



Trigeminal Pathways

ISMSN

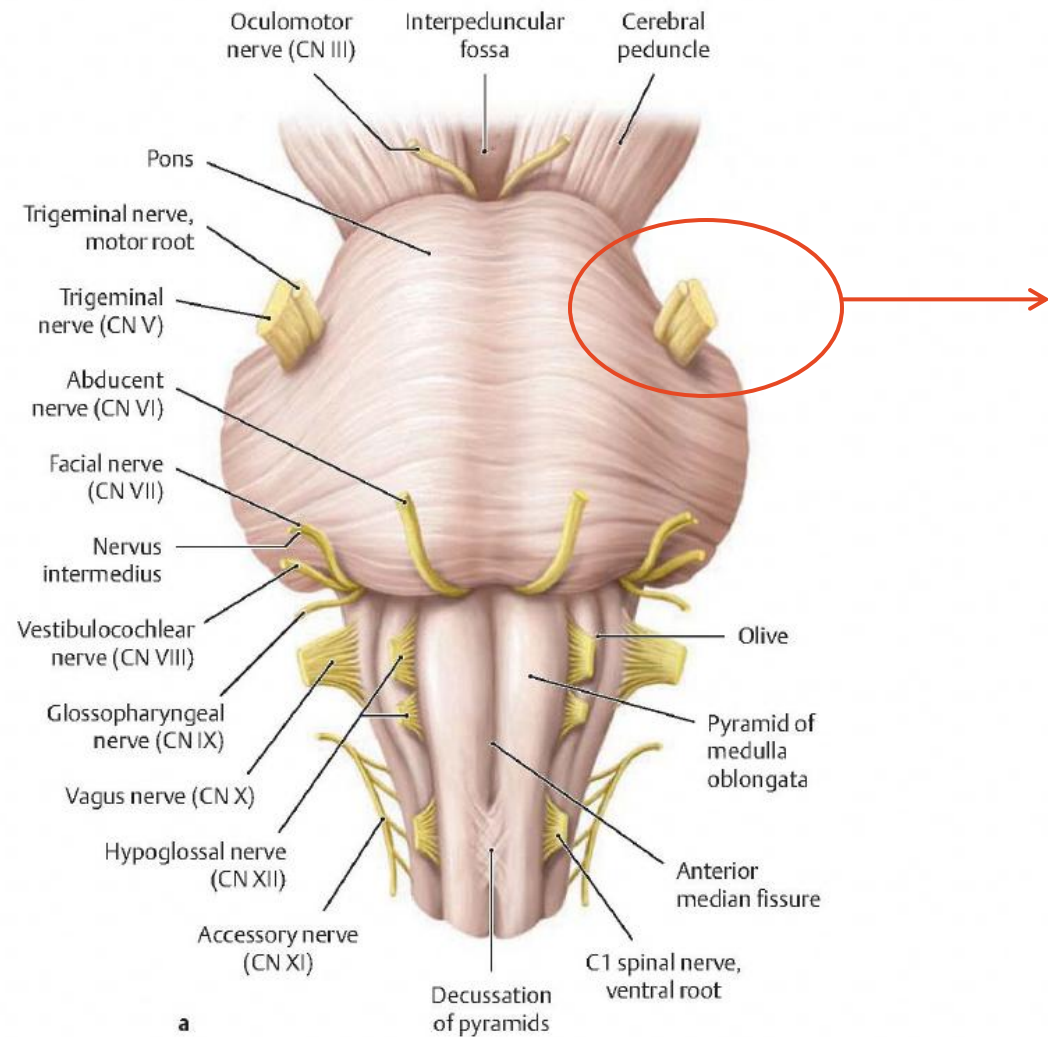
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Learning Objectives

1. Indicate the location where trigeminal nerve attaches to the CNS and tell its general function
2. Name the brainstem nuclei associated with the trigeminal nerve, tell their location in the brainstem and their function
3. Indicate the sensory modalities transmitted by the trigeminal lemniscal, trigemino-thalamic and proprioceptive pathways
4. Describe the trigeminal lemniscal and trigemino-thalamic tract pathways from fiber origin to cortical perception
5. Explain the pathway for conscious and unconscious proprioception from the face
6. Describe the pathways for the jaw jerk and corneal reflexes: afferent and efferent arms, and integration centers **READ - Key Clinical Concept in Blumenfeld Chapter 12**, page 518
7. Correlate the effects of a lesion at different brainstem levels with clinical exam findings - cases

OBJ. # 1



The trigeminal nerve attaches to the brainstem at the level of the mid pons. It has a large sensory root and a small motor root

E Brainstem

a Anterior view.

Illustrator: Markus Voll

pp. 226-227

Schuenke et al. THIEME Atlas of Anatomy • Head and Neuroanatomy

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Trigeminal Nerve, CN V

OBJ. # 1

Function

Sensory innervation for the face, mucous membranes of the mouth, and nasal sinuses, joints, gums, supratentorial dura matter, blood vessels, ant. 2/3 of tongue

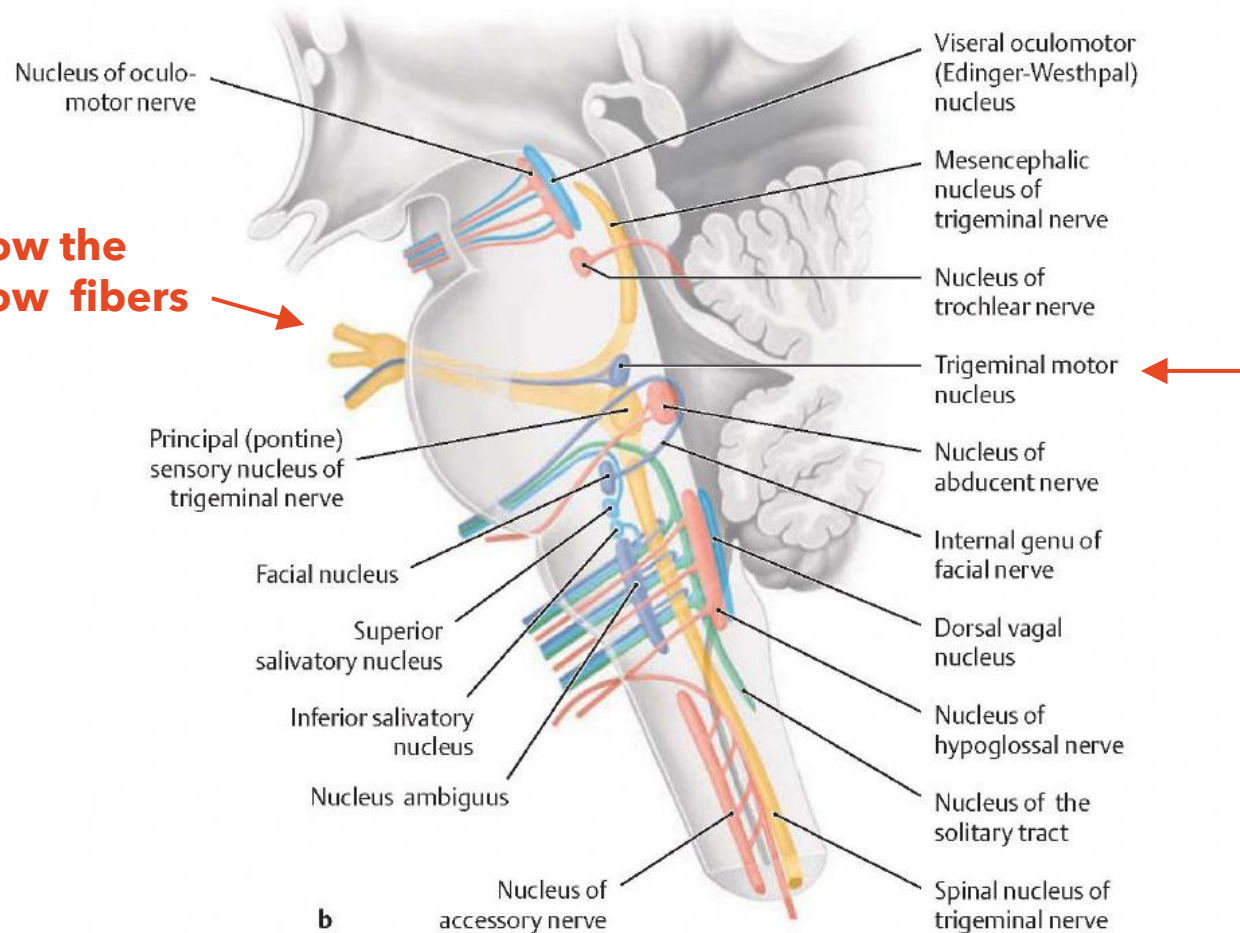
Motor innervation of the muscles of mastication

Trigeminal Nerve, CN V

4 Nuclei:

- **Principal sensory nucleus** (mid pons)
 - **Spinal nucleus of V** (long column of neurons, medulla and caudal pons)
 - **Mesencephalic nucleus** (from mid pons to midbrain)
 - **Motor nucleus** (mid pons) —————> Motor innervation for masticatory muscles
- } Sensory information from the face

Location Of CN V Nuclei In The Brainstem



A Cranial nerve nuclei in the brainstem

b Midsagittal section of the right half of the brainstem viewed from the left side.

Illustrator: Markus Voll

pp. 228-229

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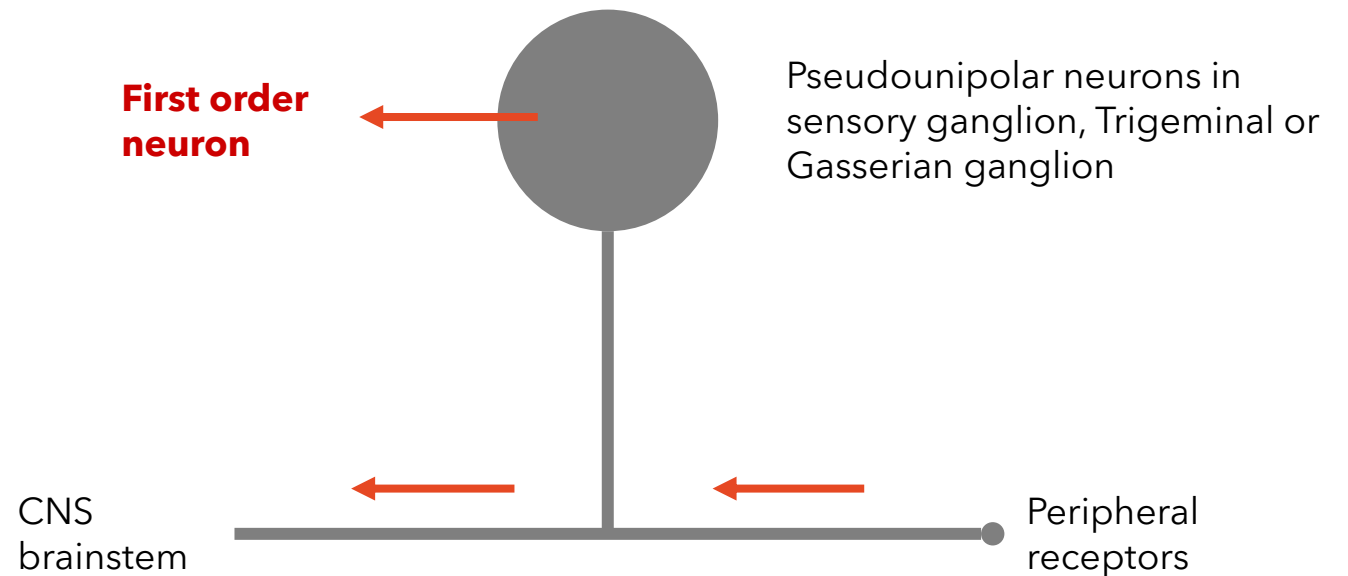


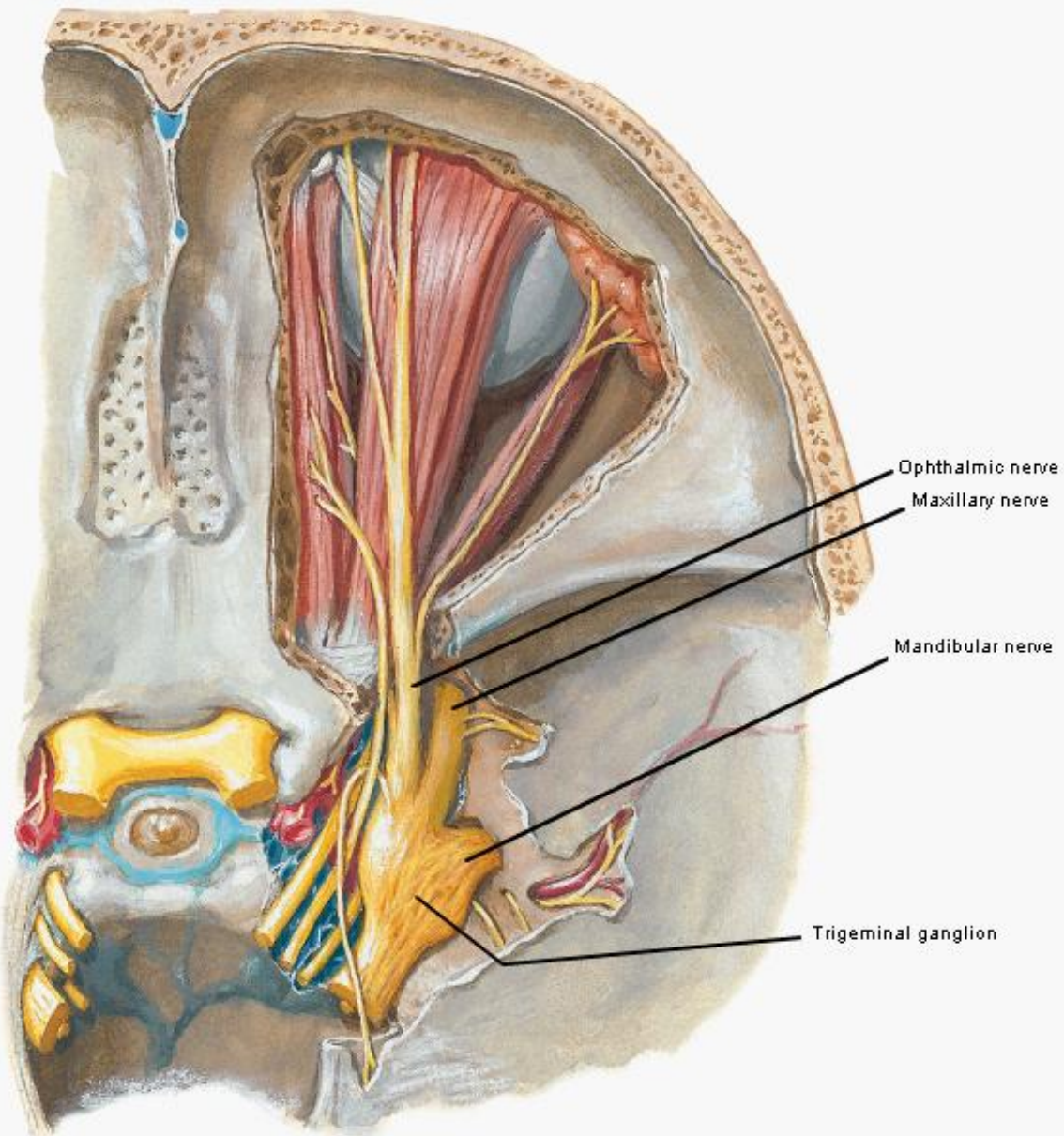
OBJ. # 2

Somatic Sensation From The Face

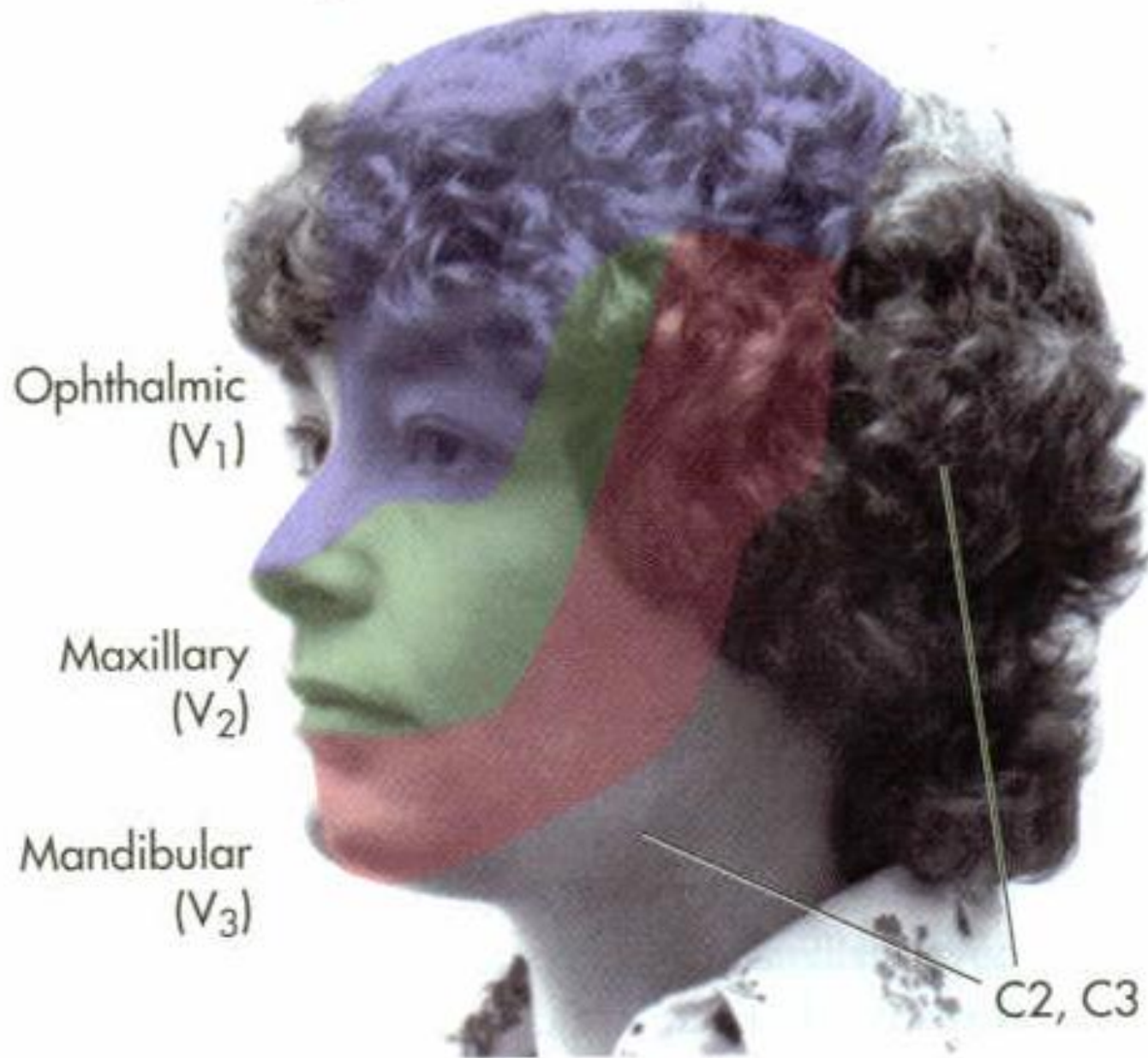
OBJ. # 3

- The trigeminal nerve transmits sensation from the face
- 3 pathways can be described:
 1. Transmits light touch / discriminative touch, vibration and SOME proprioception
 2. Transmits deep touch, thermal sensation and nociception
 3. Transmits most of the proprioception: from the muscles of mastication and eye muscles





**Nerves of the orbit
and the ciliary
ganglion: dorsal
view and cross-
section through the
cavernous sinus**



Trigeminal Dermatomes

Trigeminal Lemniscus And Trigeminothalamic Tract

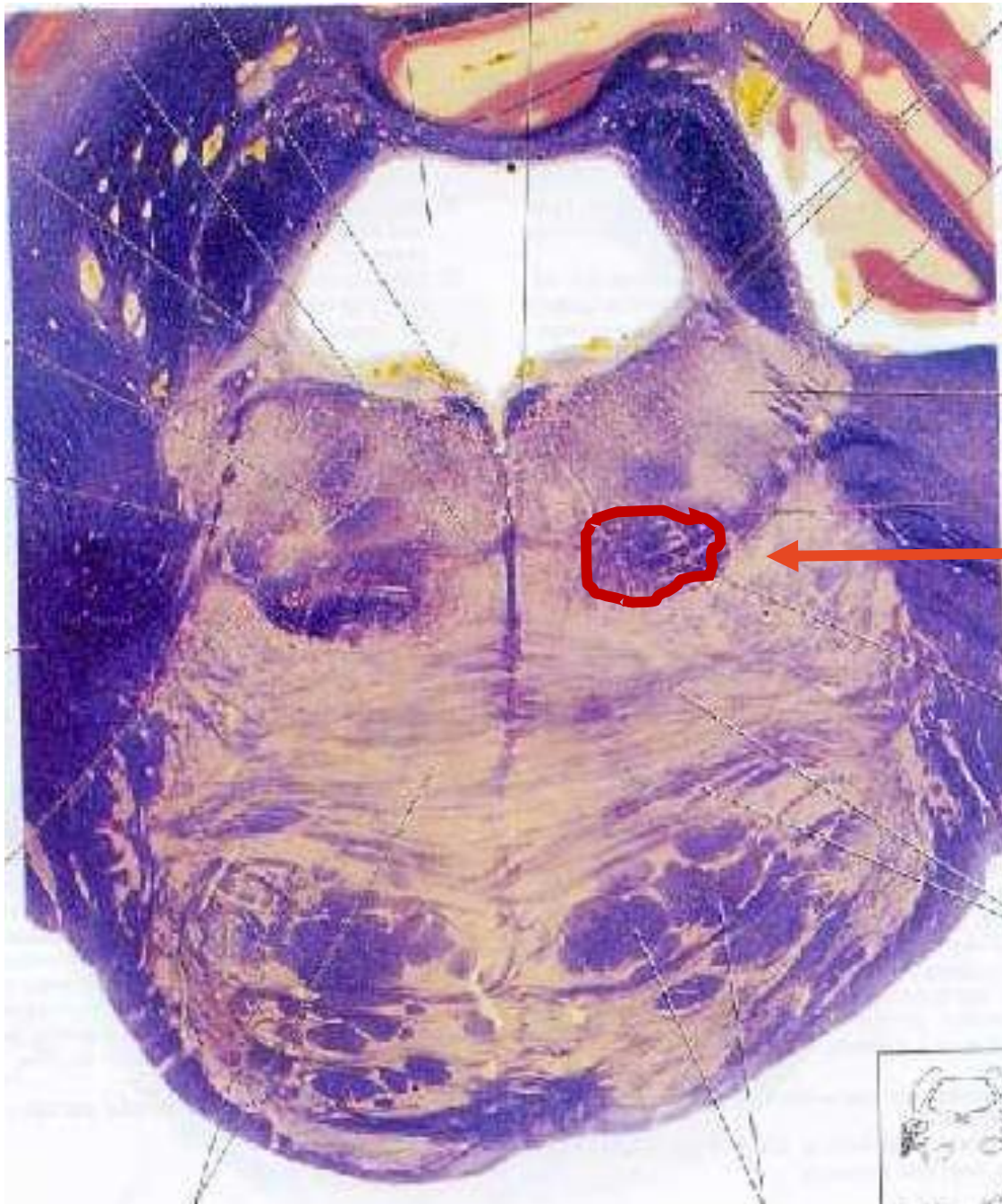


Light Touch, Vibration And Some Proprioception

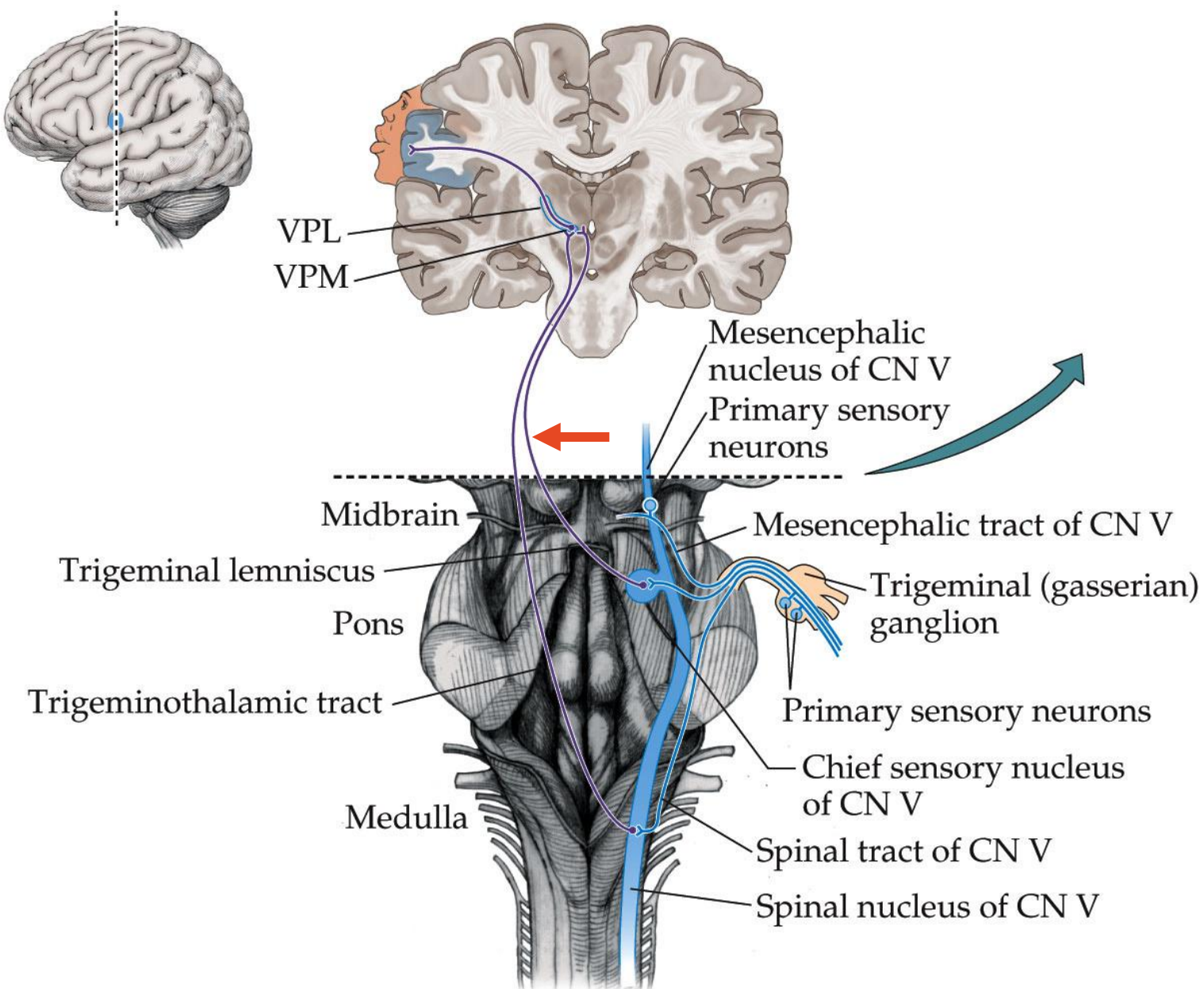
OBJ. # 4

- Fibers originate from pseudounipolar neurons in the trigeminal ganglion
- Peripheral fibers make up the 3 facial dermatomes
- Central fibers enter the brainstem at mid-pons
- Fibers for this pathway synapse with neurons mainly in the **principal sensory** nucleus of V
- The principal sensory nucleus projects to the contralateral thalamus through a fiber tract known as the **trigeminal lemniscus**.
- The fibers from the principal sensory nucleus **decussate in the mid-pons**, join the medial lemniscus (fibers from the body) and ascend to synapse with neurons in the **VPM nucleus** of the thalamus
- Thalamocortical fibers from the VPM nucleus project to the face area of the **primary sensory cortex** in the parietal lobe

OBJ. #4



The medial lemniscus Trigeminal fibers start to join this pathway as they cross from the contralateral side

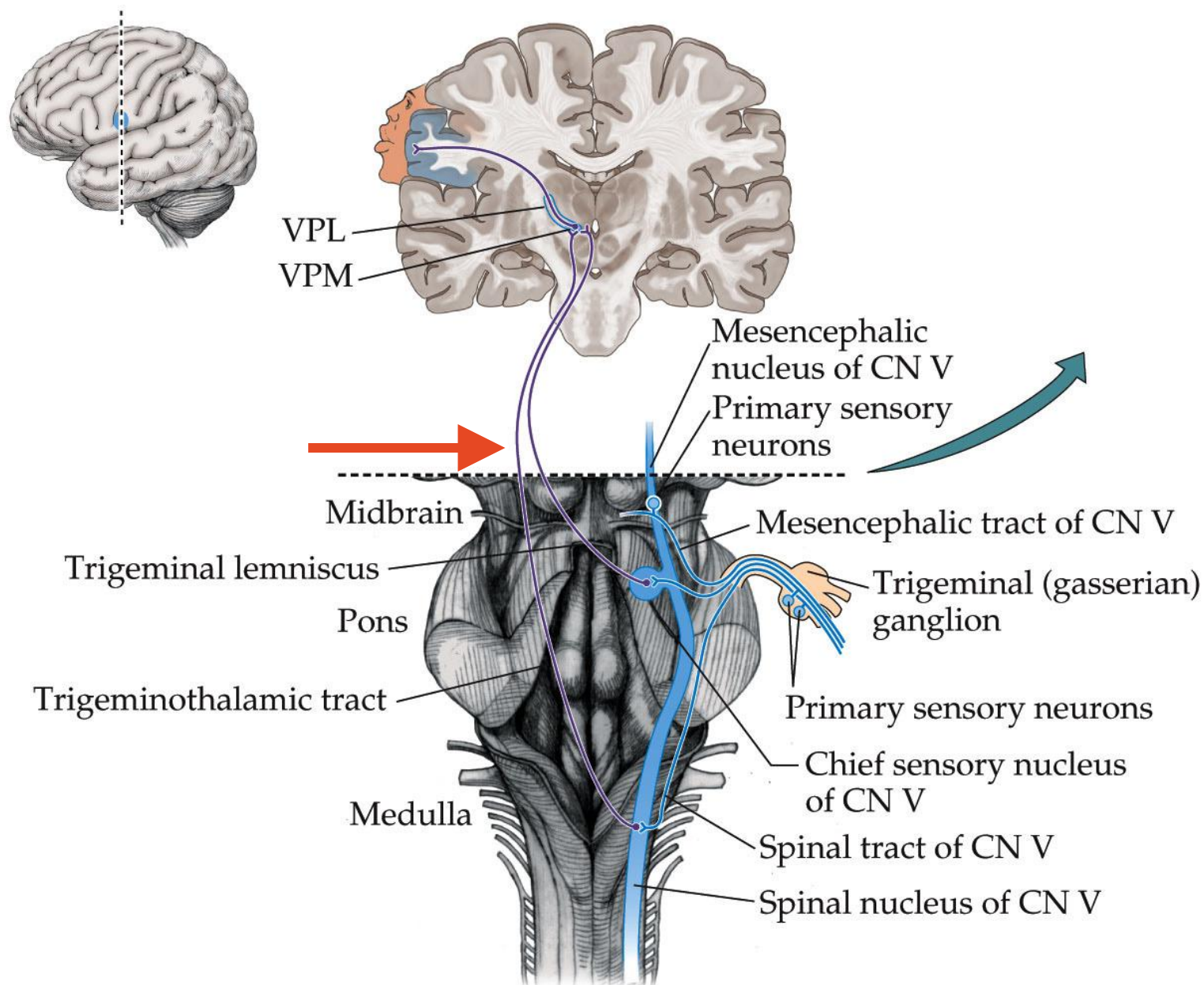


NEUROANATOMY 2e, Figure 12.8 (Part 1)

Deep Touch, Thermal Sensation And Nociception

OBJ. # 4

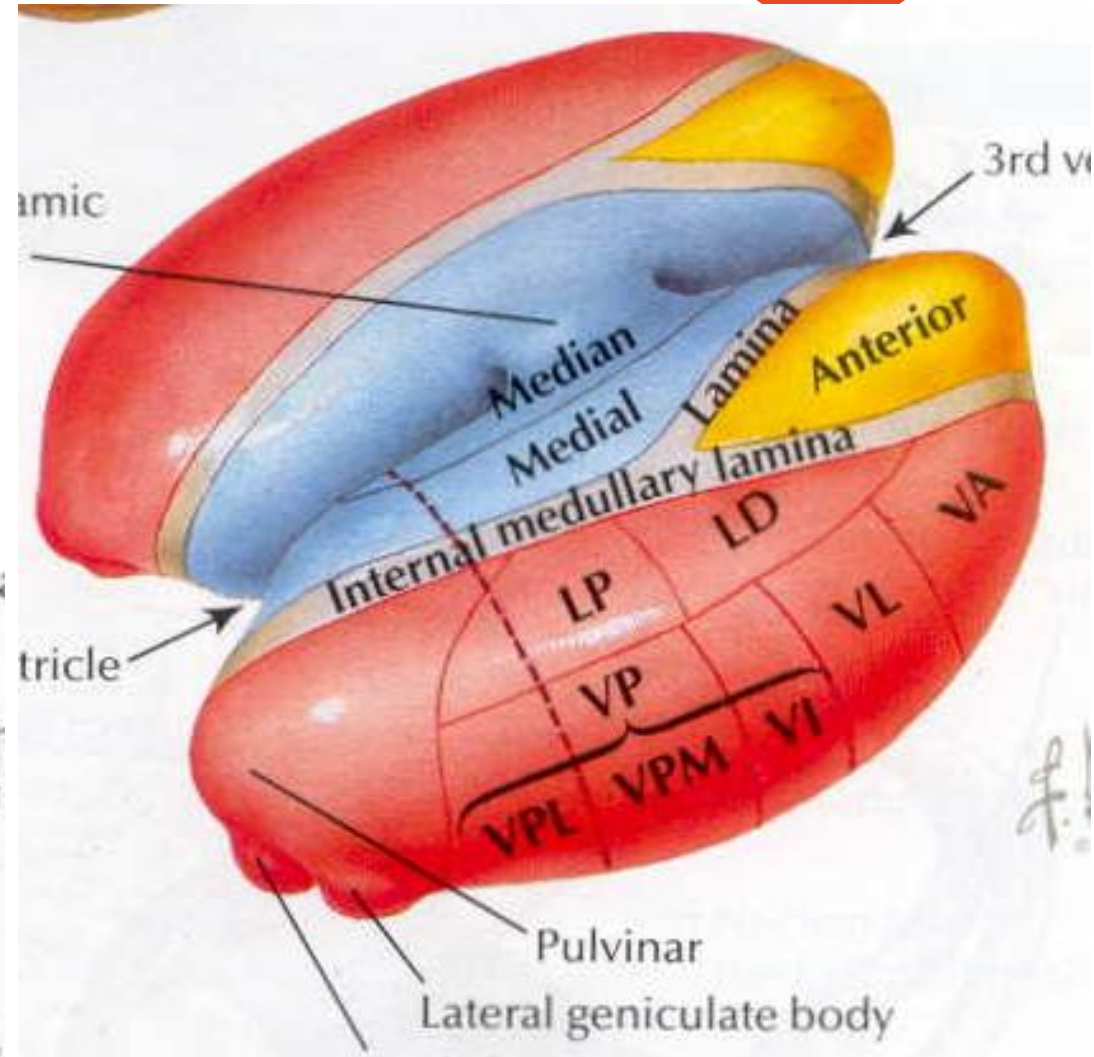
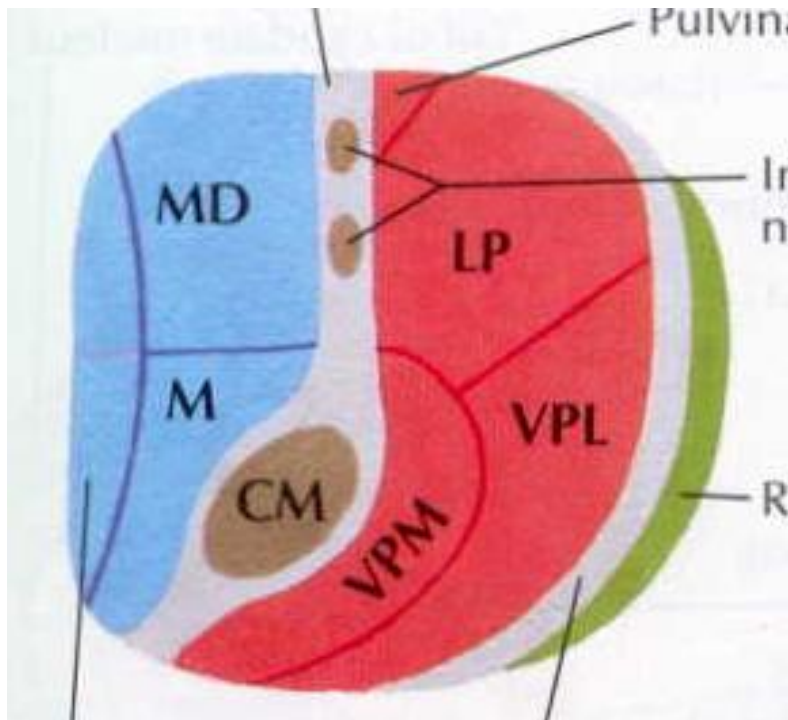
- Fibers originate from pseudounipolar neurons in the trigeminal ganglion
- Peripheral fibers make up the 3 facial dermatomes
- Central fibers enter the brainstem at mid-pons and **descend along the pons and medulla - Spinal tract of V**
- Fibers for this pathway synapse with neurons in the **spinal nucleus of V**
- Neurons in the spinal nucleus project to the contralateral thalamus through a fiber tract known as the **trigeminothalamic tract**
- Spinal trigeminal fibers decussate at all medullary levels, join the other sensory pathways and ascend to the **VPM nucleus** of the thalamus
- Thalamocortical fibers from the VPM terminate in the face area of the **primary sensory cortex** in the parietal lobe



NEUROANATOMY 2e, Figure 12.8 (Part 1)

The Thalamus

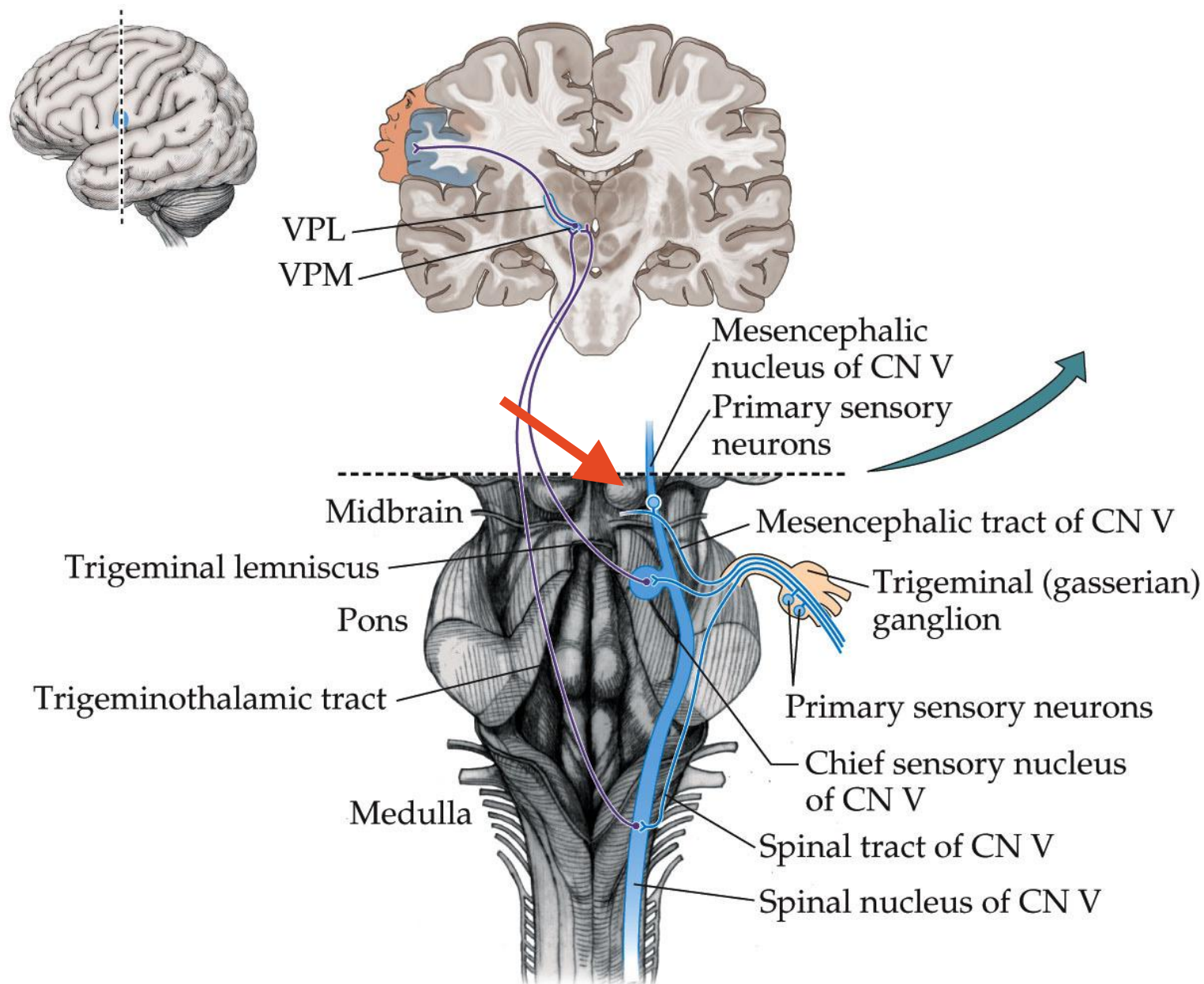
OBJ. # 4



Proprioceptive Pathways

OBJ. # 5

- Fibers ORIGINATE in the **mesencephalic nucleus**
- Peripheral fibers exit with V1 and V3 to contact the muscle spindles of the appropriate muscles
- **The flow of information is towards the CNS** and enters the brainstem with the peripheral fibers of mesencephalic neurons
- Proprioceptive information is then transmitted through the central fiber of the mesencephalic neurons to different CNS locations
- Proprioceptive fibers reach the **ipsilateral thalamus** (conscious proprioception), the **cerebellum** (unconscious proprioception) and the **trigeminal motor nucleus**
- Thalamocortical fibers from VPM terminate in the face area of the **primary sensory cortex**
- The **motor nucleus** uses the proprioceptive information to produce a motor response - the Jaw Jerk Reflex



Nuclei Associated With CN V

- Spinal nucleus of V
- Principal sensory nucleus
- Motor nucleus
- Mesencephalic nucleus

Ganglia Associated With CN V

- Trigeminal ganglion
- Mesencephalic nucleus

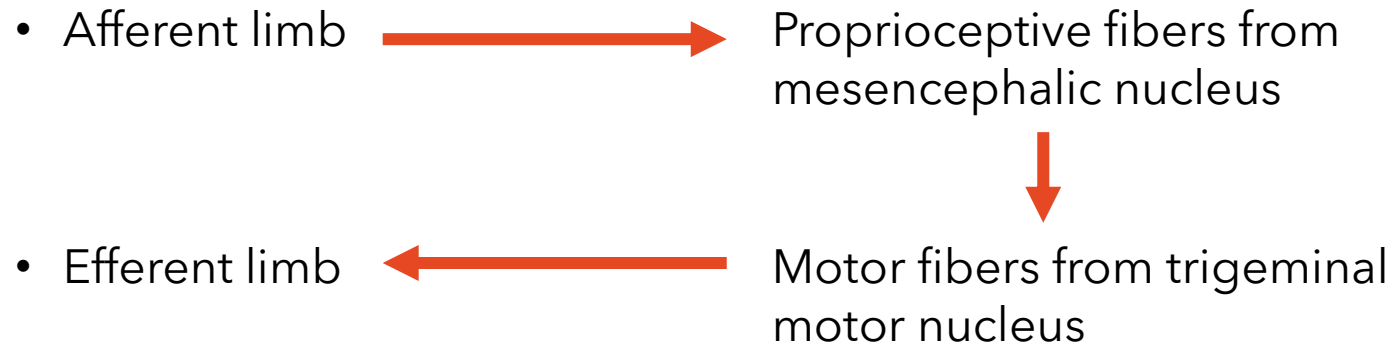
Trigeminal Nerve, CN V

OBJ. # 6

- Reflexes
 - Corneal reflex:
 - Afferent limb → CN V
 - Efferent limb → Facial nerve
 - Jaw Jerk reflex
 - Afferent limb → CN V, proprioceptive fibers
 - Efferent limb → CN V, motor fibers

Jaw Jerk Reflex

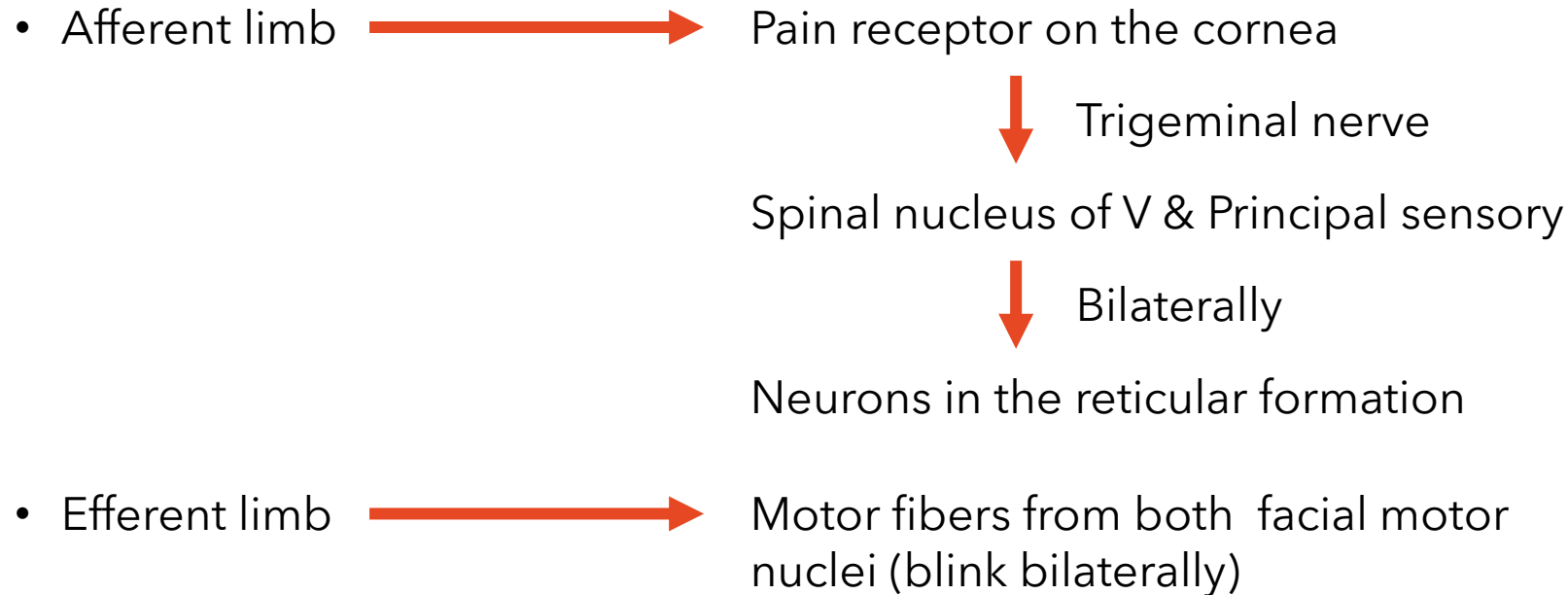
OBJ. # 6



Both motor nuclei of V coordinate and integrate this bilateral reflex

Blink Reflex / Corneal Reflex

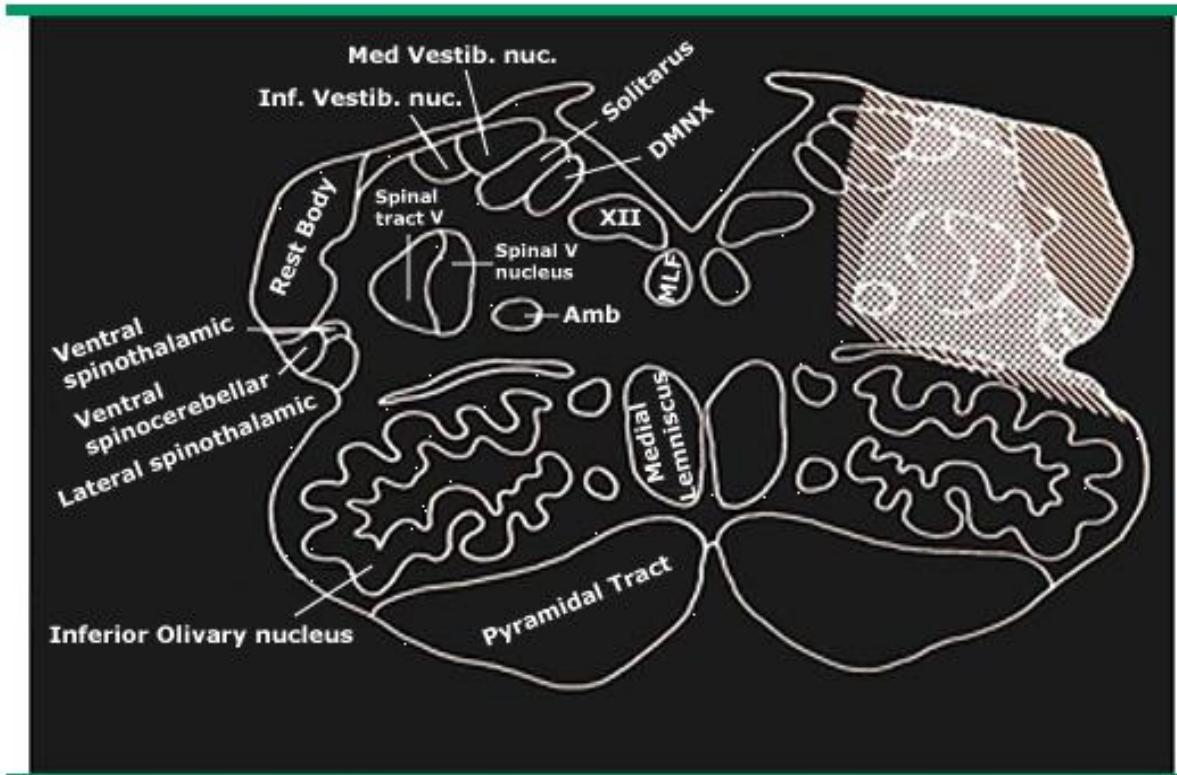
OBJ. # 6



The pontine reticular formation is the reflex integration center

Clinical Correlate: Lateral Medullary Syndrome

Medulla oblongata



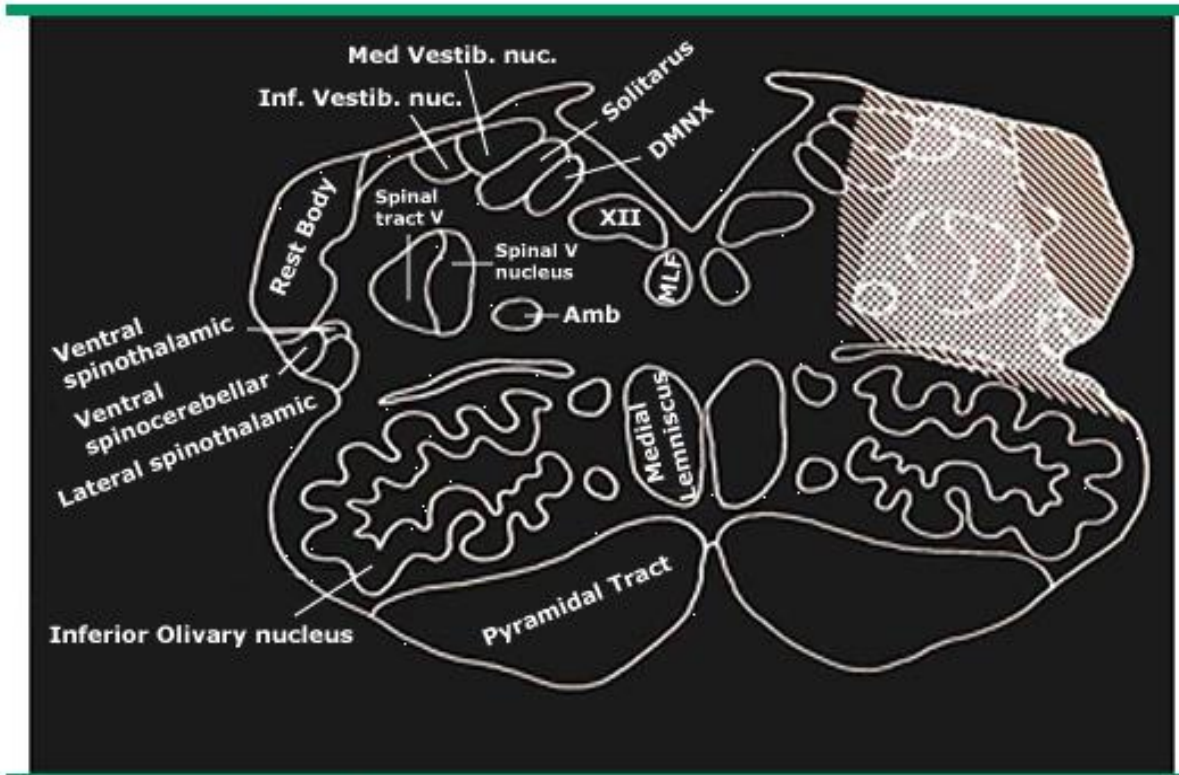
The usual location of lateral medullary infarcts is hatch-marked in the upper right of the figure. The anatomical structures are labeled on the diagram.

UptoDate

- Also called Wallenberg's Syndrome
- Usually due to thrombosis of vertebral artery, PICA, or a perforating medullary branch
- Of the structures you've learned, which do you predict would be injured?
- What sensory deficits would you anticipate?

Clinical Correlate: Lateral Medullary Syndrome

Medulla oblongata



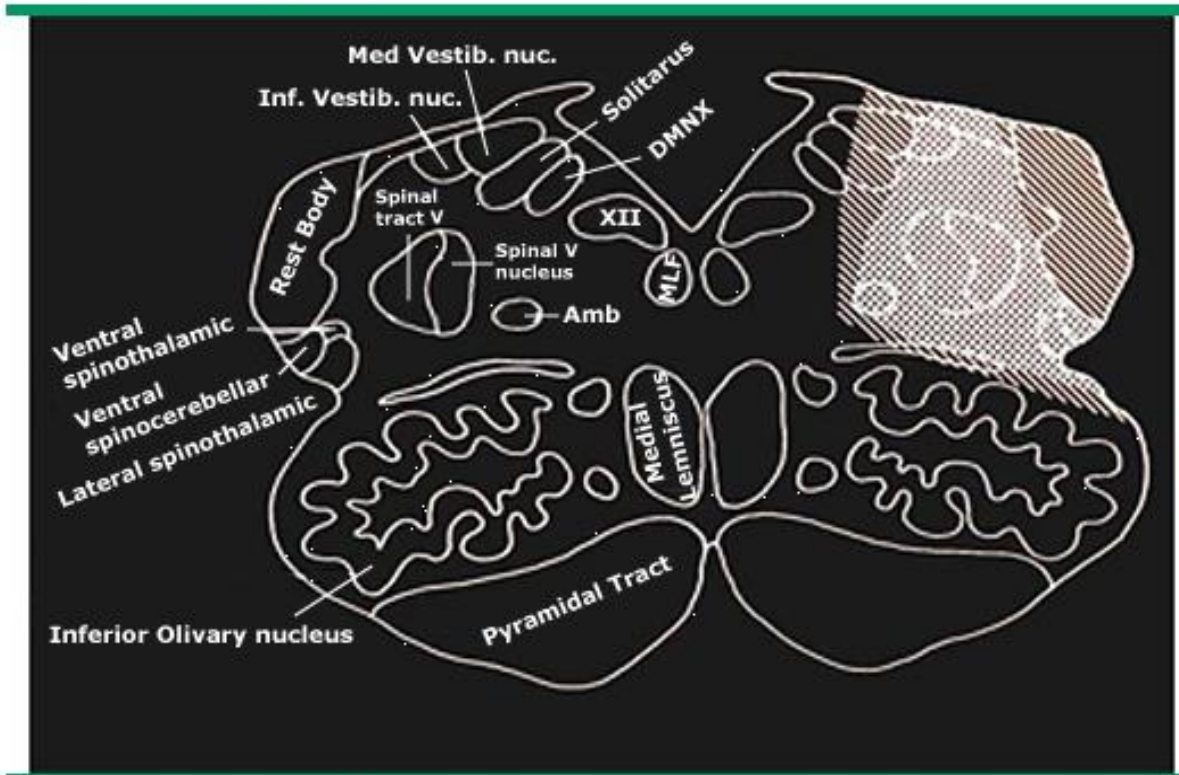
The usual location of lateral medullary infarcts is hatch-marked in the upper right of the figure. The anatomical structures are labeled on the diagram.

Structures:

- Spinal nucleus/tract of V
- Nucleus Ambiguus
- Ventral/lateral spinocerebellar tracts
- Lateral spinothalamic tract
- Vestibular nuclei

Clinical Correlate: Lateral Medullary Syndrome

Medulla oblongata



The usual location of lateral medullary infarcts is hatch-marked in the upper right of the figure. The anatomical structures are labeled on the diagram.

Deficits:

- Ipsilateral facial sensory loss for pain and temp
- Contralateral body sensory loss for pain and temperature
- Vertigo, tendency to fall towards ipsilateral side, nystagmus
- Dysphagia, dysarthria
- Ipsilateral Horner's syndrome (ptosis, anhidrosis, miosis)