Physical and Radiographic Examination of the Spine

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Task at hand...

- How to examine a patient
- How to interpret radiographic images
Systematic Approach

• Steps
  – Components

1. Injury
2. Listen Touch Think
3. Obtain Imaging Studies
4. Interpretation and Synthesis
5. Correct Diagnosis Best Treatment
Systematic Approach

• Miss a Step

- Injury
- Listen
- Touch
- Think
- Obtain Imaging Studies
- Interpretation and Synthesis
Examination

Starts in the Trauma Bay E.R.

- Information
- Mechanism
  - ↑energy, ↓energy
- Direction of Impact
- Associated Injuries
Is the patient awake or “unexaminnable”? 

- What’s the difference
  - Awake
    - ask/answer question
    - push/pain/tenderness
    - motor/sensory exam
  - Not awake
    - you can ask (but they won’t answer)
    - can’t assess tenderness
    - no motor/sensory exam
Does “unexaminable” mean no exam?

NO!

- Inspect for bruising or ecchymosis
- Palpate for step-off or deformity
- Rectal Tone
- Reflex exam
  - Bulbocavernosus
  - Clonus/Babinski
  - Posturing
Ideal: Patient Awake
Step 1: Frontal Inspection

- Inspection—patient flat/frontal view
  - Head: Raccoon eyes
  - Neck: cock-robin posture
  - Thorax: chest contusions, flail chest, asymmetric chest expansion
Step 1: Frontal Inspection

- Inspection -- patient flat/frontal view
  - Abdomen: lap-belt ecchymosis
  - Peritoneum/Pelvis: priapism, scrotal swelling, bruising
  - Extremities: gross movement, tone, flaccid

Remove all clothes
Special Circumstances

Motorcyclists and Athletes

- Helmet—stays in place initially
- Face mask off
- Complete initial inspection
- Multi-member team to remove
- x-rays before/after
Step 2: Neurological Examination

• Detailed and Systematic
  – Motor
  – Sensory
  – Reflexes
Motor
Cervical
1 muscle to test each level/root

C5: Deltoid
C6: Biceps
C7: Triceps
C8: Finger flexors
T1: Hand Intrinsics

Pick one muscle
Motor

Lumbar

1 motion to test each level/root

L1/2: Hip Flexion
L2/3: Knee Extension
L4: Tibialis Ant. - foot dorsi-flexion
L5: EHL and toe dorsi-flexion
S1: Ankle plantar flexion
Motor

Thoracic

Testable?

Functional?

(e.g. $T_5$ intercostals vs. $T_7$ intercostals)
Motor Grade

+/-

0/5 none
1/5 trace
2/5 some movement
3/5 anti-gravity
4/5 anti-resistance
5/5 normal

Test in contracted/shortened position
Sensory

Normal

Diminished

None

Light touch
Beware: “Cervical Cape”

Sensation over the sternum is not “sensory sparing”
T10 umbilicus

T12 inguinal crease

L3

Pick one spot

Anterior view

Posterior view
Rectal

- Anal sensation
- Rectal tone
- Anal sphincter contraction
Reflexes

Hyper (3+) or Hypo (1+)
Present or absent

C5   Biceps
C6   Brachialis
C7   Triceps
L3   Patellar Tendon
S1   Achilles
Conus Bulbo-Cavernosus
Pathologic Reflexes

- Hyperreflexia
- Clonus $\geq$ 4 beats
- Babinski
- Inverted Radial Reflex
- Hoffmans
Don’t forget the Cranial Nerves

• Why?
  – Occipito-atlantal injuries
  – ↑ incidence of CN injuries
    • VI
    • IX
    • X
    • XI
    • XII
Step 3: Posterior Inspection

- Log-roll side-to-side
  - palpate spinous processes
  - palpate ribs
  - again-----inspection
    - ecchymosis
    - bullet wounds-markers
    - open wounds (probe)
Step 4: Radiographic Examination

what to order

how to interpret

• Studies that are “automatic”
  – lateral C-spine (or equivalent)

CT scan w/ sagittal recon
Step 4: Radiographic Examination

what to order

how to interpret

• Studies that are “automatic”

  –complete C, T, L films if 1 injury is detected

  10-15 % non-contiguous injuries
Step 4: Radiographic Examination

what to order

how to interpret

• Studies that are “automatic”
  → calcaneus fx → lumbar films
Getting organized…make a distinction between:

Injury Detection vs. Injury Description
Injury Detection
Injury Detection: Cervical Spine

- Systematic
- Start at the top
- Start with PLAIN LATERAL FILM

WORKHORSE OF CERVICAL TRAUMA

85% of injuries
Occipitocervical Junction

- Dislocations
- Dissociations
- Challenges of Detection/Missed Diagnosis
Detecting O-A Injuries

HARRIS' MEASUREMENTS
(BDI AND BAI)
RULE OF TWELVES

POSTERIOR AXIAL LINE

TIP OF DENS

C1

C2

C3

BASION
C1-C2: sagittal instability

- Widened ADI
- 3mm in adults
- 4-5 mm in children
Lower Cervical (C3-T1)

CHECK YOUR LINES

- Spinolaminar line
- Posterior VB line
- Anterior VB line
Lower Cervical Detection

- Spinous process gapping
- Facet joint apposition
- Inter-vertebral gapping
- Angulation
- Translation
Lower Cervical Detection

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Subtle Signs of Injury

- No obvious fracture/dislocation
- *look for* RETROPHARYNGEAL OR PRE-VERTEBRAL SOFT TISSUE SWELLING

PRESENT → +injury
NOT PRESENT → +/- injury
Soft Tissue Edema

Using:
- 6 mm at C3 → 59% sensitivity
- 22 mm at C6 → 5% sensitivity

Doesn’t mean much if not there

DeBehne and Havel, 1994
Anteroposterior (A-P) View

- Spinous process deviation
- Lateral Translation
- Coronal deformity
Open Mouth View

- Mostly C1-C2 lateral mass
- ±Occipital Condyles/CO-C1
- Odontoid Process
Swimmer’s View

- Cervico-thoracic junction
  - obliques *sometimes* helpful
CT: as initial screening modality

- Sagittal recon--like lateral x-ray
- Most sensitive for fracture detection
  - esp. Upper/Lower (difficult w/ x-ray)
MRI for injury detection

negative plain films
negative CT scan

but still suspicious

• Continuity of ligaments
• Edema in soft-tissues
MRI for injury detection

- Herniated Discs

Clinical suspicion/neural deficit
“Clearing” the C-spine

- Standardized Protocol
- no consensus
Boston Medical Center Protocol

Agreement between:

Ortho, Neuro, Trauma, Radiology
Neck Pain
Neurologic Deficit
Distracting Injury)
Intoxicated

yes ➔ 3-views
CT through suspicious areas or if not visualized
CT entire w/ Hd CT

Abnormal ➔ Neck Pain (Alert/Awake)
Normal ➔ Flexion/Extension Lateral X-rays

Obtunded Patient

Normal: D/c collar
Abnormal ➔ MRI
Normal: d/c collar

Consult Spine

Abnormal ➔ Abnormal

D/C collar ➔ no

Goal: clear w/in 48 hrs
Injury Detection
Thoracic and Lumbar Spines

• Same principles
• Landmarks and Lines:
  Lateral View
  – Posterior VB line
  – Anterior VB line
  – Inter-spinous Distance
  – Translation
Injury Detection
Thoracic and Lumbar Spines

• Same principles
• Landmarks and Lines: A-P View
  – Spinous process to Pedicles
  – Inter-pedicular Distance
  – Translation
• More common as initial study
• indicated if suspicious plain film
• best for bony detail
• axial--can miss translation
Thoracic and Lumbar Injuries

What is “normal” angulation
Height Loss

Adjacent fracture
Frequently Missed Injuries
Flexion-Distraction Injuries

Look at Facets
Using MRI to assess the PLC
Using MRI to assess the PLC

Continuity of the Ligamentum Flavum
Using MRI to assess the PLC

Anterior Alone vs. Combined A/P
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