

Normal Anatomy and Function of the Spinal Cord

Spinal Cord Injury Medicine Review Course

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DISCLOSURE OF CONFLICT OF INTEREST

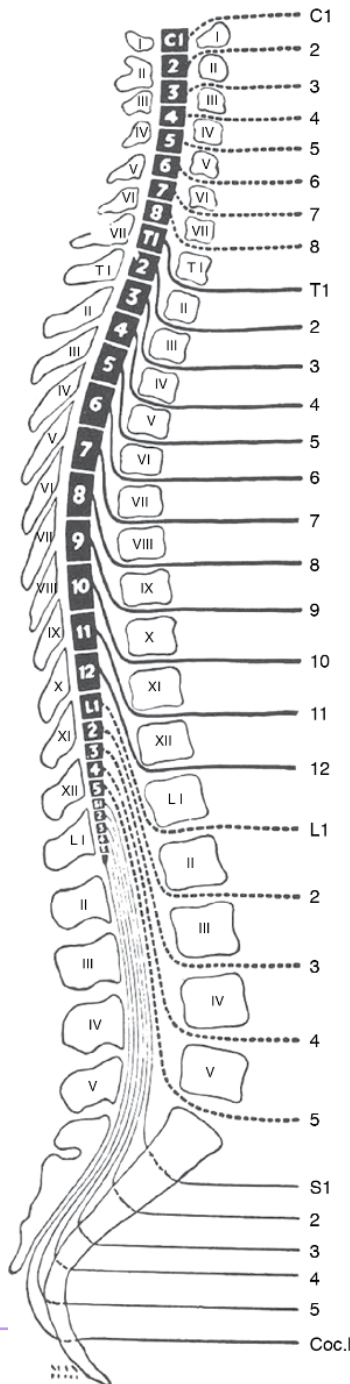
- Dr. Kryger has no financial conflicts of interest relevant to this activity.

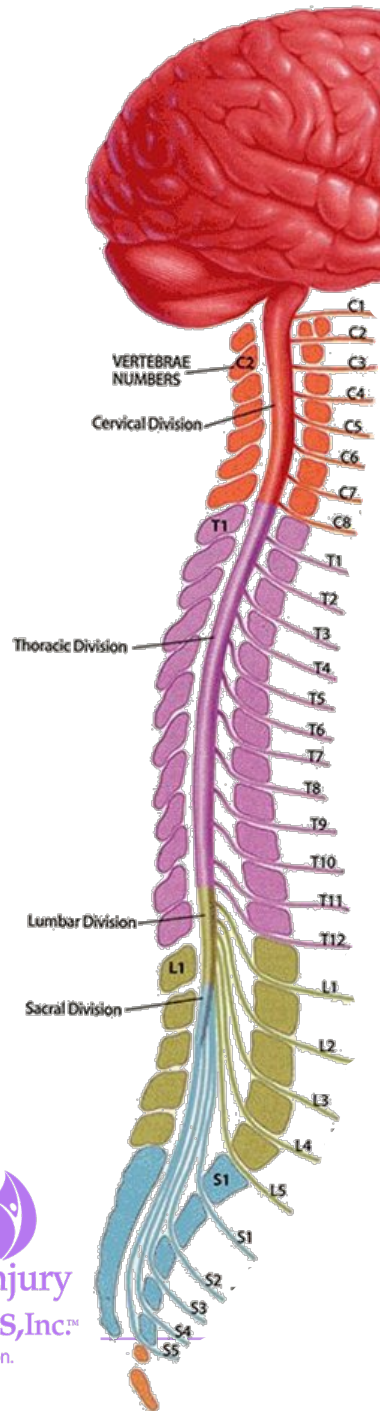
LEARNING OBJECTIVES

- At the conclusion of this activity, the participant will be able to:
 - Describe the spinal cord tracts and their function
 - Describe the spinal cord vascular supply
 - Discuss different spinal cord syndromes and how the anatomy of the spine explains these syndromes

SPINAL CORD GROSS ANATOMY

- Begins at the caudal end of the Medulla Oblongata
- Usually terminates around L1-L2 at the L1 vertebrae
- Inferior portion of the Spinal Cord= Conus Medullaris, may extend between T12-L3
- Cauda Equina =bundle of nerve routes that separate from Conus Medullaris to innervate lower spinal levels



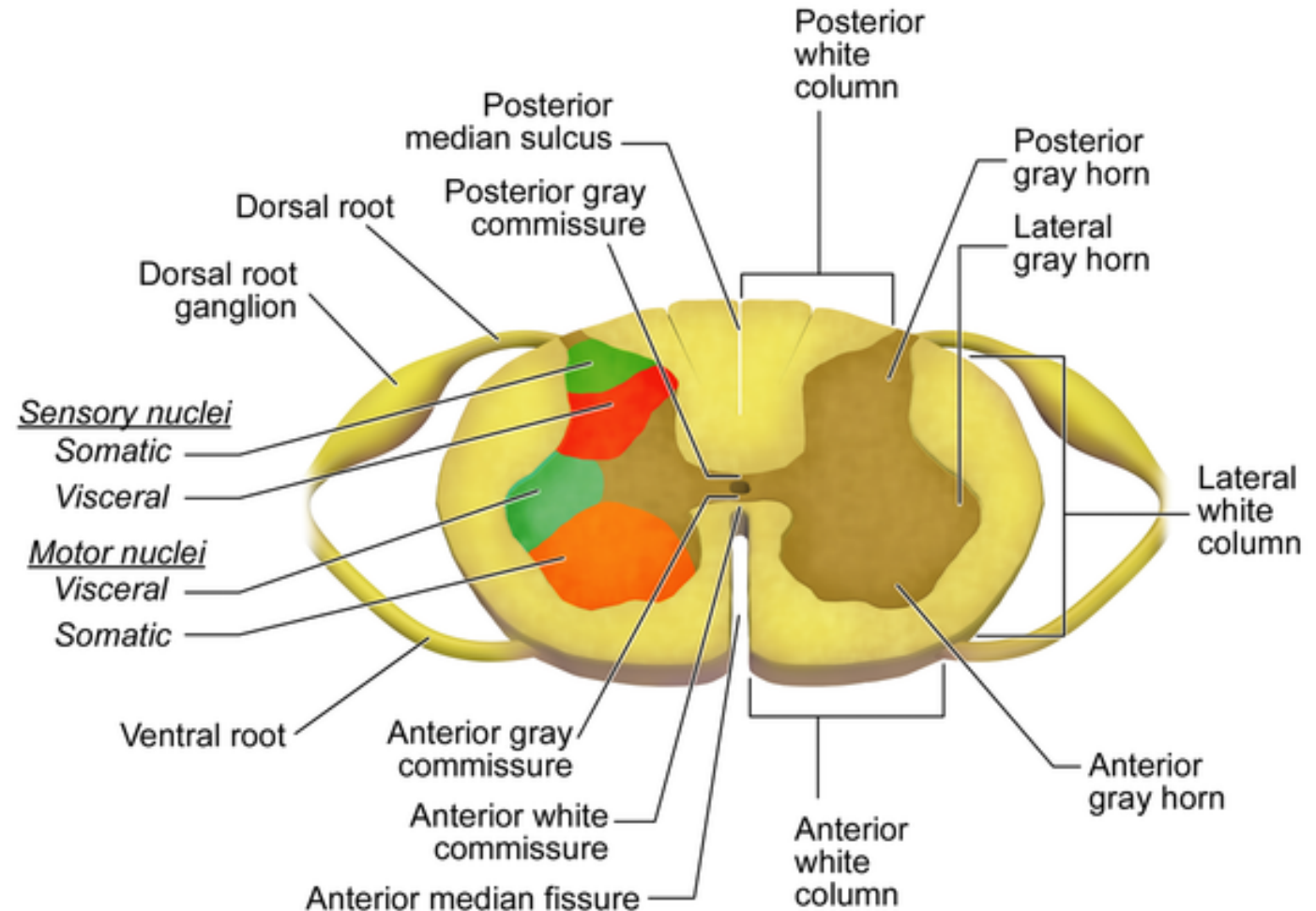


SPINAL NERVES

- 8 cervical nerves
 - C1 exits **above** C1 vertebrae. C8 exits **below** C7 vertebrae
 - C1 has no dorsal root/dermatome
- Remaining nerves exit below corresponding vertebrae
 - 12 thoracic nerves
 - 5 lumbar nerves
 - 5 sacral nerves
 - 1 coccygeal nerve- no dorsal root/dermatome

SURFACE ANATOMY

- Anterior (ventral) Median Fissure
 - location of anterior spinal artery/vein
- Posterior (dorsal) median sulcus
- Anterior lateral sulcus- anterior roots exit
- Posterior lateral sulcus- posterior roots exit

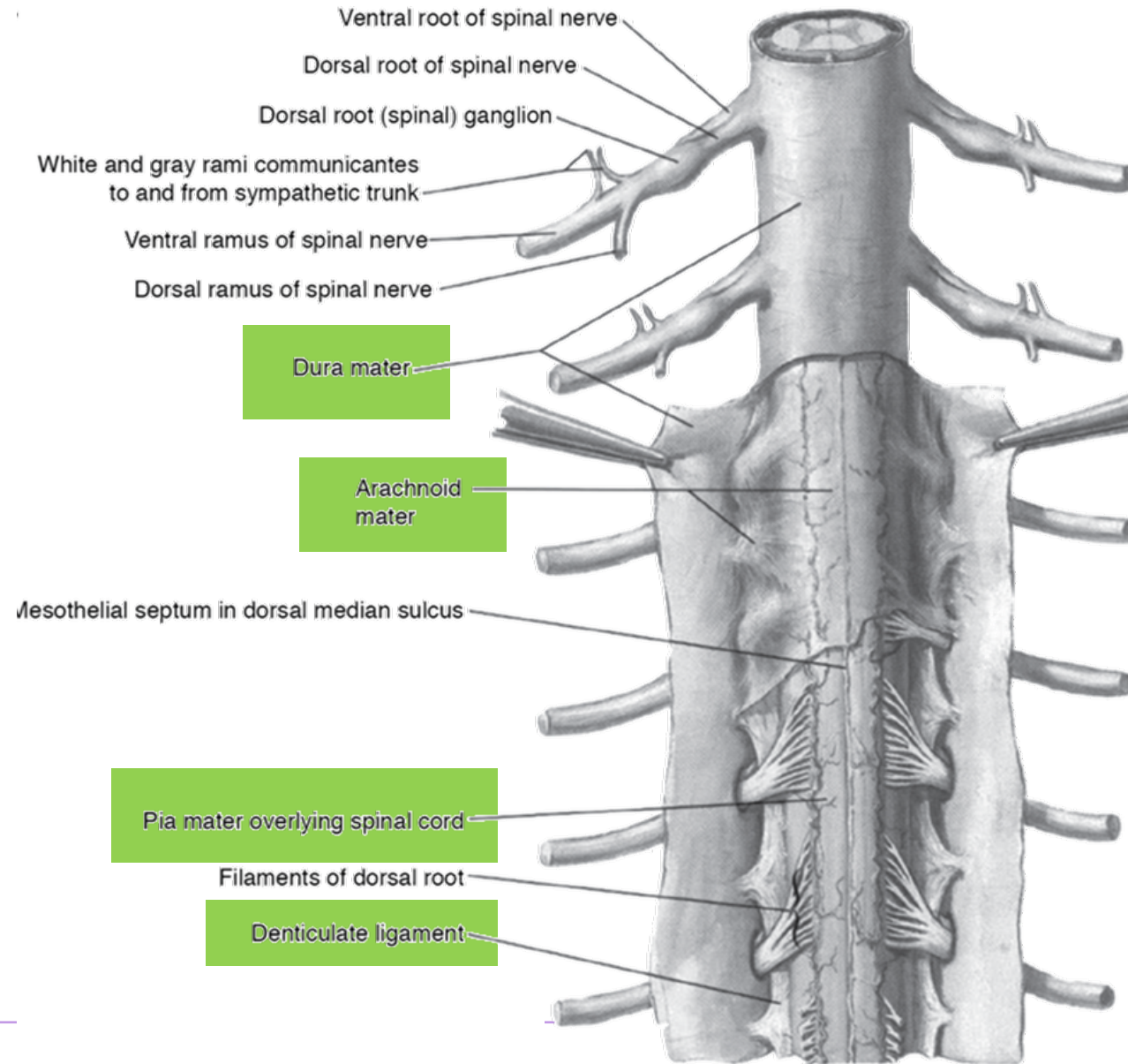


SPINAL CORD ENLARGEMENTS

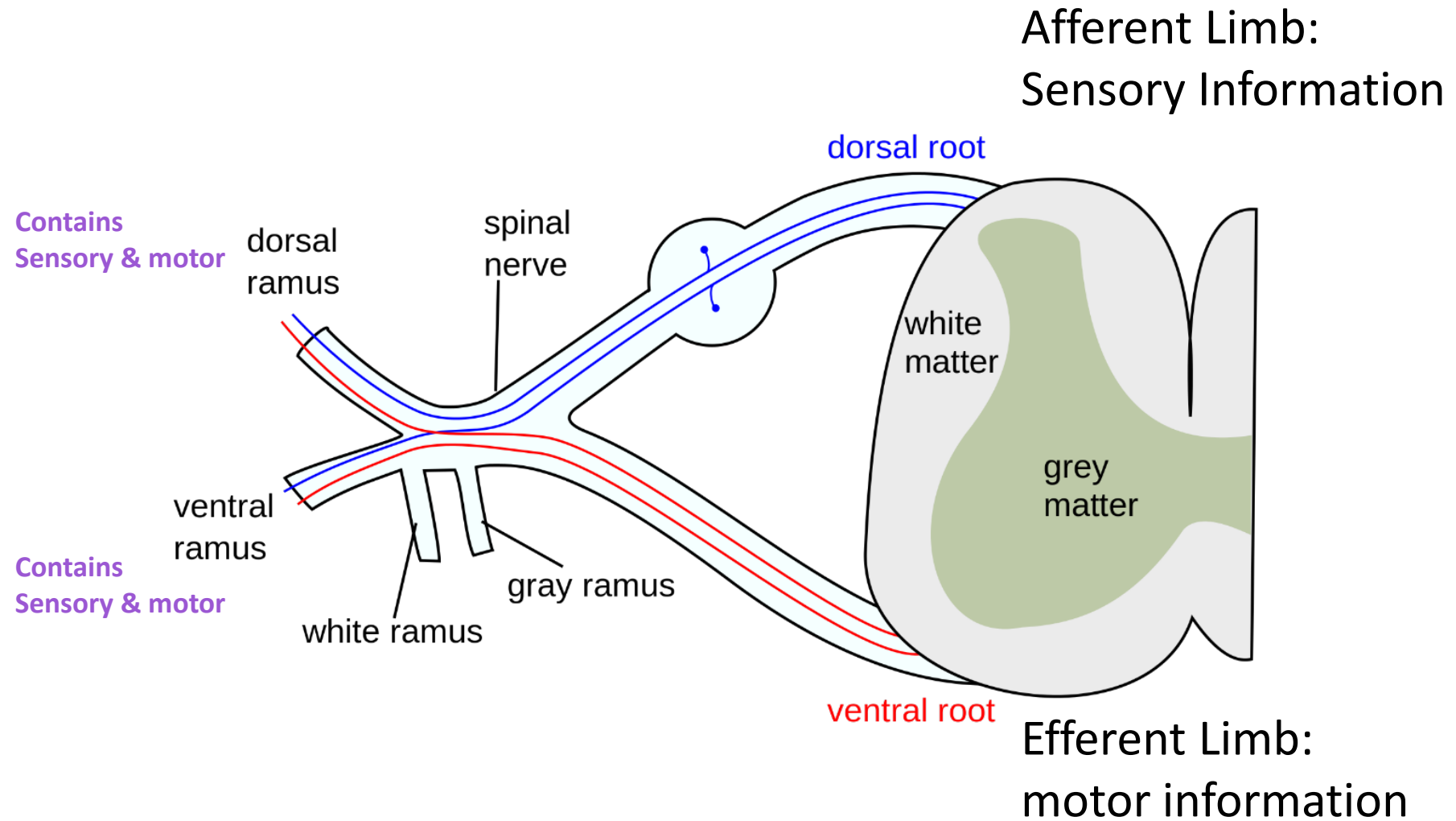
- Cervical Enlargement C5-T1- larger of the two
 - Innervates the brachial plexus/arms
- Lumbosacral Enlargement L1-S2
 - Innervates the lumbosacral plexus/legs

MENINGES

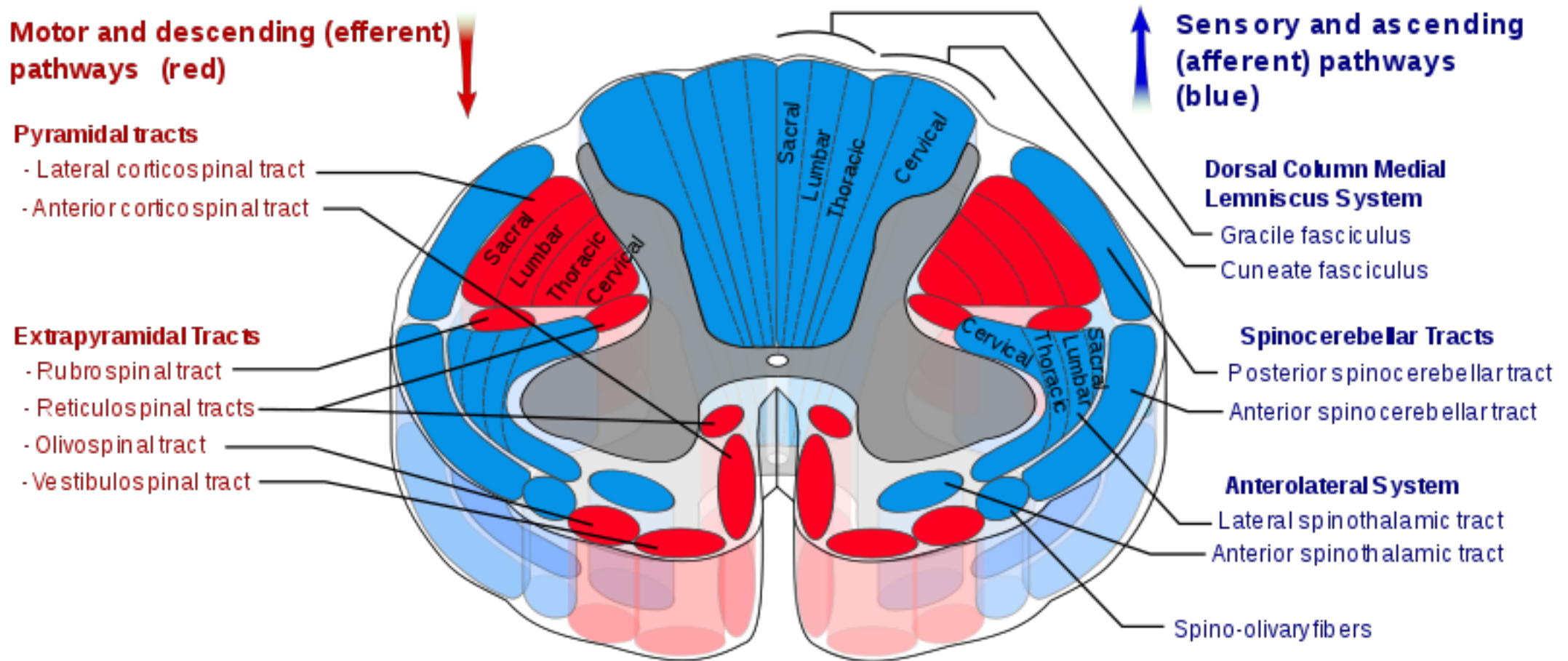
- Continuous with the brain
- Dura Mater
 - outer layer, ends at Coccyx
- Arachnoid Mater-
 - avascular, ends at 2nd sacral vertebra
- Pia Mater-
 - Direct contact with spinal cord
 - Covers nerve routes and vessels
 - Lateral extension create denticulate ligaments that connect between nerve routes to dura mater, protect from sudden displacement



SPINAL NERVE ORGANIZATION

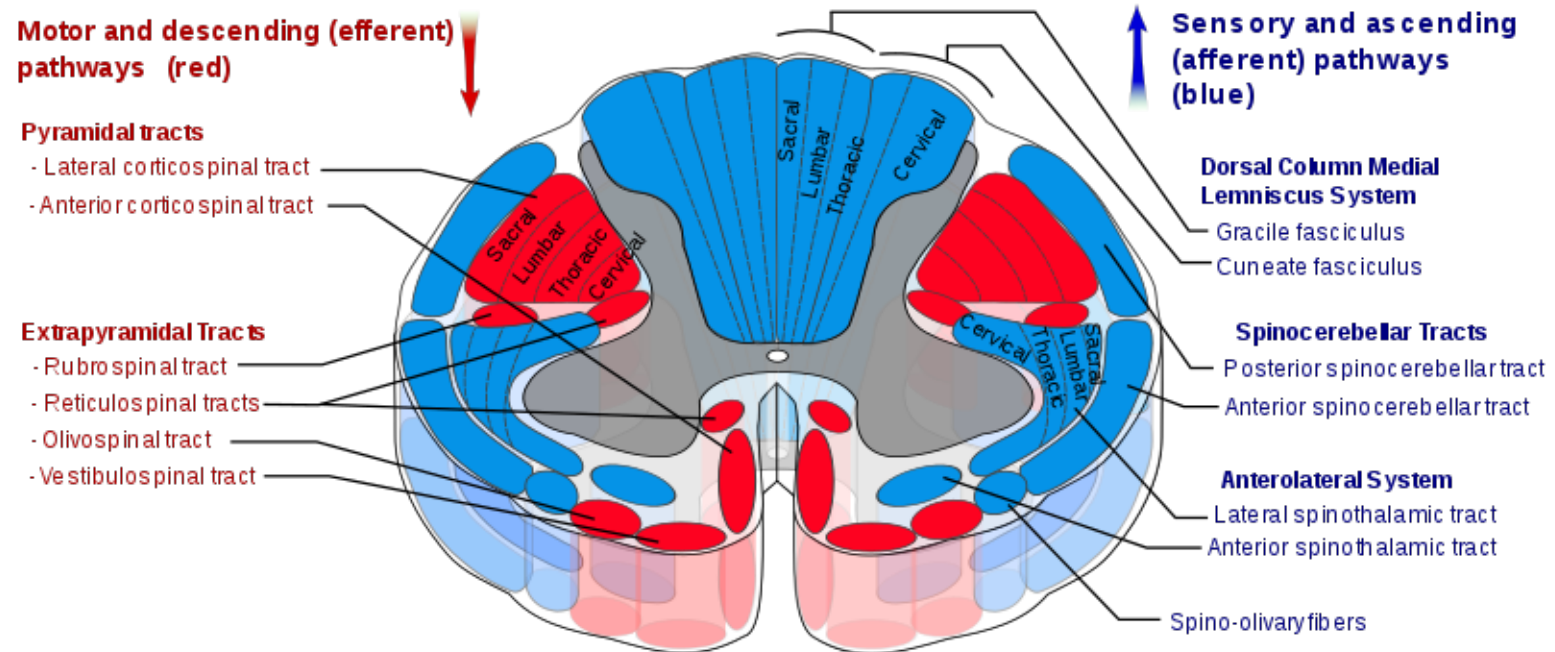


ORGANIZATION OF GRAY AND WHITE MATTER



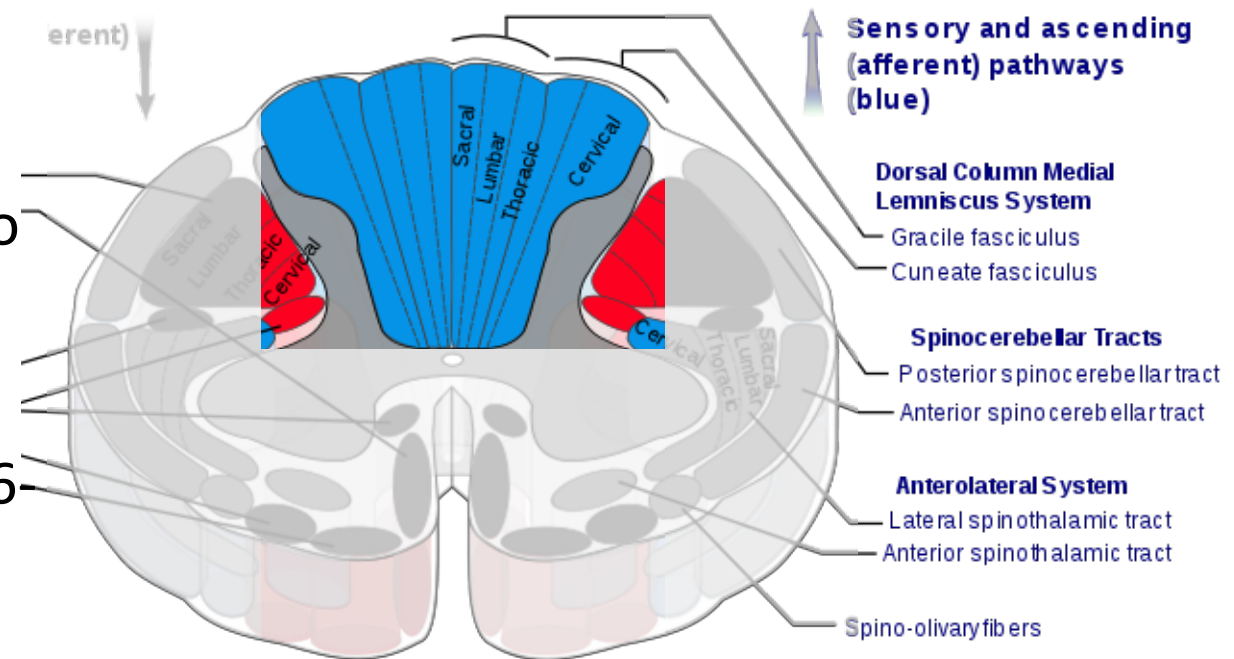
ORGANIZATION OF GRAY AND WHITE MATTER

- Gray Matter= central butterfly
- White Matter= peripheral tracts of myelinated axons
- Ventral/Anterior white commissure= decussation of several spinal tracts



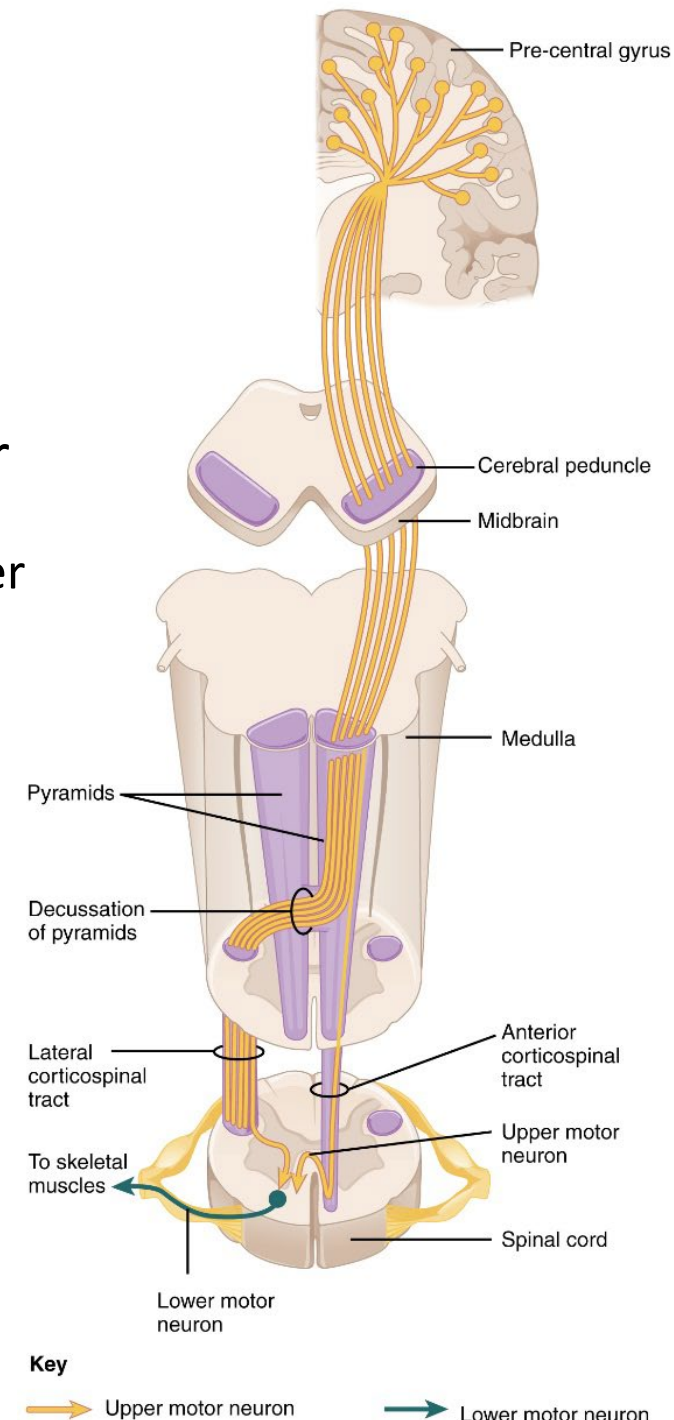
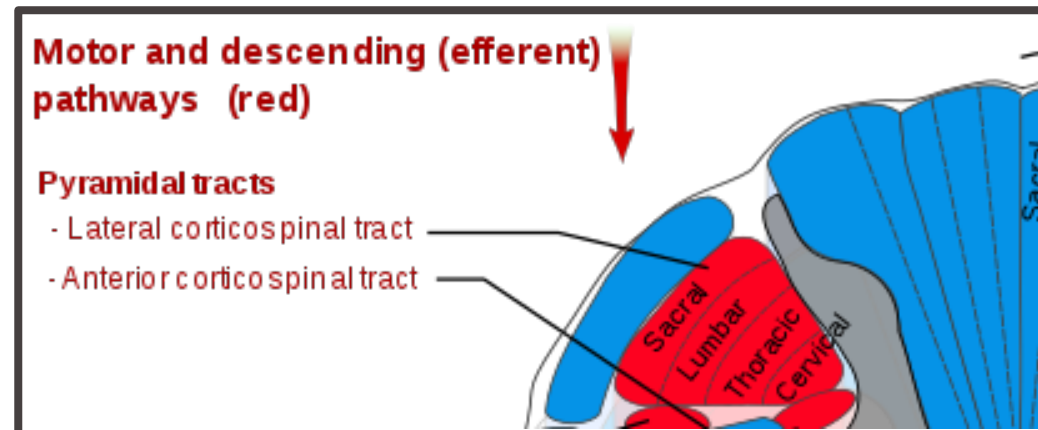
TRACTS OF POSTERIOR FUNICULUS ("DORSAL COLUMN")

- Proprioception/vibration/fine touch
- Fasciculus Gracilis
 - Sensory Info from lower body (to T6)
- Fasciculus Cuneatus
 - Sensory Info from upper body T6-C2

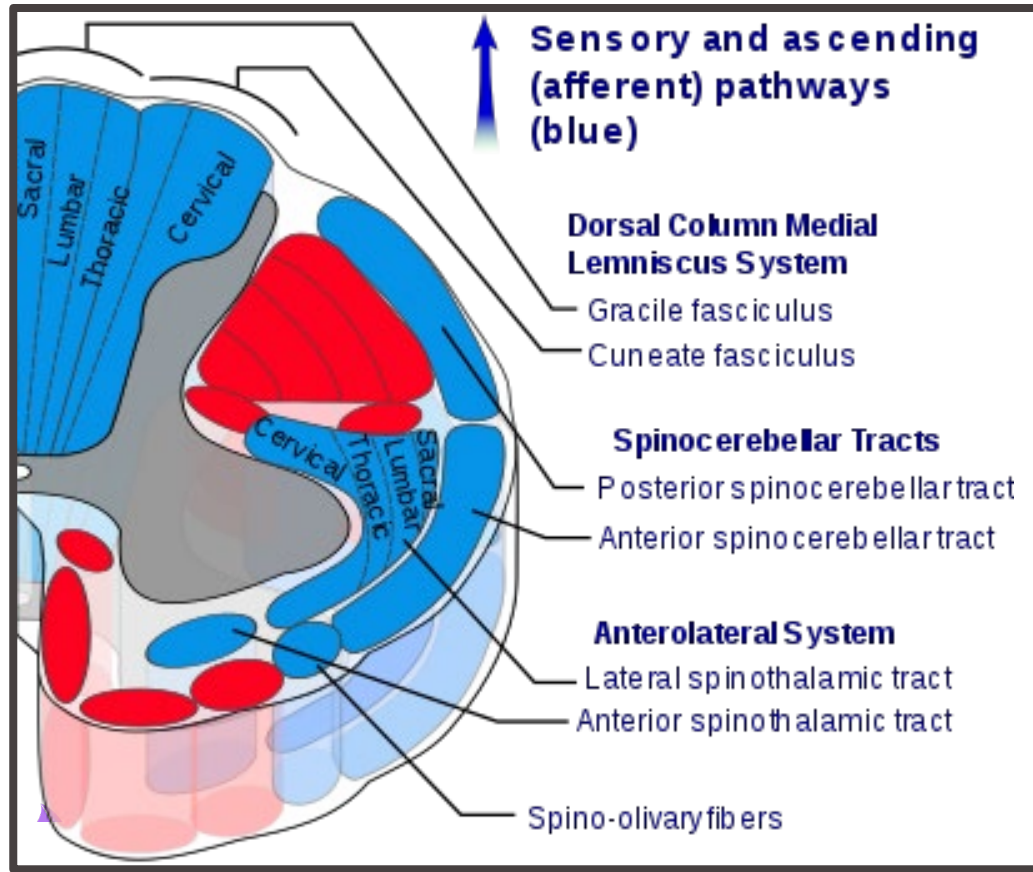


LATERAL CORTICOSPINAL TRACT ("PYRAMIDAL TRACT")

- Originates from contralateral cerebral cortex, crosses at Pyramidal decussation of caudal medulla, synapses at interneurons and lower motor neurons
 - (Undecussated fibers form anterior corticospinal tract, innervate neck/upper extremities)
- Controls voluntary motor activity
- Injury to this tract results in Upper Motor Neuron Syndrome
- Majority of these nerves end in cervical spine (55%), 20% thoracic, 25% lumbar



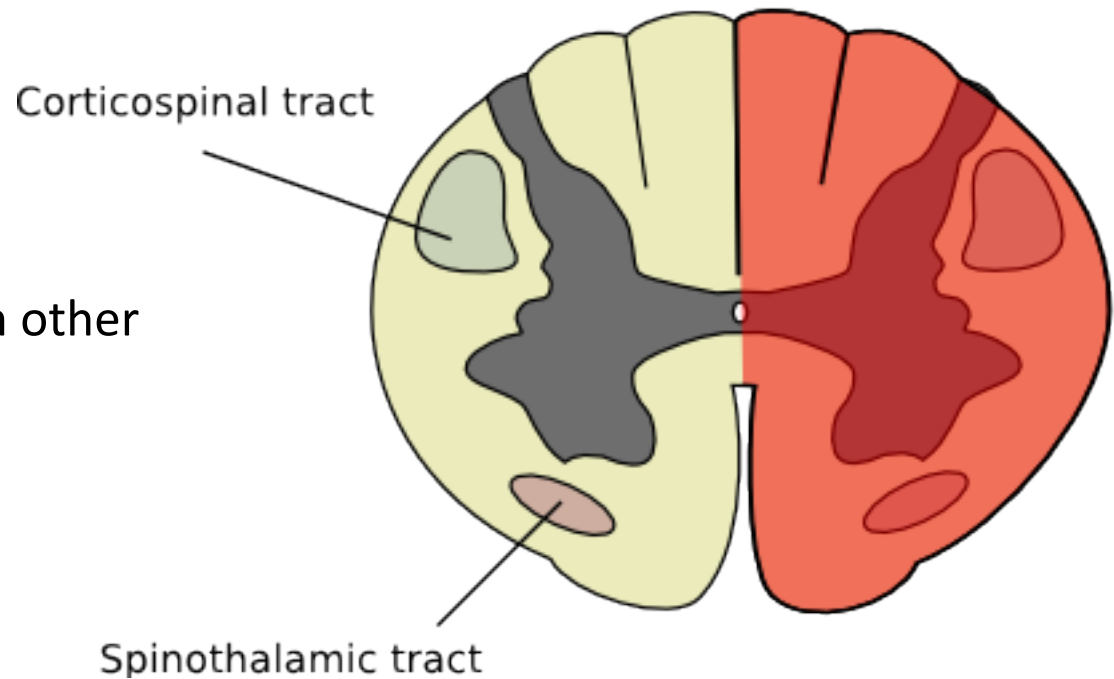
LATERAL SPINOTHALAMIC TRACT



- Originates peripherally from sensory nerves
- First order Neurons are in dorsal root ganglia- then ascends 1-2 segments.
- 2nd order neurons are in dorsal horn, axon crosses at AWC
- Synapse in the contralateral thalamus
- Provides pain and temperature sensation
- Injury at the AWC results in bilateral loss of pain and temperature

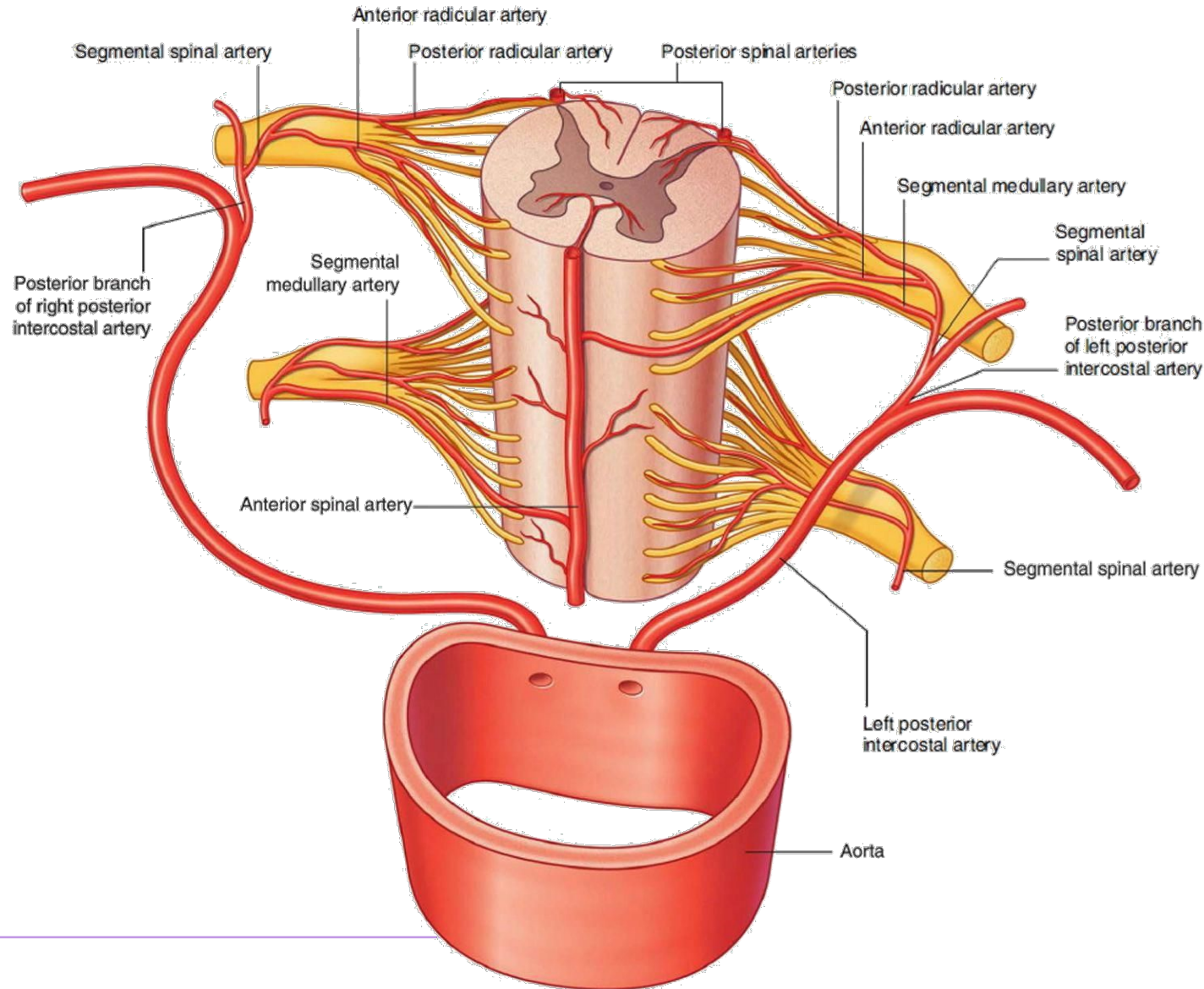
BROWN-SEQUARD SYNDROME

- Hemi-section of spinal cord
 - Ipsilateral loss of motor
 - Ipsilateral loss of proprioception/fine touch
 - Contralateral loss of pain/temp
 - Hanging deficits- 1-2 levels lower than other two



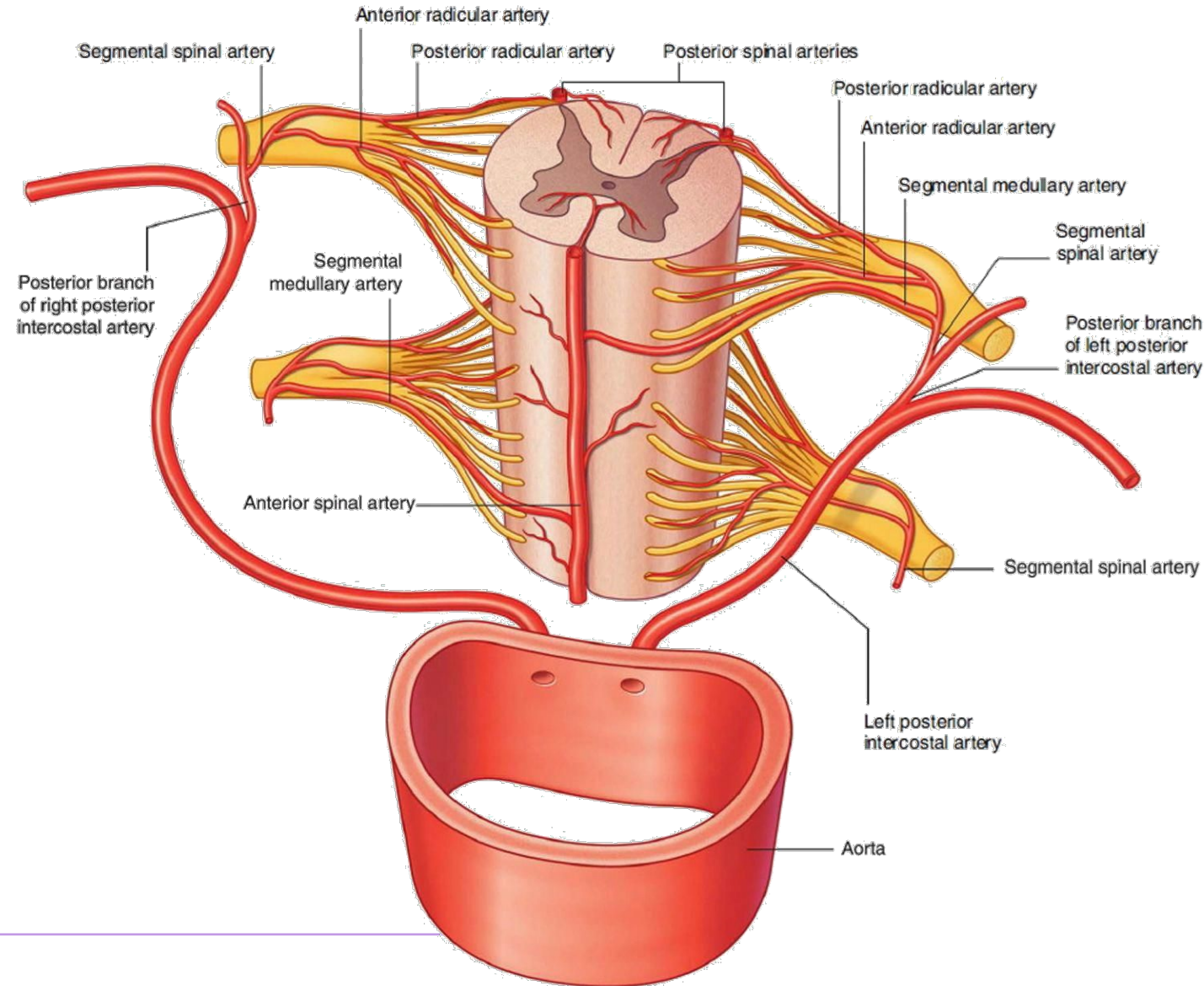
ANTERIOR SPINAL ARTERY

- Originates from Vertebral Artery
- Courses through anterior median fissure
- Receives anastomoses from anterior radicular arteries
 - Which come from segmental spinal arteries
- Artery of Adamkiewicz- Left L2 radicular artery
 - significant supplier at lumbosacral enlargement
 - #1 Watershed area of Spinal Cord with hypotension



POSTERIOR SPINAL ARTERIES

- Originate from posterior inferior cerebellar artery (PICA) in 75%, and vertebral artery in 25%
- Create a plexus of arteries on posterior surface of spinal cord
- Receive additional supplies from posterior radicular artery



ARTERIAL VASOCORONA

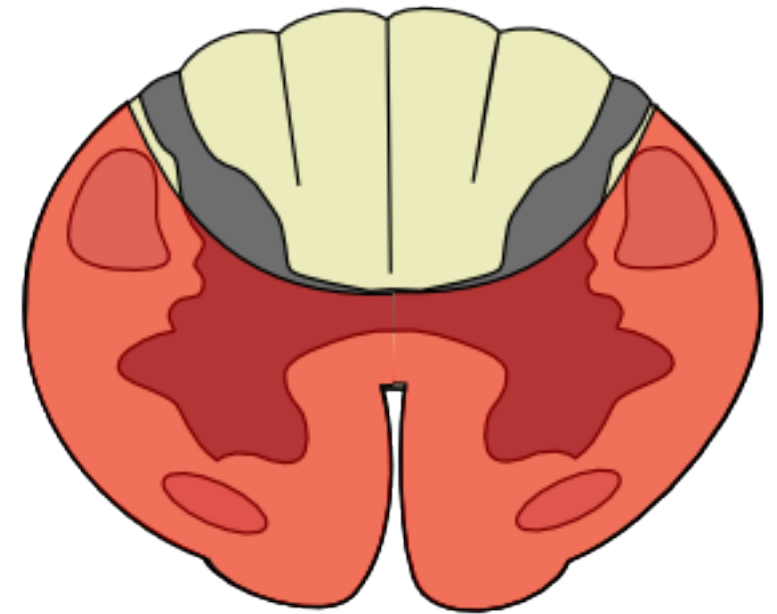
- Anastomotic connection between anterior and posterior spinal arteries, supplies lateral funiculi
- Anterior two-thirds supplied by Anterior Spinal Artery
- Posterior third supplied by Posterior Spinal Artery

OTHER VASCULAR SUPPLIES

- Subclavian Artery → Internal thoracic artery
- Axillary Artery → Lateral thoracic artery
 - Allows for clamping of aorta without necessarily stopping spinal cord perfusion
- Batson Plexus- venous plexus that allows pelvic and rectal cancers to spread to the spine

ANTERIOR CORD SYNDROME

- Caused by loss of blood flow to anterior spinal artery
- Affects anterior two thirds of spinal cord:
 - Corticospinal, spinothalamic
 - May also affect autonomics
- Proprioception/fine touch remain intact



CENTRAL CORD SYNDROME

- Arms affected more than legs (arms weaker than legs)
- Most often seen in older adults with spinal stenosis, hyperextension injuries
- *Not* due to somatotopic position of arms vs legs
- Mostly affects white matter (not central gray matter), and more white matter corticospinal tracts supply upper extremity function, not LE function

THANK YOU!

Q & A

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QUESTION

- Which of the following is **not** characteristic of Brown-Sequard Syndrome?
 - 1) Ipsilateral loss of motor
 - 2) Ipsilateral loss of proprioception/fine touch
 - 3) Contralateral loss of pain/temp
 - 4) Hanging deficit where motor loss is 1-2 levels below sensory loss