Cervical Spine Trauma: Interpretation of the C-Spine Film
Common Mechanisms of Injury

- Hyperflexion - MVA, car comes to sudden stop
- Hyperextension - MVA, car struck from behind
- Compression - Head first dive in shallow water
Clinical Procedure involving Pts with suspected spine injury

• Pt kept in cervical collar and immobilized on spine board

• “ABCDEF” ER protocol followed (airway, breathing, circulation, disability/drugs, exposure, Foley catheter)

• History and physical (pt handled as though serious injury present)

• Decide if imaging is necessary
Vandermark “risk-tailored” approach in assessing need for neck imaging

- **No Risk** - no hx or physical findings suggestive of neck injury
- **Low Risk** - pt has hx for a mechanism of injury unlikely to have exceeded physiologic range of cervical motion
- **Medium Risk** - pt has hx for mechanism of injury sufficient to have exceeded physiologic cervical ROM
- **High Risk** - pt has hx for mechanism of injury very likely to have exceeded physiologic ROM
High Risk Factors for cervical vertebral injury

- High-velocity blunt trauma
- Multiple, severe long bone fractures
- Direct cervical region injury
- Altered mental status
- Fall from greater than 10 feet
- Drowning / head first diving accident
- Significant head or facial injury
- Neck pain, tenderness, or deformity
- Abnormal neurological examination
- Thoracic or lumbar vertebral fracture
- Hx of pre-existing vertebral disease
Imaging Must Assess for Spinal Cord Stability

• Critical assessment which determines pt’s management and handling
• Unstable- spinal canal is no longer protected by its ligament and bony supports
• Any movement of neck could result in permanent cord damage
Menu of Imaging Options

• **Cervical Spine Plain Films**
  - standard first line imaging modality in assessing cervical vertebral injury

• **Cervical CT**
  - to evaluate extent of injury with any definitive finding on plain film
  - delineating equivocal/uncertain findings on plain film

• **Cervical MRI**
  - pt with c-spine trauma who exhibits neurological signs and symptoms suggestive of cord injury
In order to recognize the abnormal, we need to know the normal appearance

Let’s review some c-spine anatomy:
Atlanto-axial joint

- Anterior arch
- Posterior arch
- Lateral mass
- Superior articulating surface
- Odontoid

C1, Atlas
C2, Axis
Cervical spine

Occipito-Atlanto-Axial Joint

Cervical Vertebrae

Vertebral body

Pedicle

Facet

Lamina

Spinous process

C7


Radiograph Correlations

Rotation effect on lateral view

Apophyseal / facet joints

Ligaments


C-Spine Plain Films

Standard 5 view series:

- Cross table lateral
- AP of lower cervical column
- Atlanto-axial AP (open mouth, odontiod)
- Bilateral supine trauma oblique views
Normal C-spine 5 view series

Lateral

AP

Odontoid

Right Oblique

Left Oblique

C-spine Film Interpretation
7 step process

1. Count Vertebrae (lateral)
   - C1 through C7
   - If T1 not seen → get a swimmer’s view

2. Assess Curvature (frontal and lateral)

3. Assess Vertebral Alignment (on lateral: 4 lines)
   - ant vertebral line
   - post vertebral line
   - spinolaminar line
   - post spinal line
The 4 Contour Lines

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4. Assess Bony Integrity

5. Assess Intervertebral Disk Spaces

6. Assess OAA joint

7. Soft Tissues
Patient

• 91 y.o. female who presents to ED with a laceration and contusion to her right eye, suffered when she fell out of her bed at the assisted living facility. Fall was not witnessed. Pt is also complaining of neck pain. Pt reports no loc, n/v, visual changes, headache, numbness or weakness. Exam reveals no focal or gross neurological deficits. Pt is secured in a hard cervical collar.

• Pt sent for plain films
Our patient’s lateral c-spine

Film findings:

1. C2 fracture through base of odontoid process

2. Approx 4mm posterior displacement of C1 on C2

*Farrell, Susan MD. Teaching Files. BIDMC dept of Emergency Medicine, 2000*
Our patient’s course

- An MRI confirmed the dens fx with no compromise of the spinal canal.
- Treatment: Due to pt’s age and medical conditions, she was treated conservatively with hard collar immobilization. Interval x-rays were ordered to assess for odontoid mobility.
Let’s review some other patients whose c-spine plain films demonstrate common cervical fractures
Hangman’s Fracture

- Bilateral pedicle fractures of C2 (axis)
- Anterolisthesis of C2 on C3
- Unstable fracture
- Hyperextension injury
  - fracture is identical to those occurring upon hanging
  - elderly may slip and strike chin on basin or counter
  - MVA in which chin strikes steering wheel
Hangman’s Fracture

Teardrop Fracture

- Avulsion fracture of anterior margin of vertebral body
- Anterior longitudinal lig instability (rupture, avulsion)
- Hyperextension injury
- Unstable injury
- Lamina may jam together causing ligamenta flava to buckle inward and compress/contuse the spinal cord
Teardrop Fracture

Compression Fracture

- Variable severity, from minimal anterior wedging to complete disruption of vertebral body (burst)
- Look for loss of vertical height of vertebral body
- Due to long axis compression or hyperflexion - diving into shallow pool
- Stable → unstable
Compression Fracture

Jefferson Fracture

- Compression/bursting fracture of C1 ring
- Due to long axis compression forces
- Results in uni or bilateral displacement of C1 lateral masses with respect to C2 sup articulating facets
- Best seen on odontoid (open mouth) view
- Unstable if transverse ligament is disrupted, resulting in C1 anterolisthesis
- May be stable
Jefferson Fracture

Clay Shoveler’s Fracture

- Avulsion fracture of spinous process by supraspinous ligament
- Usually occurring from C6-T2
- Hyperflexion; direct trauma; downward force via thoracoscapular muscle (as in shoveling motion)
- Stable
Clay Shoveler’s Fracture

Dens Fracture

- Fracture of the base of the dens (odontoid) of C2
- Anterior or posterior displacement of the dens
- Can occur at various levels on the dens
- Via hyperflexion or hyperextension of head on neck
- Unstable if displacement occurs
Dens Fracture

References

- Farrell, Susan MD. Teaching Files. BIDMC dept of Emergency Medicine, 2000
- Gunderman, RB: *Essential Radiology, clinical presentation, pathophysiology, imaging*. Thieme, 1998
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