

# Injury of spinal cord



# Definition

Insult to spinal cord resulting in a change, in the normal motor, sensory or autonomic function. This change is either temporary or permanent.

## *Mechanisms:*

- i) Direct trauma
- ii) Compression by bone fragments / haematoma / disc material
- iii) Ischemia from damage / impingement on the spinal arteries

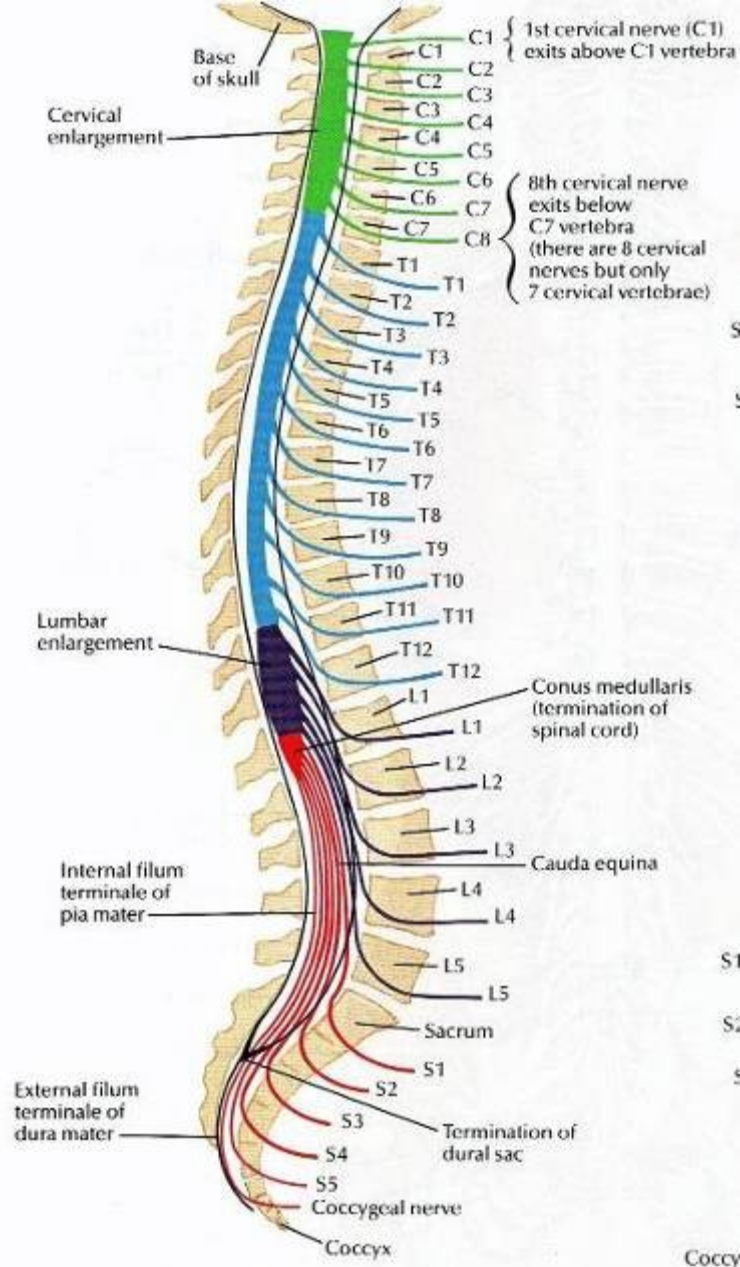
*Other causes:*

- Vascular disorders
- Tumours
- Infectious conditions
- Spondylosis
- Iatrogenic
- Vertebral fractures secondary to osteoporosis
- Development disorders

# *Anatomy :*

## *Spinal cord:*

- Extends from medulla oblongata – L<sub>1</sub>
- Lower part tapered to form conus medullaris



- Cervical nerves
- Thoracic nerves
- Lumbar nerves
- Sacral and coccygeal nerves

## On the surface :

- Deep anterior median fissure
- Shallower posterior median sulcus

## Spinal cord segment :

- Section of the cord from which a pair of spinal nerves are given off

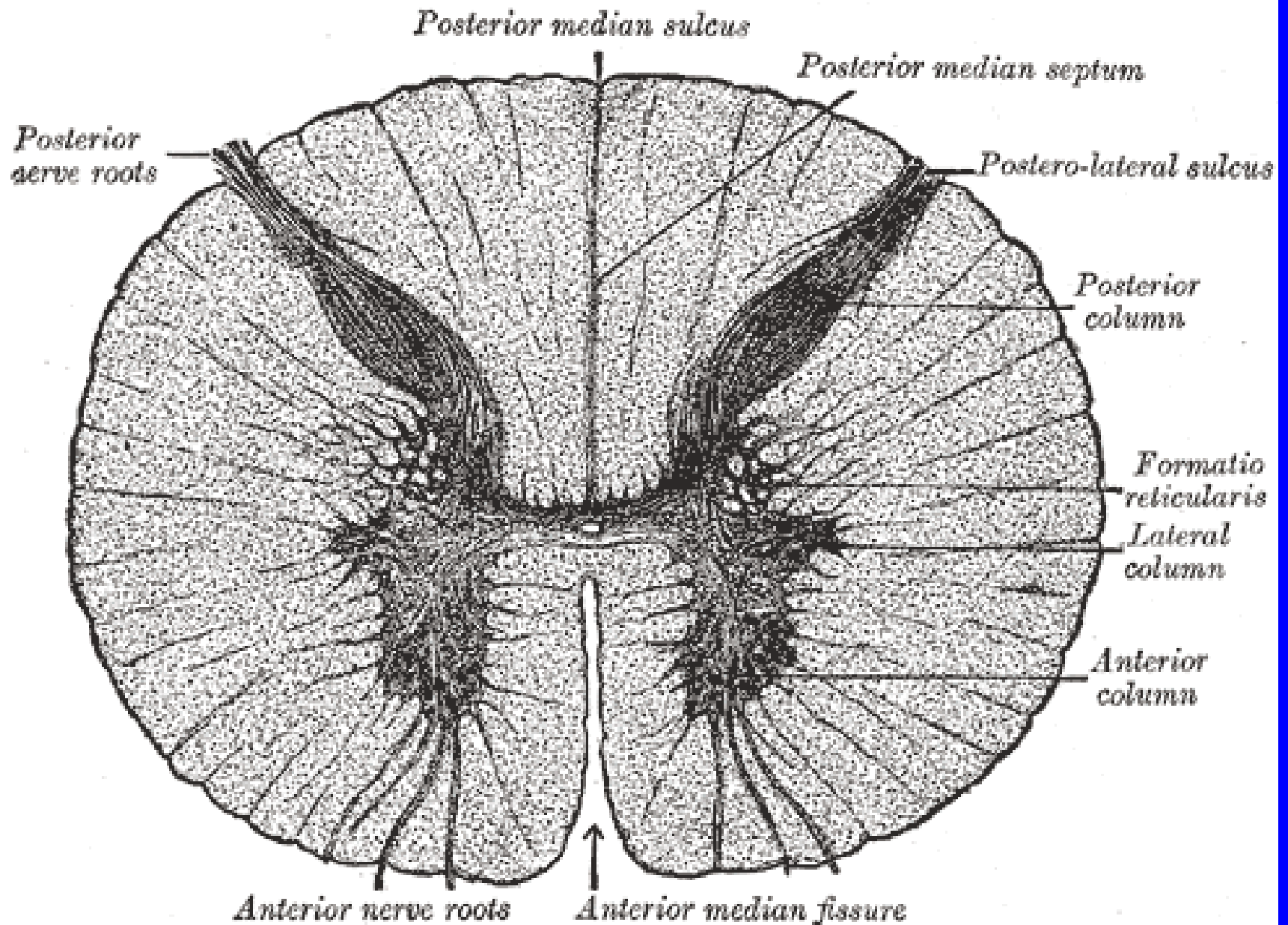
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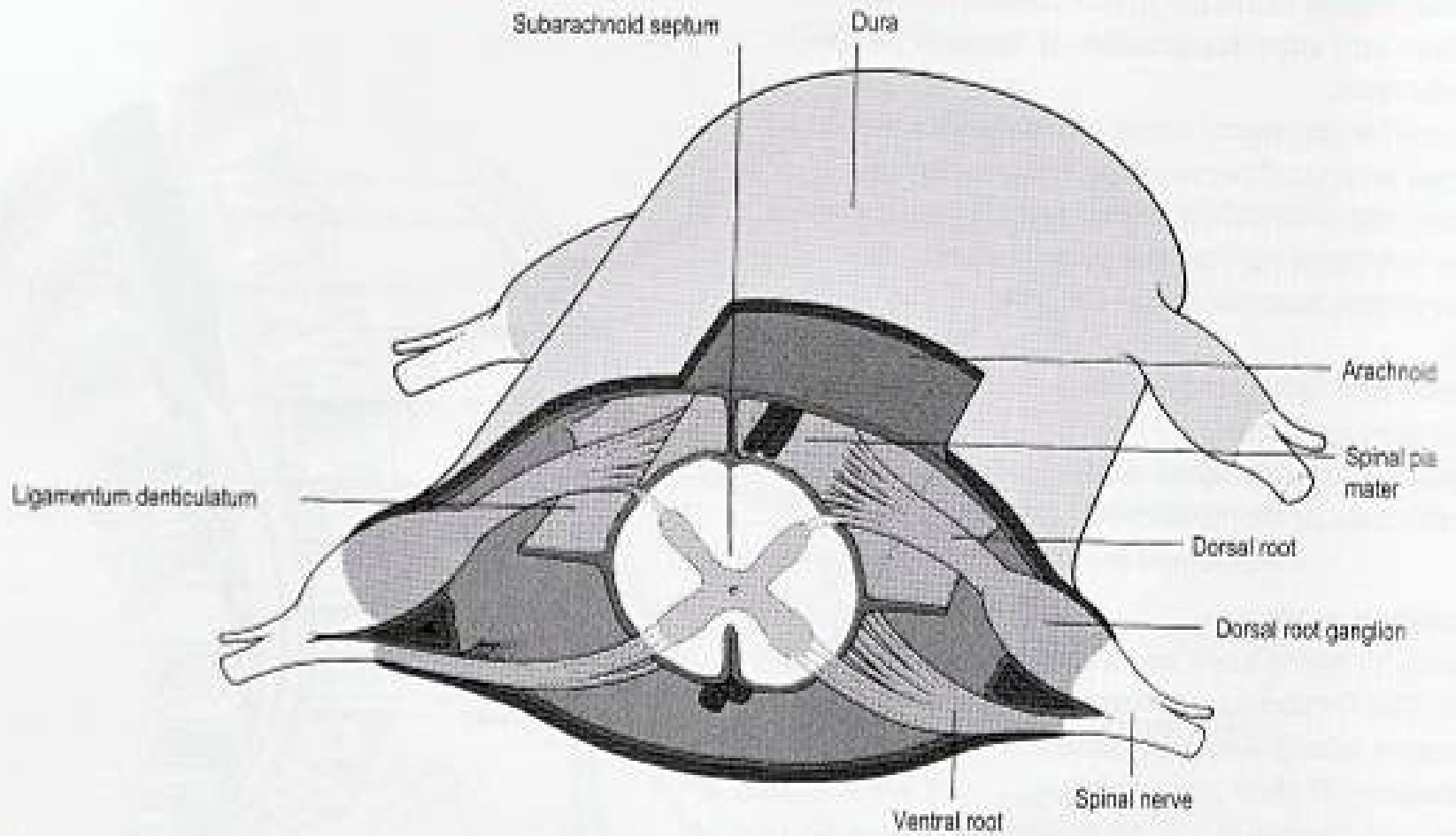
## Spinal cord segment :

- Section of the cord from which a pair of spinal nerves are given off





- Dorsal root – sensory fibres
- Ventral root – motor fibres
- Dorsal and ventral roots join at intervertebral foramen to form the spinal nerve



**Fig. 8.22 The spinal meninges.**  
Source: Rogers op. cit.

# *Physiology and function*

- Grey matter – sensory and motor nerve cells
- White matter – ascending and descending tracts
- Divided into
  - dorsal
  - lateral
  - ventral

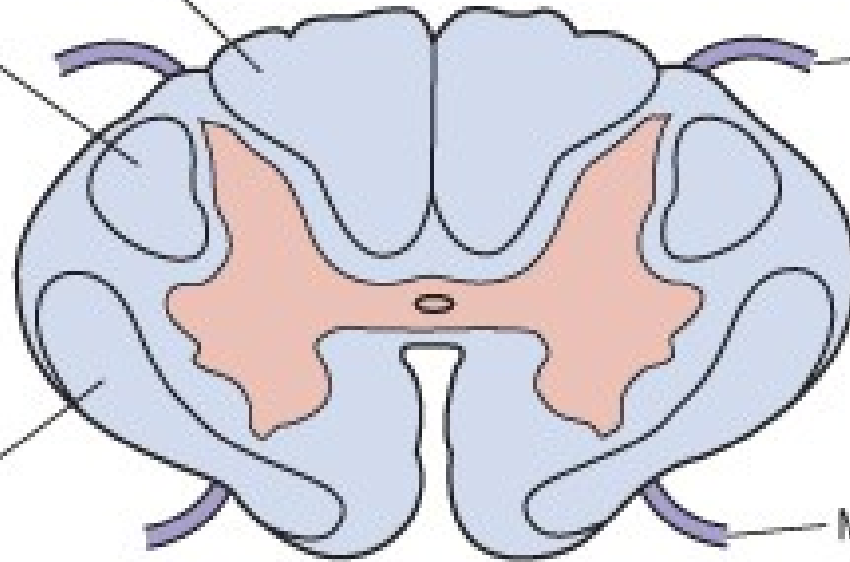
## CROSS SECTION OF CERVICAL SPINAL CORD

Posterior white columns  
(position and vibration)

Lateral corticospinal tract  
(voluntary motor function)

Dorsal sensory root

Lateral spinothalamic tract  
(pain and temperature)



Motor root

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# Tracts :

## *1) Posterior column:*

- Fine touch
- Light pressure
- Proprioception

2) *Lateral corticospinal tract* :

- Skilled voluntary movement

3) *Lateral spinothalamic tract* :

- Pain & temperature sensation

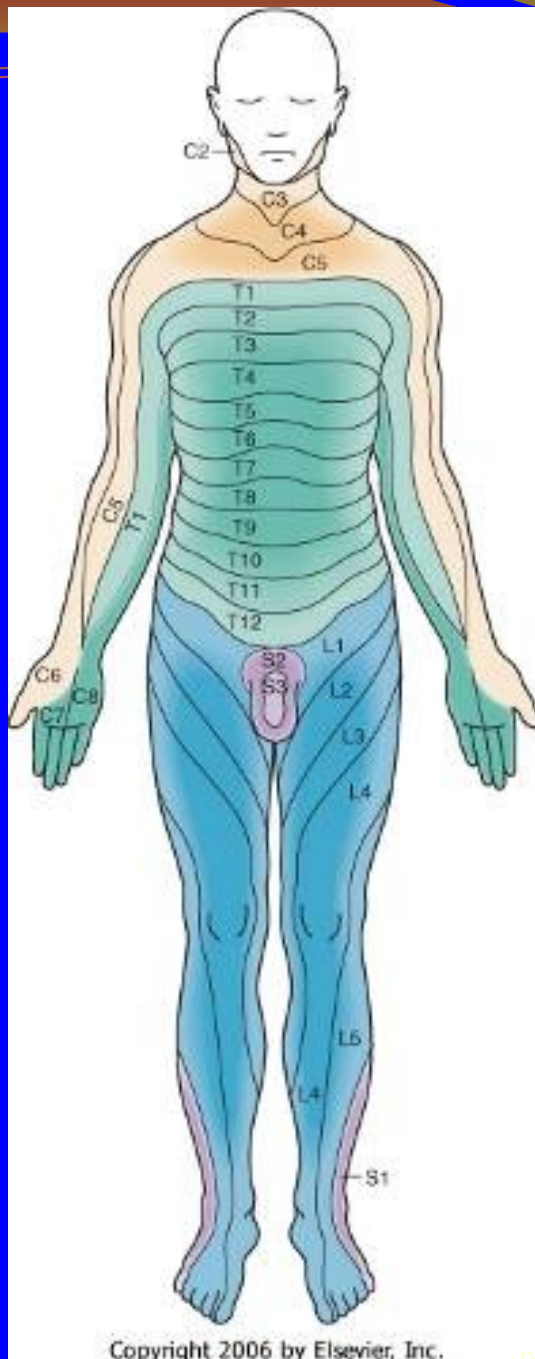
- Posterior column and lateral corticospinal tract crosses over at medulla oblongata
- Spinothalamic tract crosses in the spinal cord and ascends on the opposite side

**NB to understand this as it helps to understand the clinical features of injury patterns and the neurological deficit**



# *Dermatomes*

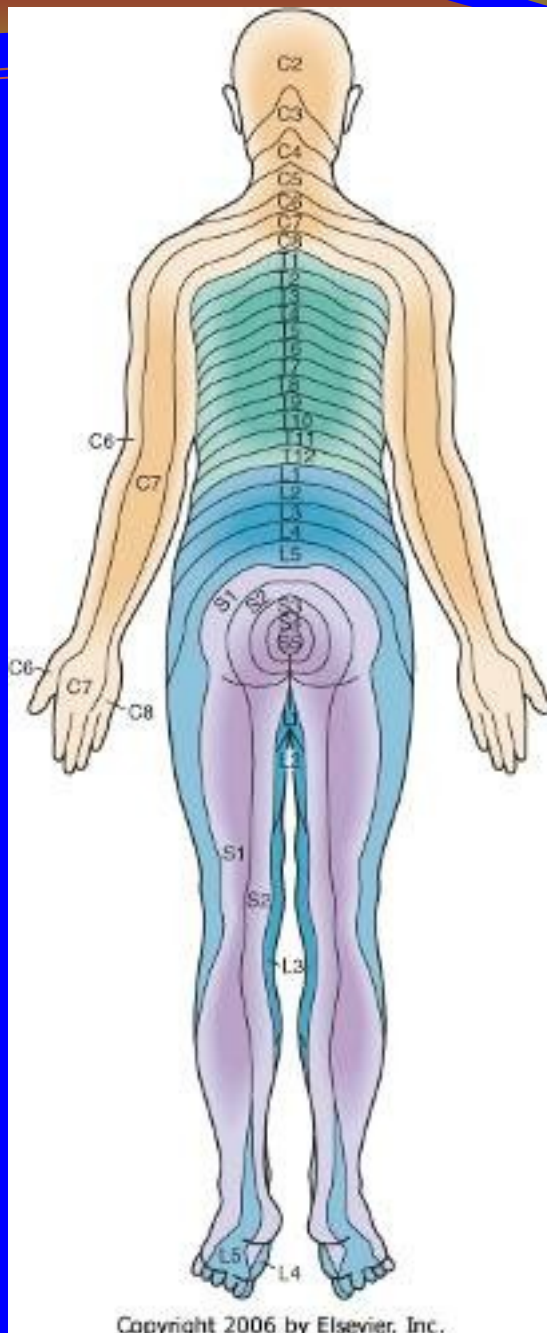
- Area of skin innervated by sensory axons within a particular segmental nerve root
- Knowledge is essential in determining level of injury
- Useful in assessing improvement or deterioration



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# Myotomes :

- Segmental nerve root innervating a muscle
- Again important in determining level of injury

- *Upper limbs:*

*C<sub>5</sub> - Deltoid*

*C<sub>6</sub> - Wrist extensors*

*C<sub>7</sub> - Elbow extensors*

*C<sub>8</sub> - Long finger flexors*

*T<sub>1</sub> - Small hand muscles*

- *Lower Limbs :*

*L<sub>2</sub> - Hip flexors*

*L<sub>3,4</sub> - Knee extensors*

*L<sub>4,5</sub> - S<sub>1</sub> - Knee flexion*

*L<sub>5</sub> - Ankle dorsiflexion*

*S<sub>1</sub> - Ankle plantar flexion*

# Spinal Cord Injury Classification

- Quadriplegia :  
injury in cervical region  
all 4 extremities affected
- Paraplegia :  
injury in thoracic, lumbar or sacral segments  
2 extremities affected

*Injury either:*

- 1) Complete
- 2) Incomplete

## *Complete:*

- i) Loss of voluntary movement of parts innervated by segment, this is irreversible
- ii) Loss of sensation
- iii) Spinal shock



## *Incomplete:*

- i) Some function is present below site of injury
- ii) More favourable prognosis overall
- iii) Are recognisable patterns of injury, although they are rarely pure and variations occur

# Injury defined by ASIA Impairment Scale

*ASIA – American Spinal Injury Association :*

*A – Complete: no sensory or motor function preserved in sacral segments S<sub>4</sub>– S<sub>5</sub>*

*B – Incomplete: sensory, but no motor function in sacral segments*

*C – Incomplete: motor function preserved below level and power graded < 3*

*D – Incomplete: motor function preserved below level and power graded 3 or more*

*E – Normal: sensory and motor function normal*

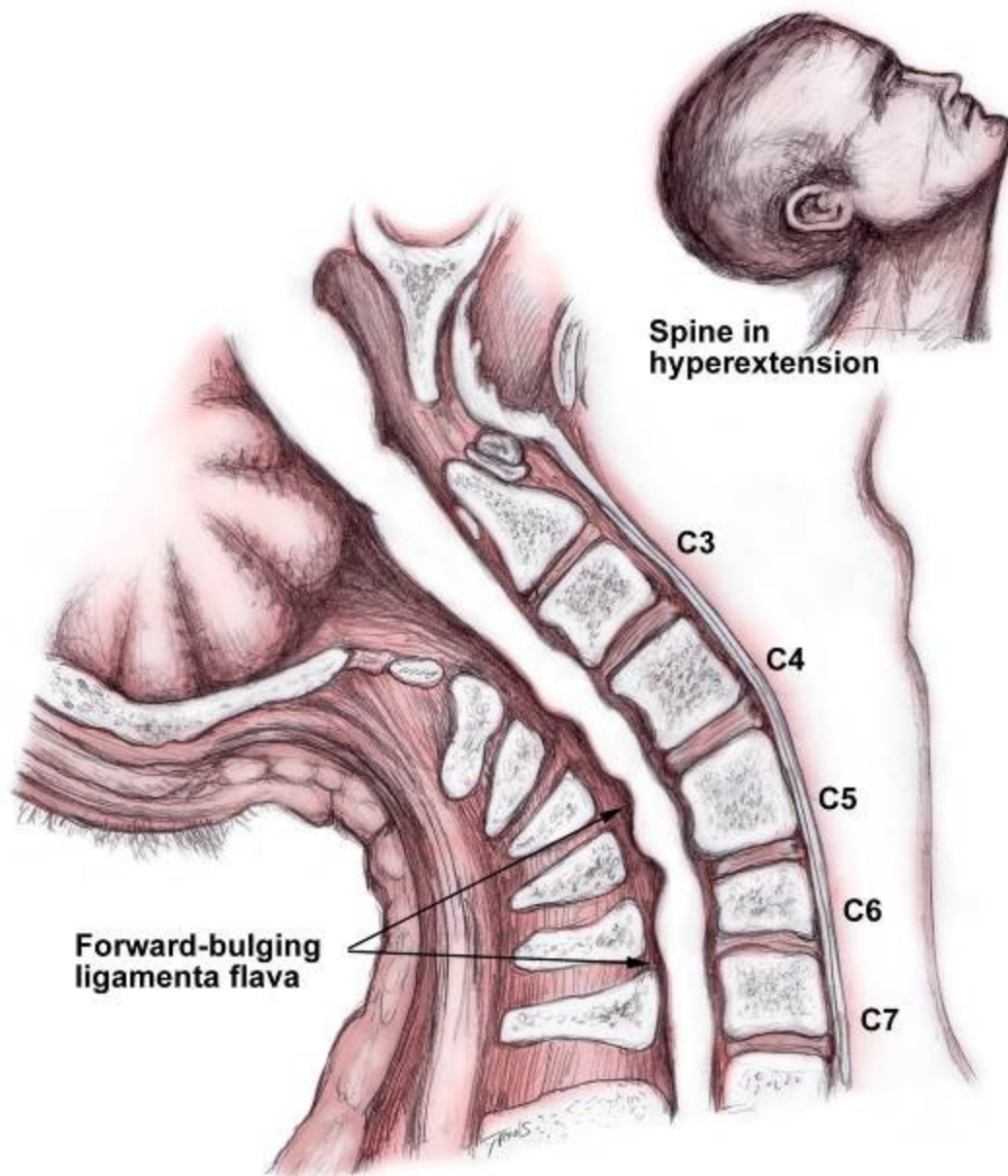
# Types of incomplete injuries

- i) Central Cord Syndrome
- ii) Anterior Cord Syndrome
- iii) Posterior Cord Syndrome
- iv) Brown – Sequard Syndrome
- v) Cauda Equina Syndrome

*i) Central Cord Syndrome :*

- Typically in older patients
- Hyperextension injury
- Compression of the cord anteriorly by osteophytes and posteriorly by ligamentum flavum

- Also associated with fracture dislocation and compression fractures
- More centrally situated cervical tracts tend to be more involved *hence*  
*flaccid weakness of arms > legs*
- Perianal sensation & some lower extremity movement and sensation may be preserved



Spine in hyperextension

C3

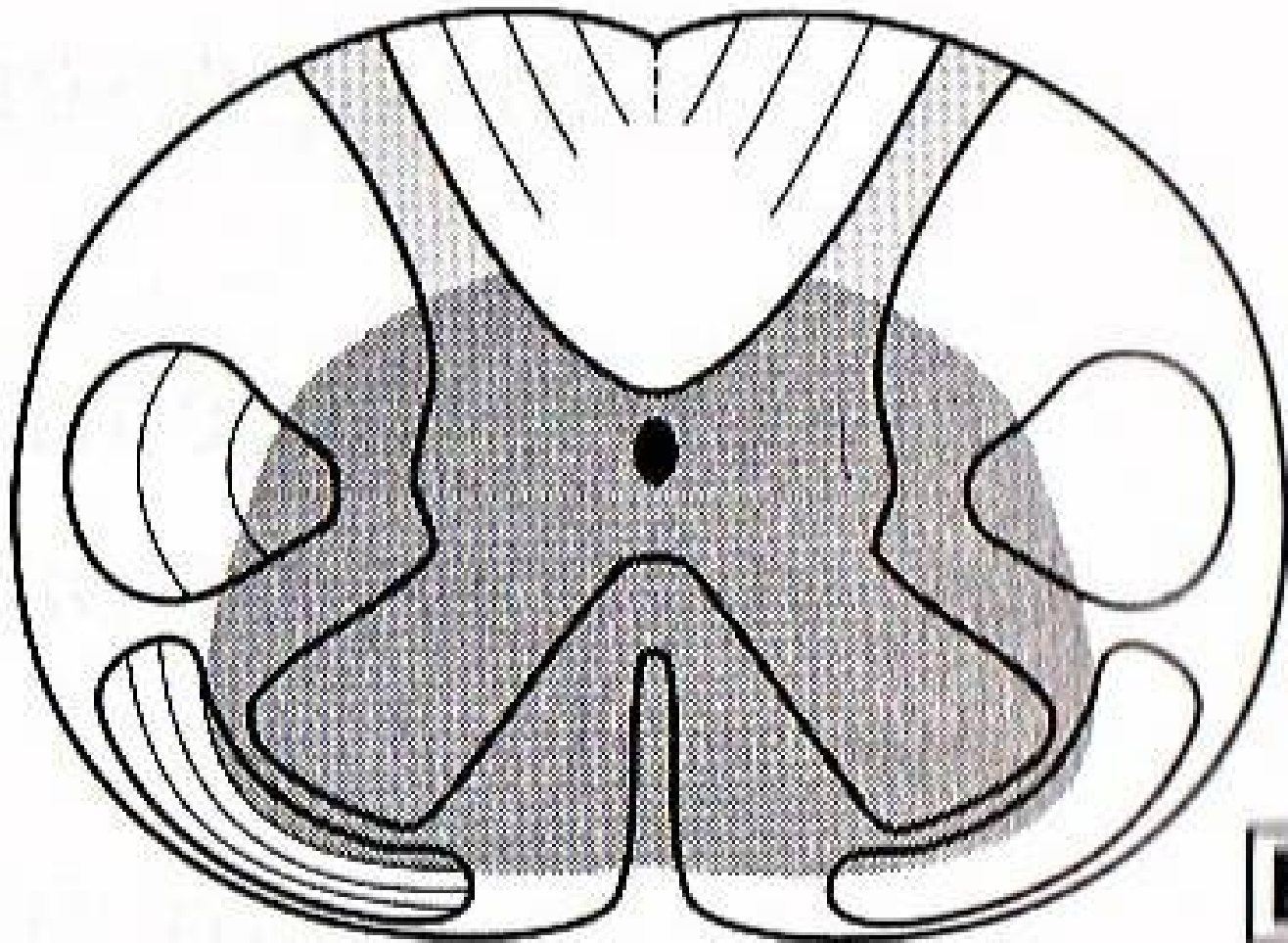
C4

C5

C6

C7

Forward-bulging ligamenta flava



**B**

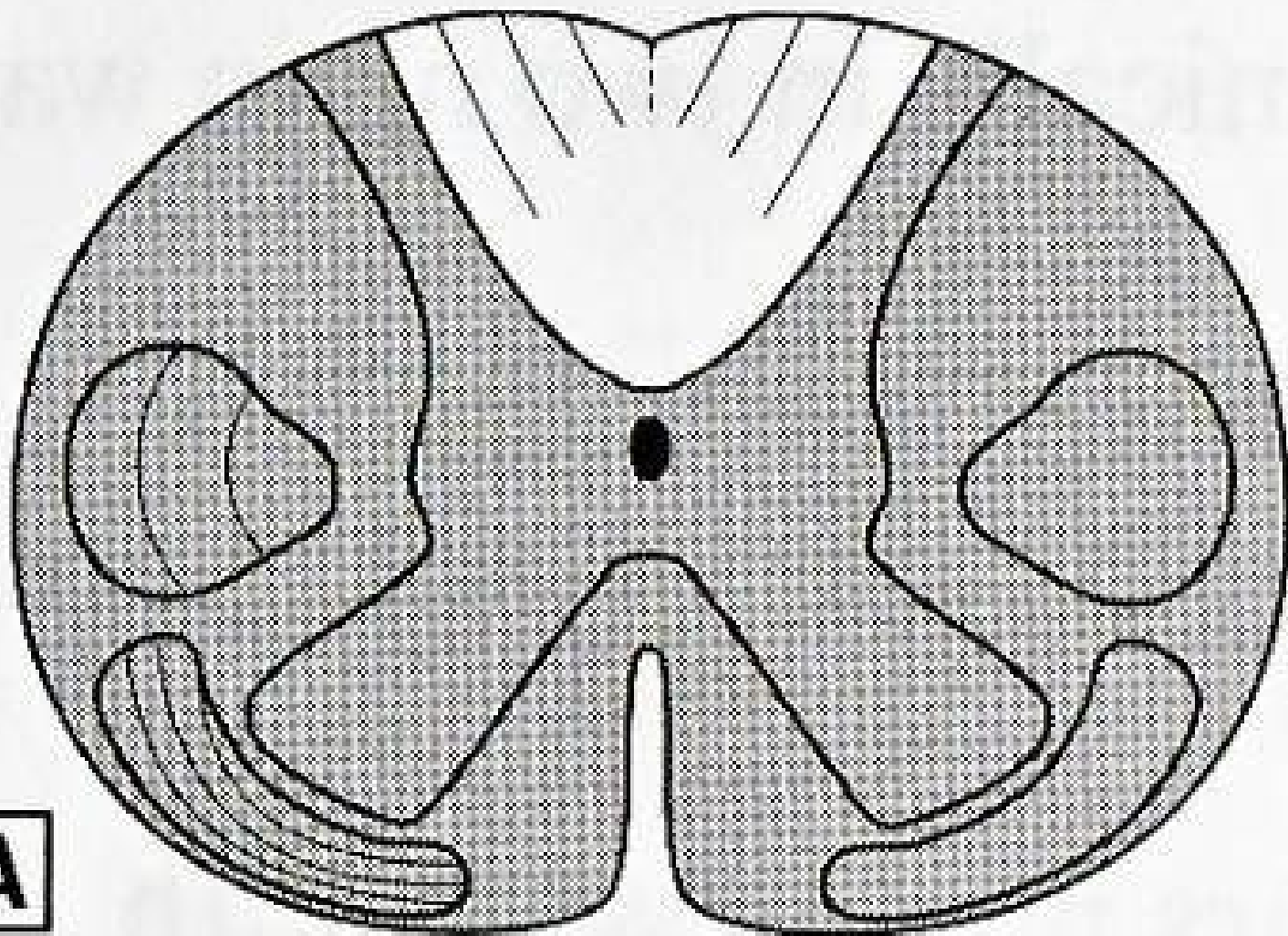


*ii) Anterior cord Syndrome:*

- Due to flexion / rotation
- Anterior dislocation / compression fracture of a vertebral body encroaching the ventral canal
- Corticospinal and spinothalamic tracts are damaged either by direct trauma or ischemia of blood supply (anterior spinal arteries)

*Clinically:*

- Loss of power
- Decrease in pain and sensation below lesion
- Dorsal columns remain intact



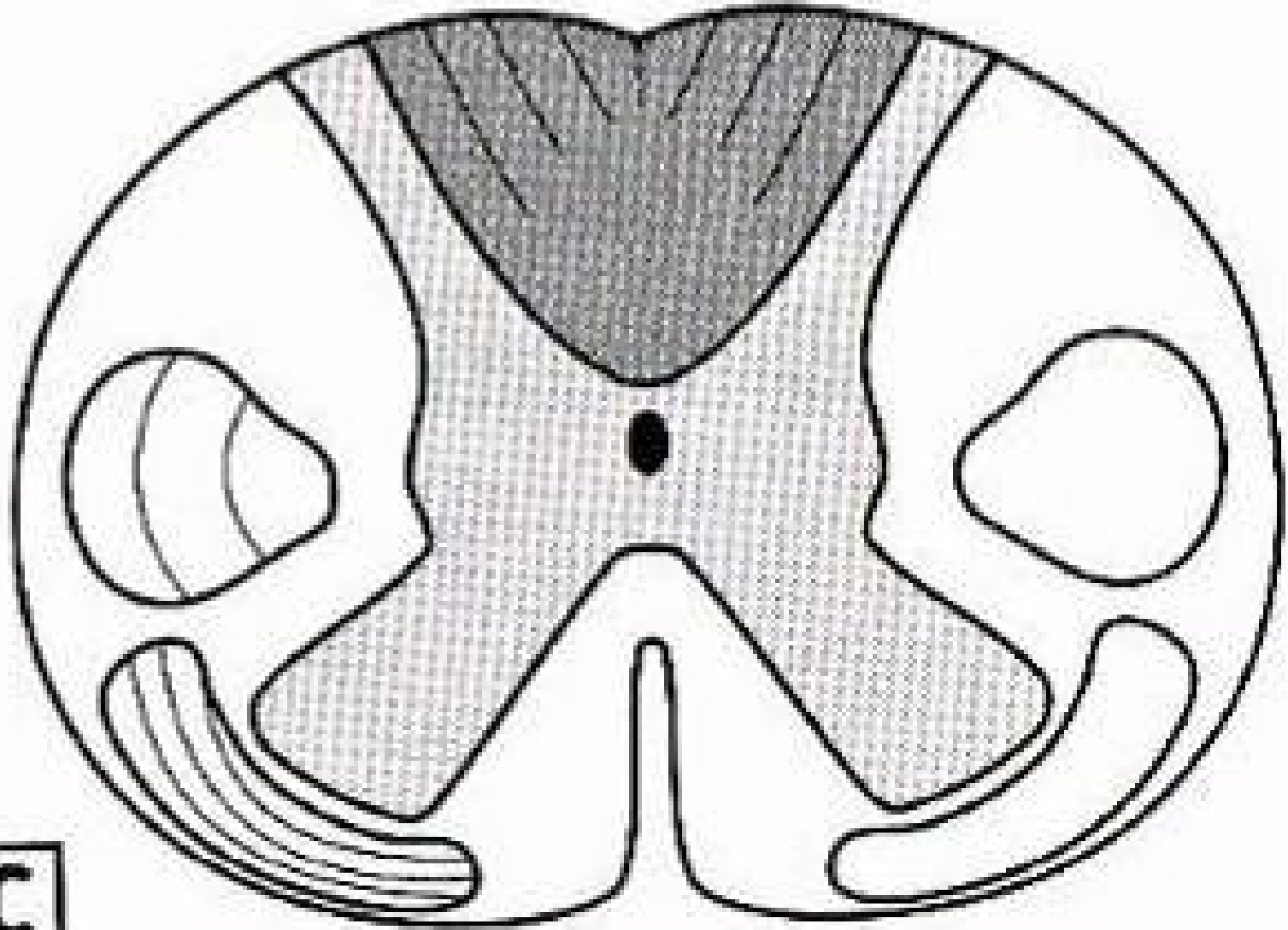
**A**

*ii) Posterior Cord Syndrome:*

Hyperextension injuries with fractures of the posterior elements of the vertebrae

*Clinically:*

- Proprioception affected – ataxia and faltering gait
- Usually good power and sensation

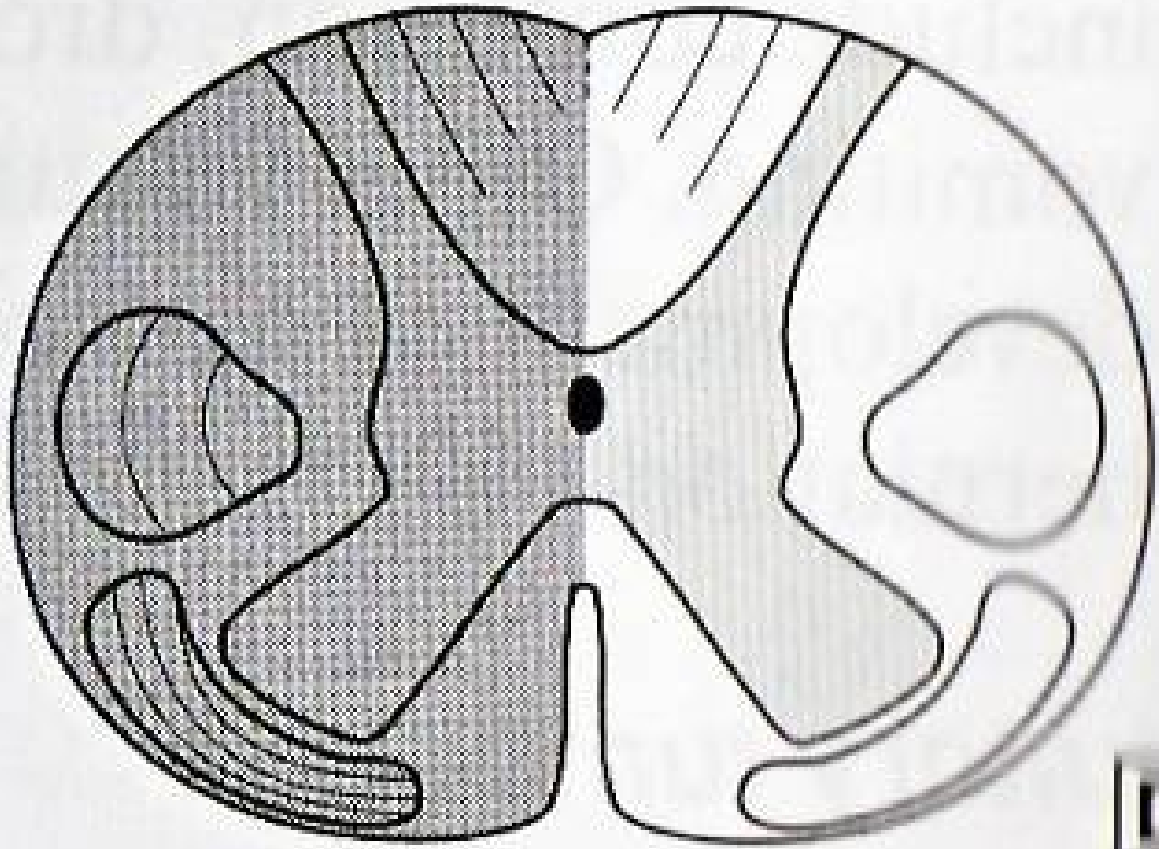


*iv) Brown – Sequard Syndrome:*

- Hemi-section of the cord
- Either due to penetrating injuries:
  - i) stab wounds
  - ii) gunshot wounds
- Fractures of lateral mass of vertebrae

*Clinically:*

- Paralysis on affected side (corticospinal)
- Loss of proprioception and fine discrimination (dorsal columns)
- Pain and temperature loss on the opposite side below the lesion (spinothalamic)





## *v) Cauda Equina Syndrome:*

- Due to bony compression or disc protrusions in lumbar or sacral region

### *Clinically*

- Non specific symptoms – back pain
  - bowel and bladder dysfunction
  - leg numbness and weakness
  - saddle parasthesia