MBB Lab 3, Part B: PowerPoint Handout
Cranial Nerves

This is a guide to cranial nerves that can be used as a reference throughout MBB (and beyond). **It is an attempt to consolidate everything you are ultimately expected to know about each cranial nerve.** Each cranial nerve is covered two ways in this handout.

1. **The Basics:** These slides contain the name of the cranial nerve, where it passes through the skull, the fiber types contained within the nerve, and function. This information is what you should become familiar with early on in your study of head and neck anatomy. **You should be familiar with "The Basics" slides prior to Lab 3 (Cranial Cavity).**

2. **The Details:** These slides contain the pathway, named branches, how to test, and any miscellaneous clinical information for each cranial nerve. As we progress through future lab sessions, the beginning of the PowerPoint handout for that session will list the relevant cranial nerves. Throughout your time studying head and neck anatomy you should be referring back to this PowerPoint Handout.

General Information

- All cranial nerves except one, the accessory nerve (CN XI), originate from the brain. After emerging from the brain, they pass through foramina or fissures of the skull to exit the cranial cavity.
- While cranial nerves are generally considered to be peripheral nerves, the optic nerves are the exception. The optic nerves are *not* peripheral nerves consisting of primary sensory nerve fibers. Instead, they are neuron tracts consisting of the secondary sensory neuron fibers. In addition, the optic nerves are covered by all three cranial meninges.
- As a group, cranial nerves contain both motor and sensory components; however, individual nerves may consist of only motor, only sensory, or contain both sensory and motor fibers. A cranial nerve that consists of both motor and sensory fibers is called a mixed nerve.
- Cranial nerves function to innervate skeletal muscle, smooth muscles, glands, and/or transmit signals from sensory receptors.
- Cranial nerves consist of one or more of the following types of fibers.
    - Motor fibers innervating (voluntary) skeletal muscles that are derived from somites are classified as: Somatic Motor (General Somatic Efferent: GSE) fibers.
    - Motor fibers innervating skeletal muscles derived from the branchial (pharyngeal) arches have classically been described as special visceral efferent, but better terminology is: Branchial Motor (Branchial Efferent: BE) fibers.
    - Motor fibers innervating (involuntary) smooth muscle or glands are classified as: Visceral Motor (General Visceral Efferent: GVE) fibers. It is important to remember that these are neurons of the autonomic nervous system.
    - Sensory fibers transmitting general sensation (pain, touch, pressure, heat, cold, etc.) from skin and mucous membranes are classified as: Somatic Sensory (General Somatic Afferent: GSA) fibers.
    - Sensory fibers transmitting general sensation sensation from (chemoreceptors, baroreceptors, stretch receptors, etc.) from viscera are classified as: Visceral Afferent (General Visceral Afferent: GVA fibers)..
    - Sensory fibers transmitting ”special” senses (smell, taste, vision, balance, hearing) are classified as: Special Sensory (Special Afferent: SA) fibers.

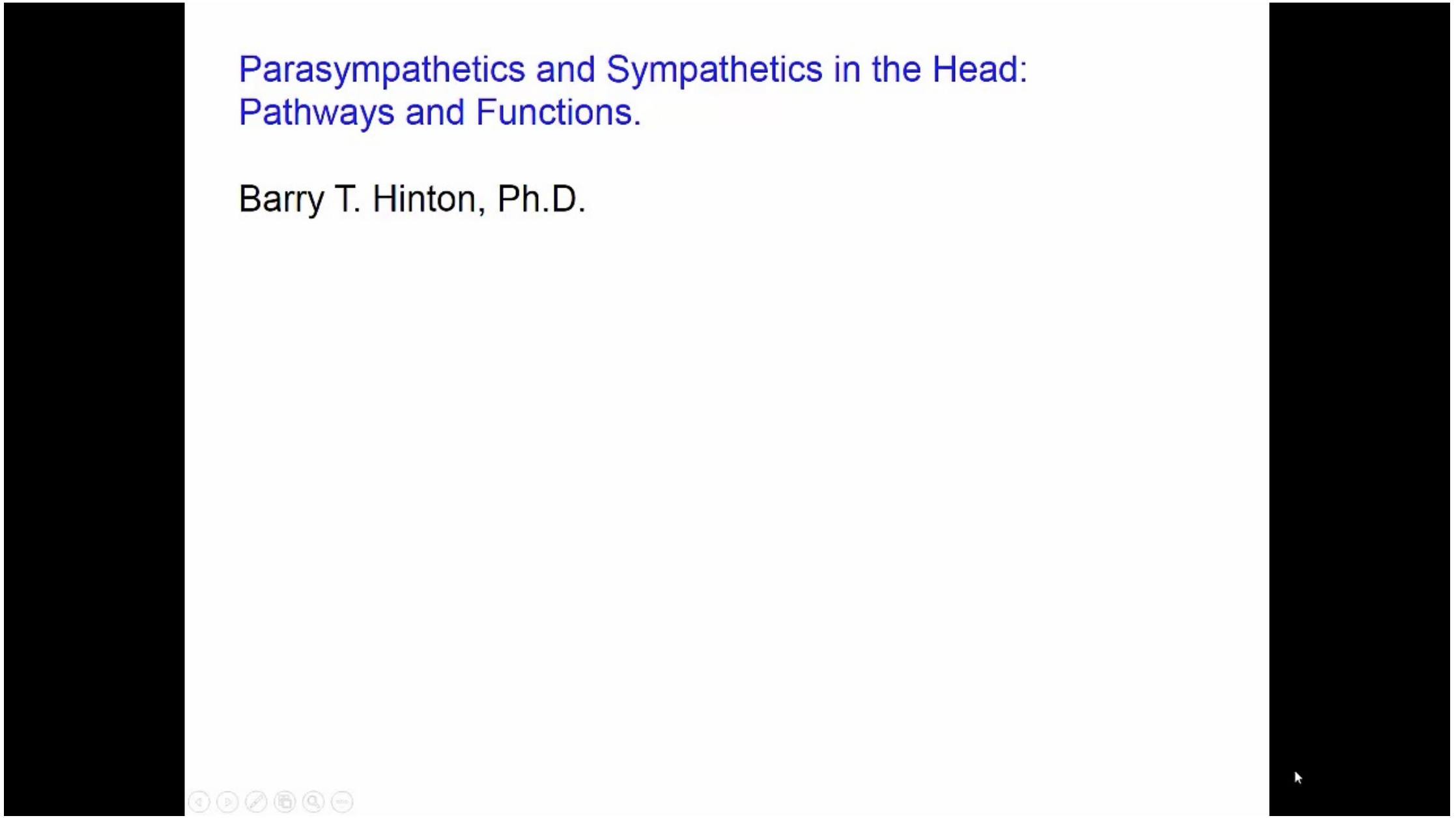
General Information: Cranial Nerves Organized by Fiber Types

Fiber Type	Abbreviation	Function	CN Containing
General Somatic Sensory (Afferent) AKA: General Sensory	GSA	Touch, pain, temperature skin & mucous membranes	V, VII, IX, X
General Visceral Sensory (Afferent) AKA: Visceral sensory	GVA	Sensory from viscera: GI tract, larynx (inferior to true vocal fold), trachea, bronchi, lungs, heart, carotid and aortic bodies (chemoreceptors), aortic arch and carotid sinus (baroreceptors)	IX, X
Special Sensory (Afferent)	SA	Smell, Vision ,Taste, Hearing, and Balance	I (smell), II (Vision), VII (Taste anterior 2/3 tongue), VIII (Balance), IX (Taste posterior 1/3 tongue), X (Taste epiglottis)
General Somatic Motor (Efferent) AKA: Somatic motor	GSE	Motor to Skeletal Muscle	III, IV, VI, XI, XII
*General Visceral Motor (Efferent) AKA: Visceral motor	GVE	Motor (parasympathetic) to smooth muscle, cardiac muscle, and glands	III, VII, IX, X
Branchial Motor (Efferent) AKA: Special visceral motor	BE	Motor to skeletal muscles derived from pharyngeal arch	V, VII, IX, X

Important point about autonomics: Autonomic fibers ORIGINATE in only cranial nerves III, VII ,IX, and X. However, these neuron fibers can “jump” to other cranial nerves to reach their final destination. For example, the parasympathetic pathway to the parotid gland begins in CN IX, but the postganglionic fibers TRAVEL WITH the auriculotemporal nerve (branch of V3) to reach the parotid gland. Because the fibers DID NOT originate in the trigeminal nerve, we DON’T classify the trigeminal nerve as a visceral motor nerve having parasympathetic function.

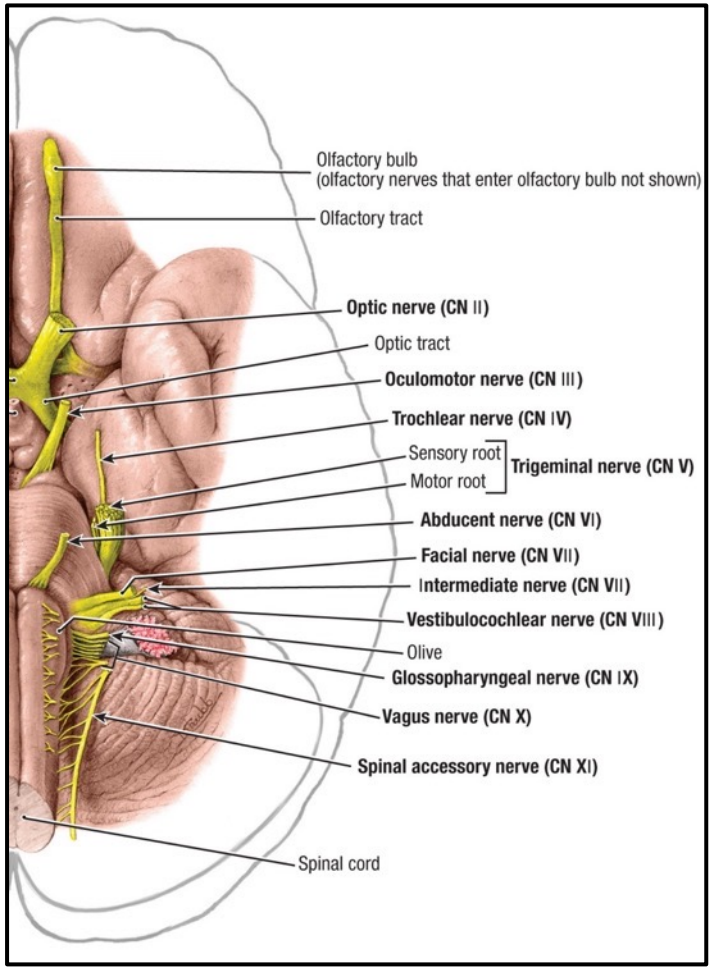
*PRL on Introduction to Autonomic NS in the Head: Embedded in next slide and and available on Panopto:

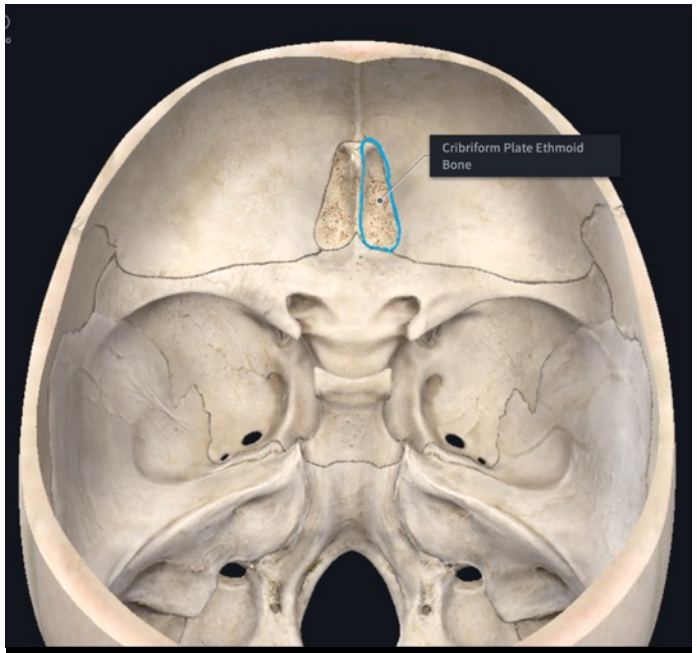
PRL: Introduction to Autonomics in the Head (Panopto)



Olfactory Nerve (CN I): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
CN I (Olfactory)	Olfactory bulb	Cribriform plate ethmoid bone	Special Sensory (SA): Smell





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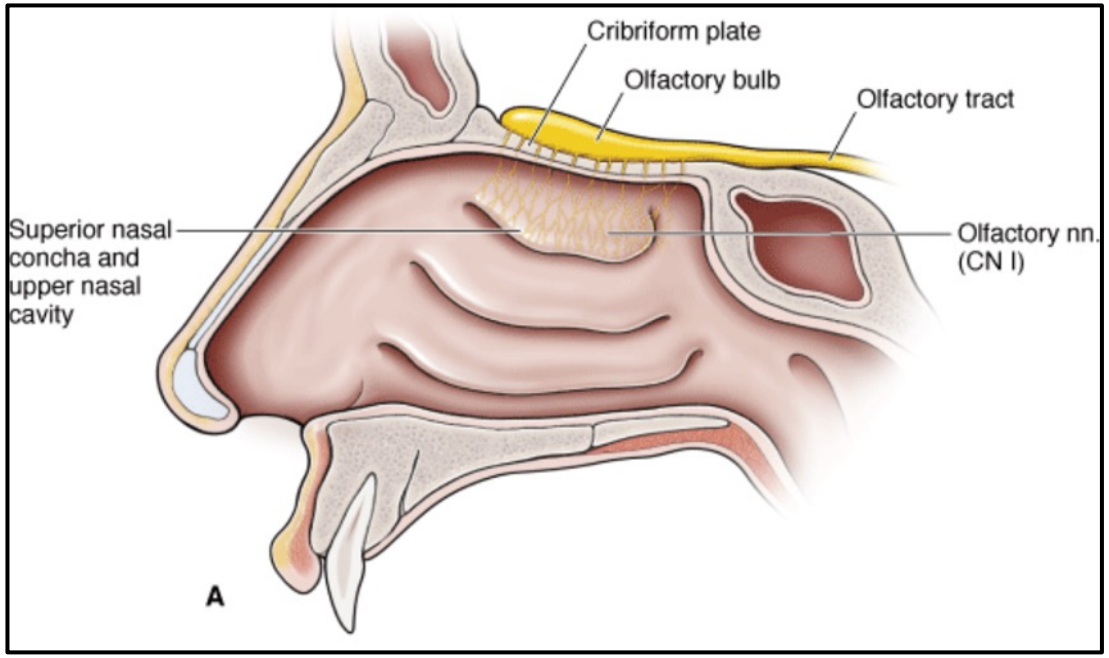


Olfactory Nerve (CN I): The Details

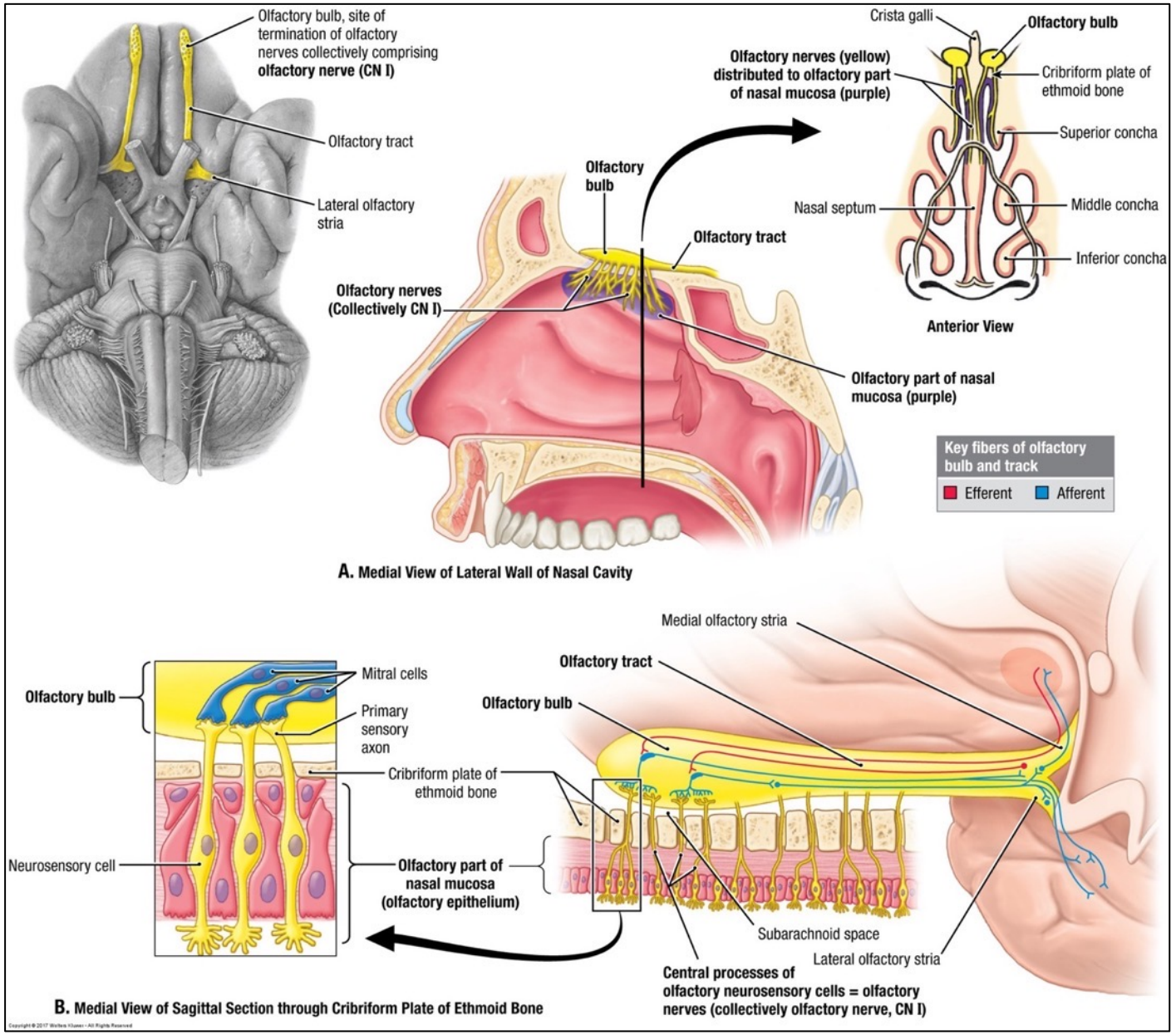
Pathway:

- The olfactory receptor neurons (first order) are located in the nasal mucosa.
- The **olfactory neuron processes (CN I)** ascend to pass through cribriform plate of ethmoid bone to to enter the **olfactory bulbs** in the anterior cranial fossa.
- At the olfactory bulb, first order neurons synapse with second-order neurons.
- The axons of secondary neurons project to the cerebral cortex bundled within olfactory tracts.
- **Provides the special sense of olfaction**

Test: Ability to smell bilaterally

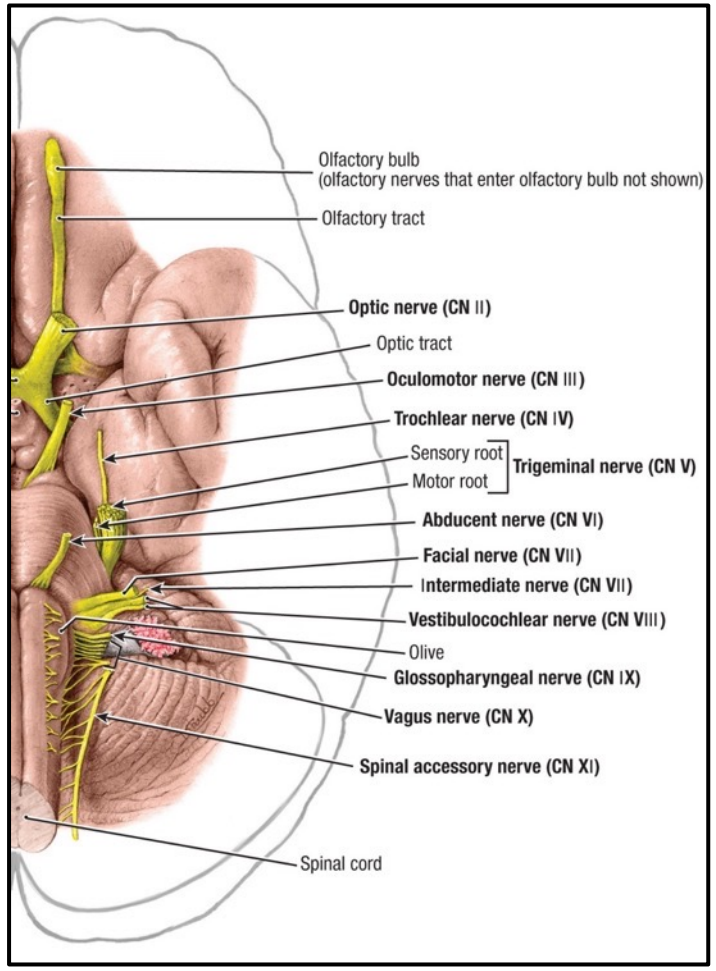
Positive Test: Inability to smell

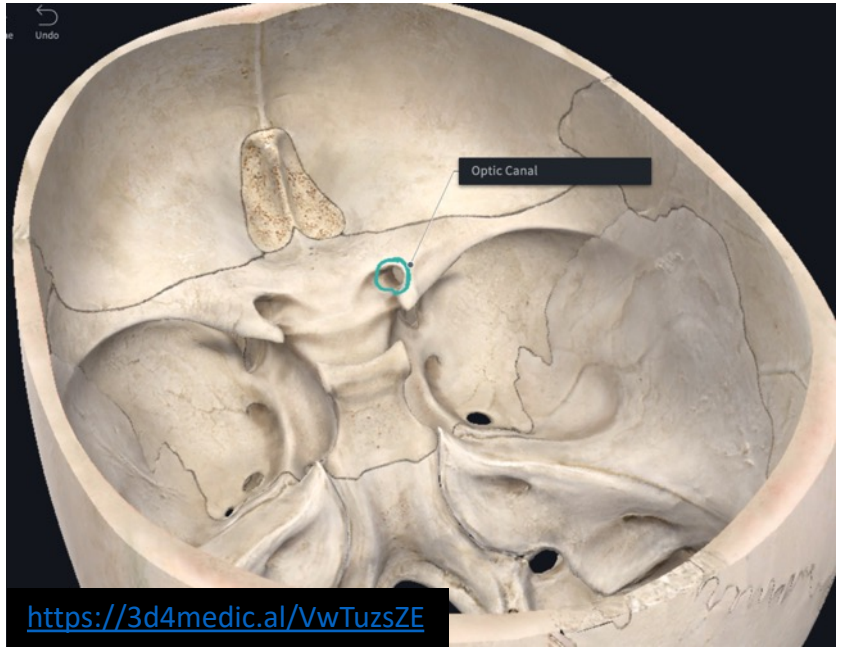
Clinical Notes: Loss of olfactory fibers usually occurs with aging; olfactory filaments can be sheared off from traumatic blows to the bridge of the nose.

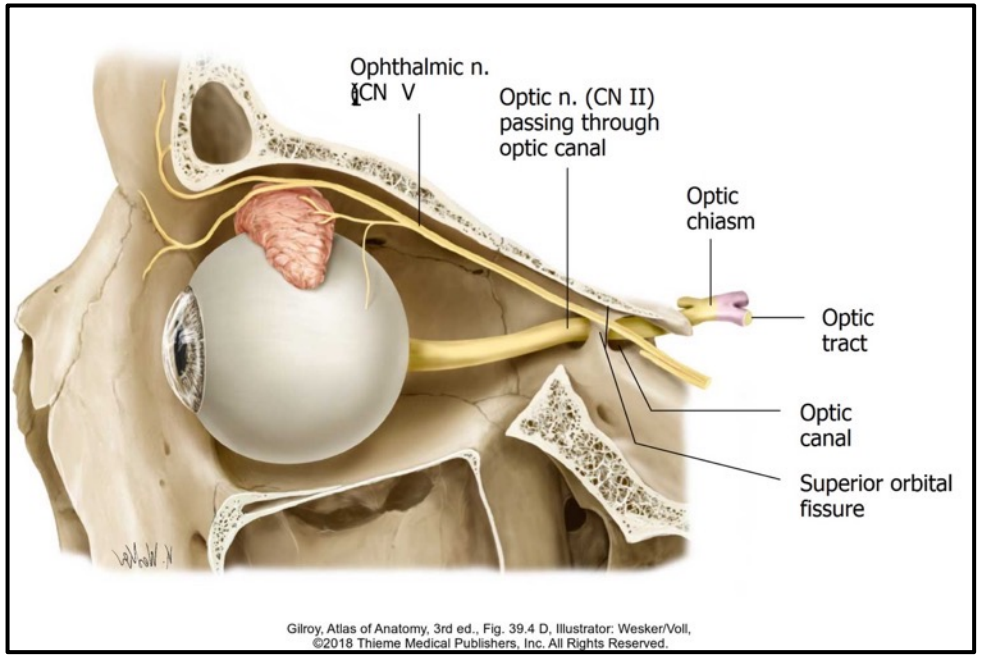


Optic Nerve (CN II): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
CN II (Optic)	N/A: Technically the optic nerve isn't a "nerve" because the retina is an extension of the brain. However, ganglion cell neuron cell bodies in the retina of the eye have their axons coursing within the optic nerve, chiasm, and tract to ultimately synapse in the thalamus.	Optic Canal	Special Sensory (SA): Vision







Gilroy, Atlas of Anatomy, 3rd ed., Fig. 39.4 D, Illustrator: Wesker/Voll,

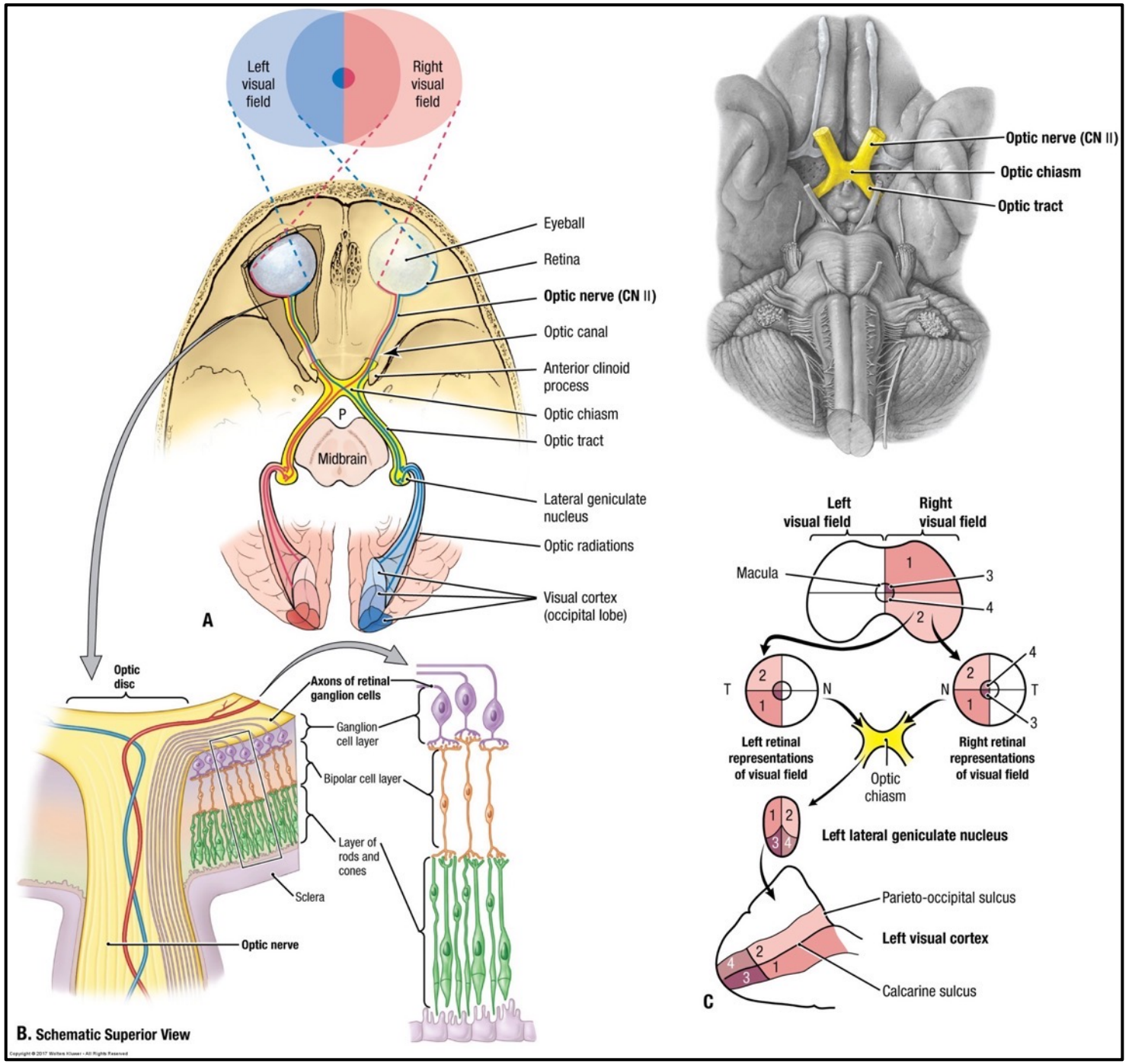
Optic Nerve (CN II): The Details

Pathway:

- Neuron fibers of the **optic nerve** originate from ganglion cells in the retina of the eye.
- The ganglion cell axons coalesce to form the optic nerve and pass through the **optic canal**.
- The optic nerves join at the optic chiasm where fibers from the nasal ½ of the optic nerve cross to the contralateral side of the optic chiasm.
- From the optic chiasm, neuron fibers are bundled as the optic tract and course to the geniculate bodies of the thalamus.
- **Provides the special sense of vision**

Test: Afferent limb of the pupillary light reflex

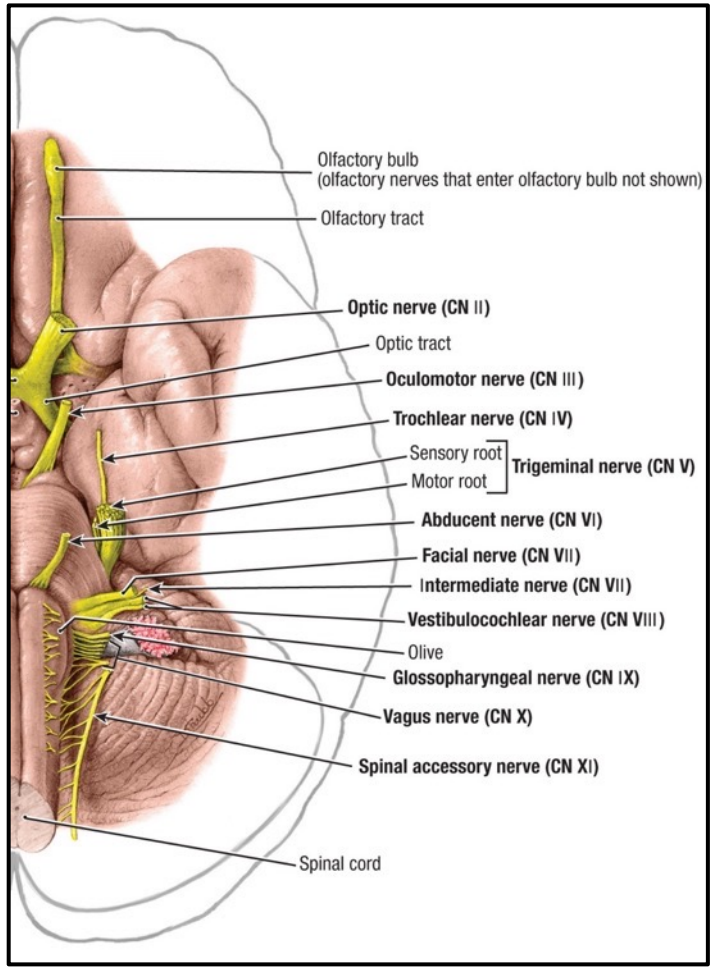
Positive Test: Shining a light into the eye afflicted with an optic nerve lesion, will result in an unresponsive pupil in the ipsilateral and contralateral eye.)

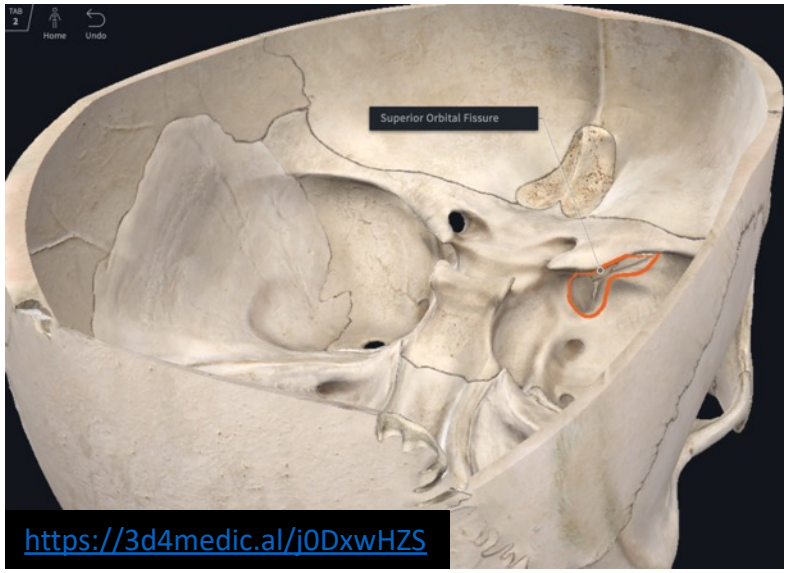


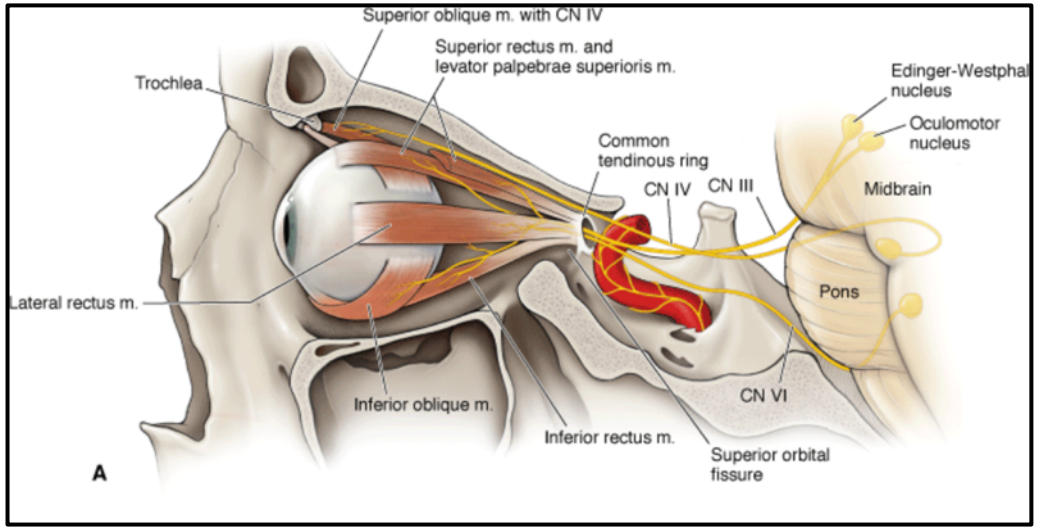
Oculomotor Nerve (CN III): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
CN III (Oculomotor)	Interpeduncular fossa	Superior orbital fissure	• Somatic Motor (GSE): 4 extraocular eye muscles (superior rectus, medial rectus, inferior rectus, and inferior oblique) and levator palpebra superioris (elevates eyelid) • *Visceral Motor (GVE): pupillary sphincter (pupil constriction) and ciliary muscle (lens accommodation)

*Preganglionic parasympathetic fibers





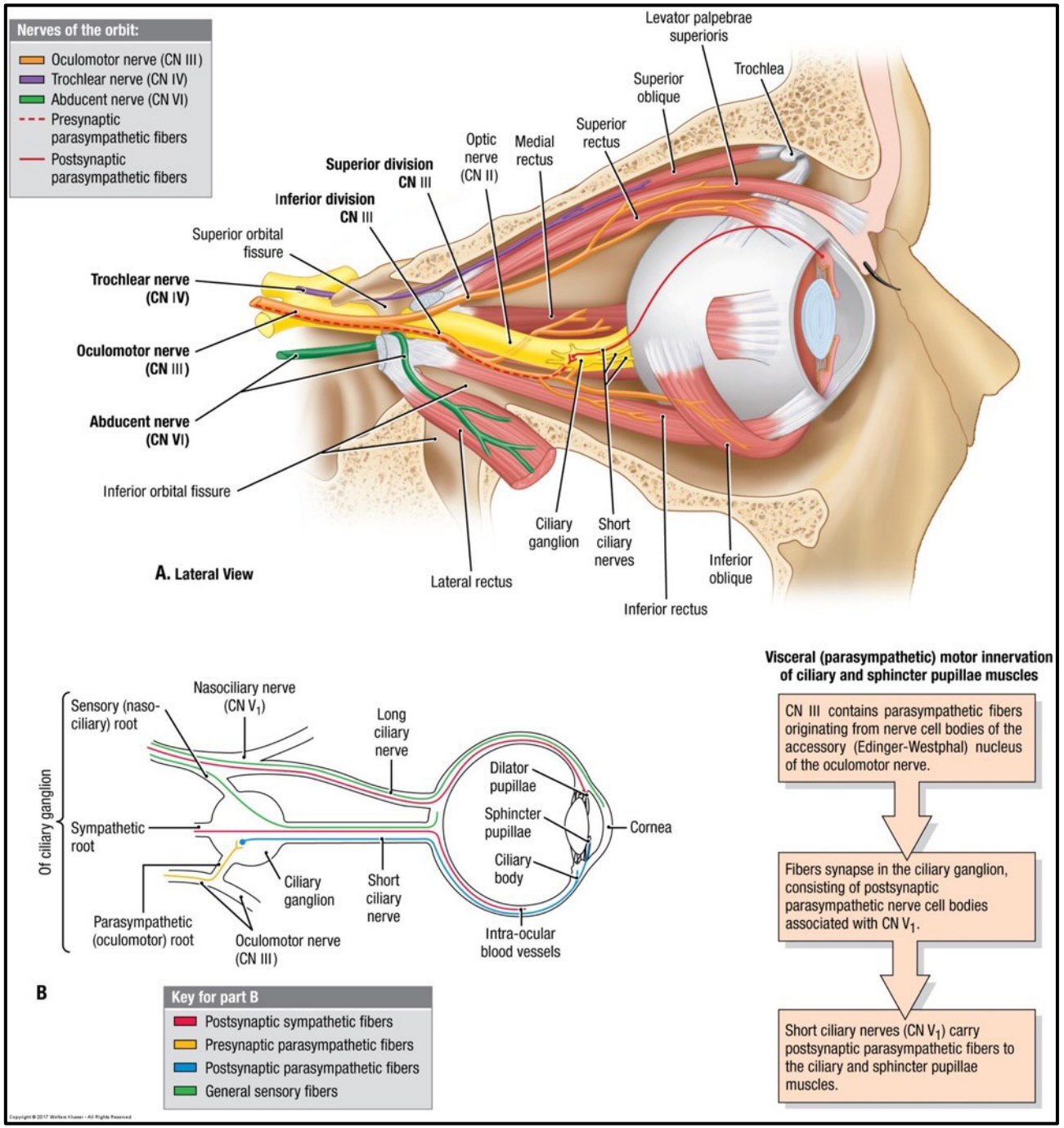


Oculomotor Nerve (CN III): The Details

Pathway:

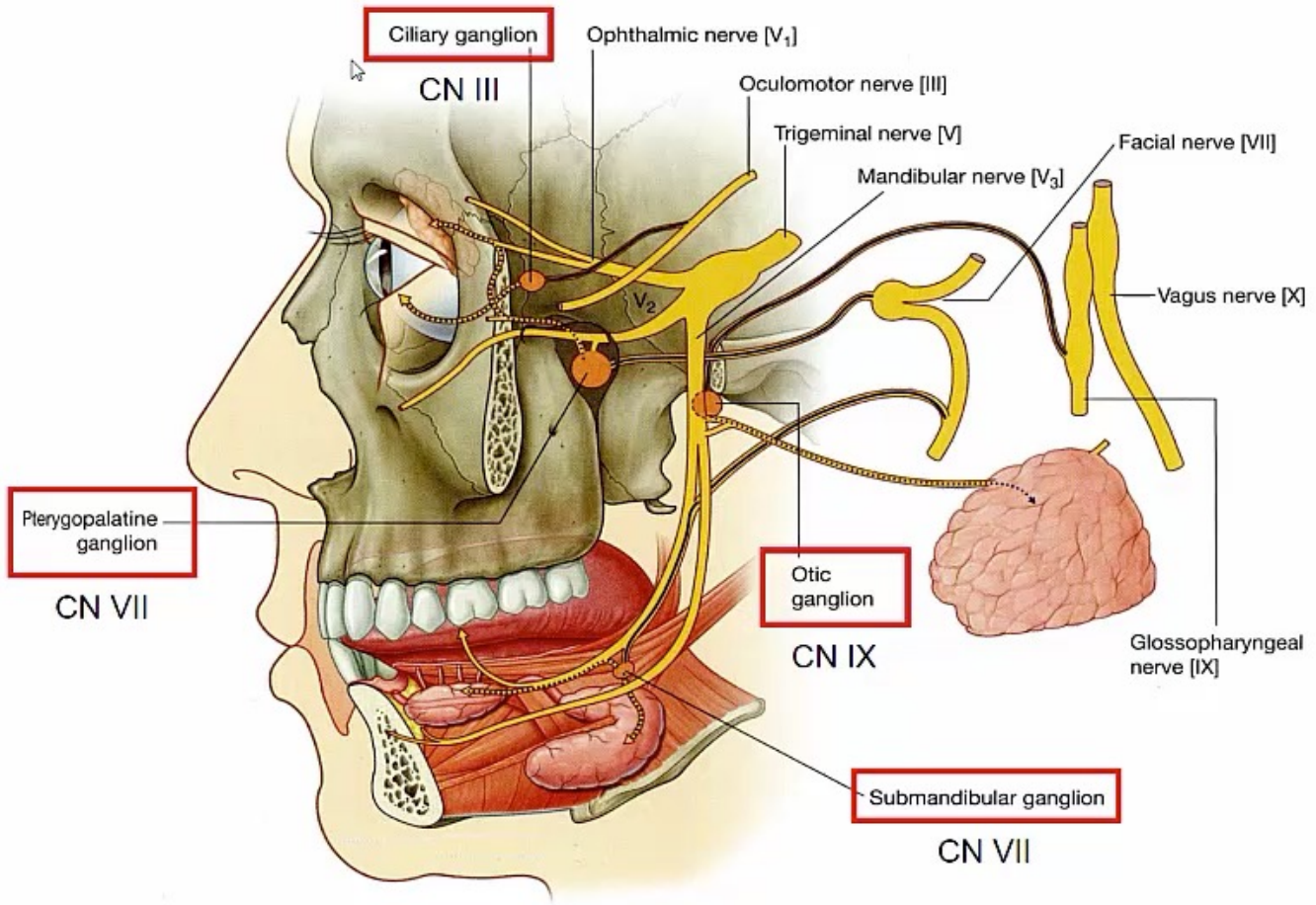
- The **oculomotor nerve** emerges from the midbrain and pierces the dura mater lateral to the diaphragm sellae.
- It then courses through the lateral wall of the cavernous sinus to enter the orbit through the **superior orbital fissure**.
- **GSE fibers of the oculomotor nerve innervate levator palpebrae superioris and extraocular eye muscles (superior rectus, inferior rectus, medial rectus, and inferior oblique muscles).**
- GVE fibers of the oculomotor nerve enter the ciliary ganglia. Within the ganglion, preganglionic fibers synapse with postganglionic fibers. Postganglionic fibers leave the ganglion and enter the eye via short ciliary nerves. Within the eye the **postganglionic fibers innervate the sphincter pupillae (pupillary constriction) and the ciliary muscles (accommodation of the lens for near vision)**.

PRL of CNIII Autonomic Pathway: Embedded in next slide and available on Panopto.



PRL: Oculomotor Nerve (CN III) Autonomics (Panopto)

Parasympathetic Ganglia of the Head



CN X: no parasympathetics in the head and neck

Oculomotor Nerve (CN III): The Details (Continued)

Test:
- GSE: ”H” eye exam
- GVE: Efferent limb of pupillary light reflex

Positive Test:
- GSE: Inability to move the eyes into the testing position of the following muscles: superior rectus, inferior rectus, inferior oblique, and medial rectus) (Figure 1)
- GVE: No pupillary constriction when light is shined into the ipsilateral or contralateral pupil.

Clinical Notes:
- Injury can result in mydriasis (dilated pupil) and ptosis (droopy eyelid) (Figure 2).
- Due to lack of innervation of multiple extraocular eye muscles, the eye is displaced in an abducted and depressed position in a complete nerve palsy (Figure 2).
- An aneurysm of the posterior cerebral or superior cerebellar aa. may exert pressure on CN III where it passes between these vessels; CN III affected in cavernous sinus infections; rapidly increasing intracranial pressure often compresses CN III against the petrous portion of the temporal bone, which results in superficial parasympathetic fibers being affected first.

Figure 1

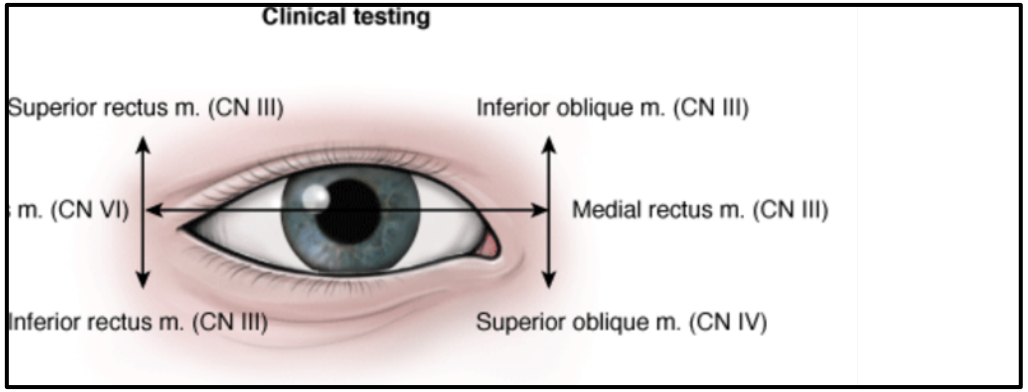
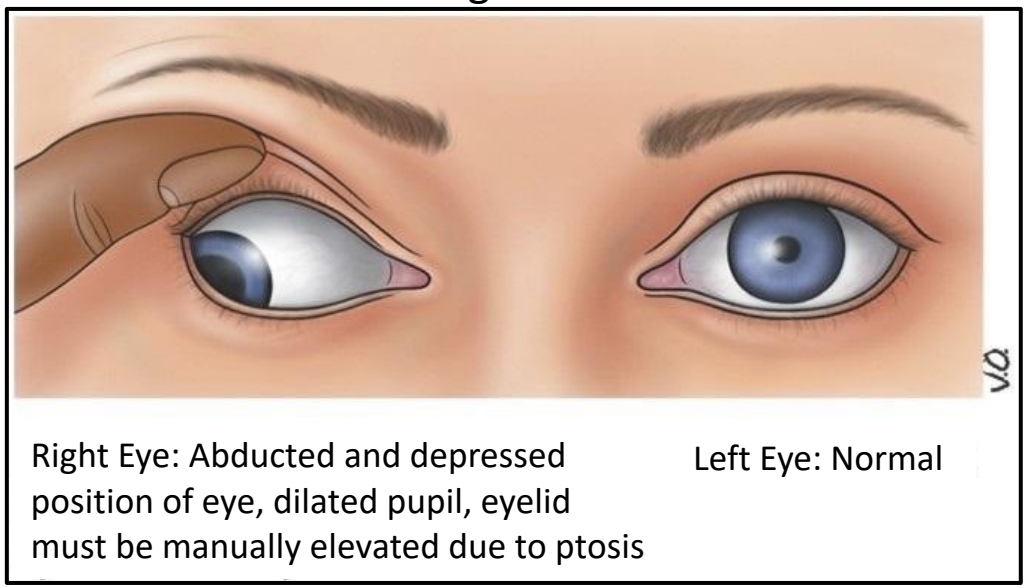


Figure 2

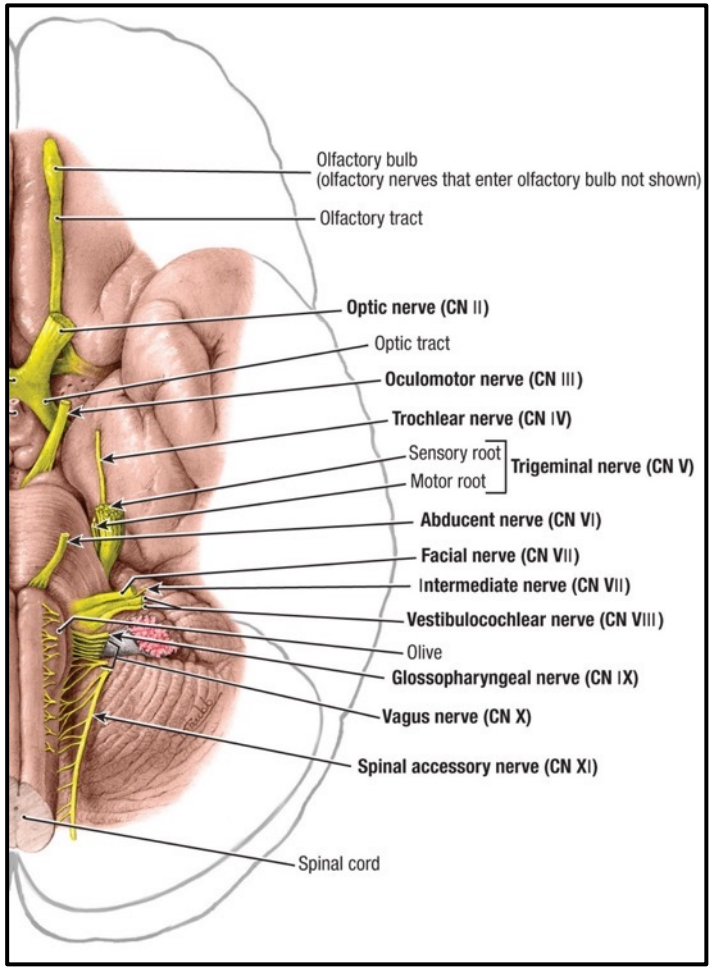


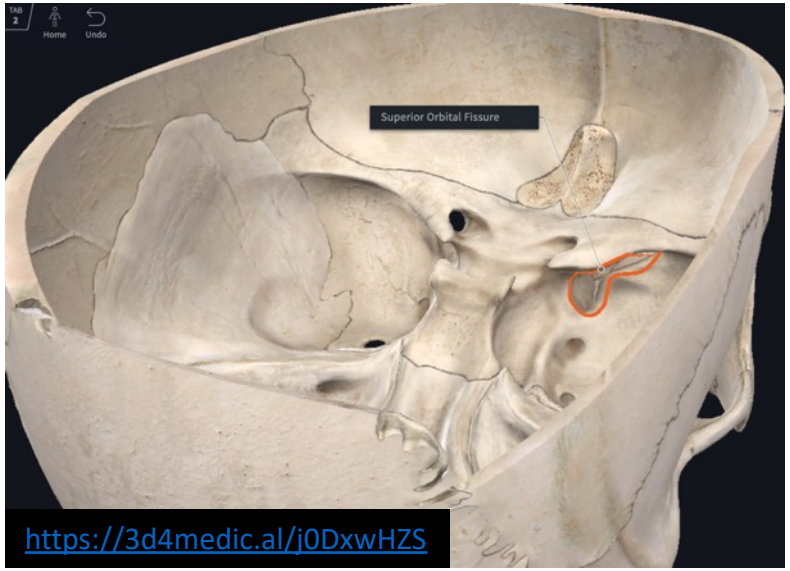
Right Eye: Abducted and depressed position of eye, dilated pupil, eyelid must be manually elevated due to ptosis

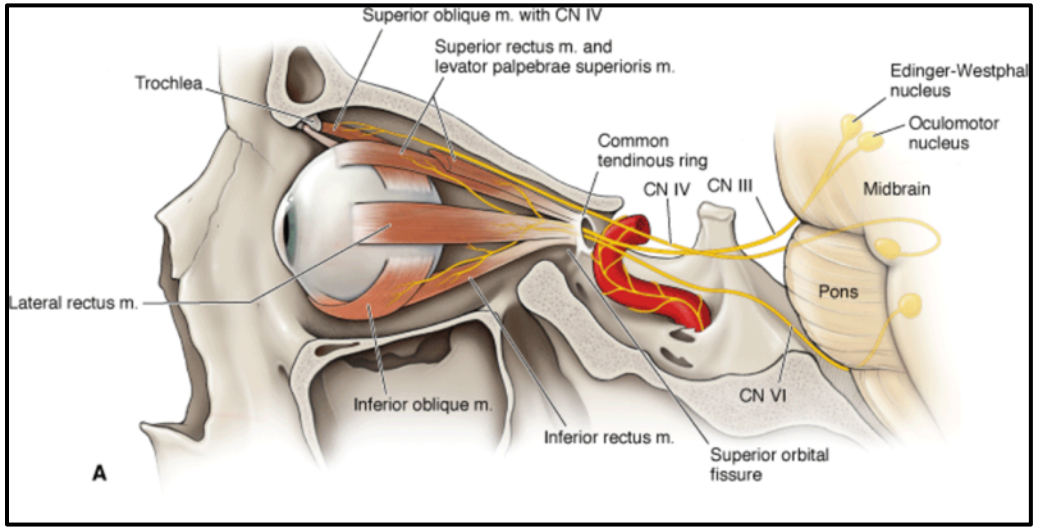
Left Eye: Normal

Trochlear Nerve (CN IV): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
CN IV (Trochlear)	Dorsolateral surface of midbrain	Superior orbital fissure	Somatic Motor (GSE): 1 extraocular eye muscle: superior oblique m.







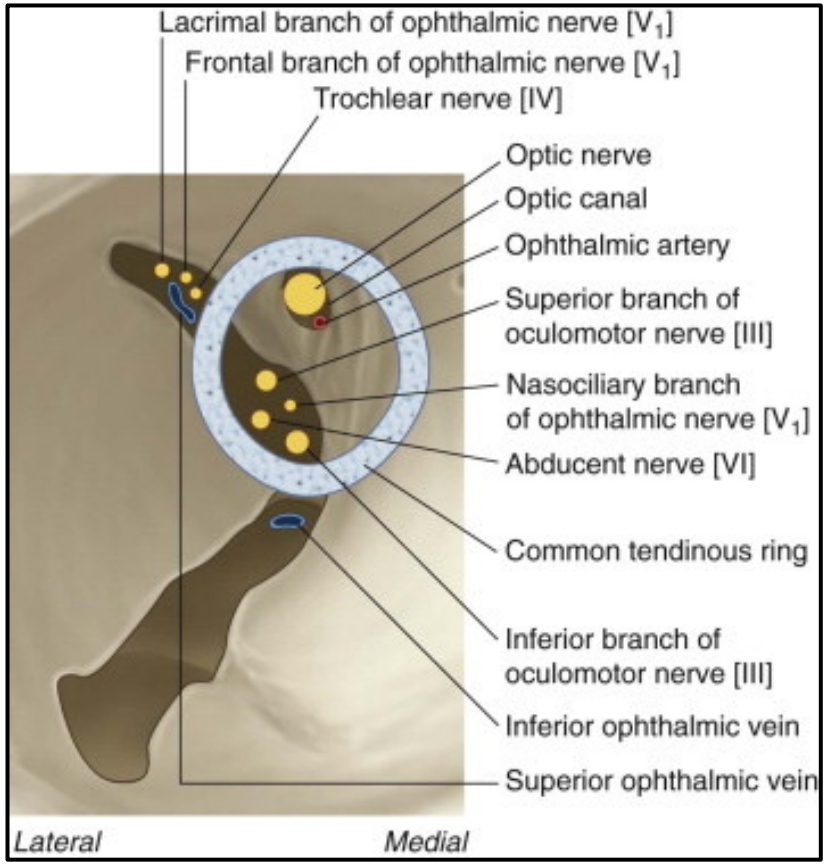
Trochlear Nerve (CN IV): The Details

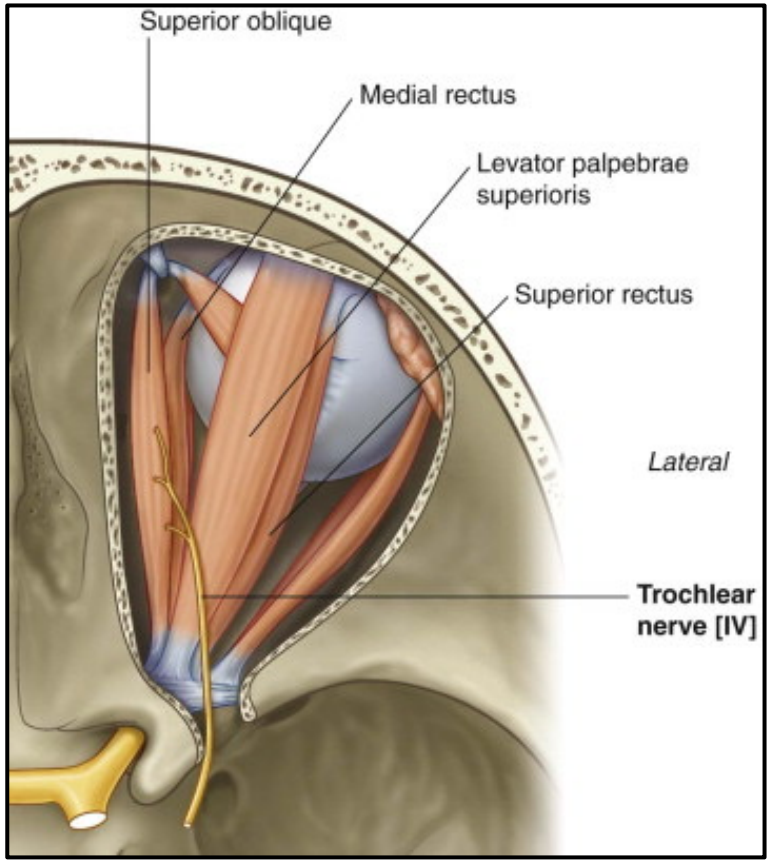
Pathway:

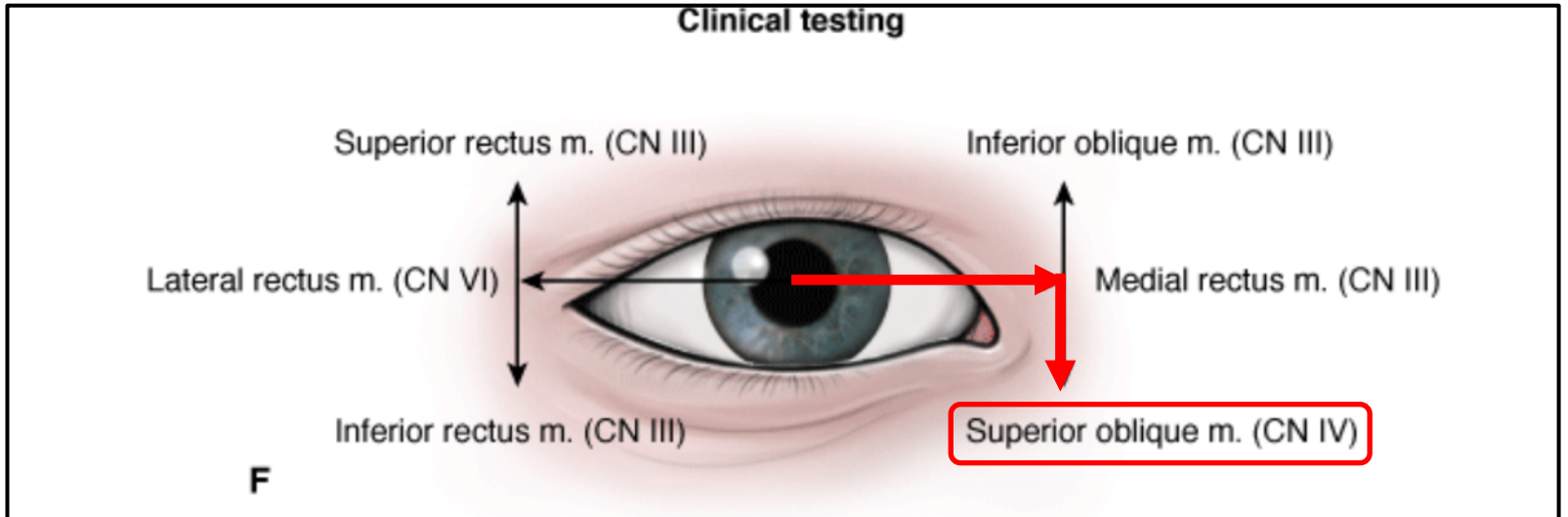
- The **trochlear nerve** emerges from the midbrain on its posterior surface.
- It pierces the dura mater at the margin of the tentorium cerebelli adjacent to the posterior clinoid processes.
- The nerve courses along the lateral wall of the cavernous sinus before it enters the orbit through the **superior orbital fissure** where it traverses the orbit to enter the superior oblique muscle.
- **It provides somatic innervation to the superior oblique muscle.**

Test: ”H” eye exam: adduction combined with depression of eye
Positive Test: Inability to depress the eye, especially when the eyeball is adducted.

Clinical: CN IV rarely paralyzed alone; CN IV affected in cavernous sinus infections

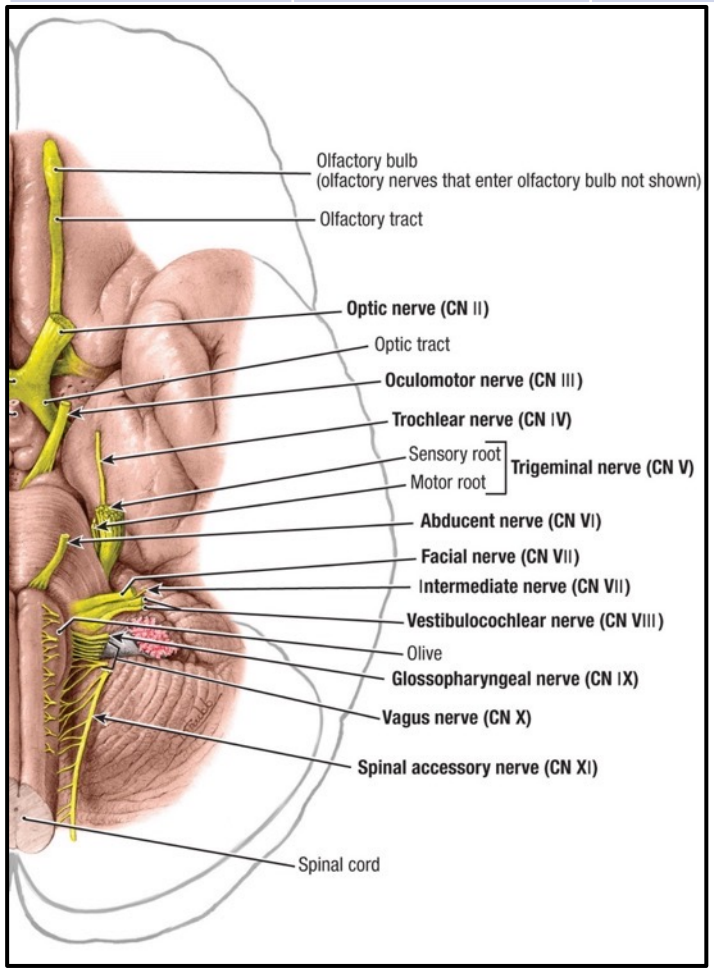


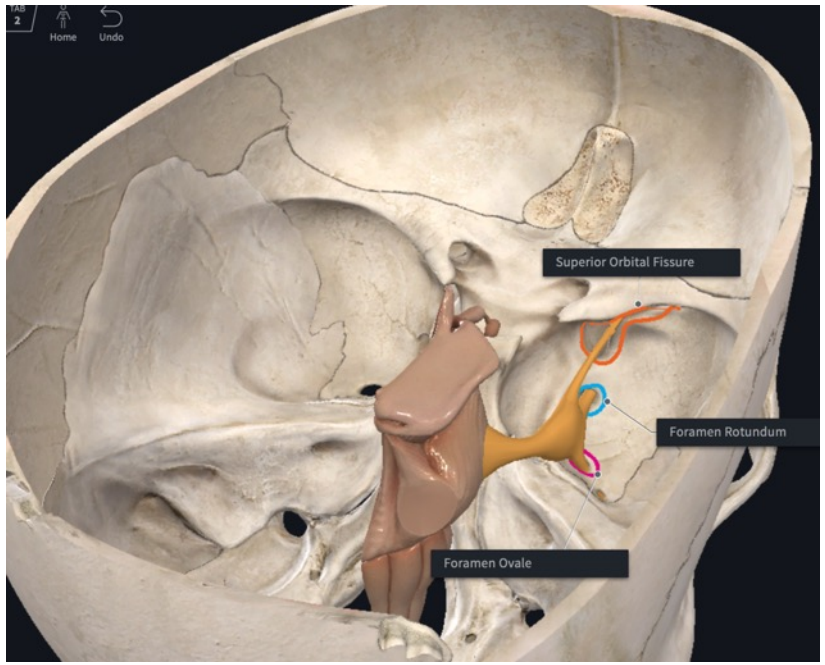


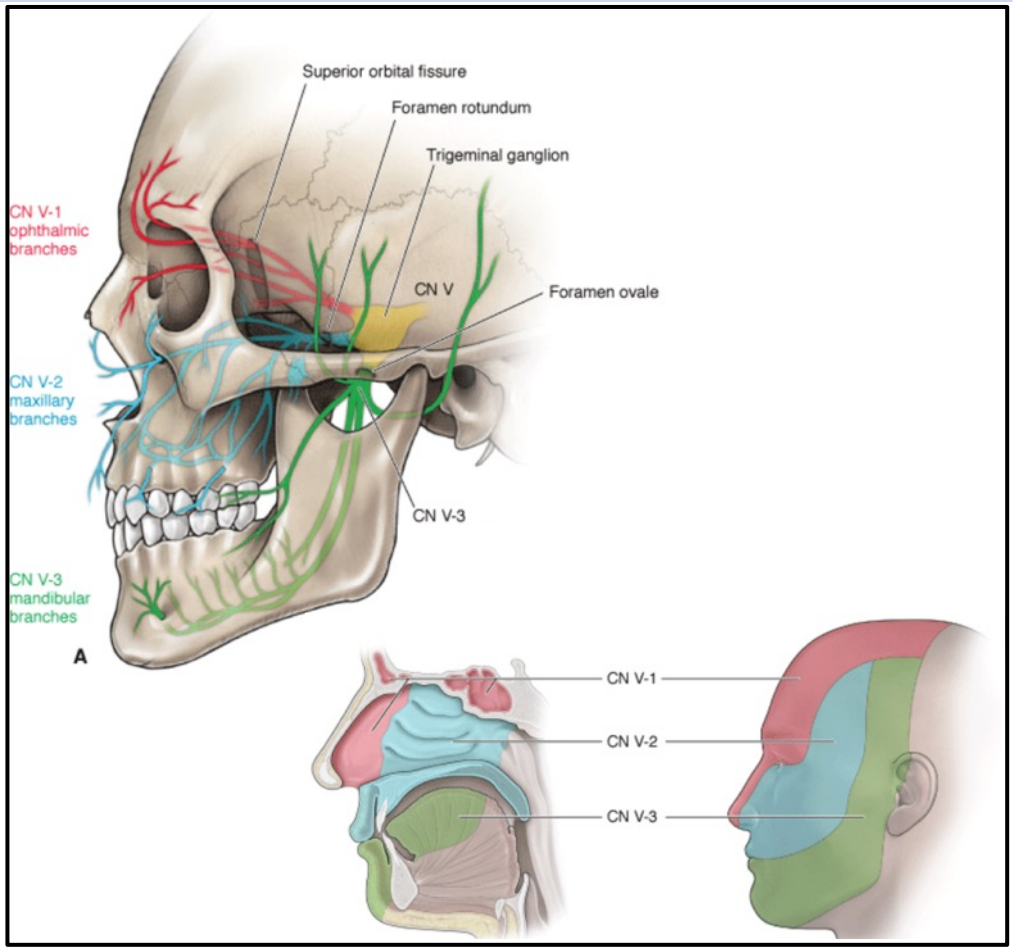


Trigeminal Nerve (CN V): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
CN V (Trigeminal)	Anterolateral pons	V1: superior orbital fissure V2: foramen rotundum V3: foramen ovale	Branchial Motor (BE): V3: muscles mastication, mylohyoid, anterior belly digastric, tensor tympani, tensor veli palitini Somatic Sensory (GSA): • V1: cornea, upper eyelid and its conjunctiva, lacrimal gland, anterosuperior nasal cavity, frontal sinus, ethmoid sinus, dorsum nose, forehead, and anterior part scalp • V2: Lower eyelid and its conjunctiva, upper cheeks, maxillary sinus, posteroinferior nasal cavity, nasopharynx, palate, teeth of maxilla, maxillary sinus, skin side of nose, upper lip • V3: anterior part external ear, temporal region, lower cheek, chin, lower lip, teeth of mandible, anterior two-third tongue



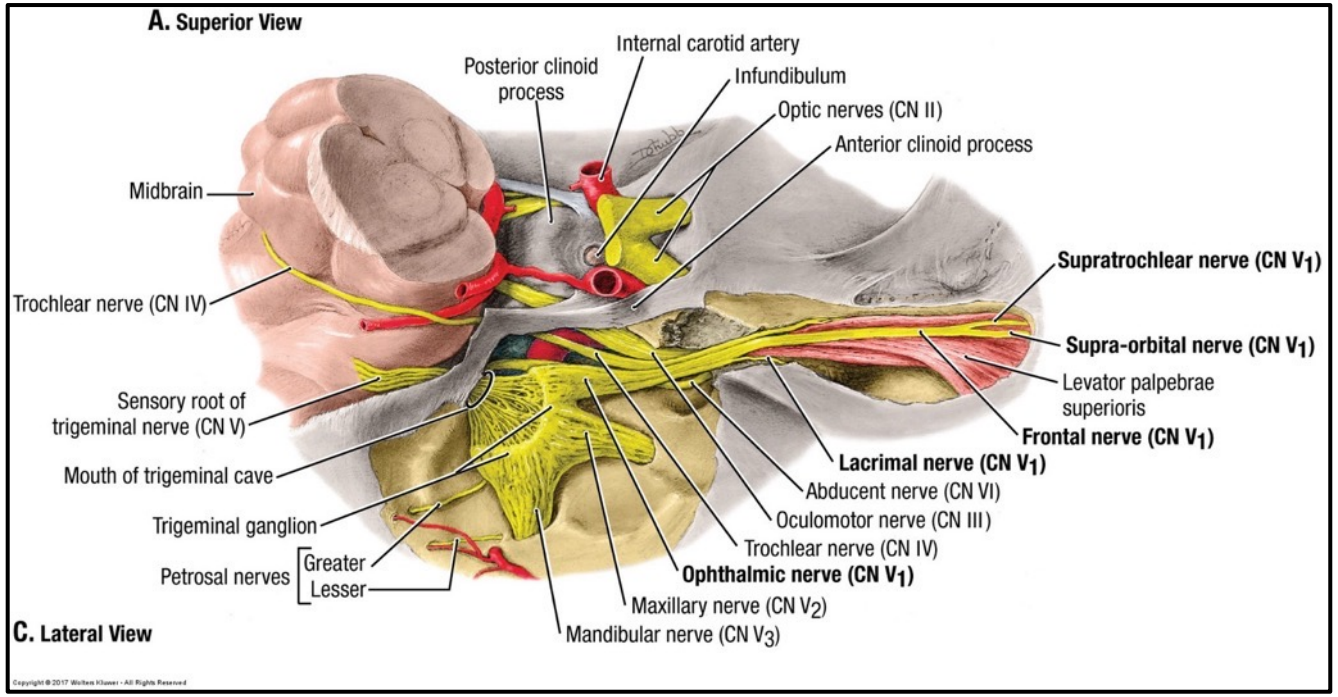


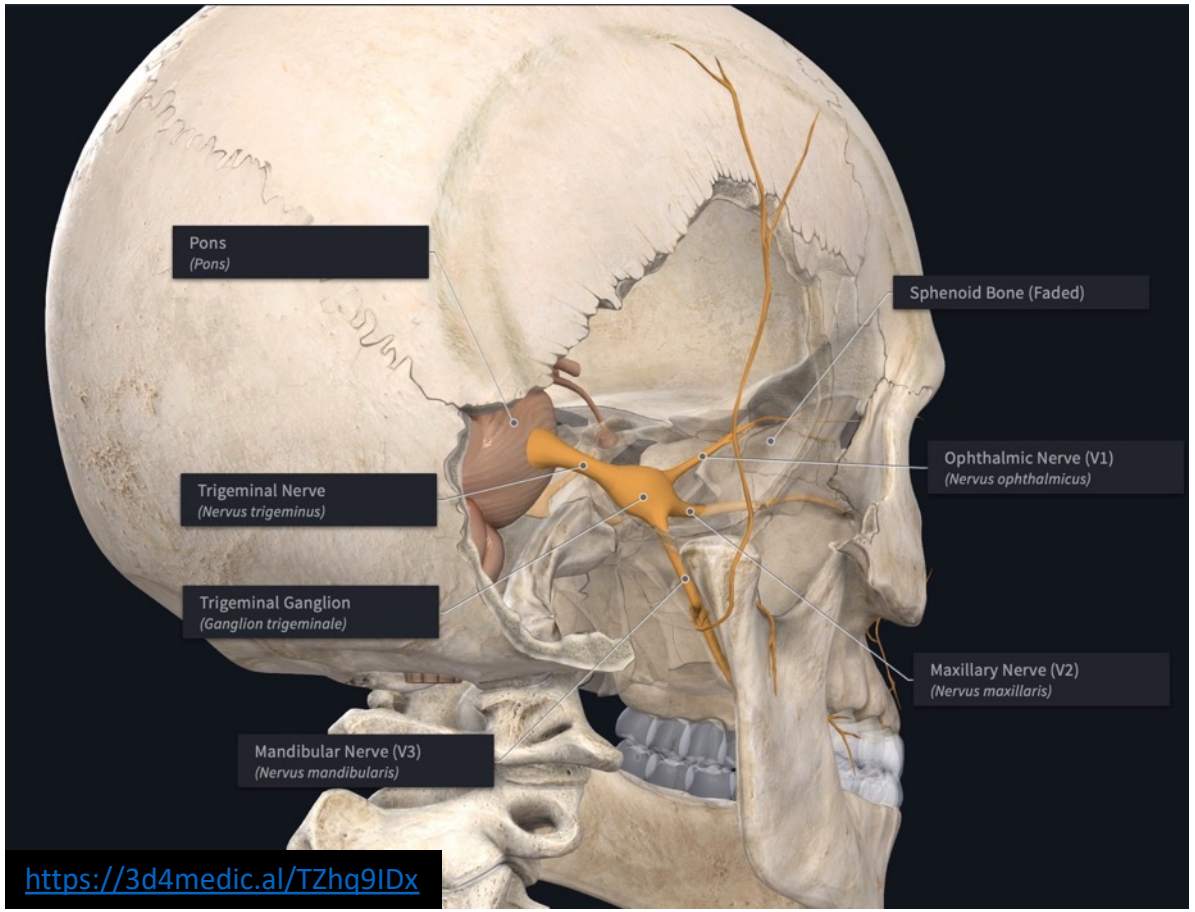


Trigeminal Nerve (CN V): The Details

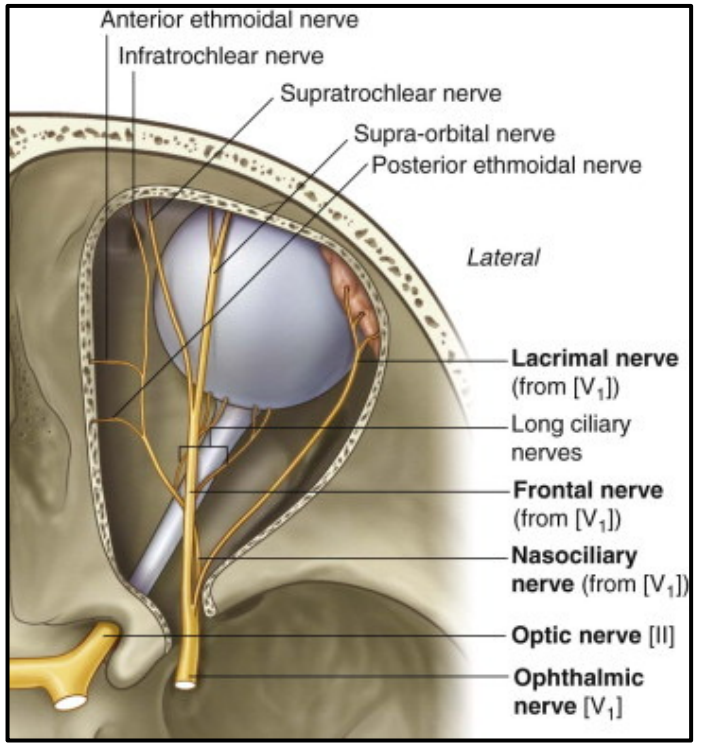
Pathway:

- The trigeminal nerve emerges from the lateral aspect of the pons as a large sensory root and a smaller motor root.
- The nerve roots enter the trigeminal (Meckel's) cave, which is a space lateral to the cavernous sinus and covered by dura.
- In Meckel's cave, the sensory root joins with the trigeminal ganglion, which contains general somatic afferent neuron cell bodies.
- The neuron fibers of the motor root bypasses the ganglion to course within the mandibular division (V3)





Ophthalmic Division (CN V1) Trigeminal: The Details

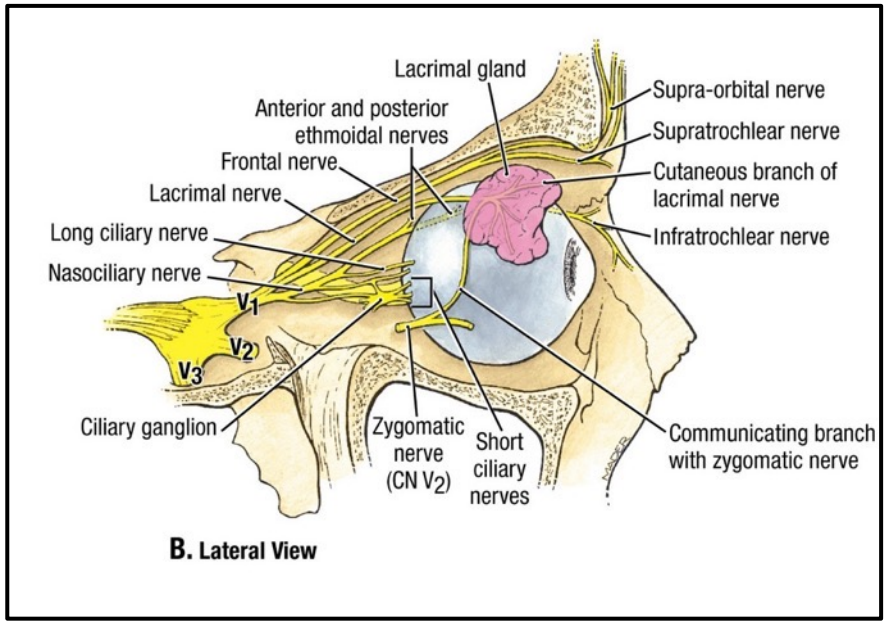


Pathway: The **ophthalmic division (CN V1)** courses along the lateral wall of the cavernous sinus to enter the orbit via the **super orbital fissure**. The nerve has three main branches:

- **Frontal nerve:** The frontal nerve is the largest branch. It branches from the ophthalmic division just prior to where ophthalmic division passes through the **superior orbital fissure**. The frontal nerve enters the the orbit through the superior orbital fissure, and courses medially in the orbit outside the cone of muscles between the periosteum of the orbit's roof and the levator palpebrae superioris.
  - The supraorbital is the lateral of the two branches. It exits the orbit through the superior orbital notch. **It supplies: upper eyelid, conjunctiva, forehead, and scalp.**
  - The supratrochlear nerve is the medial of the two branches. It courses through the superomedial aspect of the orbit and exits the orbit under the superior orbital margin by passing through the supratrochlear foramen, or medially to it. **It supplies: upper eyelid, conjunctiva, forehead, and scalp.**

- **Lacrimal nerve:** The lacrimal nerve branches from the ophthalmic division just prior to where ophthalmic division passes through the **superior orbital fissure**. The lacrimal nerve enters the the orbit through the superior orbital fissure, and is the most lateral nerve passing through the fissure.
  - **Sensory innervation of lacrimal gland, upper eyelid and conjunctiva**
  - Receives a branch from zygomatic nerve of CN V2 that contains postganglionic parasympathetic fibers originating from the facial nerve. Ultimately, these parasympathetic fibers innervate the lacrimal gland.

- **Nasociliary nerve** (and branches you DON'T need to know by name): The nasociliary nerve branches from the ophthalmic division just prior to where ophthalmic division passes through the **superior orbital fissure**. It enters the orbit through the superior orbital fissure and courses from lateral to medial within the orbit giving off branches along its path.
  - **Sensory from cornea, anterosuperior nasal cavity, frontal, sphenoid and ethmoid sinuses, dura, upper eyelid, and bridge of nose**



Ophthalmic Division (CN V1) Trigeminal: The Details (Continued)

Test:

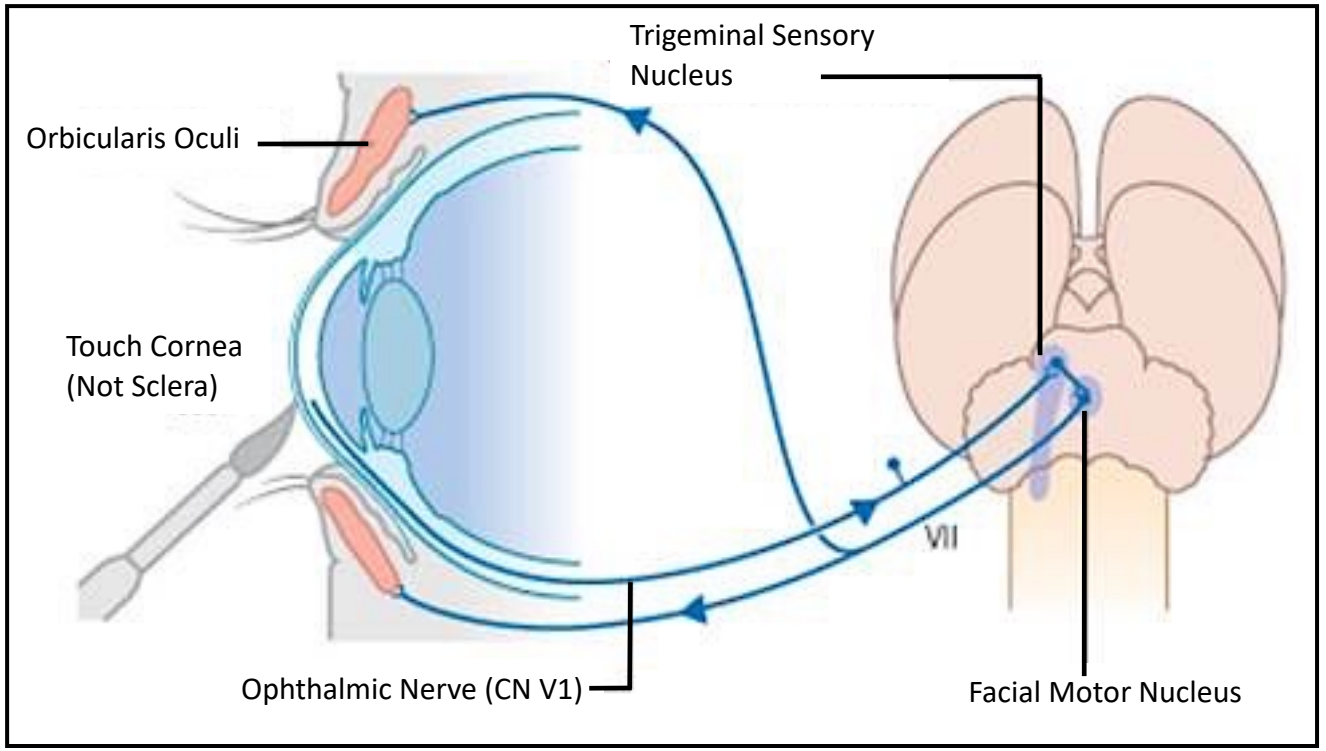
- Afferent limb of corneal reflex
- Perception of touch on forehead

Positive Test:

- Corneal reflex: Lack of blinking when cornea is touched with twisted piece of cotton ball.) (Figure)
- Lack of touch sensation on forehead

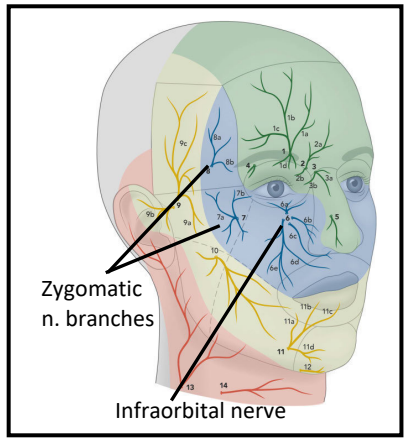
Clinical:

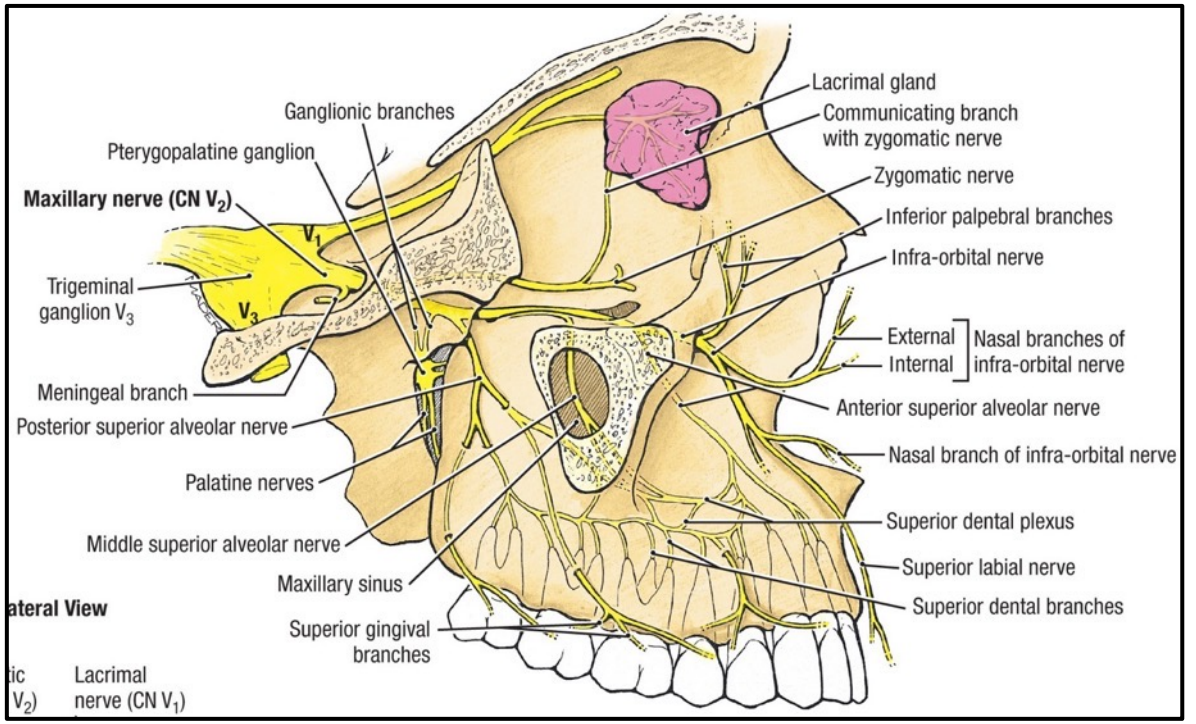
- CN V can be injured by trauma, tumors, aneurysms or meningeal infections
- Damage to CN V nerve may result in reduced ipsilateral facial sensation. Trigeminal neuralgia, sharp intermittent dermatomal facial pain, can result from irritation to this nerve by an abutting vessel (most often the SCA).



Maxillary Division (CN V2) Trigeminal: The Details

Pathway: The **maxillary nerve** arises from the trigeminal ganglion and courses anteriorly along the lateral/inferior wall of the cavernous sinus. It continues anteriorly to exit the skull via the **foramen rotundum**. After traversing the foramen rotundum it is located in the superior part of the pterygopalatine fossa where it forms branches with the pterygopalatine ganglion. The maxillary nerve exits the pterygopalatine fossa to enter the deepest part of the infratemporal fossa.

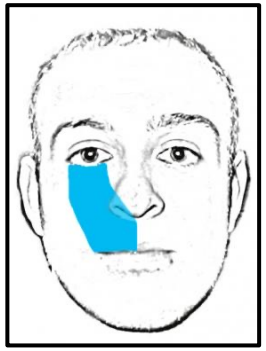




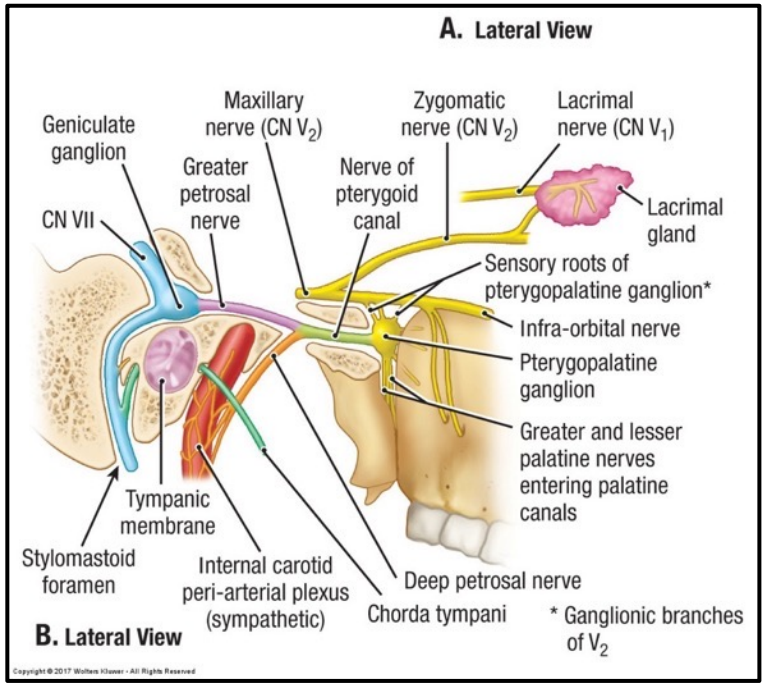
- Within the the infratemporal fossa, the **zygomatic nerve** branches from the maxillary nerve. The zygomatic nerve passes through the **inferior orbital fissure** to course along the lateral wall of the orbit. The terminal branches (zygomaticofacial & zygomaticotemporal) emerge from the skull via separate foramina to supply **skin over the zygomatic bone and anterior scalp of temporal region**. A small branch of the zygomatic nerve (communicating branch) contains the postganglionic parasympathetic fibers of the facial nerve that ultimately innervate the lacrimal gland (see Facial Nerve, CN VII).

- After passing through the infratemporal fossa, the maxillary nerve enters the inferior aspect of the orbit through the **inferior fissure** to become the **infraorbital nerve**. The **infraorbital nerve** courses through the infraorbital groove and canal to exit the maxillary bone at the infraorbital foramen: **It innervates the lower eyelid, side of the nose, and upper lip**.

- There are other smaller branches that you don't need to identify and memorize by name, but you should know the regions they innervate as being associated with the domain of the maxillary nerve.
  - **Sensory: posteroinferior nasal cavity, maxillary sinus, palate, maxillary teeth (superior alveolar nerves), anterior cheek & upper lip.**



Infraorbital n. Skin Sensory Domain



Test: perception of touch in infraorbital region
Positive Test: Lack of sensation in infraorbital region.

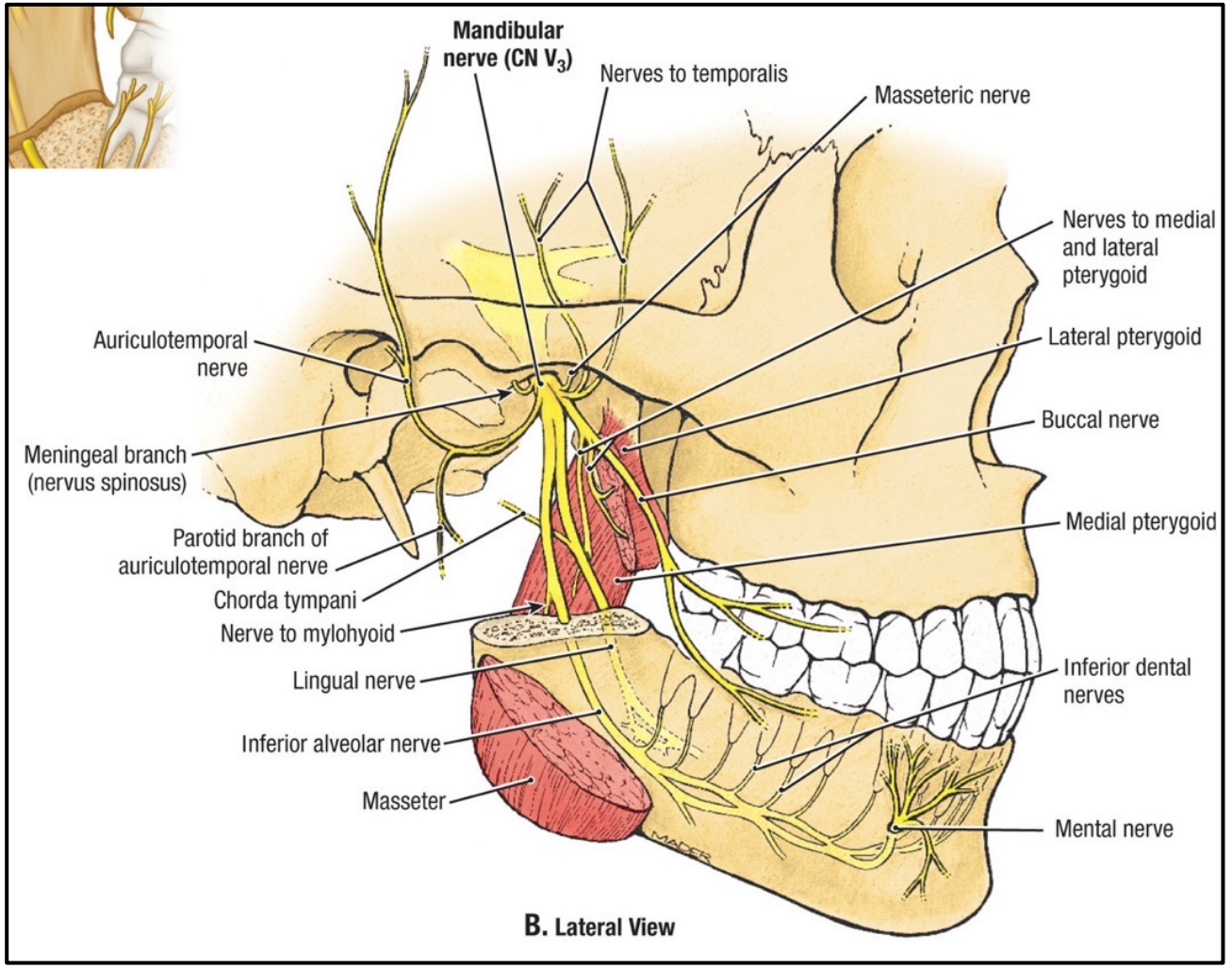
Clinical: CN V can be injured by trauma, tumors, aneurysms or meningeal infections

Mandibular Division (CN V3) Trigeminal: The Details

The **maxillary nerve** arises from the trigeminal ganglion and passes through the foramen oval to descend in the infratemporal fossa. Several important branches are formed from the mandibular nerve.

- The **lingual nerve** courses in an inferior direction between the medial and lateral pterygoid muscles. It courses across the lateral surface of the medial pterygoid muscle to enter the floor of the oral cavity at the posterior attachment of the mylohyoid muscle immediately inferior to the last moral tooth. In this location, the nerve is palpable through the oral mucosa, which makes it vulnerable to to damage during oral surgery in this location. **It provides sensory innervation to the anterior two-thirds of the tongue and the floor of the oral cavity.** In addition, **preganglionic parasympathetic fibers from the facial nerve (chorda tympani) course along with the lingual nerve on their destination to the submandibular ganglion** (see Facial Nerve, CN VII).

- The **buccal nerve** courses between the two heads of the lateral pterygoid muscle and passes deep to the masseter. Ultimately, it forms branches on the surface of the buccinator muscle: **The nerve provides general sensory innervation to the buccal (cheek) region, including the buccal mucous membranes of the mouth.** It also branches to supply the **buccal gingivae of the second and third mandibular molar teeth**.



- The **inferior alveolar nerve** courses inferiorly along with the lingual nerve, superficial to the medial pterygoid muscle and deep to the lateral pterygoid muscle. It then enters the mandibular foramen. It terminates as the mental nerve when it emerges from the mental foramen. Prior to passing through the mental foramen, **it provides general sensation to the mandibular teeth and gums**. In addition, prior to entering the mandibular foramen, it forms a branch that **provides branchial motor innervation to the mylohyoid muscle and the anterior belly of the digastric muscle.**

Mandibular Division (CN V3) Trigeminal: The Details (Continued)

- The **mental nerve** is the termination of the inferior alveolar nerve after it emerges through the mental foramen. **It provides general sensation to the skin over the chin and skin of lower lip**.

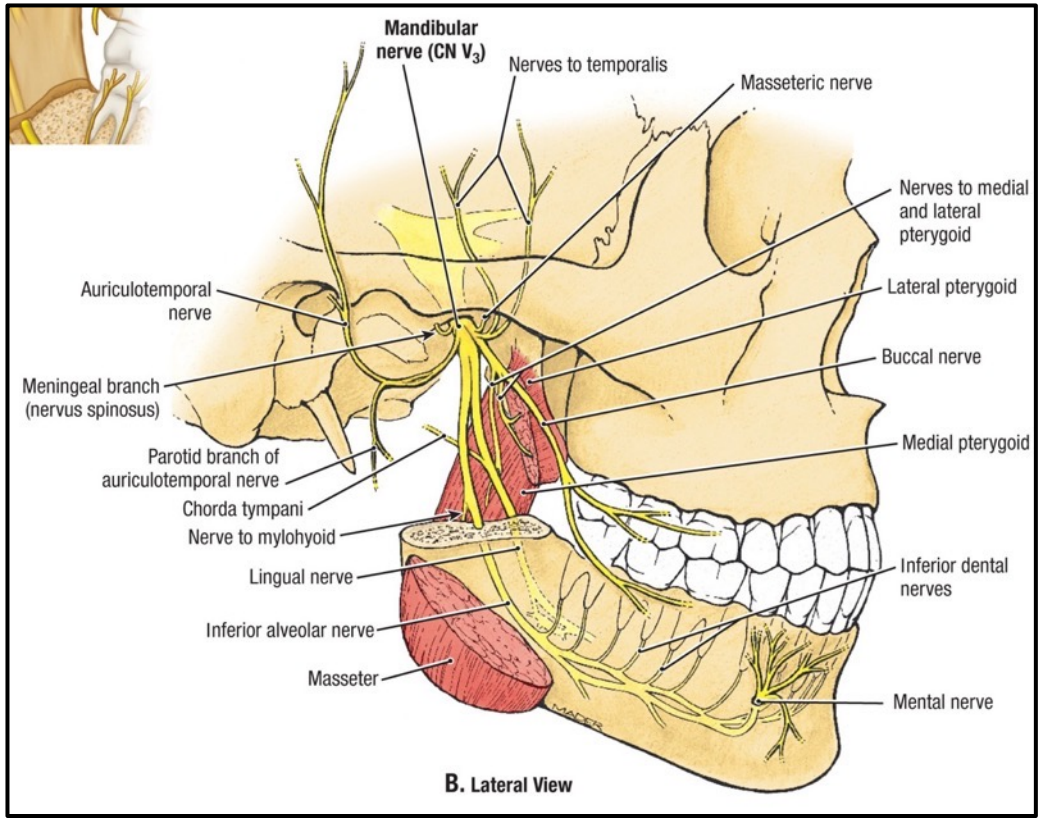
- The **auriculotemporal nerve** splits to surround the middle meningeal artery. After recombining, the nerve courses deep to the lateral pterygoid muscle and deep to the neck of the mandible. Ultimately, it branches at the side of the head in a distribution pattern similar to the superficial temporal artery. **It provides general sensory innervation to the temporal region, external ear, and external surface of tympanic membrane.** In addition, the auriculotemporal nerve **delivers postganglionic parasympathetic fibers from the otic ganglion to the parotid gland.** (Preganglionic fibers are brought to otic ganglion by the glossopharyngeal nerve).

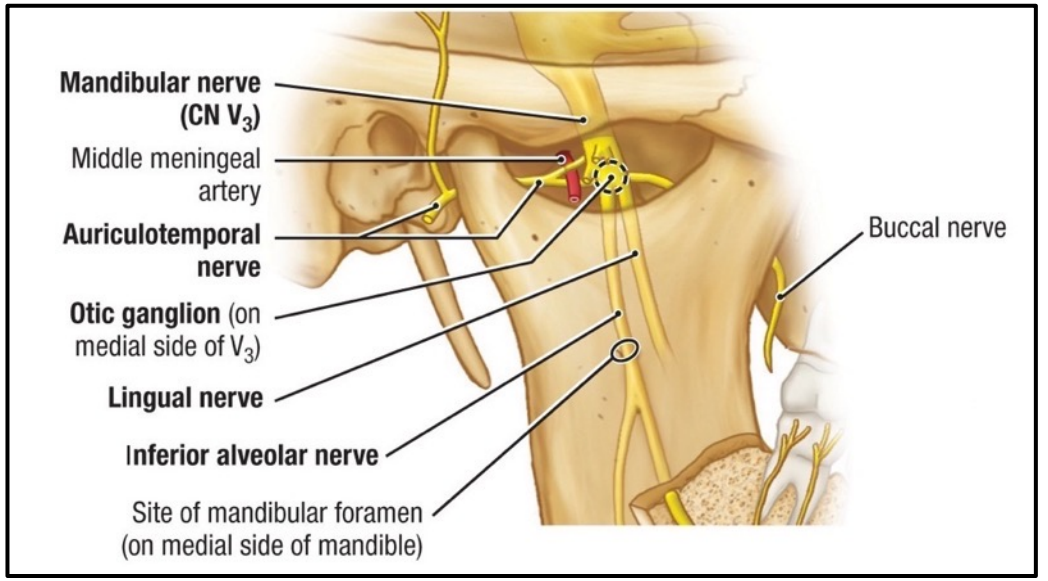
- **Branches of the mandibular nerve supply the muscles of mastication: masseter, temporalis, lateral pterygoid, medial pterygoid.**

Test:
- Motor: Jaw clench and medial and lateral protraction of the jaw against resistance
- Sensory: Perception of touch on chin

Positive Test
- Motor: weakness of jaw movements
- Sensory: Lack of sensation over chin

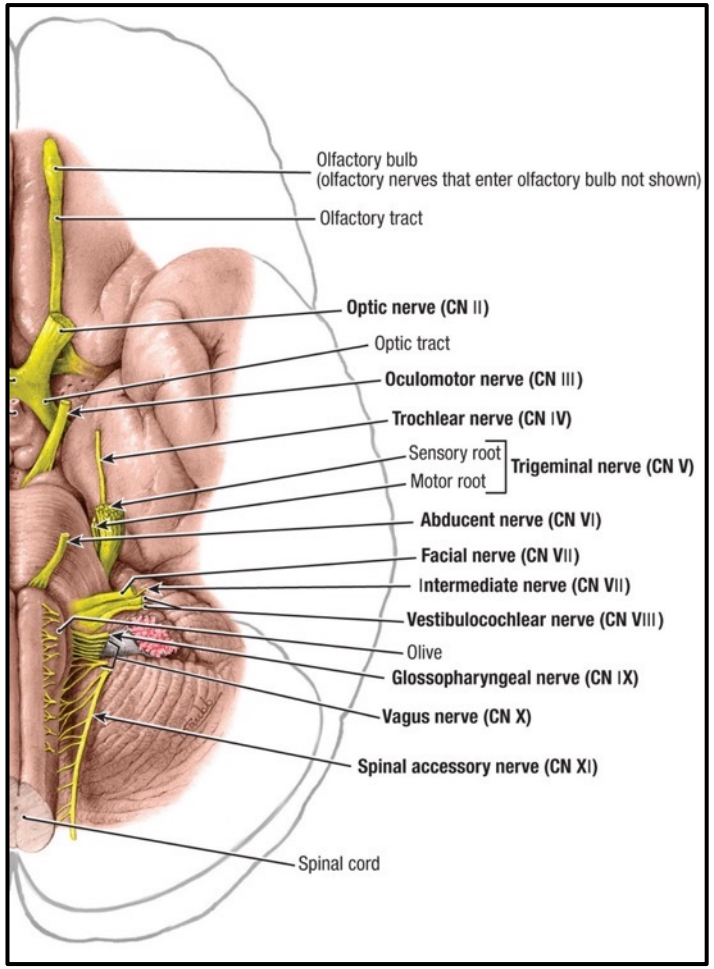
Clinical:
- CN V can be injured by trauma, tumors, aneurysms or meningeal infections.

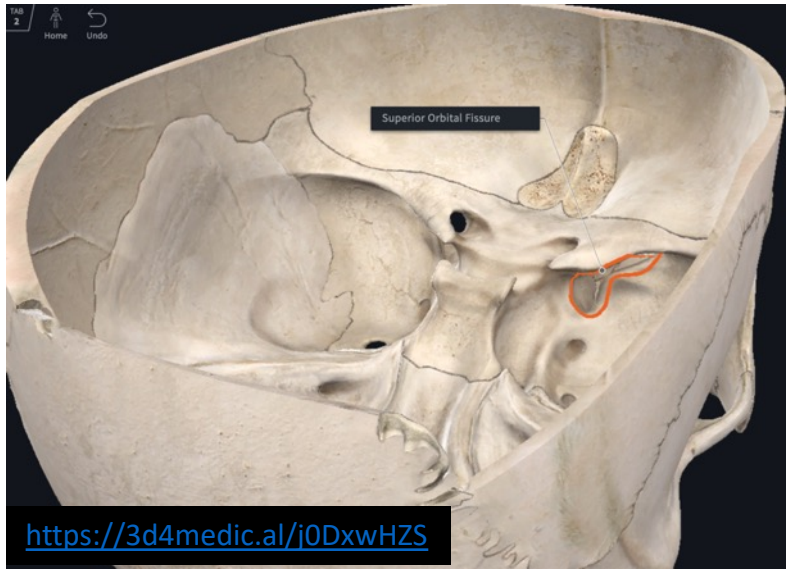


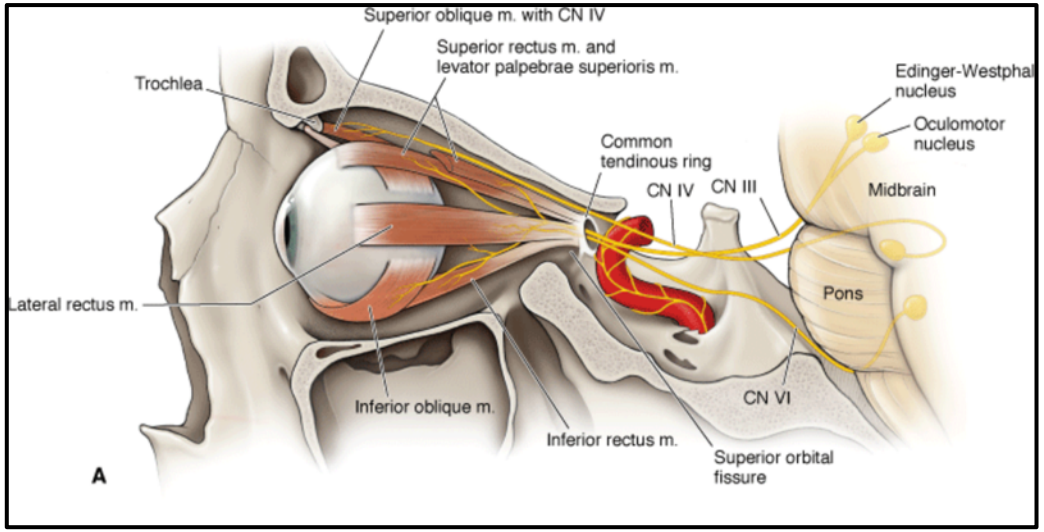


Abducens Nerve (CN VI): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
CN VI (Abducens)	Ventral aspect of pontomedullary junction	Superior orbital fissure	• Somatic Motor (GSE): 1 extraocular eye muscle: lateral rectus m.





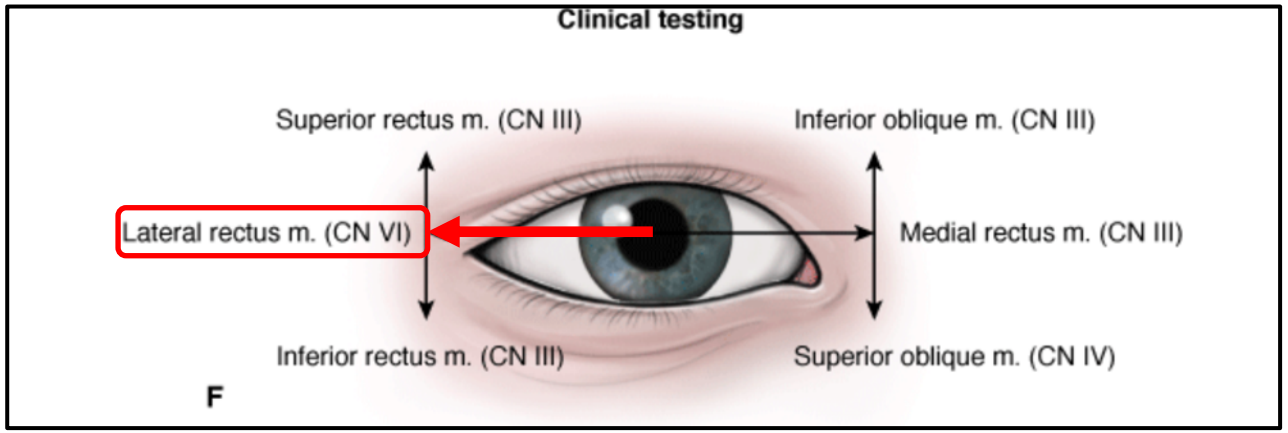


Abducens Nerve (CN VI): The Details

Pathway: The **abducens nerve** emerges from the brainstem at the junction between the pons and the medulla to first courses through the subarachnoid space. It then pierces the the dura covering the clivus to course in the direction of the cavernous sinus in a space called Dorello's canal. The nerve then passes through the cavernous sinus parallel to the internal carotid arteries in the direction of the orbit. It enters the orbit by passing through the superior orbital fissure to innervate lateral rectus muscle.

Test: "H" eye exam (adduction of eye)
Positive Test: Inability to abduct the eye (lateral rectus muscle)

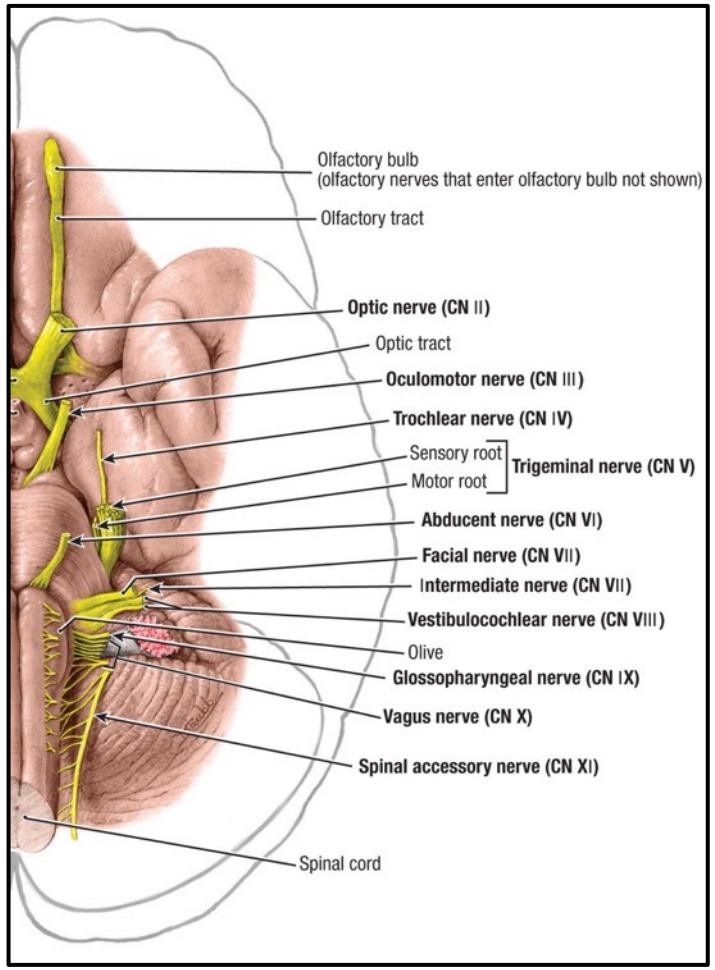
Clinical: Due to its long intracranial course, CN VI is often stretched when intracranial pressure rises; a space-occupying lesion within the cranial cavity (tumor) may also compress the nerve.

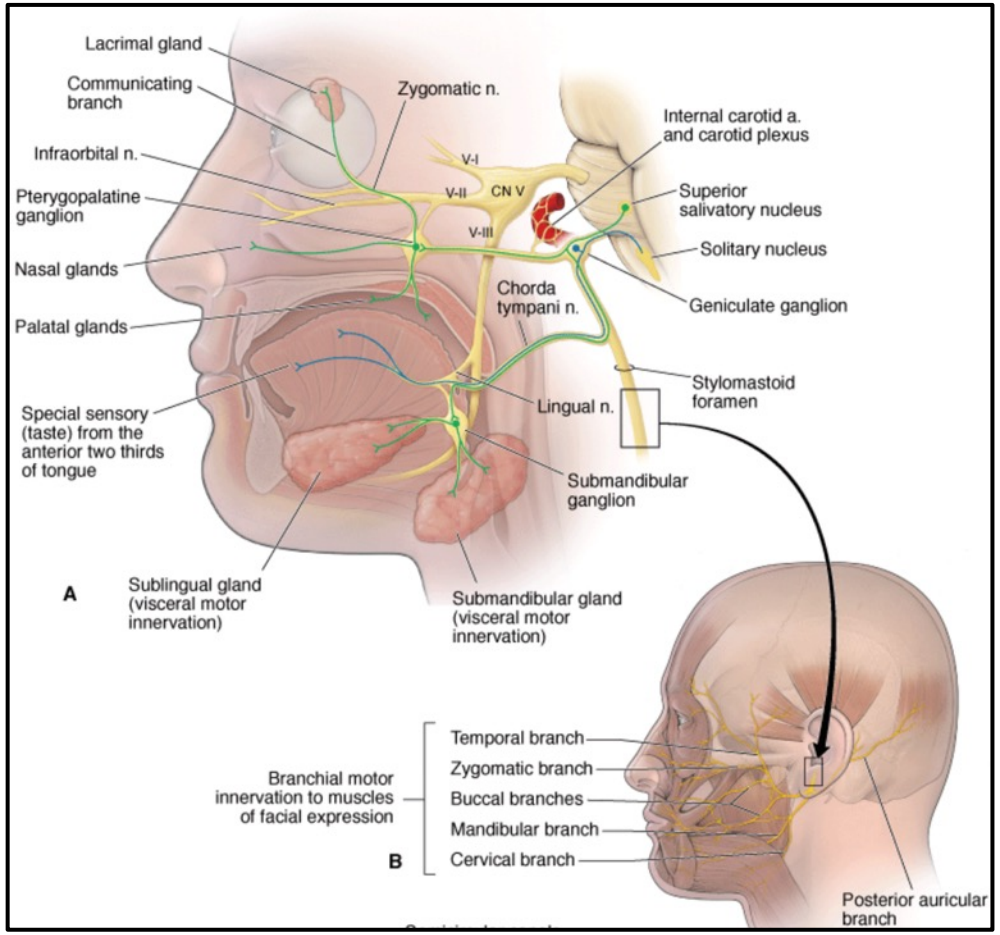


Facial Nerve (CN VII): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
CN VII (Facial)	Pontomedullary junction	1. Internal acoustic meatus 2. Facial canal 3. Stylomastoid foramen	• Branchial Motor (BE): Muscles of facial expression • *Visceral Motor (GVE): lacrimal gland, submandibular gland, sublingual gland, mucous glands of nasal cavity and oral cavity • Somatic Sensory (GSA): portion of external auditory canal • Special Sensory (SA): taste from anterior 2/3 tongue

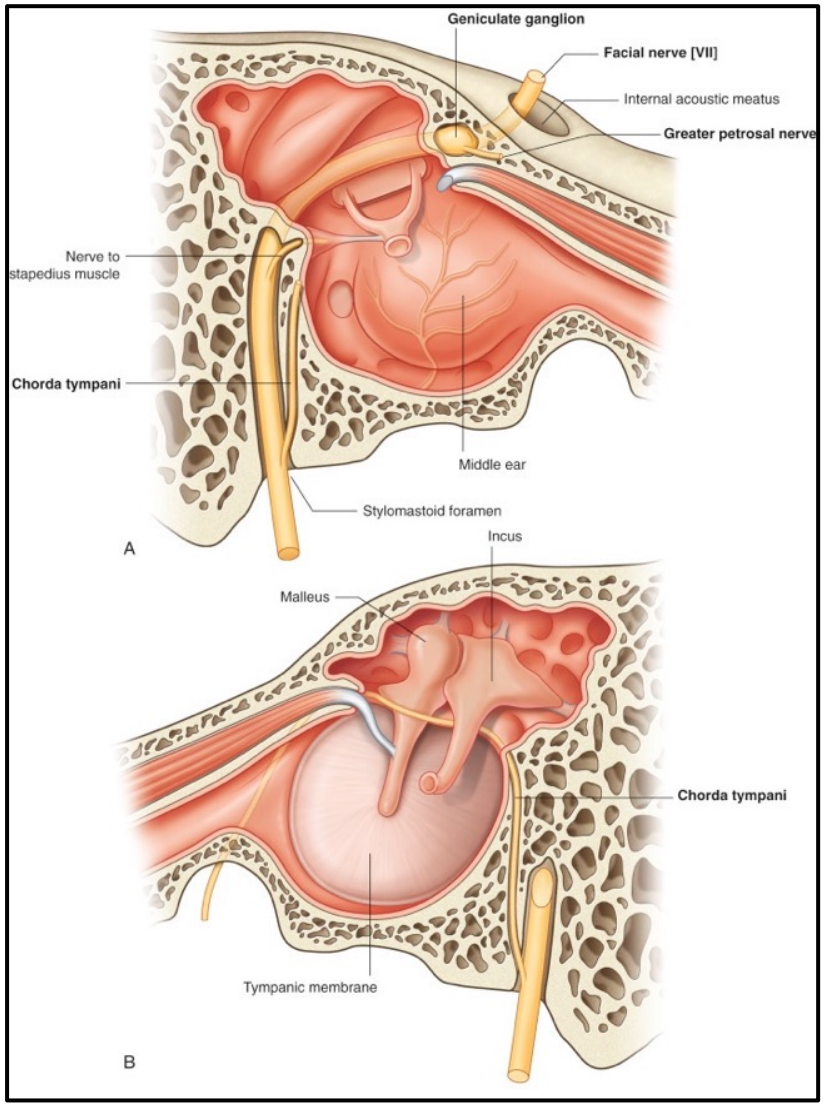
*Preganglionic parasympathetic fibers

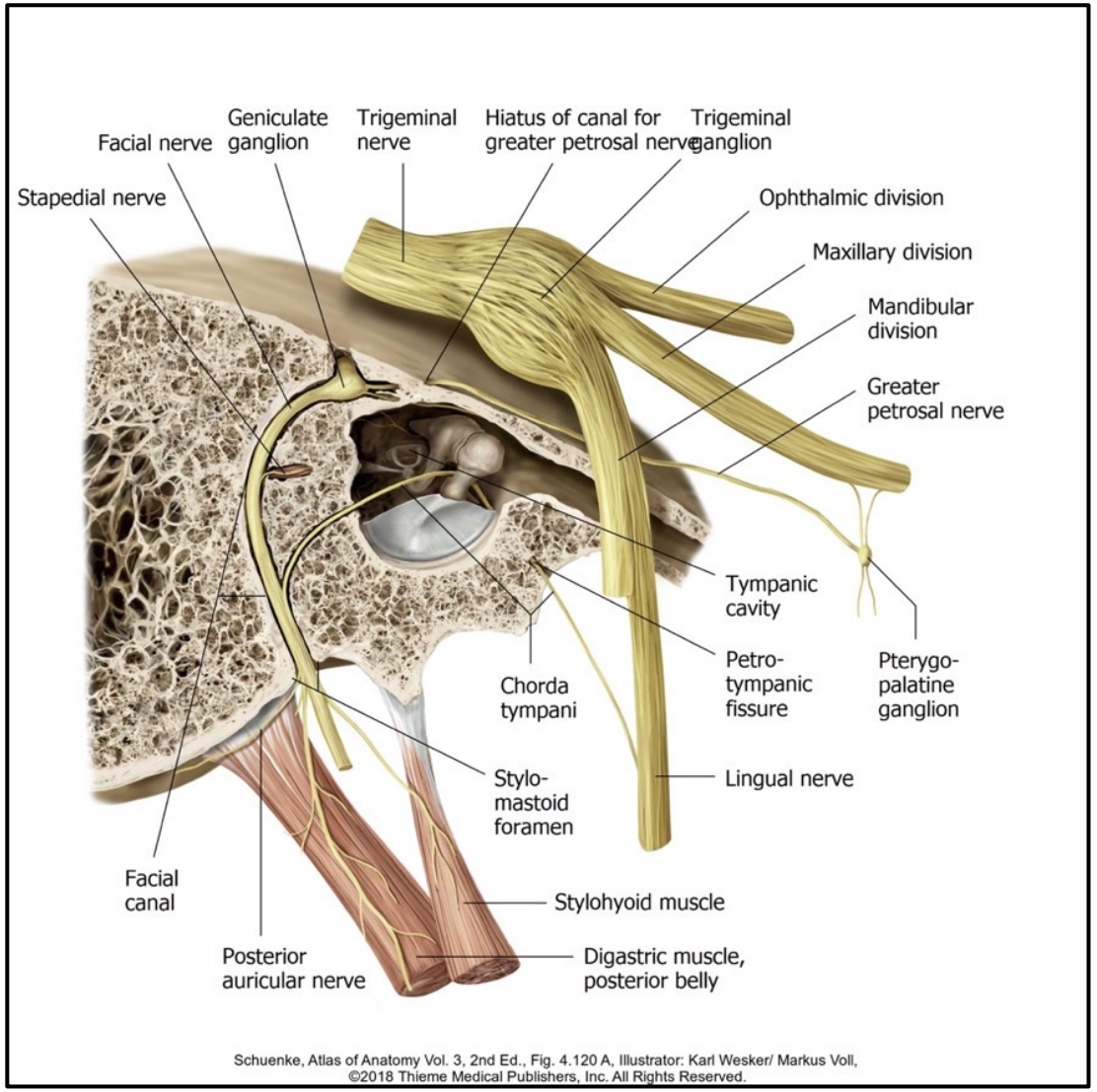




Facial Nerve (CN VII): The Details

Pathway: The **facial nerve** emerges from the brainstem and enters the **internal acoustic meatus**. It passes through the petrous portion of the temporal bone within an osseous tunnel **called the facial canal**. Within the facial canal, it contains a ganglion consisting of neuron cell bodies involved in sensing taste from the anterior two-thirds of the tongue. This cluster of neuron cell bodies is called the geniculate ganglion, and is located where the nerve takes a sharp curve posteriorly and inferiorly. This curve, known as the genu (knee), is the location of the facial nerve's first branch. Branches of the facial nerve begin on the next slide.





Facial Nerve (CN VII): The Details (Continued)

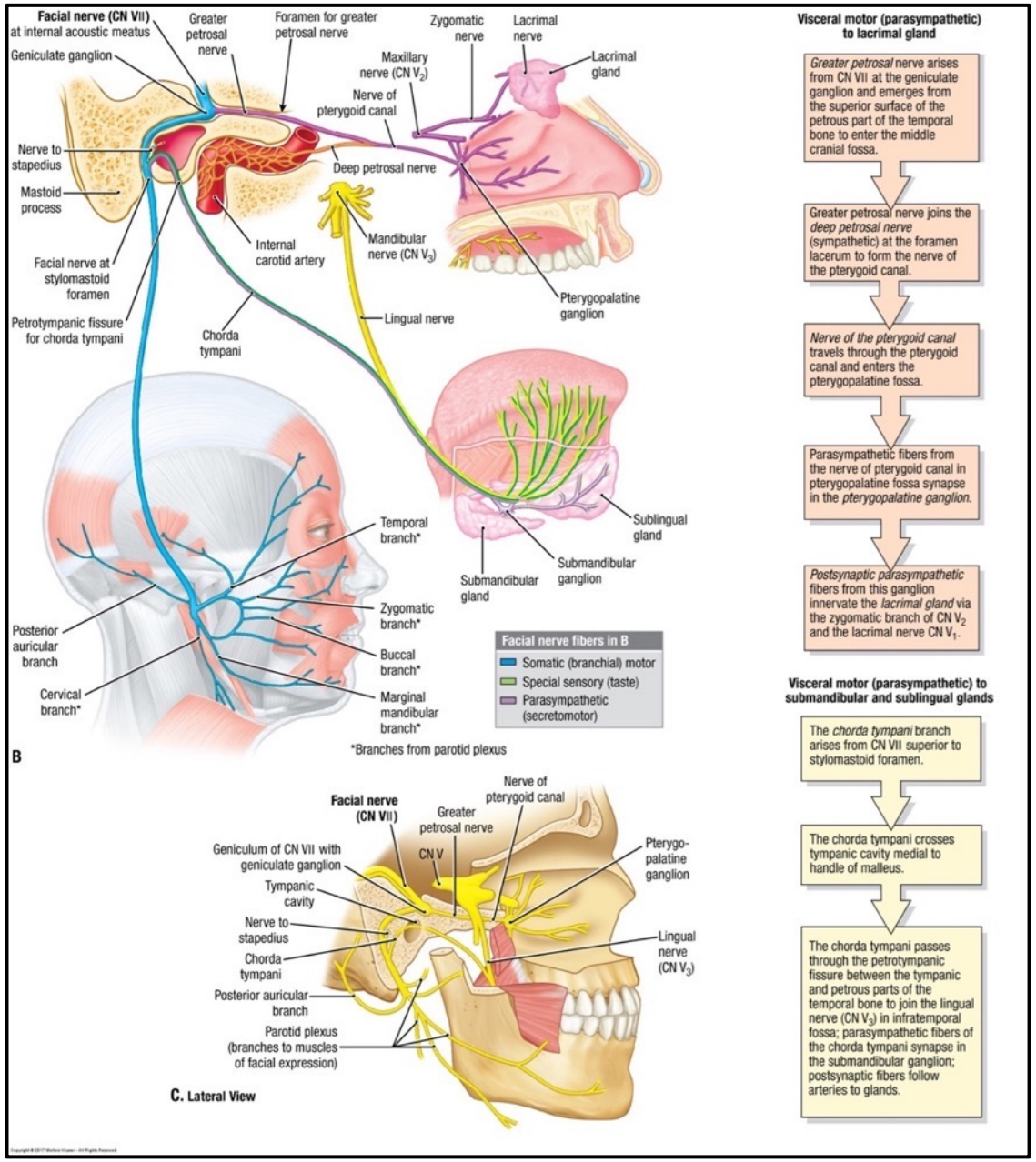
Pathway: Branches of the facial nerve.

- The **greater petrosal nerve** emerges anteriorly from the genu of the facial nerve.
  - It enters the middle cranial fossa by exiting the petrous portion of the temporal bone by passing through the **hiatus of the greater petrosal nerve**.
  - It is then joined by postganglionic sympathetic fibers from the deep petrosal nerve.
  - Together, these fibers pass through the anterior wall of the foramen lacerum to enter the pterygoid canal to become the nerve of the pterygoid canal (Vidian nerve).
  - The nerve of the pterygoid canal passes into the pterygopalatine fossa, where its fibers synapse in the pterygopalatine ganglion.

PRL of autonomic pathway into to the pterygopalatine ganglion (Facial Nerve Autonomics, Part 1): Embedded in the next slide and available on Panopto.

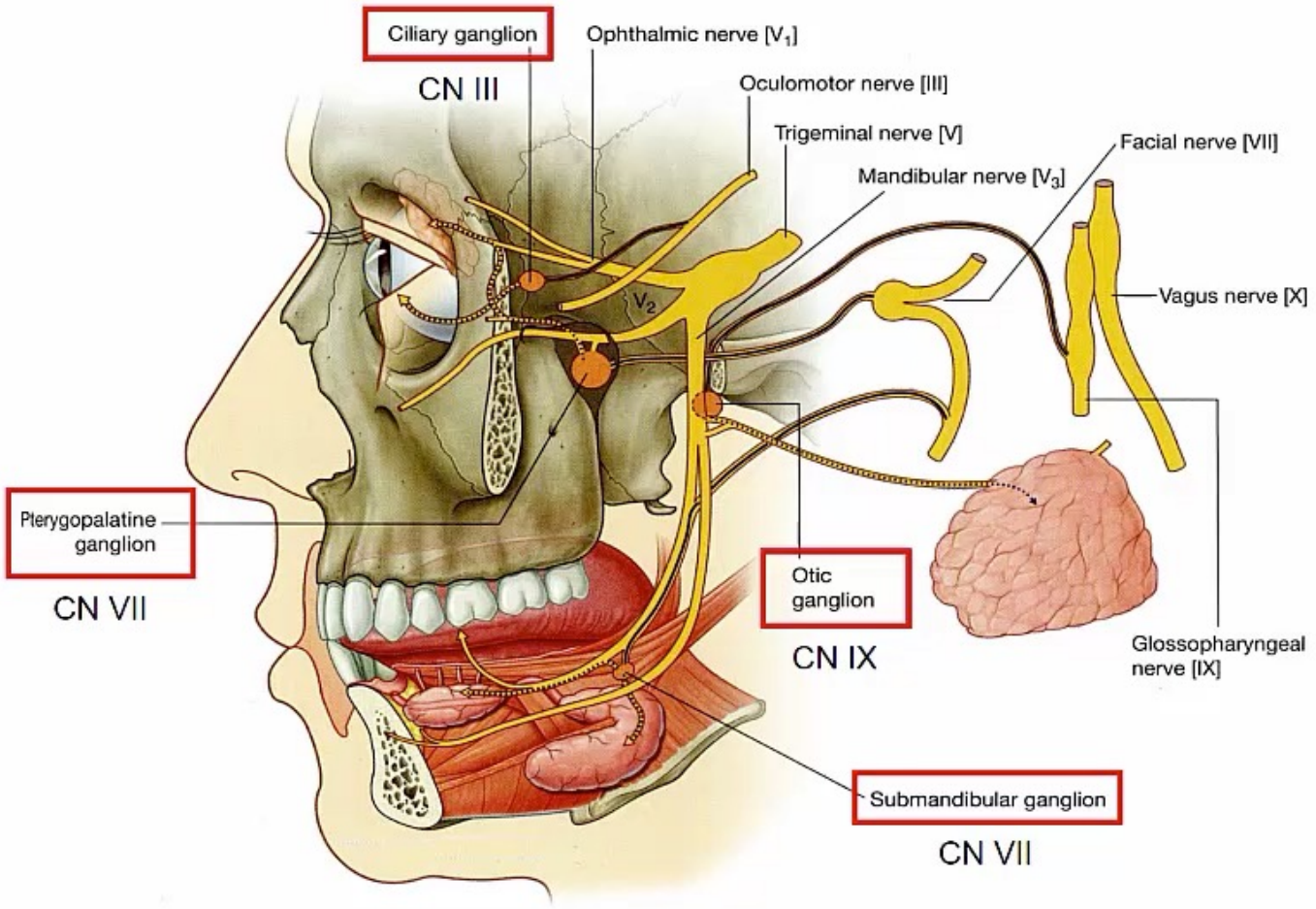
  - Postganglionic fibers exit the ganglion by joining the maxillary division of the trigeminal nerve (CN V2).
  - The fibers then follow the path of the zygomatic branch and the zygomaticotemporal branch of CN V2.
  - From this location, the postganglionic fibers join the lacrimal nerve of CN V1 by a nerve branch called the communicating branch.
  - The postganglionic fibers reach their lacrimal gland destination by coursing with the lacrimal nerve.

PRL of autonomic pathway after exiting pterygopalatine ganglion (Facial Nerve Autonomics, Part 2): Embedded in slide 29 and available on Panopto.



PRL: Facial Nerve (CN VII) Autonomics, Part 1 Pterygopalatine Ganglion (Panopto)

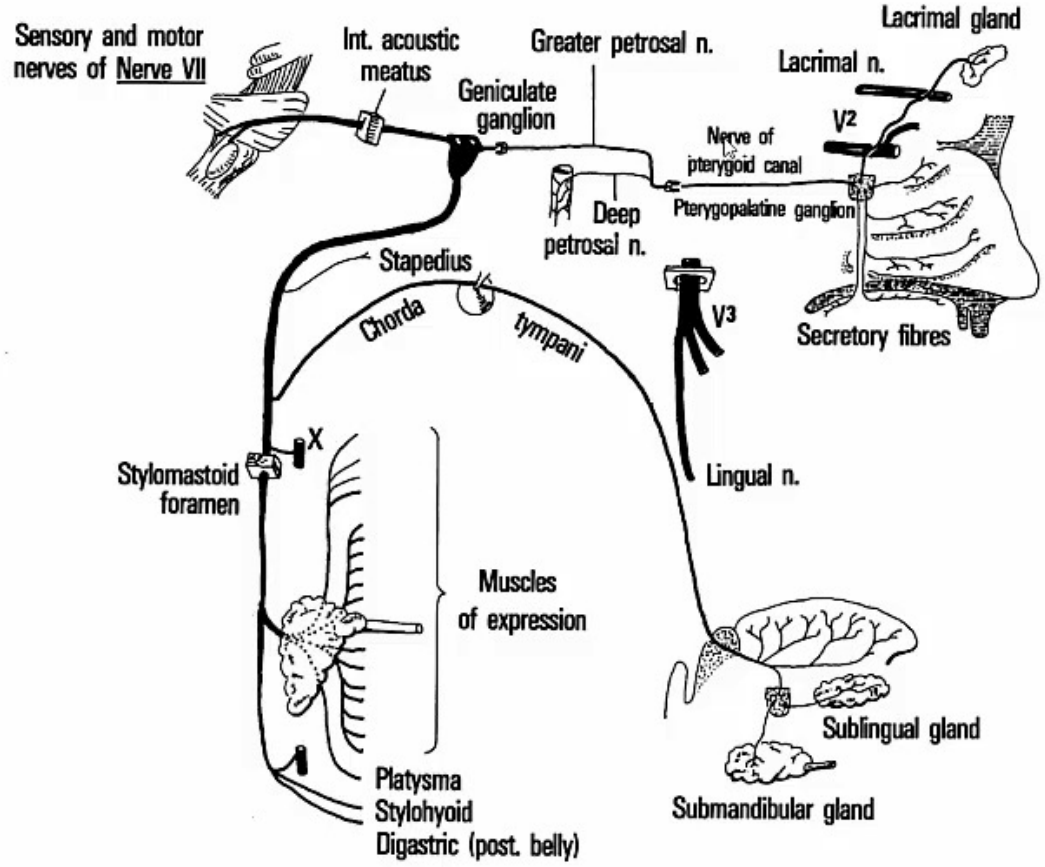
Parasympathetic Ganglia of the Head



CN X: no parasympathetics in the head and neck

PRL: Facial Nerve (CN VII) Autonomics, Part 2 Lacrimal Gland (Panopto)

Pathway of CN VII



8-7 DISTRIBUTION OF THE FACIAL NERVE

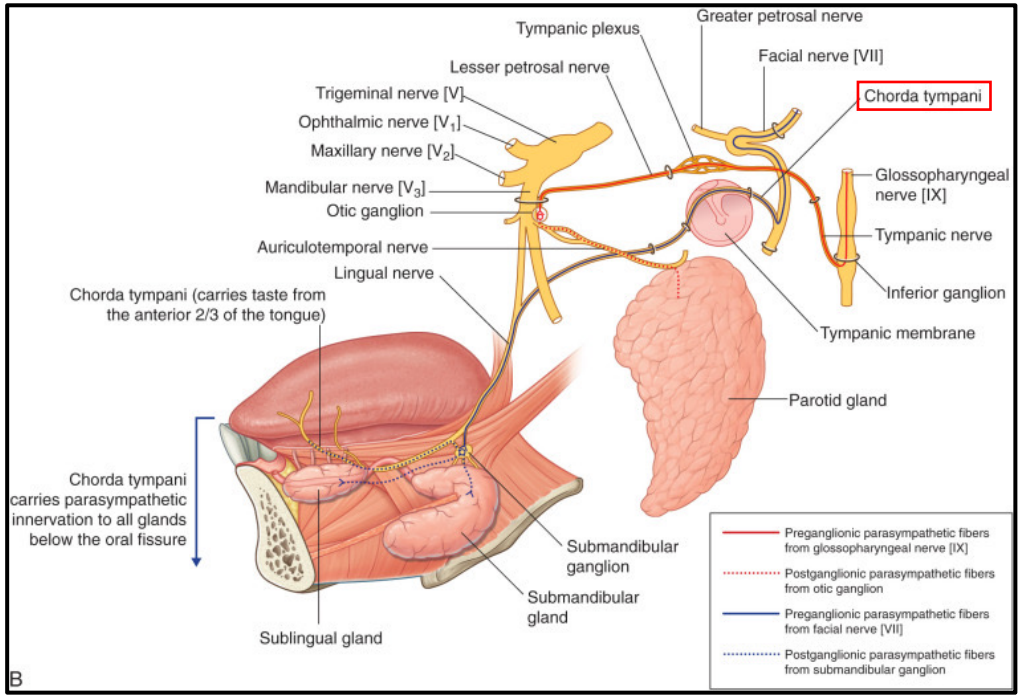
G 8th ed.

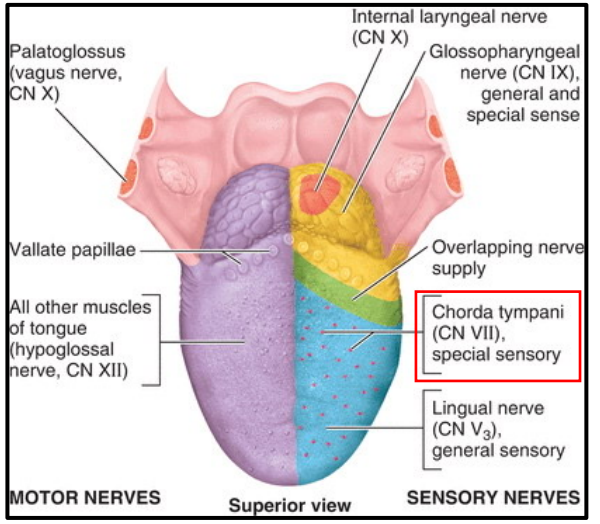
Facial Nerve (CN VII): The Details (Continued)

Pathway: Branches of the facial nerve.

- The nerve to stapedius is a branch of the facial nerve that innervates the stapedius muscle, which is the smallest skeletal muscle in the body. When the stapedius muscle contracts it stabilizes the stapes bone, which functions to dampen sounds.

- The **chorda tympani nerve** branches from the facial nerve within the facial canal.
  - The chorda tympani nerve contains special sensory fibers (taste) and autonomic fibers. The description below separates them for clarification.
    - Preganglionic fibers within chorda tympani enter the middle ear to pass between the malleus and incus.
      - It then exits the middle ear by passing through the petrotympanic fissure to enter the infratemporal fossa.
      - In the infratemporal fossa, the fibers of chorda tympani course within the lingual nerve to enter the submandibular ganglion.
      - Postganglionic fibers leaving the submandibular ganglion can course back to the lingual nerve on their path to the sublingual/submandibular glands, or travel directly to the glandular tissue.
    - Taste fibers from the **anterior 2/3 of the tongue** course alongside fibers of the lingual nerve and bypass the submandibular ganglion.
      - In the infratemporal fossa, the taste fibers of chorda tympani separate from the lingual nerve.
      - The chorda tympani exits the infratemporal fossa and enters middle ear cavity by passing through the petrotympanic fissure.
      - The chorda tympani joins with the facial nerve within the facial canal.
      - The neuron cell bodies of chorda tympani's taste fibers are located within the geniculate ganglion.

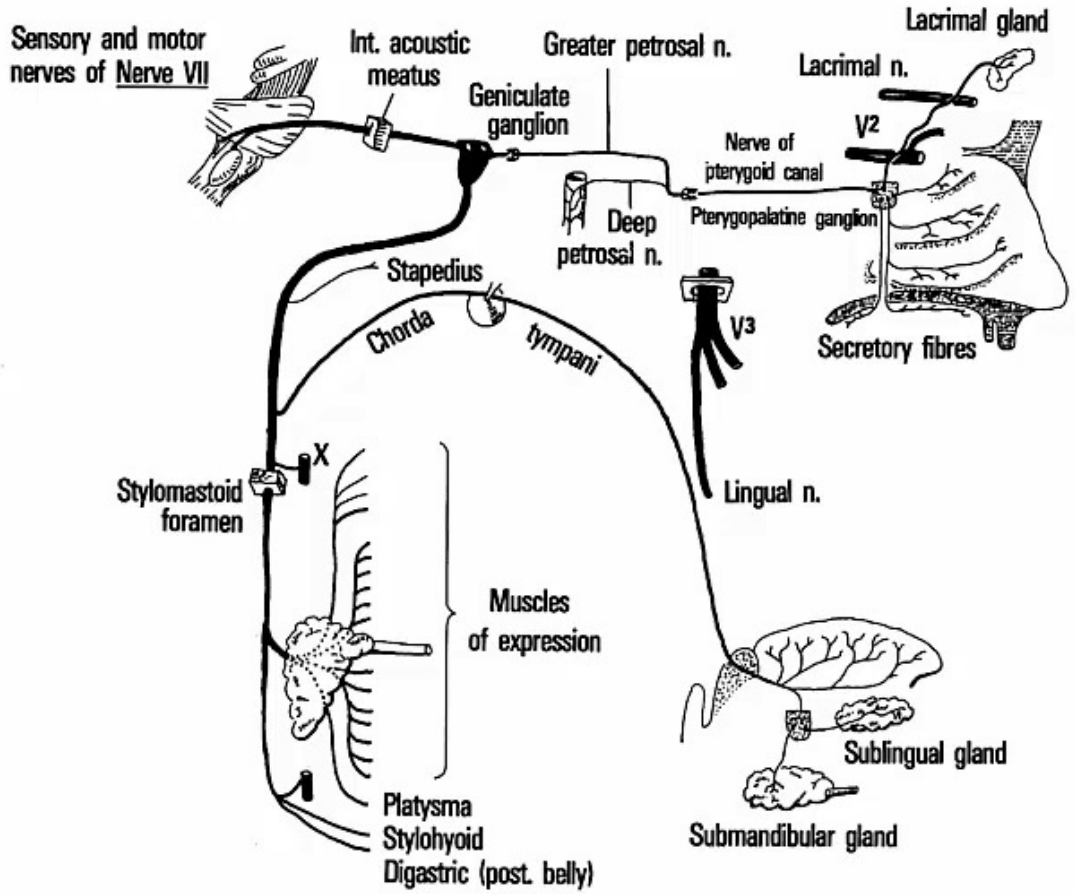




PRL of CN VII Autonomic Pathway, Part 3: Embedded in the next slide and available on Panopto.

PRL: Facial Nerve (CN VII) Autonomics, Part 3 Submandibular Gland (Panopto)

Pathway of CN VII



8-7 DISTRIBUTION OF THE FACIAL NERVE

G 8th ed.

Facial Nerve (CN VII): The Details (Continued)

Pathway: Branches of the facial nerve.

- The remaining branches of the facial nerve are formed after the nerve exits the facial canal at the stylomastoid foramen.
  - The **posterior auricular nerve** branches from the facial nerve before it enters the parotid gland. This nerve innervates the **occipitalis muscle**. It also provides general sensation to a small area of the auricle.
  - Five nerve branches are formed after the facial nerve enters the parotid gland.
    - **The temporal nerve** supplies the frontalis muscle and upper ½ of **orbicularis oculi**.
    - The **zygomatic nerve** supplies the lower ½ of **orbicularis oculi**.
    - The **buccal nerve** supplies the **buccinator** and **orbicularis oris** muscles.
    - The **mandibular nerve** supplies the **orbicularis oris** muscle.
    - The **cervical nerve** supplies the platysma muscle.

Test:

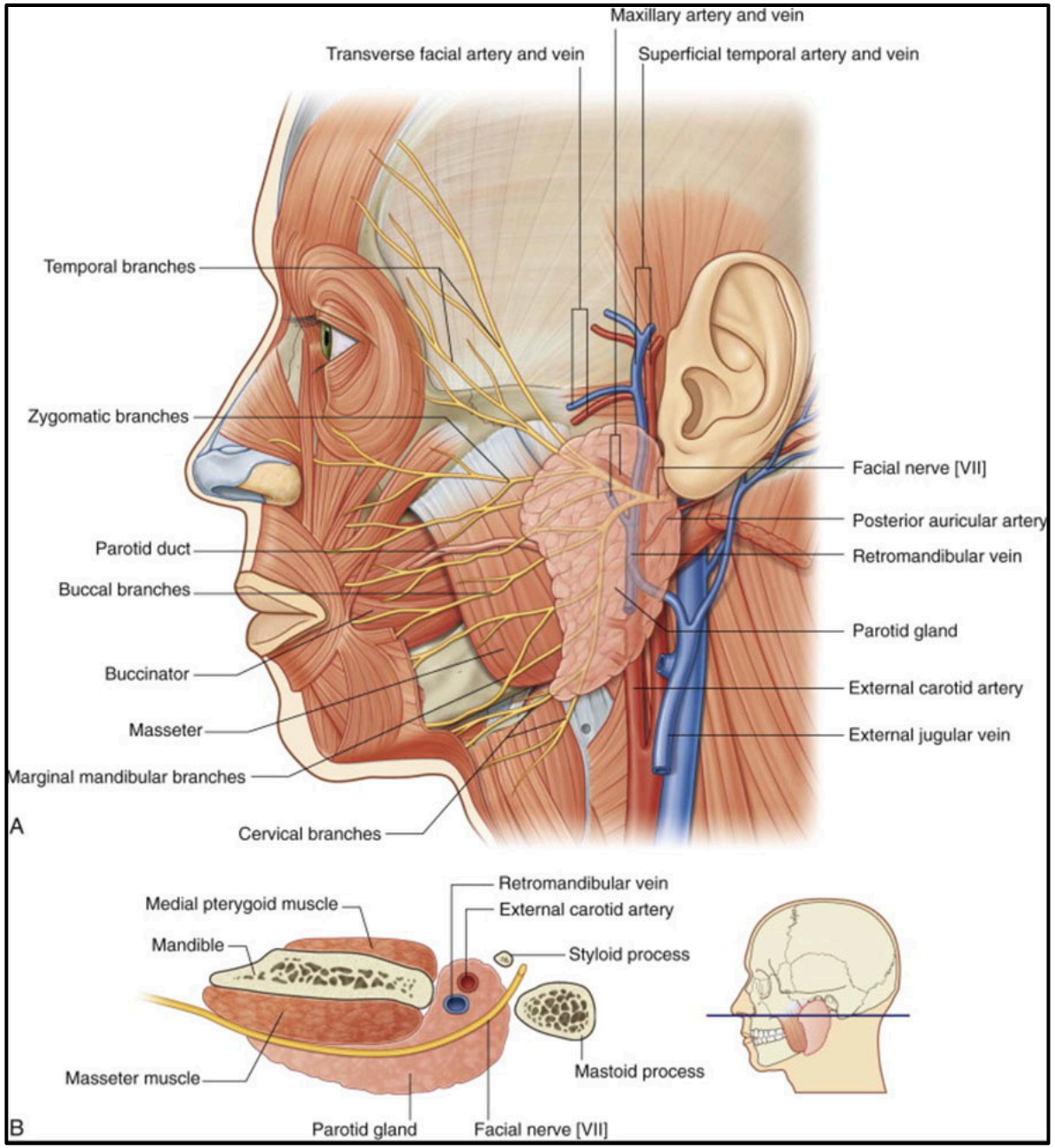
- Efferent limb of corneal reflex
- Muscles of facial expression: smile/squint, raising eyebrows

Positive Test:

- Corneal reflex: No blink reflex when cornea is touched with twisted piece of cotton ball.
- Muscles of facial expression: Inability to make facial movements

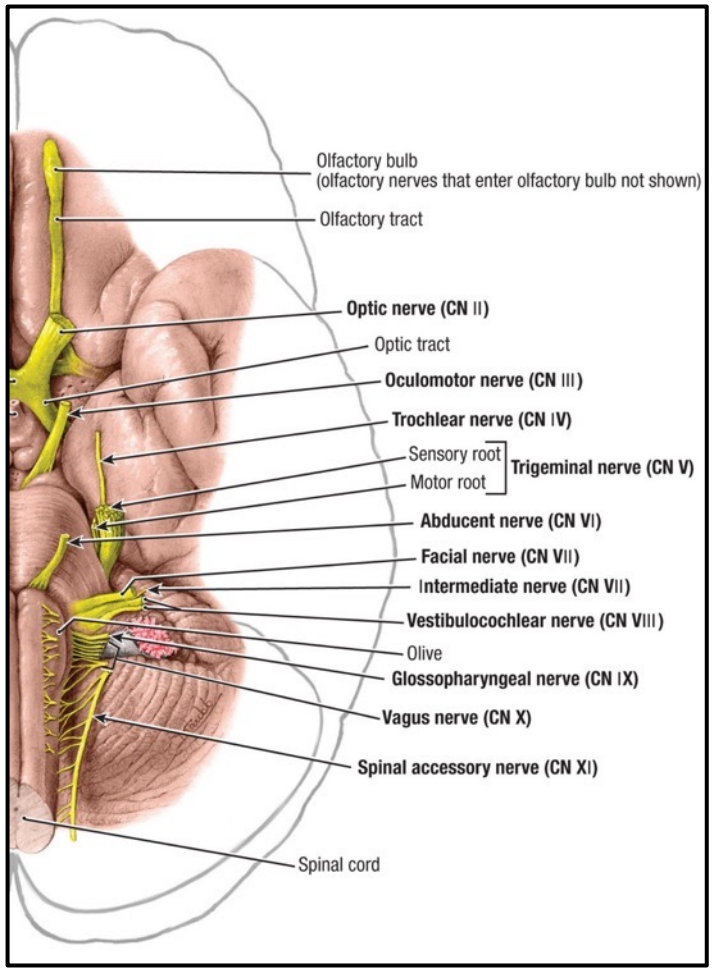
Lesion:

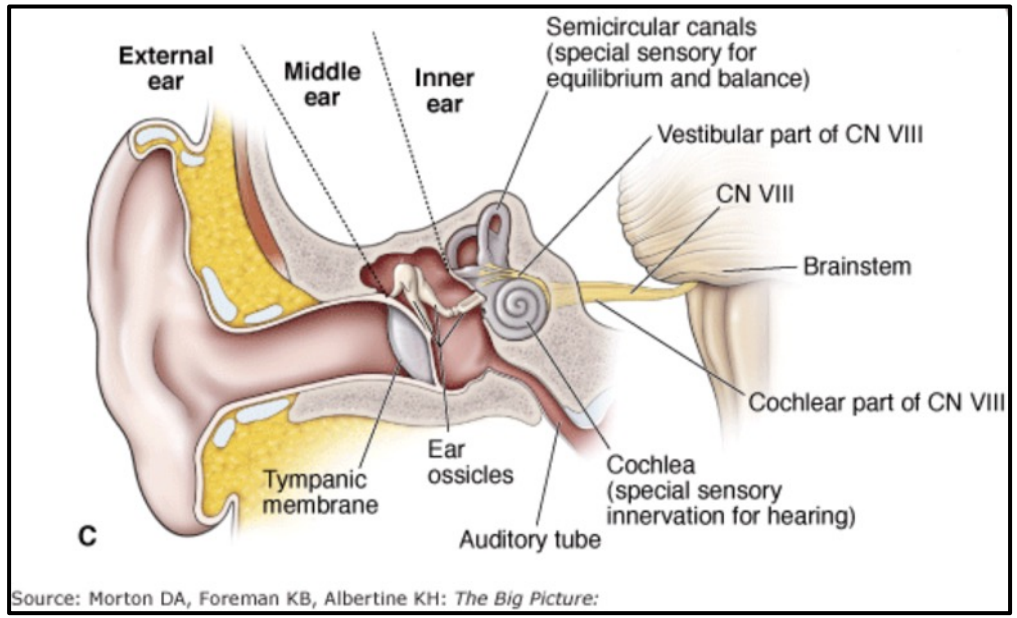
- Damage to CN VII may result in ipsilateral facial muscle weakness (*hemiplegia).* Bell's palsy, also termed idiopathic facial paralysis (IFP), is the most common cause of unilateral facial paralysis and the most common cause of facial paralysis worldwide. Injury to the facial nerve in Bell's palsy is peripheral to the nerve's nucleus within the brainstem.



Vestibulocochlear Nerve (CN VIII): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
CN VIII (Vestibulocochlear)	Pontomedullary junction lateral to CN VII	Internal acoustic meatus	• Special Sensory (SA): Hearing (cochlear division) • Special Sensory (SA): Balance (vestibular portion)



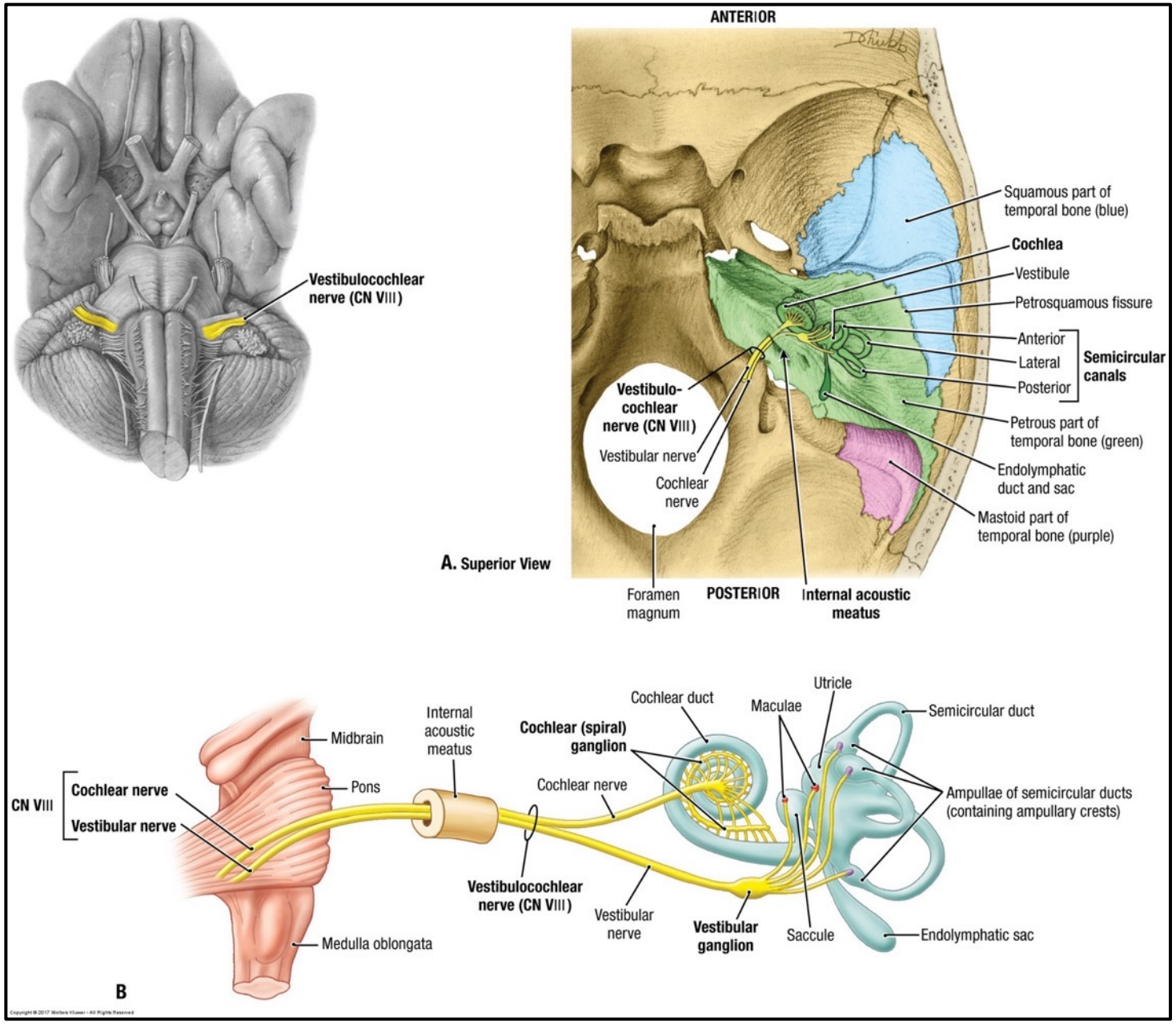


Vestibulocochlear Nerve (CN VIII): The Details

Pathway:

- The **vestibular and cochlear portions** of the **vestibulocochlear nerve** are functionally discrete, which means they originate from different brain nuclei. Neuron fibers from both portions of the nerve combine in the pons and emerge from the brain at the cerebellopontine angle.
- The nerve exits the cranial cavity by passing though the **internal acoustic meatus** of the temporal bone. In the distal aspect of the internal acoustic meatus, the nerve splits to form the vestibular nerve and the cochlear nerve.
    - The vestibular nerve consists of axons (central processes) emerging from neuron cell bodies housed in the vestibular ganglion. These axons are involved in transmitting impulses involved in balance and equilibrium.
    - The cochlear nerve is composed of axons (central processes) emerging from neuron cell bodies located in the spiral ganglia. These axons are involved in transmitting impulses involved in hearing.

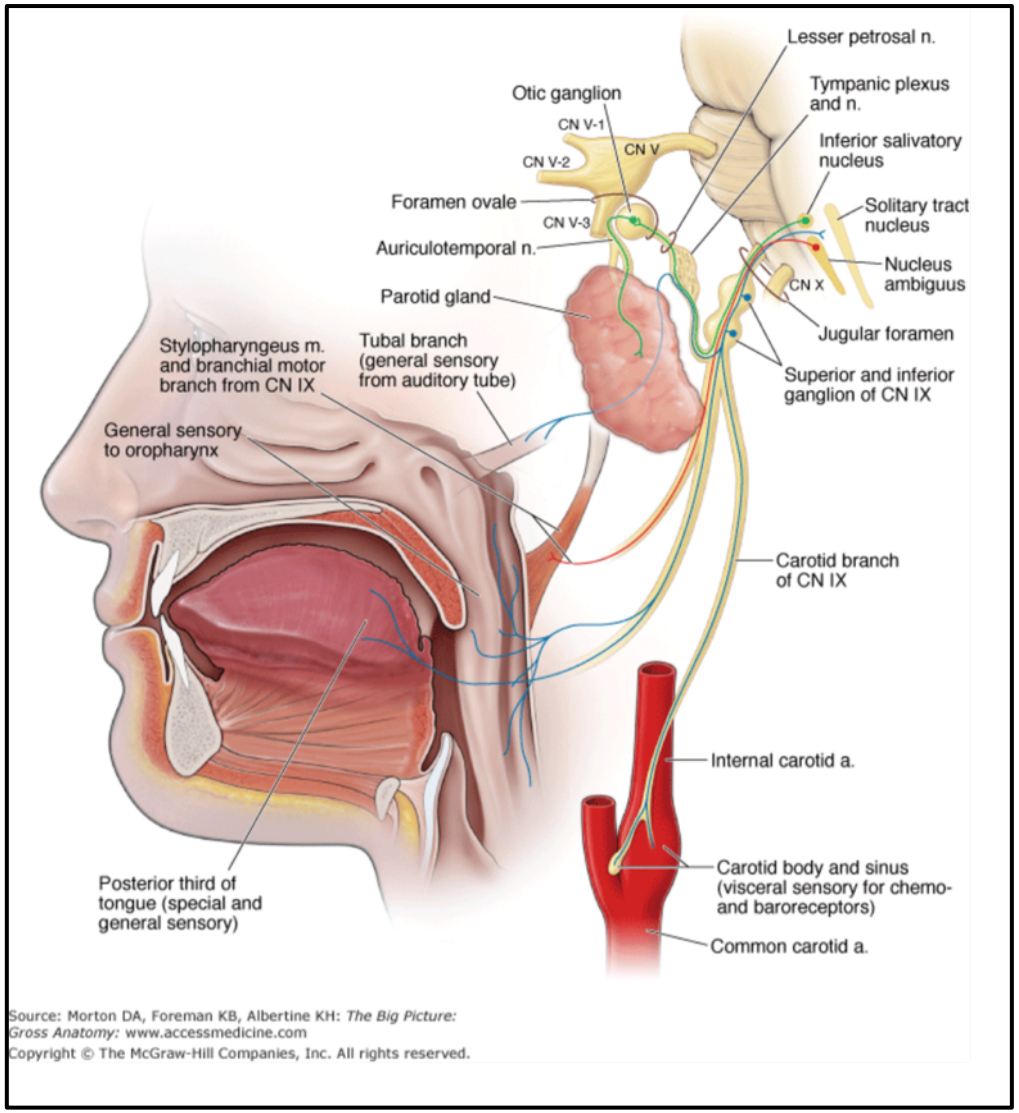
Clinical: Damage to CN VIII may result in ipsilateral sensorineural hearing loss and disequilibrium/dizziness.

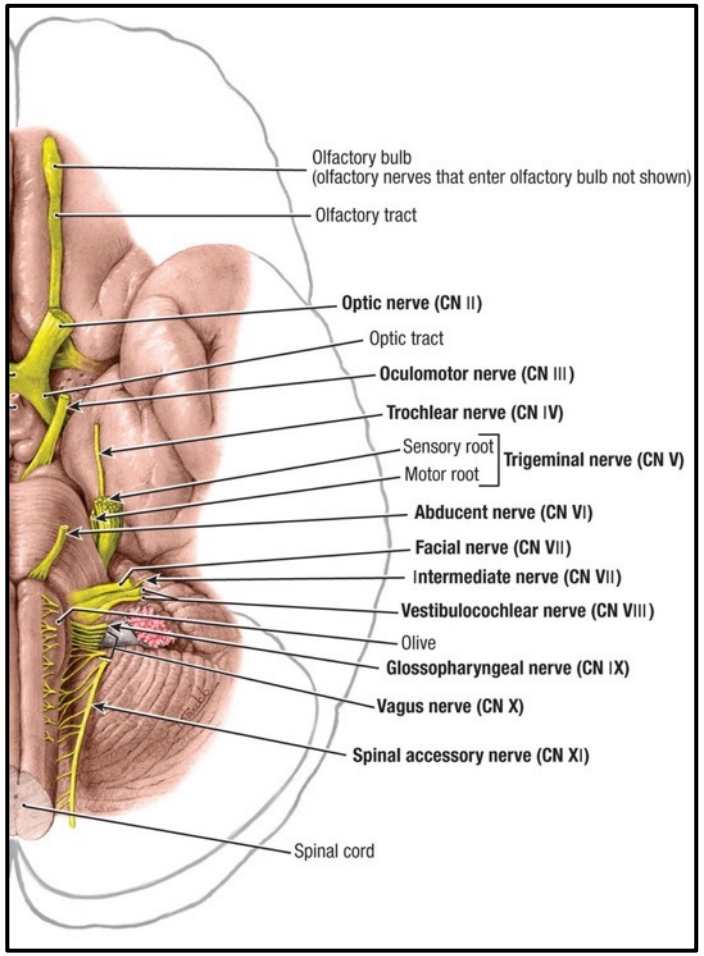


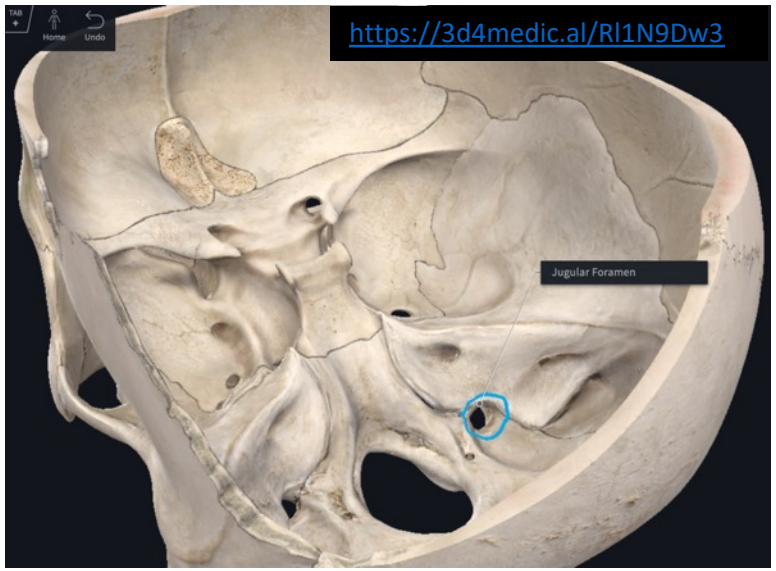
Glossopharyngeal Nerve (CN IX): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
CN IX (Glossopharyngeal)	Medulla oblongata lateral to the inferior olive	Jugular foramen	• Branchial Motor (BE): Stylopharyngeus m. • *Visceral Motor (GVE): Parotid gland • Somatic Sensory (GSA): Posterior one-third tongue, oropharynx, tympanic membrane, middle ear, and auditory (Eustachian) tube • Visceral Sensory (GVA): carotid sinus (baroreceptor) and carotid body (chemoreceptor) • Special Sensory (SA): Taste from posterior one-third tongue

*Preganglionic parasympathetic fibers







Glossopharyngeal Nerve (CN IX): The Details

Pathway:

- The **glossopharyngeal nerve** emerges from the lateral aspect of the medulla and exits the skull by passing through the jugular foramen. The nerve's superior and inferior ganglia, which contain the pseudounipolar neuron cell bodies for the nerve's sensory fibers, are located at the jugular foramen (Figure 1).
- The nerve begins its descent between the internal jugular vein and the internal carotid artery.
- As it completes is descent, it curves anteriorly to pass between the internal and external carotid arteries and then curves around the stylopharyngeus muscle (Figure 2).
- It then passes between the superior and middle pharyngeal constrictor muscles to enter the tongue by passing deep to the hyoglossus muscle. Along its path it branches to form several nerves (next slide).

Figure 1

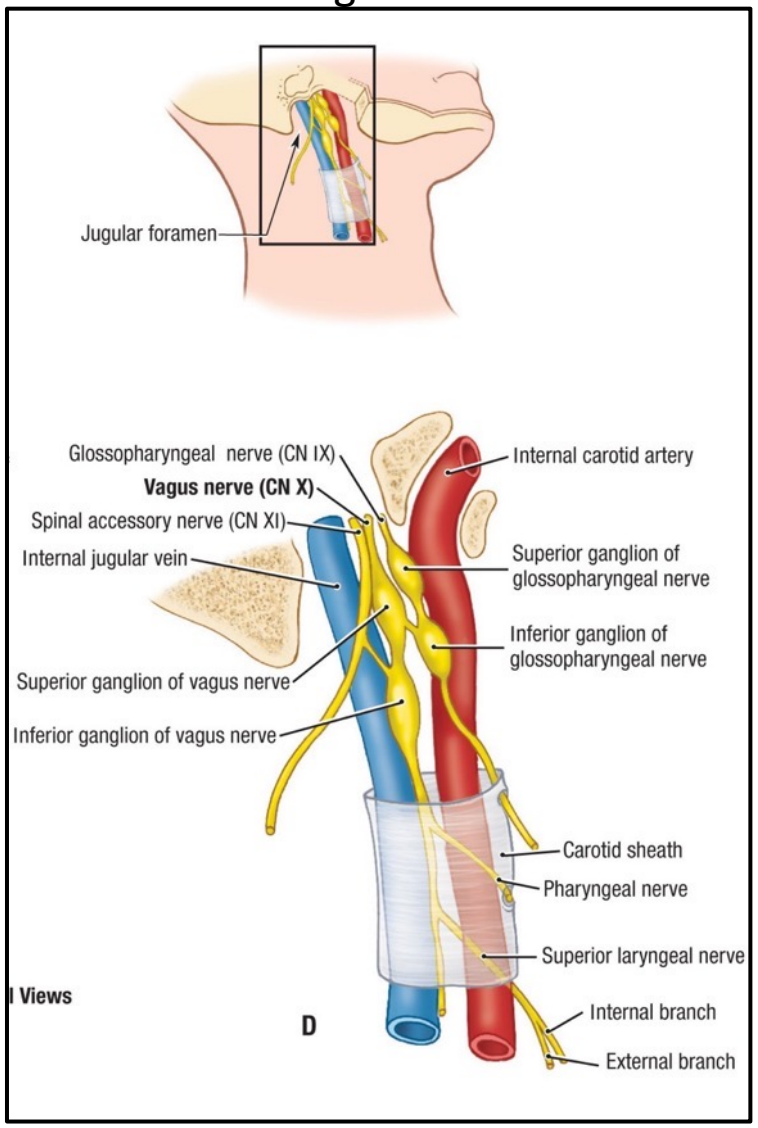
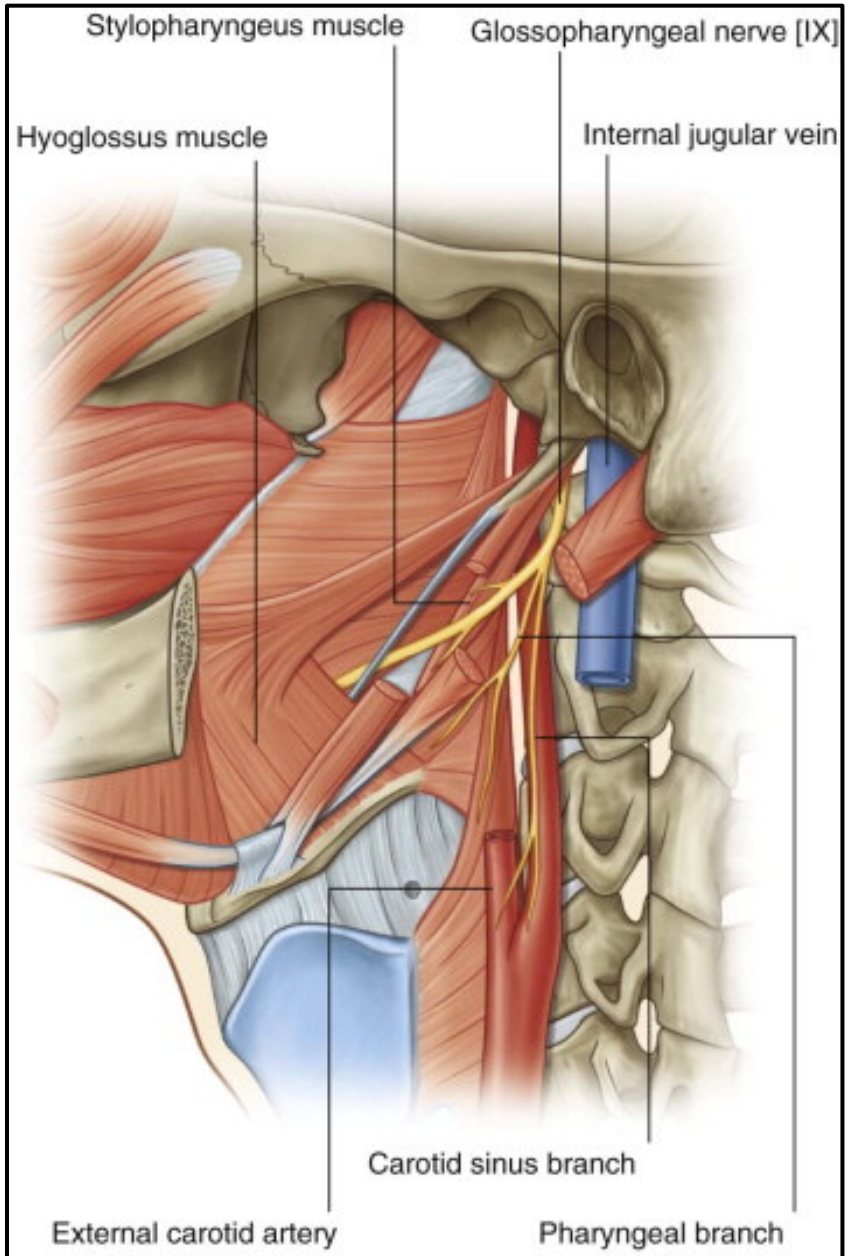


Figure 2

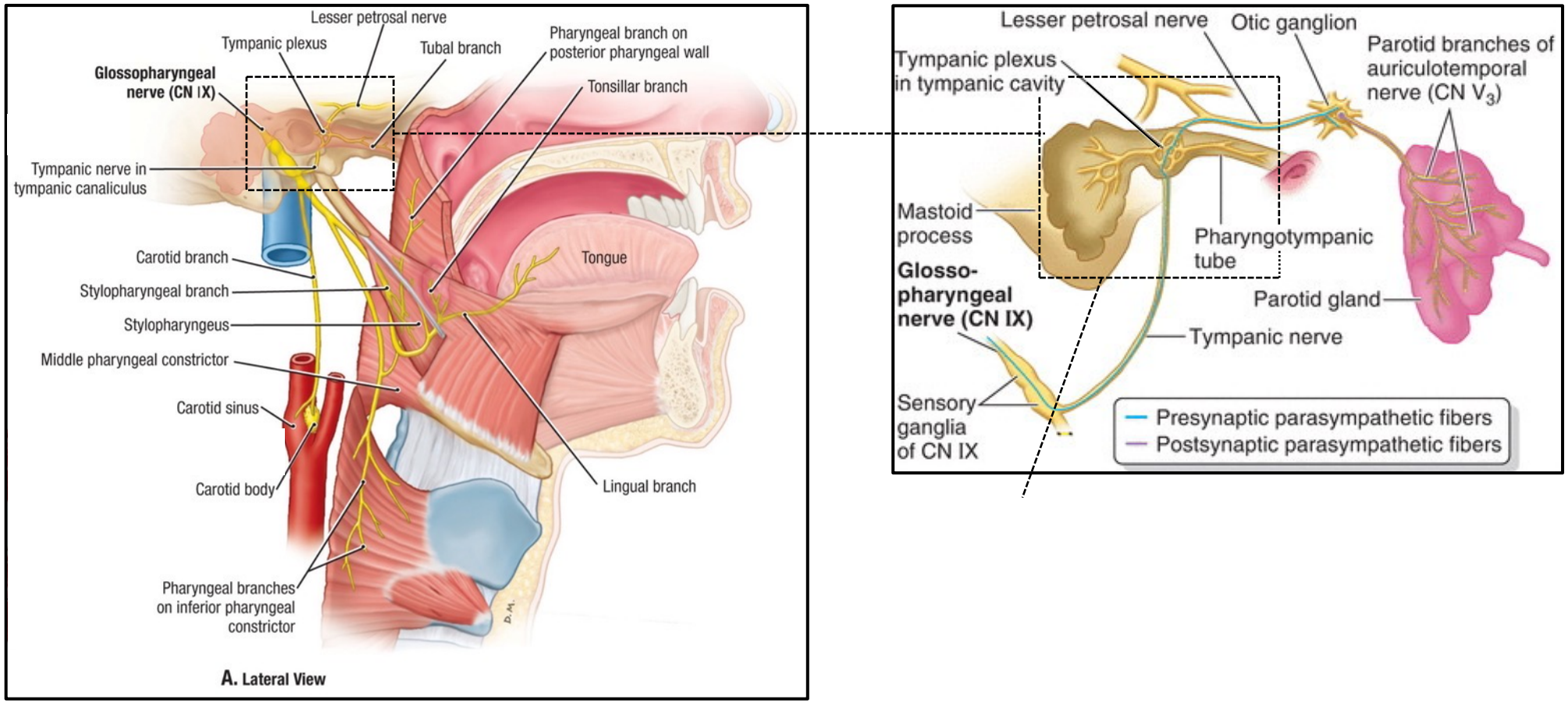


Glossopharyngeal Nerve (CN IX): The Details (Continued)

Pathway: Glossopharyngeal nerve branches

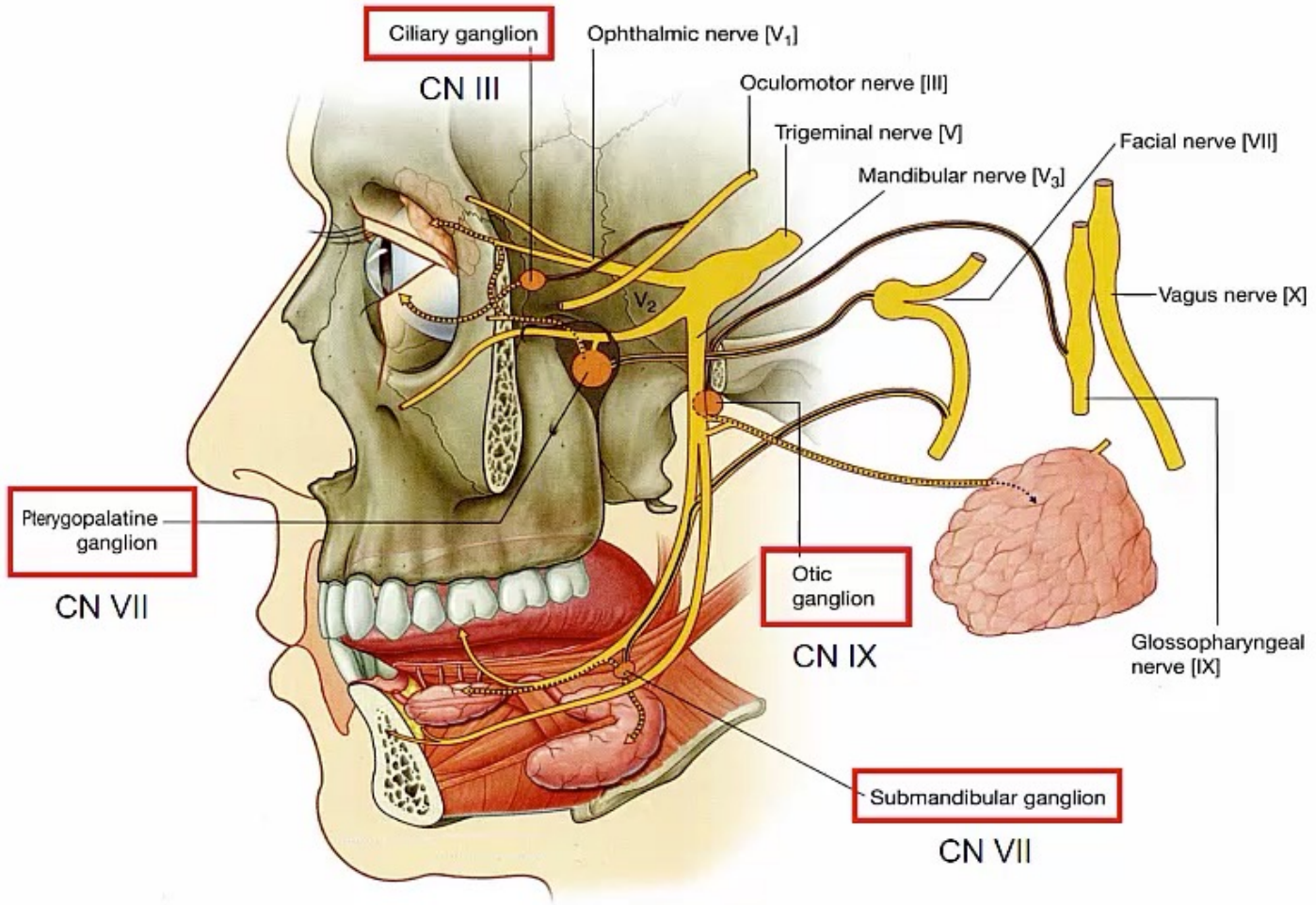
- After branching, the **tympanic nerve** ascends to reenter the skull through the tympanic canaliculus.
  - Sympathetic fibers from the superior cervical ganglion and the tympanic nerve form the tympanic plexus within the tympanic (middle ear) cavity.
  - The plexus provides general sensation to mucous membrane of the cavity. The **lesser petrosal nerve**, which consists of preganglionic parasympathetic fibers, emerges from the plexus to exit the tympanic cavity by passing through the hiatus for the lesser petrosal nerve.
  - The lesser petrosal nerve exits the cranial cavity by passing through the foramen ovale to synapse in the otic ganglion. The postganglionic fibers travel with the **auriculotemporal nerve** (CN V3) to reach the parotid gland.

PRL of CN IX Autonomics: Embedded in the next slide and available on Panopto.



PRL: Glossopharyngeal Nerve (CN IX) Autonomics: Parotid Gland (Panopto)

Parasympathetic Ganglia of the Head



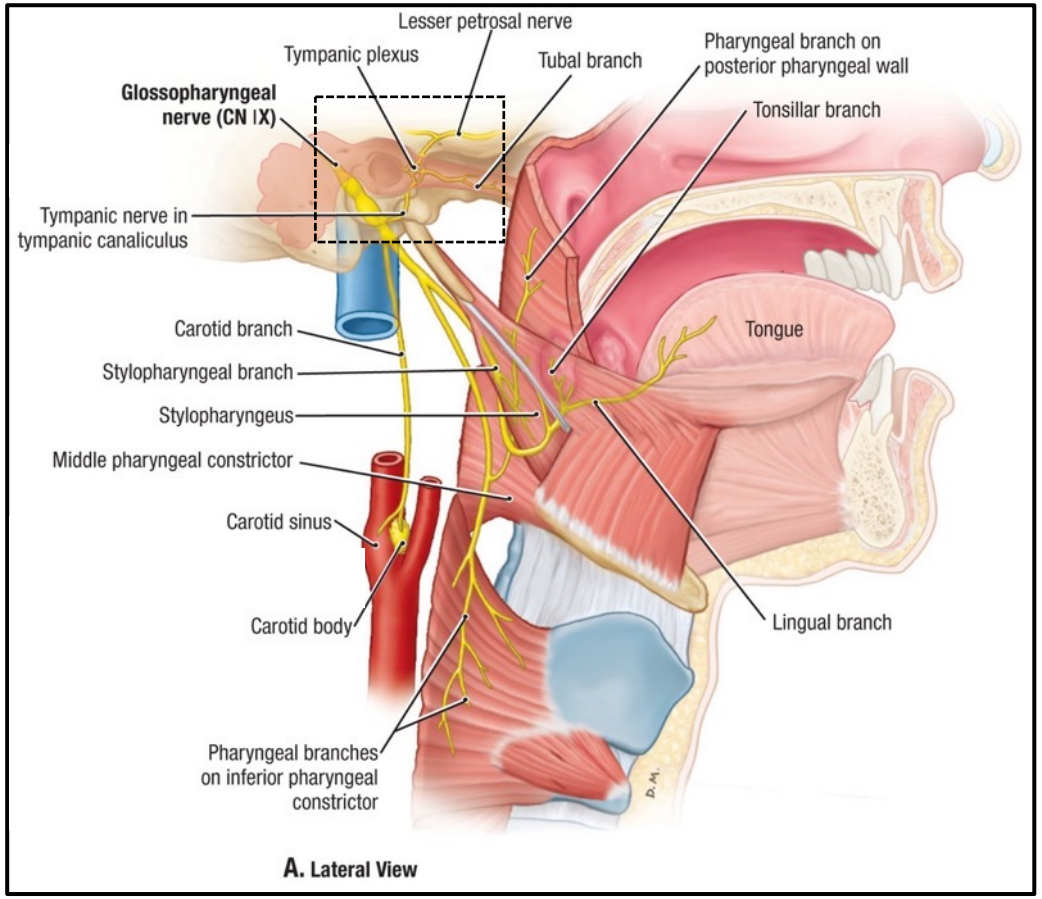
CN X: no parasympathetics in the head and neck

Glossopharyngeal Nerve (CN IX): The Details (Continued)

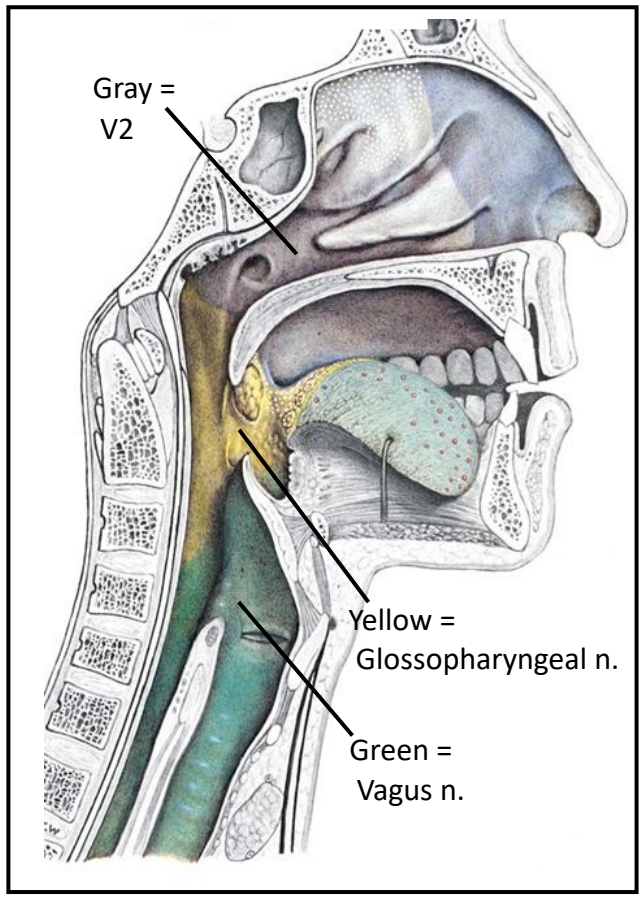
Glossopharyngeal nerve branches

- The **carotid branch** innervates the carotid **body and sinus**, which transmits visceral sensation.
- A branch is provided to the **stylopharyngeus muscle**, which is the one muscle innervated by CN IX.
- The **terminal branches** supply sensory innervation to the mucous membranes of
  - **Posterior nasopharynx**
  - **Oropharynx**
  - **Posterior 1/3 of tongue (sensory and taste)**

Test: Afferent limb of gag reflex
Positive Test: The uvula does not elevate following stimulus



Sensory Innervation



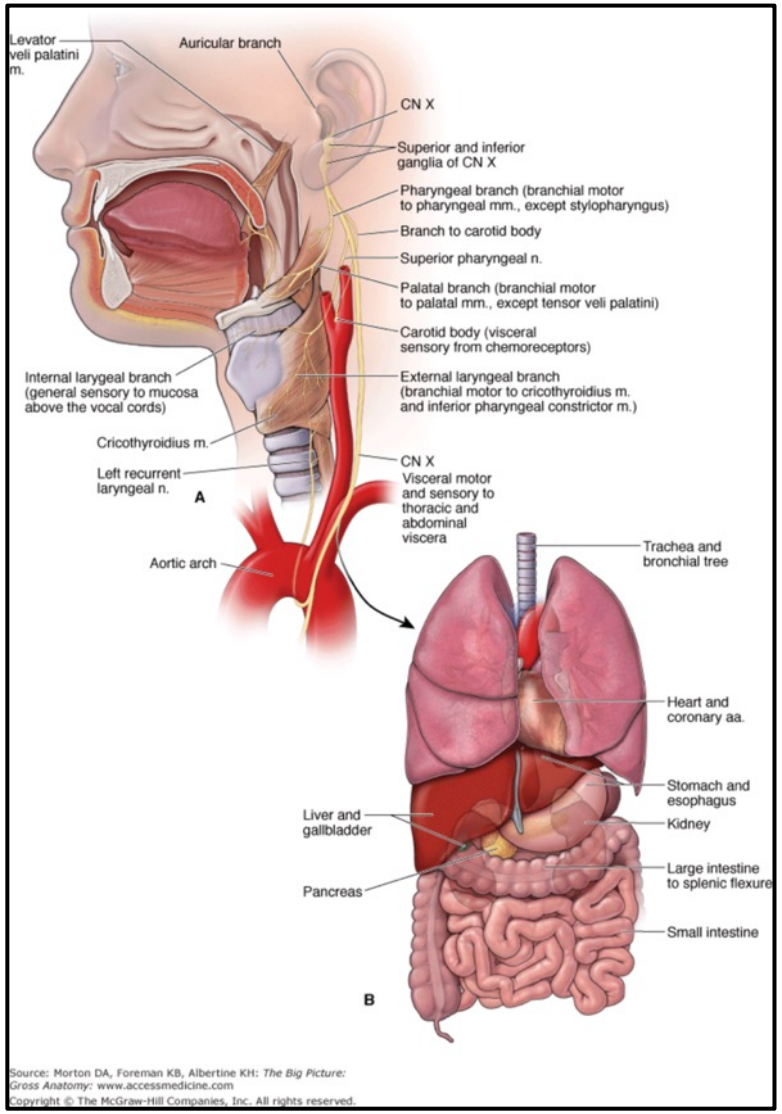
Clinical:

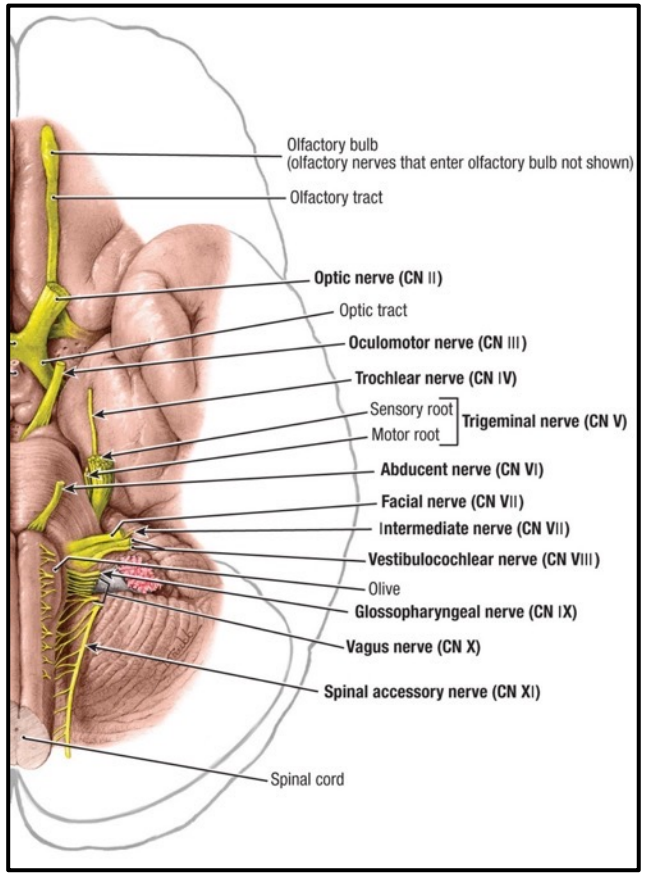
- Damage to CN IX may result in decreased taste and sensation on the posterior 1/3 of the tongue and difficulty swallowing.
- Isolated lesions of complete nerve are uncommon; CN IX may be injured along with CNs X and XI in tumors in the region of the jugular foramen (jugular foramen syndrome); lingual branch may be injured in tonsillar bed during tonsillectomy

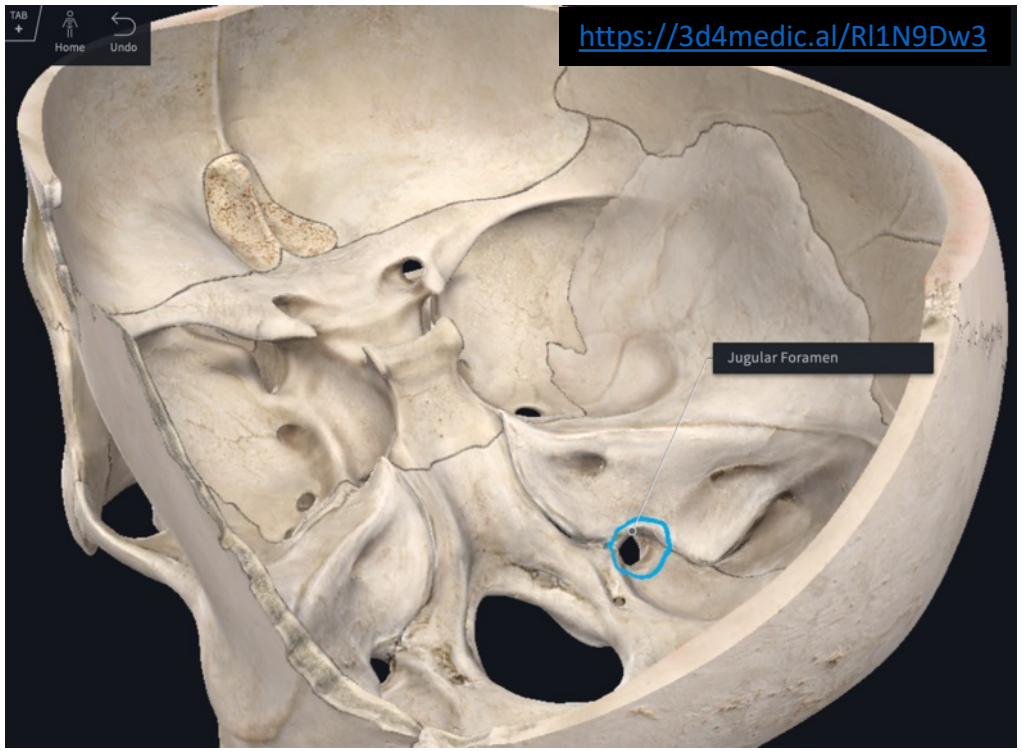
Vagus Nerve (CN X): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
CN X (Vagus)	Ventral aspect of the medulla lateral to the inferior olive and inferior to CN IX	Jugular foramen	• Branchial Motor (BE): palatoglossus, muscles of soft palate (except tensor veli palatini), pharyngeal muscles (except stylopharyngeus), all laryngeal muscles, and skeletal muscle of upper 1/3 esophagus • *Visceral Motor (GVE): heart, smooth muscle and glands of pharynx, larynx, and thoracic and abdominal viscera • Somatic Sensory (GSA): Skin posterior ear and skin external acoustic meatus • Visceral Sensory (GVA): pharynx, larynx, trachea, thoracic viscera, abdominal viscera, stretch receptors in aortic arch, chemoreceptors aortic bodies • Special Sensory (SA): Taste epiglottis

*Preganglionic parasympathetic fibers







Vagus Nerve (CN X): The Details

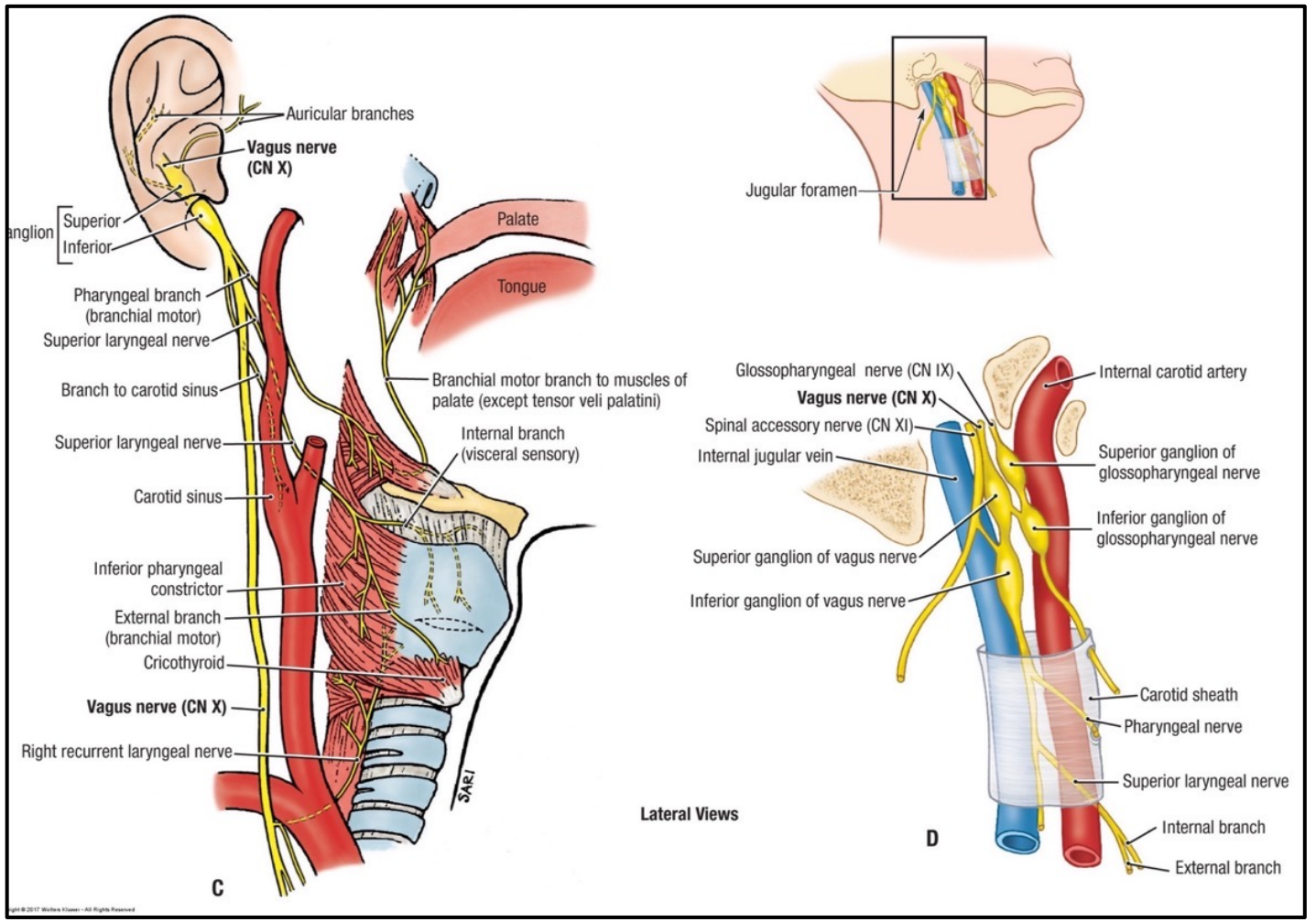
Pathway: The **vagus nerve** emerges from the medulla as several rootlets that merge and exit the cranial cavity through the jugular foramen. The vagus nerve's two sensory ganglia are located at the jugular foramen (superior and inferior ganglia). As the nerve descends beyond the inferior ganglion, it is contained within the carotid sheath throughout its path in the neck. Inferior from the root of the neck, the nerve takes a different path on each side of the body. It exits the neck by passing into the thoracic cavity.

Branches in the neck

- **Pharyngeal branches** provide **banchial motor innervation to superior, middle, and inferior constrictor muscles and muscles of the soft palate (except tensor veli palatini).**

- The **superior laryngeal nerve** branches from the vagus, descends inferiorly, and divides into the internal and external laryngeal branches.
  - The **internal laryngeal nerve branch** passes through the thyrohyoid membrane and **provides somatic sensory innervation the laryngeal mucosa *superior* to the true vocal fold (vocal cords), laryngopharynx, and epiglottis.**
  - The **external laryngeal nerve branch** provides **branchial motor innervation to cricothyroid muscle of the larynx and a few fibers innervate inferior portion of the inferior pharyngeal constrictor muscle (cricopharyngeus) .**

- **Cardiac nerves** branch from the vagus within the carotid sheath, descend inferiorly within the sheath, join with the cardiac plexus in the thorax, and ultimately innervate the heart.
  - **Visceral motor: SA node AV node**
  - **Visceral sensory: aortic bodies and arch (chemoreceptors and baroreceptors)**

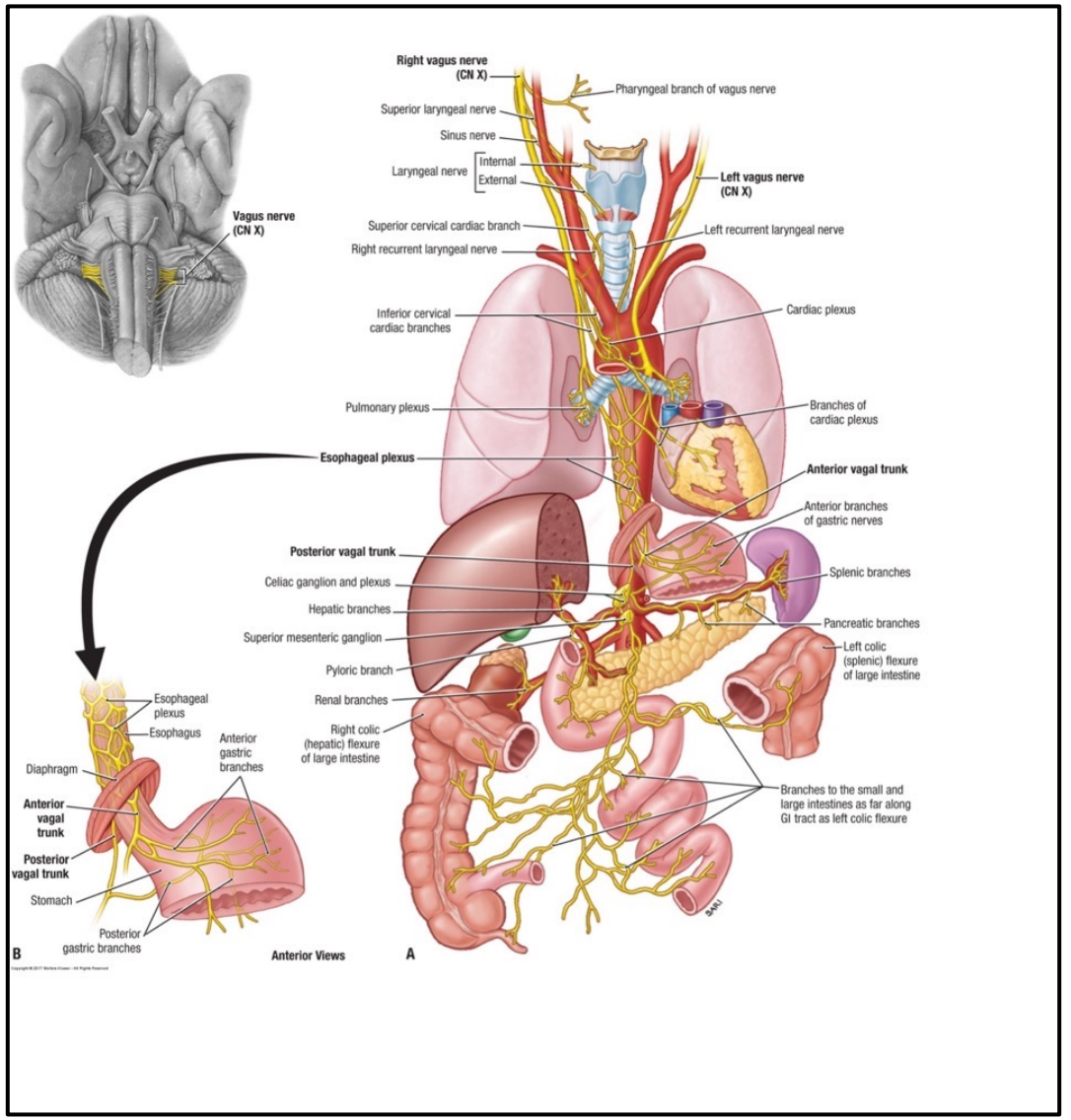


Vagus Nerve (CN X): The Details (Continued)

Branches (Continued)

- The **recurrent laryngeal nerves** branch from the vagus nerve in different locations on the right side of the body compared to the left.
  - On the right sided of the body, the recurrent laryngeal nerve loops around the subclavian artery
  - On the left side of the body, the recurrent laryngeal nerve loops around the arch of the aorta.
  - After looping around their respective structures, both the right and left vagus nerves ascend in the neck in the tracheoesophageal groove.
  - **Motor innervation: intrinsic muscles of the larynx (except cricothryoid), upper esophageal muscle,**
  - **sensory innervation: mucosa of the larynx *inferior* to the true vocal fold (vocal cords) and sensory innervation to the trachea.**

- The vagus nerves course along either side of the distal esophagus where they share branches with each other to form the esophageal plexus surrounding the esophagus. Just before passing through the diaphragm, the vagus nerves again become separate and distinct to form the anterior and posterior vagal trunks. The vagal trunks then pass through the diaphragm with the esophagus into the abdomen **where the trunks divide into branches that innervate the stomach and intestinal tract as distal as the left colic flexure.**



Test:

- Efferent limb of gag reflex
- Observing the soft palate while patient says: “Ahh.”

Positive Test:

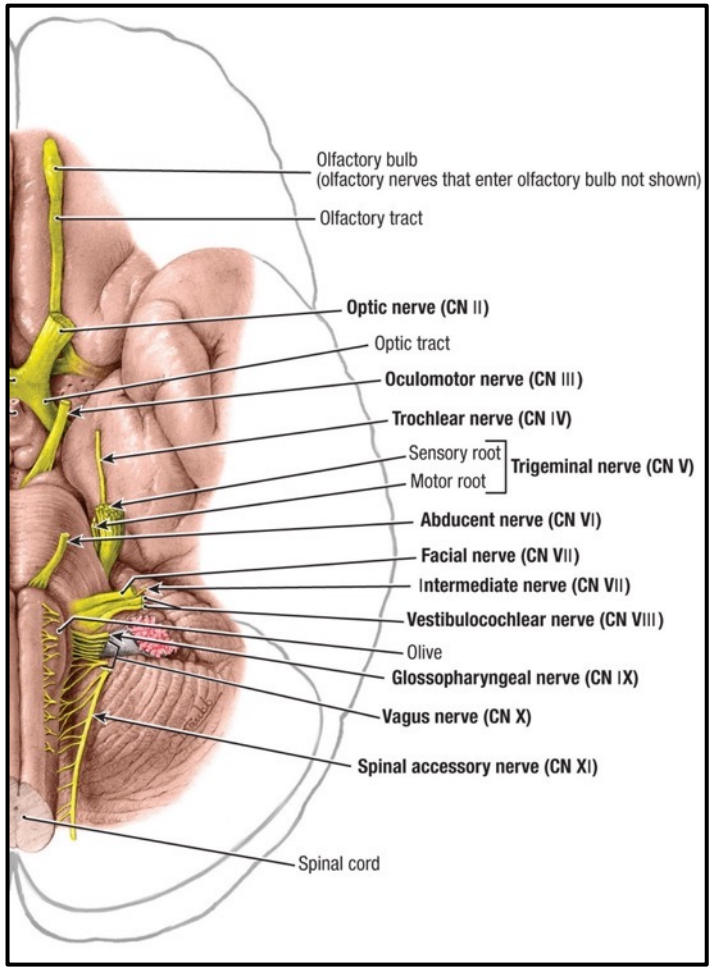
- Gag Reflex: The uvula does not elevate following eliciting of gag reflex
- Patient saying “AHH:” Lack of symmetric elevation of the soft palate

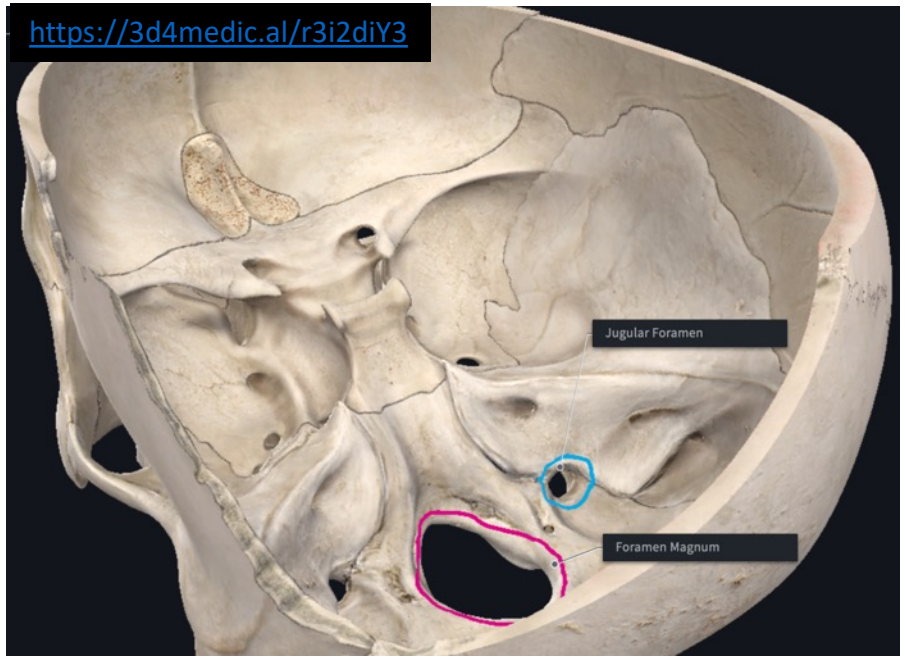
Clinical:

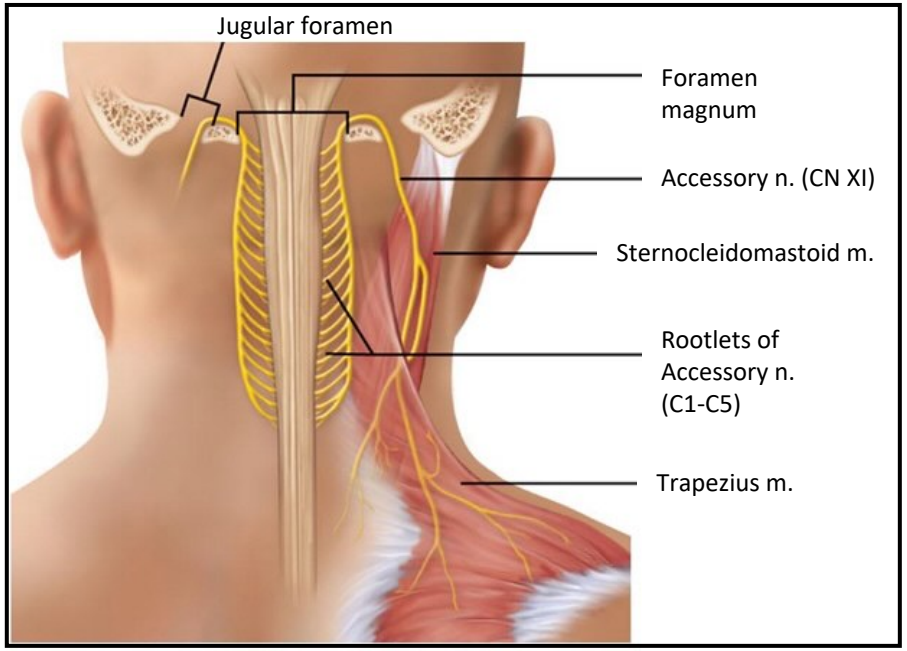
- Damage to CN X may result in breathiness of the voice, tachycardia, and orthostasis.

Accessory Nerve (CN XI): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
Accessory nerve (CN XI)	Rostral cervical spinal cord lateral to the inferior olive	• Enters through foramen magnum • Exits through jugular foramen	• Somatic Motor (GSE): Trapezius and Sternocleidomastoid muscles



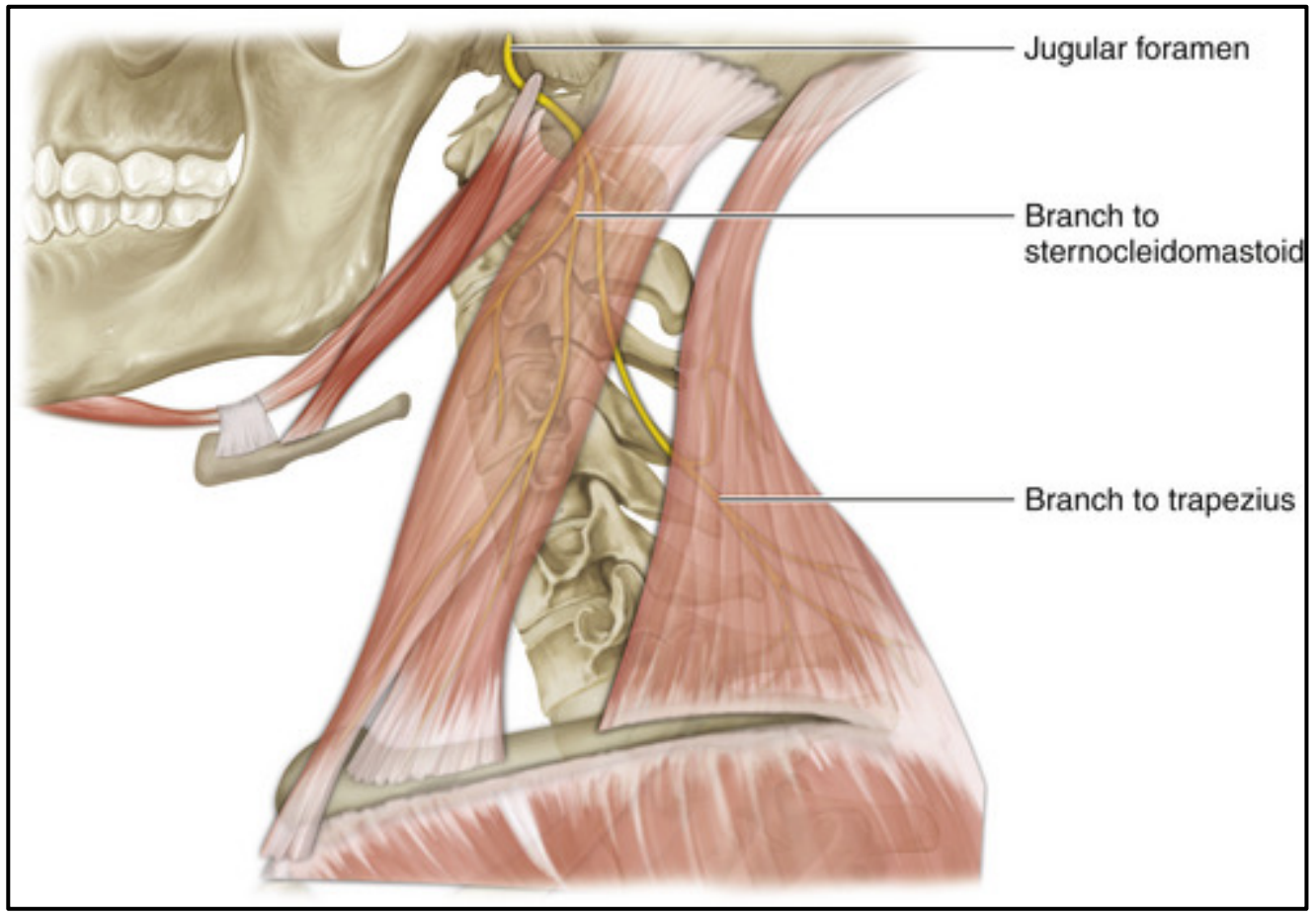




Accessory Nerve (CN XI): The Details

Pathway:

- Fibers from the cervical region C1-C5 coalesce to form the **accessory nerve**, which ascends through the **foramen magnum** to enter the cranial cavity.
- It traverses the posterior cranial fossa and exits the cranial cavity through the **jugular foramen.** Outside the cranial cavity, it descends along the internal carotid artery to penetrate the sternocleidomastoid muscle, which it innervates.
- It then emerges from the posterior border of the sternocleidomastoid muscle to traverse the posterior triangle of the neck on its path to innervate the trapezius muscle.
- **Provides somatic motor innervation to the trapezius and sternocleidomastoid muscles.**



Test:

- Shrug shoulders (trapezius)
- Using resistance, patient turns head away from the side of the body on which the muscle being tested is located. (contralateral rotation)

Positive Test:

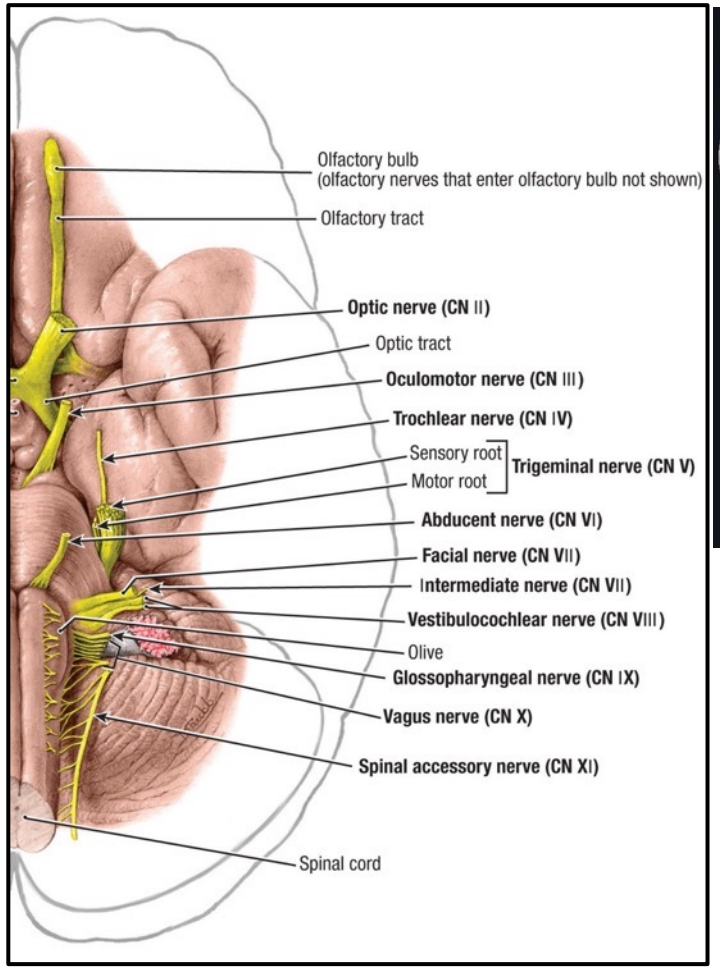
- Ipsilateral shoulder weakness
- Weakness during contralateral rotation

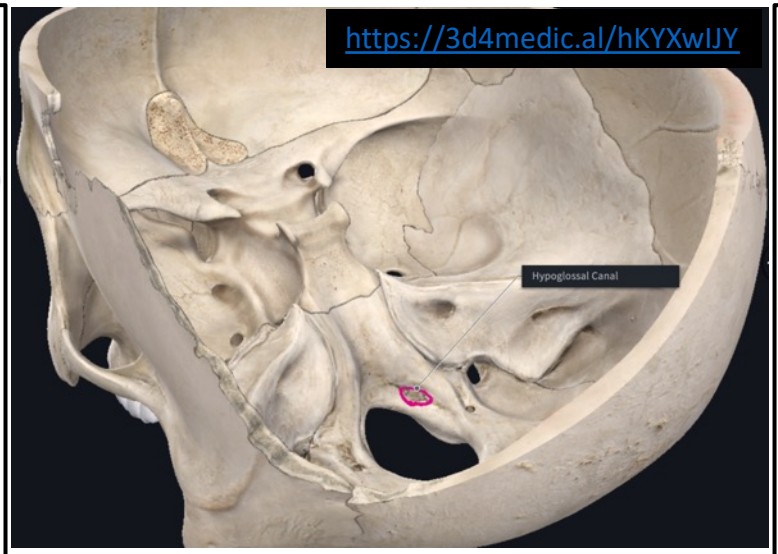
Clinical:

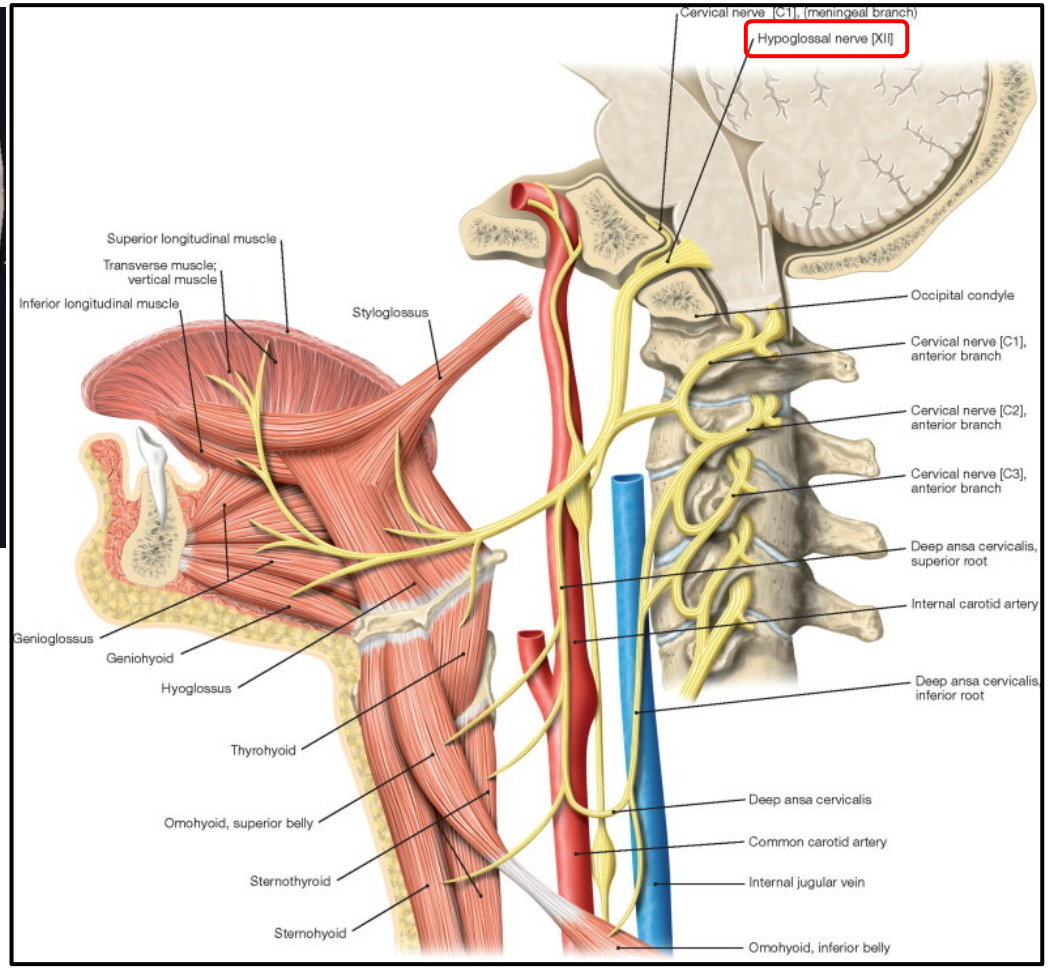
- Damage to CN XI may result in weakness of ipsilateral shoulder shrug (trapezius) and contralateral head turning (sternocleidomastoid).
- CN XI may be injured along with CNs IX and X in jugular foramen syndrome; nerve at risk of injury in surgical procedures of the sup. neck

Hypoglossal Nerve (CN XII): The Basics

Cranial nerve	Junction With CNS	Passes Through Skull	Function
Hypoglossal nerve (CN XII)	Medulla oblongata lateral to the pyramids and medial to the inferior olive	Hypoglossal canal	• Somatic Motor (GSE): All intrinsic and extrinsic tongue muscles (except palatoglossus)







Hypoglossal Nerve (CN XI): The Details

Pathway:

- The **hypoglossal nerve** emerges from the medulla of the brainstem and exits the cranial cavity via the **hypoglossal canal**.
- Outside of the cranial cavity, the nerve receives a nerve branch from the cervical plexus (C1/C2), which travels with the hypoglossal nerve in its connective tissue sheath to reach the hyoid muscles.
- The hypoglossal nerve passes inferior to the angle of the mandible to cross the the lateral border of both the internal and external carotid arteries.
- It then continues in an anterior direction deep to both the posterior belly of the digastric muscle and the stylohyoid muscle to enter the tongue.
- **It provides somatic motor innervation to the intrinsic tongue muscles and 3 of the four extrinsic tongue muscles (genioglossus, hyoglossus, styloglossus).** The exception is palatoglossus muscle, which is innervated by CN X)

Test: Protrude tongue

Positive Test: Tongue will deviate *toward* the side of muscle weakness.

Clinical: Damage to CN XII may result in *ipsilateral* tongue weakness.