** Post-ganglionic fibres from the otic ganglion (derived from the glossopharyngeal nerve, CN IX), travel with the auriculotemporal branch of the V3 to innervate the parotid gland.

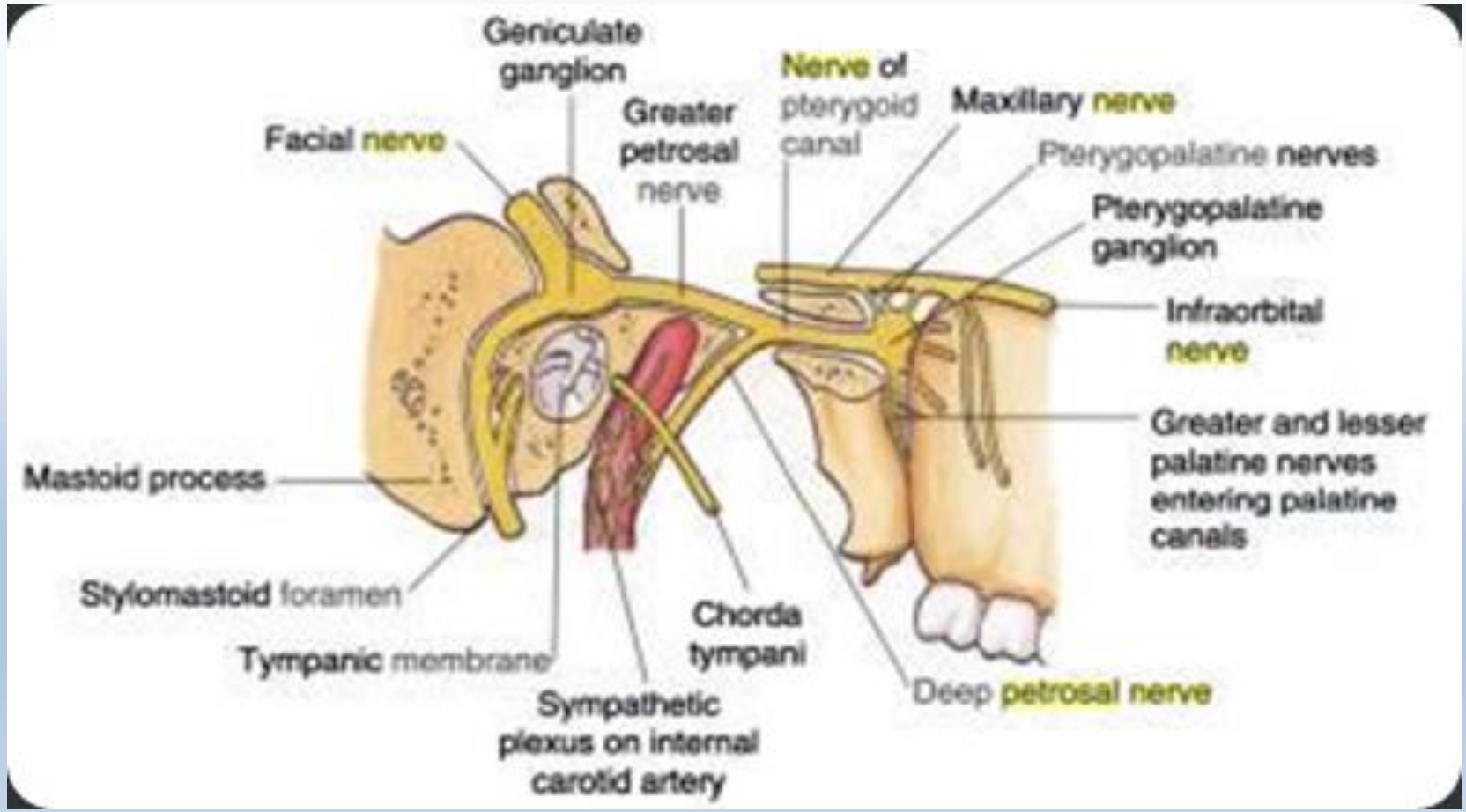
GANGLIA ASSO WITH THE TRIGEMINAL NERVE

1.CILLIARY GANGLION

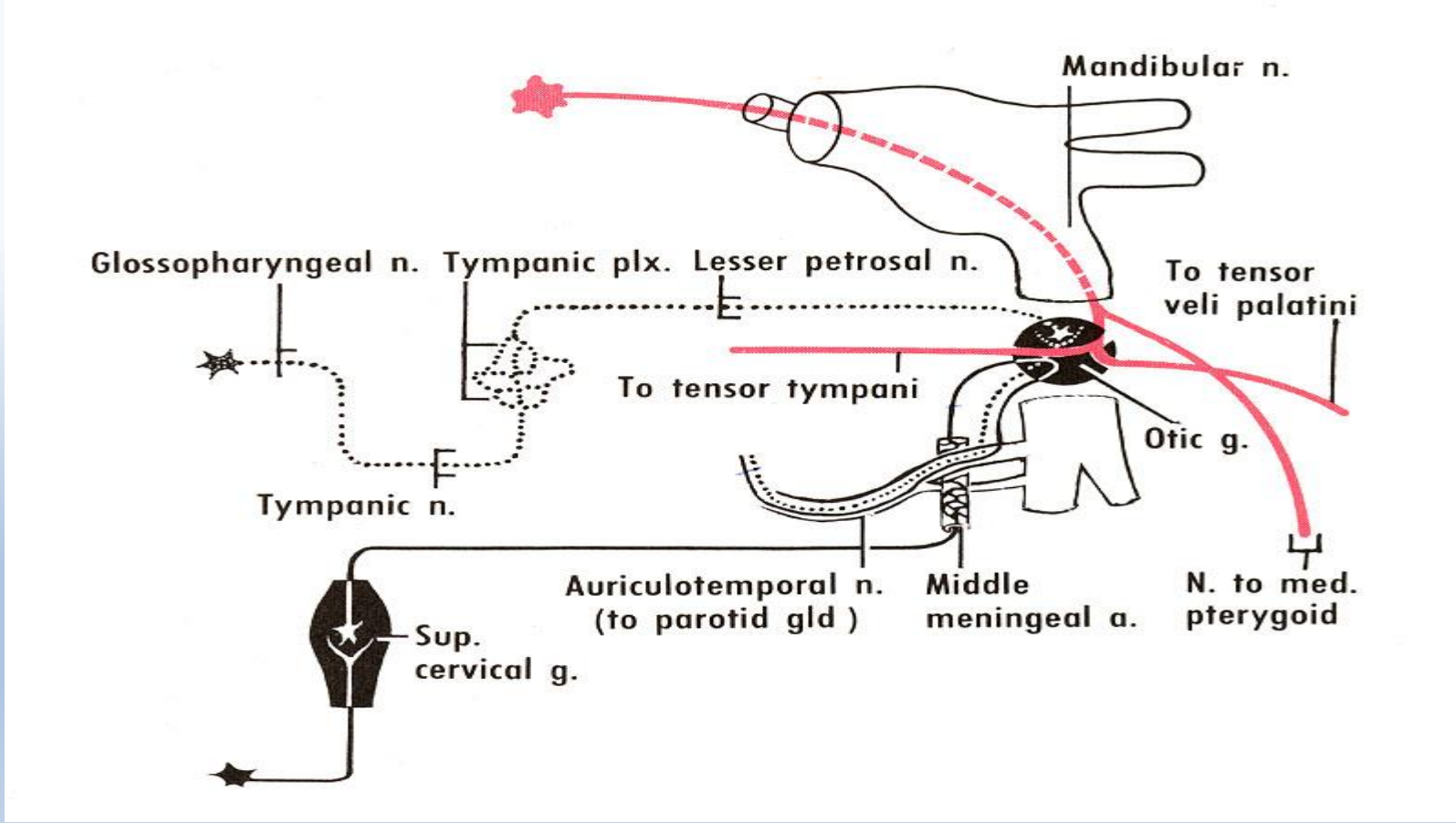
- connected with nasocilliary nerve by ganglionic branches in orbit, non synapsing
- sensory for orbit



2.PTERYGOPALATINE GANGLION:
connected to maxillary nerve in infratemporal fossa
sensory to orbital septum, orbicularis and nasal cavity, maxillary sinus , palate , nasopharynx.

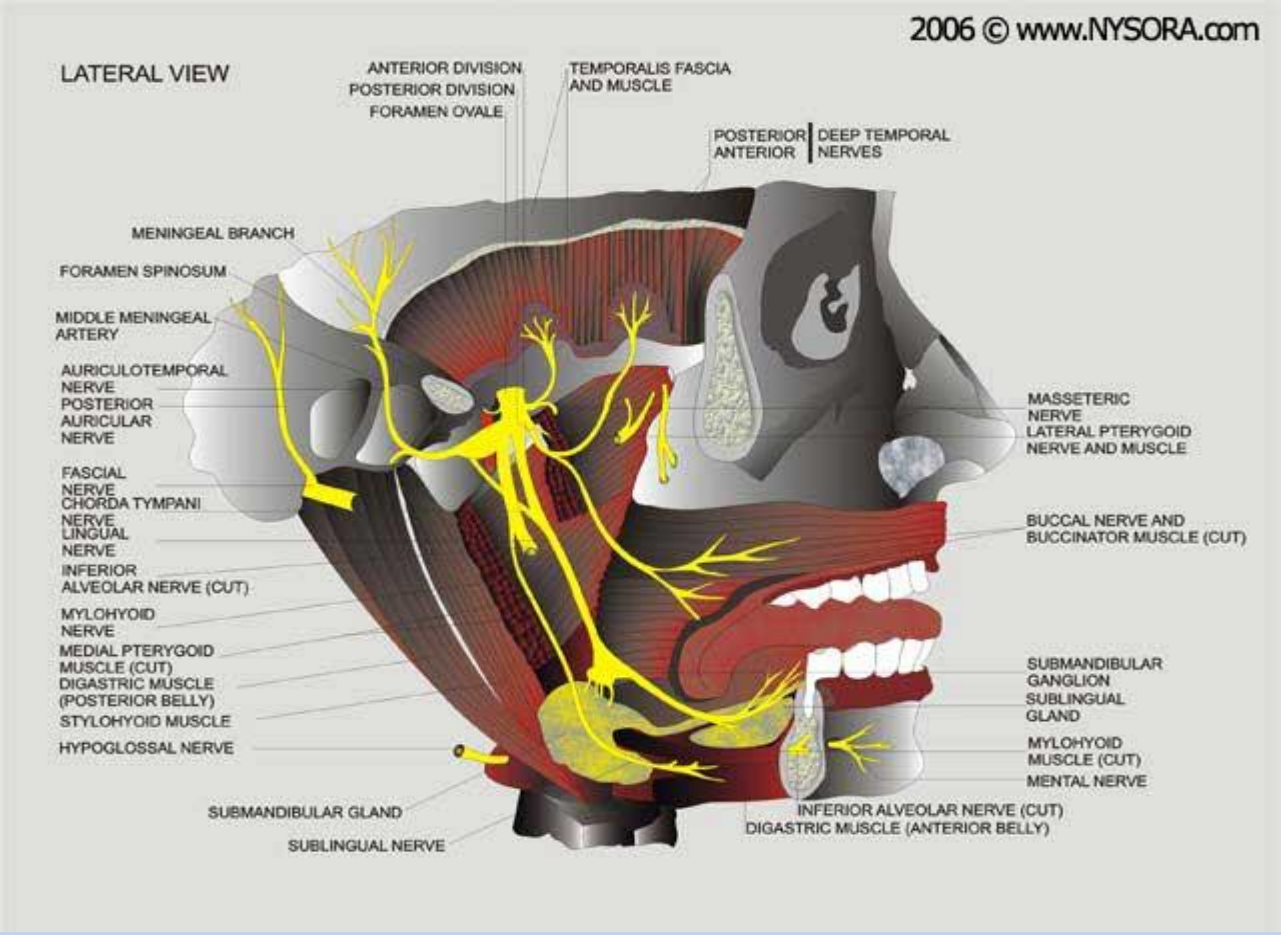


3. OTIC GANGLION: lies between trunk of mandibular nerve. The tensor palatini nerve and nerve to med pterygoid passes through but does not synapse in the ganglion.



4.SUBMANDIBULAR GANGLION: related to lingual nerve, rest on hypoglossus

supplies posterior ganglionic Parasympathetic secretomotor fibres to submandibular and sublingual gland.



APPLIED ANATOMY

1.Trigeminal neuralgia.

2. Herpes zoster ophthalmicus.

3.Wallenberg Syndrome.

Trigeminal Neuralgia:

also known as Fothergill's disease
Tic douloureux (painful jerking)

it is defined as
sudden ,usually ,unilateral ,severe ,brief ,stabbing , lancinating , recurring pain in the distribution of one or more branches of trigeminal nerve.

Mean age: 50 y onwards

Female predominance (male : female = 1:2 ~2:3)

- **Pathogenesis of trigeminal neuralgia**

  It is usualy idiopathic.

  The probable etiologic factors are:-

  1.Intra cranial tumors:-Traumatic compression of the trigeminal nerve by neoplastic (cerebellopontine angle tumor) or vascular anomalies eg arteriovenous malformations

  2. Infections :- granulomatous and non granulomatous infections involving 5^{th} cranial nerve.

Clinical characteristics:-

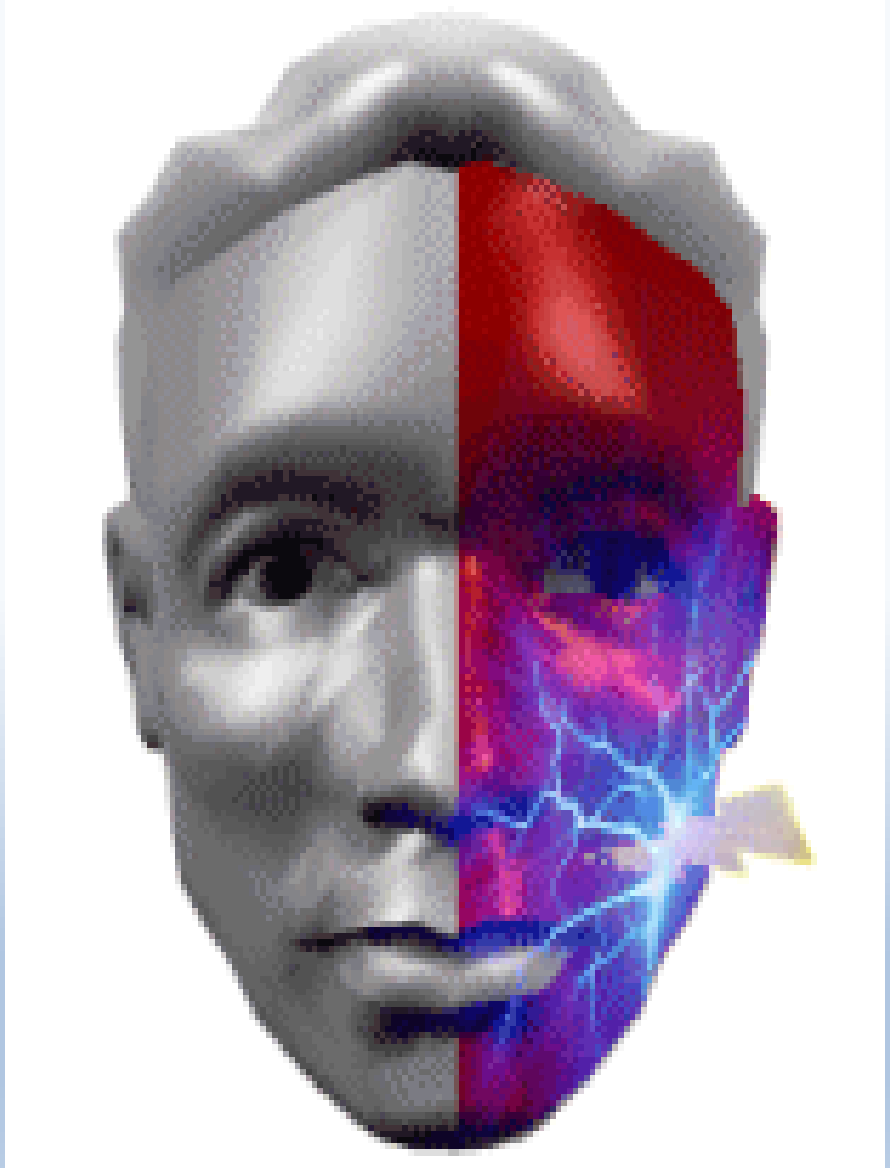
1.sudden

2.unilateral

3.intermittent paroxysmal

4.sharp shooting

5.lancinating shock like pain elicted by slight touching



1.superficial trigger points which radiates across the distribution of one or more branches of the trigeminal nerve

2.pain rarely crosses the midline

3.pain is of short duration and last for few seconds to minutes

4.in extreme cases patient has a motionless face called the frozen or mask like face

5.presence of intraoral or extraoral trigger points

Provocated by obvious **stimuli** like

Touching to face at particular site

Chewing

Speaking

Brushing

Shaving

Washing the face

<u>The characteristic of the disorder being that the attacks do not occur during sleep.</u>

- *DIAGNOSIS:-*

  CLINICAL EXAMINATION with HISTORY is mandatory.

  Response to treatment with tablet of carbamazepine is universal.

  Injections of local anaesthetic agents into patients trigger zone gives temporarily relief from pain.


THANK
YOU