

Subaxial Cervical Spine Trauma

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Initial Evaluation

A, B, C: Airway, Breathing,
Circulation

- Control Airway
- Stabilize & Immobilize Neck
- Nasal or Fiber Optic Intubation

Physical exam

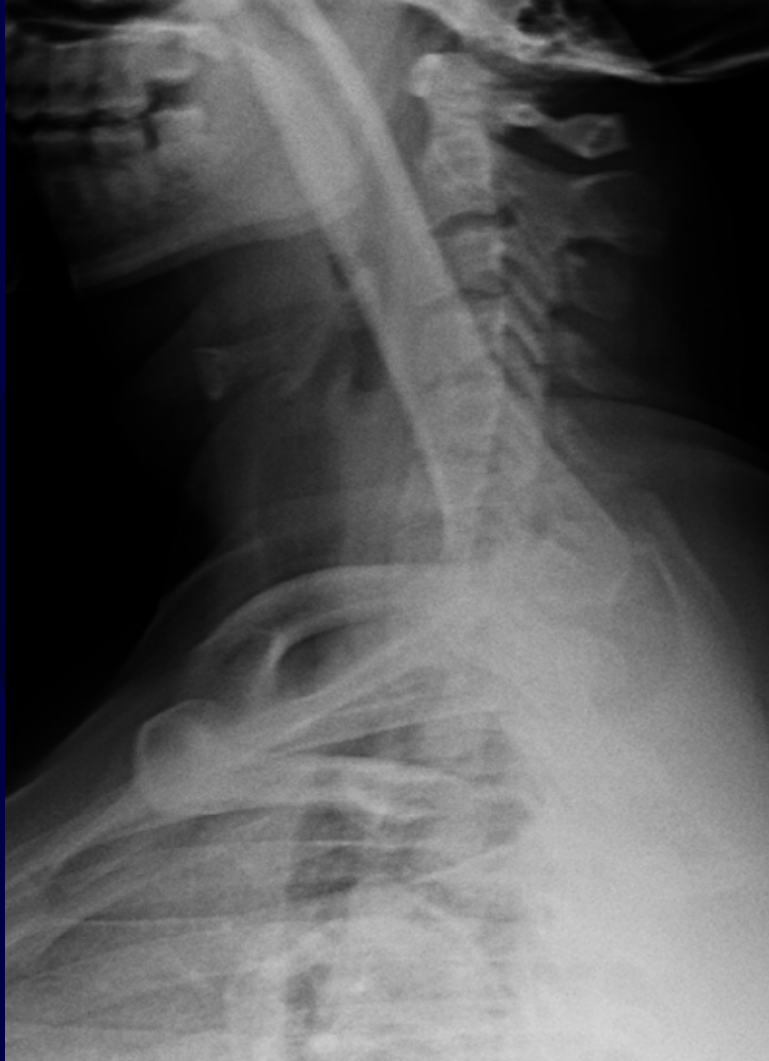
- Palpation
 - Neck pain
 - 84% patients with a clinical exam and fracture have midline neck pain
 - Step off between spinous processes
 - Crepitus
- Range of motion
- Detailed neurologic exam (RECTAL!)

Radiographic Evaluation

- Lateral C-spine to include C7-T1
- BEWARE with changing standards (most centers get CT)
- Bony anatomy
- Helpful to have baseline XR for comparison at clinic follow ups
- Soft tissue detail
- Don't forget T-L spine



Must See C7-T1, get
Swimmer's lateral view



Missed Injuries

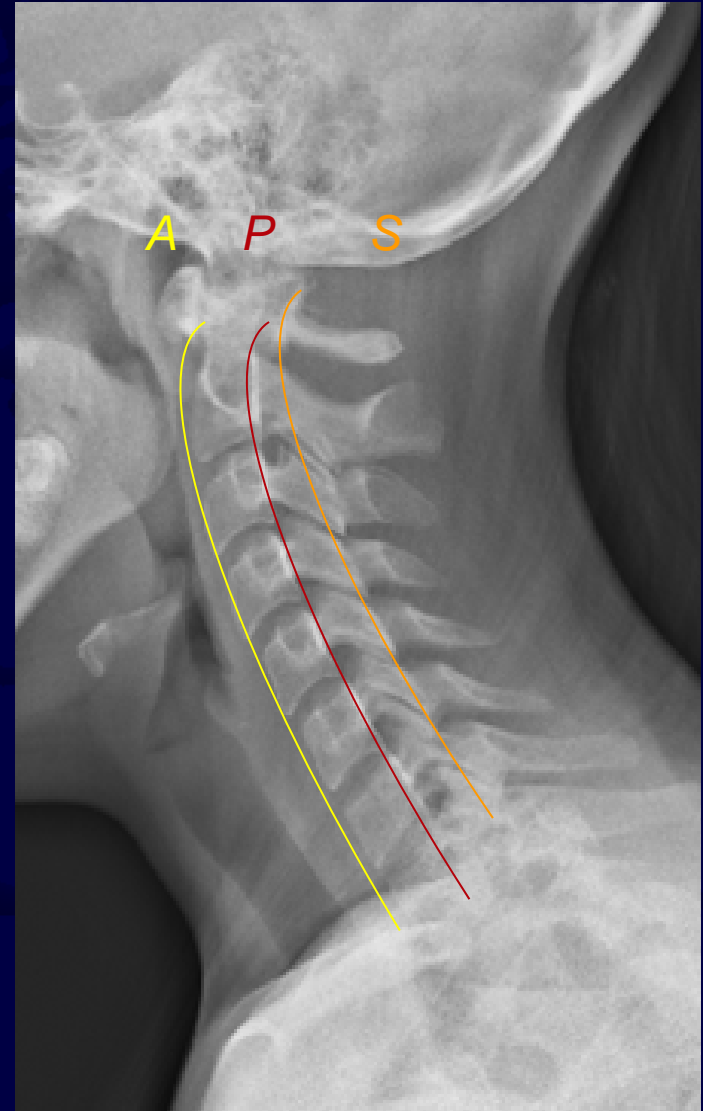
- The presence of a single spine fracture does not preclude the inspection of the rest of the spine!



Lines

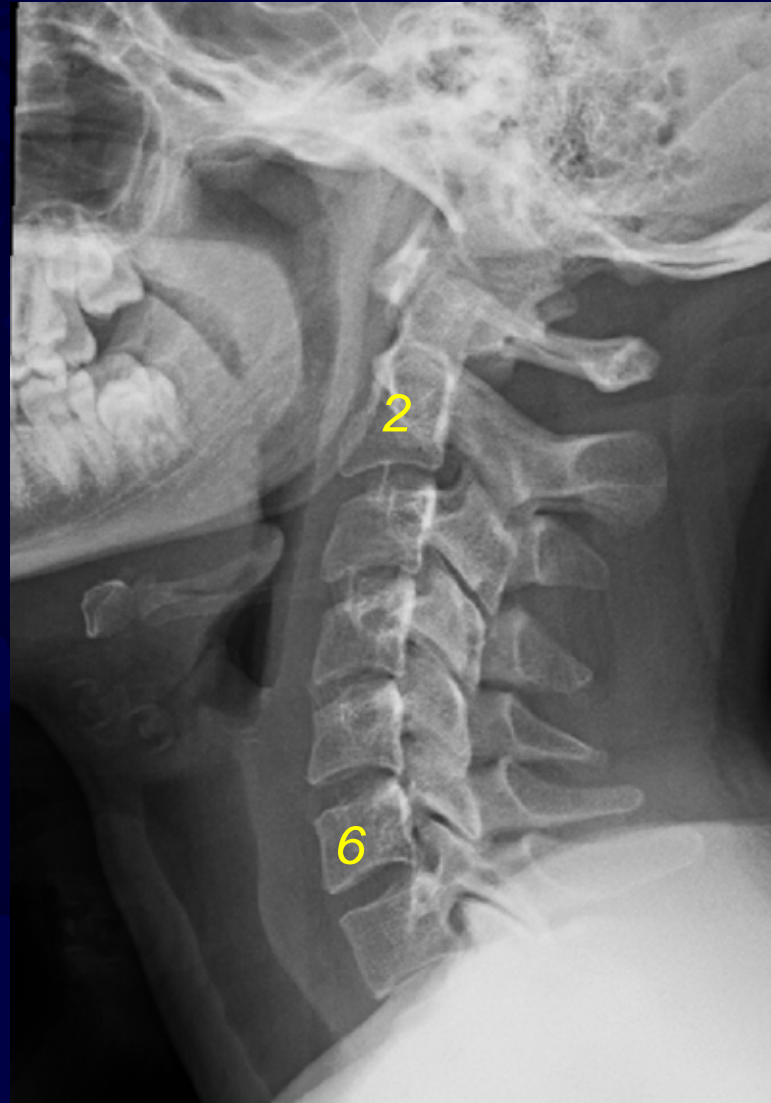
Check for Alignment

- Anterior Vertebral Line
- Posterior Vertebral Line
- Spino-laminar Line



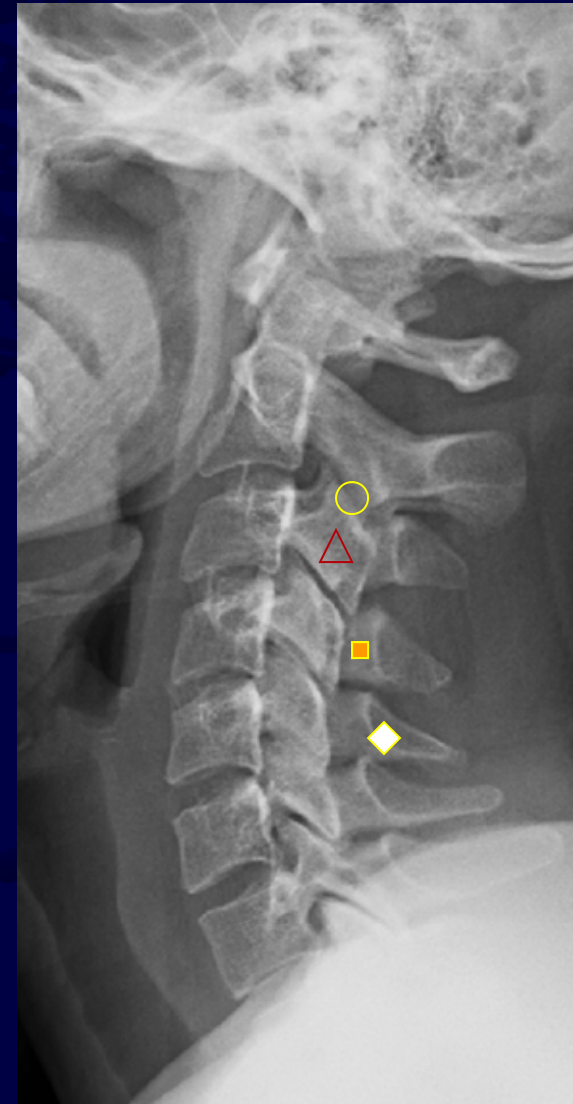
Soft Tissue Shadows

- *Max: 6 mm at C2*
- *2 cm at C6*
- *(6 at 2 & 2 at 6)*



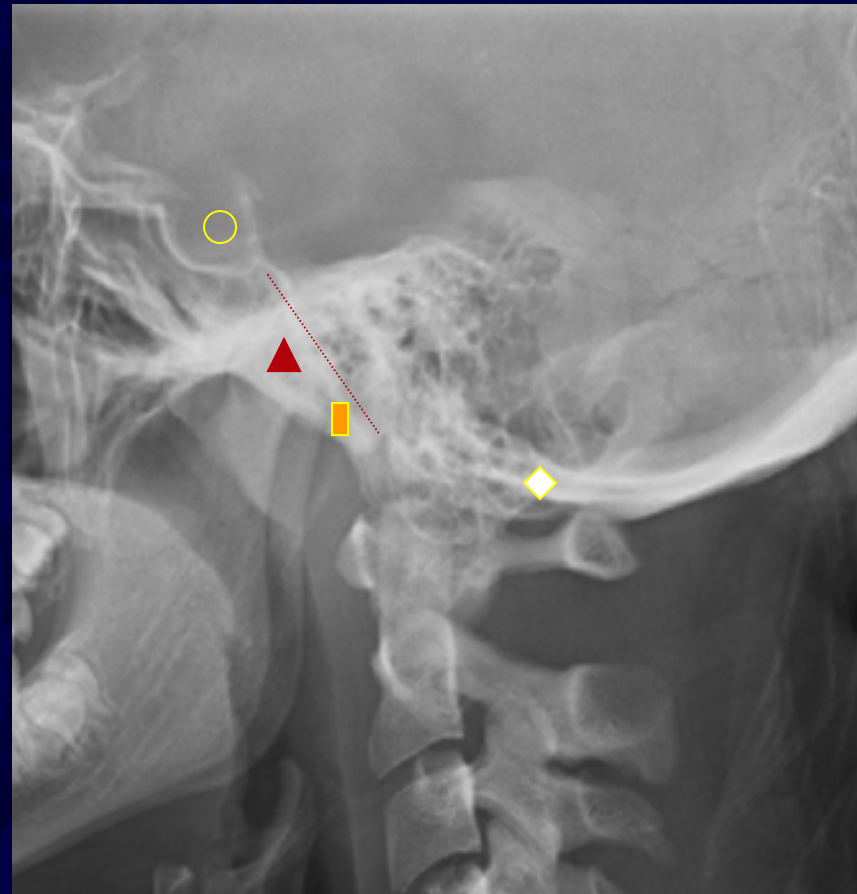
Radiologic Assessment

- Facet
- ▲ Lateral Mass
- Lamina
- ◆ Spinous Process



Radiologic Assessment

- Sella Tursica
- ▲ Clivus
- Basion
- ◆ Opisthion



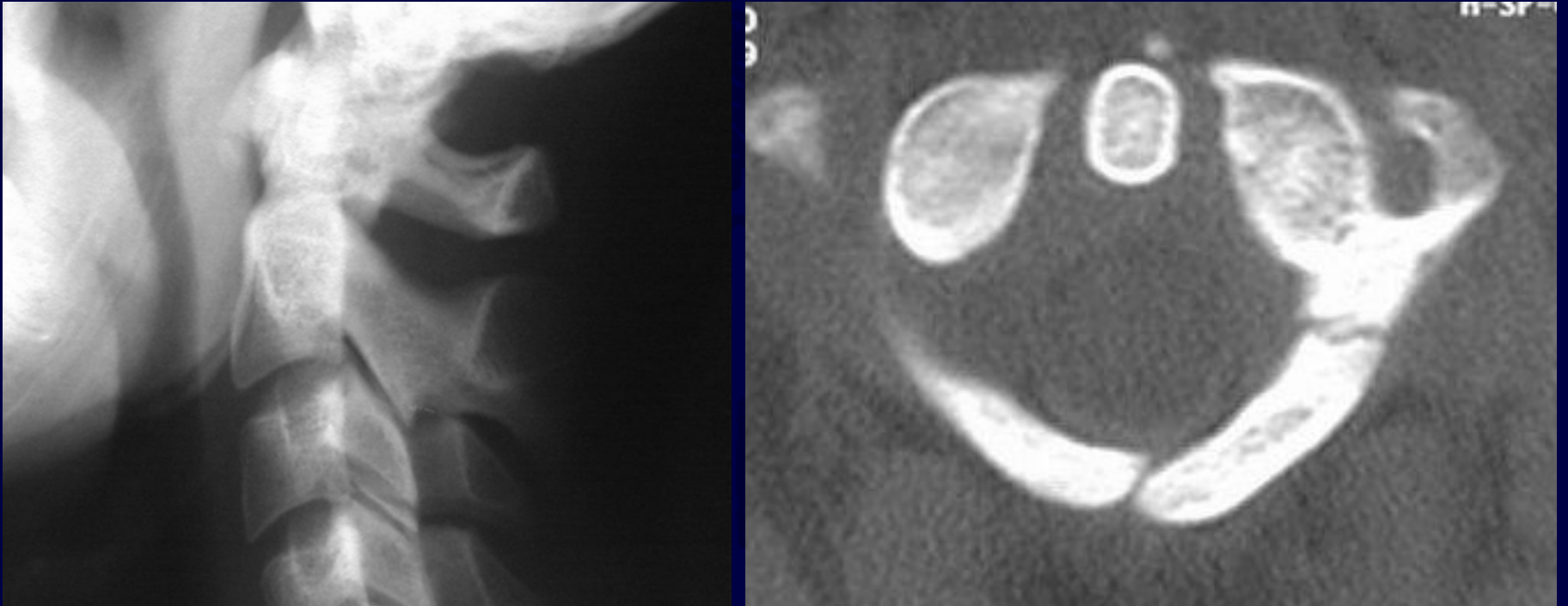
Additional Radiographs

- AP
- Open-mouth odontoid
- Oblique
- AP & Lat. of entire spine
 - T-L-S spine: injured 5-10%

CT Scans

- Subtle bone injuries
- Facet abnormalities
- Sagittal reconstructions
- O-C2 & C7-T1

CT Scan



Can detect subtle fractures undetectable on plain films

MRI

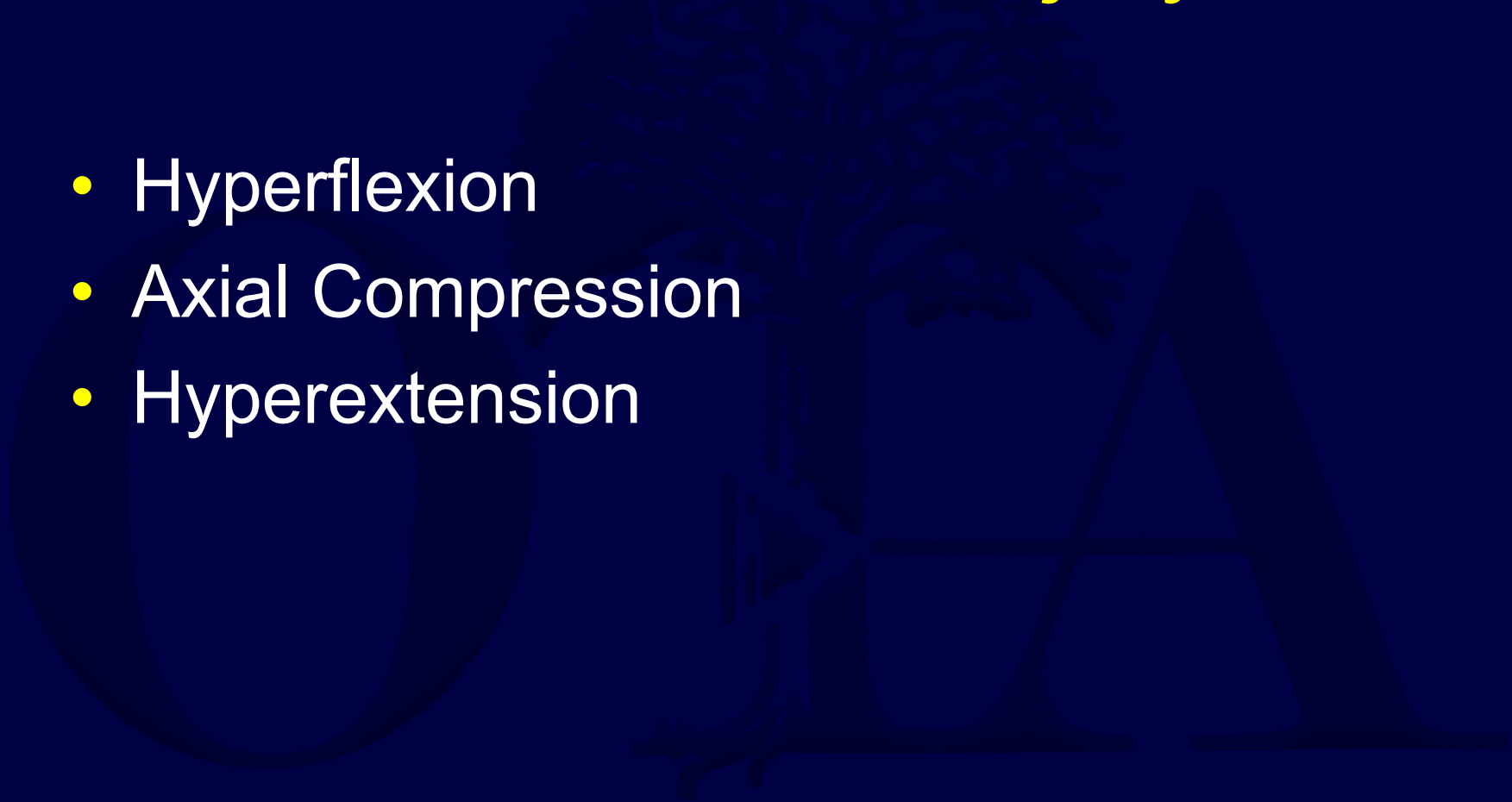
- All injuries w/ Neuro deficit
 - Spinal cord integrity
 - Space available for cord
 - Disc herniation
 - Posterior ligamentous injuries



Ligamentous Injury

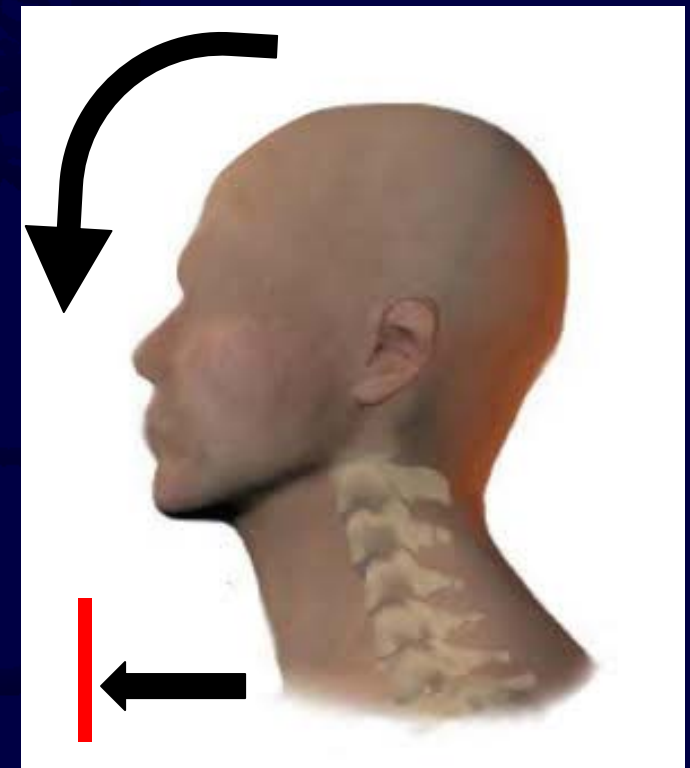
Mechanism of Injury

- Hyperflexion
- Axial Compression
- Hyperextension



Hyperflexion

- Distraction creates tensile forces in posterior column
- Can result in compression of body (anterior column)
- Most commonly results from MVC and falls

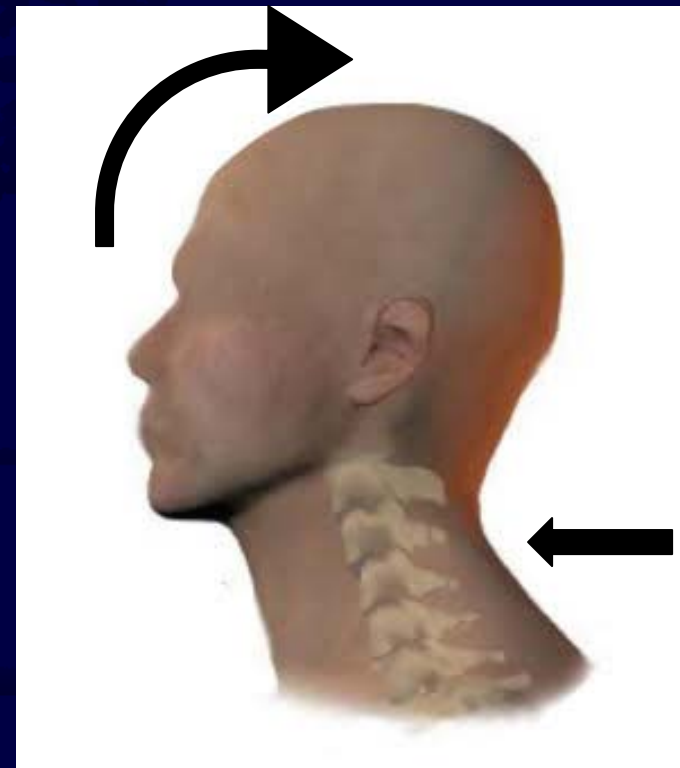


Compression

- Result from axial loading
- Commonly from diving, football, MVA
- Injury pattern depends on initial head position
- May create burst, wedge or compression fx's

Hyperextension

- Impaction of posterior arches and facet compression causing many types of fx's
 - lamina
 - spinous processes
 - pedicles
- With distraction get disruption of ALL
- Evaluate carefully for stability
- **CENTRAL CORD SYNDROME**

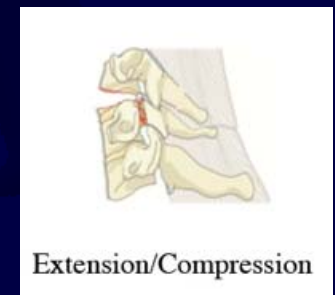
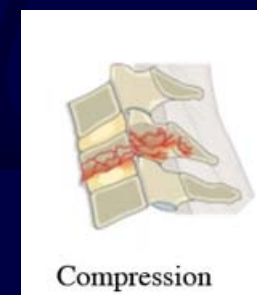
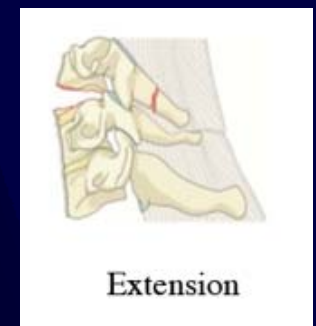
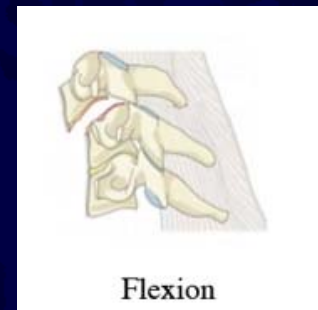
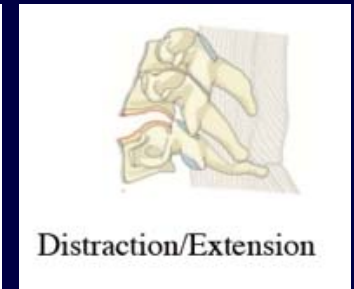
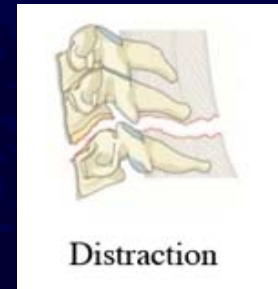
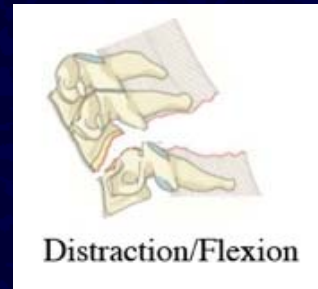


Classification

- Multiple Classification System
- Most are based on mechanism of injury
 - Harris et al OCNA 1986
 - Anderson Skeletal Trauma 1998
 - Stauffer and MacMillan Fractures 1996
 - Allen and Ferguson Spine 1982
 - AO/OTA Classification
 - Sub-axial Cervical Spine Injury Classification (SLIC)

Allen and Ferguson

- Mechanical
- Based on static radiographs
- Categories
 - Compressive flexion
 - Vertical compression
 - Distractive flexion
 - Compression extension
 - Distractive extension
 - Lateral flexion



AO/OTA Classification

- Mechanical
- Multiple subgroups and modifiers
 - Type A
 - Compression injuries
 - Type B
 - Distraction injuries
 - Type C
 - Translational injuries

Subaxial Cervical Spine Injury Classification (SLIC)

Spine (Phila Pa 1976). 2007 Oct 1;32(21):2365-74.

The subaxial cervical spine injury classification system: a novel approach to recognize the importance of morphology, neurology, and integrity of the disco-ligamentous complex.

Vaccaro AR¹, Hulbert RJ, Patel AA, Fisher C, Dvorak M, Lehman RA Jr, Anderson P, Harrop J, Oner FC, Arnold P, Fehlings M, Hedlund R, Madrazo I, Rechtine G, Aarabi B, Shainline M; Spine Trauma Study Group.

- Three major components
 - Injury Morphology
 - Compression
 - Distraction
 - Translation/Rotation
 - Discoligamentous status
 - Neurological status
- Point system

Subaxial Cervical Spine Injury Classification (SLIC)

Injury Morphology	Points	DLC status	Points
Compression Burst	1 1	Intact	0
Distraction	3	Intermediate	1
Translation/ Rotation	4	Disrupted	2
Total	Max 4	Total	Max 2

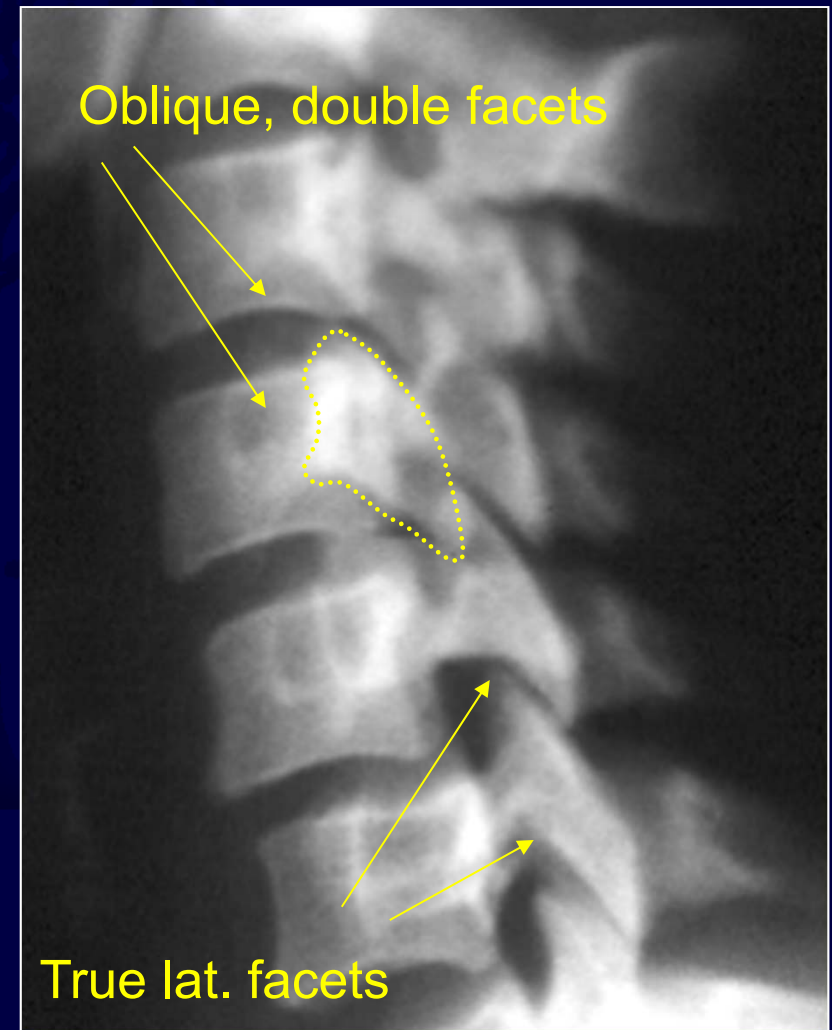
Neuro status	Points
Intact	0
Nerve root Deficit	1
Complete Cord injury	2
Incomplete Cord Injury	3
Add-on: Persistent compression or stenosis with deficit	1
Total	Max 4

Subaxial Cervical Spine Injury Classification (SLIC)

- Recommended treatment based on points
 - Score > 4 \rightarrow Operative
 - Score < 4 \rightarrow No operative
 - Score $= 4$ \rightarrow Surgeons choice

Unilateral Facet Dislocation

- Flexion/distraction injury \pm rotation
- Painful neck
- 70% radiculopathy, 10% SCI
- Easy to miss-supine position can reduce injury!
- “Bow tie” sign: both facets visualized, not overlapping



Unilateral Facet Dislocation

- “Empty Facet” on CT Scan
- Rotated vertebra



Unilateral Facet Dislocation

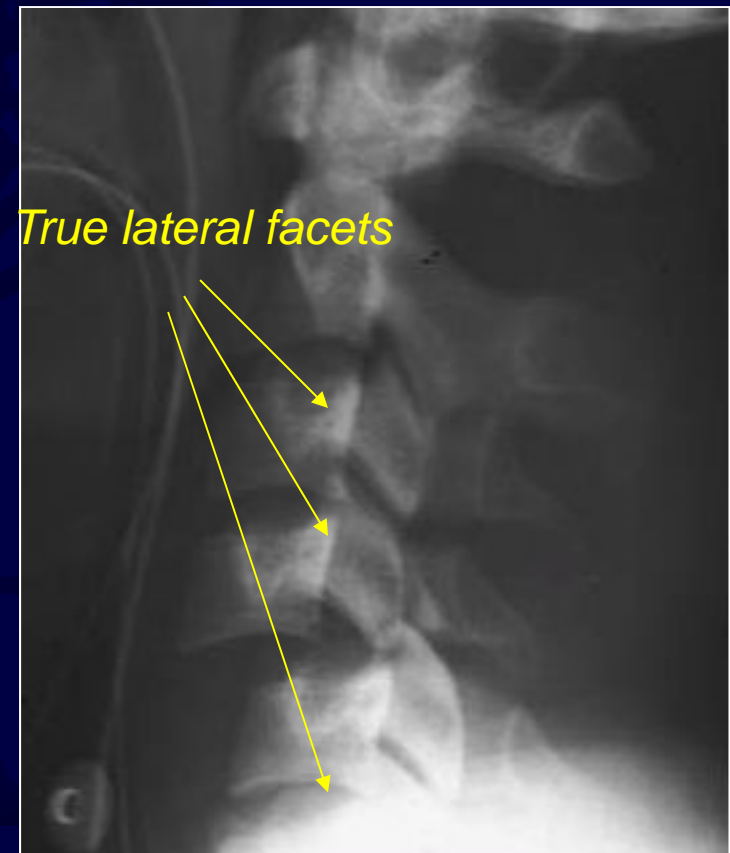
- Reduce to minimize late pain, instability
- Manual reduction
 - Gradually increase axial traction with the addition of weights
 - Some cervical flexion can facilitate reduction
 - Serial neurologic exams and plain radiographs is critical

Unilateral Facet Dislocation Treatment

- Non operative
 - Cervicothoracic brace or halo x 12 weeks
 - Need anatomic reduction
- OR approach and treatment depends on pathology
 - Anterior diskectomy and fusion
 - Posterior foraminotomy and fusion

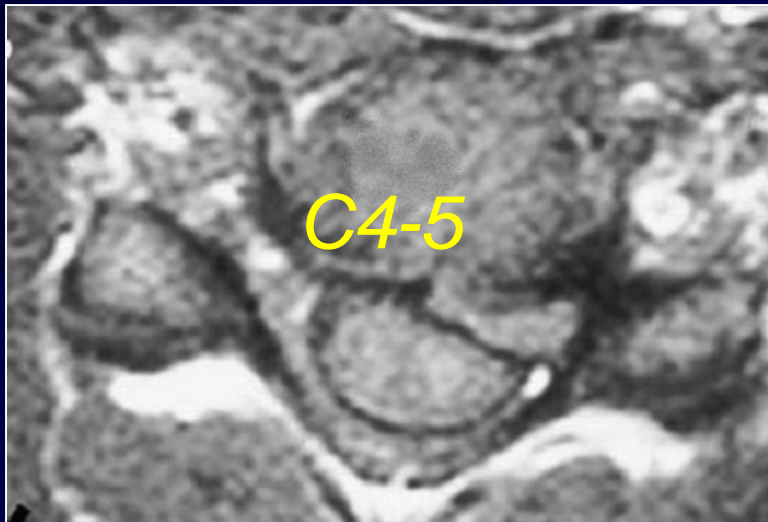
Bilateral Facet Dislocation

- Vertebral body displaced at least 50%
- Injury to cord is common
- 10-40% herniated disk into canal



HNP With Facet Dislocation

- Reduction drags disc back
- Quadriplegia
- Classic paper to know
 - Eismont, et al, JBJS



Bilateral Facet Dislocation

- Timing for reduction and pre reduction MRI controversial
 - Spinal cord injury may be reversible at 1-3 hours
- Awake reduction then MRI vs. MRI before reduction in all
 - If significant cord deficits, reduce prior to MRI
 - If during awake reduction, paresthesias or declining status
 - Difficult closed reduction
 - If neurologically stable, perform MRI prior to operative treatment
- Obtain or repeat MRI before operating

Bilateral Facet Dislocation

- Definitive treatment requires surgical stabilization
 - Anterior decompression and fusion
 - If poor bone quality, consider posterior segmental stabilization
 - Occasional anterior & posterior stabilization

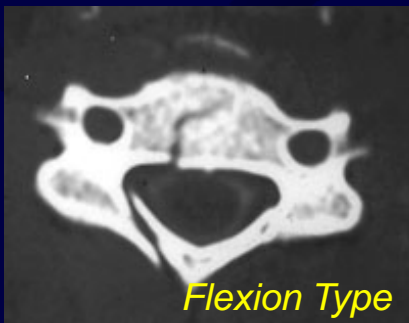


Facet fractures

- Stability depends on ligamentous complex
 - SLIC 0
 - Can be rotationally unstable
- Most commonly involves superior articular process (80%)
- Can have late pain and disability
- Late arthrodesis is an option
- Be aware of “fracture separation” of lateral mass

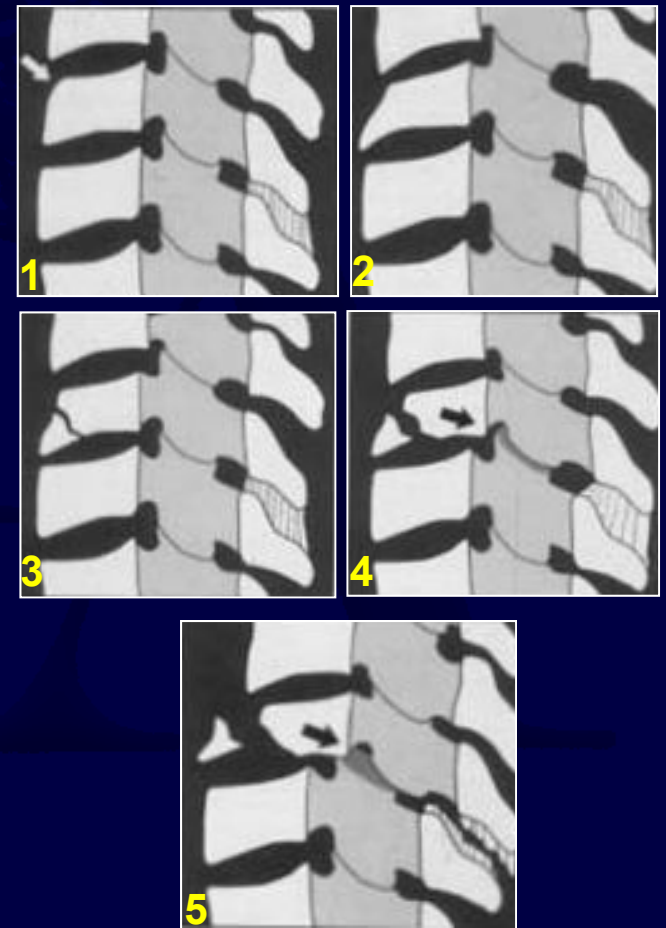
Teardrop Fracture

- Extension (upper cervical spine)
 - Usually benign
 - Avulsion type
- Flexion (lower cervical spine)
 - Anterior wedge or quadrangular fragment



Teardrop Fracture (Flexion Type)

- High energy flexion, compressive force
- Complex A/P injuries
- Often posterior element disruption
 - Unstable injury
- Routinely requires surgery
 - Corpectomy, A/P recons



Lateral Mass Fractures

- Lateral mass fracture involves ipsilateral lamina and pedicle
- Extension type injury?
- Understand the anatomy
- Usually surgical treatment
 - 2 level surgical stabilization



Cervical Fractures in DISH or Ankylosing Spondylitis



DISH



AS

CAUTION!

- *Beware:*
 - Ankylosing spondylitis
 - If neck pain, treat as fracture → MRI
 - Obese patients
 - Poorly imaged patients
 - Distracting injuries
 - Rotational injuries



Cervical Fractures in DISH or Ankylosing Spondylitis

- The fused spine that fractures behaves more like a long bone

Do not underestimate the
instability of such fractures!!





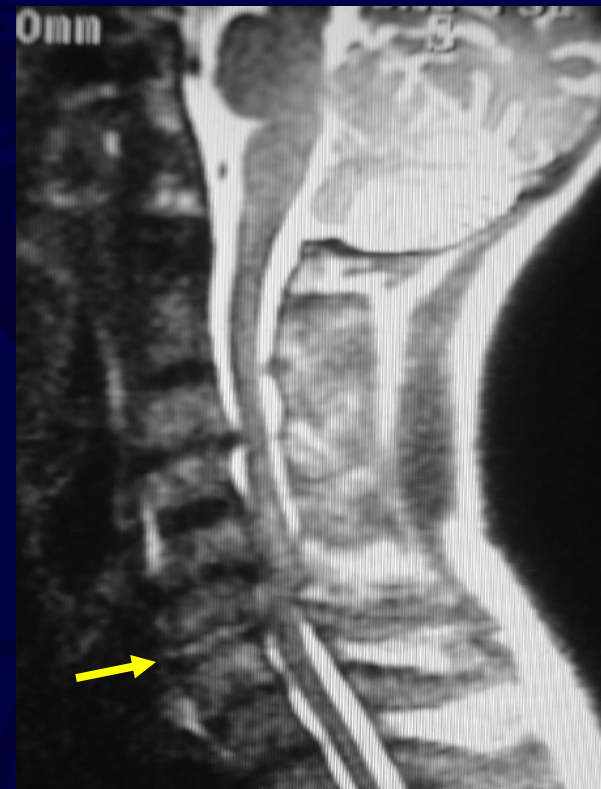
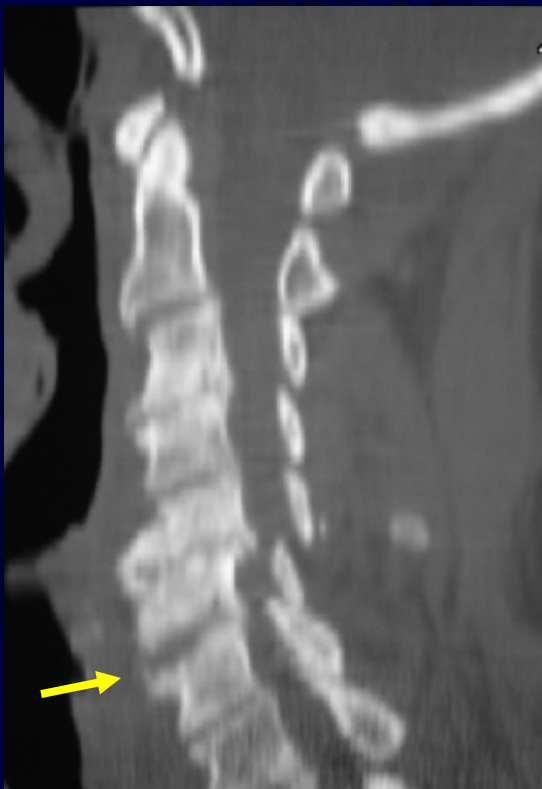
Long lever arm concentrates forces

Cervical Fractures in DISH or Ankylosing Spondylitis

- 71 y.o. hits head
- Central cord syndrome
- DISH throughout TL spine



Cervical Fractures in DISH or Ankylosing Spondylitis

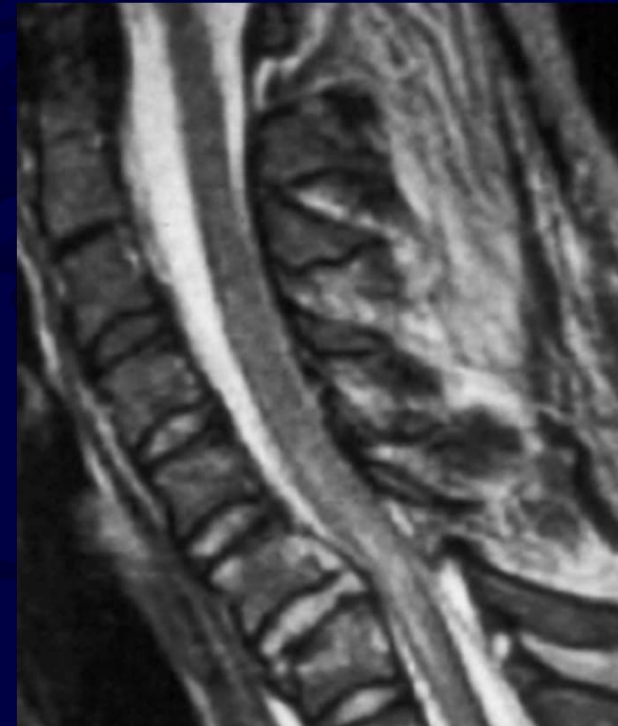


Take advantage of all imaging
modalities

Cervical Fractures in DISH or Ankylosing Spondylitis



*C6/7 fracture in DISH
(extension-distraction)*



*C6/7 facet dislocation
(flexion-distraction)*

These C6/7 discs are not the same

Cervical Fractures in DISH or Ankylosing Spondylitis

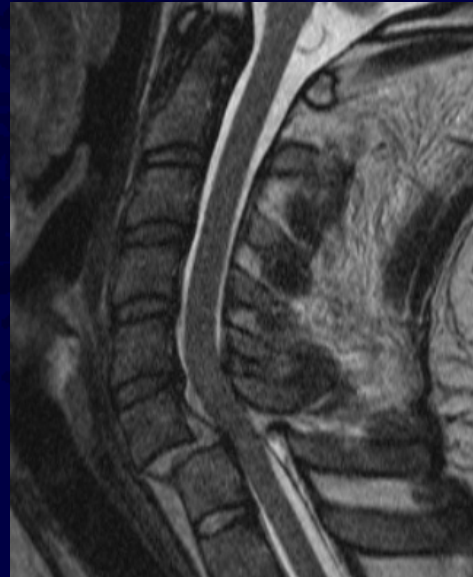
Pitfall in managing extension-distraction injuries:

- When performing anterior discectomy and fusion, avoid large grafts that “overstuff” the disc space and induce further distraction!!

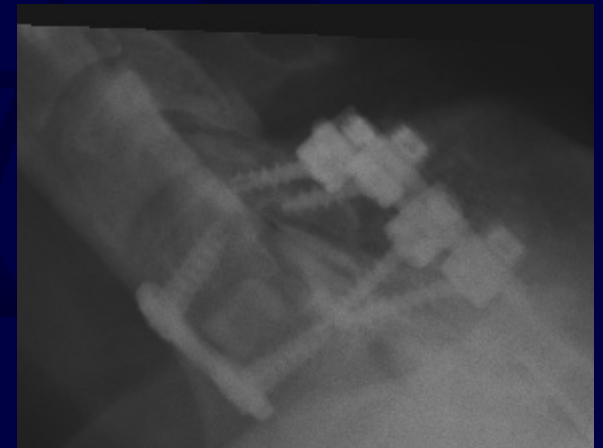


Treatment Guidelines

- Anterior Approach
 - Burst fx w/SCI
 - Disc involvement
 - Significant compression of anterior column



- Posterior Approach
 - Ligamentous injuries
 - Lateral mass Fx
 - Dislocations



Occasionally you need circumferential approach!

Anterior Surgery

- Advantages
 - Anterior decompression
 - Trend towards improved neuro outcome
 - Atraumatic approach
 - Supine position
 - Acute polytrauma
- Disadvantages
 - Limited as to number of motion segments included
 - Potential for increased morbidity
 - Poor access to CT transition zone

Posterior Surgery

- Advantages
 - Rigid fixation
 - Foraminal decompression
 - Deformity correction
 - May extend to occiput and CT transition zones
 - Implant choices
- Disadvantages
 - Minimal anterior cord decompression
 - Prone positioning
 - Trend towards increased blood loss

Non-operative Care

- Rigid collars
 - Conventional collars offer little stability to subaxial spine and transition zones
 - May provide additional stability with attachments
 - Good for post-op immobilization
- Halo
 - Many complications
 - Better for upper cervical spine injuries
 - Subaxial “snaking”



Sternal-Occipital-Mandibular immobilizer (SOME)



Minerva



Thank You