MODULE 5:
SCI MECHANISMS

(A) Three Column Model

- Physicians use a three column model of the spinal column in order to describe and explain the spinal column injuries.

- These three columns are as follows:

  1. Anterior column - the anterior longitudinal ligament and the anterior one-half of the vertebral body,

  2. Middle column - the posterior one-half of the vertebral body

  3. Posterior column - laminae and the spinal canal.

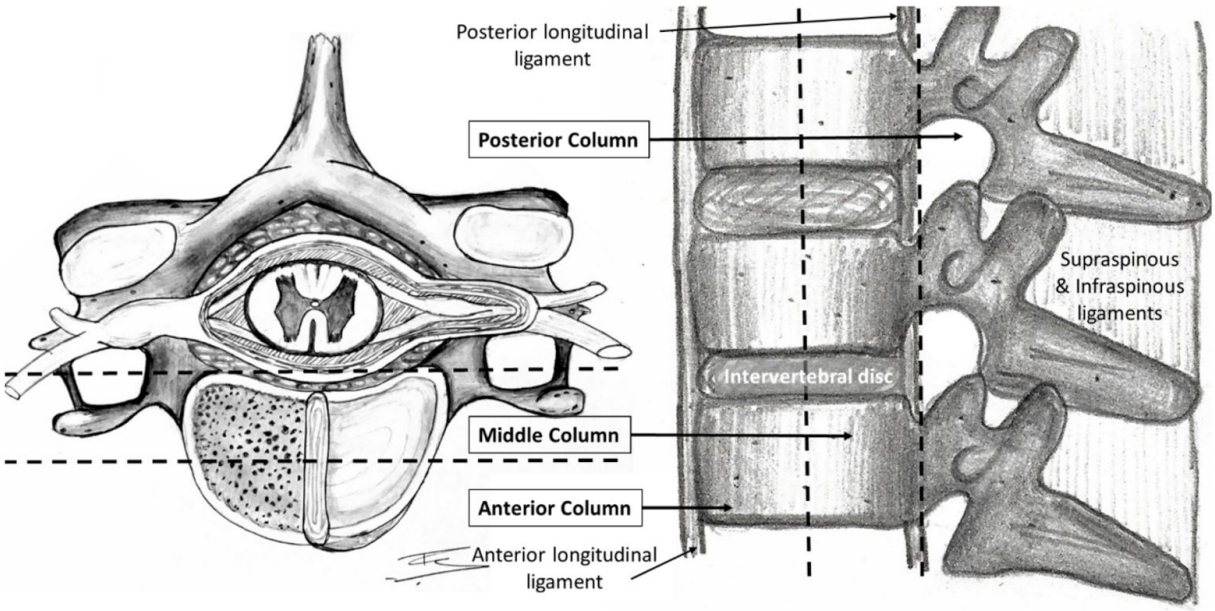

Figure: Three column model of the spinal column

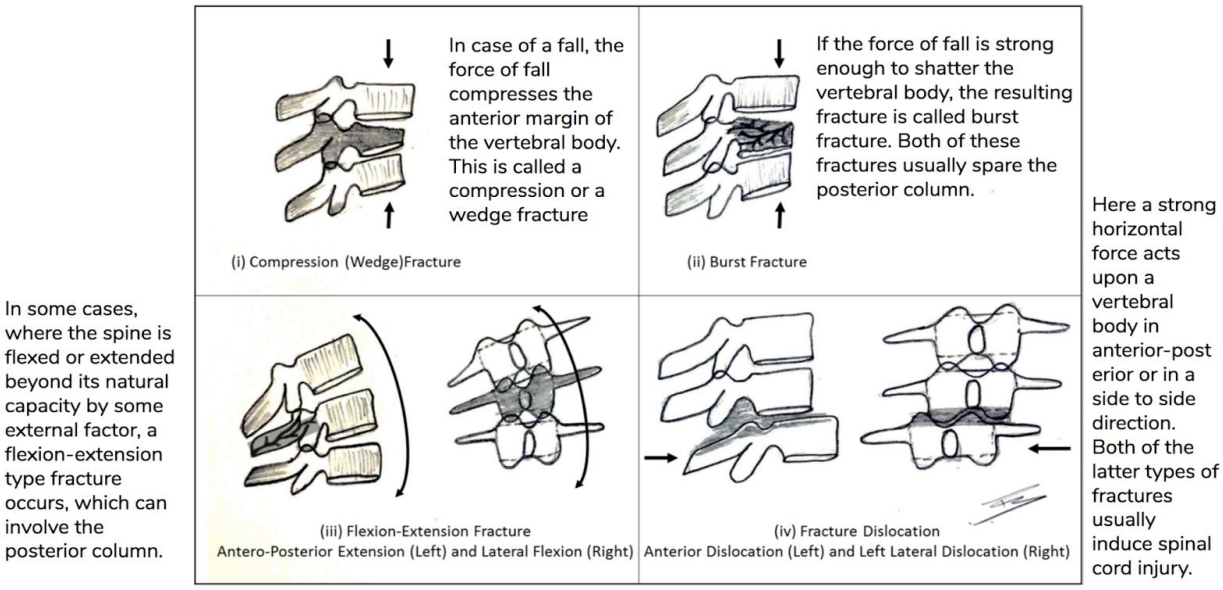

Figure: Different scenarios of spinal column injuries

(B) Clinical Classification

- The clinical classification of spinal cord injuries is done by guidelines given by the American Spinal Injury Association (ASIA).

- There are 5 clinical grades in ASIA classification:

  A = Complete injury: No motor or sensory function is preserved in the sacral segments S4-S5.

  B = Incomplete injury: Only sensory (no motor) function is preserved below the neurological level including the sacral segments S4-S5.

  C = Incomplete injury: Motor function is preserved below the neurological level, but with at least half of major muscles below the neurological level showing a muscle power less than grade 3.

  D = Incomplete injury: Motor function is preserved below the neurological level, and over half of major muscles below the neurological level have a muscle power of grade 3 or more.

  E = Normal: Normal motor and sensory function.

(C) Sequelae to SCI

- Sequelae of spinal cord injury are described in the following phases.
- The events that occur in each phase are specific and signify specific stages of injury progression or recovery.

Phase	Duration after injury	What happens here?
Immediate	0-2 hours	• Structural damage • Bleeding, spinal shock • Grey matter necrosis
Acute	2 hours – 2 days	• Necrosis, acute inflammation • Hematoma, pressure symptoms • Axonal swelling, secondary damage begins
Subacute	2 days – 2 weeks	• Acute inflammation subsides, hematoma dissolves • Pressure symptoms are relieved, glial scar formation begins • Wallerian degeneration begins
Intermediate	2 weeks – 6 months	• Glial scar formation is complete, cyst may form at the lesion site • Stabilization of injury, spinal shock is resolved, • Wallerian degeneration continues
Chronic	Beyond 6 months	• Wallerian degeneration is complete, functional and structural deficit become permanent, some functional recovery may occur

Figure: Sequelae of spinal cord injury

- Other than the spinal cord itself, a number of body systems are affected following the spinal cord injury:
  - Neurogenic shock- involves the whole nervous system
  - Thromboembolism- stagnant blood inside the veins may form clots
  - Bed sores - due to immobility
  - Ectopic bone formation
  - Pain – not only in the acute phase, also in chronic phase
  - Mental health is compromised leading to depression, anxiety, shock
  - Autonomic dysregulation involving heart, breathing, bowel movements, bladder control, sweating, temperature dysregulation and sexual dysfunction.
  - In severe cases of quadriplegia, autonomic dysreflexia may happen where the patient suffers from very high blood pressure, low heart rate, low respiration rate, excessive sweating and hot flushed skin. This happens without warning and may be life threatening if left untreated.