

- Transverse section of spinal cord shows grey matter and white matter.
- Grey matter forms H shaped or butterfly shaped mass.
- Grey matter → Ventral Horn
Dorsal Horn
Central gray.

3D

- Anterior } Gray Column.
- Posterior }

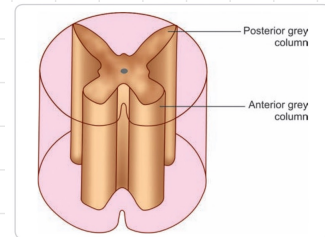


Figure 3.2: Three-dimensional view of grey matter of the spinal cord

- Lateral Projection of grey matter is seen in thoracic & sacral parts → Lateral grey column.

- Posterior } Funiculus → white matter or white column
- Lateral }
- Anterior }

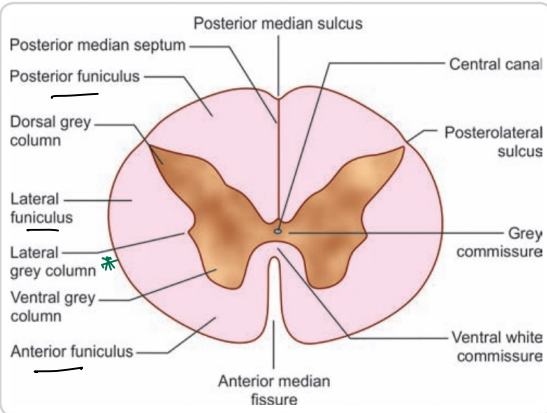
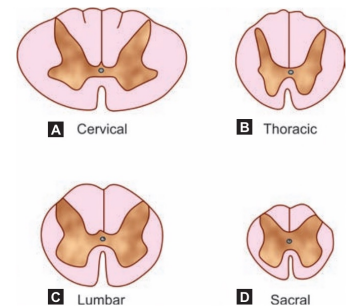


Figure 3.1: Transverse section through the spinal cord showing grey and white matter

Variations of Spinal Cord at Different Levels:-

- Shape of Transverse section: Oval → Cervical Region
Round → Thoracic & Sacral.
Round/oval → Lumbar
- Grey matter is greatest in cervical & lumbar.
- White matter decreases down the line.



Figures 3.3A to D: Differences in appearance of transverse sections through various levels of the spinal cord

Nuclei in Grey Matter:-

- Lamina I to IV : Dorsal part (Dorsal horn)
- Lamina V & VI : Base of (Dorsal horn)
- Lamina VII : Intermediate grey column.
- Lamina VIII & IX : Ventral horn.
- Lamina X : Central gray.

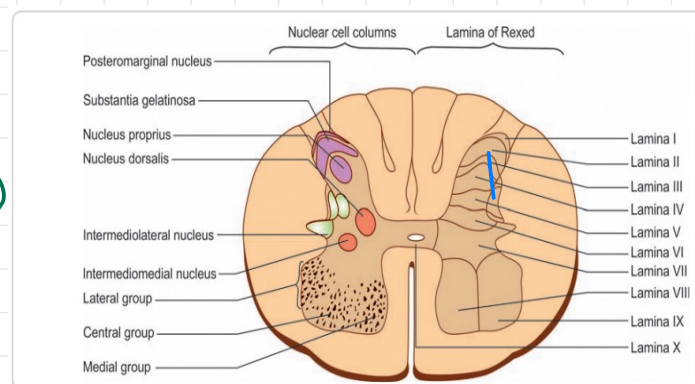
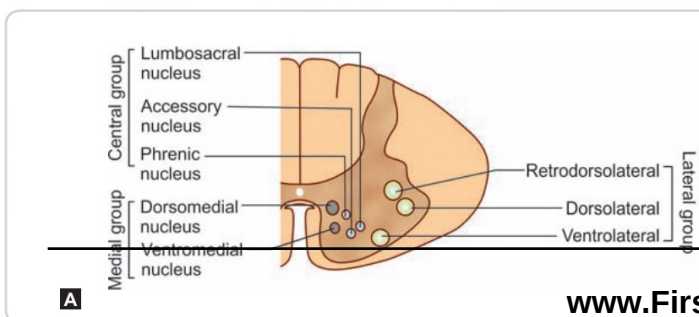


Figure 3.4: Nuclei and laminae of Rexed



A

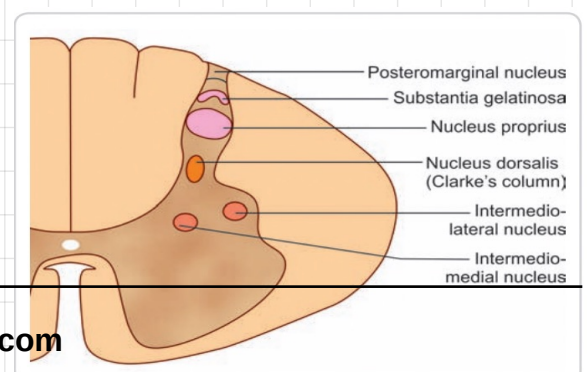


Figure 3.5: Nerve cell groups in the posterior grey column

Rexed lamina	Nuclei in grey column	Afferent connections	Efferent connections
I	Posteromarginal nucleus	"Fast" pin-pricking type of pain from dorsolateral tract of Lissauer	Gives origin to lateral spinothalamic tract of the opposite side
II	Substantia gelatinosa	Stimulation from large diameter sensory fibres; inhibitory from pain fibres	Presynaptic inhibition to nucleus proprius (See Figure 3.6)
III and IV	Nucleus proprius	Fibres carrying sensation of crude touch, pressure, thermal and "slow" burning pain	Gives origin to anterolateral spinothalamic tracts of the opposite side
V	Diffuse spinal reticular nucleus	Exteroceptive, nociceptive, proprioceptive and visceral senses; corticospinal tract and subcortical inputs	Gives origin to spinoreticular, spinotectal and spino-olivary tracts
VI	Interneurons for spinal reflexes	Exteroceptive, nociceptive, proprioceptive senses; corticospinal tract	Motor neurons for superficial spinal reflexes

TABLE 3.3: Nerve cell groups and their connections (Lateral grey column)

Rexed lamina	Nuclei in grey column	Afferent connections	Efferent connections
VII	Central cervical nucleus	Proprioception from lower limbs	Proprioception from lower limbs
	Posterior thoracic (Clarke's column)	Proprioception from lower limbs	Gives origin to posterior spinocerebellar tract of same side
	Intermediomedial nucleus	Interception from viscera	Intermediolateral nucleus, hypothalamus, reticular formation
	Intermediolateral nucleus	Hypothalamus, reticular formation, intermediomedial nucleus	Preganglionic autonomic to smooth muscles and glands

TABLE 3.4: Nerve cell groups and their connections (Anterior grey column)

Rexed lamina	Nuclei in grey column	Afferent connections	Efferent connections
VIII	Spinal border nucleus	Proprioception from lower limbs	Gives origin to anterior spinocerebellar tract of opposite side
	Interneurons for motor neurons	Corticospinal and extrapyramidal tracts, other spinal neurons	Motor neurons
	Ventromedial nucleus	Corticospinal, spinal interneurons, muscle spindle	Dorsal muscles of trunk
	Dorsomedial nucleus	Corticospinal, spinal interneurons and muscle spindle	Ventral muscles of trunk
	Spinal accessory	Corticospinal, spinal interneurons, muscle spindle	Sternocleidomastoid and trapezius
	Phrenic nucleus	Corticospinal, spinal interneurons, medullary respiratory centre	Diaphragm
	Nucleus of Onuf	Spinal interneurons and visceral afferents	Pelvic diaphragm, voluntary sphincters of urethra and anal canal
	Ventrolateral	Corticospinal, spinal interneurons and muscle spindle	Dorsal muscles of limbs
	Dorsolateral	Corticospinal, spinal interneurons and muscle spindle	Ventral muscles of limbs
	Retrodorsolateral	Corticospinal, spinal interneurons and muscle spindle	Muscles of hand and foot

Tracts in White Matter :-

- A collection of nerve fibres within the CNS, that connects two masses of grey matter, is called a tract (or fasciculus).
- Ascending, Descending or Intersegmental.
- Tracts are present in White matter.

TABLE 3.5: Important ascending and descending tracts in various funiculi

Funiculus	Ascending tracts	Descending tracts
Posterior	- Fasciculus gracilis - Fasciculus cuneatus	- Septomarginal tract - Fasciculus interfascicularis (Semilunar tract/ Comma tract of Schultze)
Lateral	- Posterior spinocerebellar - Anterior spinocerebellar - Lateral spinothalamic - Spinotectal - Spino-olivary - Dorsolateral (Lissauer's tract)	- Lateral corticospinal - Rubrospinal - Lateral reticulospinal - Olivospinal - Hypothalamospinal - Raphespinal
Anterior	- Anterior spinothalamic - Spinoreticular	- Anterior corticospinal (Lateral) vestibulospinal - Medial vestibulospinal (Medial longitudinal fasciculus) - Tectospinal - Medial reticulospinal

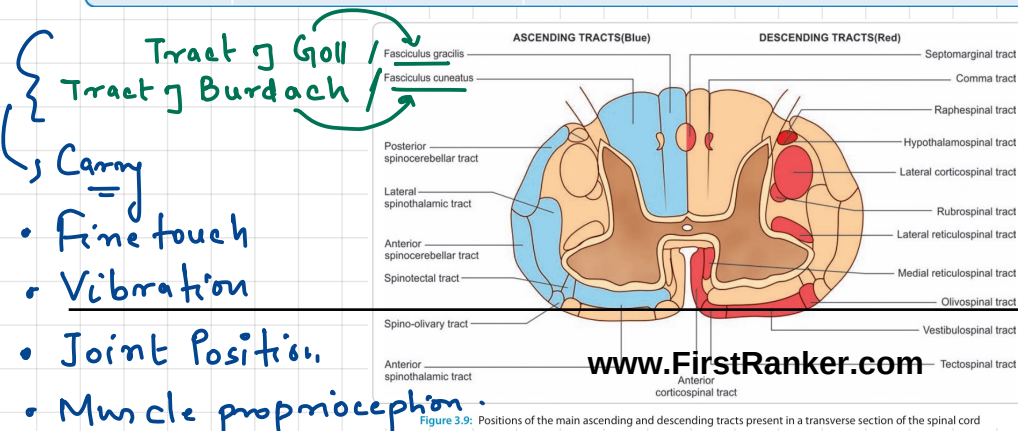
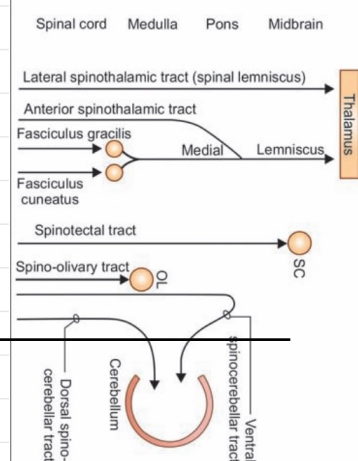
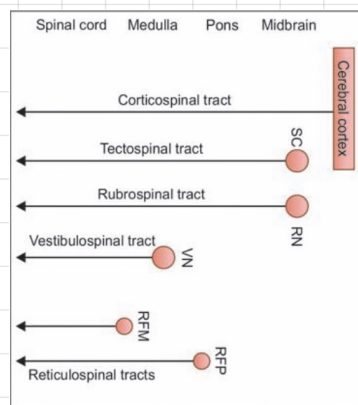


Figure 3.9: Positions of the main ascending and descending tracts present in a transverse section of the spinal cord

TABLE 3.6: Ascending tracts of spinal cord

Tract	Function	First-order neuron			Second-order neuron			Third-order neuron	
		Peripheral process	Cell body	Central process	Cell body	Crossing	Ascent	Cell body	Axons
Fasciculus gracilis	Fine touch, proprioception, vibration, joint position sense from below T6	Skin, joint, tendon	Dorsal nerve root ganglia	Fasciculus gracilis in the posterior funiculus	Nucleus gracilis in medulla oblongata	Internal arcuate fibres	Medial lemniscus	Ventral postero-lateral nucleus of thalamus	Superior thalamic radiation to postcentral gyrus
Fasciculus cuneatus	Fine touch, proprioception, vibration, joint position sense from above T6	Skin, joint, tendon	Dorsal nerve root ganglia	Fasciculus cuneatus in the posterior funiculus	Nucleus cuneatus in medulla oblongata	Internal arcuate fibres	Medial lemniscus	Ventral postero-lateral nucleus of thalamus	Superior thalamic radiation to postcentral gyrus
Anterior spino-thalamic tract	Crude touch, pressure	Skin	Dorsal nerve root ganglia	Synapses with nucleus proprius of spinal cord	Nucleus proprius in spinal cord	Anterior white commissure of spinal cord	Joins medial lemniscus in medulla oblongata	Ventral postero-lateral nucleus of thalamus	Superior thalamic radiation to postcentral gyrus
Lateral spino-thalamic tract	Pain and thermal sensation	Skin	Dorsal nerve root ganglia	Ascends few segments up in dorso-lateral tract of Lissauer	Nucleus postero-marginal and nucleus proprius	Anterior white commissure of spinal cord	Continues as spinal lemniscus in brain-stem	Ventral postero-lateral nucleus of thalamus	Superior thalamic radiation to postcentral gyrus
Posterior spinocerebellar	Unconscious proprioception from lower limb	Muscles and joints of lower limb	Dorsal nerve root ganglia	Ascends in fasciculus till Clarke's column	Posterior thoracic nucleus	—	Terminates in anterior lobe of cerebellum	—	—
Anterior spinocerebellar	Unconscious proprioception from lower limb	Muscles and joints of lower limb	Dorsal nerve root ganglia	Synapses with spinal border cells	Spinal border cells	Anterior white commissure of spinal cord	Terminates in anterior lobe of cerebellum	—	—
Spino-reticular tract	Deep pain	Deep tissues	Dorsal nerve root ganglia	Synapses with cells in lamina V	Lamina V of Rexed	Anterior white commissure of spinal cord; some fibres do not cross	Reticular formation of brain-stem	—	—
Spino-olivary tract	Feedback about performance	Muscles and joints	Dorsal nerve root ganglia	Synapses with cells in lamina V	Lamina V of Rexed	Anterior white commissure of spinal cord	Inferior olivary nucleus of medulla oblongata	—	—
Spinotectal tract	Reflex movements of the head and eyes	Skin, joint, muscles	Dorsal nerve root ganglia	Synapses with cells in lamina V	Lamina V of Rexed	Anterior white commissure of spinal cord	Superior colliculus of mid-brain	—	—

TABLE 3.8: Descending tracts of spinal cord

Tract	Origin	Crossing	Termination	Funiculus of cord	Function
Lateral corticospinal	Cerebral cortex area 4, area 6, and areas 3, 1, 2	Lower medulla	Interneuron and alpha motor neuron	Lateral	Fine motor function of distal muscles of limb and modulation of senses
Anterior corticospinal	Cerebral cortex area 4, area 6, and areas 3, 1, 2	Just before termination in the spinal cord	Interneuron and alpha motor neuron	Anterior	Gross motor function of axial musculature
Rubrospinal	Red nucleus	Upper midbrain	Gamma motor neuron	Lateral	Facilitates flexors of upper limb
Tectospinal tract	Superior colliculus	Upper midbrain	Interneurons	Anterior	Reflex postural movements of neck
Medial reticulospinal tract	Pontine reticular formation	—	Gamma motor neuron	Anterior	Facilitates extensors and bladder, bowel control
Lateral reticulospinal tract	Medullary reticular formation	Various levels	Gamma motor neuron	Lateral	Facilitates flexors, automatic breathing, modulation of pain
Lateral vestibulospinal tract	Lateral vestibular nucleus	—	Alpha motor neuron	Anterior	Facilitates extensors
Medial vestibulospinal tract (MLF)	Medial vestibular nucleus	Upper midbrain	Alpha motor neuron	Anterior	Turning of head
Olivospinal	Inferior olivary nucleus	Upper medulla	Interneurons	Lateral	Feedback to spino-olivary tract
Descending autonomic	Limbic lobe, hypothalamus	—	Preganglionic autonomic neurons	—	Output to autonomic output
Raphespinal	Raphe magnus nucleus	—	Dorsal horn	Lateral	Pain inhibition by release of serotonin