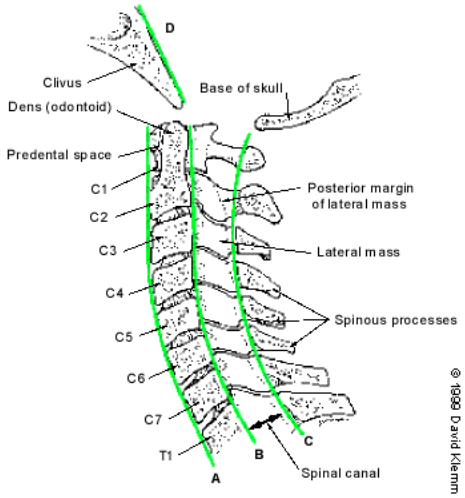
Spine Trauma- Part B

Cervical Spine Injuries



- Atlanto- Occipital Dislocation
  - Hyperextension and distraction mechanism
    - Down's syndrome, RA more susceptible
  - Asymmetric lateral masses on odontoid view
  - Widened predens space
  - Treatment-
    - Often fatal
    - Highly unstable
    - If not fatal avoid traction, definitive fusion occiput to C1

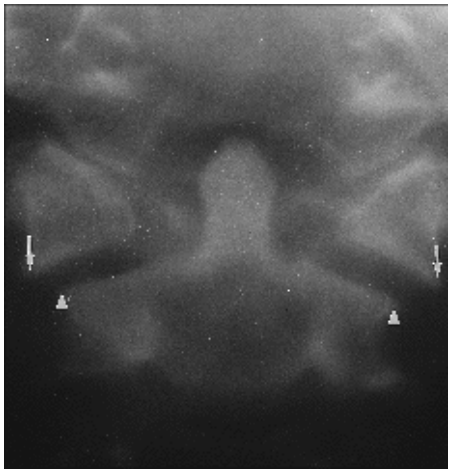
Atlanto-axial Dislocation

- **Hyperextension injury**
- **Children>adults**
- **Head slips forward on C1**
- **Usually fatal**

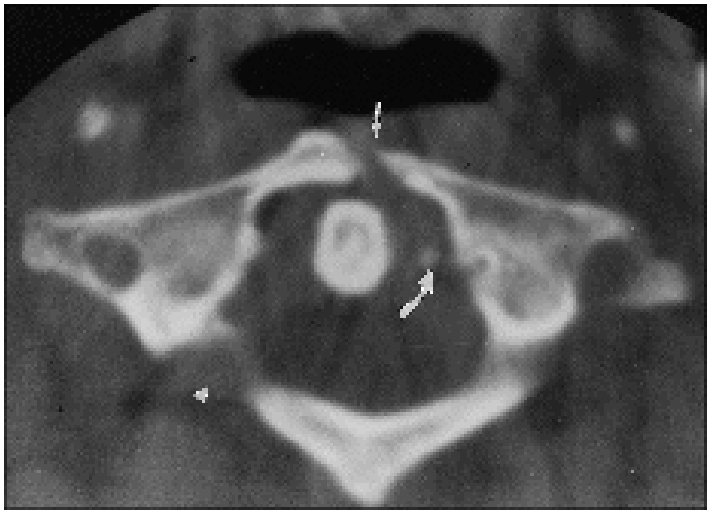
Atlas Fractures

- **Neural Arch Fracture of C1**
- **Most common fracture of C1**
- **Hyperextension injury**
- **Not associated with neurologic deficit**
- **May be confused with congenital anomaly**

Atlas Fractures



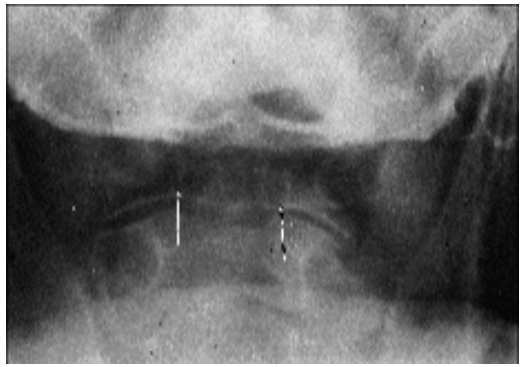
- Jefferson fracture
  - Burst fracture of atlas (C1)
  - Usually bilateral breaks in ant/ post arches
  - Vertical compression/ axial load injury
  - Widened lateral masses of C1 on open-mouth odontoid view
  - Widened predens space
  - Moderately unstable
  - Neuro deficits uncommon
- Associated with:
  - **Fractures of C7 (25%)**
  - **Fractures of C2 pedicle (15%)**
  - **Extraspinal fractures (58%)**



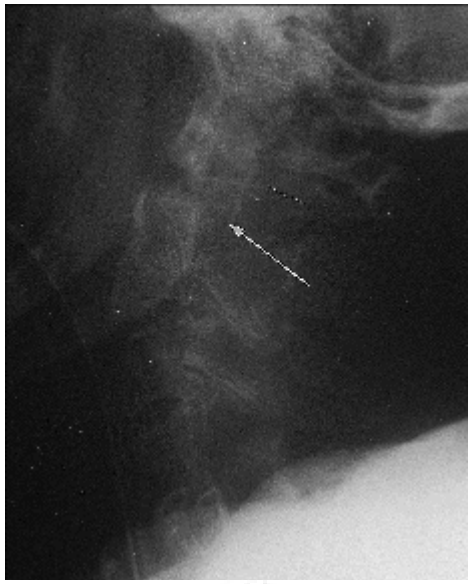
Transverse Ligament Ruptures

- May occur alone or with fracture atlas or atlanto-axial subluxation
- Transverse lig is the main restraint to ant motion of C1
- Mechanism- due to flexion
- Widening of normal distance between ant ring of atlas and dens less than 3mm
- Unstable

Axis Fractures

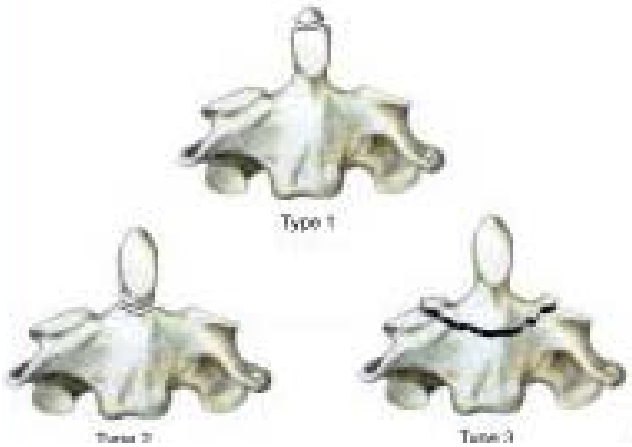


- Incidence: 6% of cervical spine fractures
- Associated with atlas fractures in 8%
- Hyperextension
- Often forward subluxation of C1 on C2



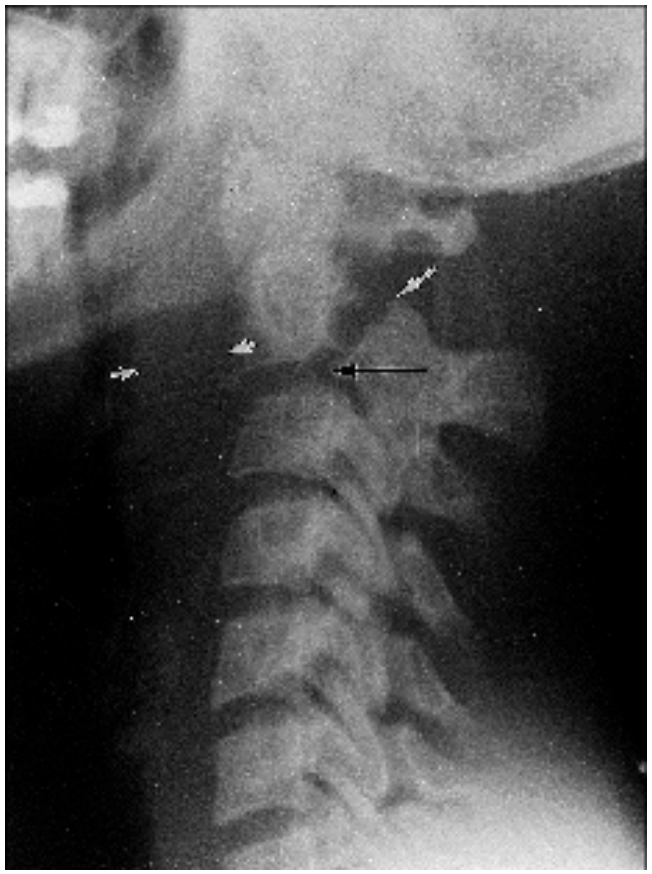
Odontoid fracture

- Type I
  - Avulsion of tip of odontoid (5-8%)
  - Difficult to detect; required CT
- Type II
  - Fracture through base of dens (54-67%)
  - Complication: nonunion
- Type III
  - Subdental injury (30-33%)
  - Prognosis: good



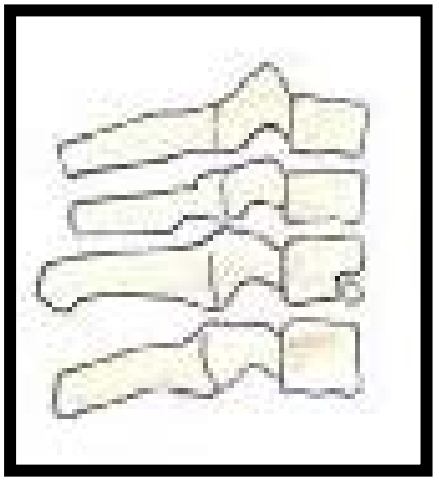
Hangman's Fracture

- Most common fracture of C2
- Bilateral fracture of pedicles of axis (C2)
- Anterior slip of C2 on C3
- Mechanism: Sudden deceleration with hyperextension
- May or may not have anterior subluxation
- Unstable
- Neuro deficits variable
- Teardrop fracture of inferior aspect of C2 or C3 is clue

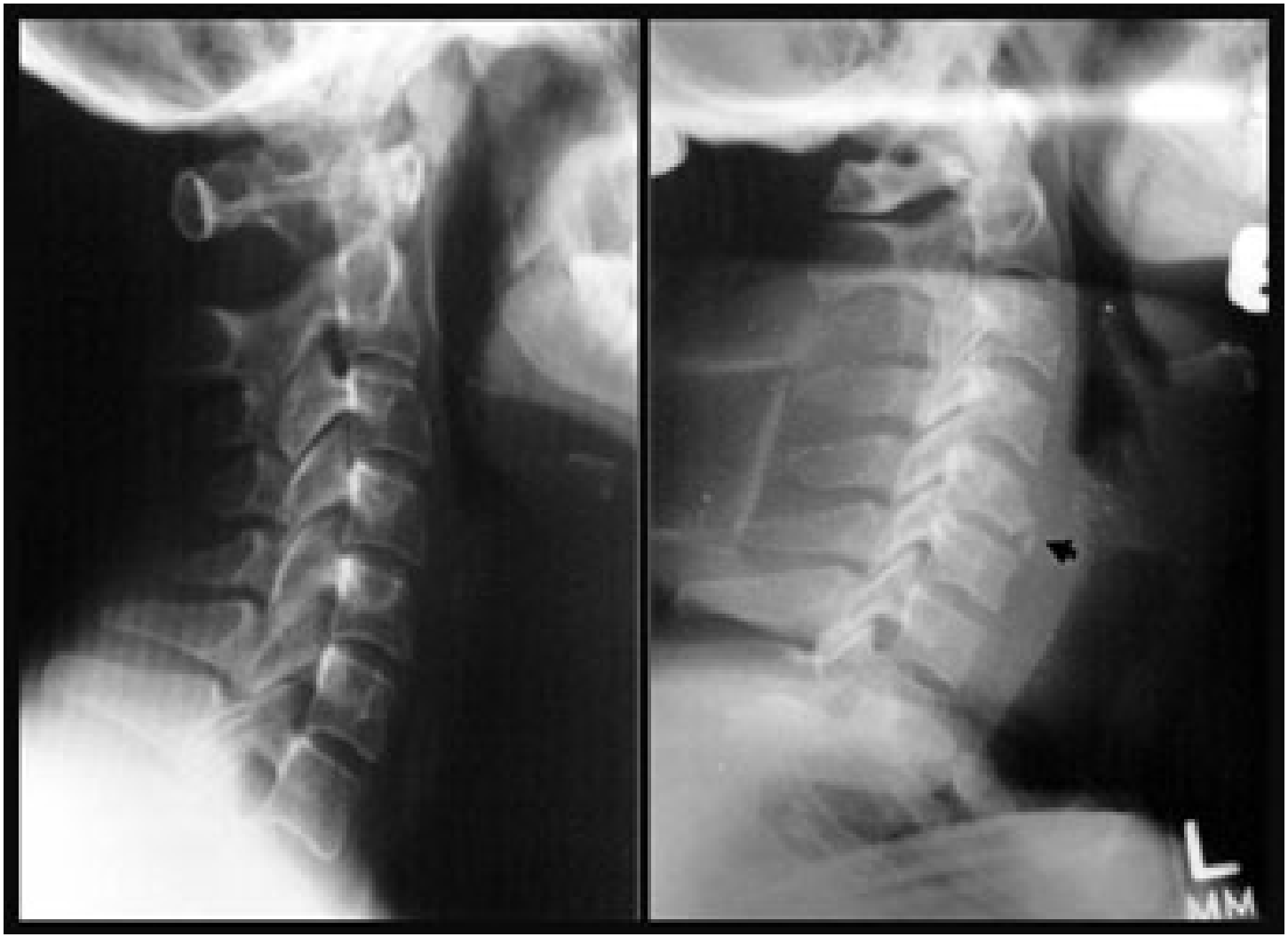


Tear Drop Fracture

- Avulsion of antero-inferior corner of cervical vertebral body by anterior ligament
- Most severe and unstable injury of the C-spine
- Mechanism: may be secondary to hyperflexion or hyperextension sudden, forceful flexion
  - Often the result of diving into shallow water
- Typically at C2
- Unstable with ligamentous instability
- Remainder of body displaced backward into spinal canal
- Facet joint and interspinous distances usually widened
- Disk space may be narrowed
- Neuro deficit in up to 70%



Teardrop



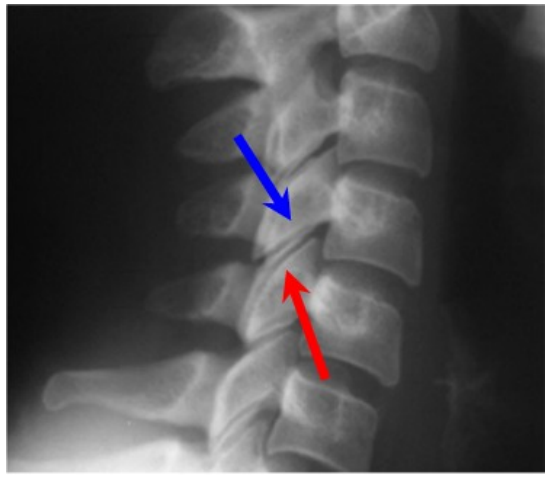
Teardrop

Compression Fracture

- Flexion injury
- Anterior wedging of 3mm or more suggests fracture
- Usually involves superior endplate of vertebral body

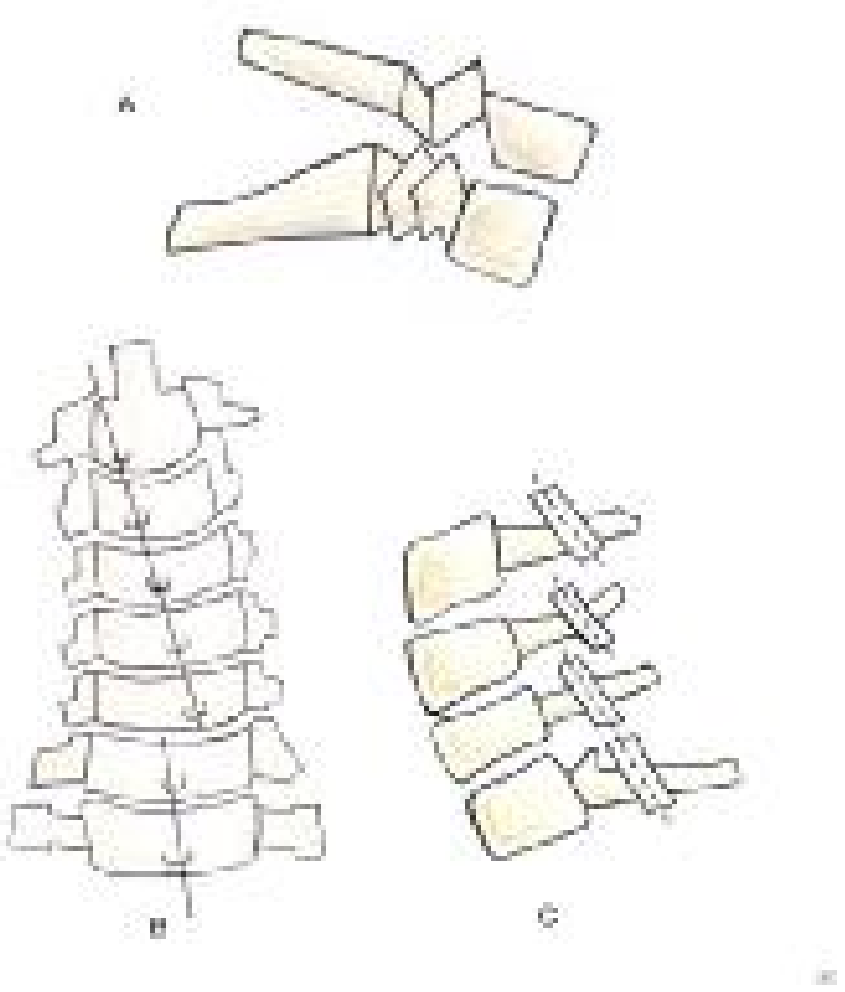
Unilateral facet dislocation

- Mechanism: flexion, combined flexion/ rotation
- Anterior dislocation of one vertebral body by 25- 30% on lateral view
- Stable if anterior displacement on lateral less than ½ width of VB
- Only 30% associated with neurologic defect

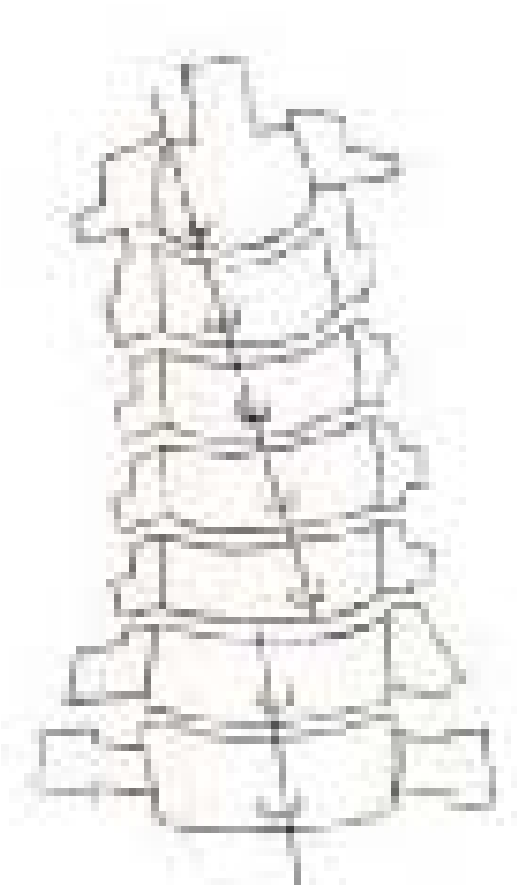


Unilateral facet dislocation

- AP view-disruption of spinous process line
- Oblique- disruption of the tilting of the lamina
  - Superior articulating facet impinges in neural foramina

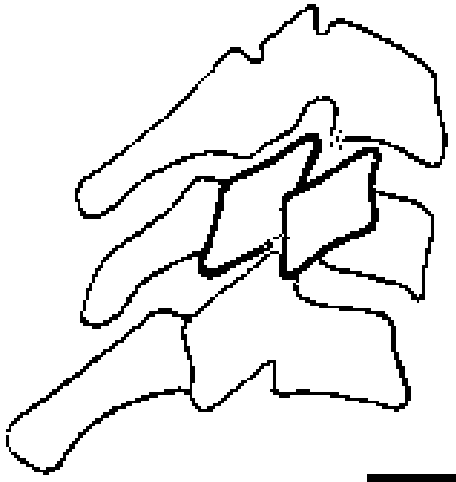


Unilateral Facet Dislocation

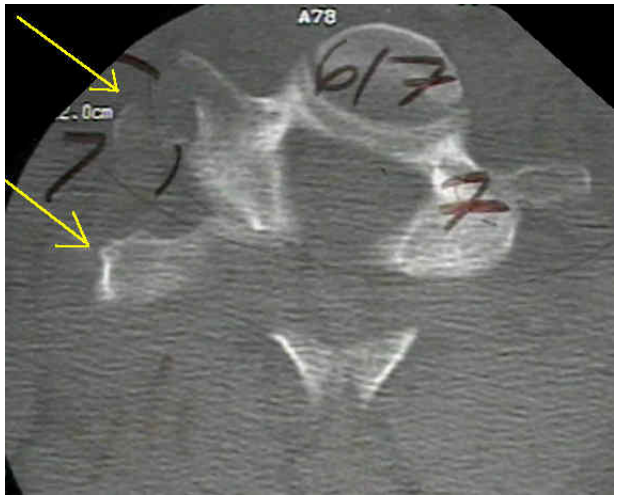


AP view- spinous processes of the vertebrae above the dislocation displaced towards the side of the dislocated facet

Unilateral Facet Dislocation

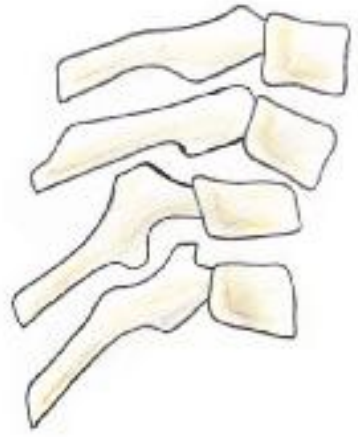


Bowtie Sign

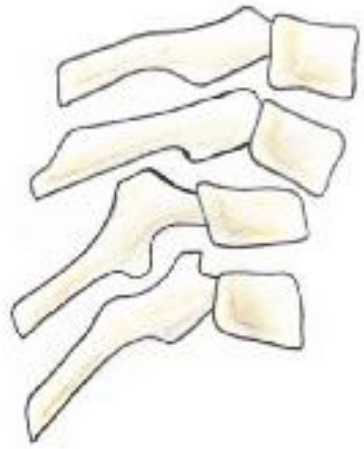


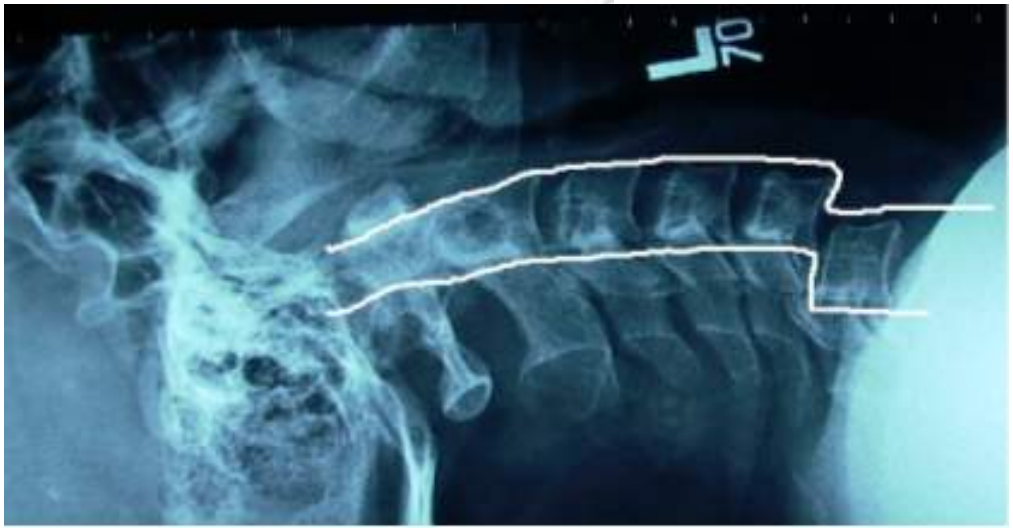
Bilateral Facet Dislocation

- Mechanism: flexion, combined flexion/ rotation
- Anterior dislocation of one vertebral body by 50% on lateral view
- Unstable
- Neurologic deficits common
  - **Seen in up to 85%**



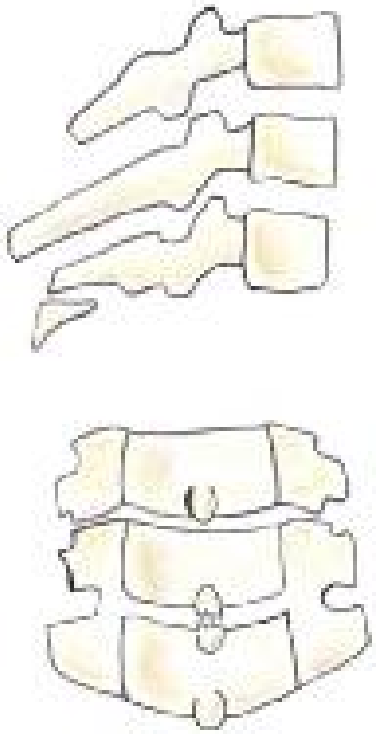
Bilateral Facet Dislocation





Clay Shoveler's Fracture

- Avulsion fracture of posterior spinous process of C7 or T1
- Mechanism: sudden load on a flexed spine or secondary to rotational injury
  - Shoveling snow, clay
- Very stable



Clay Shoveler’s Fracture

Cervical Spine Fracture Stability

Failure of middle column bony structures indicated by-

- Wide pedicles
- More than 25% loss of post body ht
- Fracture lines through post body cortex

Failure of middle column ligamentous structures indicated by-

- Interspinous or intervertebral angulation 11 deg more than than adjacent segment
- Horizontal translation more than 3.5 mm
- Intervertebral disc space separation more than 1.7 mm

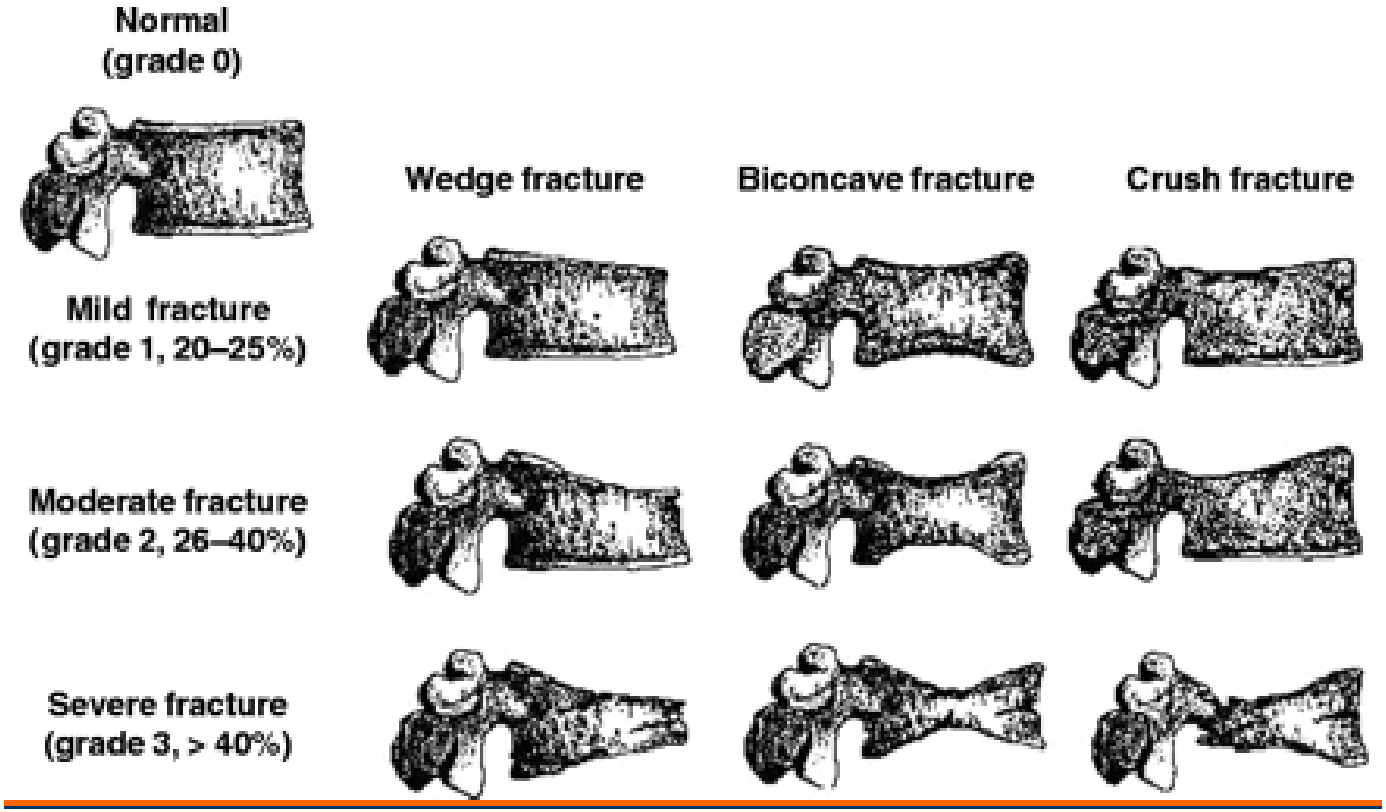
Cervical Ligamentous Injury

- Mechanism is flexion/distraction
- Clues to diagnosis
- Disk space narrower anteriorly than posteriorly
- Widening of the interspinous distance
- Widening of the facet joint
  - Usually the posterior aspect

Thoracic Spine

- Rigid
- Spinal canal narrower than cervical or lumbar spine
  - Large spinal cord diameter relative to canal diameter increases the risk of cord injury
- Injury, usually significant (complete), less common than in other regions
- Association between fractures of the thoracic spine and severe pulmonary injuries,mediastinal hemorrhage

Thoracic Spine Fractures



Thoracic Spine Injuries

Compression fracture

- Injury to anterior column due to anterior or lateral flexion
  - Middle, posterior column remains intact
- X-ray - decreased height anterior vertebral body, post body ht normal
- Amount of ant compression usually less than 40% of post body height
- Clinically - stable, cord injury rare

Thoracic Compression Fracture

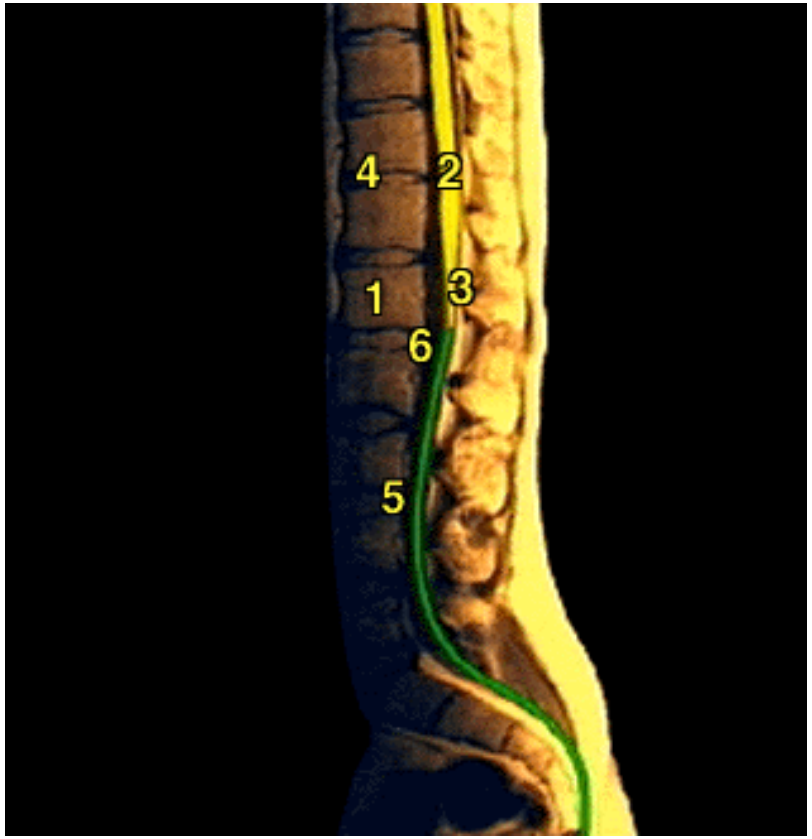
- Unstable if:
  - Loss of vertebral ht > 50%
  - Angulation more than 20 deg
  - Multiple adjacent compression fractures

Thoracic Spine Injuries

Burst

- Disruption of the middle column
- Mechanism- axial loading
- Varying degrees of retropulsion into the neural canal
- X-ray- spreading of post elements
- If post elements involved- 50% have neuro injury
- Neurologic injury more common in:
  - Loss of vertebral ht > 50%
  - Angulation > 20 deg
  - Canal compromise more than 40%

Lumbar Spine



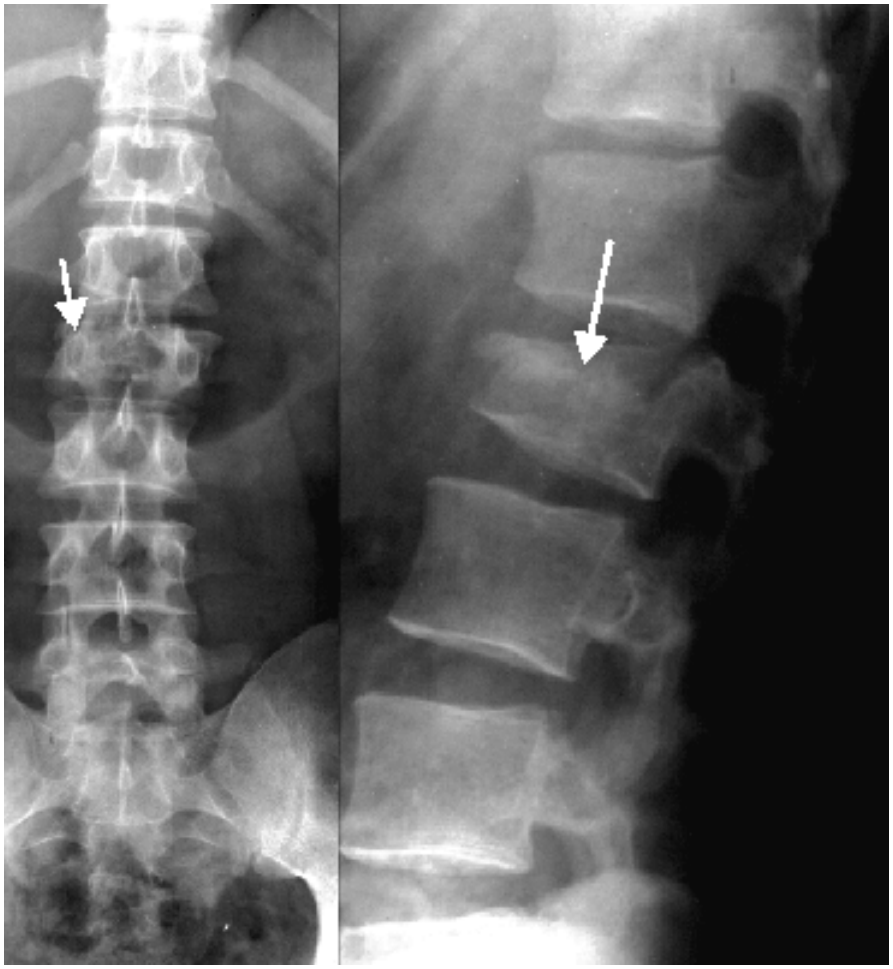
1. Vertebral body
2. Spinal cord
3. Conus medullaris
4. Intervertebral disc
5. Filum terminale
6. Subarachnoid space

Lumbar Spine Fractures

- Thoracolumbar spine and lumbar spine are the most common sites for fractures due to the high mobility of the lumbar spine compared to the more rigid thoracic spine
- Injury to the cord or cauda equina occurs in approximately 10-38% of adult thoracolumbar fractures and in as many as 50-60% of fracture dislocations.
- Most occur in people younger than 30 years
- Nearly 60% of patients have serious disabling deficits
- Etiology- 40% caused by motor vehicle accidents, 20% by falls, and 40% by gunshot wounds, sporting accidents, industrial accidents, and farming accidents

Lumbar Spine Injury

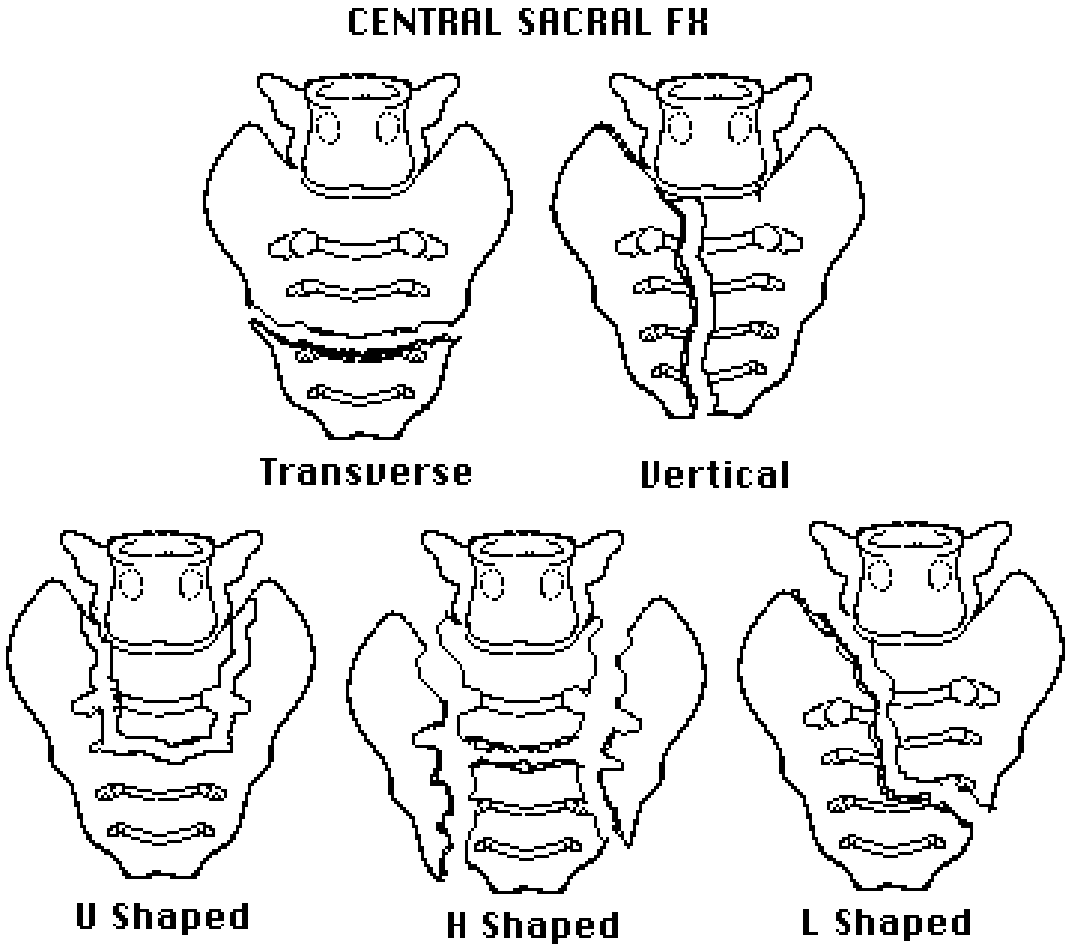
- Lower lumbar spine is the most mobile
- Isolated fractures of the lower lumbar spine rarely result in complete neurologic injuries
- Injuries usually complete cauda equina
  lesions or isolated nerve root injuries



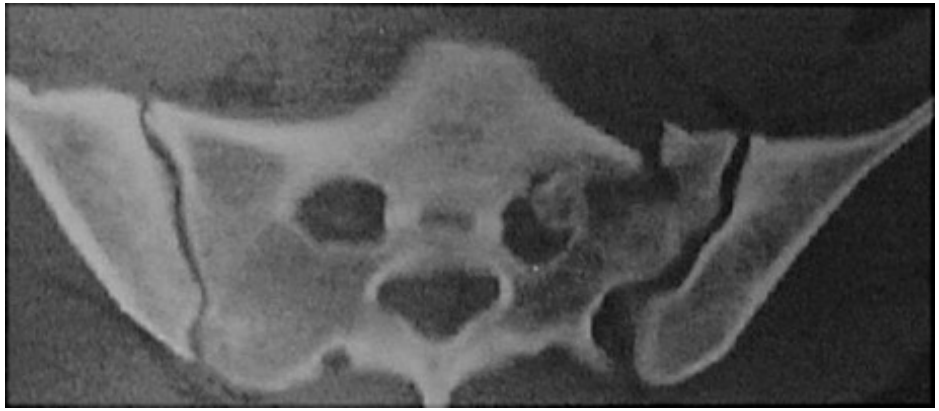
Sacro-coccygeal Injuries

- Sacral spine, nerve root injuries unusual
- Frequently associated with fractures of the pelvis
- Transverse fx through the body are most significant
  - May cause injury to part or all of the cauda equina
  - If there is involvement of the central sacral canal, however, bowel or bladder dysfunction may also occur
- Longitudinal fx may cause radiculopathy
  - Rectal examination to assess anal sphincter tone and the bulbocavernosus reflex
  - Often associated with fractures of the pelvis

Sacral Fractures



Sacral Fractures



Sacro-coccygeal Injuries

- Careful neurologic evaluation is essential
- Rectal examination will assess anal sphincter tone and the bulbocavernosus reflex
- Patients with complete damage to the sacral portion of the cord
  - Loss of control of bowel and bladder function
  - Paralysis of the lower extremities with preservation of some movement of the hips and knees and preserved knee jerks and sensation in the lumbar dermatomes.

Sacro-coccygeal Injuries

- Coccygeal injuries are usually associated with direct falls onto the buttocks
- Diagnosis of fracture is made on rectal exam
  - Pain with of the coccyx
  - X- rays are not needed
  - Rarely a bony injury
- Treatment symptomatic
  - Analgesics, rubber doughnut pillow

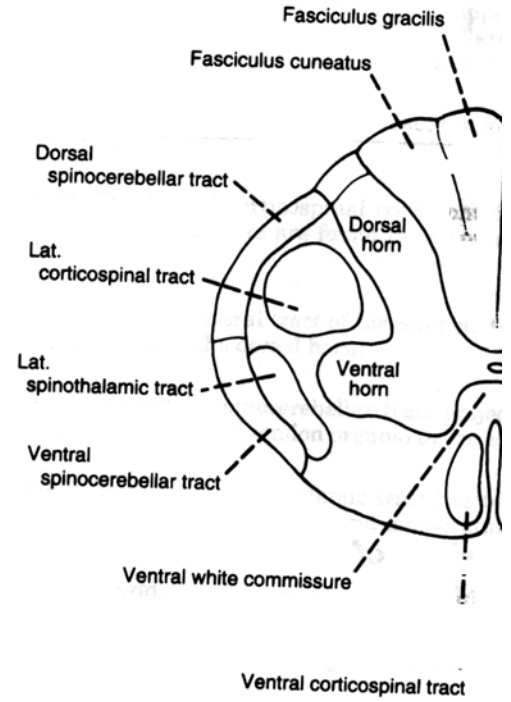
Penetrating Spine Trauma

- Majority caused by gunshot wounds.
  - Most gunshot wounds result in stable vertebral injuries
  - Cord lesions are often complete.
- Stabbing injuries are much less common
  - Prognosis better than similar paralysis with GSW
  - Majority of stab wounds involve incomplete Brown-Séquard lesions of the thoracic cord
  - Best prognosis of incomplete spinal injuries

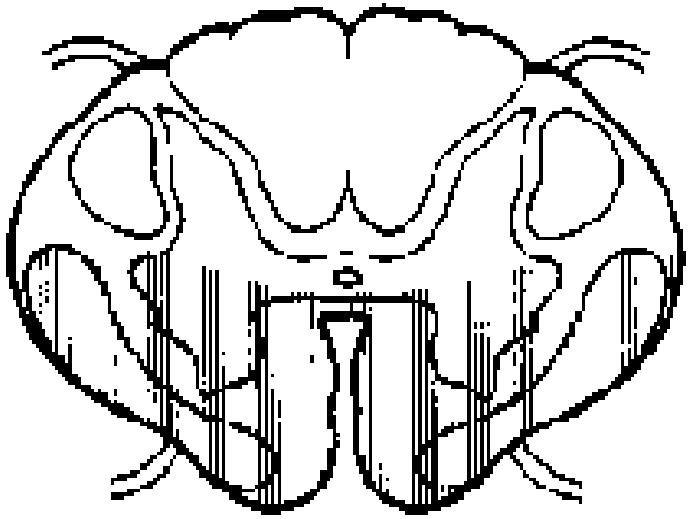
Penetrating Injuries

- Most vertebral injuries to the spine following penetrating trauma are stable and require only symptomatic treatment
- Progressive neurologic deficits warrant surgical decompression
- Bullet removal controversial in patients with stable cervical and thoracic spinal cord lesions
  - Bullet removal from the thoracolumbar spine improved motor recovery in both complete and incomplete injuries

Anterior Cord Syndrome

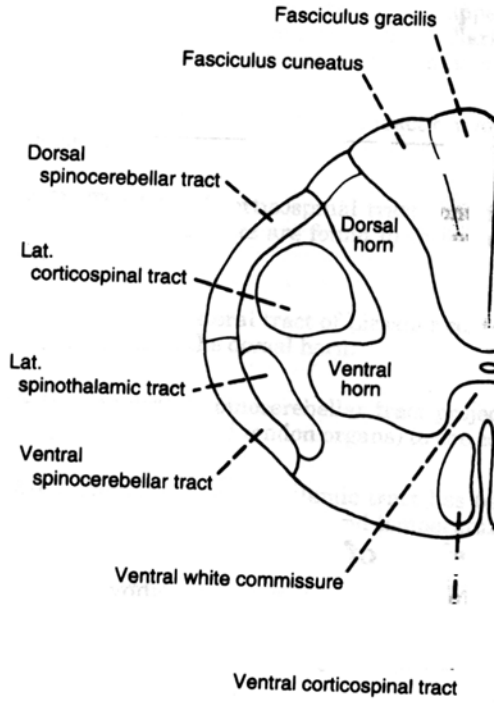


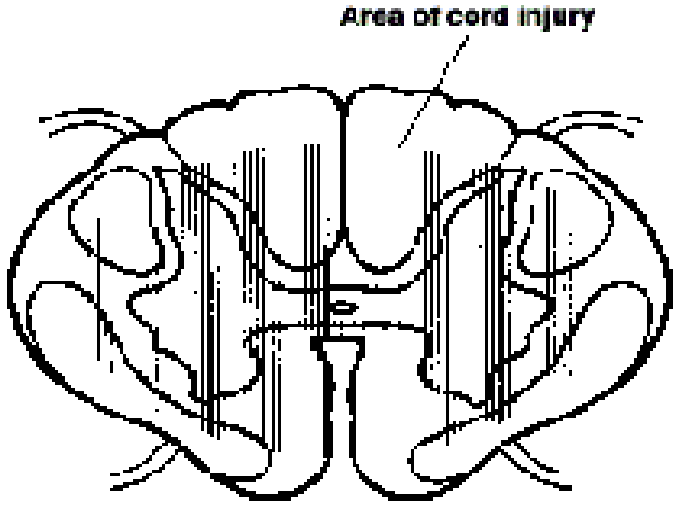
- Flexion compression of anterior cord or ischemia to anterior spinal artery
- Motor paralysis, loss of pain and temperature distal to the lesion
- Posterior columns spared
  - Light touch, motion, vibration, gross proprioception preserved
- Prognosis poor



Central Cord Syndrome

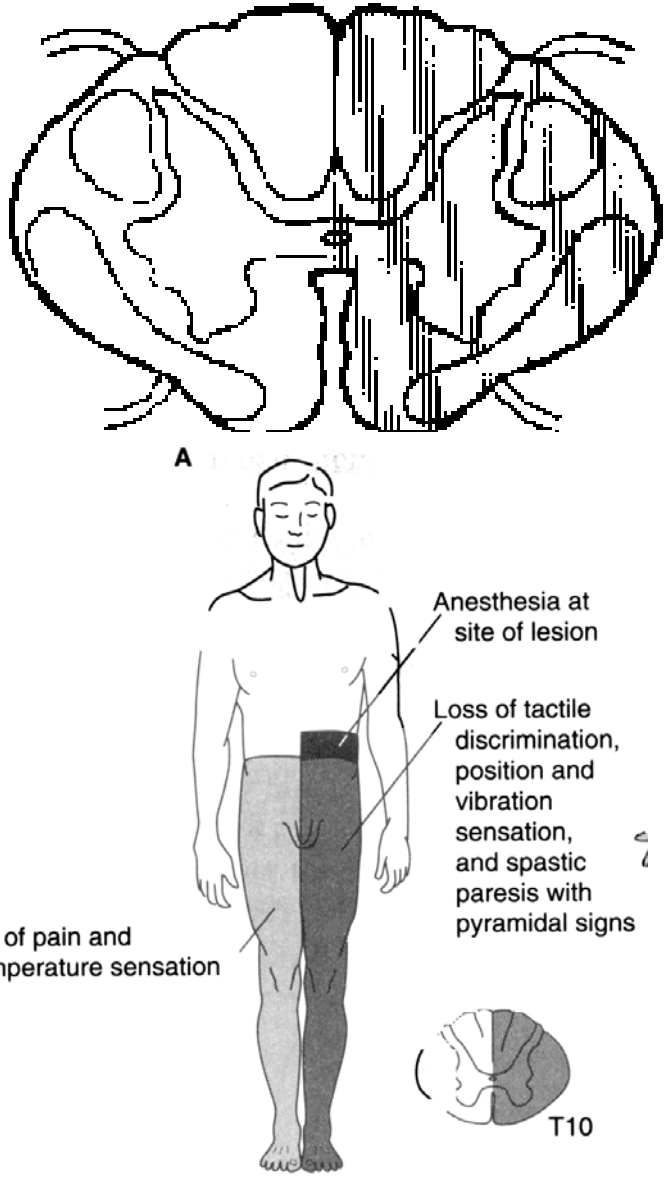
- Hyperextension injury in older patients, spondylosis, cervical stenosis
- Buckling of ligamentum flavum into cord during extension
- Partial cord syndrome
- Weakness greatest in hands
- Greater in arms than legs
- Variable sensory sensory and bladder involvement
- Treatment usually nonoperative with relatively good prognosis





Brown Sequard Syndrome

- Injury to one side of the cord
- Usually penetrating wound, hematoma, lateral disk
- Ipsilateral paralysis, loss of proprioception and vibratory sense
- Contralateral loss of pain and temperature
- Prognosis good



Cauda Equina Syndrome

- Cauda equina
  - Composed of lumbar, sacral, coccygeal nerve roots
  - Peripheral nerve injury rather than a spinal cord injury cord
- Symptoms
  - Variable motor and sensory loss in the lower extremities
  - Sciatica
  - Bowel and bladder dysfunction
  - Saddle anesthesia
    - Loss of pain sensation over the perineum
- Prognosis for recovery better than spinal cord lesions

Pediatric Spine Injury

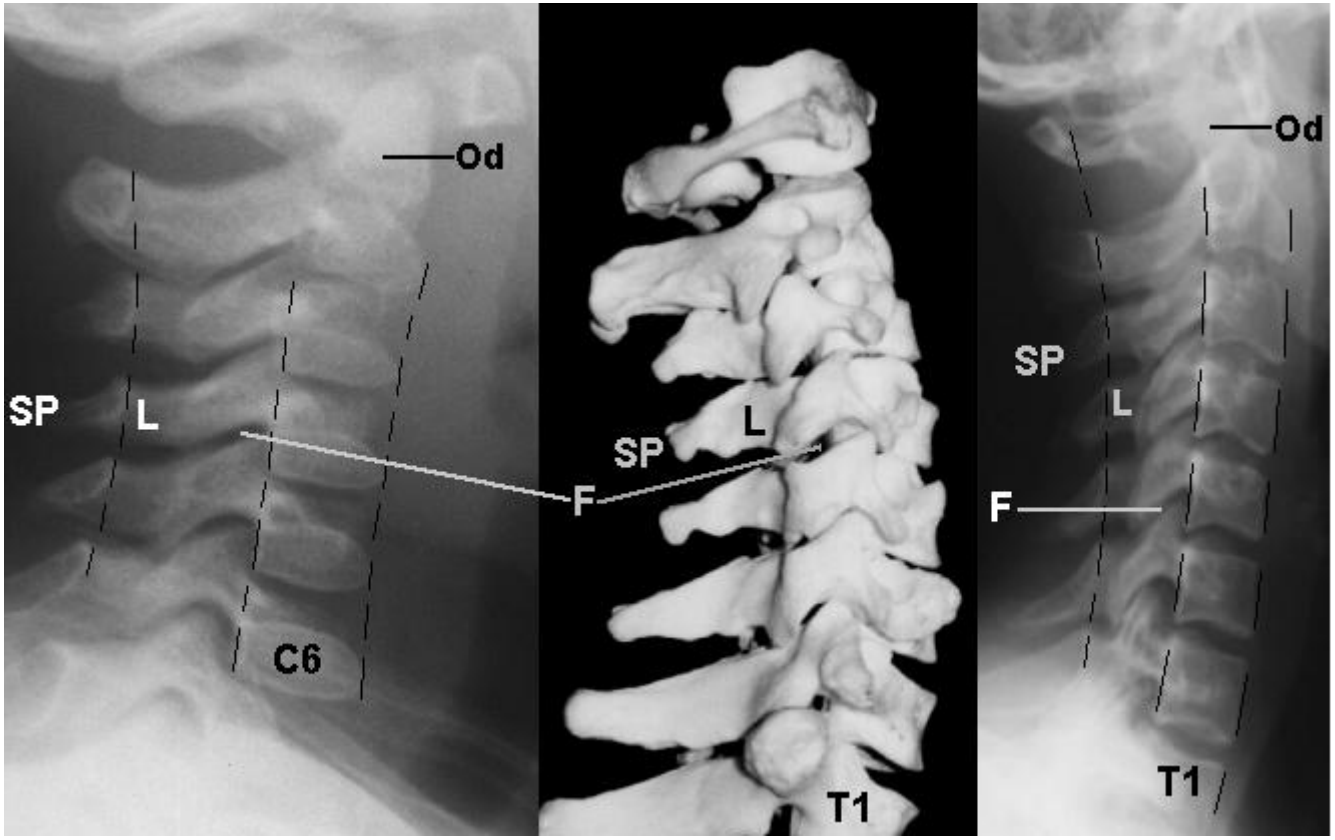
- Pediatric spine has increased mobility
  - Laxity of the interspinous ligaments and joint capsules
  - Horizontal orientation of facet joints, incompletely ossified wedge-shaped vertebrae
  - Underdeveloped neck, paraspinous muscles
- Spinal injury occur less commonly in the pediatric population
  - Usually secondary to mechanisms involving considerable force
  - High degree of neurologic compromise at presentation

SCIWORA

- Spinal cord stretching leads to neuronal injury or even complete severing of the cord
- Accounts for up to 70 % of peds SC cord injuries
- Most common in kids < 8 years
- Paralysis may be present on arrival
  - Up to 30 % have a delayed onset of neurologic abnormalities
  - May not occur until up to 4-5 days after injury
  - Many have neurologic symptoms at the time of the injury, such as paresthesias or weakness, that have subsequently resolved

SCIWORA

- Most have a complete recovery
  - Especially if the onset is delayed
- MRI defines cord anatomy, helps prognosticate



Treatment

- Airway
- Chin lift, in-line immobilization, cricoid pressure, RSI
- Patient with an injury at C5 or above should be intubated

Hemodynamic Spinal Shock

- Seen with cervical or thoracic cord injury
- Relative hypotension due to the sudden loss of sympathetic tone below the level of the lesion
- Warm, dry skin and normal capillary refill, paradoxical bradycardia
- Must exclude blood loss
  - Concurrent in 30% blunt trauma, 90% penetrating lesions
- Treat with direct acting pressors
  - Norepinephrine > dopamine

Spinal Shock

- Partial or complete injury
  - Typically at the T_6 level or above
- Temporary block of ascending/ descending communication past injured cord segment
- Clinical signs
  - Areflexia, loss of sensation, flaccid paralysis below level of lesion
  - Loss of rectal tone
  - Bradycardia,hypotension
  - Priapism implies a complete spinal cord injury

Spinal Shock

- Traumatic spine lesions not complete until spinal shock has resolved
  - Lasts variable amount of time- typically ~ 24 hours
  - Bulbocavernosus first reflex to return
    - Elicited when squeezing or tugging on the glans penis with reflex contraction of the anal sphincter
  - Cremasteric reflex suggests some spinal cord integrity
    - Tested by running a pin/ blunt instrument up medial thigh with scrotum rising in response
  - Anal wink reflex suggests some sacral sparing
    - Tested by touching skin around anus with a pin with reflex “wink” (contracture of anal sphincter)

Treatment

- Methylprednisolone
  - Load with 30 mg/kg as a bolus, followed by a continuous drip of 5.4 mg/kg/hour for the subsequent 23 hours
  - Shown to lead to a statistically significant improvement in blunt trauma in neurologic outcome
  - Not studied in penetrating trauma
  - Resulted in improvement of both motor and sensory function in complete and incomplete lesions

Conclusion

- Cervical spine CT in
  - Elderly with degenerative disease
  - Neuro deficits
  - Concurrent severe head injury
    - GCS $\leq$ 8, ICH
- MRI in
  - Suspected cord injury, especially children