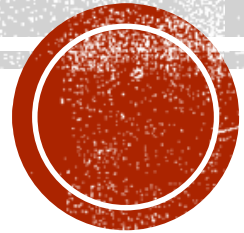
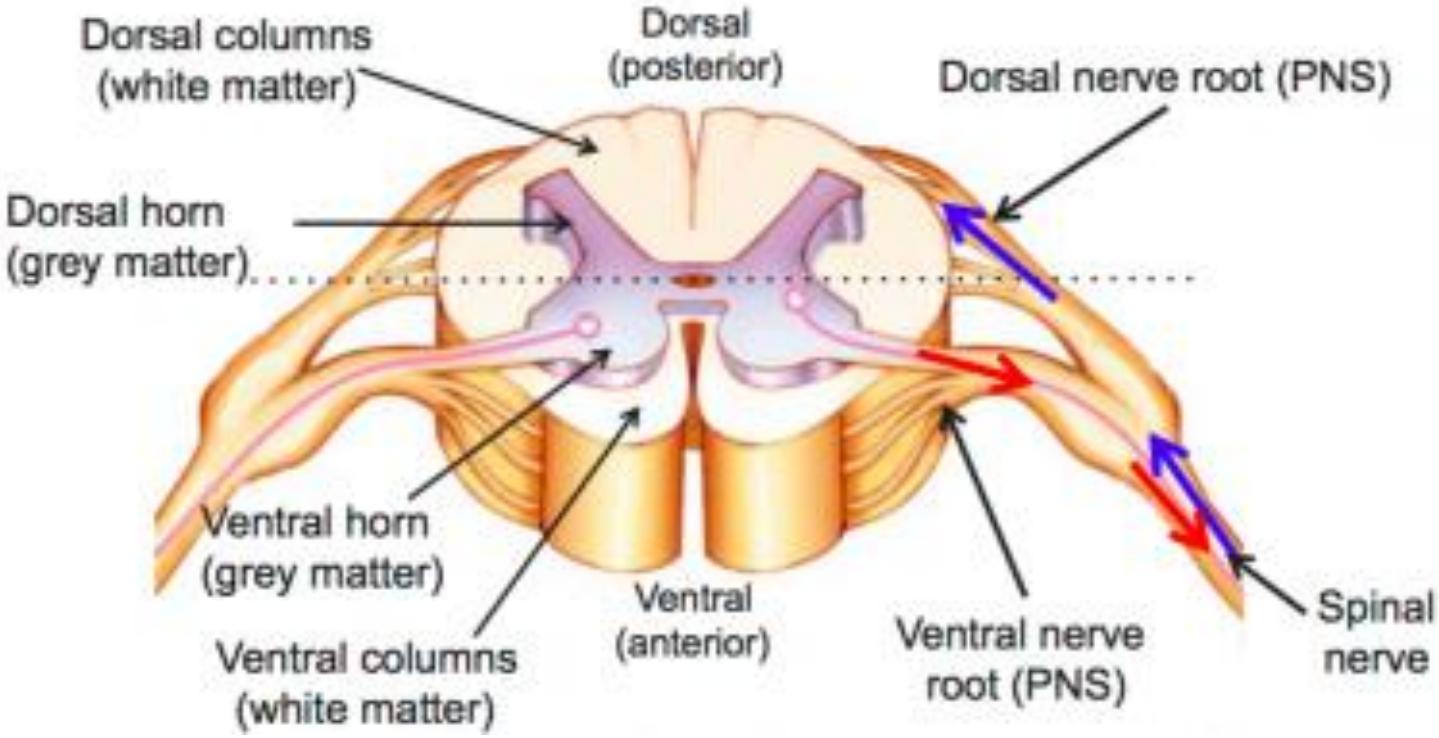
TRACTS OF SPINAL CORD

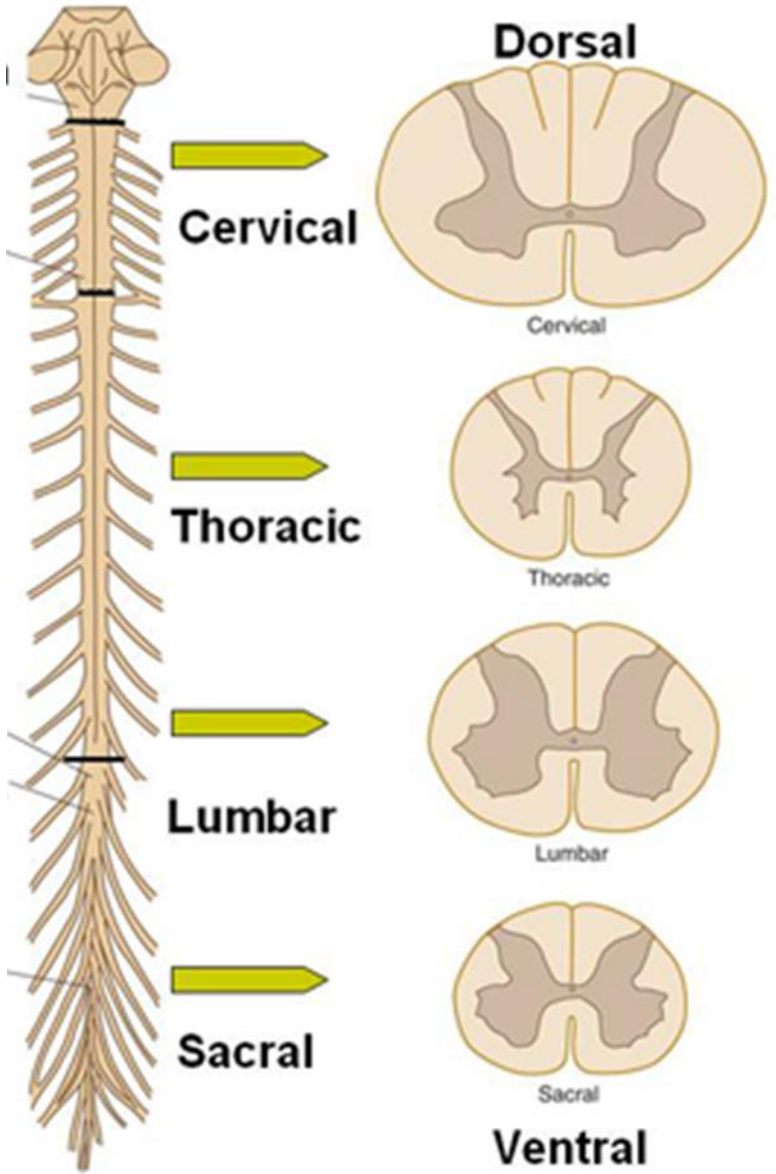


LEARNING OBJECTIVES

- White Matter- classification
- Tracts
  - Ascending Tracts
  - Descending Tracts
- Clinical Correlates

SECTION OF SPINAL CORD

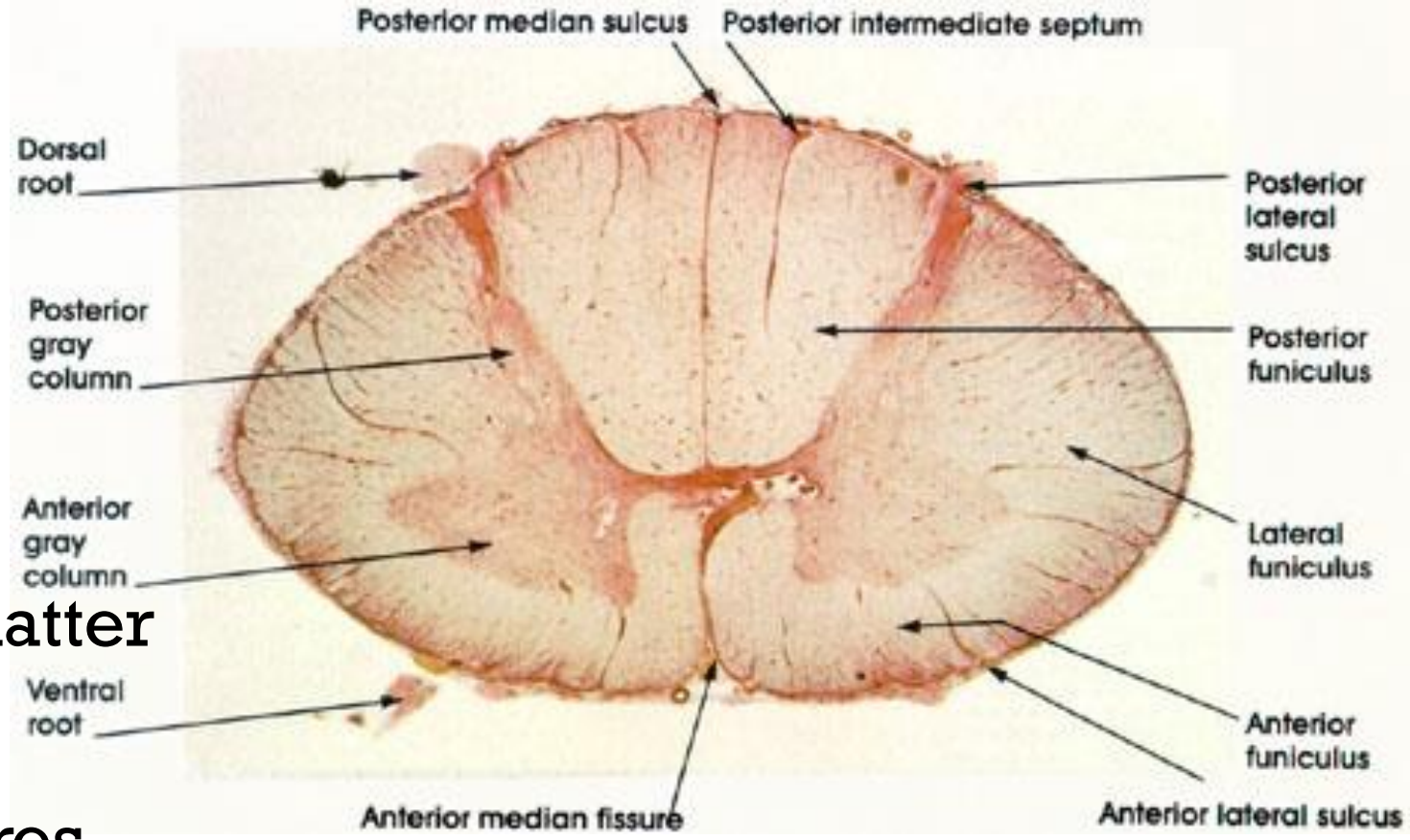




WHITE MATTER OF THE SPINAL CORD

Mixture of:

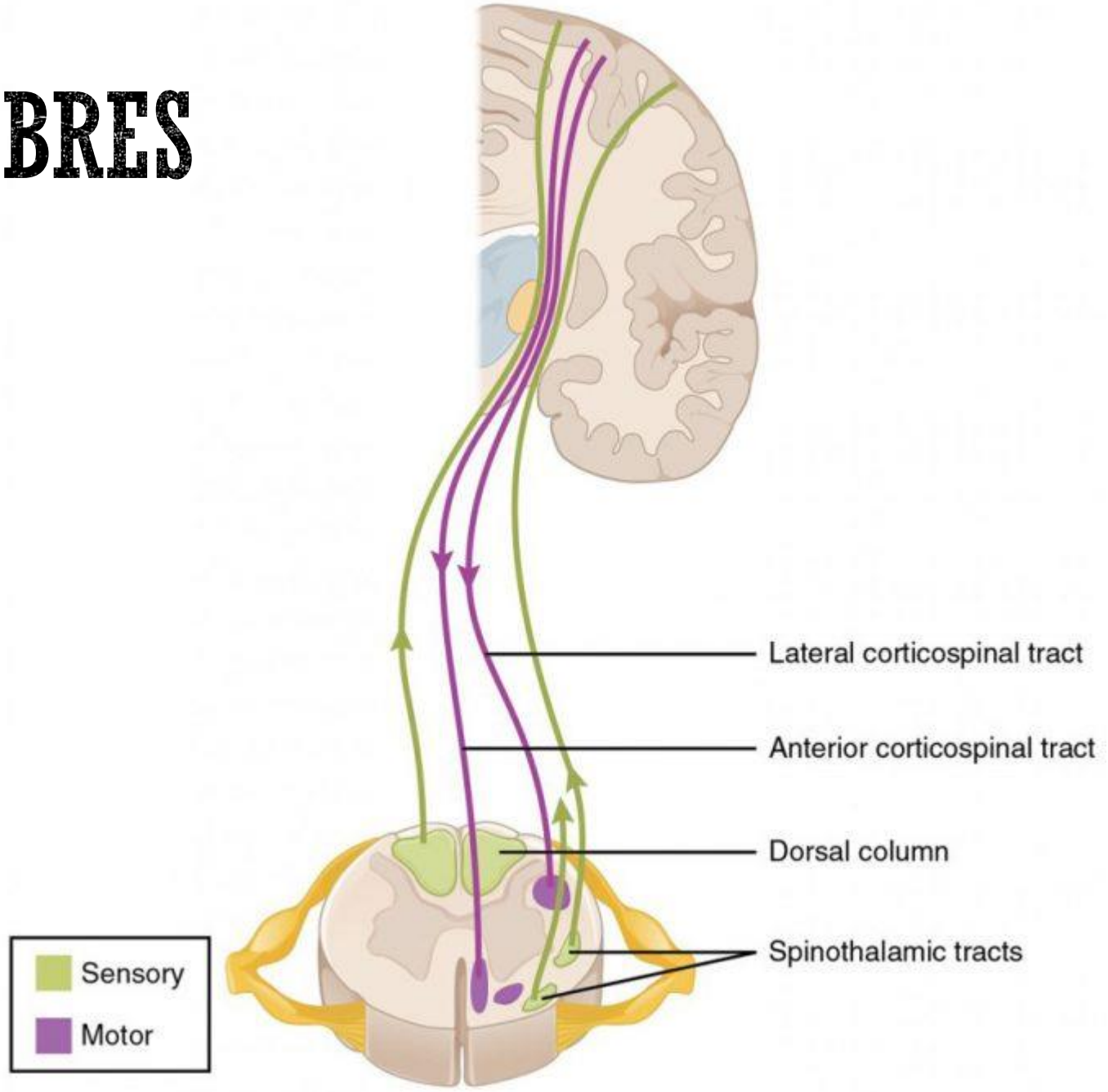
1. Nerve fibers,
2. Neuroglia,
3. Blood vessels.



- surrounds the grey matter
- white colour
- myelinated nerve fibres.

TYPES OF FIBRES

- Sensory
- Motor
- Association



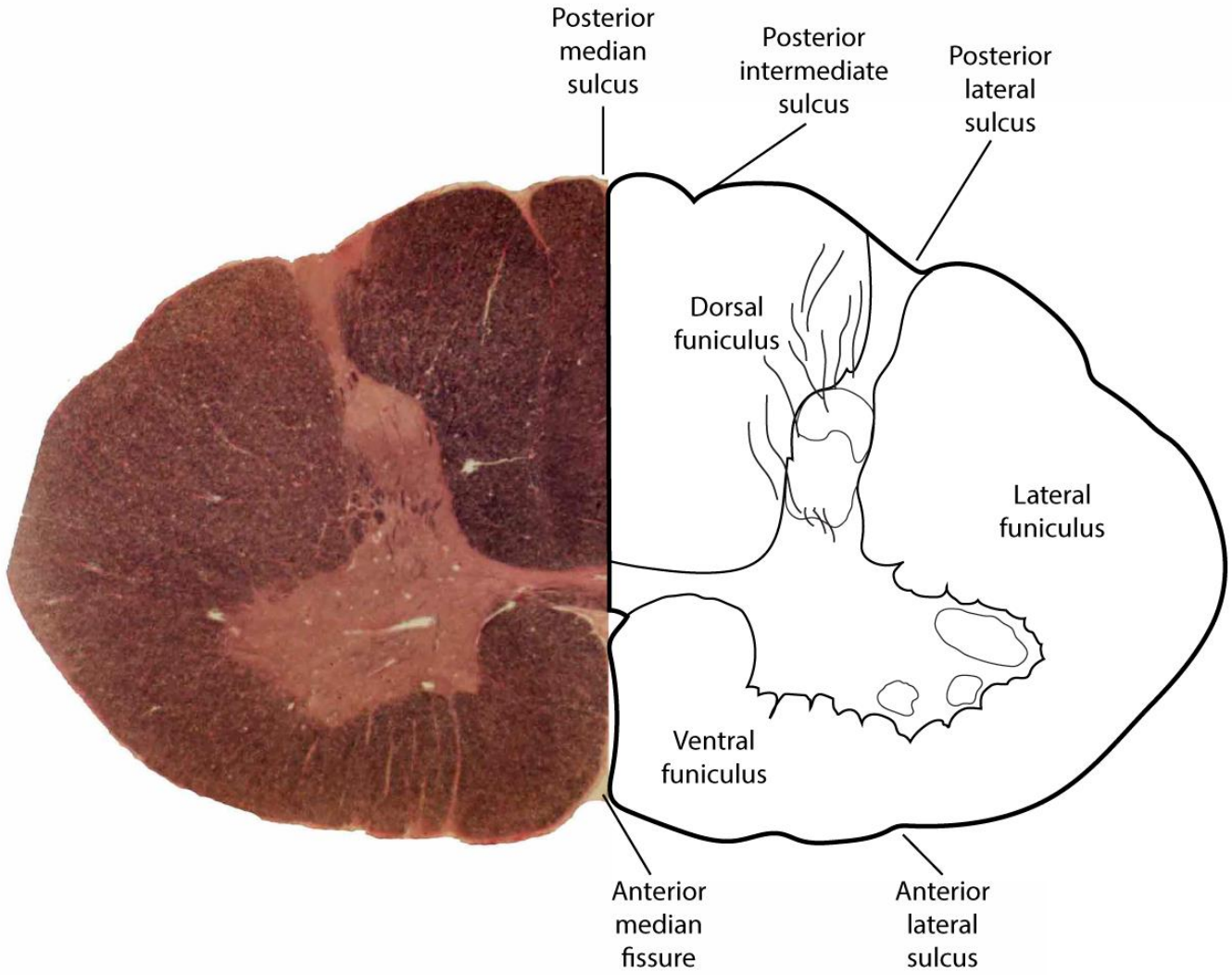
DIVISIONS IN WHITE MATTER

Anterior white column (or funiculus)

Lateral white column (or funiculi)

Posterior white column (or funiculus)

Anterior white commissure.



TRACTS

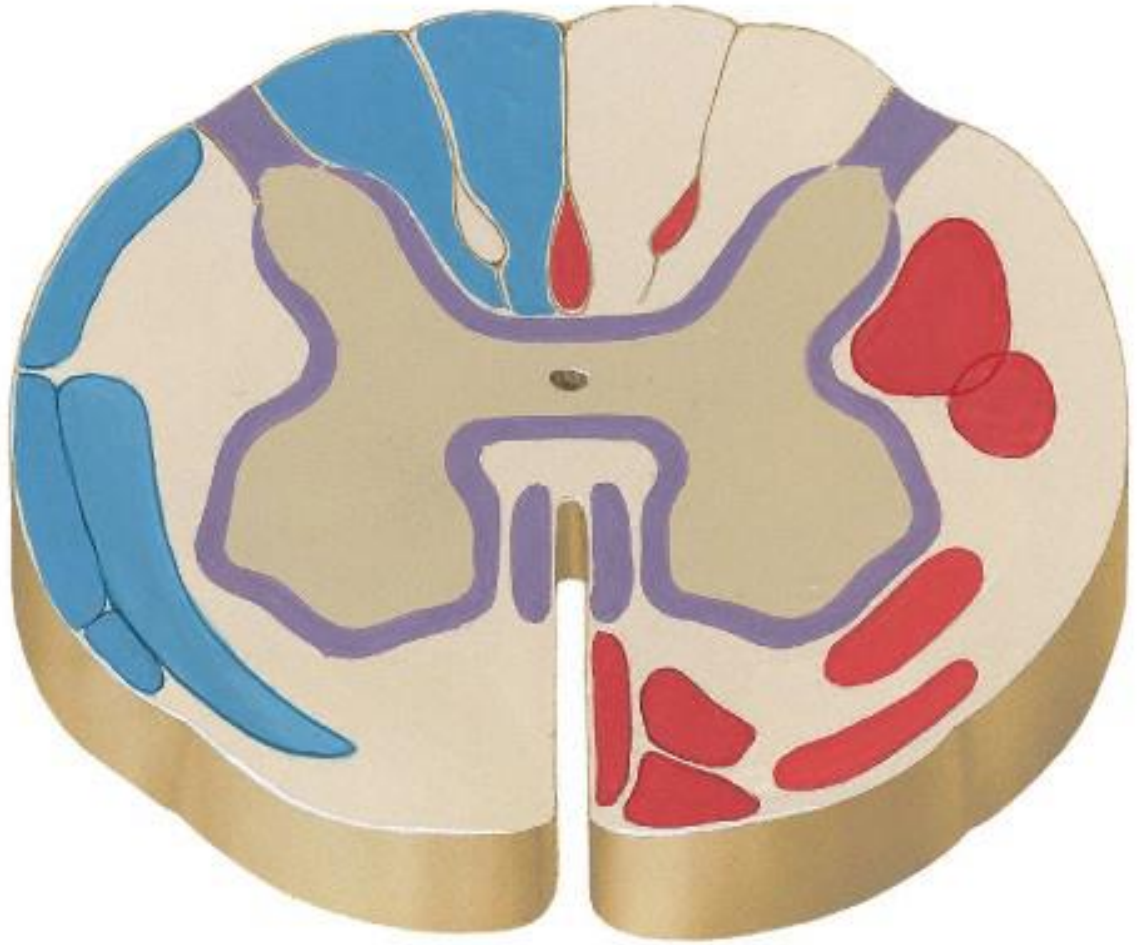
Collection of nerve fibres

with same

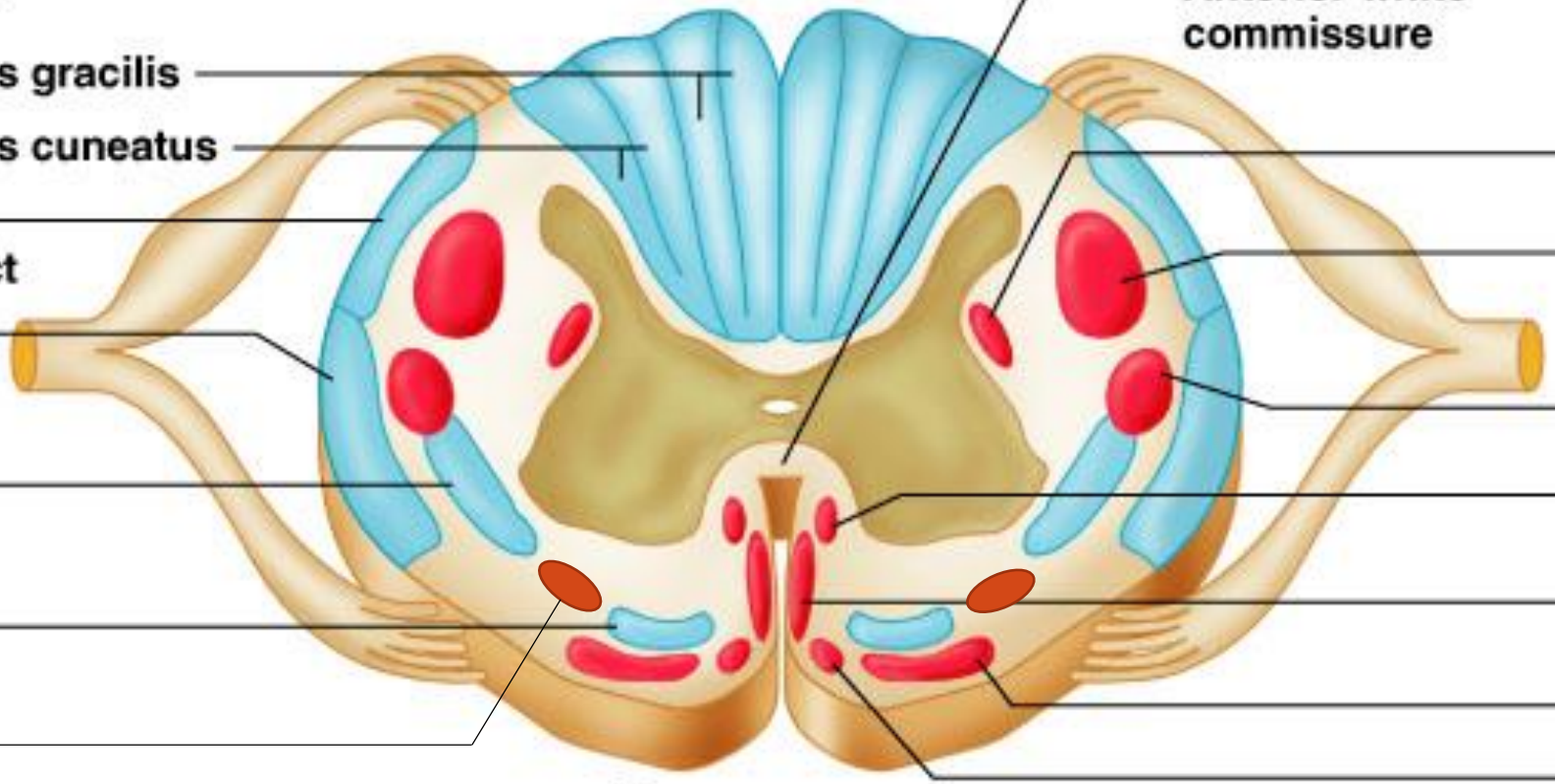
Origin,

Course,

Termination



TRACTS OF SPINAL CORD



Ascending tracts

- Dorsal white column
  - Fasciculus gracilis
  - Fasciculus cuneatus
- Posterior spinocerebellar tract
- Anterior spinocerebellar tract
- Lateral spinothalamic tract
- Anterior spinothalamic tract
- Spinotectal tract
- Spinoreticular tract
- Spino-olivary tract

Descending tracts

- Anterior white commissure
- Lateral reticulospinal tract
- Lateral corticospinal tract
- Rubrospinal tract
- Medial reticulospinal tract
- Anterior corticospinal tract
- Vestibulospinal tract
- Tectospinal tract
- Descending autonomic tract

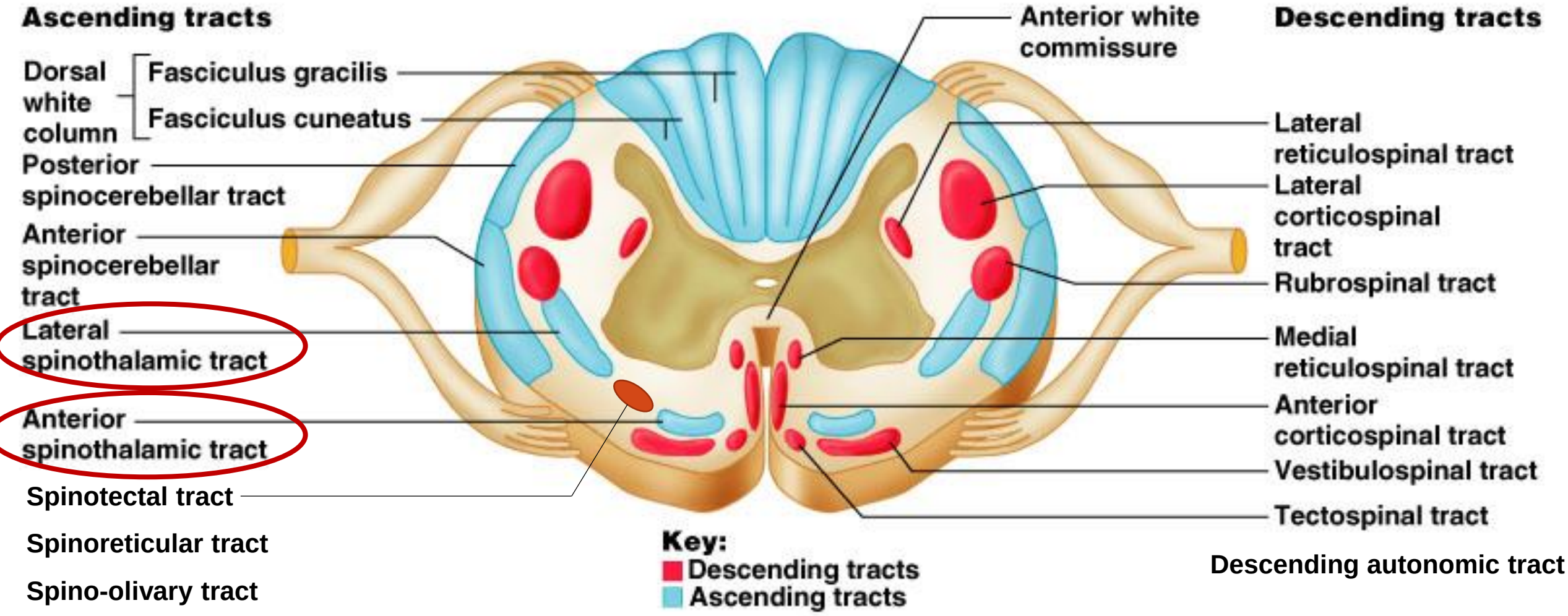
Key:
- Descending tracts
- Ascending tracts

ASCENDING TRACTS

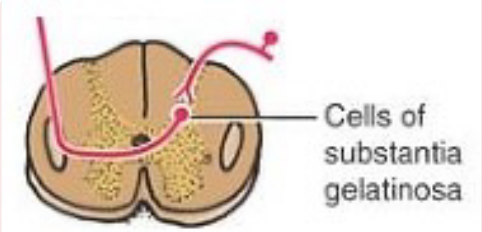
ASCENDING TRACTS

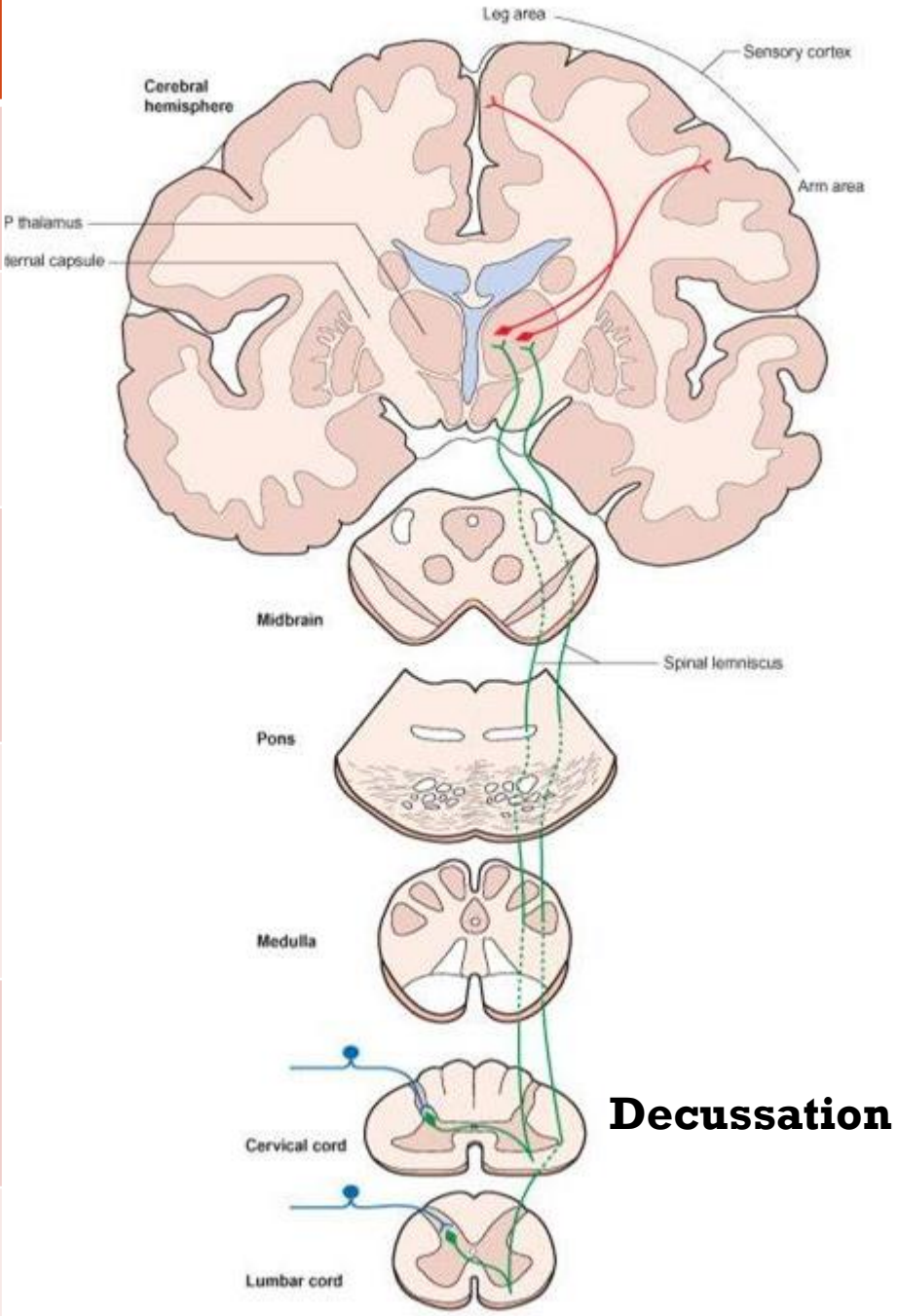
Lateral Spinothalamic Tract	Pain, Thermal sensation
Anterior Spinothalamic Tract	Crude (Light) touch, (non-discriminative touch) Pressure Tickle, Itch
Dorsal Column **Fasciculus gracilis** **Fasciculus cuneatus**	Fine touch (discriminative touch) Two point discrimination Vibration Conscious Proprioception
Anterior Spinocerebellar Tract	Unconscious Proprioception Gross movements
Posterior Spinocerebellar Tract	Unconscious Proprioception Fine movements

TRACTS OF SPINAL CORD



Lateral spinothalamic tract

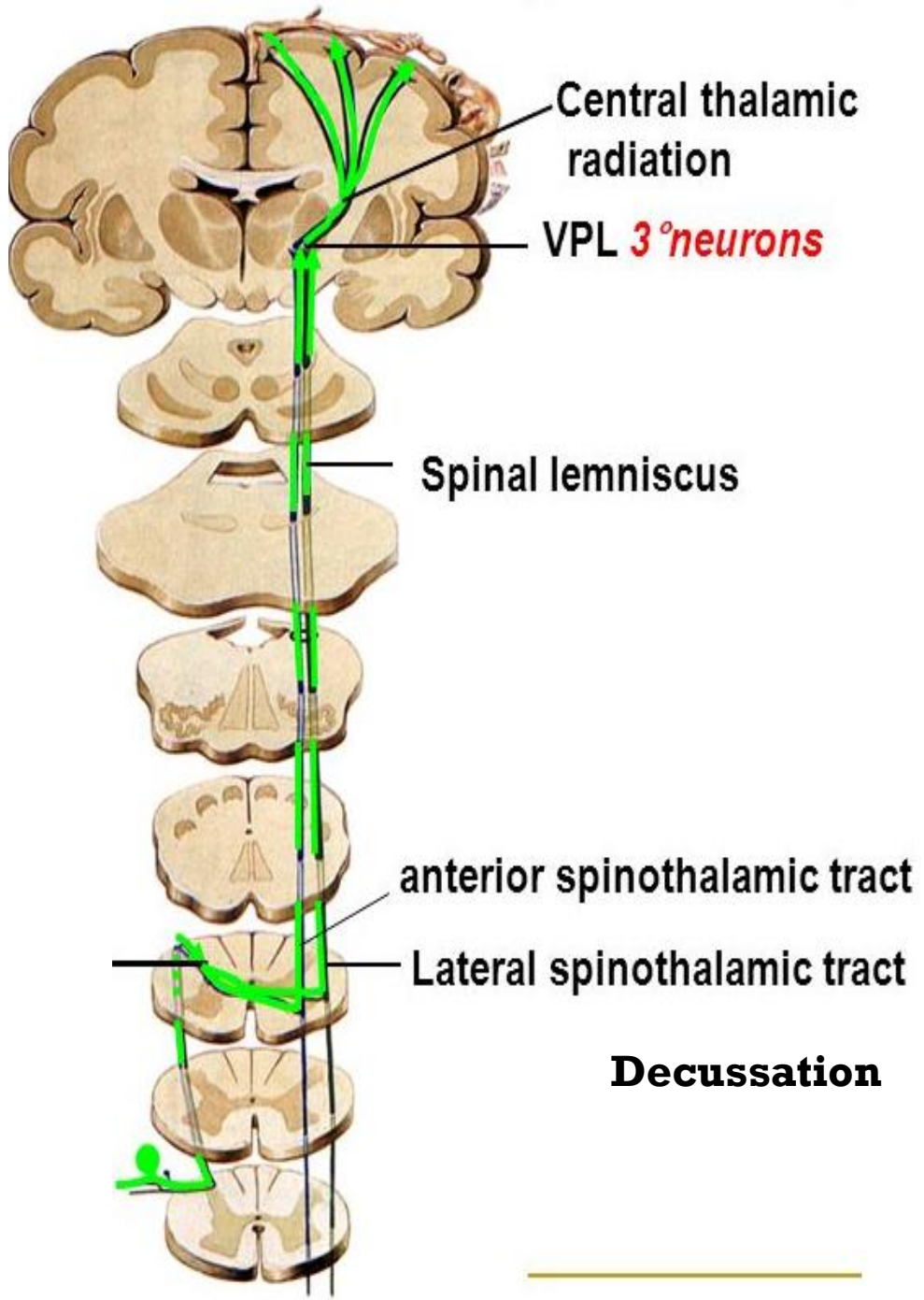
Destination	Posterior central gyrus
3rd Order Neuron	Ventral posterolateral nucleus of Thalamus
Pathways	Lateral spinothalamic, Spinal lemniscus? Spinotectal
2nd Order Neuron	? Substantia gelatinosa/ Rexed III-VII 
1st Order Neuron	Posterior root ganglion
Receptor	Free nerve endings



Decussation

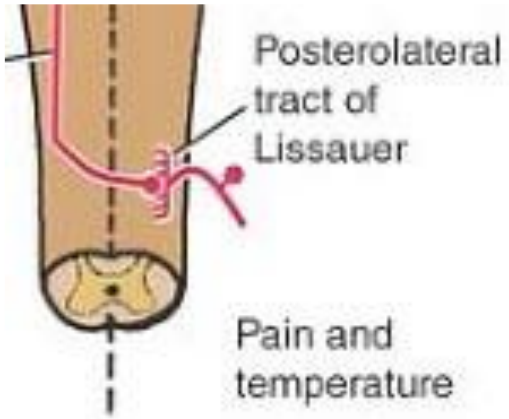
Anterior spinothalamic tract

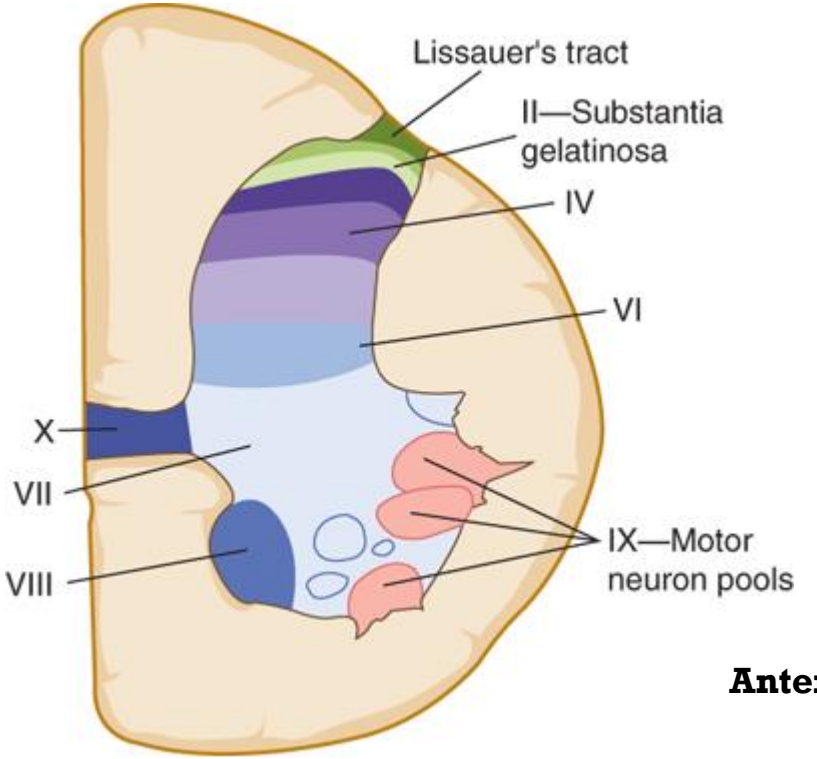
Destination	Posterior central gyrus
3rd Order Neuron	Ventral posterolateral nucleus of Thalamus
Pathways	Anterior spinothalamic, Medial lemniscus
2nd Order Neuron	? Substantia gelatinosa/ Rexed III-VII
1st Order Neuron	Posterior root ganglion
Receptors	Pacinian Corpuscle

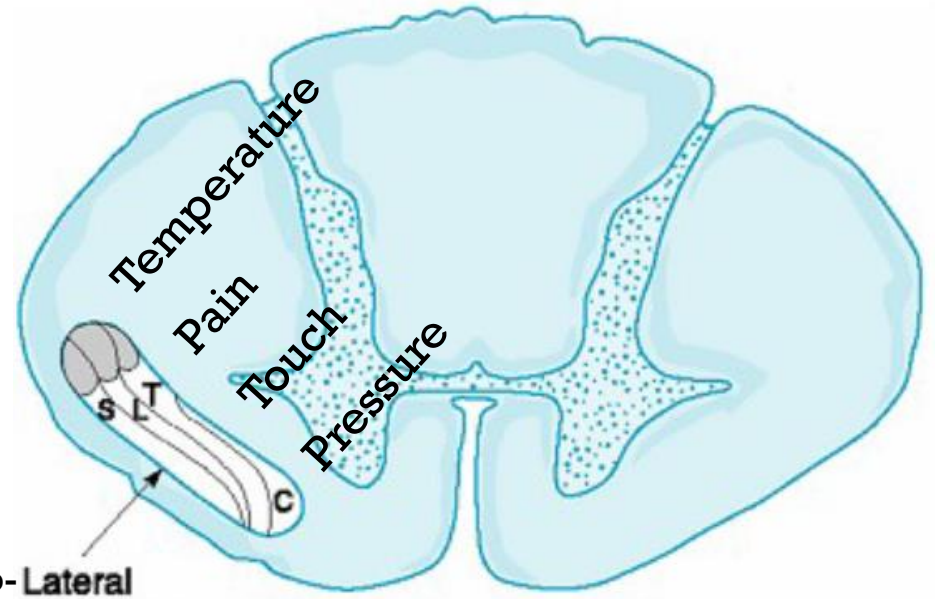


Posterolateral tract of Lissauer

1st order neuron enters posterior horn & divides into ascending and descending branches that travel for 1-2 segments, then terminate synapsing with 2nd order neurons in substantia gelatinosa.

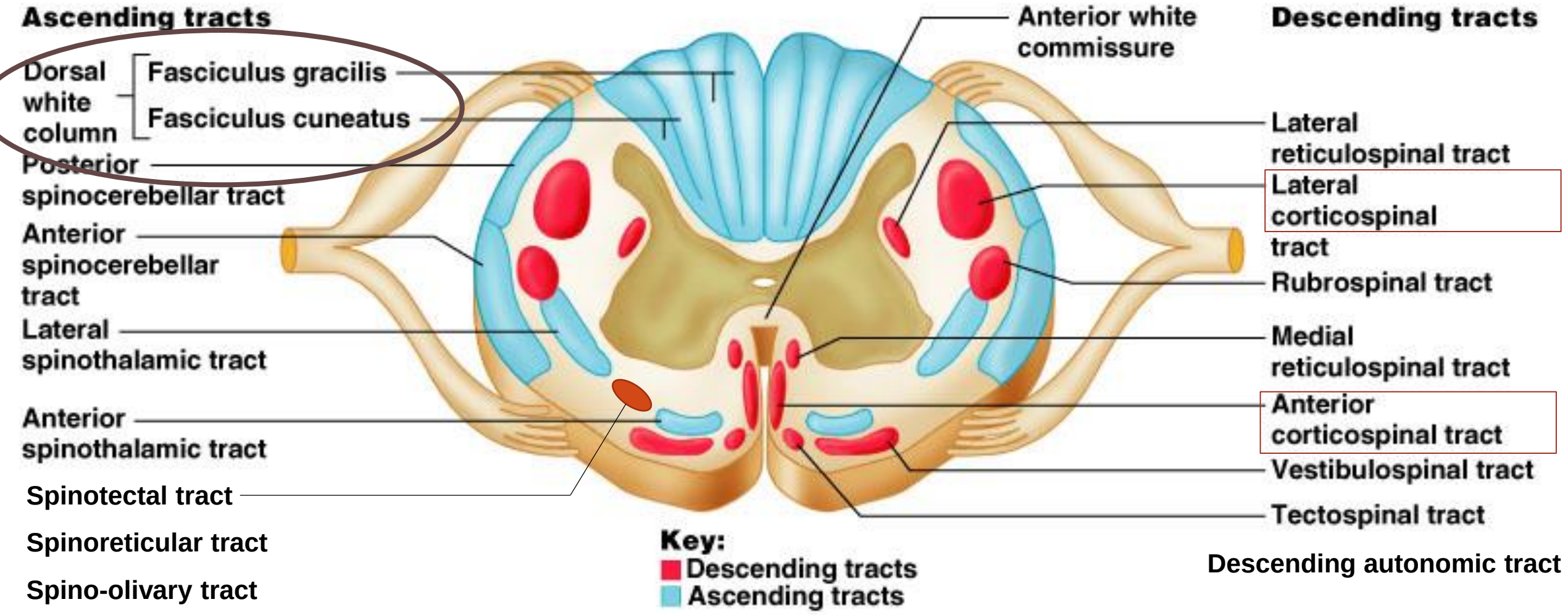






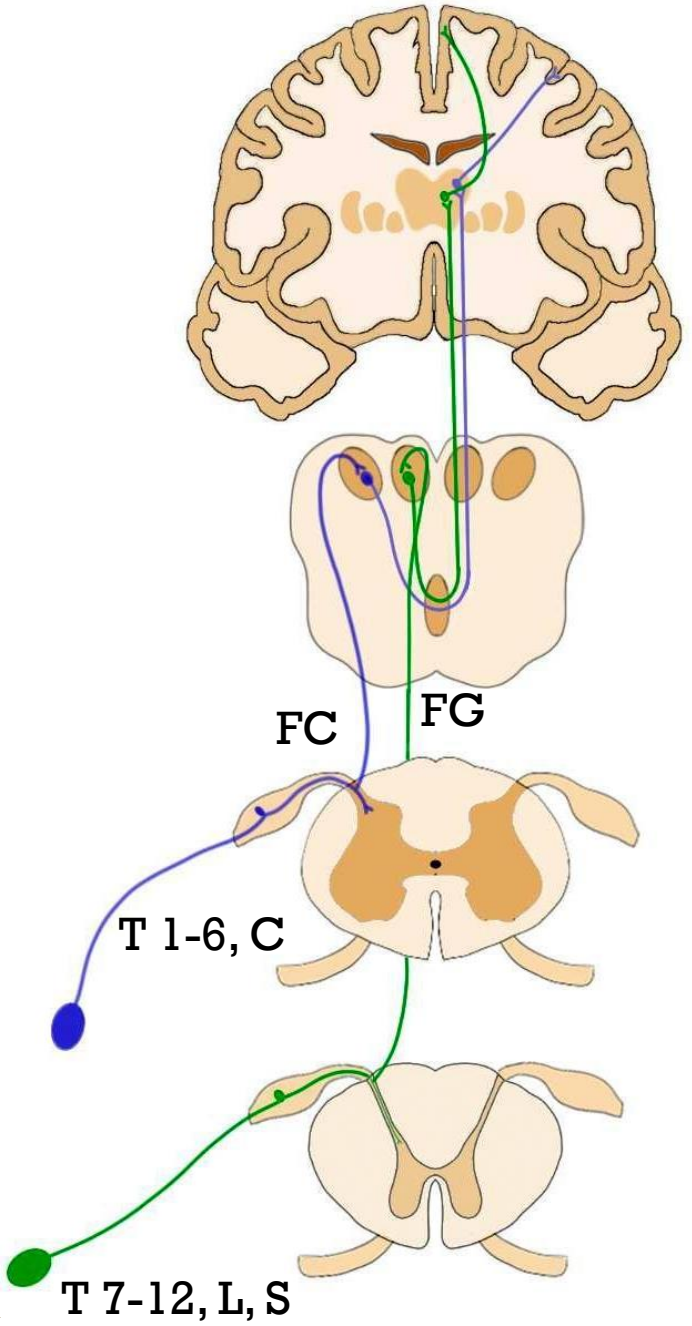
Antero-Lateral spinothalamic tract

TRACTS OF SPINAL CORD

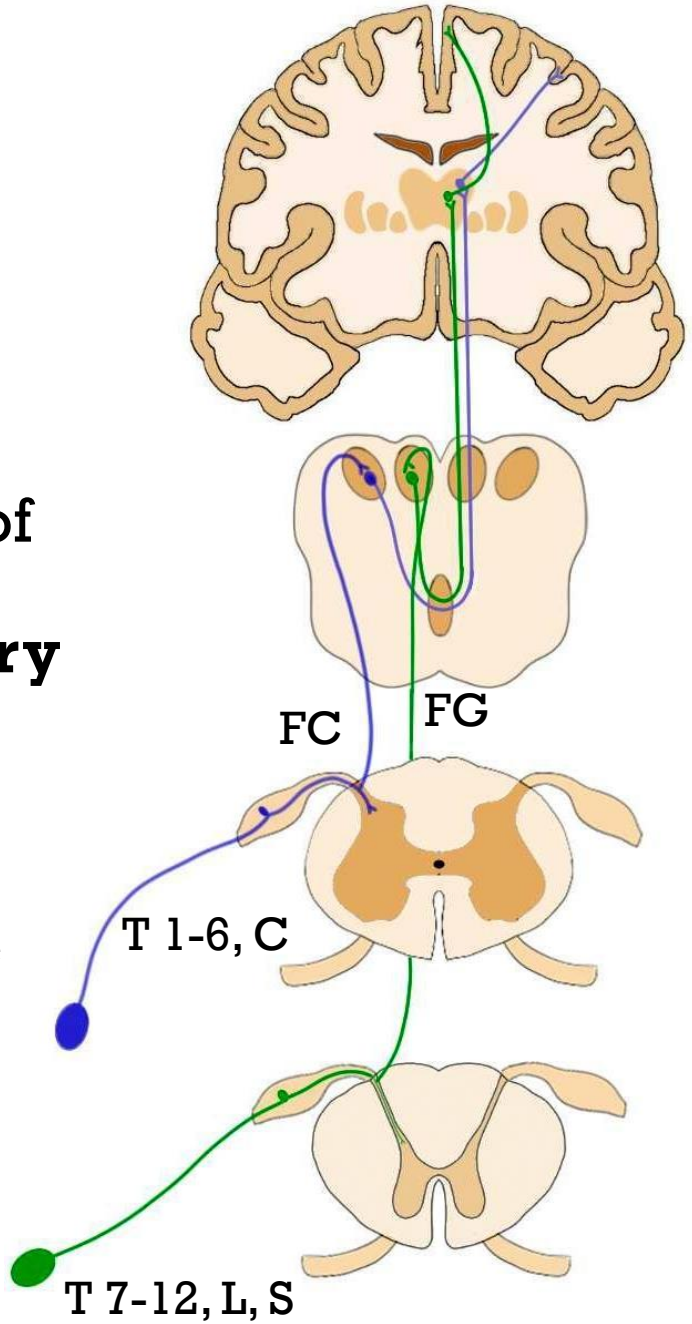


Dorsal Column

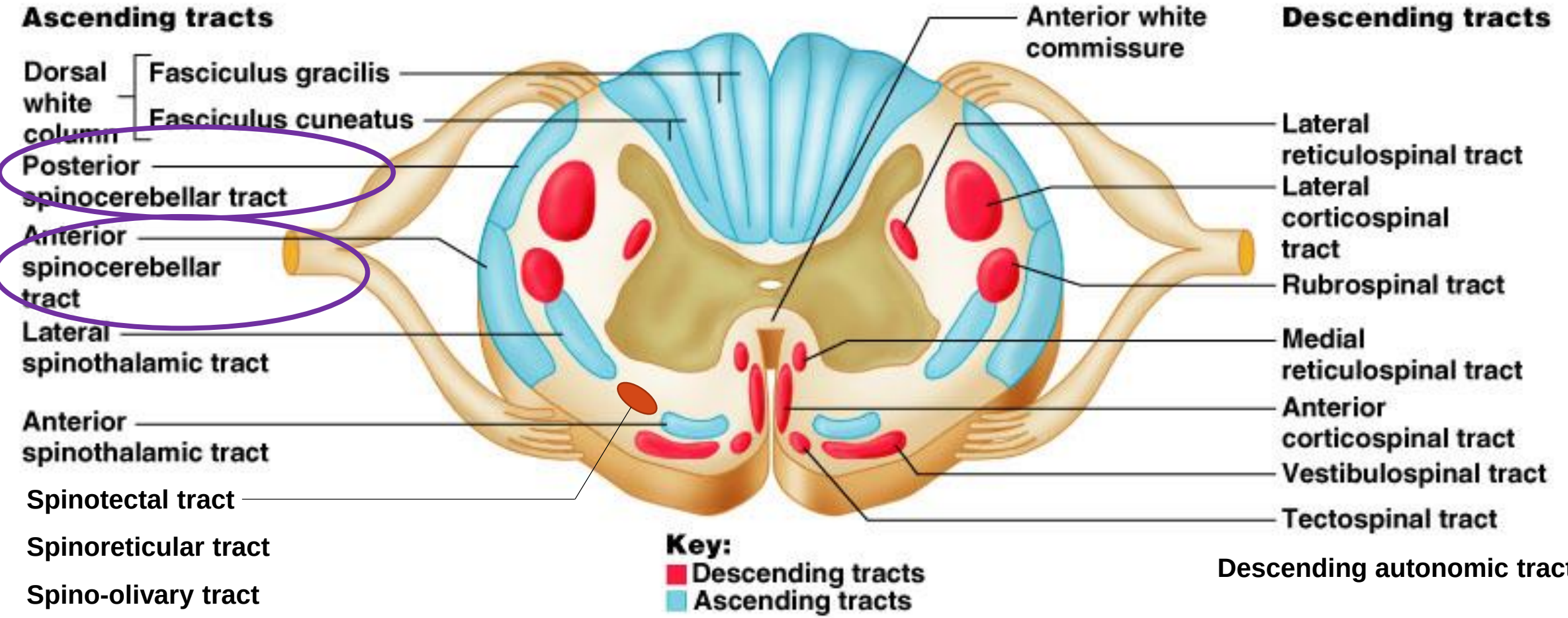
Destination	Posterior central gyrus
3rd Order Neuron	Ventral posterolateral nucleus of Thalamus
2nd Order Neuron	Nuclei gracilis and cuneatus in medulla oblagata Few IV-VI
Pathways	Ipsilateral Fasciculi gracilis & cuneatus Medial lemniscus
1st Order Neuron	Posterior root ganglion
Receptors	Meissner's corpuscles, Pacinian corpuscles, muscle spindles & tendon organs



- Axons of the second-order neurons
- Called Internal arcuate fibres cross the median plane.
- Decussate with the corresponding fibres of the opposite side in the medulla as **sensory Decussation**
- Fibres ascend as a single compact bundle called **medial lemniscus** through the brainstem.



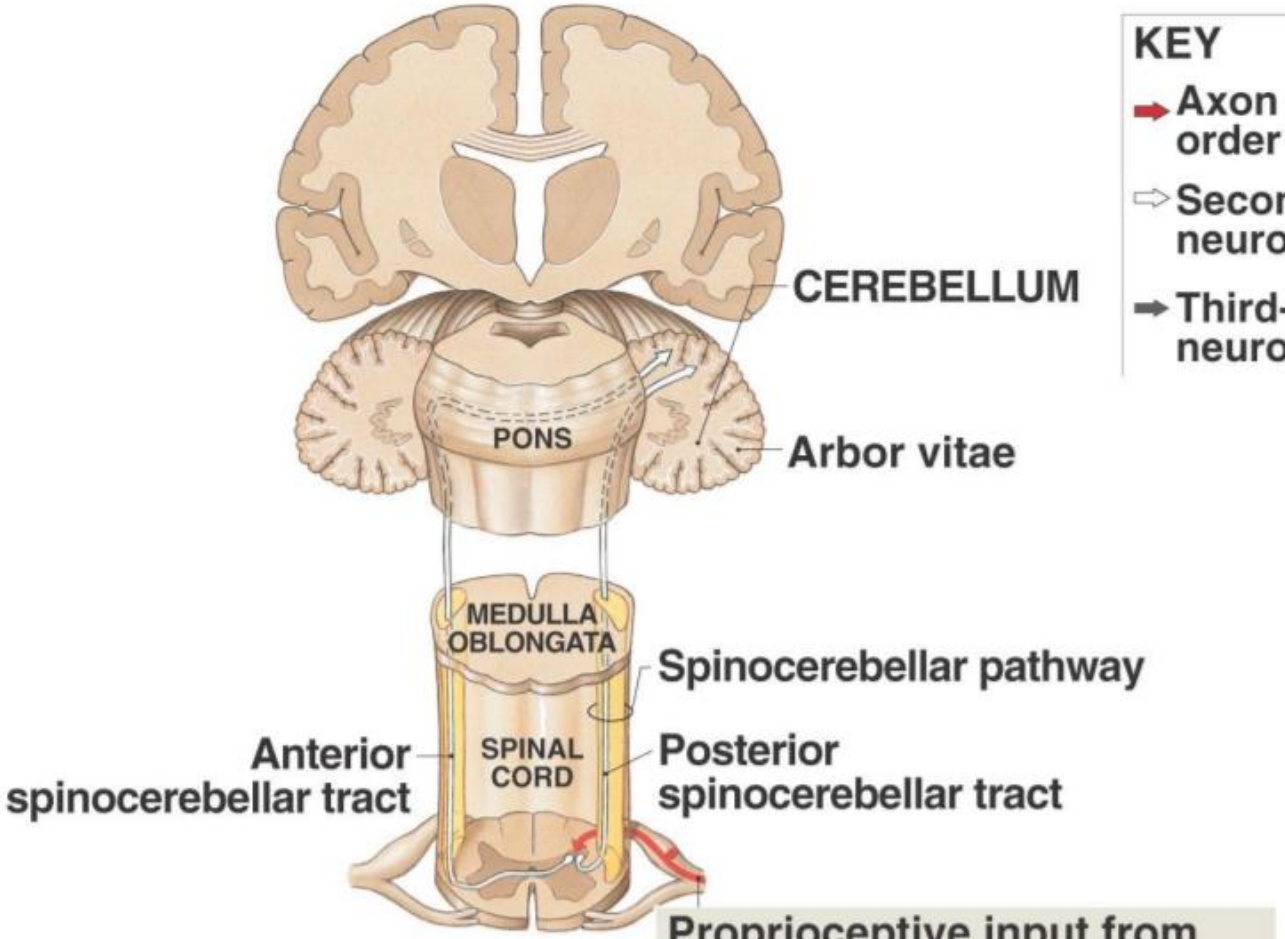
TRACTS OF SPINAL CORD



Spinocerebellar Tracts

Destination	Cerebellar Cortex Through Superior & Inferior Cerebellar peduncles
Pathways	Anterior Spinocerebellar tracts (Superior) Posterior Spinocerebellar tracts (Inferior)
2nd Order Neuron	Nucleus Dorsalis/ Clarke's column C8-L3/4 V-VII
1st Order Neuron	Collateral branches of Ascending tracts of Dorsal Column from dorsal root ganglion
Receptors	muscle spindles & tendon organs, joint receptors

SPINOCEREBELLAR TRACT



(d) Spinocerebellar pathway

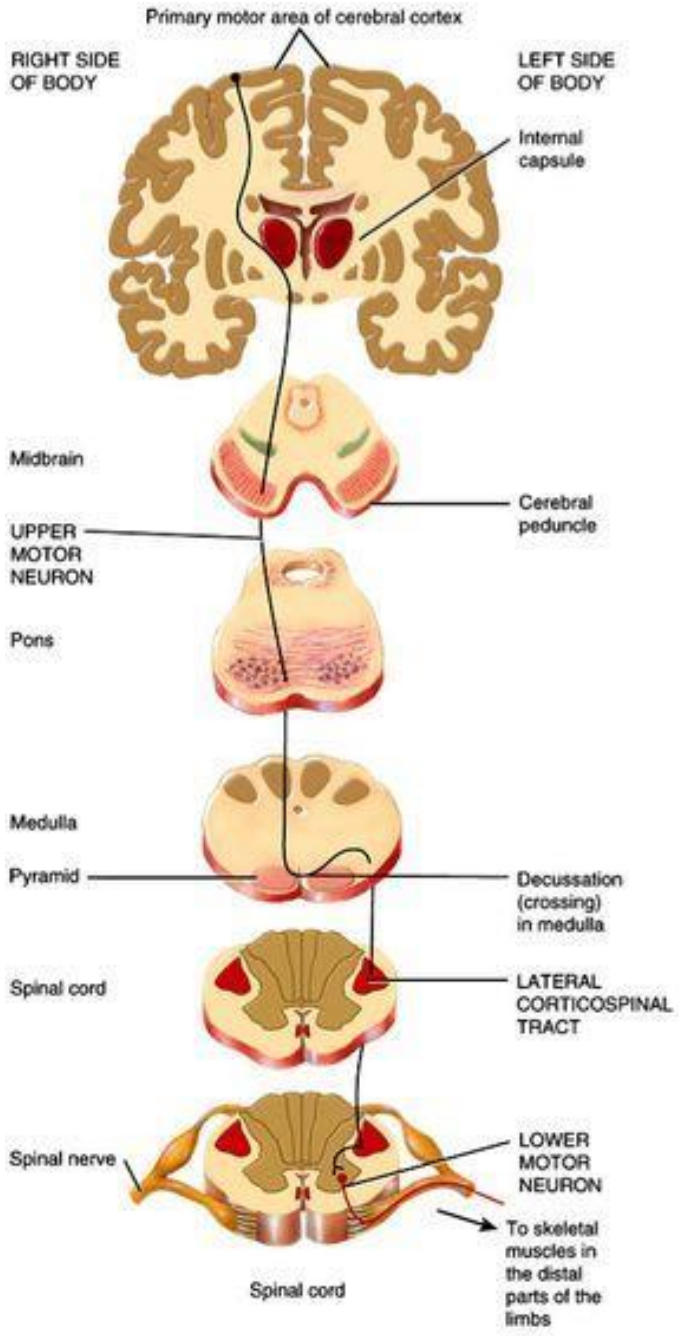
OTHER ASCENDING TRACTS

Spinotectal tract	Spinovisual reflexes Movements of the eyes & head in response to the source of the stimulation
Spinoreticular tract	Reticular formation, Levels of consciousness Pain perception
Spino-olivary tract	Conveys cutaneous and proprioceptive information to cerebellum
Spino-cervicothalamic pathway	Hair movement, pinch, pressure, thermal stimuli, noxious stimuli

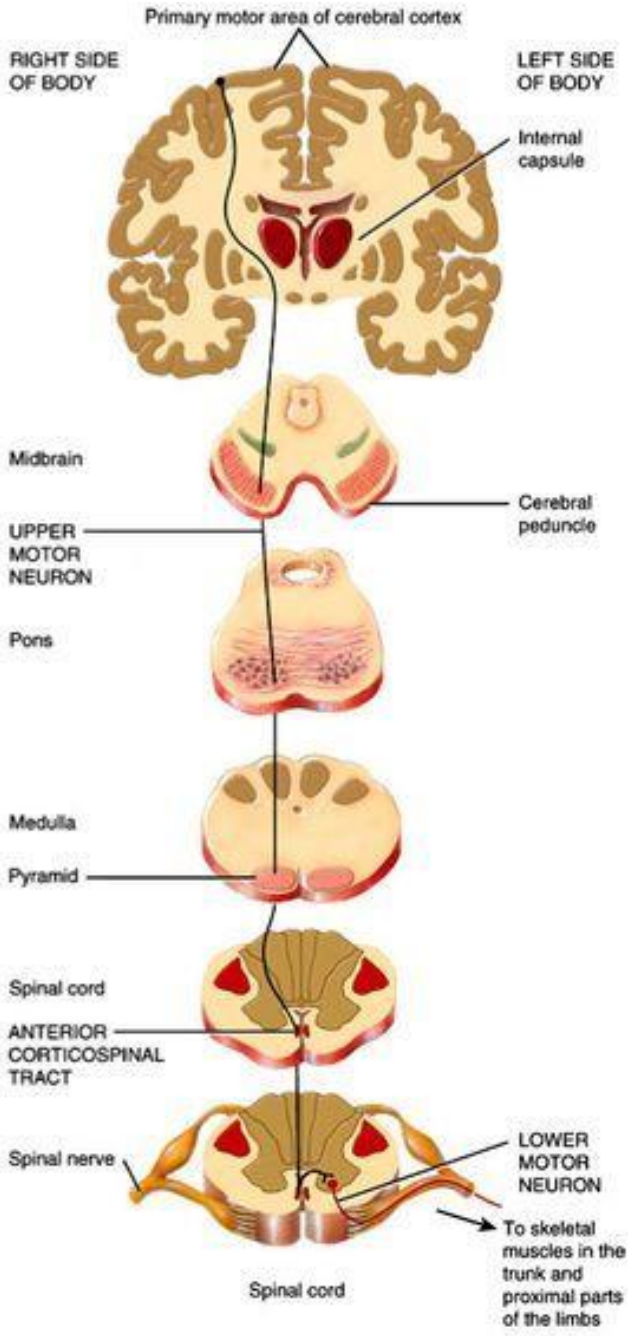
DESCENDING TRACTS

CORTICOSPINAL TRACTS

Origin	**Primary motor cortex (area 4), secondary motor cortex (area 6), parietal lobe (areas 3, 1, and 2)**
Pass through	Corona radiata, posterior limb of Internal Capsule middle 3/5 of basis pedunculi of midbrain
Site of crossover	pyramids of medulla
Pathway	Corticospinal tracts
Termination	98% on contralateral alpha and gamma motor neurons in grey matter or interneurons.



(a) The lateral corticospinal pathway



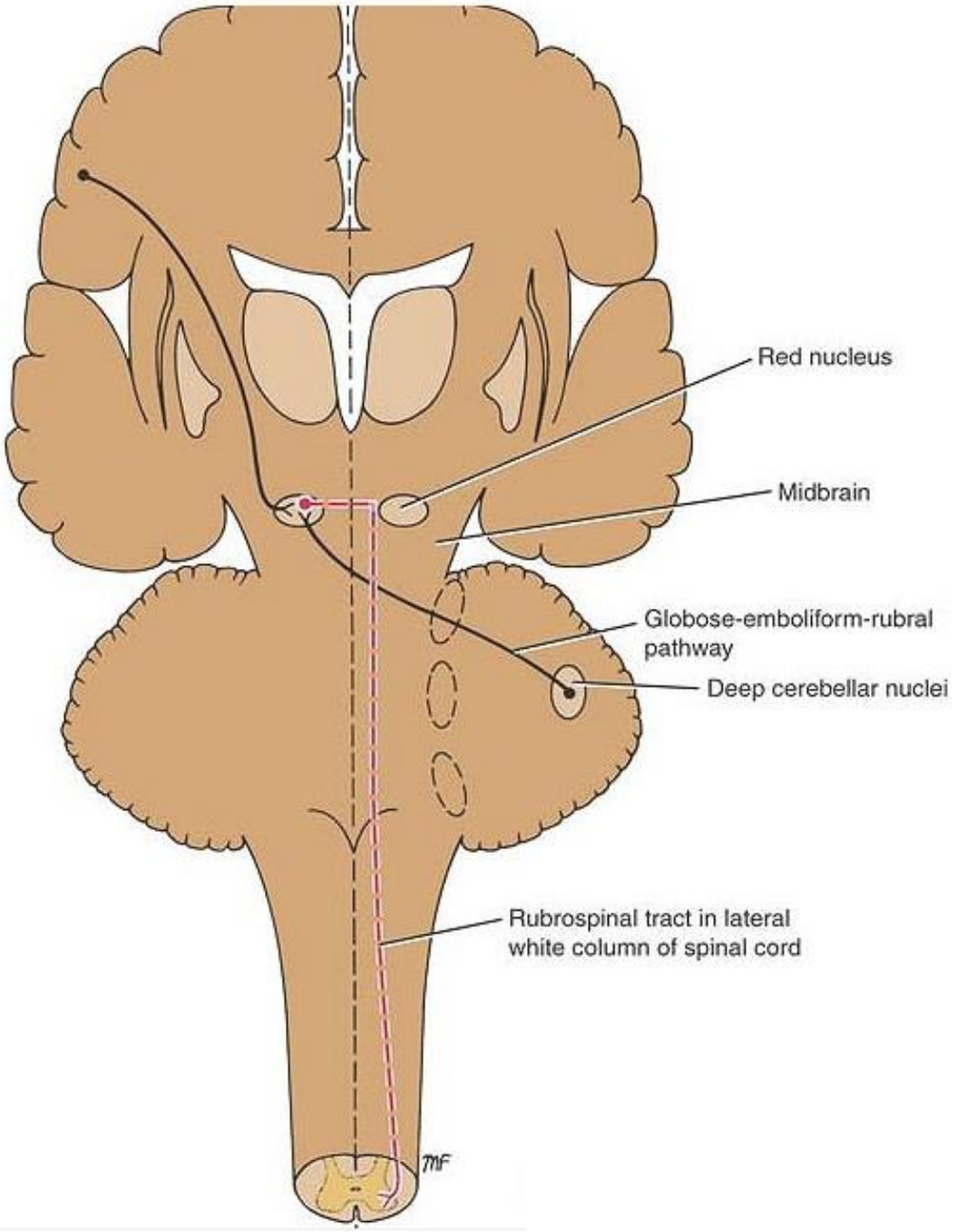
(b) The anterior corticospinal pathway

CORTICOSPINAL TRACTS

- also known as pyramidal tracts.
- Controls rapid, skilled, non-postural, voluntary movements, especially distal ends of limbs
- gives branches to cerebral cortex,
    - basal nuclei,
    - red nucleus,
    - olivary nuclei,
    - reticular formation.
- These branches keep the subcortical regions aware about the cortical motor activity.

RUBROSPINAL TRACTS

Origin	Red nucleus of midbrain
Site of crossover	Immediately in midbrain
Pathway	Rubrospinal tract
Destination	Motor neurons in grey matter
Function	Facilitates activity of flexor muscles and inhibits activity of extensor muscles in the upper limb



RUBROSPINAL TRACT

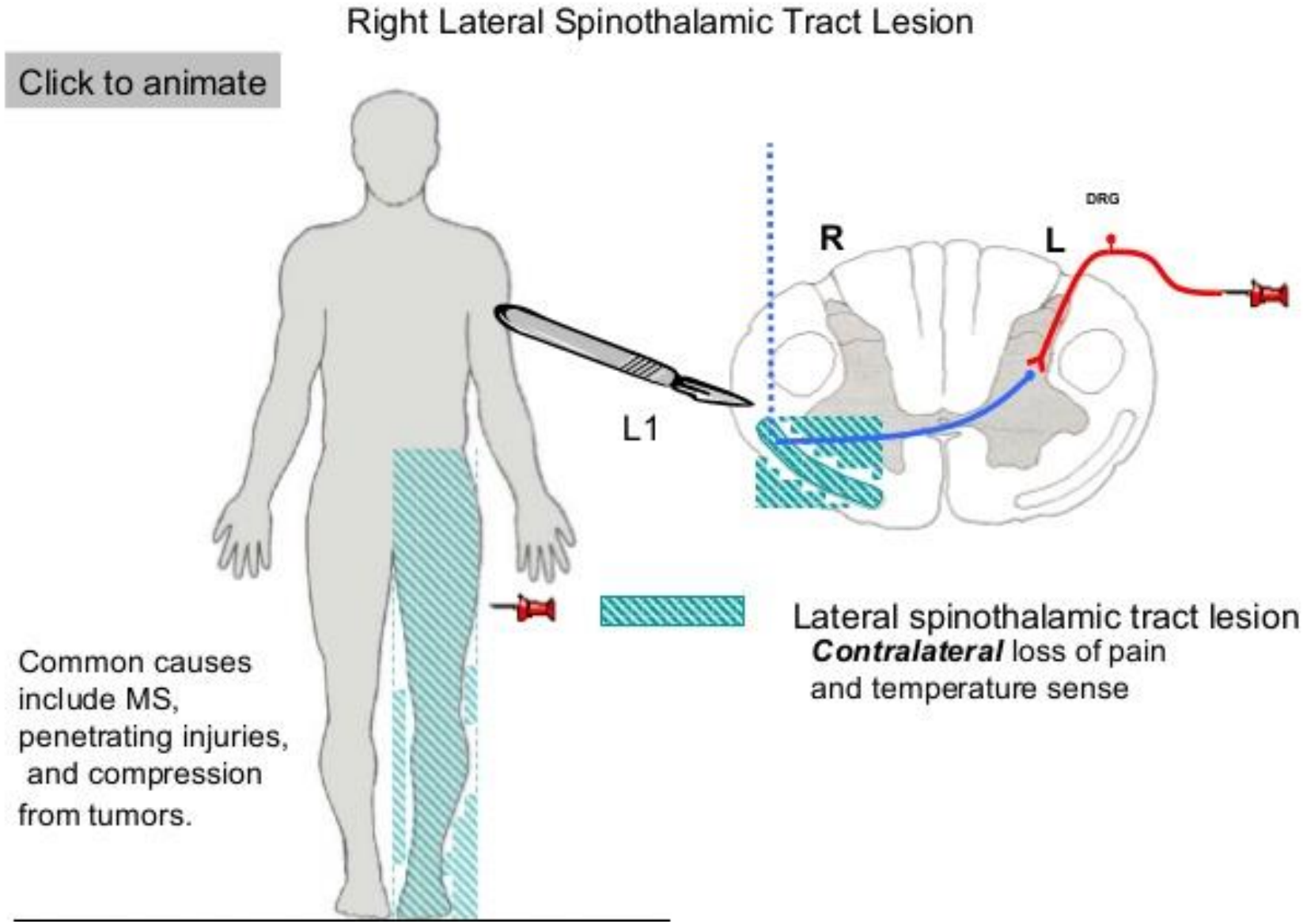
- Red nucleus receive afferent impulses through connections with the :
- 1. cerebral cortex
- 2. cerebellum.
- 3. Globus Pallidus
- Extends as far as corticospinal tract
- Cortico-rubral connections from ipsilateral red nucleus
- indirect pathway by which the cerebral cortex and the cerebellum can influence the activity of motor neurons of the spinal cord.

Extrapyramidal Tracts

Reticulospinal tract	Inhibit or facilitate voluntary movement, reflex activity, assist hypothalamus controls sympathetic, parasympathetic outflows.
Tectospinal tract	Reflex postural movements of head concerning visual stimuli
Vestibulospinal tract	Unconscious maintenance of posture and balance; acts on extensors mediates head & neck movements in response to vestibular sensory input
Descending autonomic fibers	Control sympathetic and parasympathetic systems

LESION OF SPINAL CORD

Injury to the ascending tracts within the spinal cord



- **Anterior Spinothalamic Tract**

➢ contralateral loss of light touch sensations below the level of the lesion

➢ contralateral loss of pressure sensations below the level of the lesion

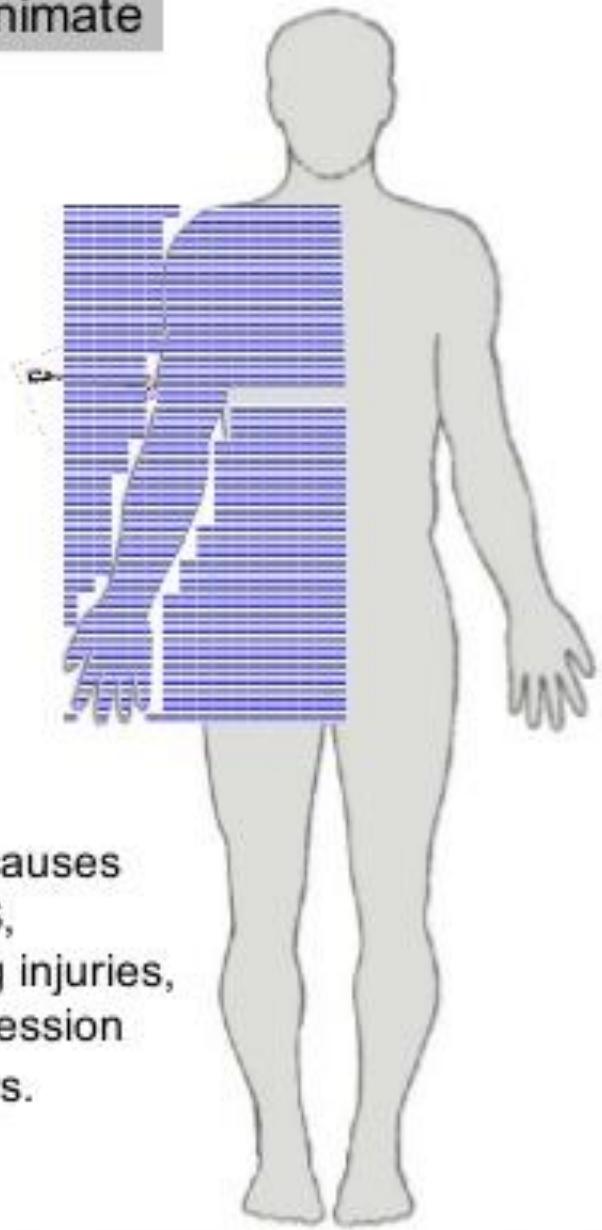
The patient will

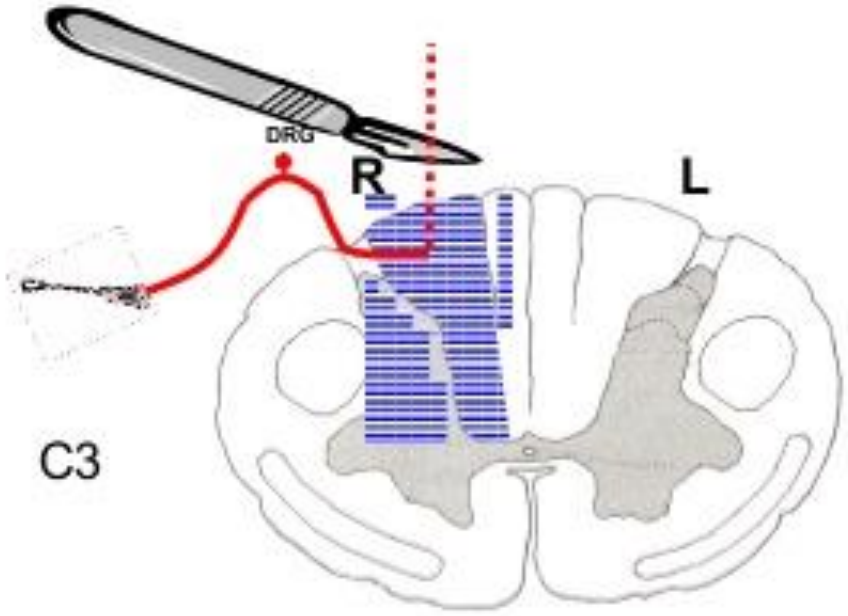
not feel the light touch of a piece of cotton placed against the skin

and cant feel pressure from a blunt object placed against the skin.

Right Fasciculus Cuneatus Lesion

Click to animate





Fasciculus cuneatus lesion

Ipsilateral loss of light touch, vibration, and position sense In the right arm and upper trunk

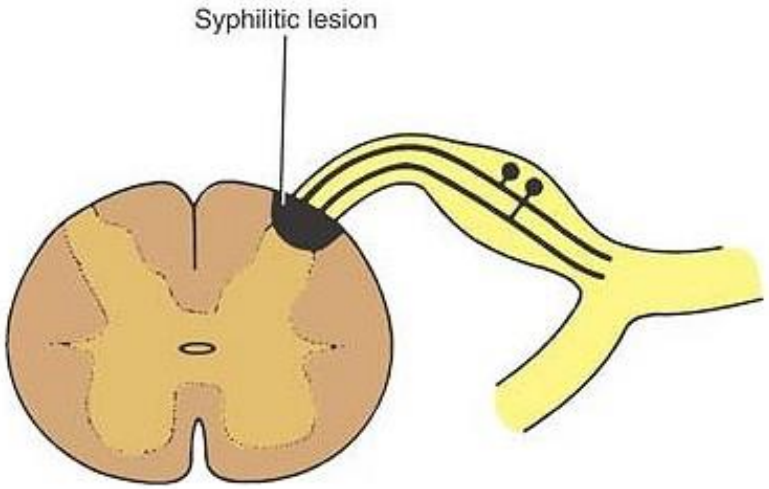
Common causes include MS, penetrating injuries, and compression from tumors.

TABES DORSALIS

- is caused by syphilis.
- a selective destruction of nerve fibres at the point of entrance of the posterior root into the spinal cord,

➢specially in the lower thoracic and lumbosacral regions.

➢Results in loss of some sensation & hypersensitivity of others.

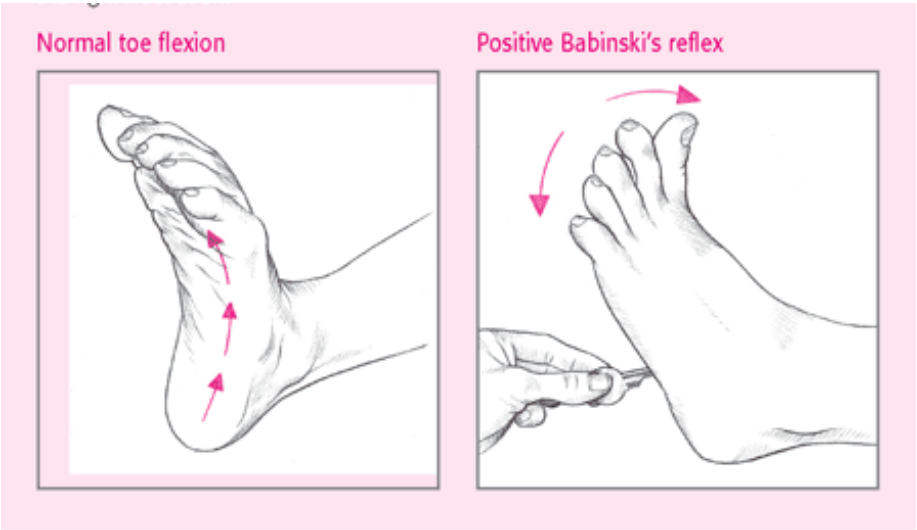


Injury to the descending tracts

Upper Motor Neuron (UMN) Lesions:

- Lesions of corticospinal tracts (Pyramidal Tracts)
- Lesions of Extrapyramidal Tracts

- **Lesions of corticospinal tracts (Pyramidal Tracts)**



- Babinski sign is present.
- superficial abdominal reflexes are absent.
- cremasteric reflex is absent.

There is loss of performance of fine-skilled, voluntary movements, especially at the distal end, of the limbs.

Lesions of Extrapyramidal Tracts lesions:

- Spastic paralysis, (lower limb extended, and the upper limb flexed),
- Exaggerated deep muscle reflexes in some flexors,
- Clasp-knife reaction -the muscles, after resistance on stretching, suddenly give way.

Lower motor neuron (LMN) lesions

- By any lesion (ex. Poliomyelitis) destroying neurons in the anterior grey column or its axon in the anterior root or spinal nerve.

Clinical signs:

1. Flaccid paralysis
2. Muscular Atrophy
3. Loss of muscular reflexes
4. Muscular fasciculation
5. Muscular contracture and degeneration .

SPINAL SHOCK SYNDROME

Following a spinal cord injury there will be :

- a short term loss of all neurological activity below the level of injury.
- loss of motor, sensory reflex & autonomic function.

due to temporary physiologic disorganisation of spinal cord function,

may last 30-60 minutes or up to 6 weeks.

COMPLETE CORD TRANSECTION

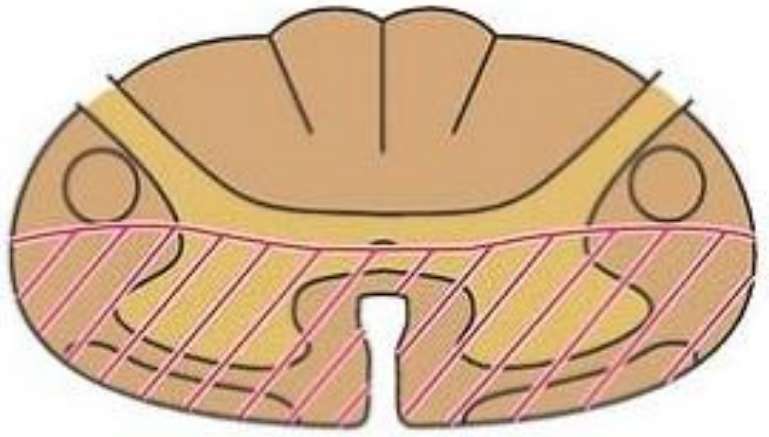
It can be caused by fracture dislocation of the vertebral column,

Clinical features :

1. Bilateral LMN paralysis
2. Bilateral spastic paralysis below the level of the lesion
3. Bilateral loss of all sensations below the level of the lesion.
4. Bladder and bowel functions are no longer under voluntary control

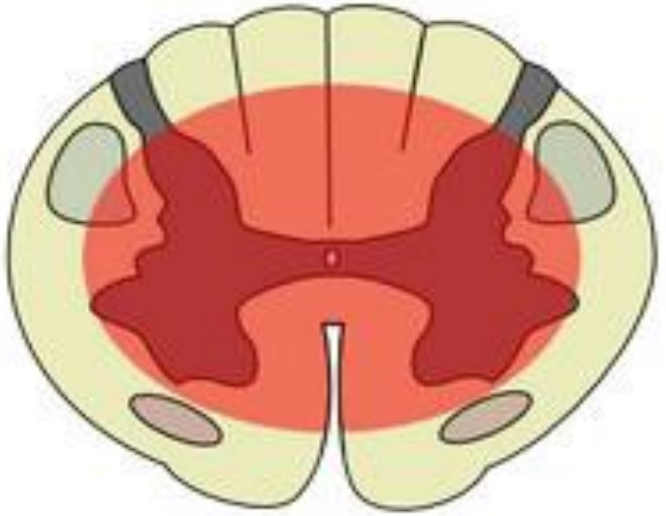
ANTERIOR CORD SYNDROME

1. Bilateral LMN paralysis in the segment of lesion,
2. Bilateral spastic paralysis below level of the lesion,
3. Bilateral loss of pain, temprature & light touch below the level of the lesion,
4. Two point discrimination & vibratory and proprioception sensations are preserved.



CENTRAL CORD SYNDROME

1. Bilateral LMN paralysis in the segment of lesion,
2. Bilateral spastic paralysis below the level of the lesion with characteristic sacral sparing,
3. Bilateral loss of pain, temperature & light touch and pressure sensations below the level of the lesion with characteristic sacral sparing.



Hemicord Lesion (Brown-Sequard Syndrome)

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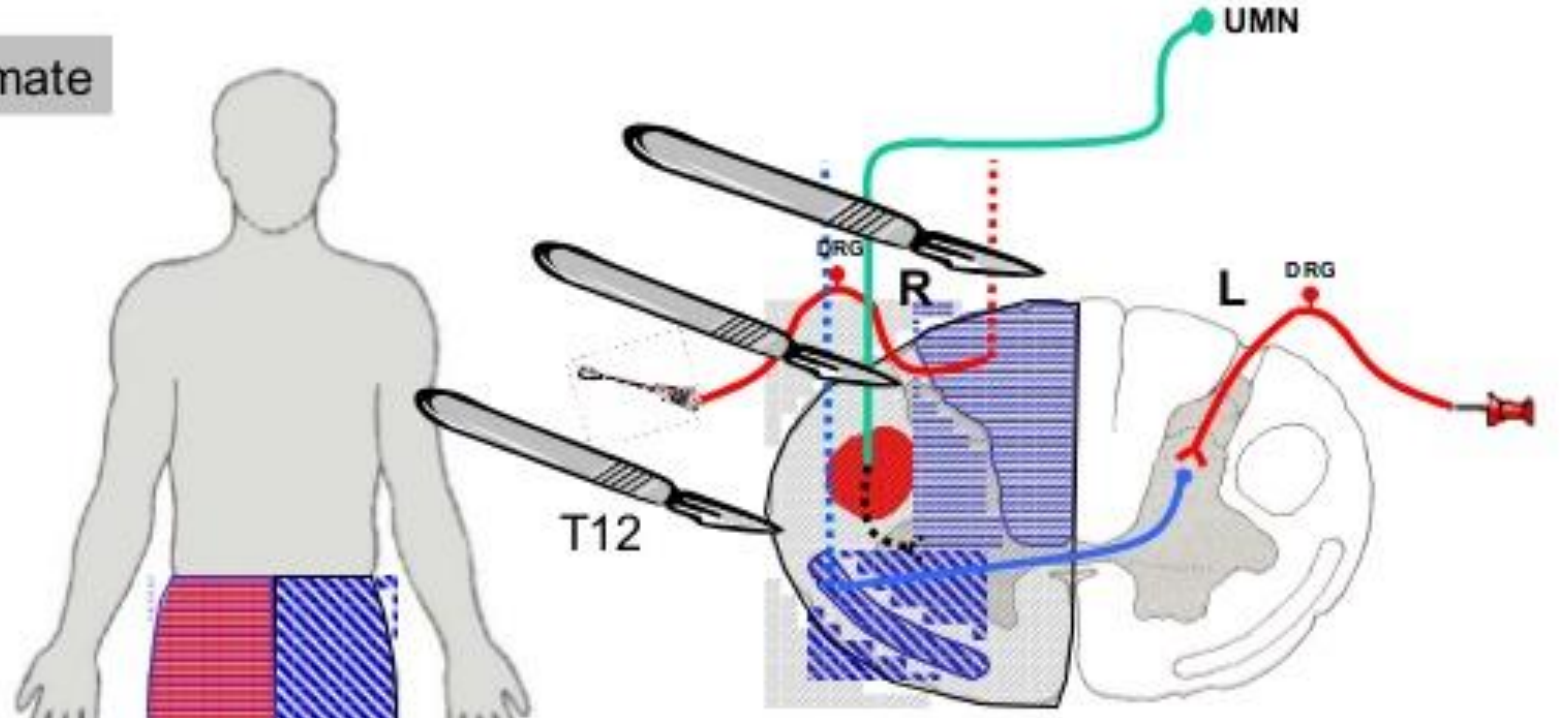

Dorsal column lesion
Ipsilateral loss of light touch, vibration, and position sense

Lateral corticospinal tract lesion
Ipsilateral upper motor neurons signs

Lateral spinothalamic tract lesion
Contralateral loss of pain and temperature sense

Hemicord lesion

- A 36 year old male is observed to have difficulty in walking during a clinic visit. Testing indicates that his joint position sense is intact. However, his reflexes in his lower limbs are diminished. Based on the findings in this patient, which of the following pathways most likely have been damaged?

A. Lateral spinothalamic

B. Ventral spinothalamic

C. Dorsal spinocerebellar

D. Cuneocerebellar

- A 19 year old gang member presented in the ER with a stab wound of the neck. Neurological examination revealed left hemiparesis with complete loss of vibratory and joint position sense below C6 on the same side as the weakness. Loss of pain and temperature sensation was elicited on the left at C6 only and on the right below C6. An MRI of the cervical spinal cord will reveal which of these findings?

A. Hemisection of the left spinal cord

B. Complete transection of the spinal cord

C. Lesion of the left anterolateral white mater only of the spinal cord

D. Damage to the cervical dorsal roots at C6 on the left side only

- A patient has an injury that results in damage to the lower motor neurons. Which of the following would you expect to see in the patient?

A. Spastic paralysis

B. Hyperreflexia

C. Increased muscle tone

D. Flaccid paralysis

- A pain researcher wants to make a lesion to the Spinothalamic tract so that his subjects feel no pain and temperature sensation from the right leg, but leaves pain and temperature sensation rostral to the arm. Where would you advise this researcher to make his lesion?

A. Lesion the most lateral aspect of the left spinothalamic tract

B. Lesion the most medial aspect of the left spinothalamic tract

C. Lesion the most lateral aspect of the right spinothalamic tract

D. Lesion the most medial aspect of the right spinothalamic tract

- During a play-off game, a college hockey player is struck hard on the back of his neck with a hockey stick. A CT scan reveals a bone fragment lodged into the medial aspect of his dorsal columns in the cervical spinal cord. Which of the following functions will most likely be affected given this patient's presentation?

A. Touch, pressure, vibratory sense from ipsilateral leg

B. Pain and temperature sense from contralateral leg

C. Pain from ipsilateral face

D. Pain and temperature sense from contralateral arm

- 5 year painter was rushed to the ER after he fell from a high building and fractured his cervical vertebra and damaged his spinal cord. During examination of his reflexes immediately after the accident, which of the following are most likely to be seen?

A. Increased reflexes

B. Decreased reflexes

C. Rigidity

D. Fasiculations