SPINE INJURY CLASSIFICATION

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FUNCTION OF THE SPINE

- To maintain alignment and position over time and protect the integrity of the neural elements

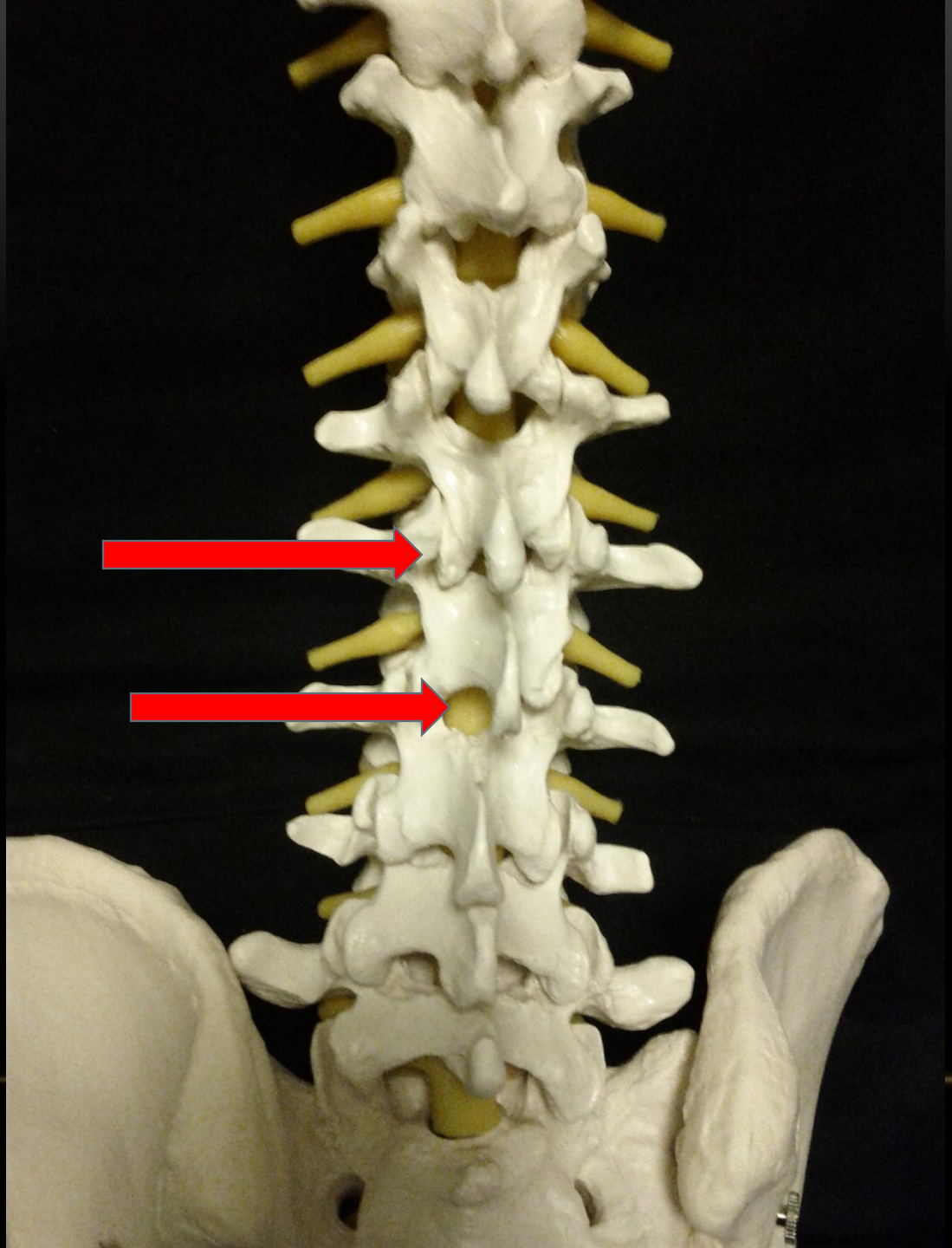
- Composed of 24 mobile vertebrae as well as the skull and sacrum/coccyx
  - 7 cervical
  - 12 thoracic
  - 5 lumbar
  - 5 sacral
  - … in most people

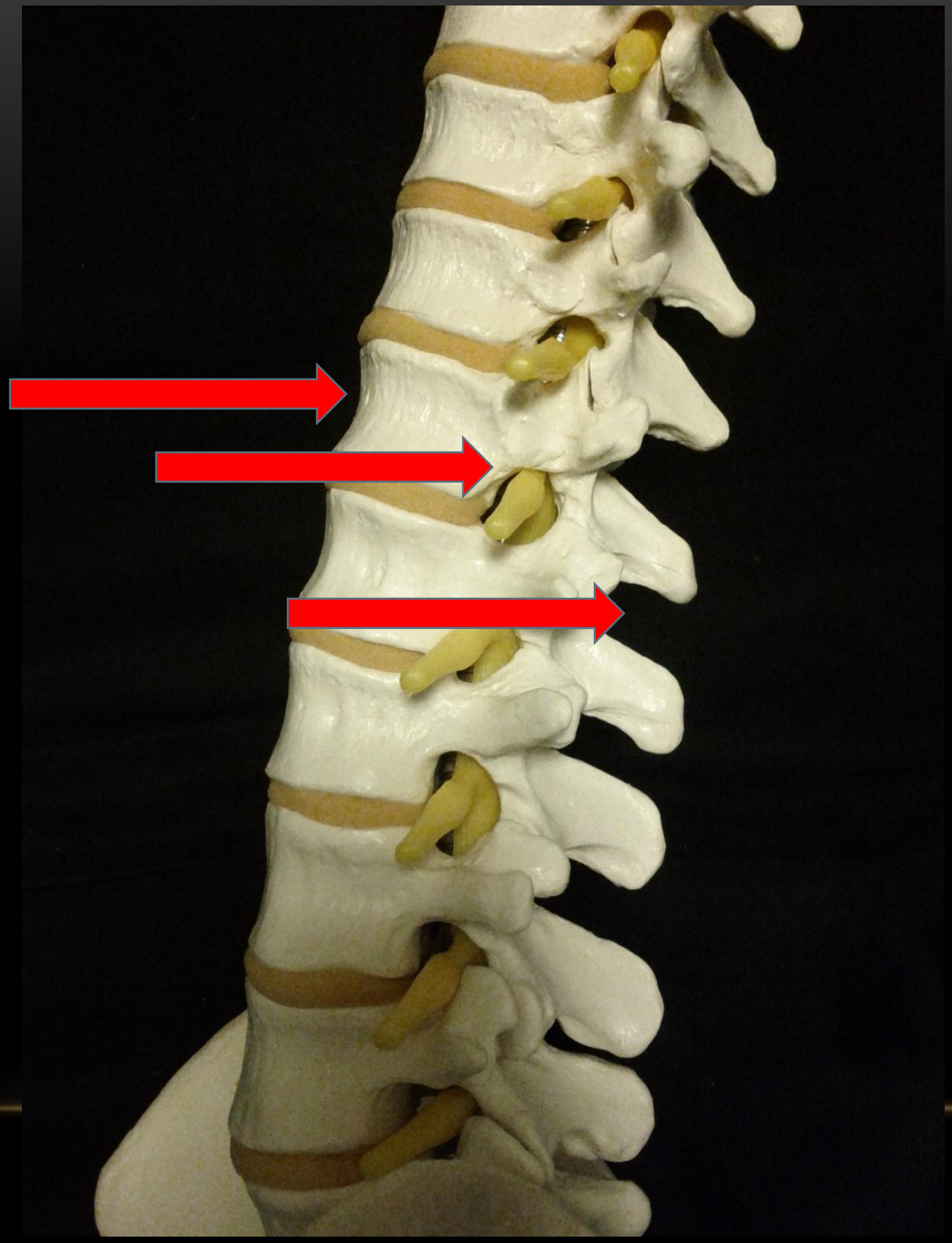
ANATOMY

- Vertebra
  - Body (corpus)
  - Pedicle
  - Lamina
  - Superior and inferior articular process
  - Pars (*interarticularis*) or lateral mass
  - Transverse process
  - Spinous process

ANATOMY

- Ligaments:
  - Ligamentum flavum
  - Anterior longitudinal ligament
  - Posterior longitudinal ligament
  - Interspinous ligament
  - Supraspinous ligament
  - Inter-transverse ligament
  - Others at the lumbosacral/pelvic junction
  - Others at the craniocervical junction





NEUROLOGIC DEFICIT

- Cord:
  - Complete:
    - No motor or sensory function below the level of injury
    - No sacral sparing
  - Incomplete:
    - Sacral sparing
    - Motor sparing
- Cauda equina / conus medularis
- Root

SPINAL CORD "SYNDROMES"

- Except for central cord syndrome, these are exceedingly Uncommon
- **Central cord syndrome**:
  - With or without a fracture, disproportionate motor and sensory deficits in upper limbs compared to lower limbs
- Anterior cord:
  - Pure motor (NOT traumatic)
- Brown-Sequard syndrome
  - Contralateral loss of pain and motor function (usually from penetrating trauma to cord … very rare)

- Cord "contusion" versus cord "laceration"

Patient Name _____

Examiner Name _____ Date/Time of Exam _____

INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

ASIA American Spinal Injury Association

ISCOS

MOTOR

KEY MUSCLES (scoring on reverse side)

	R	L	
C5	☐	☐	Elbow flexors
C6	☐	☐	Wrist extensors
C7	☐	☐	Elbow extensors
C8	☐	☐	Finger flexors (distal phalanx of middle finger)
T1	☐	☐	Finger abductors (little finger)

UPPER LIMB TOTAL (MAXIMUM) ☐ + ☐ = ☐ (25) (25) (50)

Comments:

L2	☐	☐	Hip flexors
L3	☐	☐	Knee extensors
L4	☐	☐	Ankle dorsiflexors
L5	☐	☐	Long toe extensors
S1	☐	☐	Ankle plantar flexors

(VAC) Voluntary anal contraction (Yes/No) ☐

LOWER LIMB TOTAL (MAXIMUM) ☐ + ☐ = ☐ (25) (25) (50)

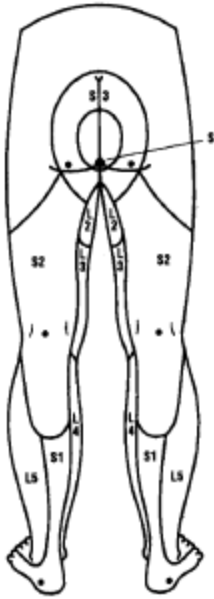
	LIGHT TOUCH R	LIGHT TOUCH L	PIN PRICK R	PIN PRICK L
C2				
C3				
C4				
C5				
C6				
C7				
C8				
T1				
T2				
T3				
T4				
T5				
T6				
T7				
T8				
T9				
T10				
T11				
T12				
L1				
L2				
L3				
L4				
L5				
S1				
S2				
S3				
S4-5				

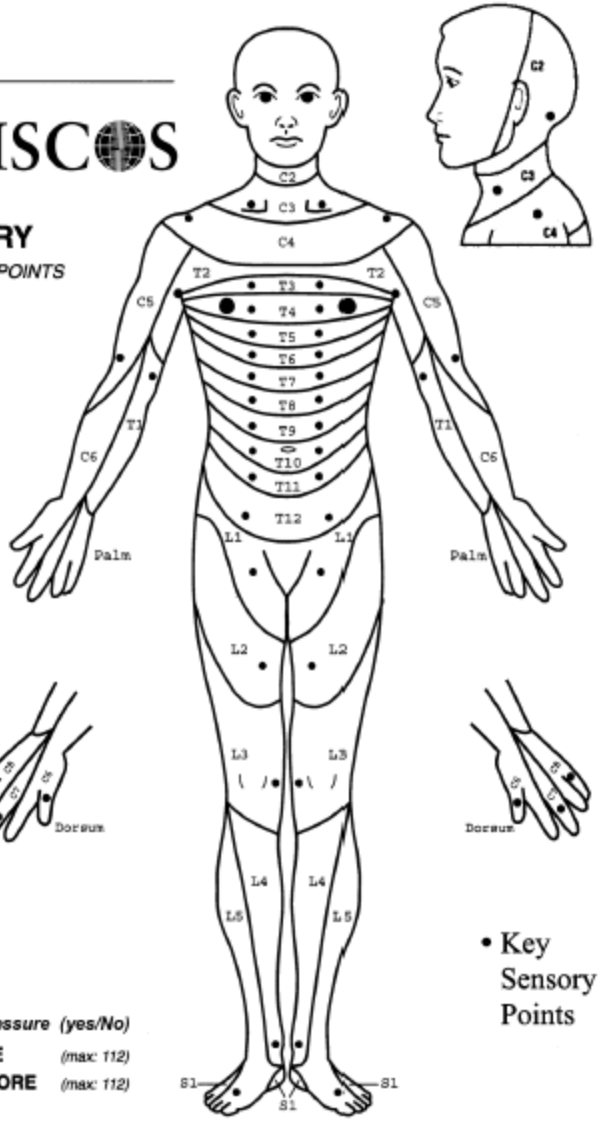
TOTALS (MAXIMUM) (56) (56) (56) (56) ☐ + ☐ = ☐ = ☐

SENSORY

KEY SENSORY POINTS

0 = absent
1 = altered
2 = normal
NT = not testable





• Key Sensory Points

(DAP) Deep anal pressure (yes/No) ☐

PIN PRICK SCORE (max: 112) ☐

LIGHT TOUCH SCORE (max: 112) ☐

NEUROLOGICAL LEVEL The most caudal segment with normal function — SENSORY R ☐ L ☐ / MOTOR R ☐ L ☐

SINGLE NEUROLOGICAL LEVEL ☐

COMPLETE OR INCOMPLETE? ☐ Incomplete = Any sensory or motor function in S4-S5

ASIA IMPAIRMENT SCALE (AIS) ☐

ZONE OF PARTIAL PRESERVATION (In complete injuries only) Most caudal level with any innervation — SENSORY R ☐ L ☐ / MOTOR R ☐ L ☐

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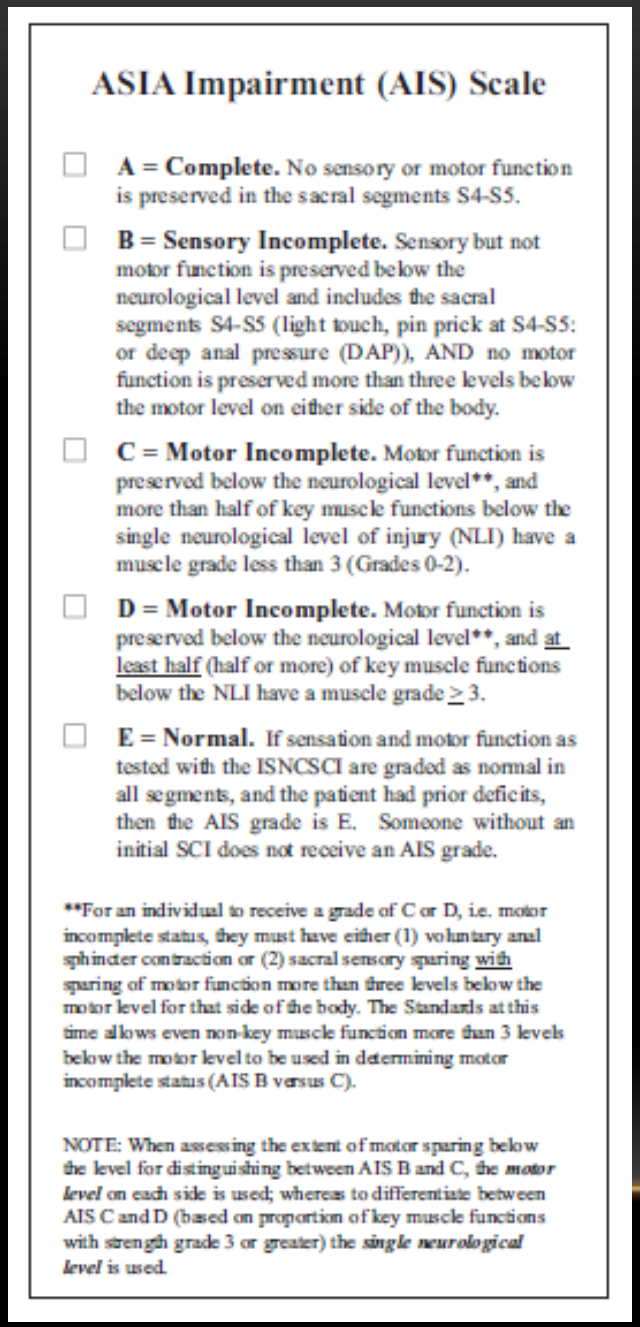
REV 04/11



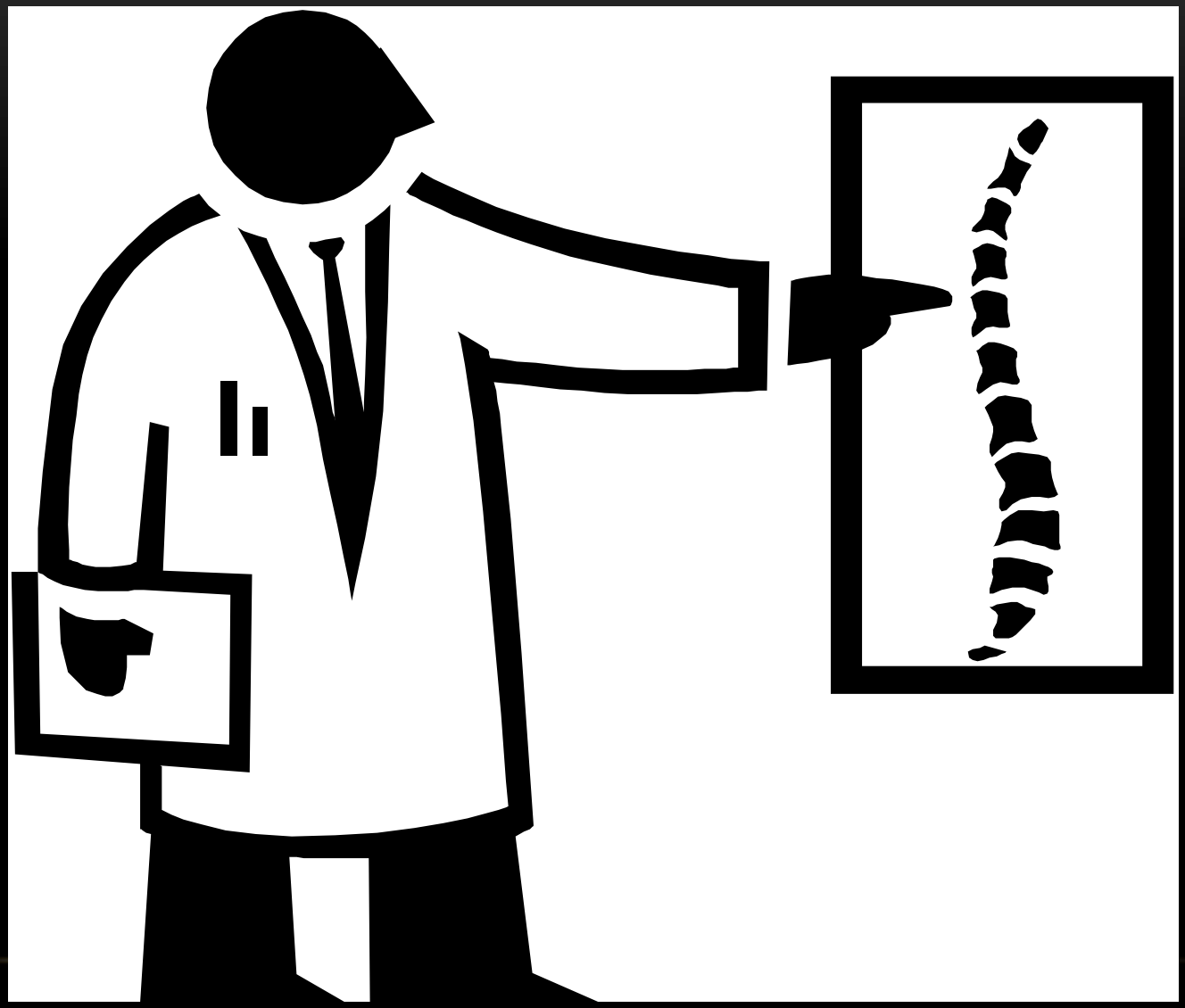
ASIA Impairment (AIS) Scale

- ☐ **A = Complete.** No sensory or motor function is preserved in the sacral segments S4-S5.
- ☐ **B = Sensory Incomplete.** Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5 (light touch, pin prick at S4-S5: or deep anal pressure (DAP)), AND no motor function is preserved more than three levels below the motor level on either side of the body.
- ☐ **C = Motor Incomplete.** Motor function is preserved below the neurological level**, and more than half of key muscle functions below the single neurological level of injury (NLI) have a muscle grade less than 3 (Grades 0-2).
- ☐ **D = Motor Incomplete.** Motor function is preserved below the neurological level**, and at least half (half or more) of key muscle functions below the NLI have a muscle grade ≥ 3.
- ☐ **E = Normal.** If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

**For an individual to receive a grade of C or D, i.e. motor incomplete status, they must have either (1) voluntary anal sphincter contraction or (2) sacral sensory sparing with sparing of motor function more than three levels below the motor level for that side of the body. The Standards at this time allows even non-key muscle function more than 3 levels below the motor level to be used in determining motor incomplete status (AIS B versus C).

NOTE: When assessing the extent of motor sparing below the level for distinguishing between AIS B and C, the ***motor level*** on each side is used; whereas to differentiate between AIS C and D (based on proportion of key muscle functions with strength grade 3 or greater) the ***single neurological level*** is used.

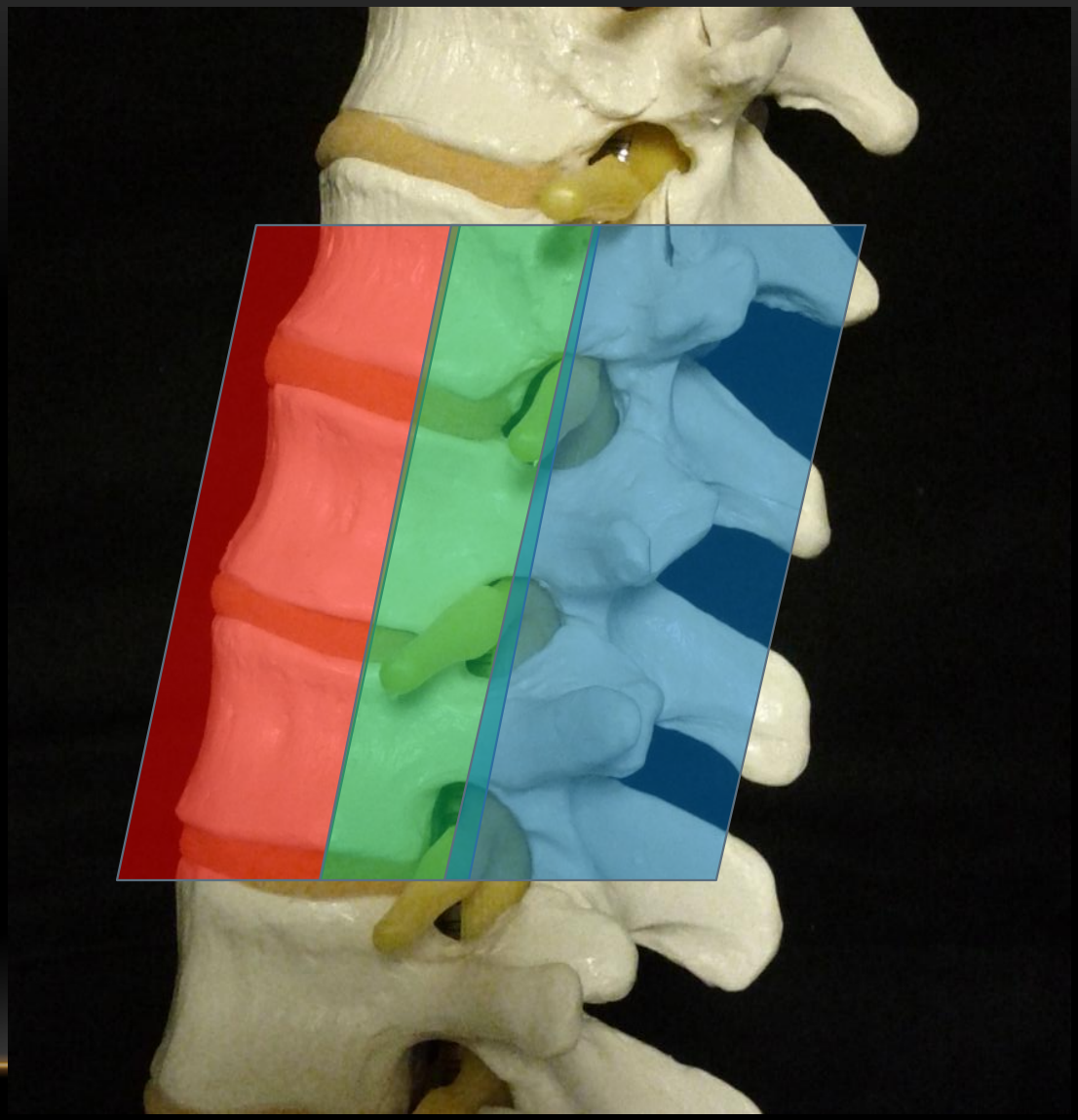
- Cord vs nerve root:
  - Spinal cord travels from the skull to about L1
  - Cauda equina is the group of nerve roots below this level
  - One nerve root exits each vertebra on each side



“EXPERT” PRACTICE AND PREFERENCE

COLUMNS

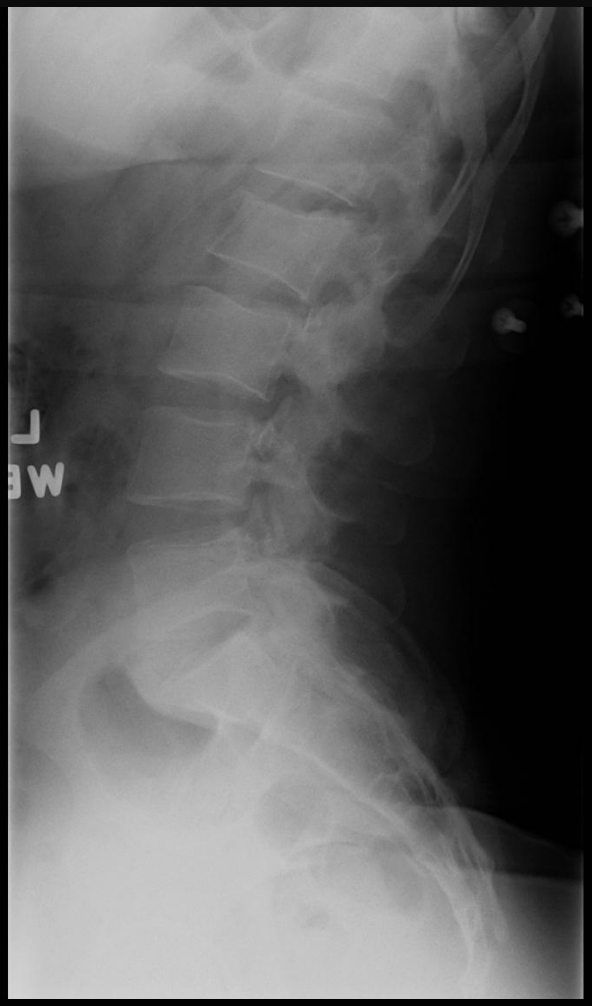
- Anterior
- Middle
- Posterior

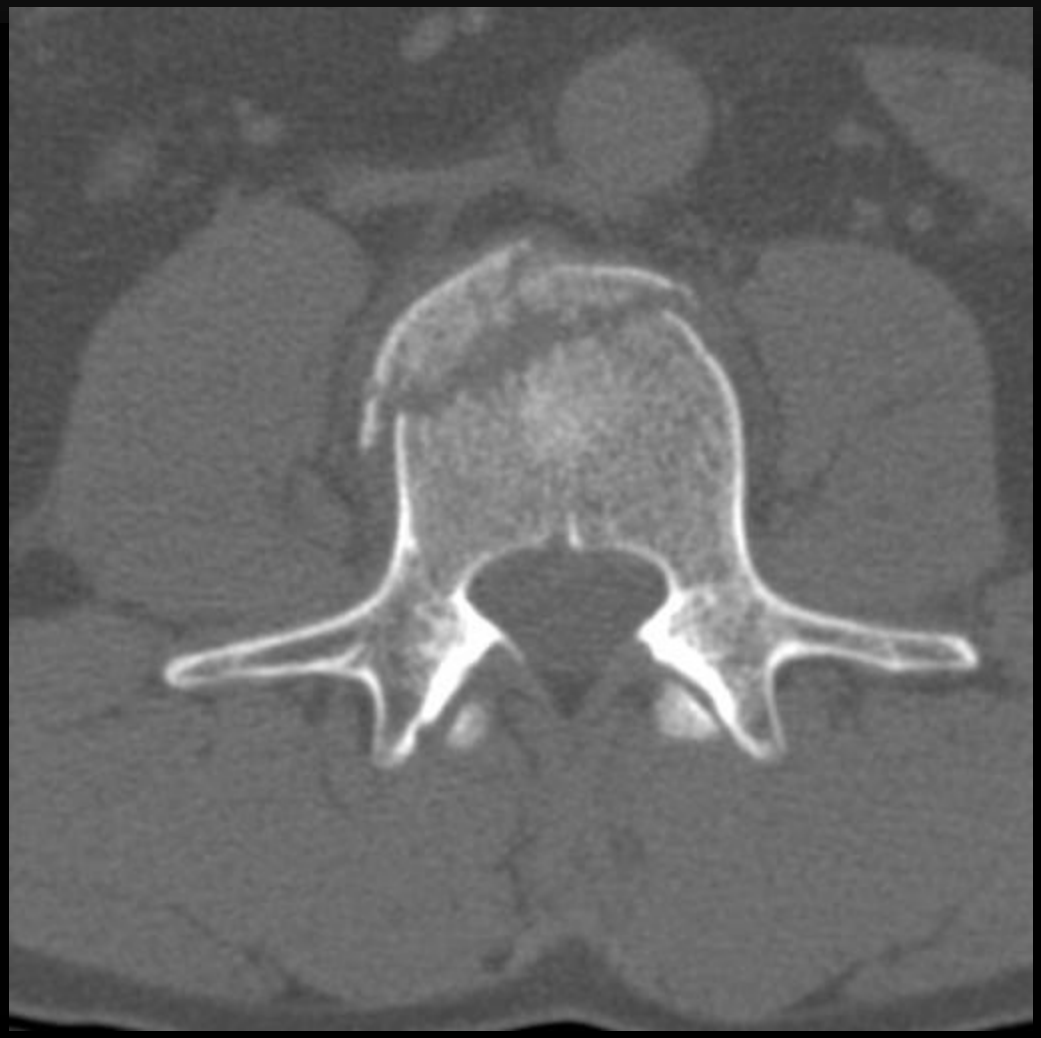


THORACIC AND LUMBAR FRACTURES

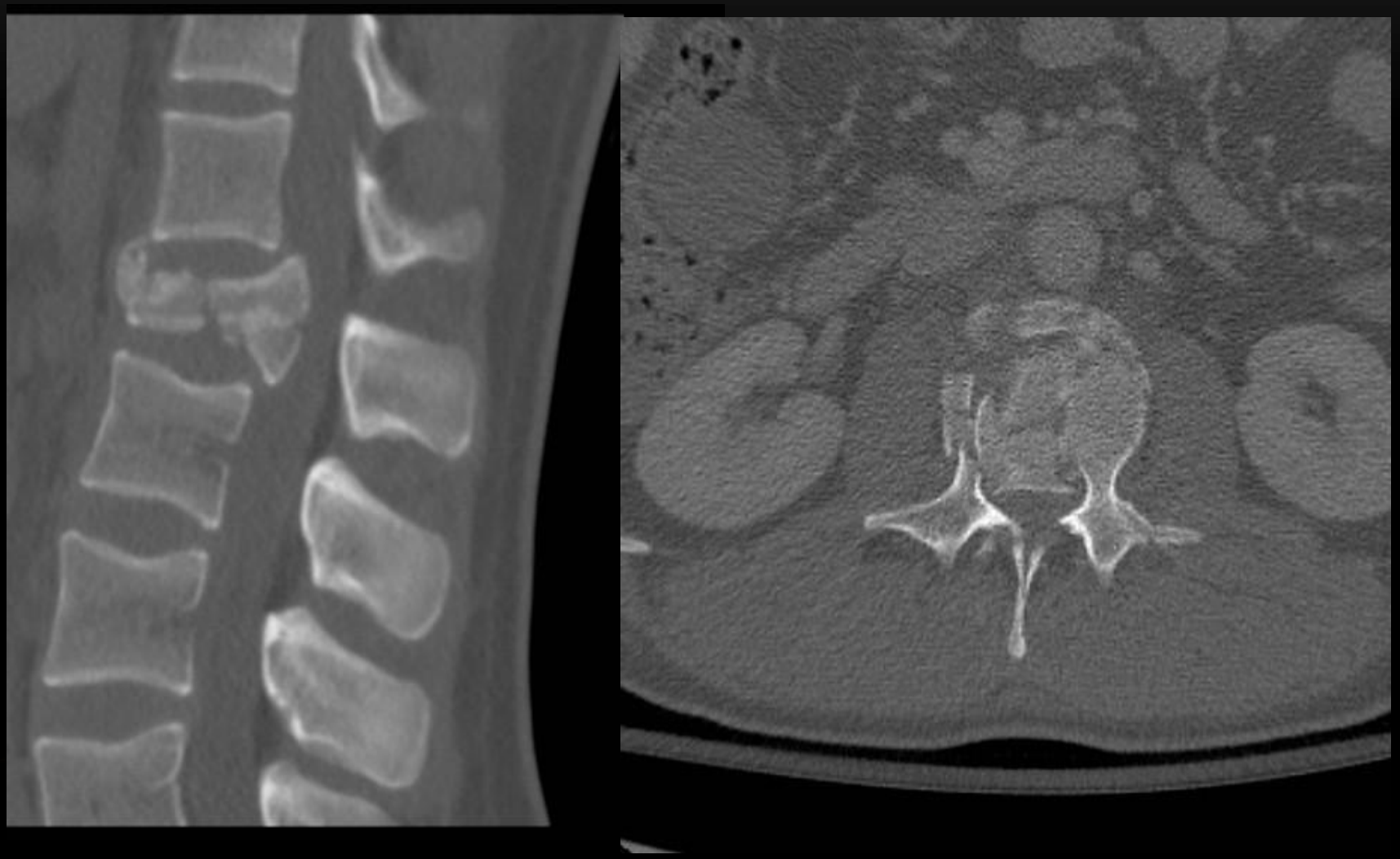
- Denis:
  - Compression
  - Burst
  - Flexion-distraction (seatbelt or Chance type)
  - Rotational/dislocation injuries
- Thoracolumabar injury and classification score (TLICS)
  - Morphology
  - Posterior ligamentous complex
  - Neurology

COMPRESSION

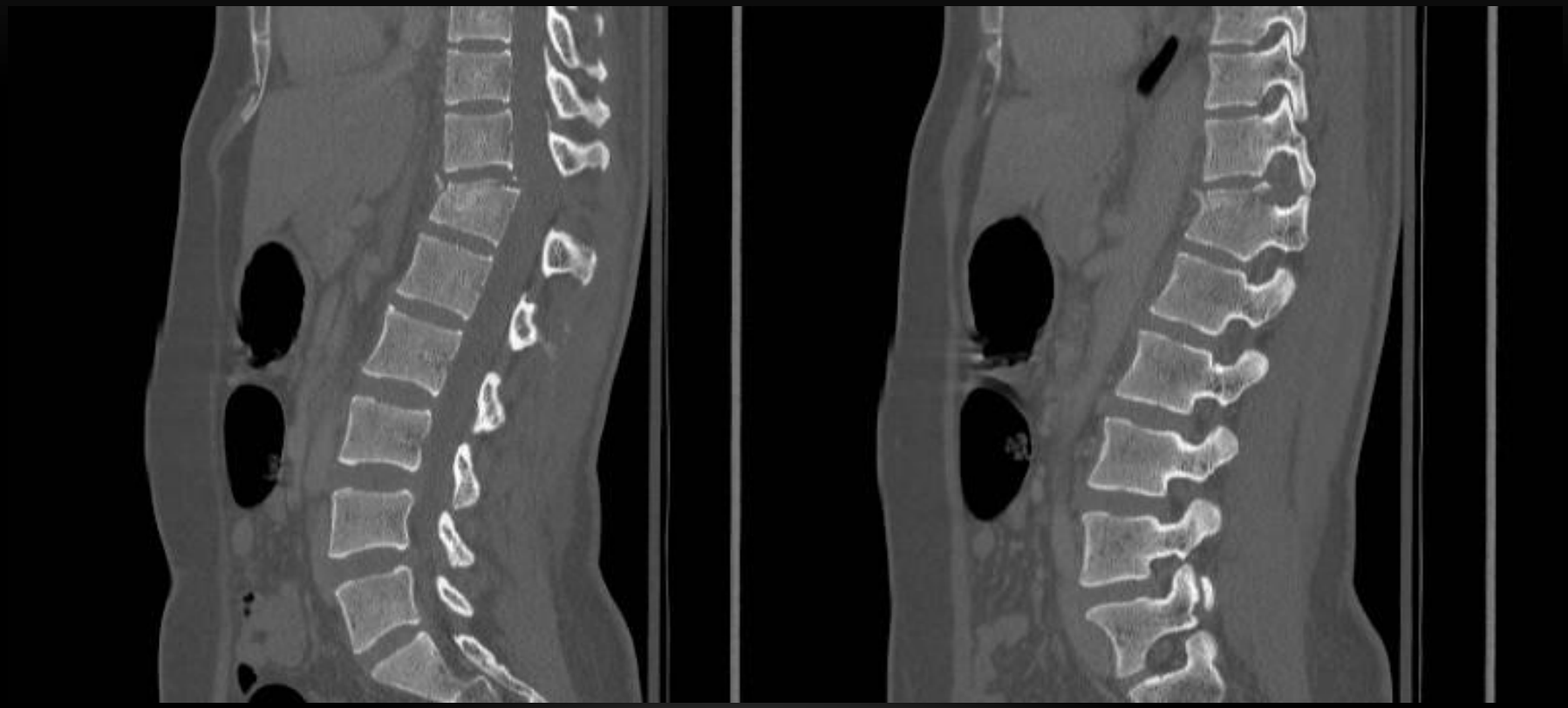




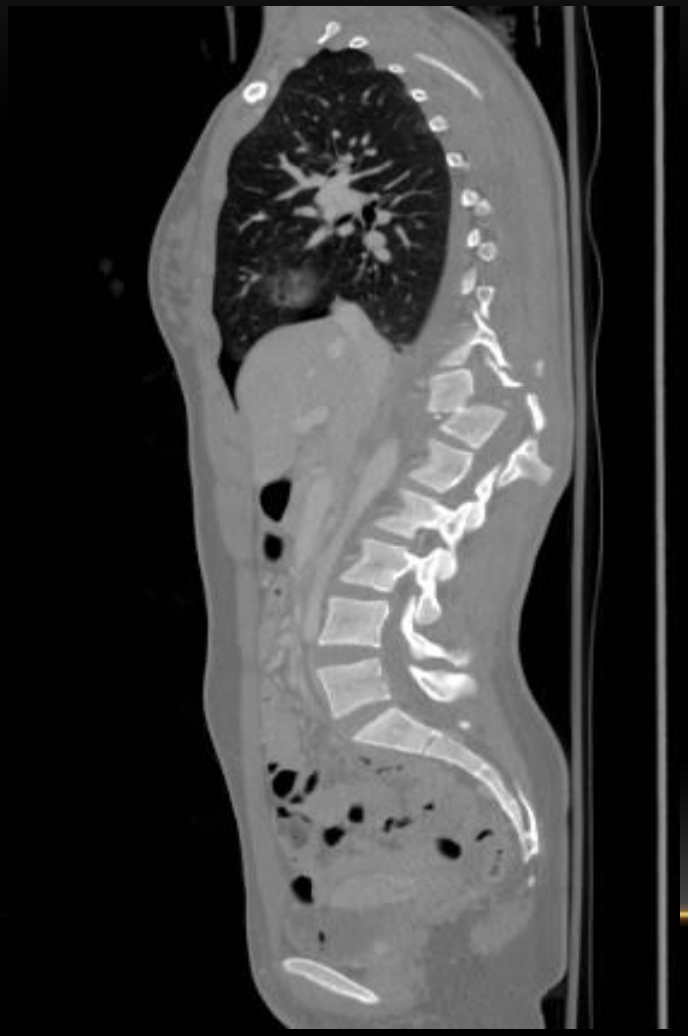
BURST

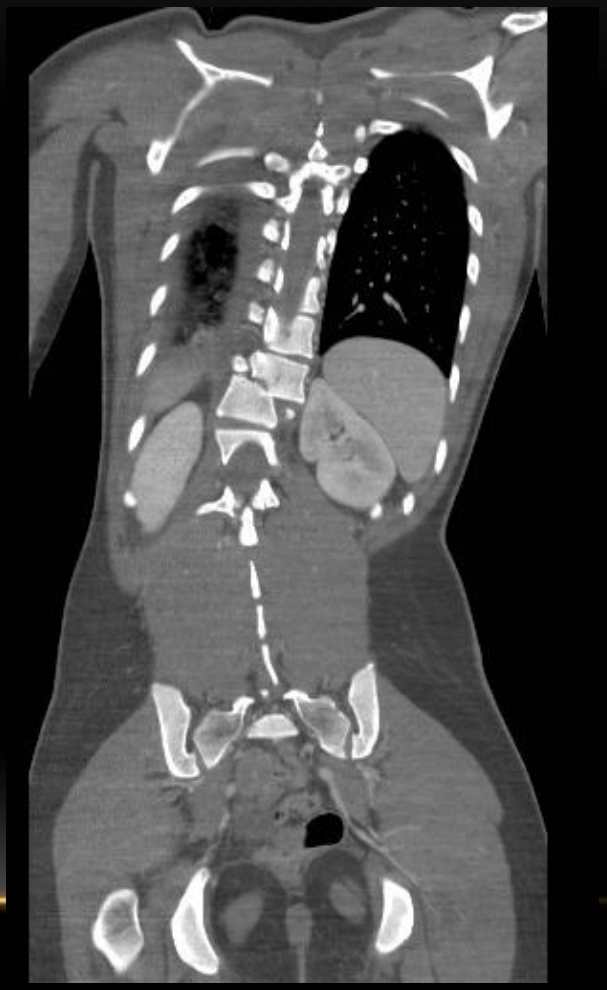


FLEXION DISTRACTION



ROTATIONAL OR TRANSLATIONAL



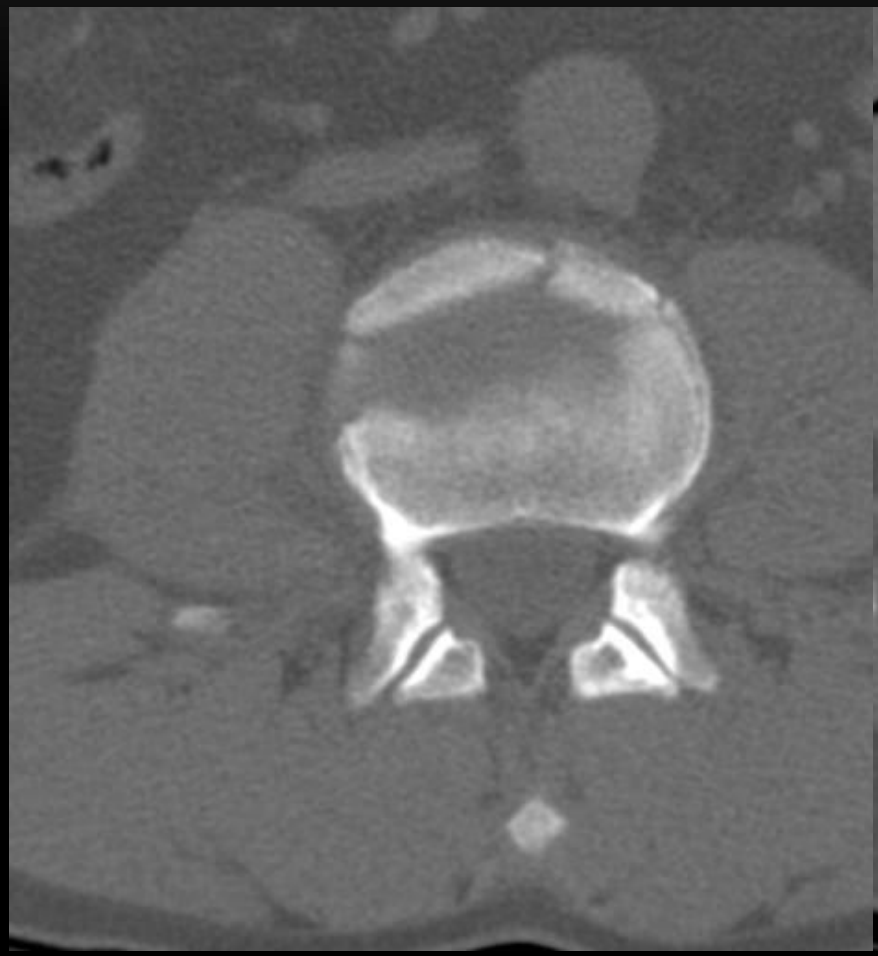


TLICS

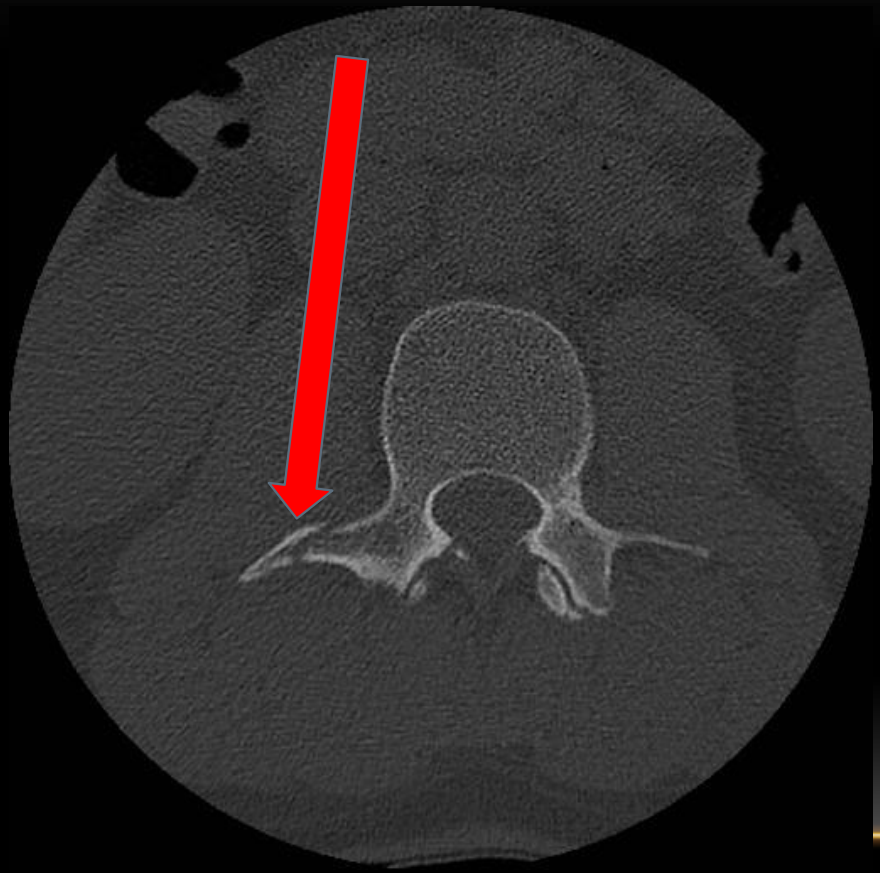
Morphology Type	Qualifier	Points
Compression	Compression fracture	1
	Burst fracture	1
Translational/rotational		3
Distraction		4
Neurologic involvement		
Intact		0
Nerve Root		2
Cord, conus medullaris	Incomplete	3
	Complete	2
Cauda equina		3
Posterior ligamentous complex integrity		
Intact		0
Injury suspected/indeterminate		2
Injured		3

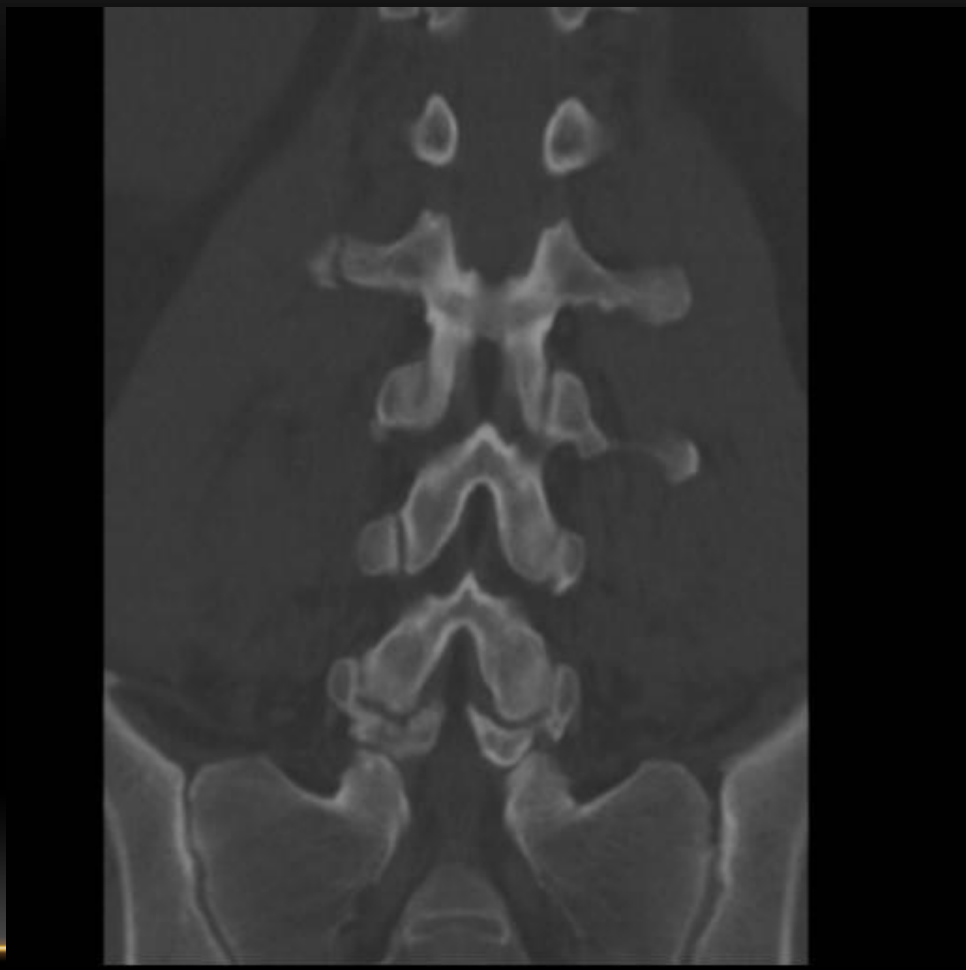
(*J Orthop Trauma* 2006;20:567–572)

POSTERIOR LIGAMENTOUS COMPLEX

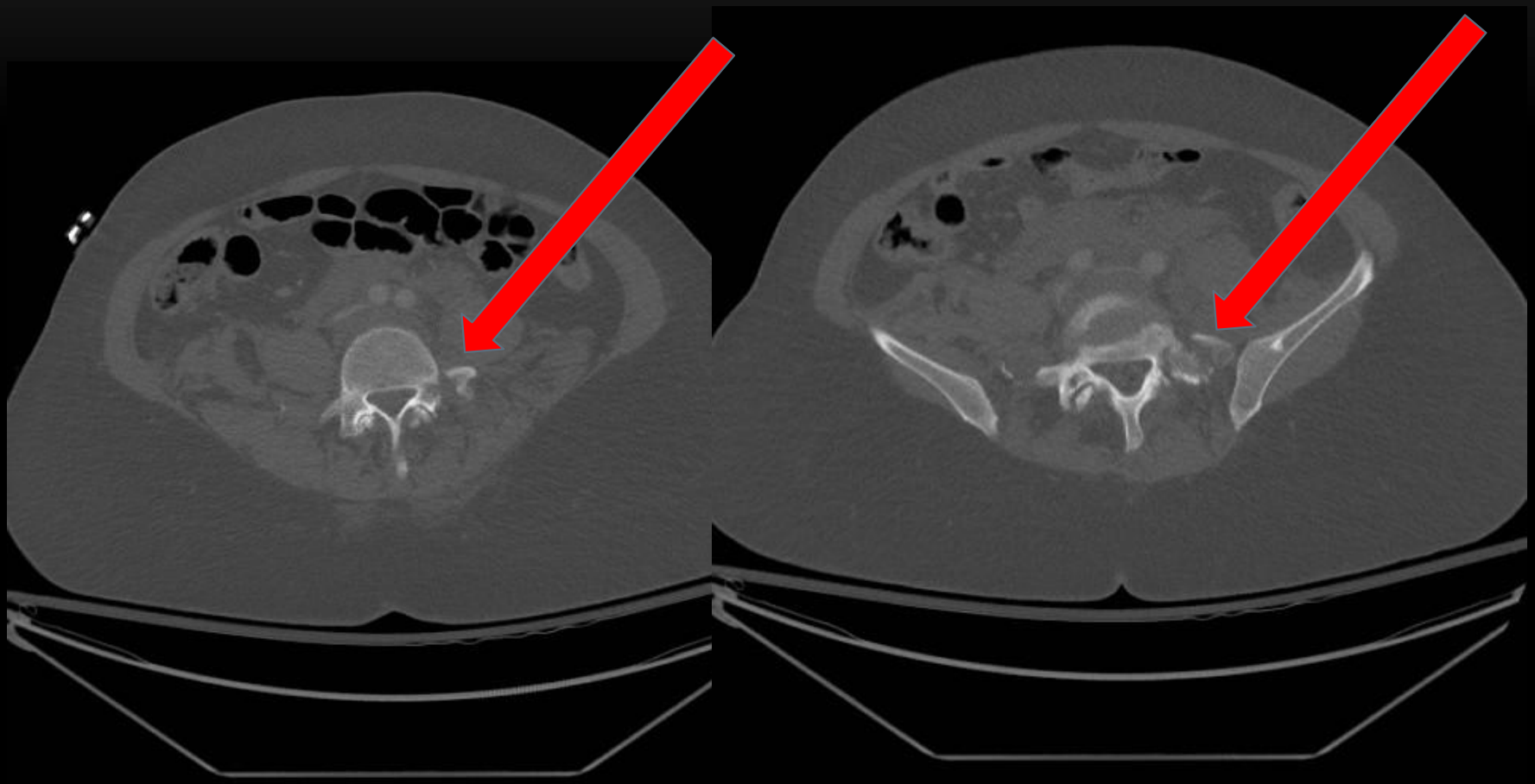


TP AND SP FRACTURES





L5 TRANSVERSE PROCESS



SACRAL FRACTURES (SPINOPELVIC DISSOCATION)

RIGID THORACOLUMBAR SPINE

CERVICAL SPINE

- Atlas (C1)
- Axis (C2)
- Subaxial spine (C3-C7)

CERVICAL SPINE FRACTURES

- Majority involve the lateral mass or articular facets
- Other injuries include:
  - Compression or burst fractures
  - Transverse process fractures

- C1 and C2 fractures have unique anatomy and LOTS of eponyms

CERVICAL SPINE CLASSIFICATIONS

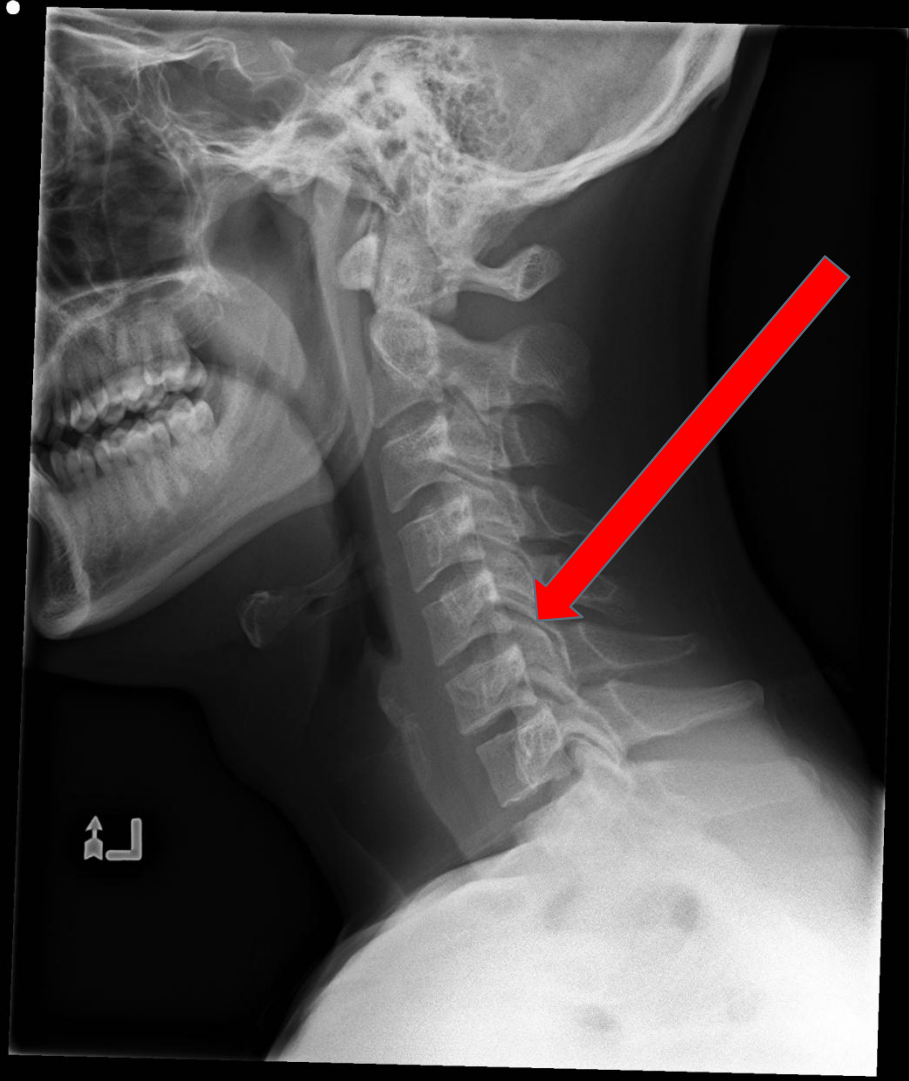
- Subaxial:
  - Flexion compression
  - Flexion distraction
  - Axial compression
  - Lateral flexion
  - Flexion rotation
  - Lateral rotation
  - Extension
  - Twisty
  - Turny
  - Bumpy
  - Curvy …

FACET FRACTURES

- Might be described as:
  - Facet fracture
  - Lateral mass fracture
  - Articular pillar fracture

- If there is instability of the spine as well:
  - Facet dislocation
  - Facet fracture/dislocation
  - Jumped facet
  - Perched facet
  - Spondylolisthesis of … (eg. C5 on C6)

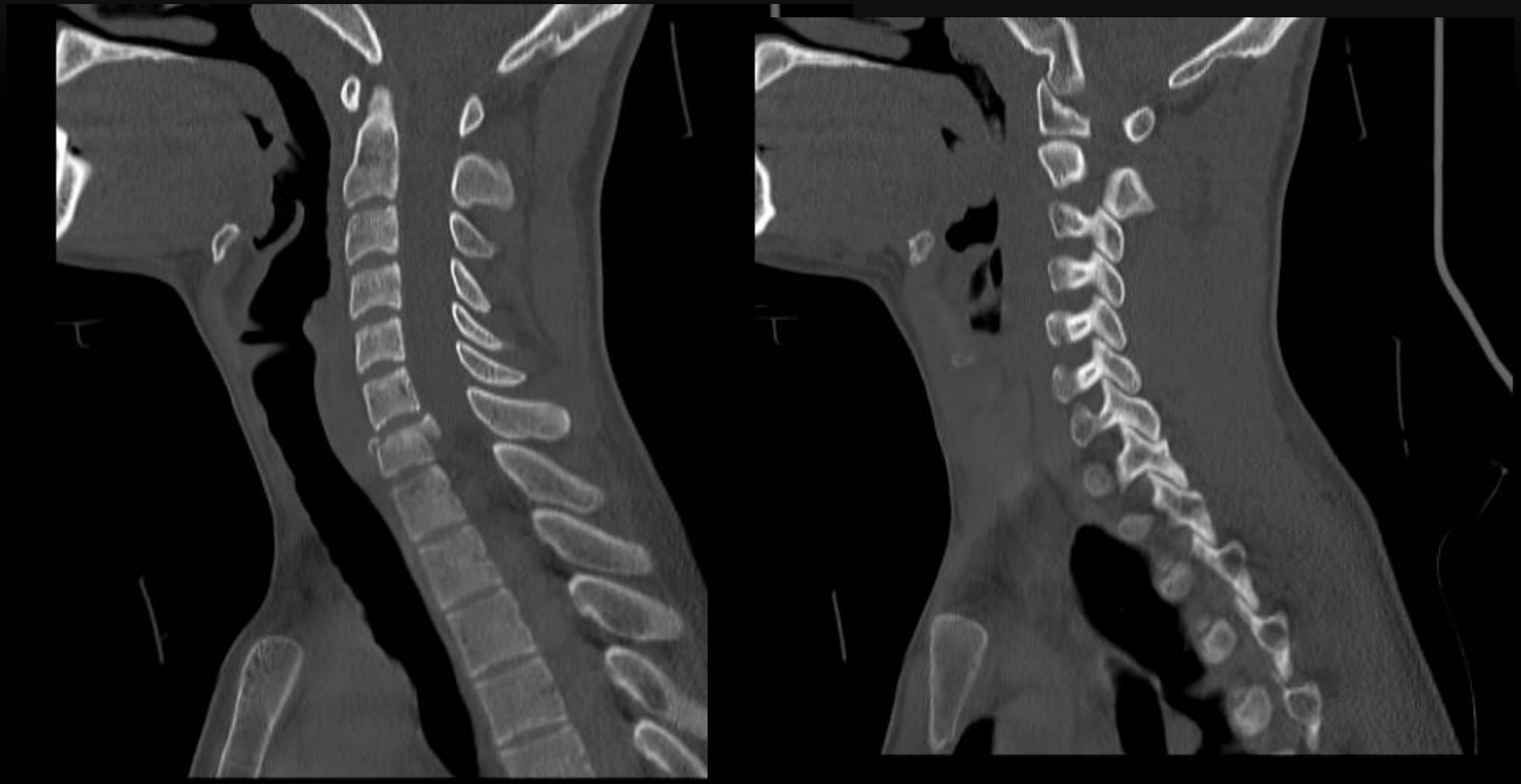
FACET FRACTURES



CERVICAL VERTEBRAL BODY FRACTURES

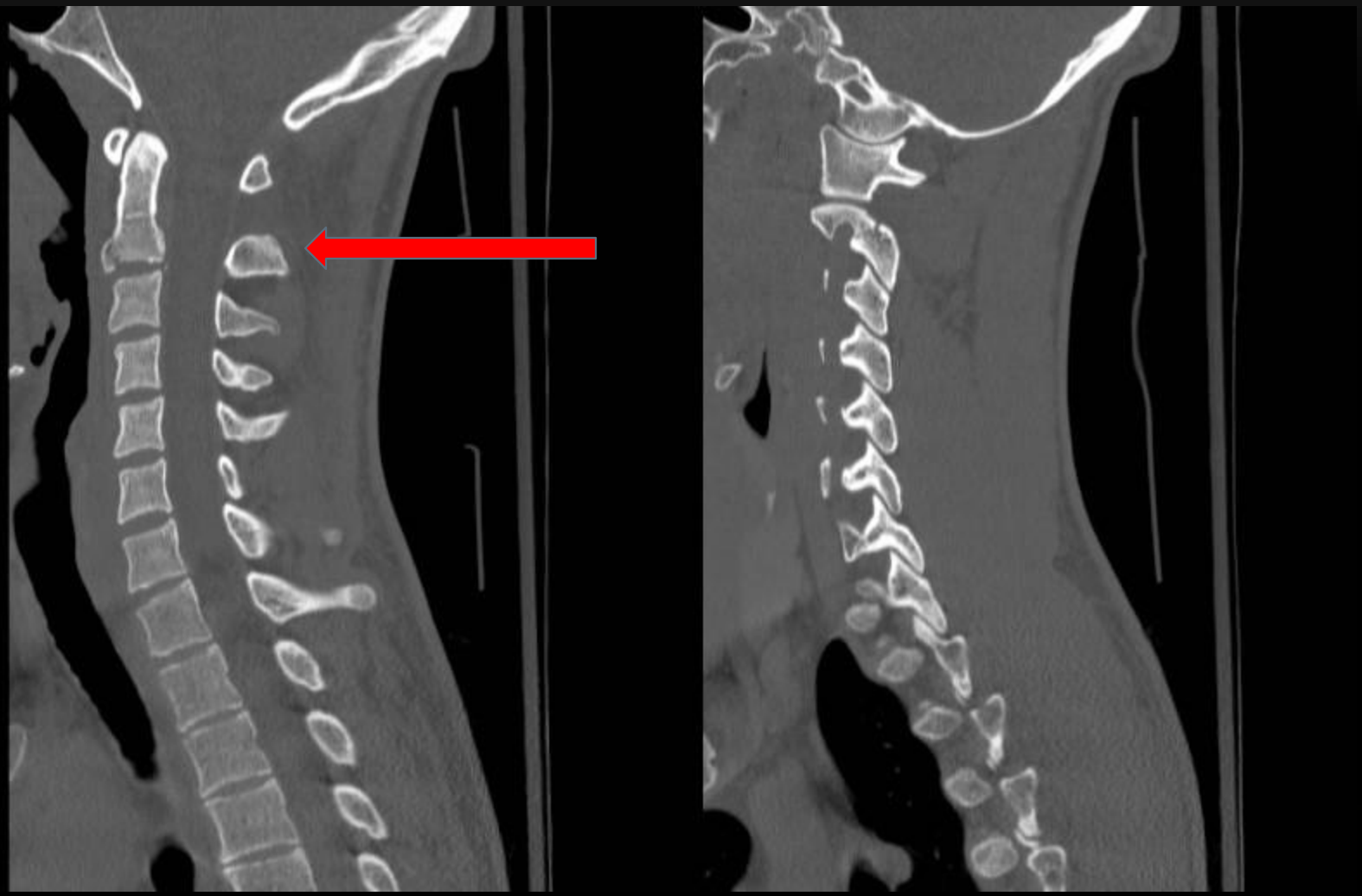
- Compression
  - Flexion compression
- Burst
  - Flexion distraction or axial compression
- Flexion teardrop (a type of burst)
  - Flexion distraction or flexion compression
- Extension tear drop
  - Extension

CERVICAL BURST FRACTURE

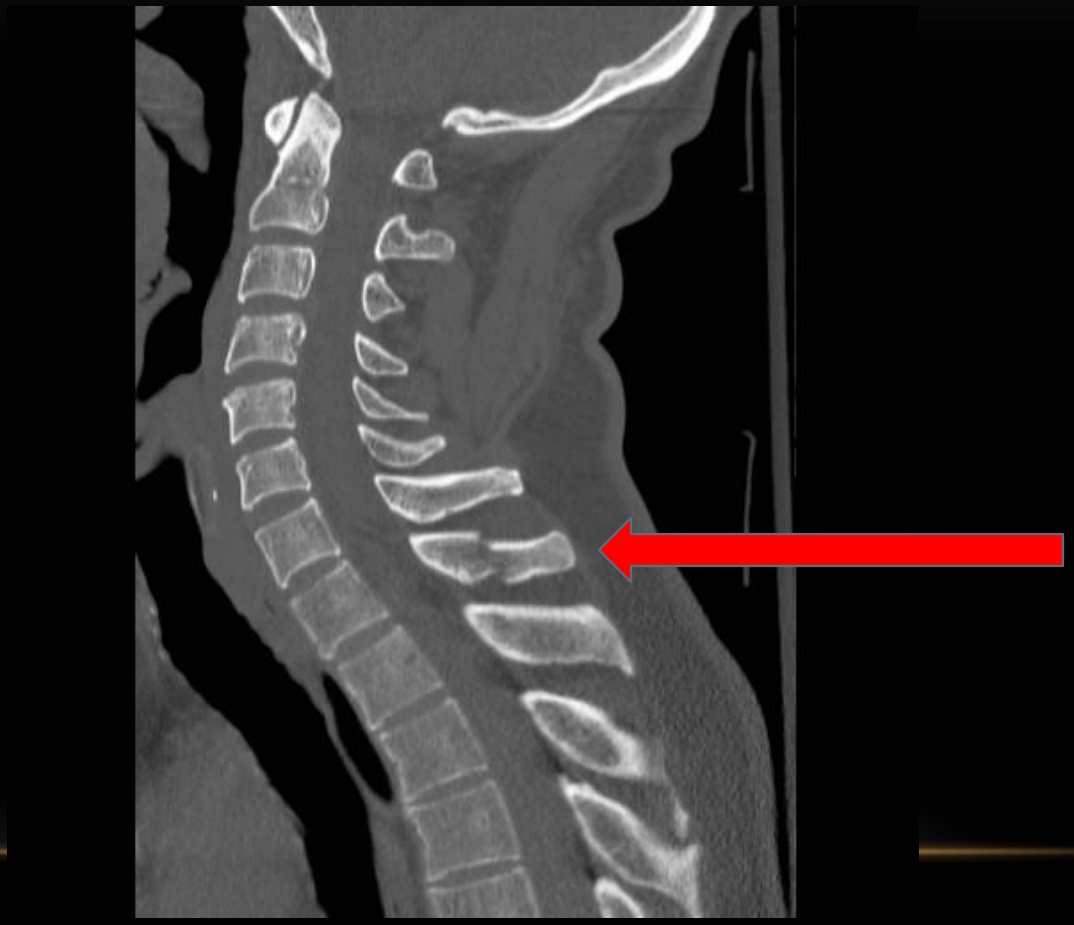


FLEXION TEAR DROP

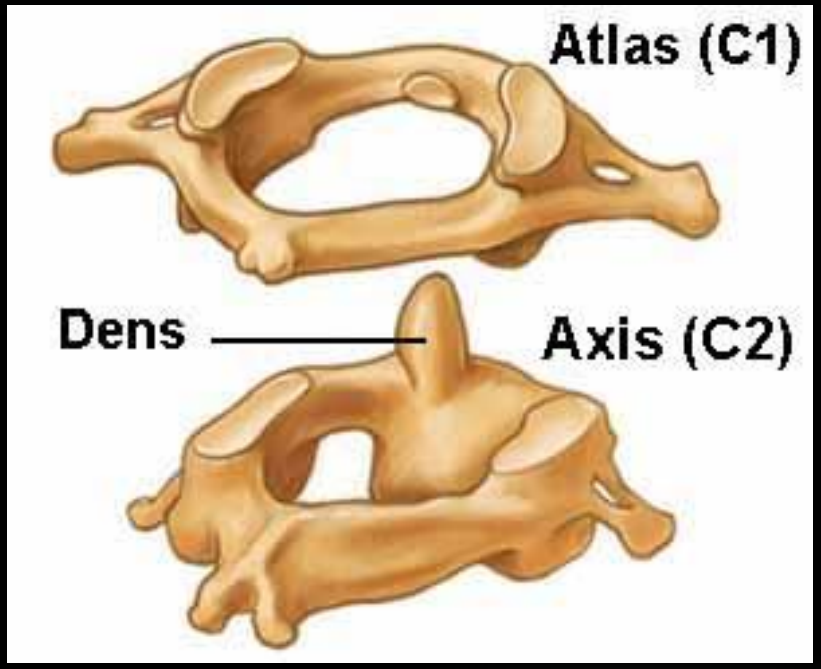
EXTENSION TEAR DROP



CLAY SHOVELLER'S FRACTURE



NORMAL ATLAS AND AXIS ANATOMY

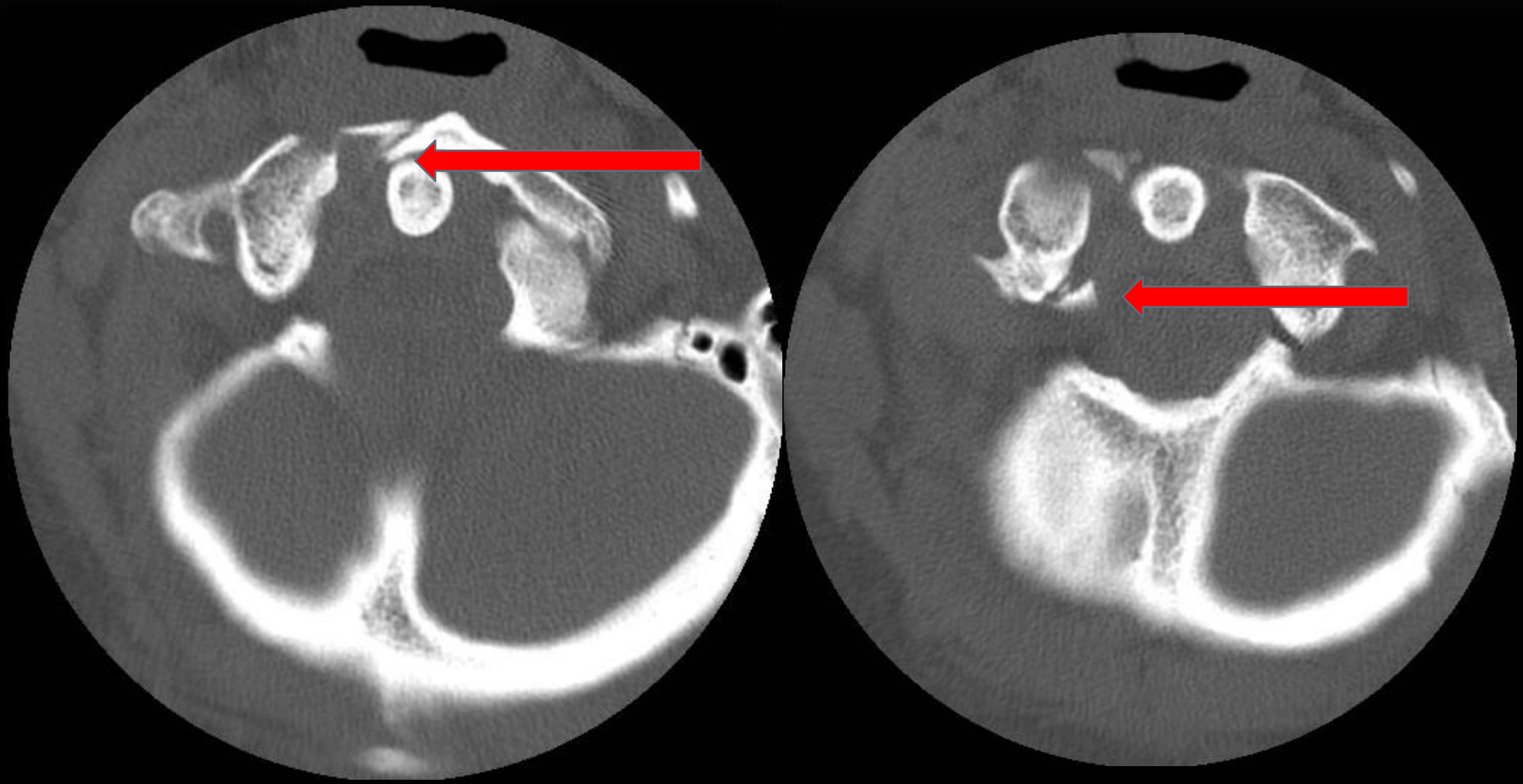


http://www.spineuniverse.com/sites/default/files/legacy-images/atlasaxis3-BB.jpg

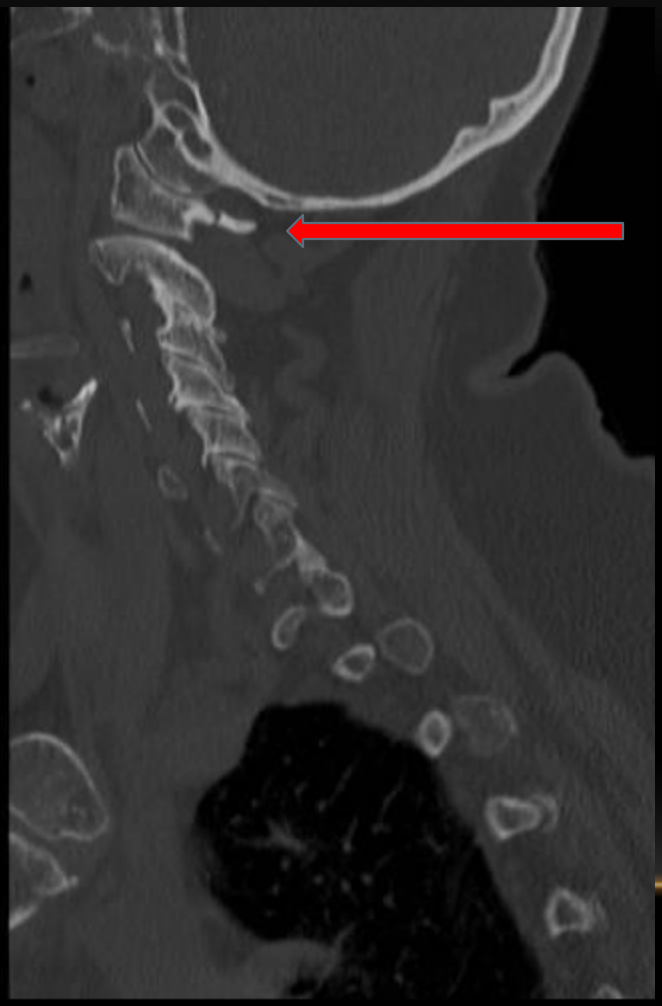
C1 (ATLAS)

- C1 is a rotational fulcrum
- Minimal ligamentous attachments
- Most C1 fractures occur from direct axial compression
  - i.e. rollovers in cars, landing on the head
- Fractures are often also associated with fractures of C2

JEFFERSON (BURST) FRACTURE



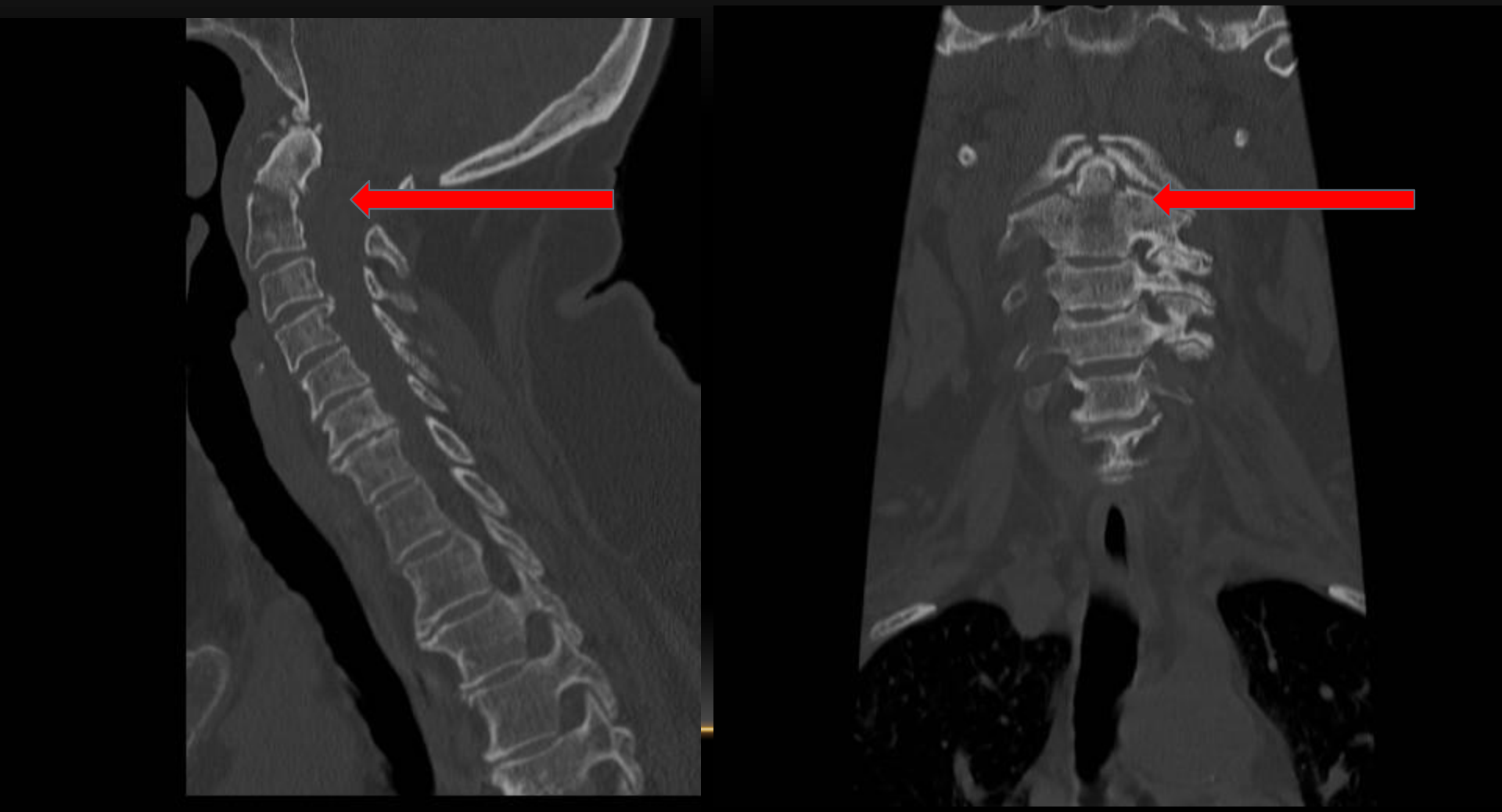
C1 ARCH (EXTENSION)



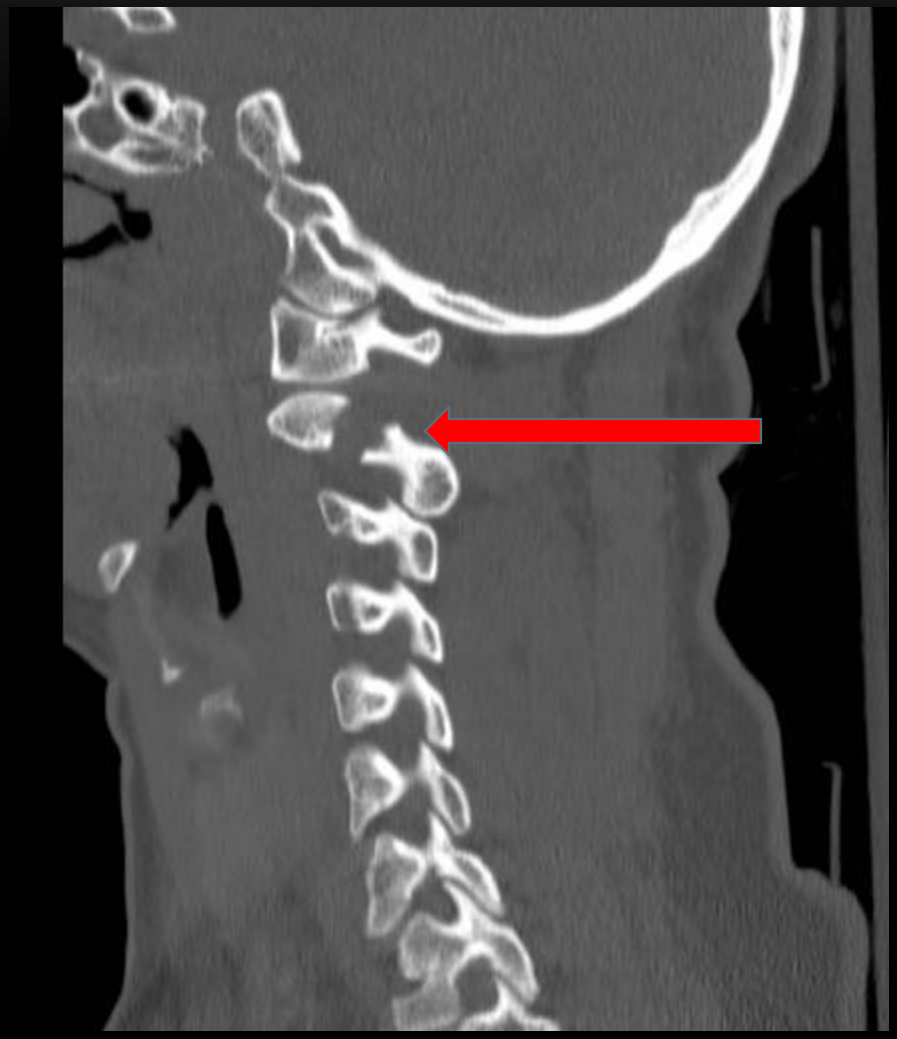
C2 FRACTURES

- Odonotoid (aka dens)
  - Types I II and III
- Hangman (pars) fractures
- Lateral mass

ODONTOID FRACTURES



HANGMAN FRACTURES (A.K.A. SPONDYLOLISTHESIS OF THE AXIS)

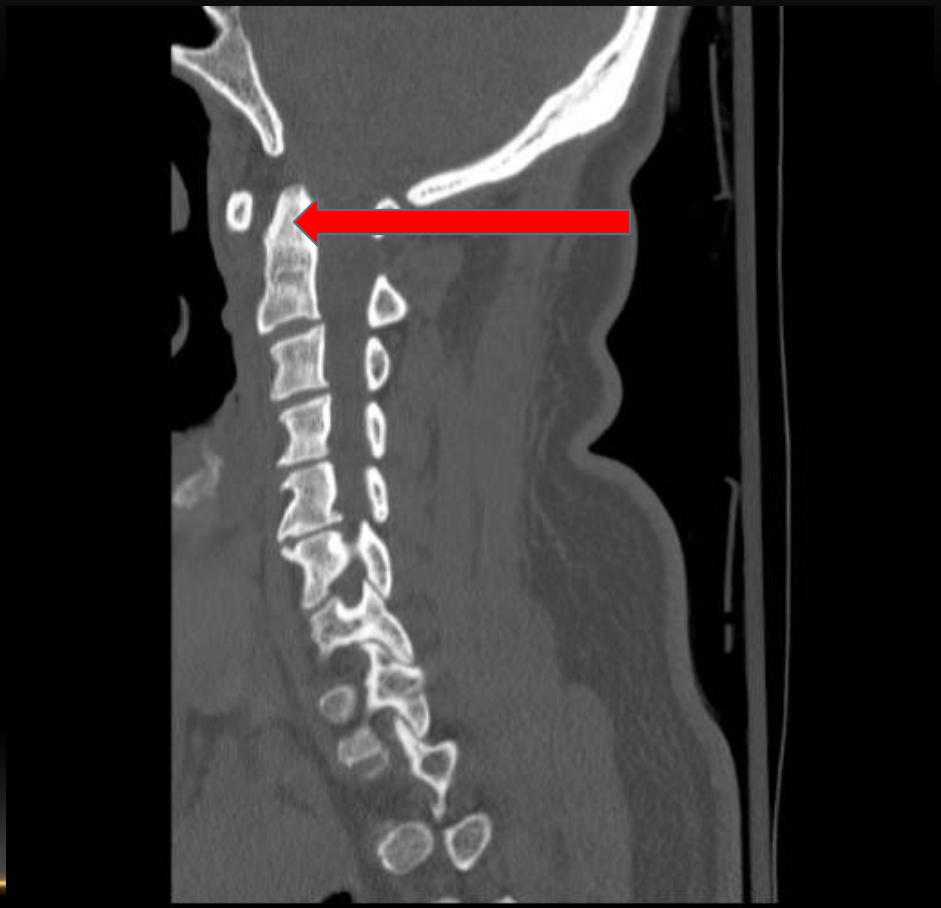


UPPER CERVICAL INSTABILITY

- Occiput to C2
  - Occipitocervical dislocation
    - Rare
- C1 to C2
  - Atlantoaxial
    - Rare outside of underlying degenerative or inflammatory conditions

NORMAL ALIGNMENT

ABNORMAL C1 TO C2 ALIGNMENT



APPROPRIATE LANGUAGE

- Description of the patient
  - Including pre-existing spine pathology
- Description of the injury
  - Including energy involved
- Neurologic examination
  - Including limitations
- Fracture level and morphology

SUMMARY

- Language may be confusing:
  - Often based on mechanism, not anatomy
  - Skewed by classifications
- Most injuries have no neurologic deficits
- Radiology reports may be less subject to these biases