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

AOSpine Classification Systems (Subaxial, Thoracolumbar) Klaus J. Schnake, MD, Gregory D. Schroeder, MD, Alexander R. Vaccaro, MD, PhD, MBA, and Cumhur Oner, MD, PhD. J Orthop Trauma Volume 31, Number 9 Supplement, September 2017
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)

- Three major components
  - Injury Morphology
    - Compression
    - Distraction
    - Translation/Rotation
  - Discoligamentous status
  - Neurological status
- Point system
## Subaxial Cervical Spine Injury Classification (SLIC)

<table>
<thead>
<tr>
<th>Injury Morphology</th>
<th>Points</th>
<th>DLC status</th>
<th>Points</th>
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<tbody>
<tr>
<td>Compression Burst</td>
<td>1</td>
<td>Intact</td>
<td>0</td>
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<tr>
<td>Distraction</td>
<td>3</td>
<td>Intermediate</td>
<td>1</td>
</tr>
<tr>
<td>Translation/Rotation</td>
<td>4</td>
<td>Disrupted</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>Max 4</td>
<td>Total</td>
<td>Max 2</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Neuro status</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intact</td>
<td>0</td>
</tr>
<tr>
<td>Nerve root Deficit</td>
<td>1</td>
</tr>
<tr>
<td>Complete Cord injury</td>
<td>2</td>
</tr>
<tr>
<td>Incomplete Cord Injury</td>
<td>3</td>
</tr>
<tr>
<td><strong>Add-on: Persistent compression or stenosis with deficit</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Max 4</strong></td>
</tr>
</tbody>
</table>
Subaxial Cervical Spine Injury Classification (SLIC)

- Recommended treatment based on points
  - Score > 4 → Operative
  - Score < 4 → No operative
  - Score = 4 → Surgeons choice
Unilateral Facet Dislocation

- Flexion/distraction injury ± 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”
Thank You