

Physical and Radiographic Examination of the Spine

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**Original Authors: Ramil S. Chatnagar, MD and
Joel Finkelstein, MD; March, 2004**

New Author: Christopher M. Bono, MD; Revised 2005, 2009, 2011



Task at hand...

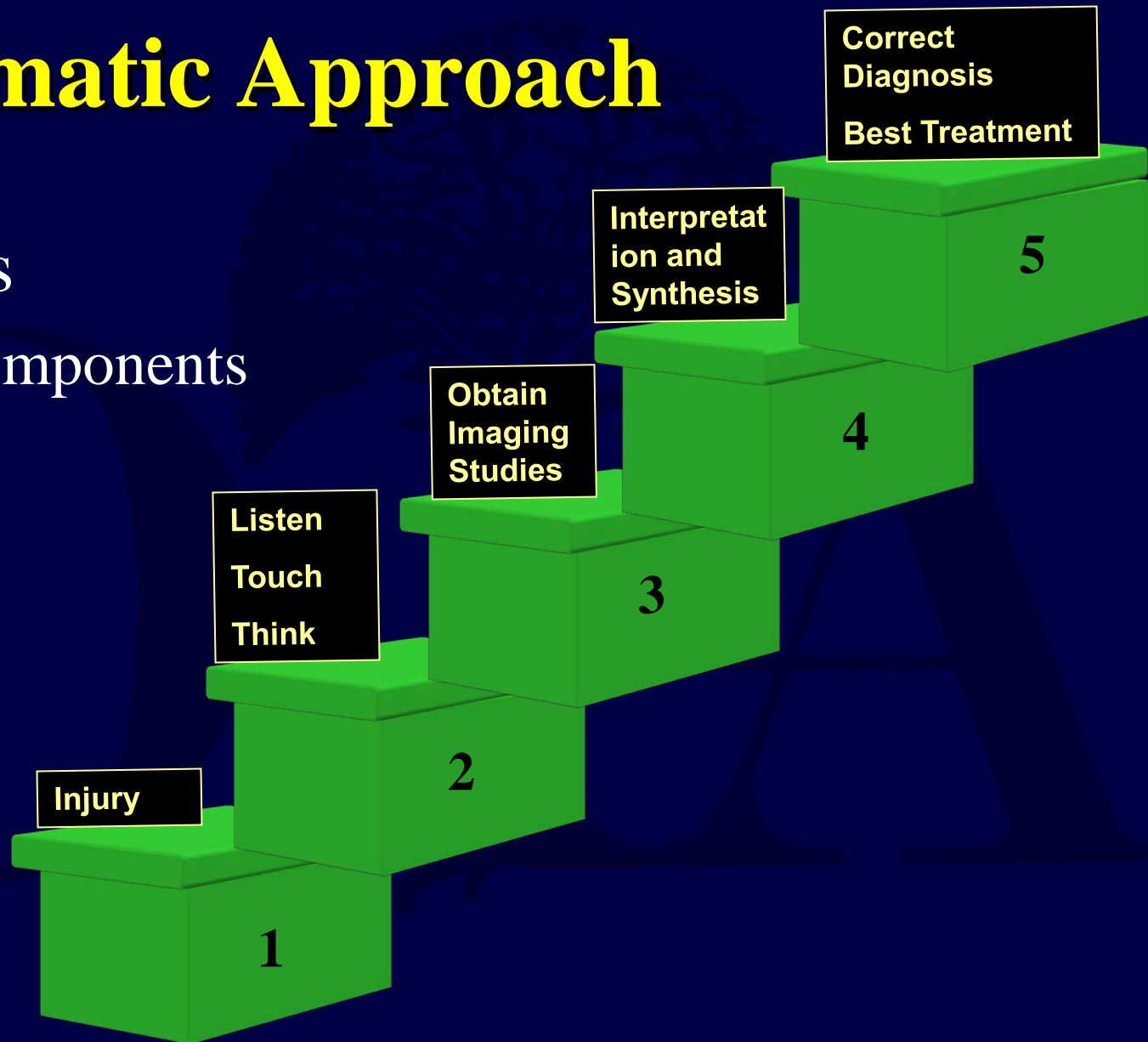
- How to examine a patient
- How to interpret radiographic images



SYSTEMATIC
APPROACH

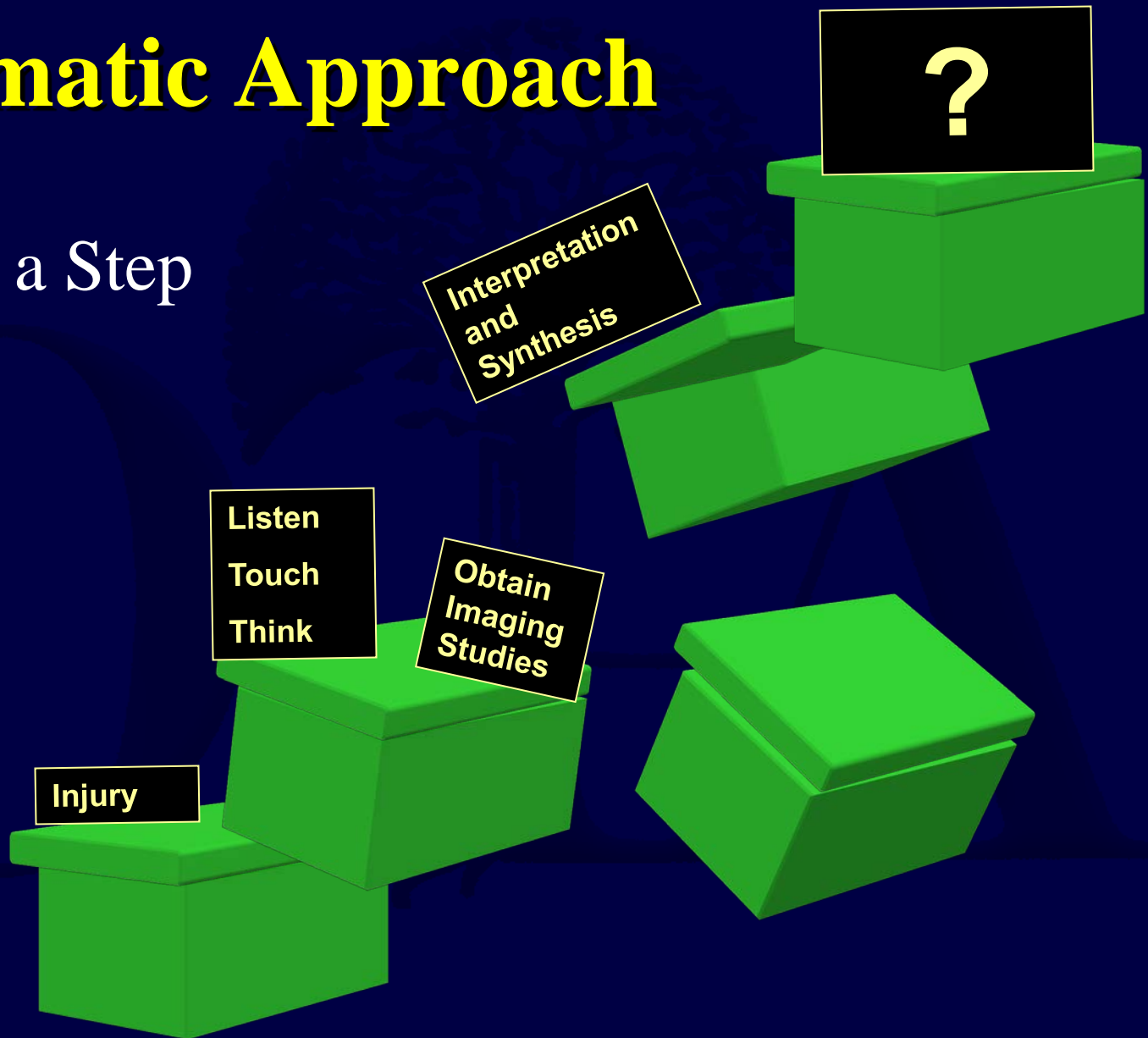
Systematic Approach

- Steps
 - Components



Systematic Approach

- Miss a Step



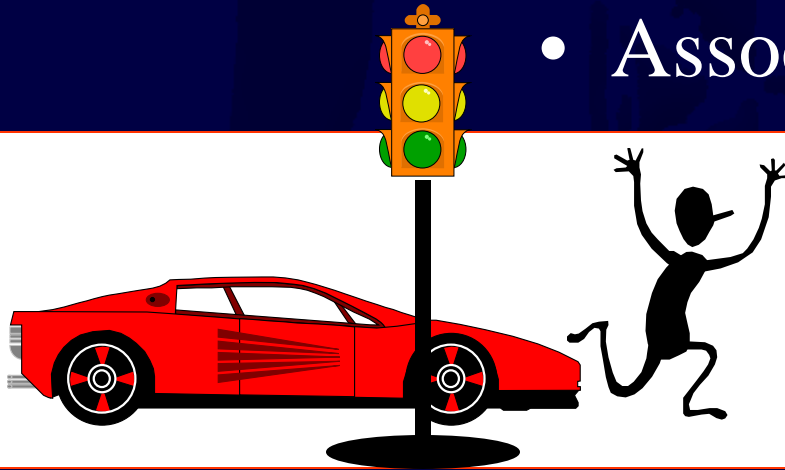
Examination

Starts in the....

Trauma Bay

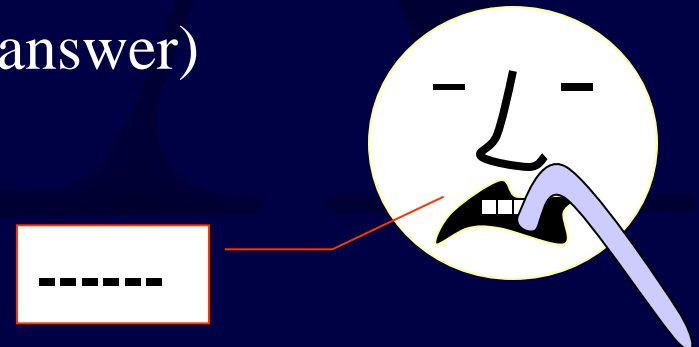
E.R.

- Information
- Mechanism
 - ↑energy, ↓energy
- Direction of Impact
- Associated Injuries



Is the patient awake or “unexaminable”?

- 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

Step1: Frontal Inspection

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

REMOVE ALL
CLOTHES

Step1: Frontal Inspection

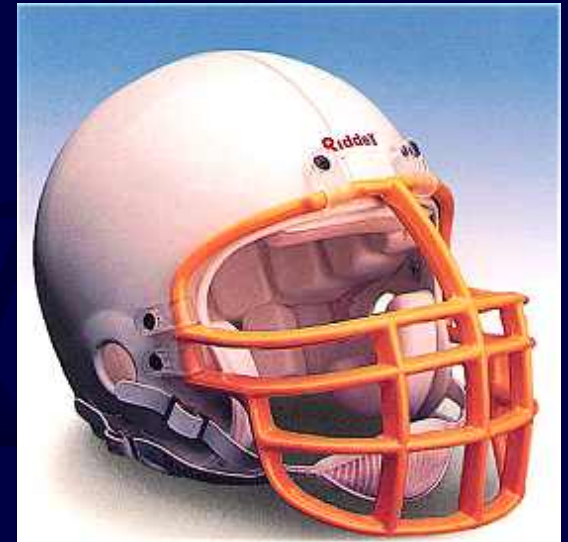
- Inspection--patient flat/frontal view
 - Abdomen: lap-belt ecchymosis
 - Peritoneum/Pelvis: priapism, scrotal swelling, bruising
 - Extremities: gross movement, tone, flaccid

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 Intrinsic

*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

*Pick one
motion*

Motor

Thoracic

Testable?

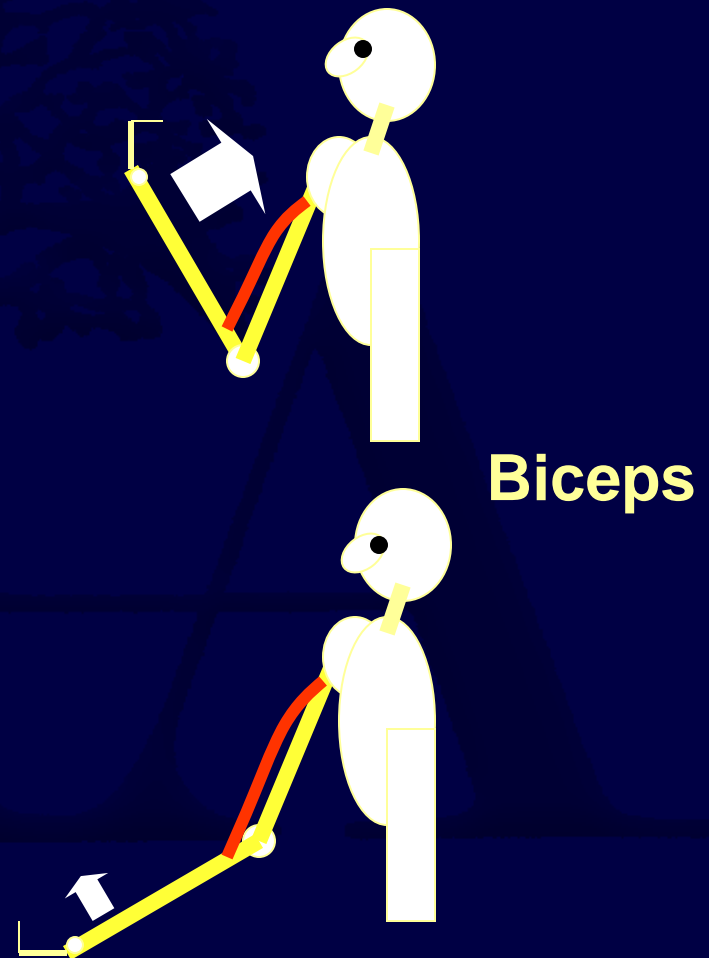
Functional?

(e.g. T5 intercostals vs. T7 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

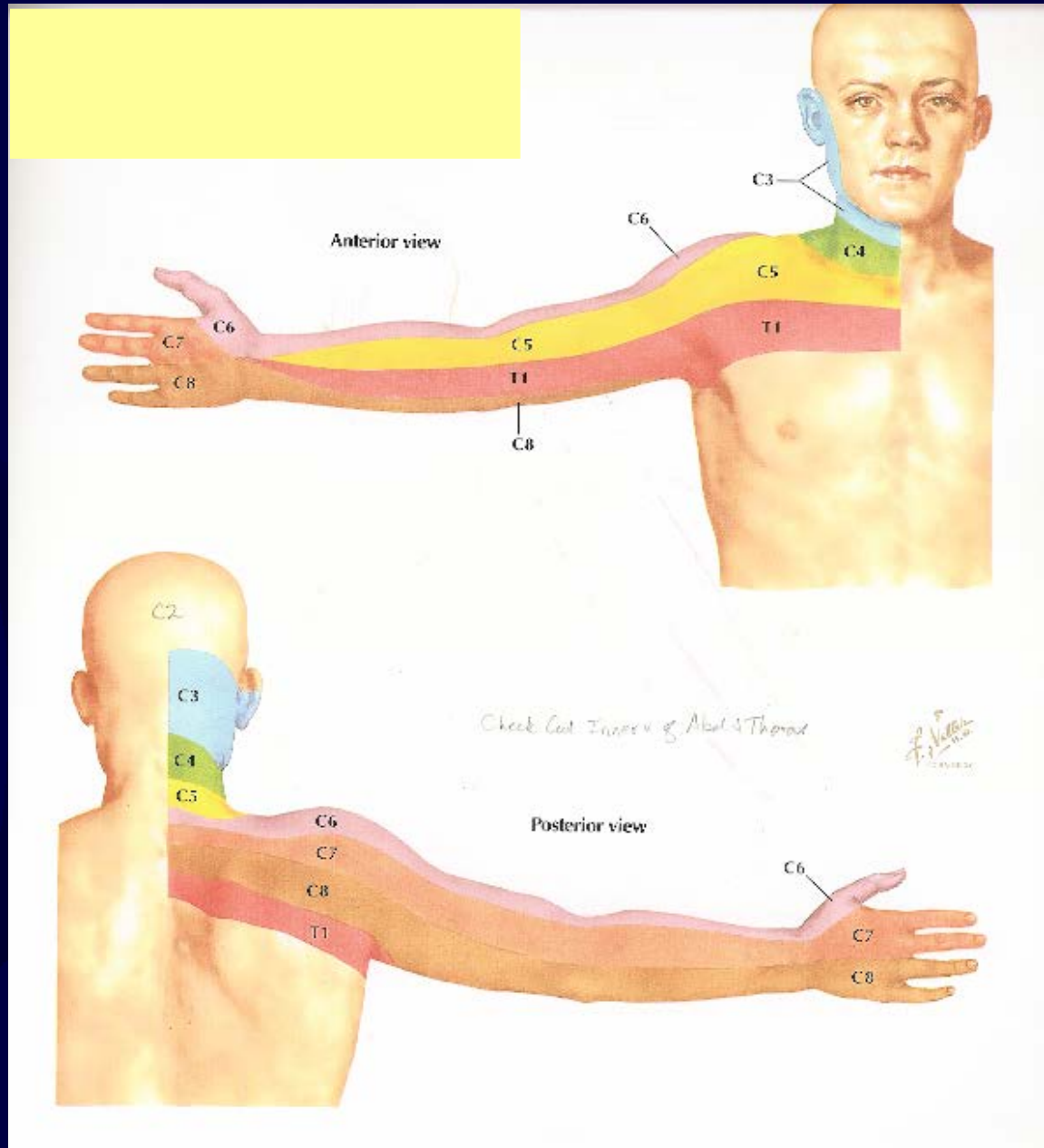
Normal

Diminished

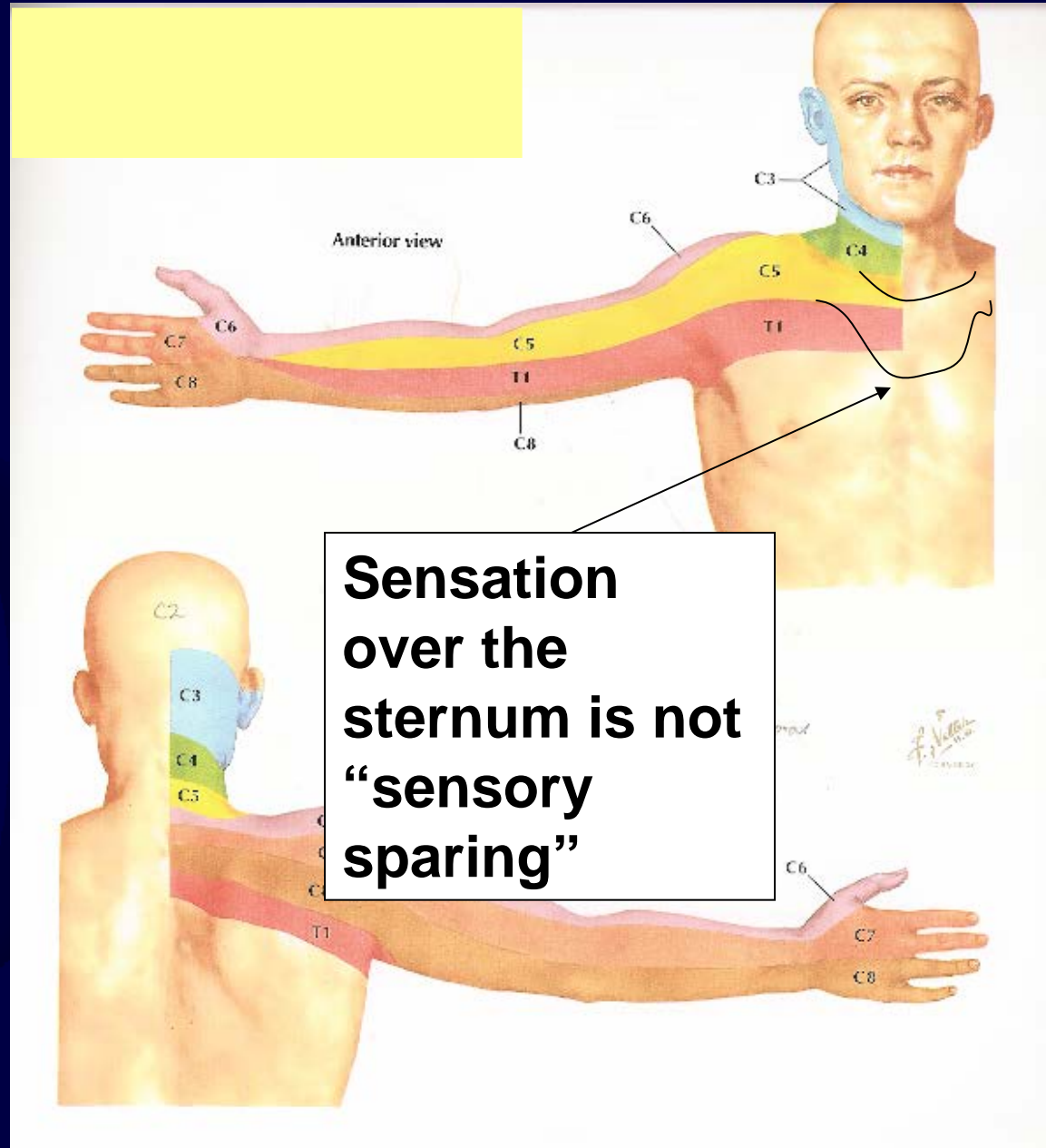
None

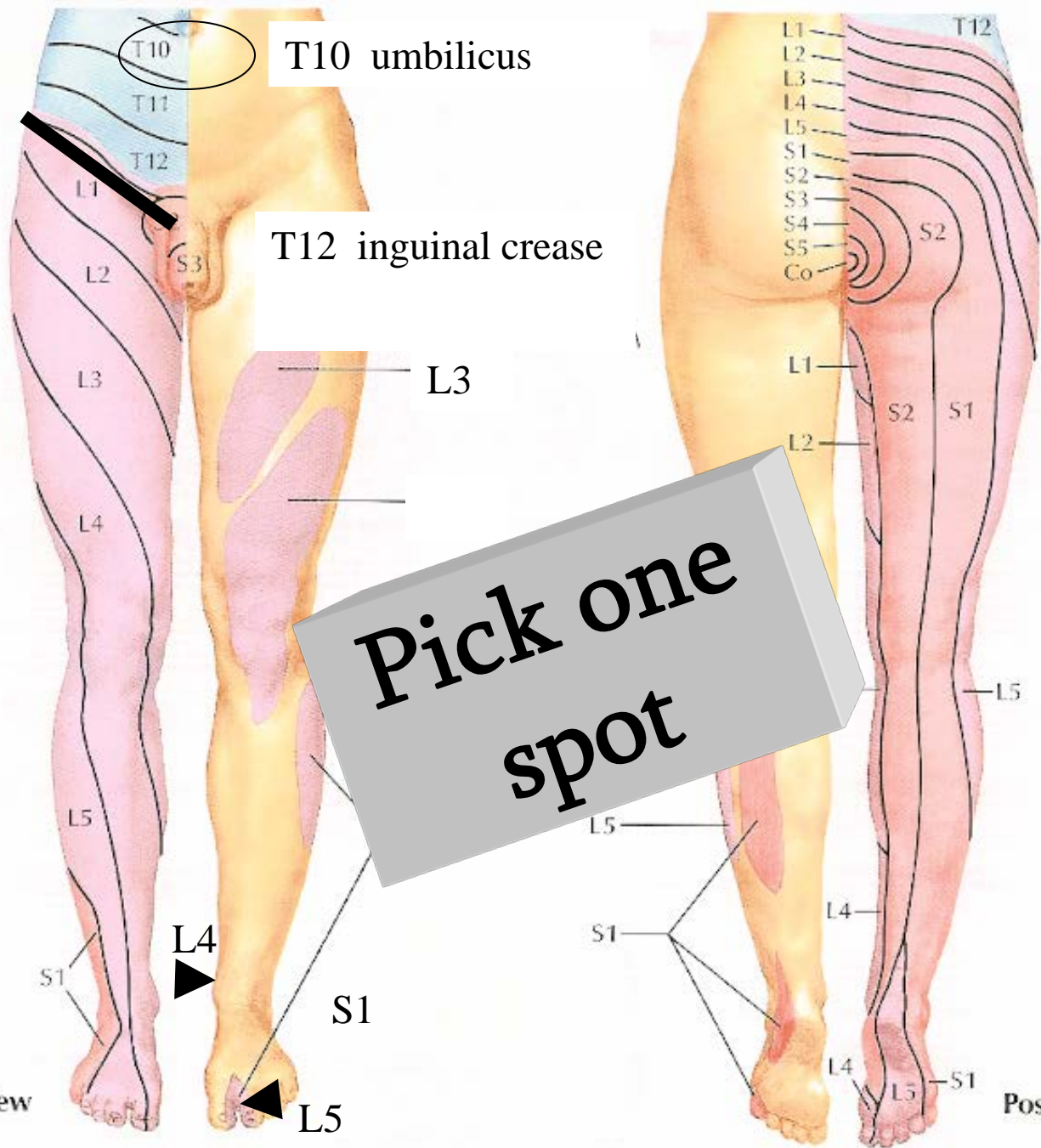
Light touch

D e r m a t o m e s



Beware: “Cervical Cape”





T10 umbilicus

T12 inguinal crease

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

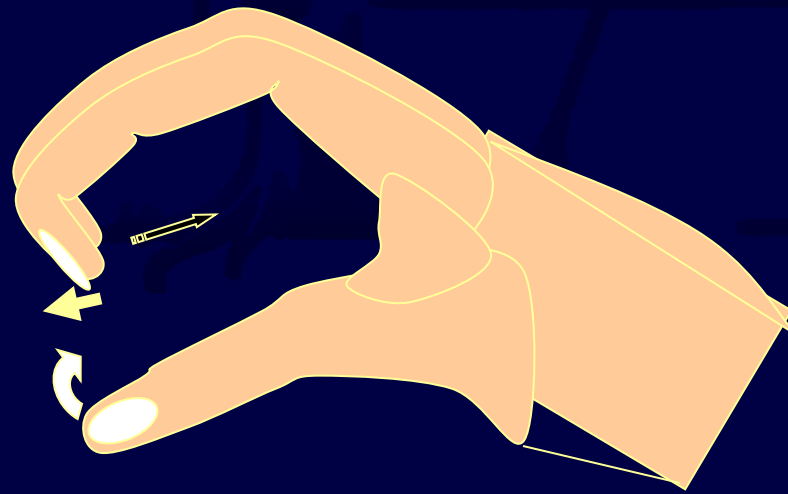
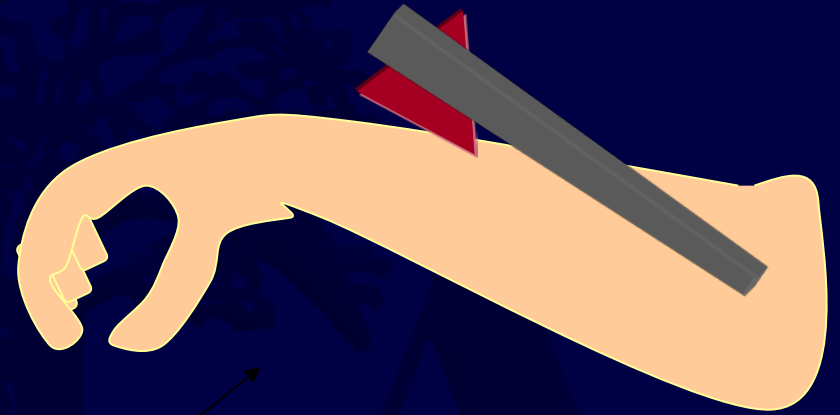
Achilles

Conus

Bulbo-Cavernosus

Pathologic Reflexes

- Hyperreflexia
- Clonus ≥ 4 beats
- Babinski
- Inverted Radial Reflex
- Hoffmans

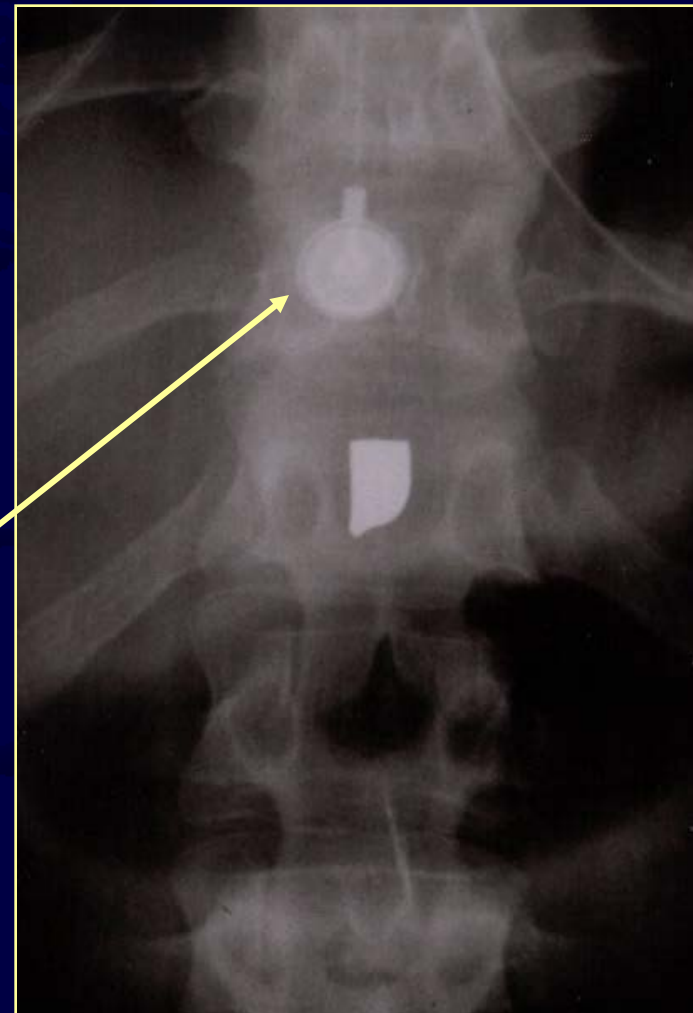


Don't forget the Cranial Nerves

- 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

Injury

Detection

Vs.

Description

Injury Detection

Injury Detection: Cervical Spine

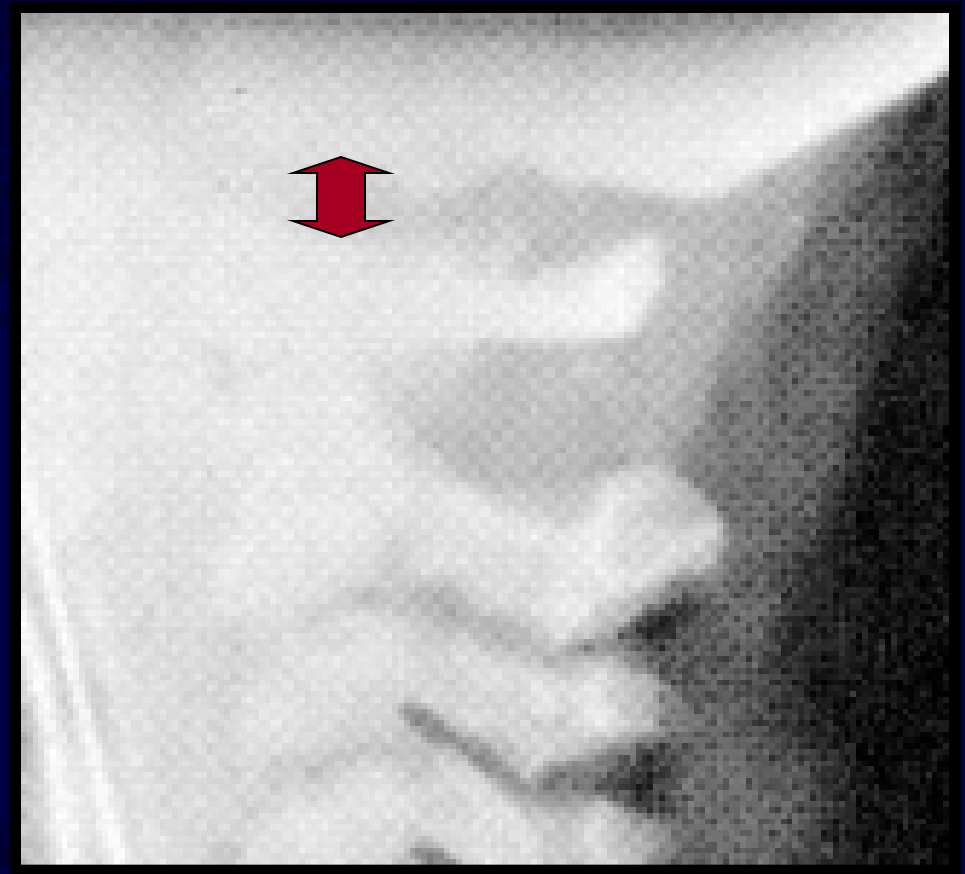
- Systematic
- Start at the top
- Start with PLAIN LATERAL FILM

**WORKHORSE OF
CERVICAL TRAUMA**

85% of injuries

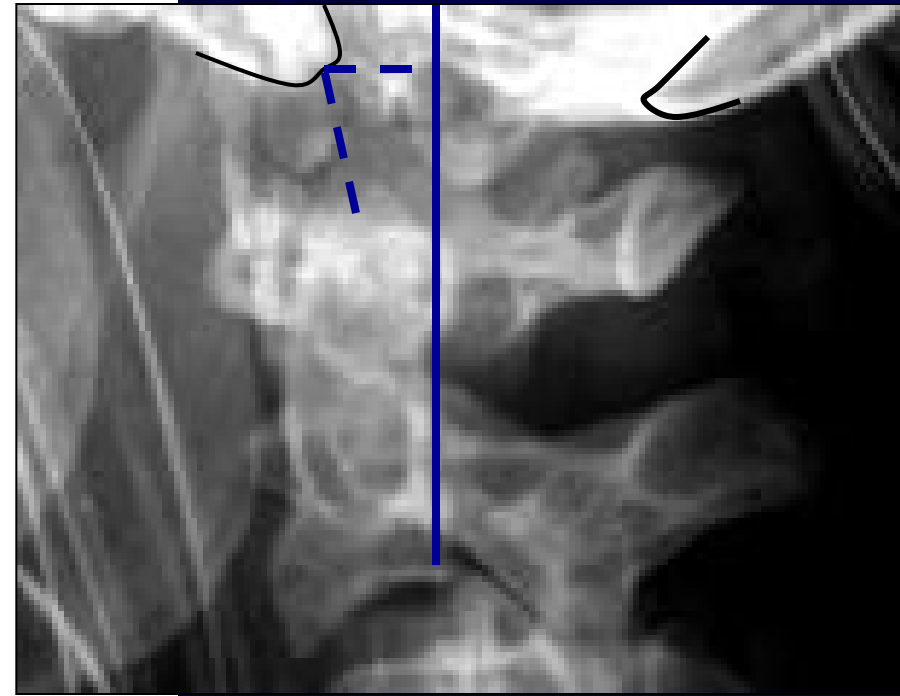
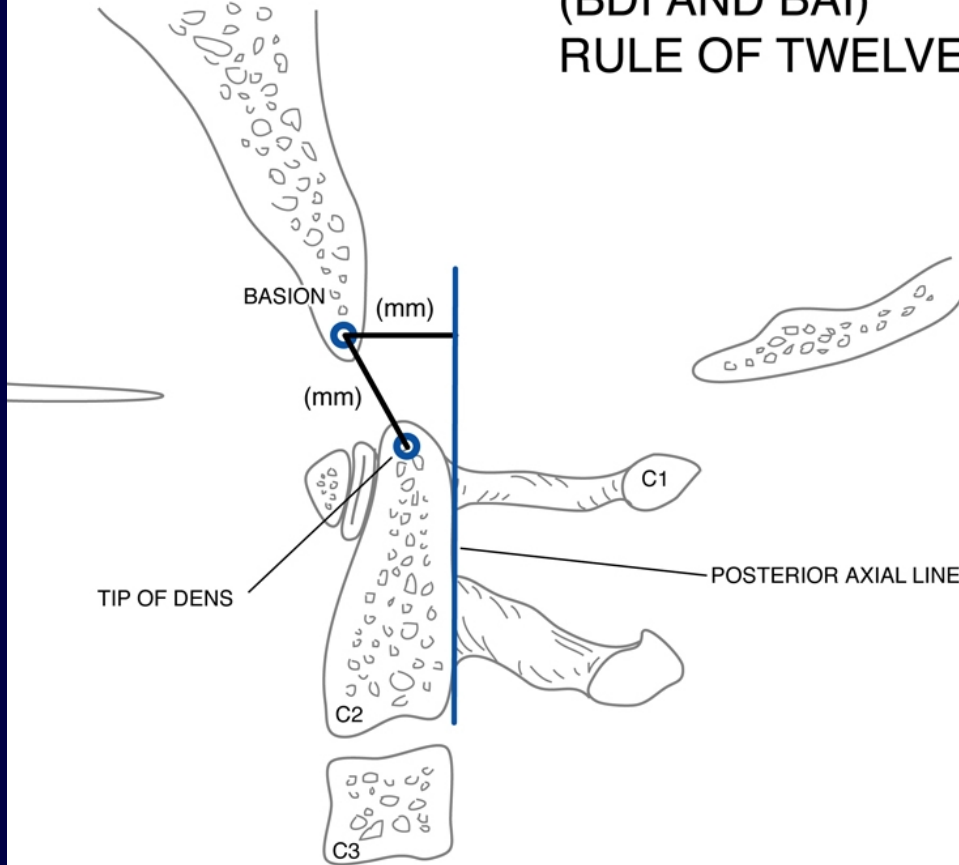
Occipitocervical Junction

- Dislocations
- Dissociations
- Challenges of Detection/Missed Diagnosis



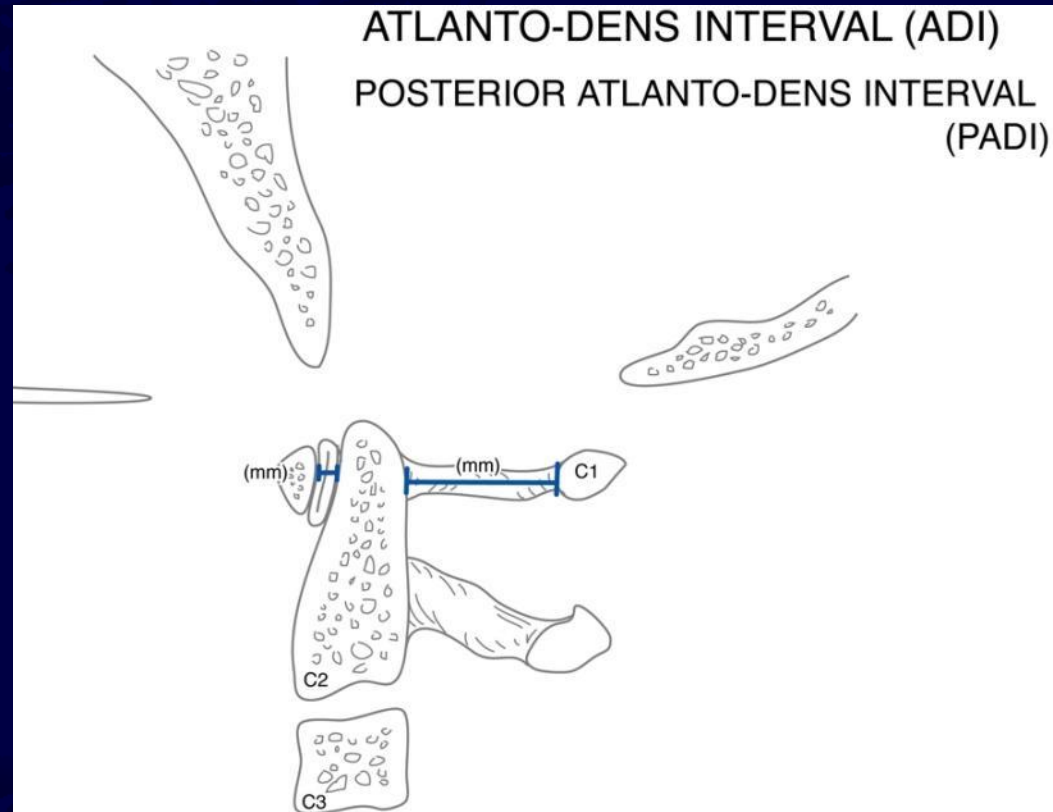
Detecting O-A Injuries

HARRIS' MEASUREMENTS
(BDI AND BAI)
RULE OF TWELVES



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



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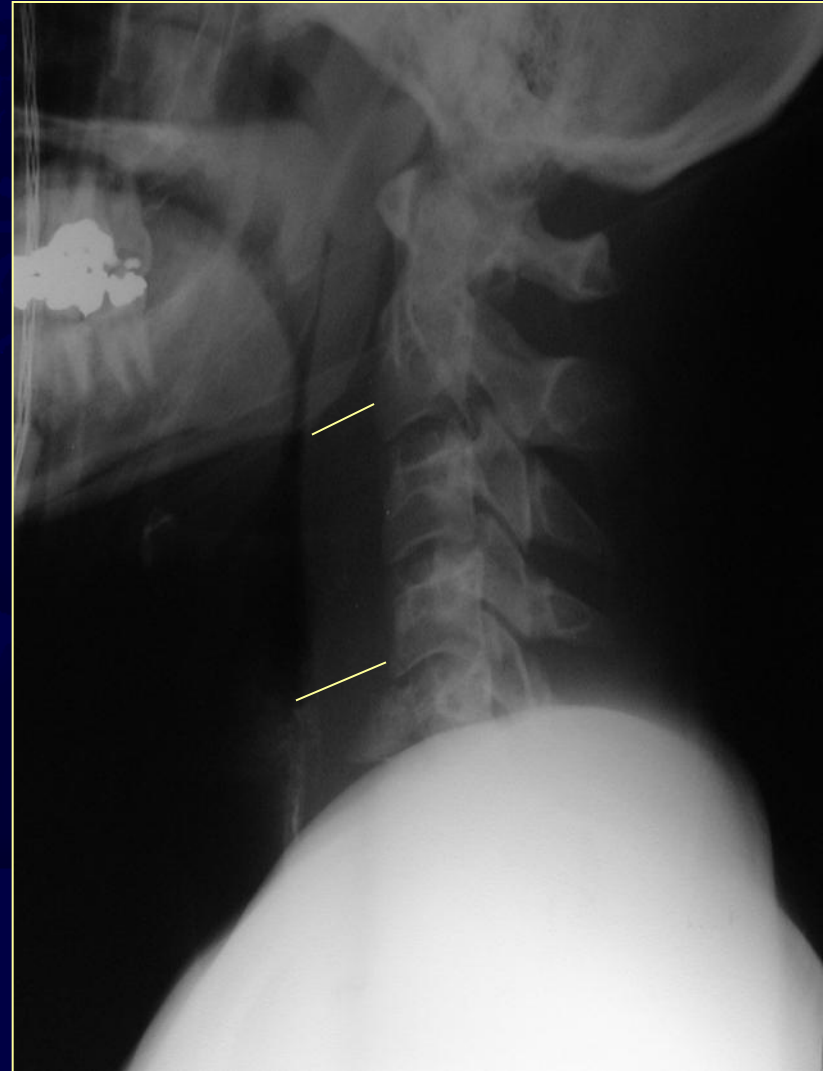
Subtle Signs of Injury

- 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

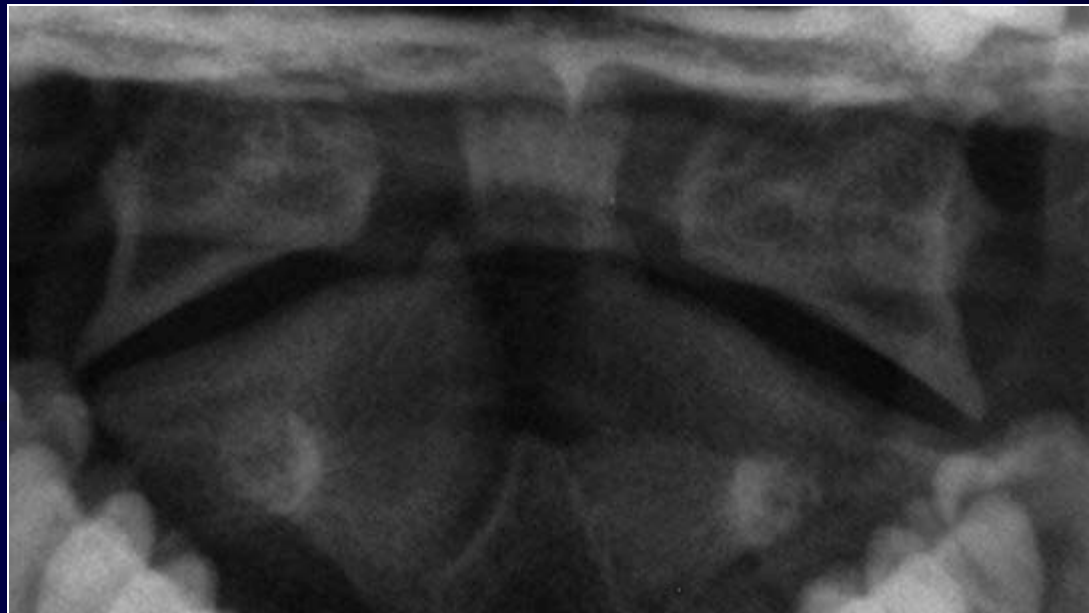
Anteroposterior (A-P) View

- Spinous process deviation
- Lateral Translation
- Coronal deformity



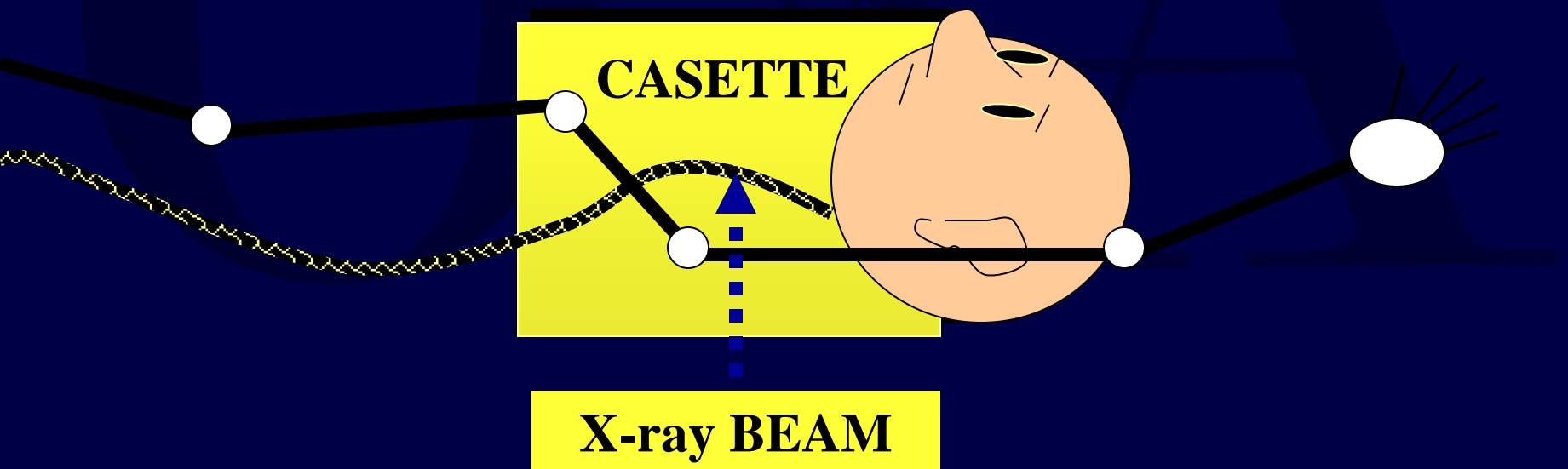
Open Mouth View

- Mostly C1-C2 lateral mass
- \pm Occipital Condyles/CO-C1
- Odontoid Process

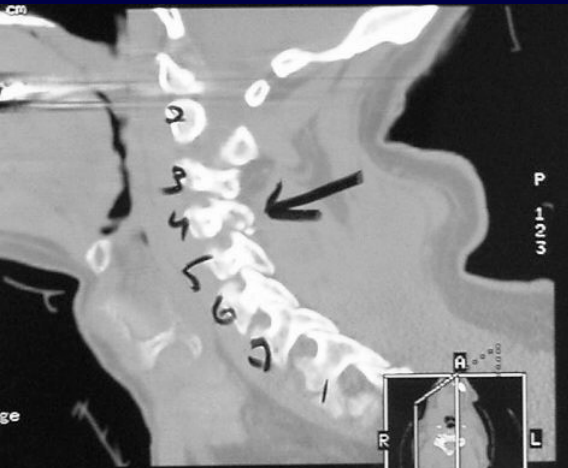


Swimmer's View

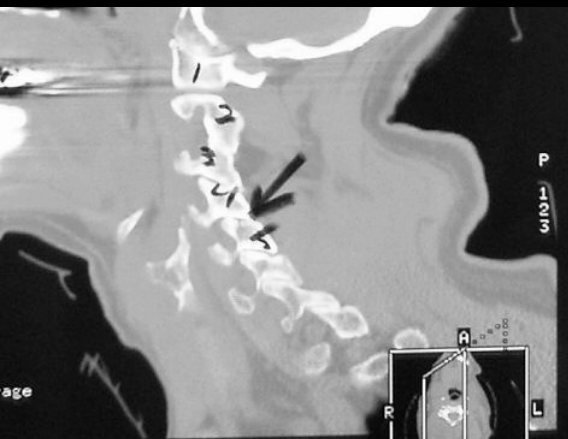
- Cervico-thoracic junction
 - obliques *sometimes* helpful



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

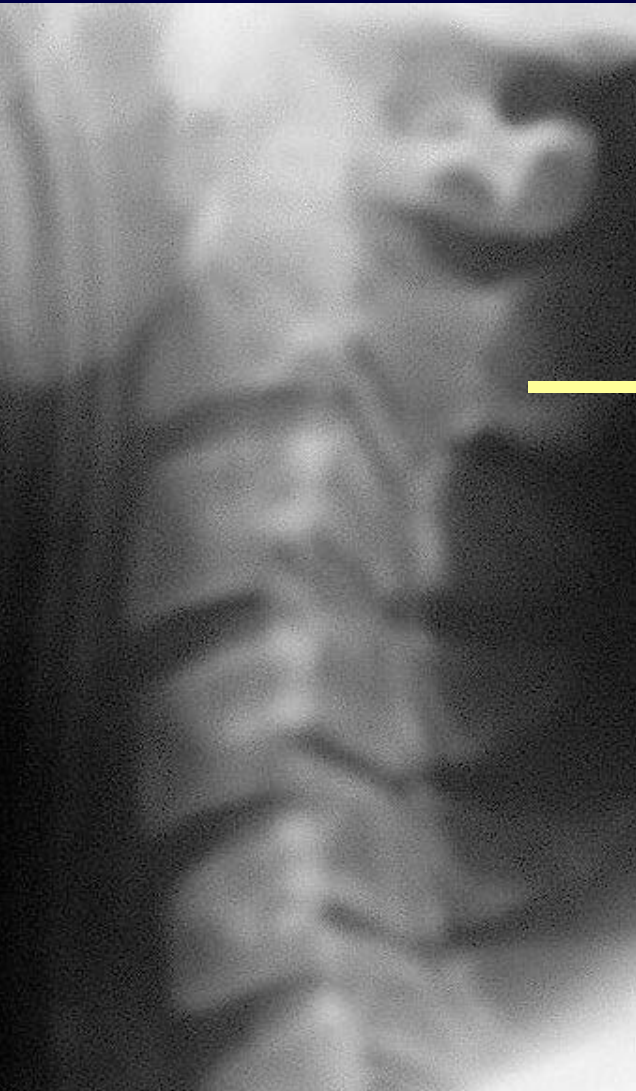
but still suspicious

MRI



- Continuity of ligaments
- edema in soft-tissues

MRI for injury detection

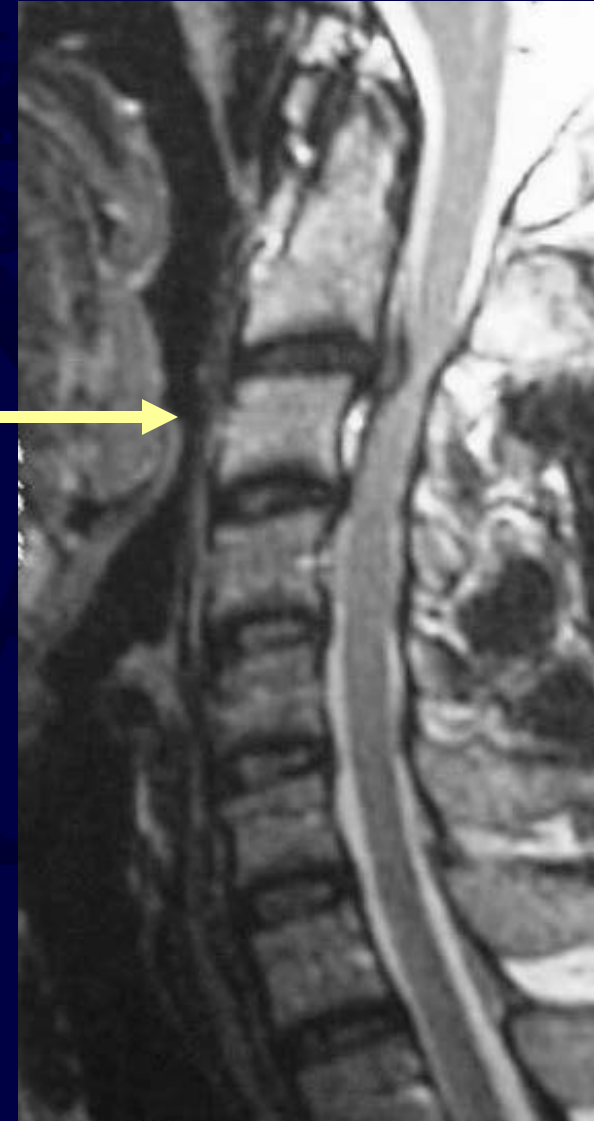


Clinical
suspicion/neural
deficit



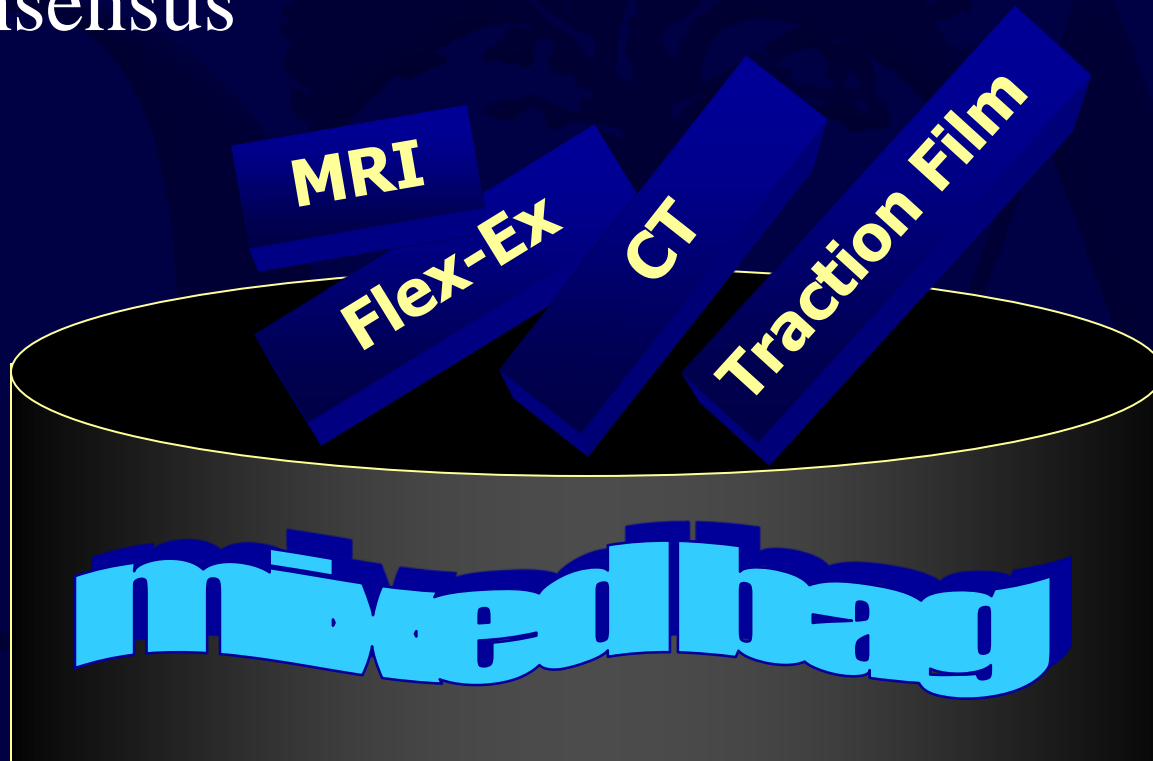
MRI

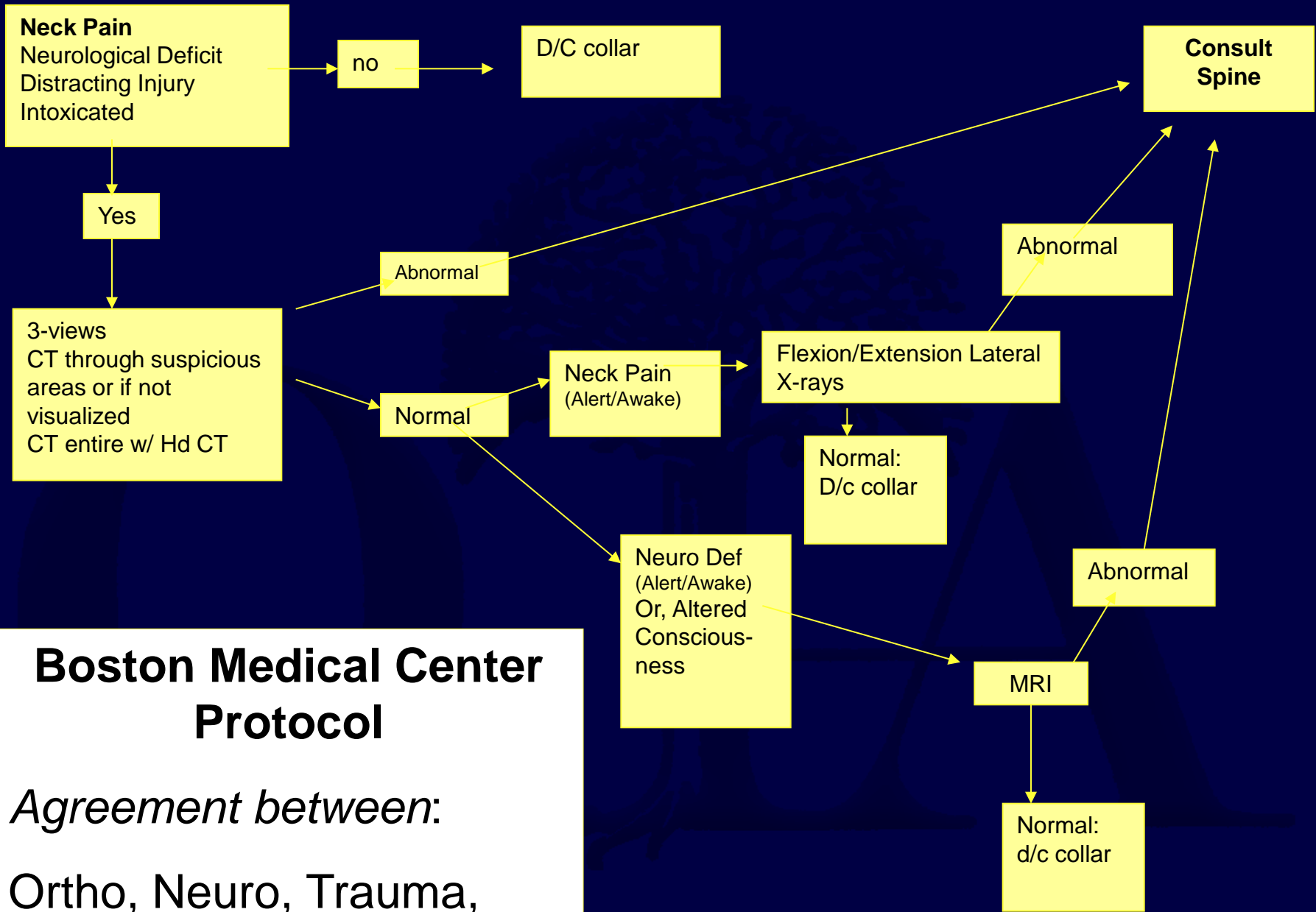
•Herniated Discs



“Clearing” the C-spine

- Standardized Protocol
- no consensus

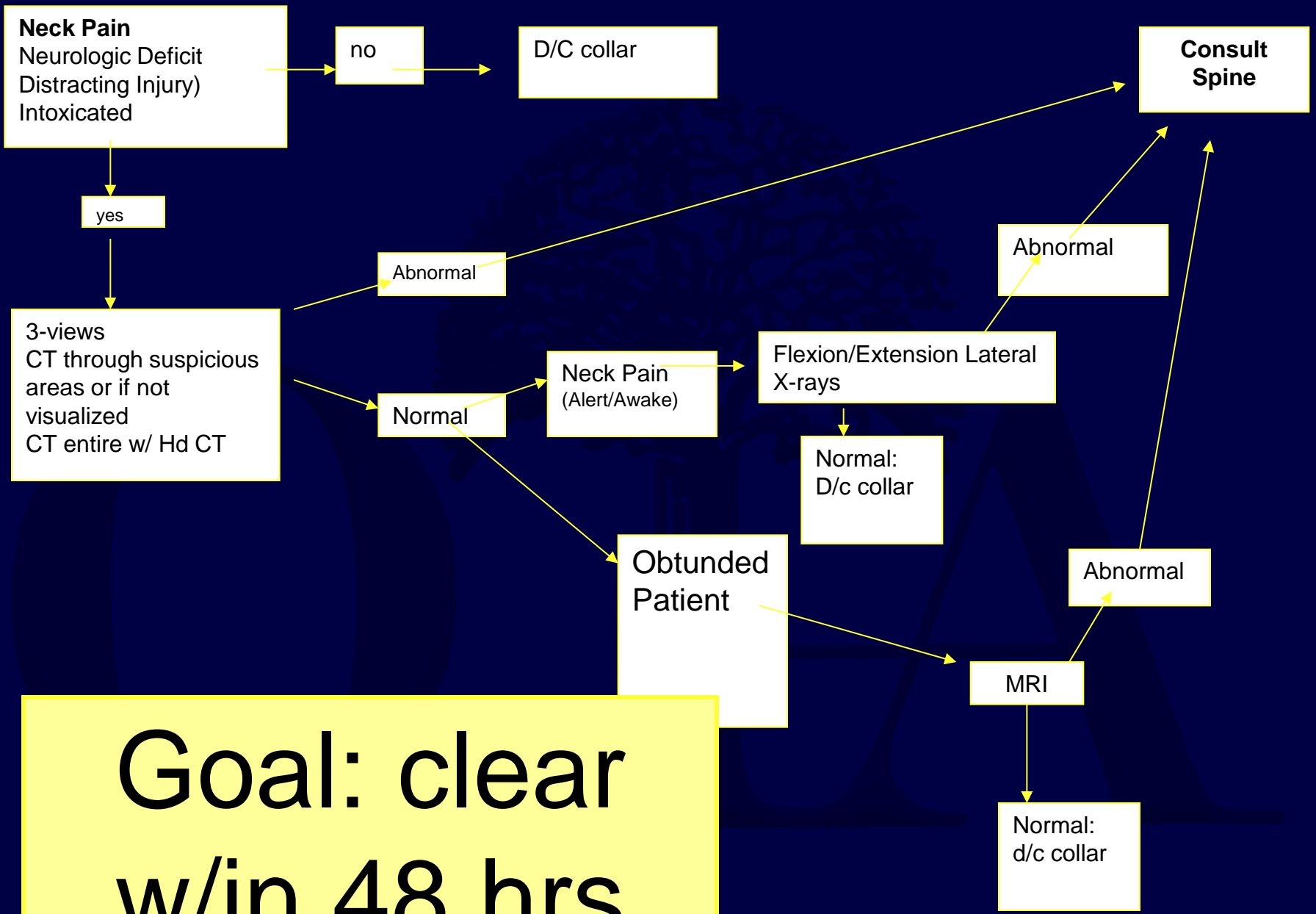




**Boston Medical Center
Protocol**

Agreement between:

Ortho, Neuro, Trauma,
Radiology

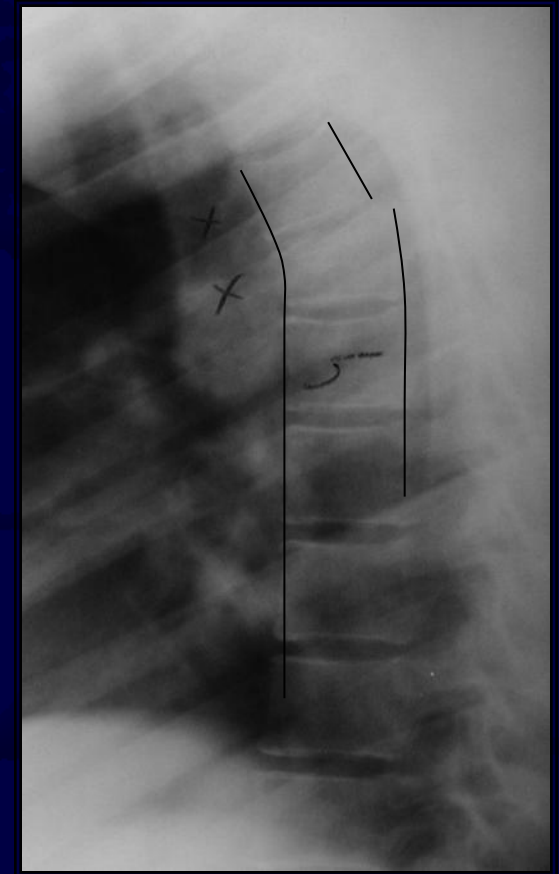


**Goal: clear
w/in 48 hrs**

Injury Detection

Thoracic and Lumbar Spines

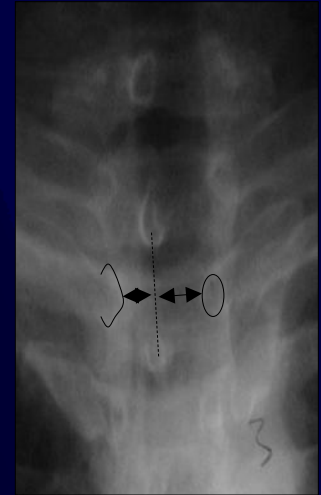
- Same principles
- Landmarks and Lines:
Lateral View
 - Posterior VB line
 - Anterior VB line
 - Inter-spinous Distance
 - Translation



Injury Detection

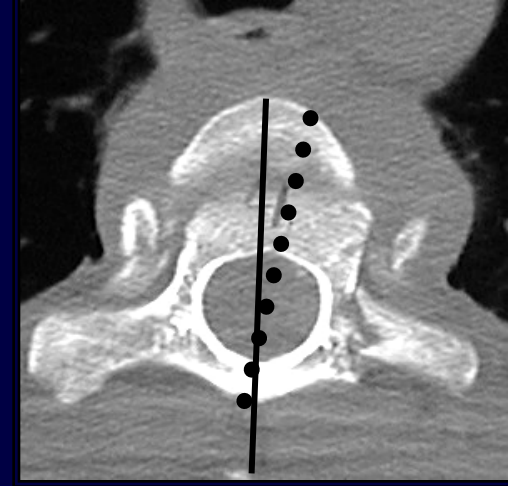
Thoracic and Lumbar Spines

- Same principles
- Landmarks and Lines: A-P View
 - Spinous process to Pedicles
 - Inter-pedicular Distance
 - Translation



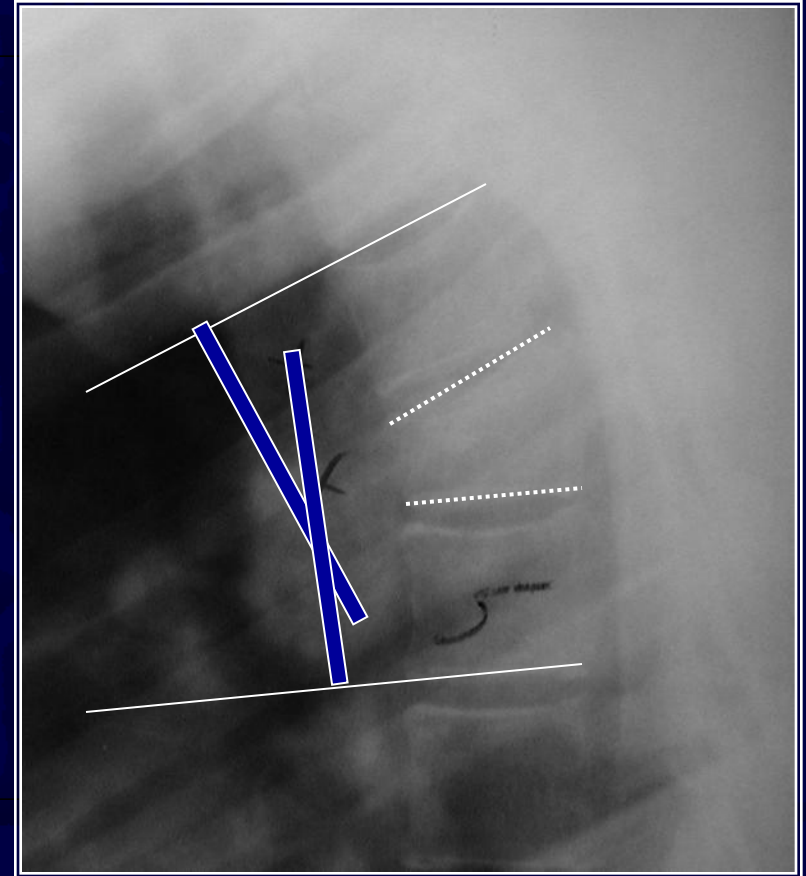


CT



- More common as initial study
- indicated if suspicious plain film
- best for bony detail
- axial--can miss translation

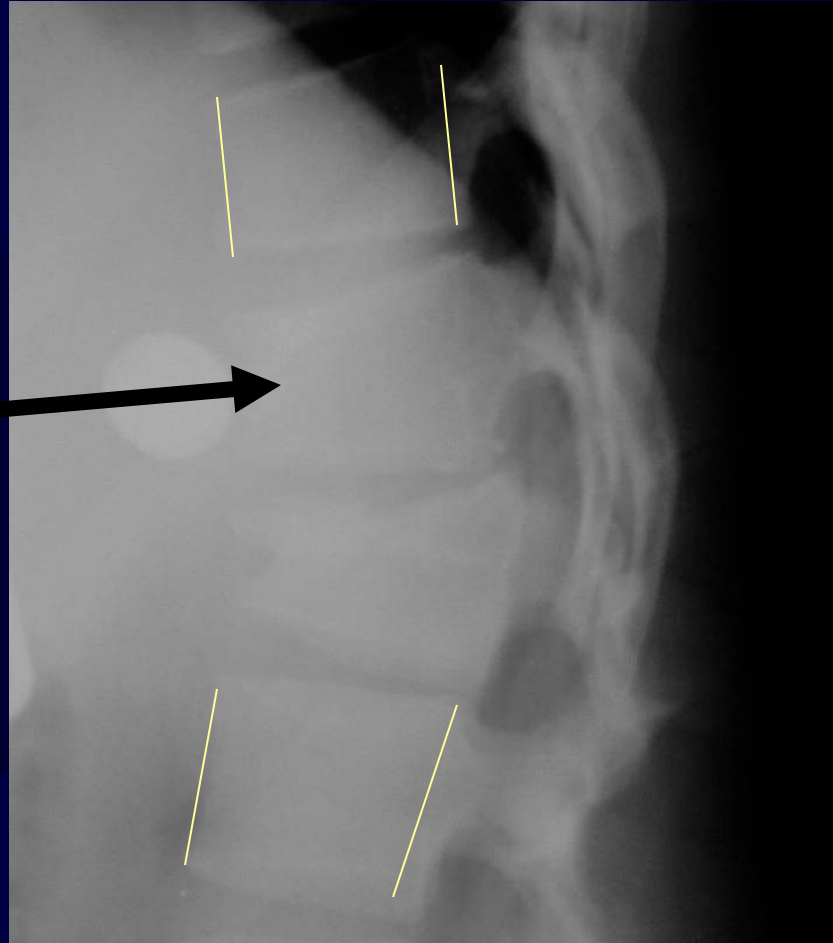
Thoracic and Lumbar Injuries



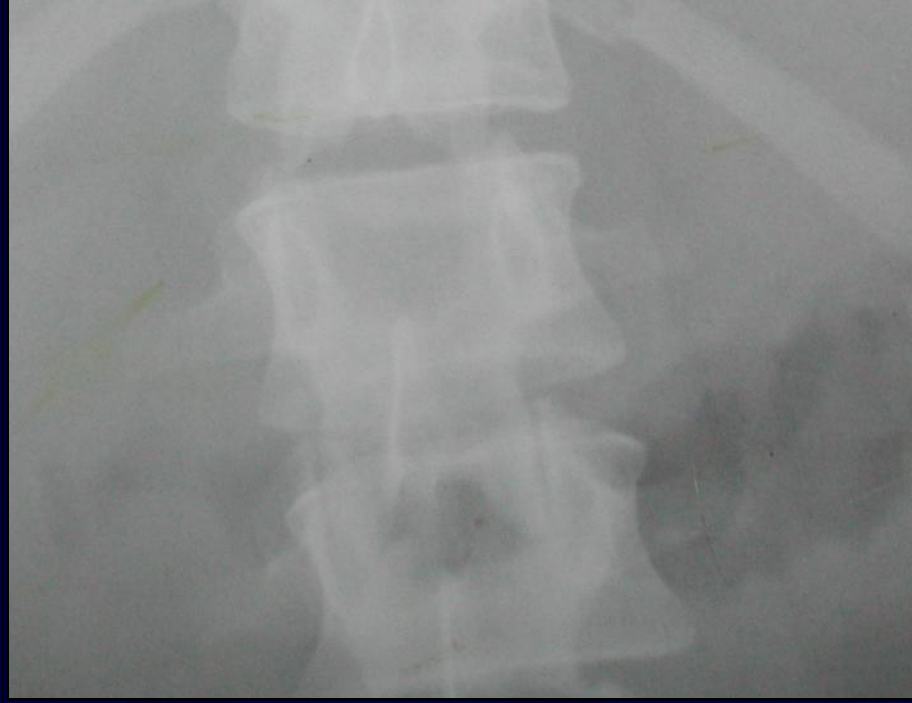
What is “normal” angulation

Height Loss

**Adjacent
fracture**

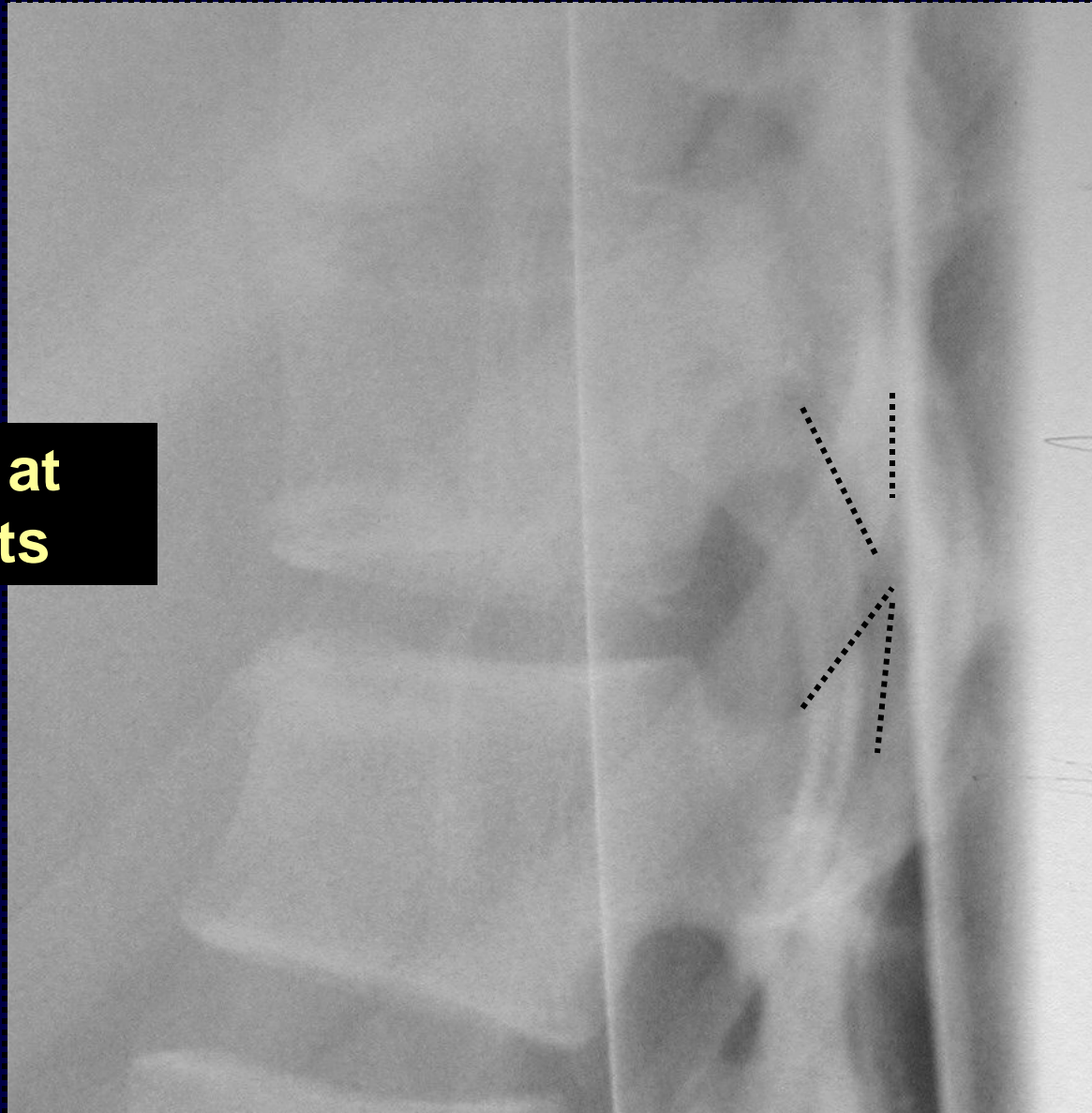


Frequently Missed Injuries

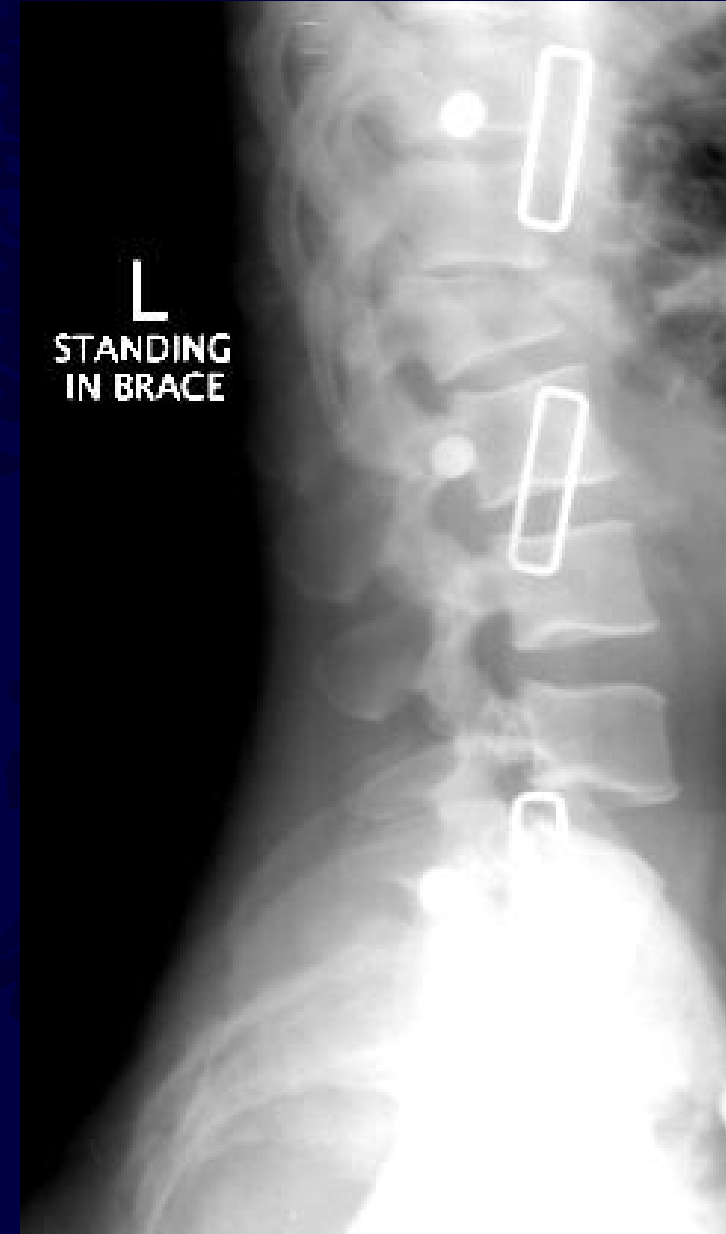


Flexion-Distraktion Injuries

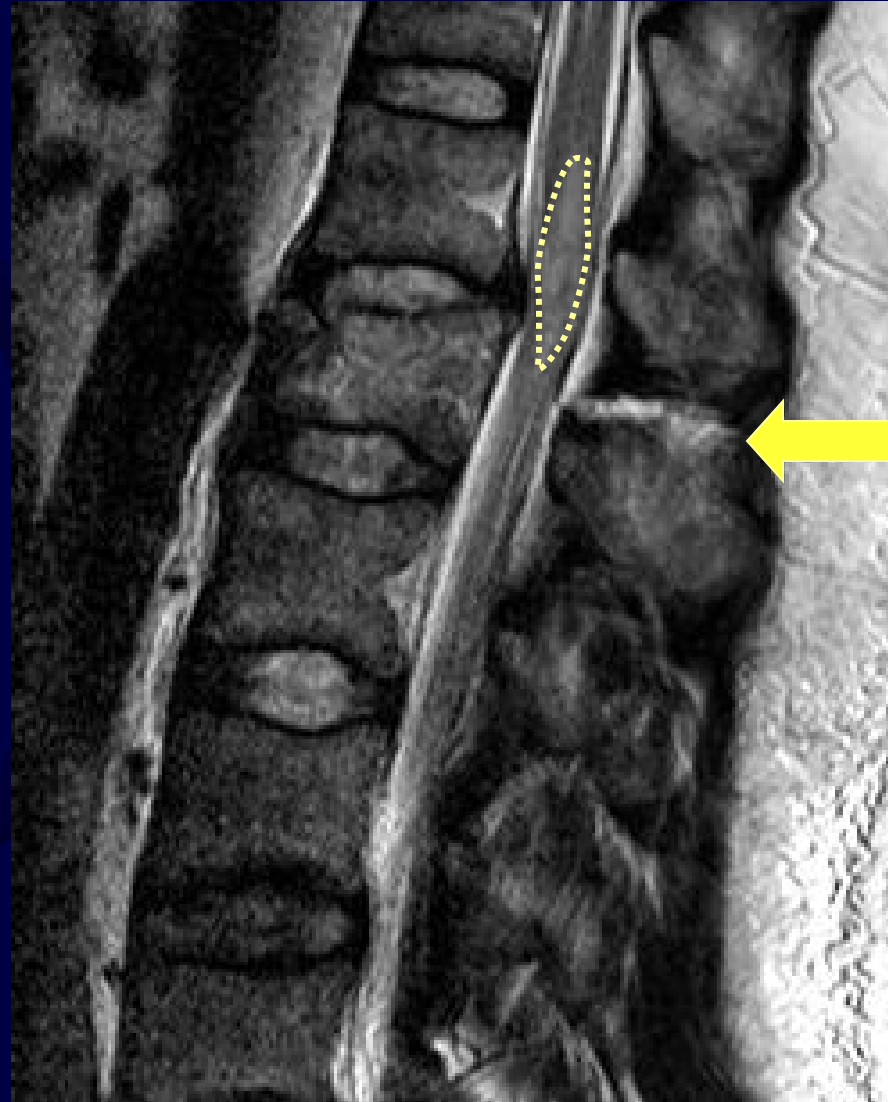
**Look at
Facets**



Using MRI to assess the PLC

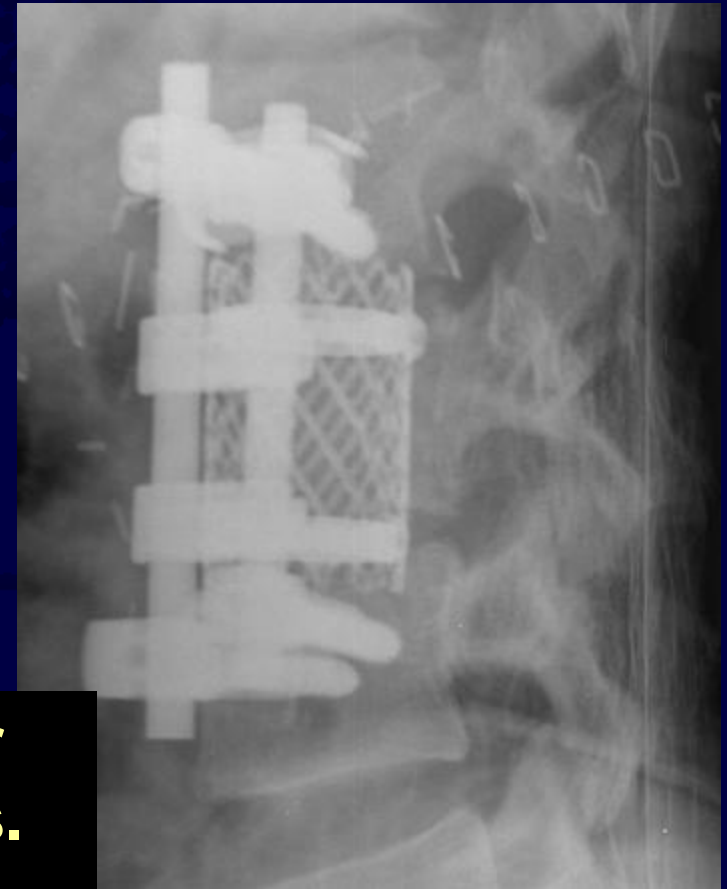


Using MRI to assess the PLC



**Continuity
of the
Ligamentum
Flavum**

Using MRI to assess the PLC



**Anterior
Alone vs.
Combined
A/P**

S
p
i
n
e
r
u
l
e
s



**Thank
you**



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