Cervical spine injury diagnosis and management

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Subaxial Cervical Spine

- From C3-C7
- **ROM**
  - Majority of cervical flexion
  - Lateral bending
  - Approximately 50% rotation

Radiographic Evaluation

- Lateral C-spine to include C7-T1
- Bony anatomy
- Soft tissue detail
- Don’t forget T-L spine

•C1/C2/C3	**7 mm**
•C6 &C7	**20mm**

Lines

anterior vertebral

posterior vertebral

spinolaminar

posterior spinous

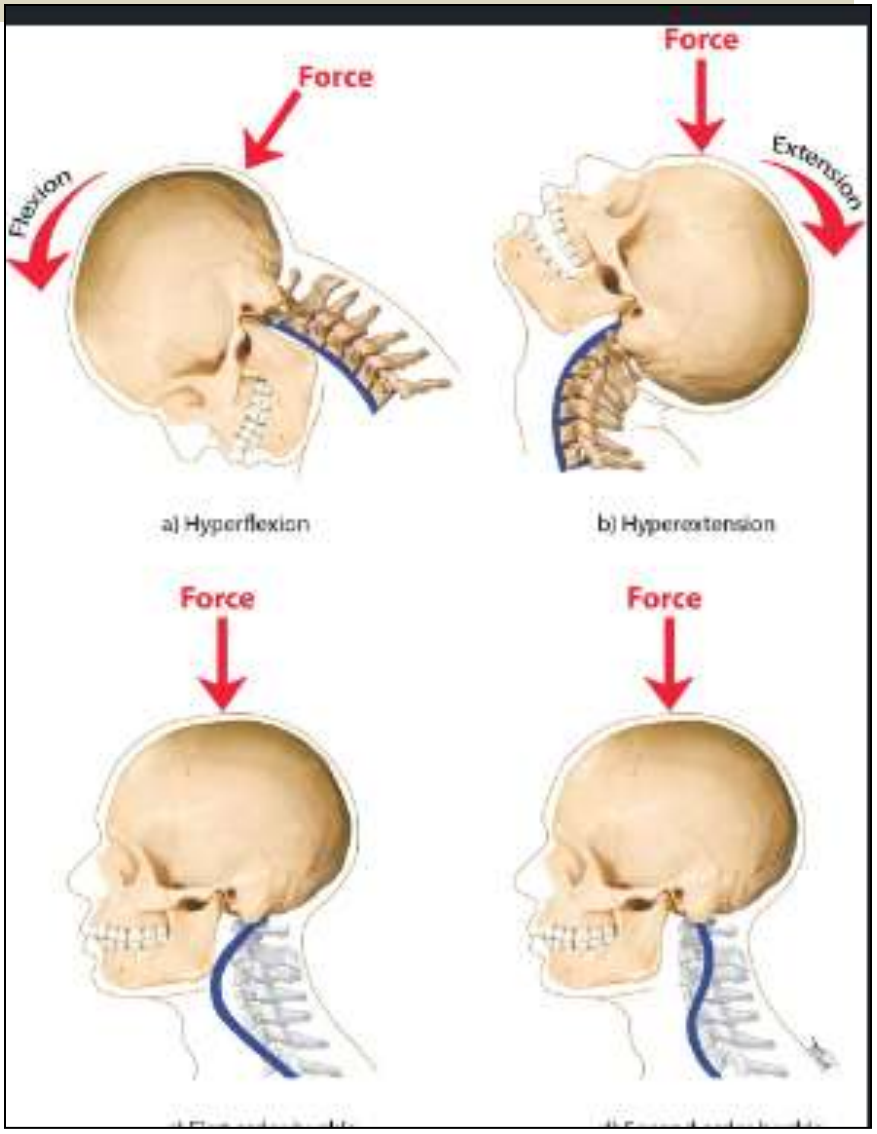
Prevertebral thickness

7mm at C2

2cm at C7

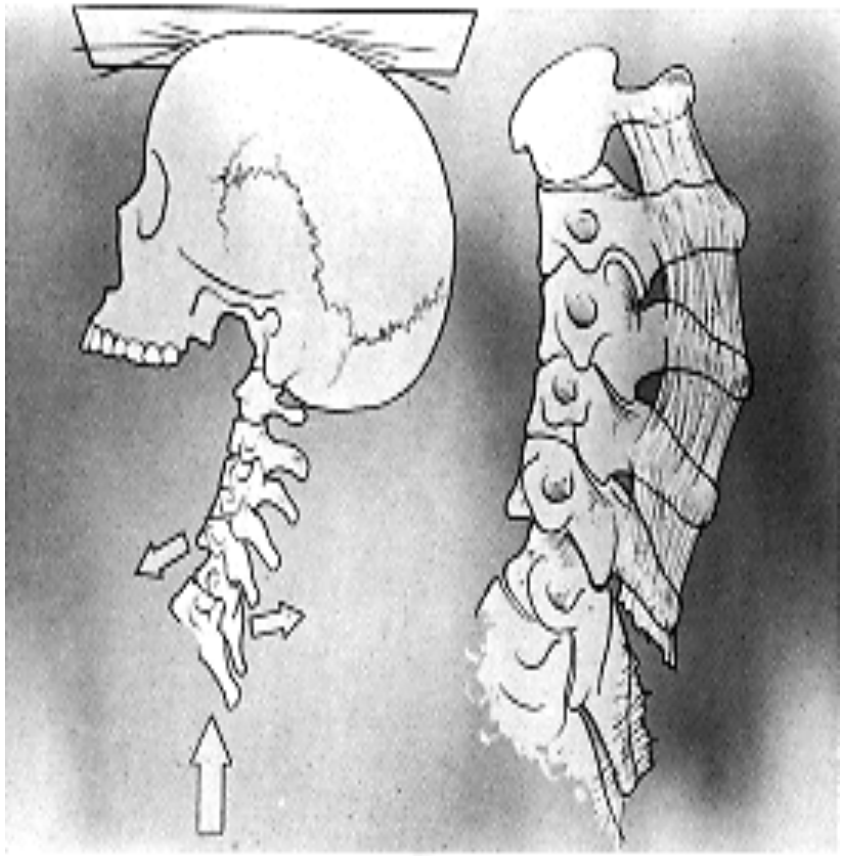
Mechanism of Injury

- Hyperflexion
- Axial Compression
- Hyperextension



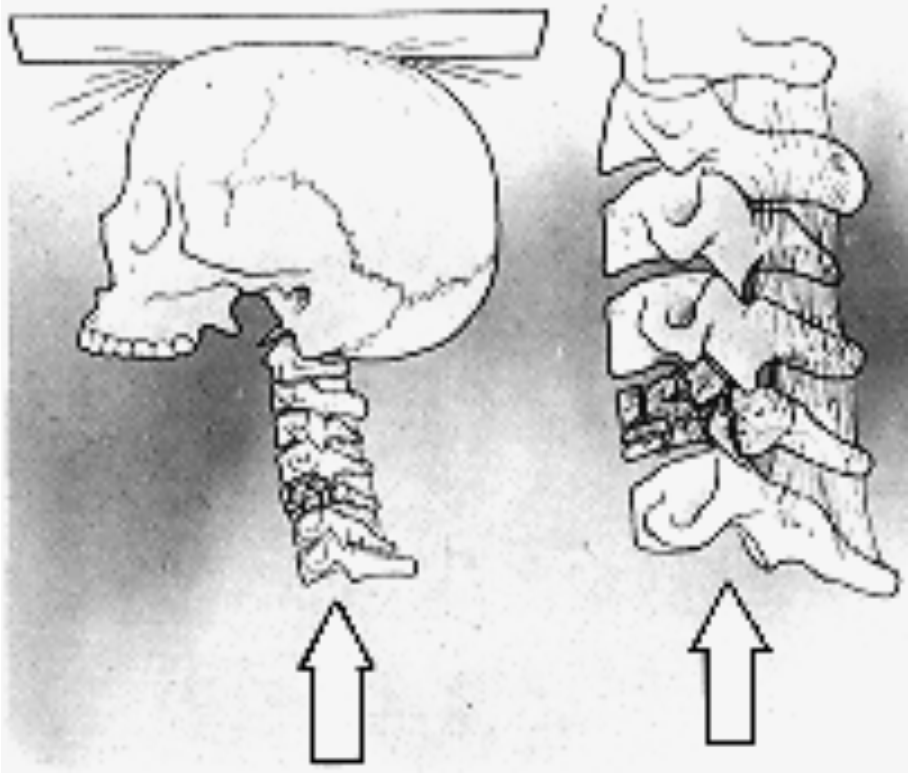
Hyperflexion

- Distraction in posterior column
- compression of body (anterior column)



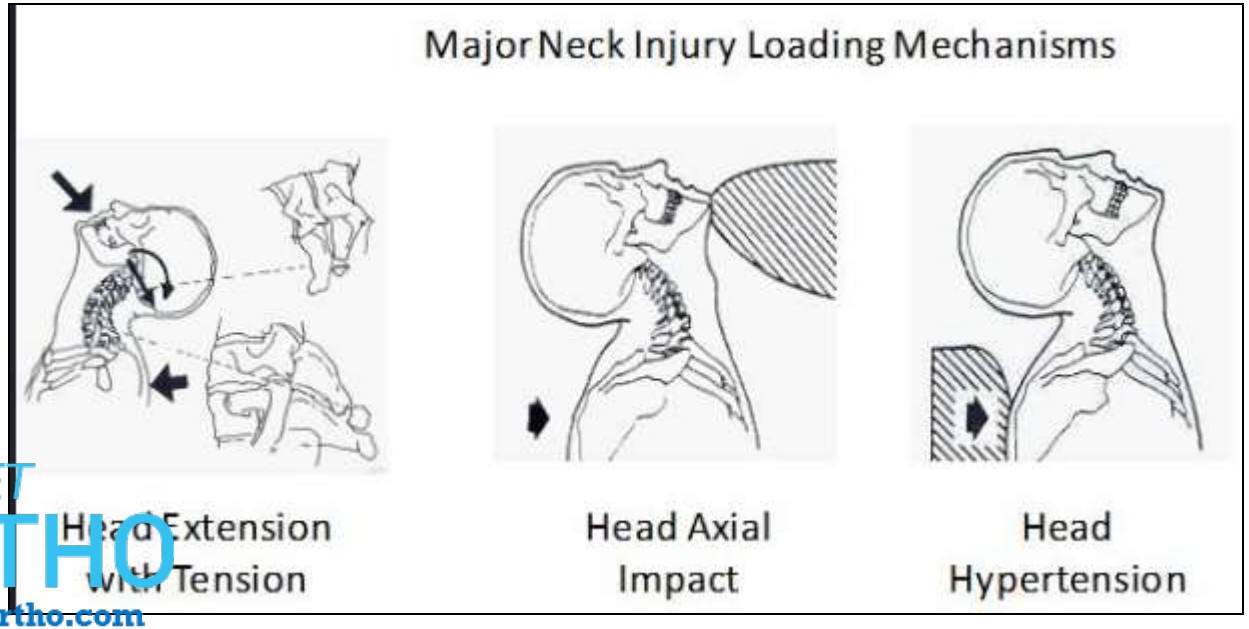
Compression

- Axial loading
- Burst
- wedge
- compression



Hyperextension

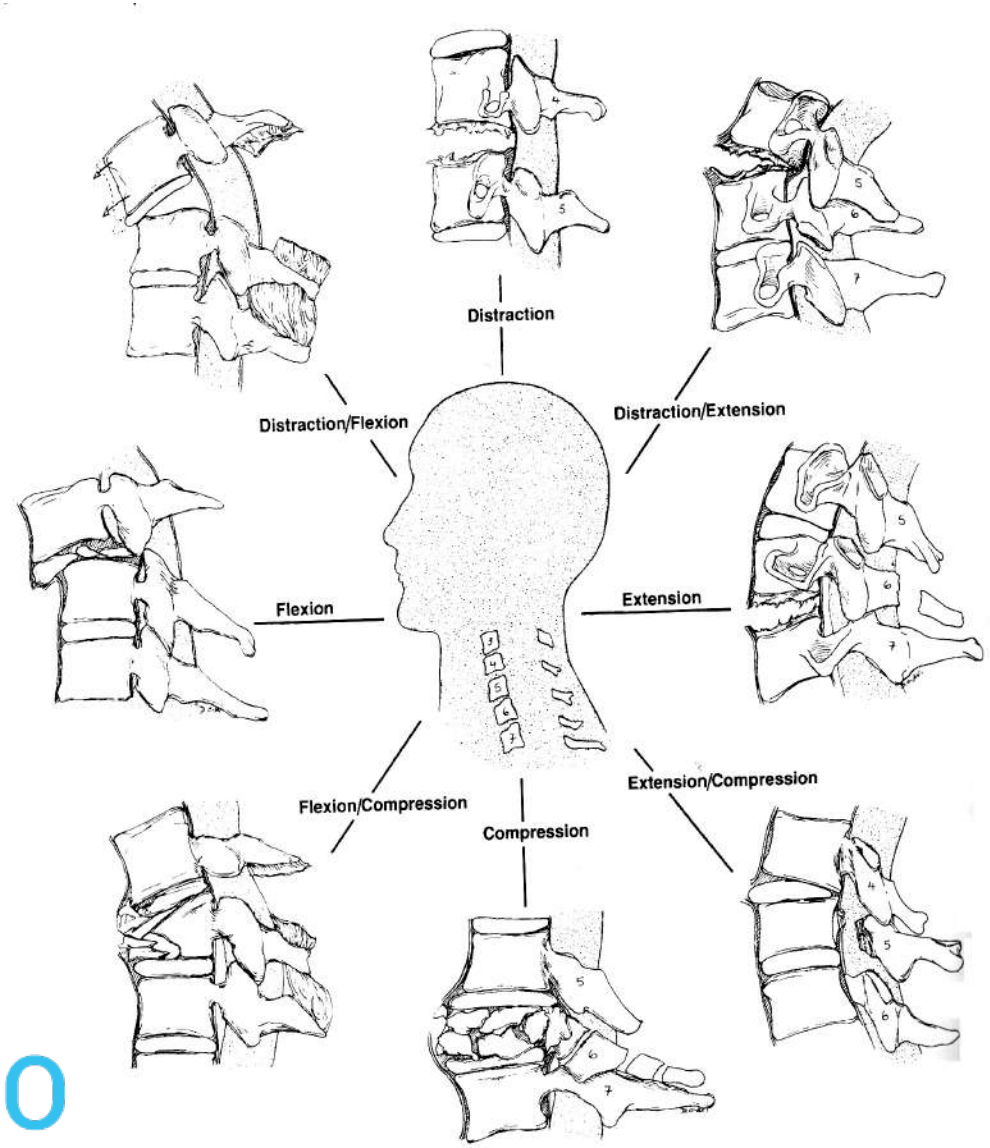
- Impaction of posterior arches and facet- Fractures of
  - **Lamina/ spinous processes /pedicles**
- distraction - disruption of ALL



Classification

- Allen and Ferguson Spine 1982
- Harris et al OCNA 1986
- Anderson Skeletal Trauma 1998
- Stauffer and MacMillan Fractures 1996
- AO/OTA Classification
- Most are based on mechanism of injury

Allen and Ferguson



Subaxial spine injury classification SLIC

- 2007- Vaccaro et al.
- Mechanism and anatomy- abandoned
- Morphology and clinical status- highlighted
- Patterns less severe to more severe- helps to objectify both structure and optimal management
- Scores in reliability and validity.

3 components of SLIC scale

1) **Injury morphology** -pattern of spinal column disruption on available imaging studies.

2) **Integrity of the disco-ligamentous complex** anterior and posterior ligamentous structures and intervertebral disc.

3) **Neurological status** of the patient

Injury morphology

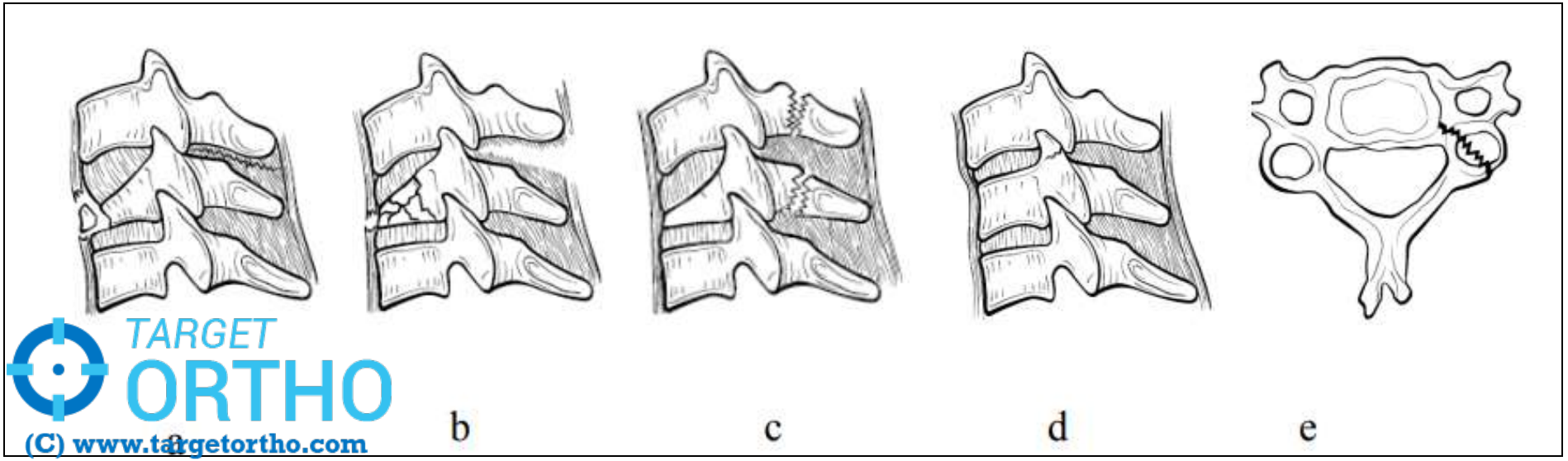
Characteristics	Points
Injury morphology	
No abnormality	0
Compression	1
Burst	2
Distraction	3
Translation	4


24.10.2011 10:48
No abnormality-0
TARGET
ORTHO
(C) www.targetortho.com

Injury morphology
Compression- 1

Visible loss of height in vertebral body

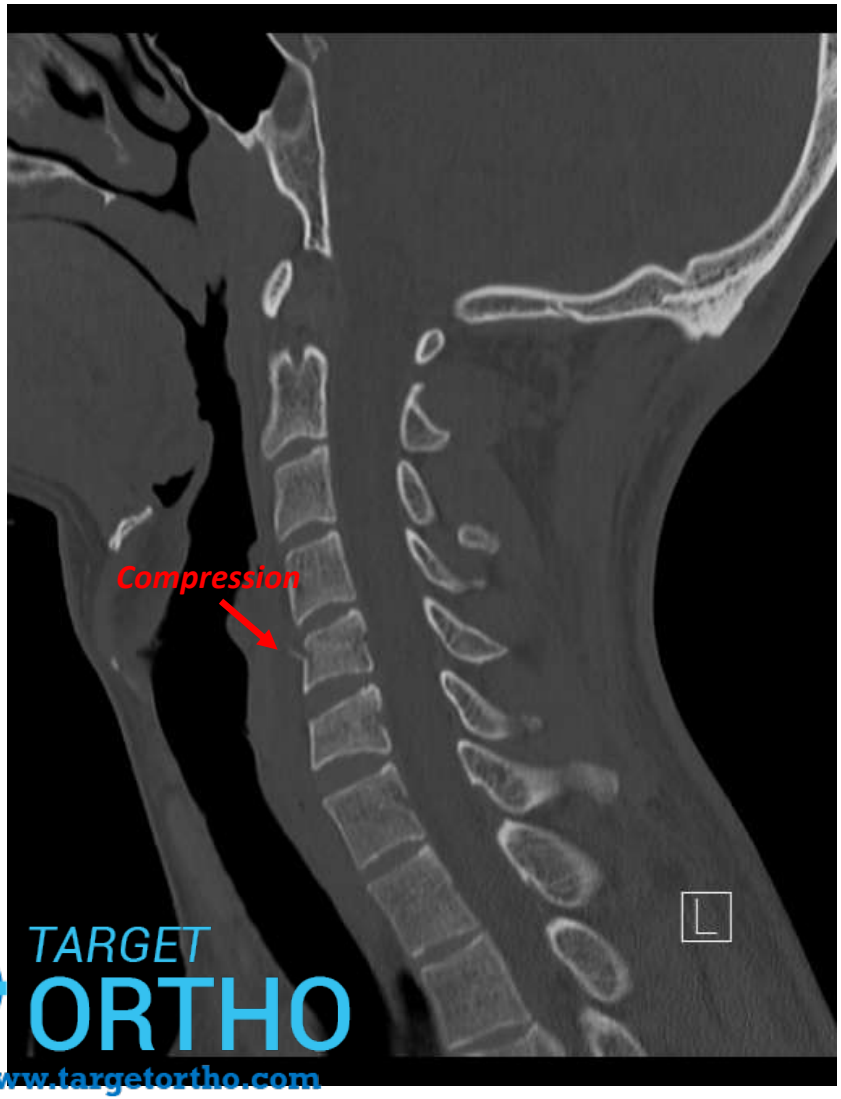
1. **Endplate disruptions**
2. **Sagittal / coronal plane fractures**
3. **Teardrop fractures**



Compression

+ 1 POINT

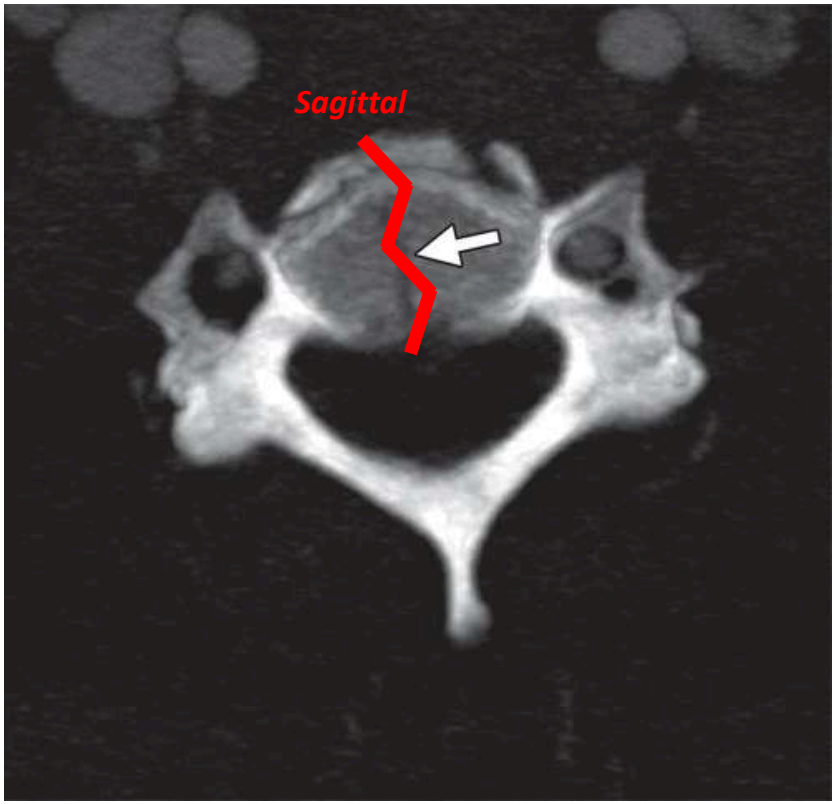
Compression # (without burst)

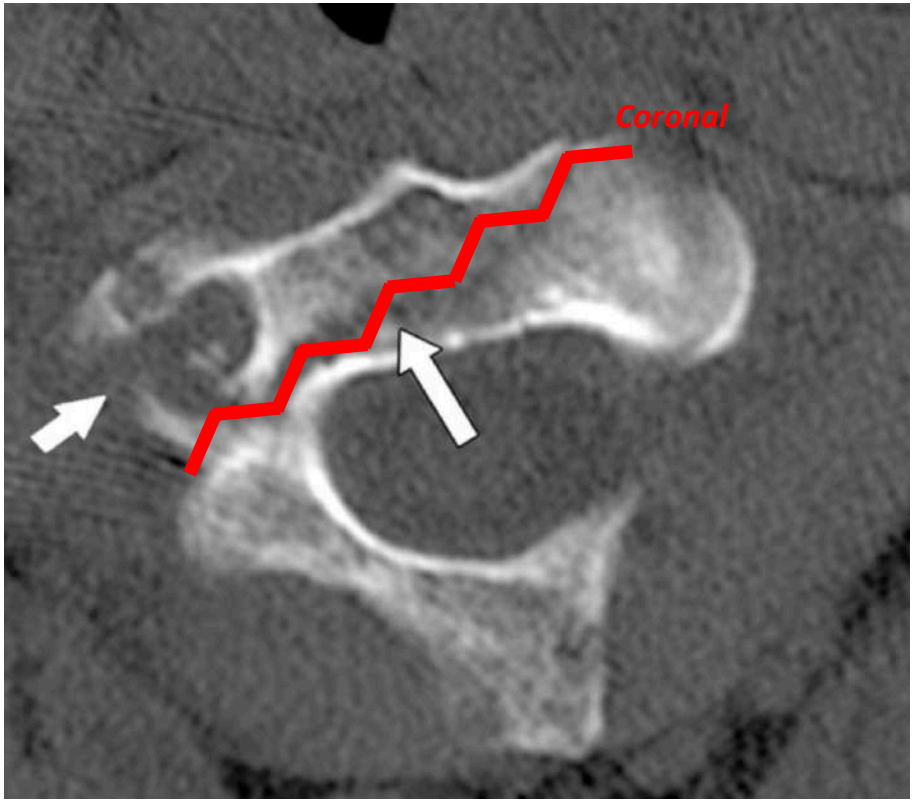


Compression

+ 1 POINT

Sagittal or coronal plane #

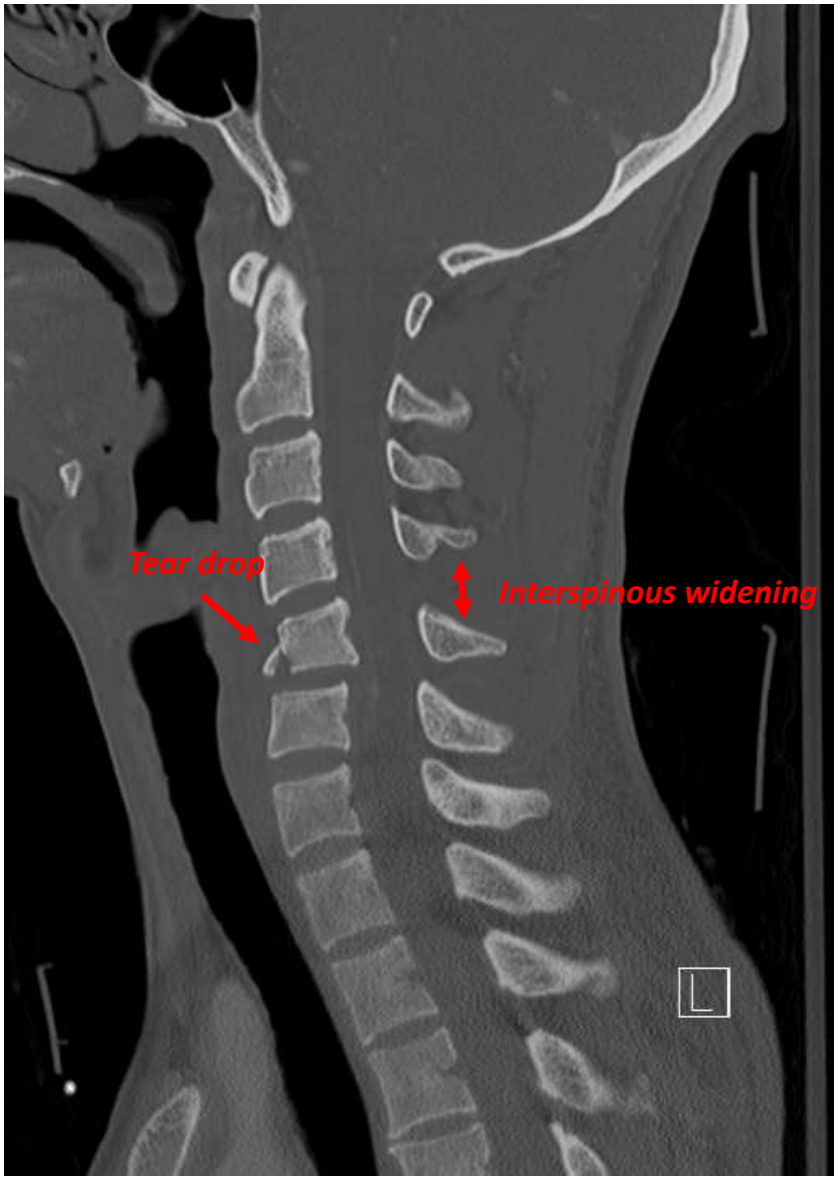




Compression

+ 1 POINT

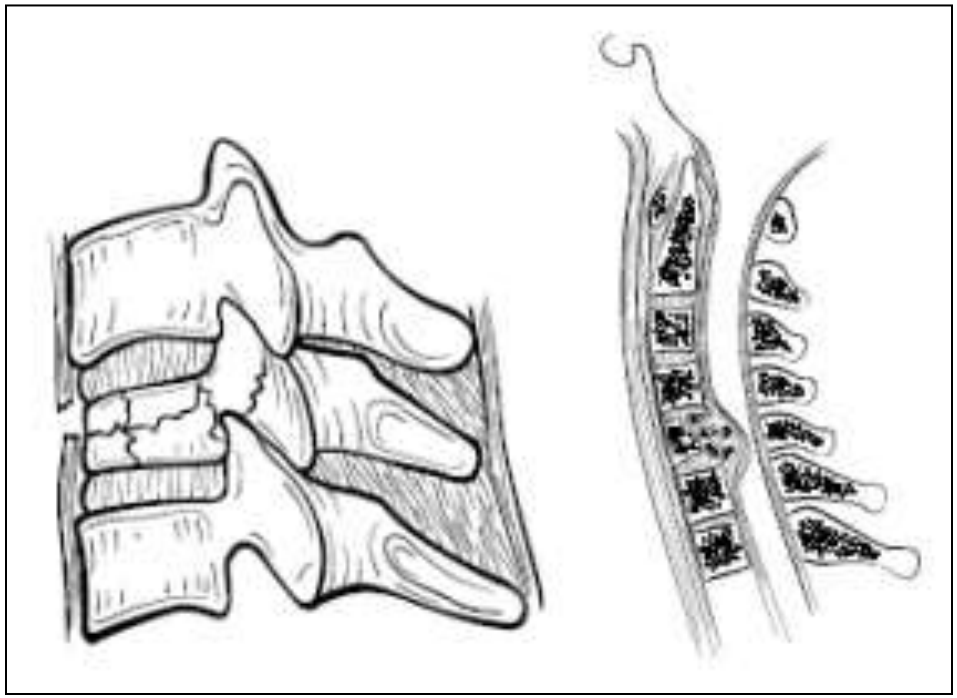
Flexion Tear Drop #



Injury morphology
Burst -2

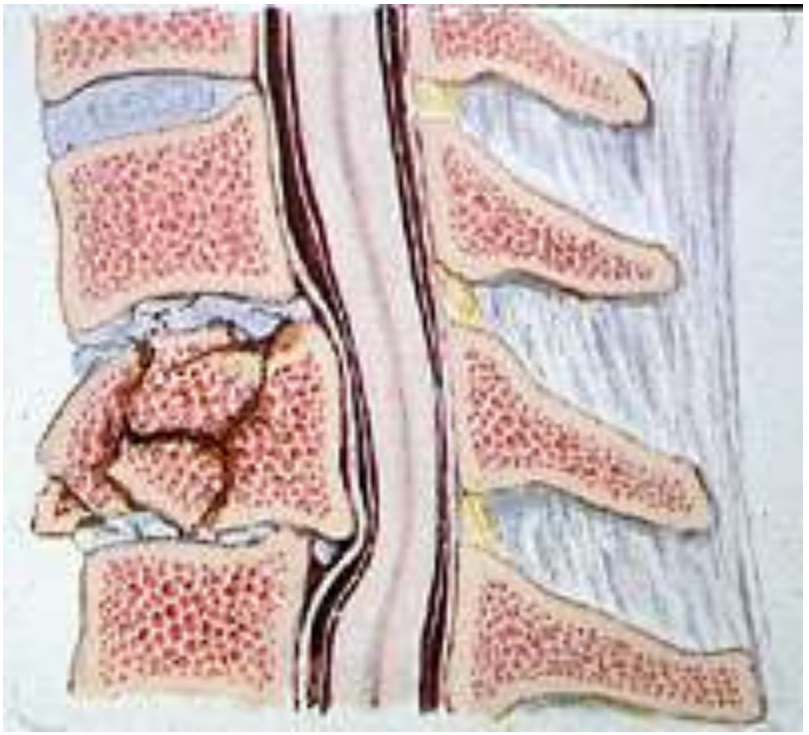
More severe compression injury

Fracture through the entire vertebral body



Burst Fractures

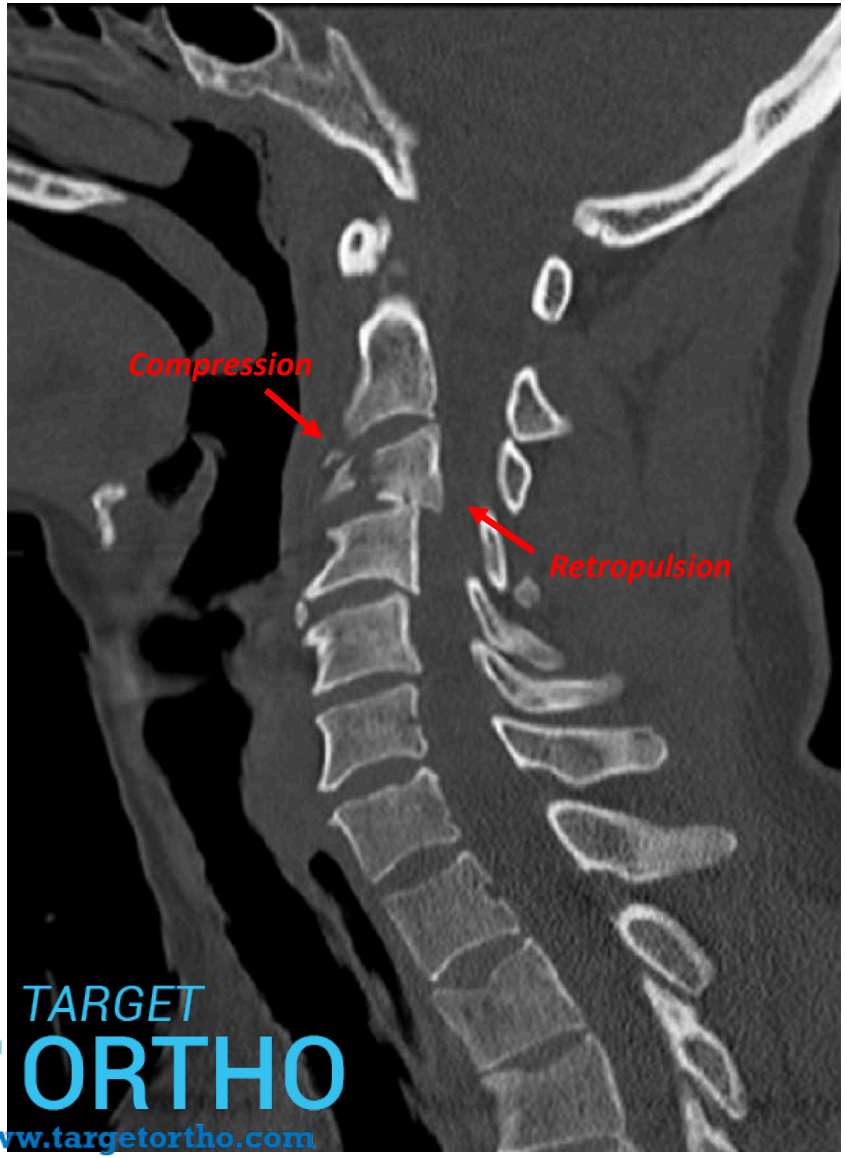
- Comminuted body fracture with retropulsion

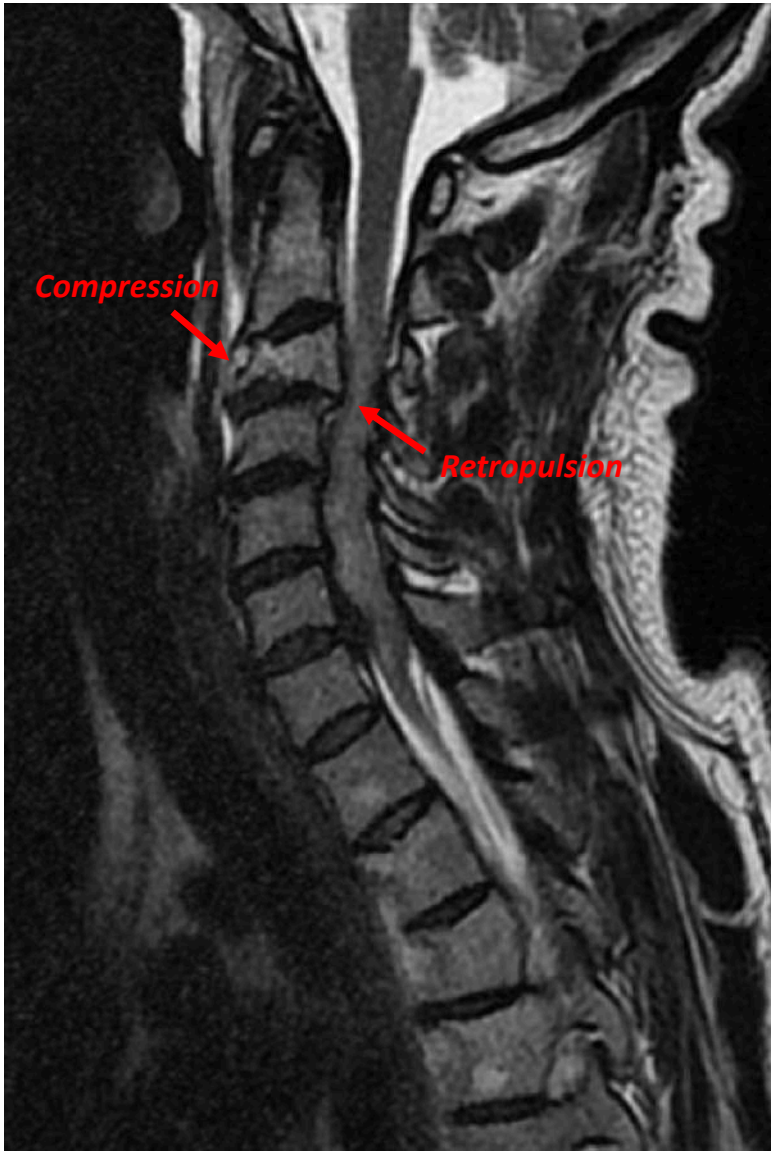


Compression

+ 2 POINTS

Compression + burst #





Injury morphology
Distraction -3

- **Definition:** imaging evidence of dissociation along the craniocaudal axis
- Does **not** involve significant displacement or rotation component
  - Defined as: < 3.5 mm displacement or 11 degrees rotation
- Requires **disruption of strong facet joint capsules and/or disco-ligamentous structures**, implying significant force, and greater clinical severity
- Two primary subtypes:

Hyper-extension

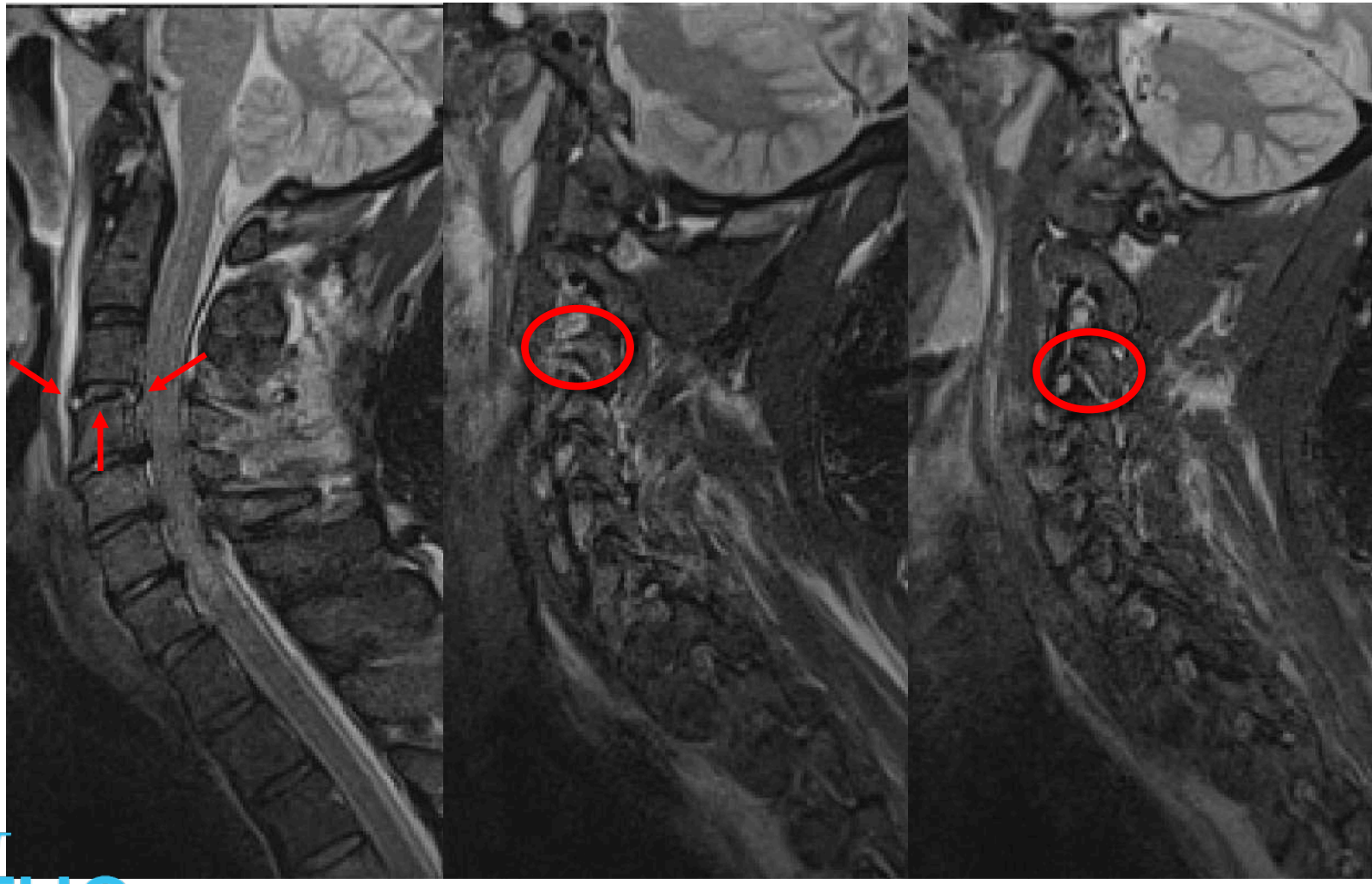
Hyper-flexion

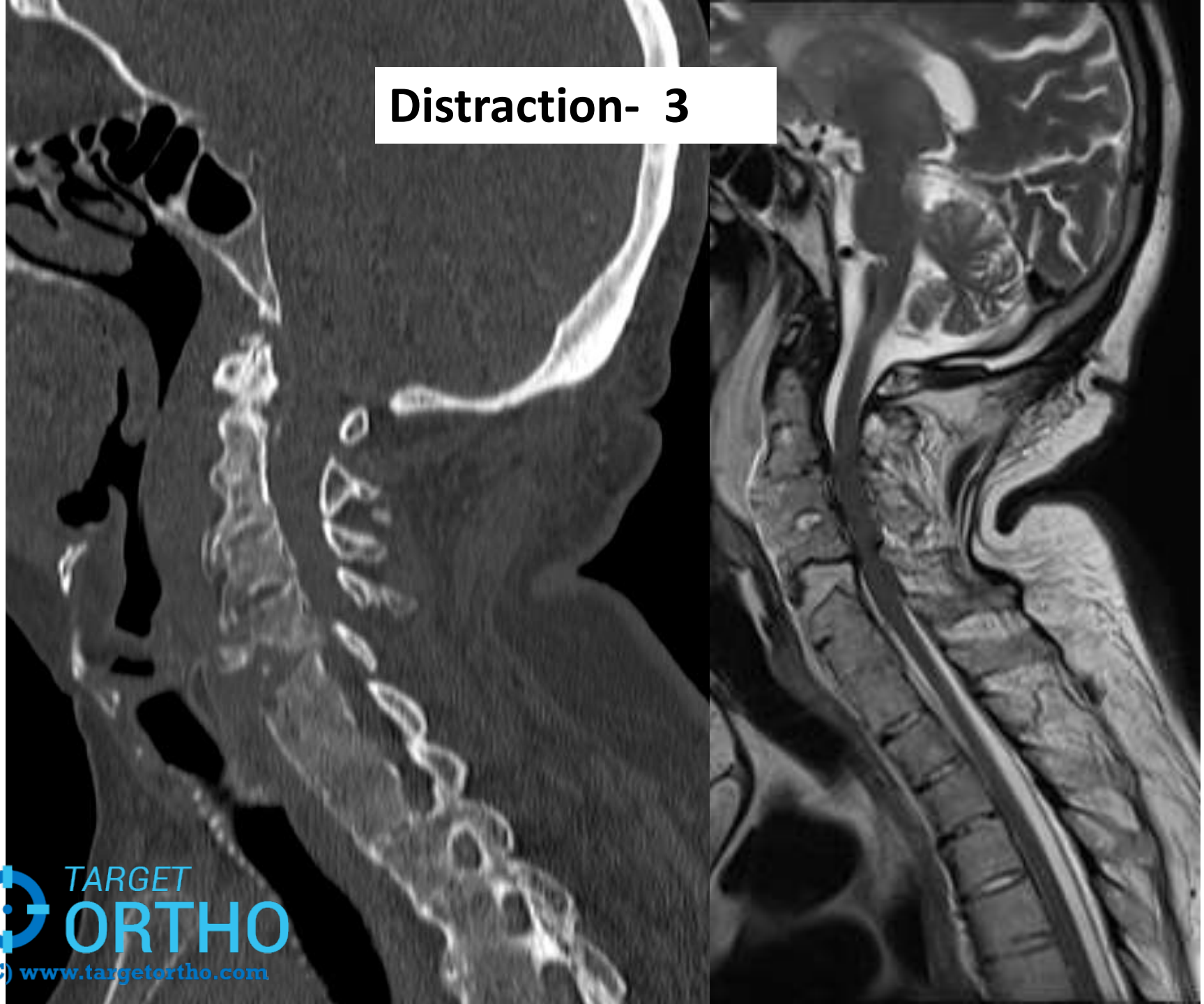
Distraction

+ 3 POINTS

Hyper-extension

- Predominantly involves anterior structures
- Typically, a combination of:
  - ALL
  - Intervertebral disc
  - PLL
  - Facets





Distraction

+ 3 POINTS

Hyper-flexion

- Predominantly involves <u>posterior</u> structures
- Typically, a combination of:
  - Facets
  - Interspinous ligaments
  - Ligamentum flavum
- Includes:
  - 'Perched' or subluxed facets

Injury morphology
Translation /Rotation-4

Horizontal displacement of one part of the sub-axial cervical spine with respect to the other

Disruption to both anterior and posterior structures

Rotation > 11 degrees
Translation> 3.5mm

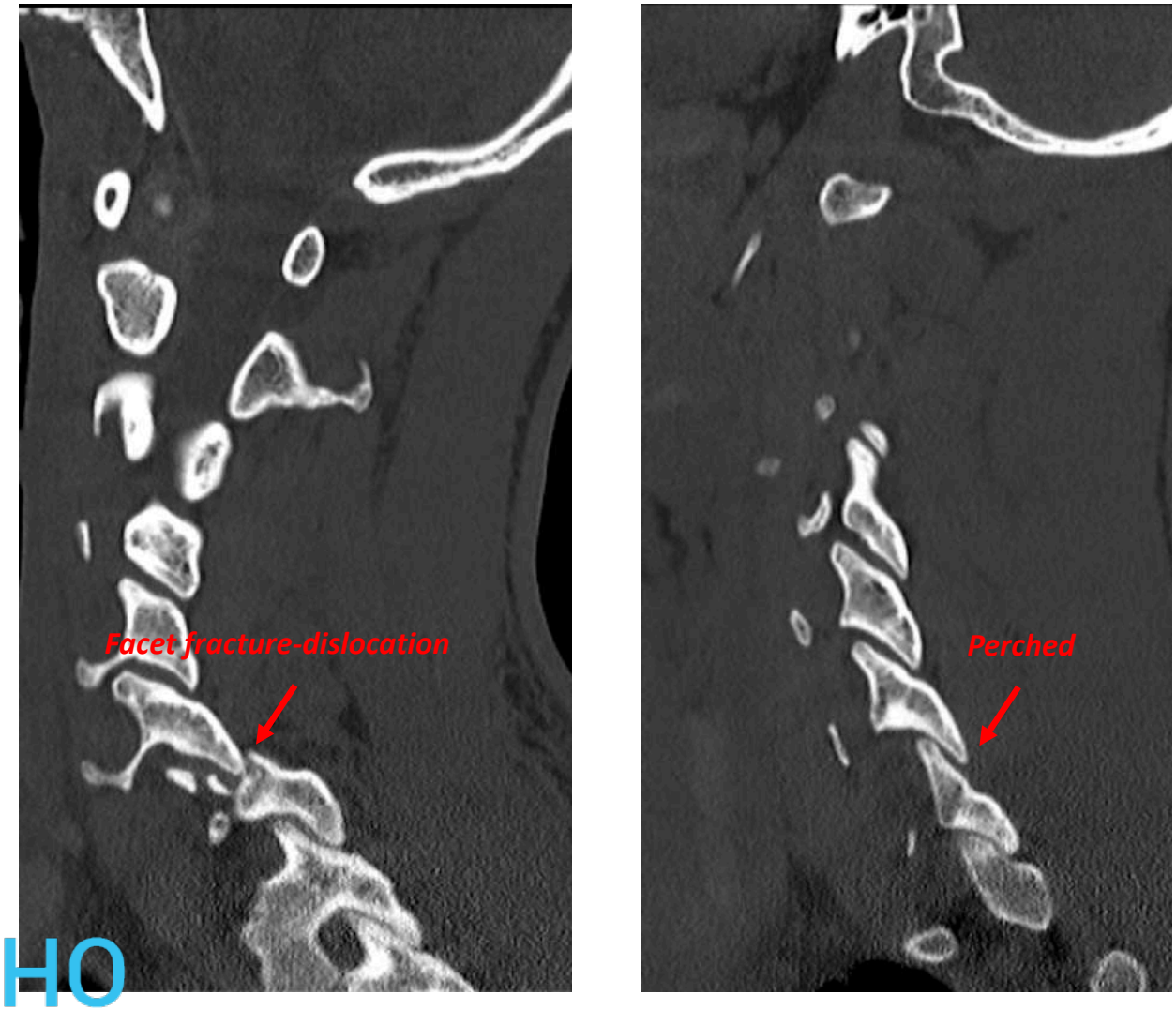
- Typified by the following types of injuries:

Unilateral facet fracture-dislocation	Bilateral facet fracture-dislocation	Lateral mass fracture-separation	Bilateral pedicle fractures

Translation/rotation

+ 4 POINTS

Unilateral facet fracture-dislocation

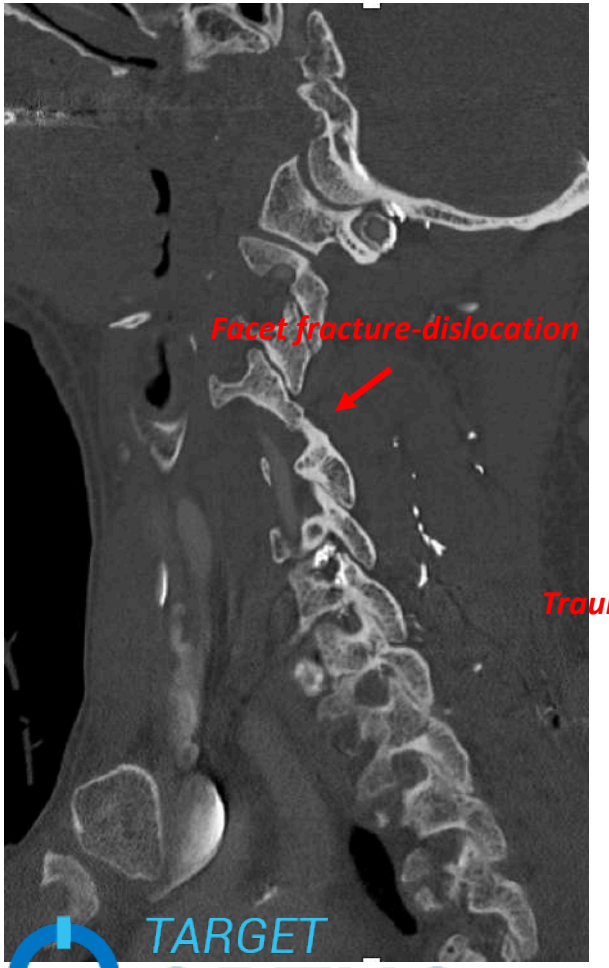


Left *Right*

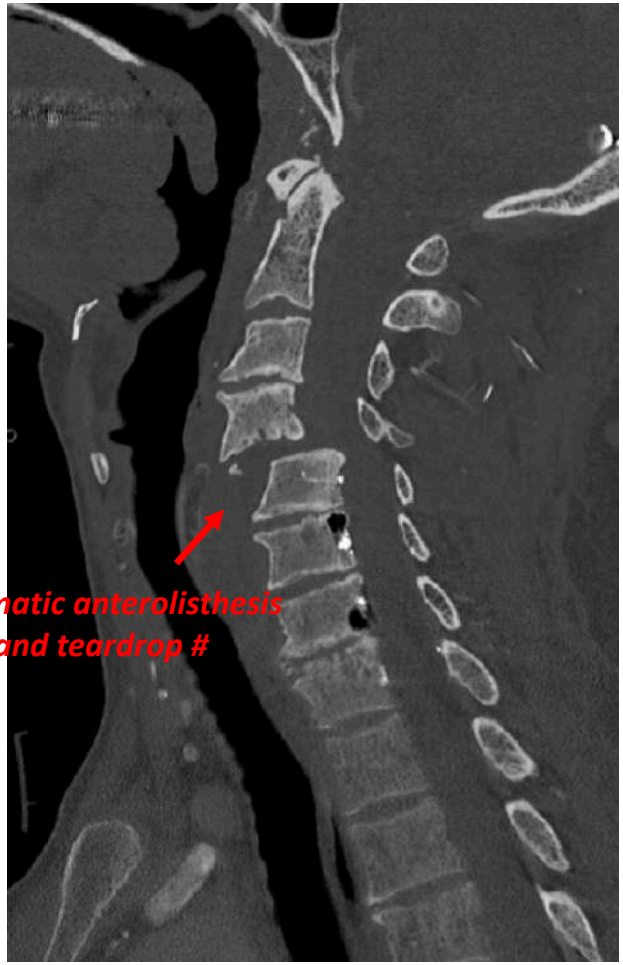
Translation/rotation

+ 4 POINTS

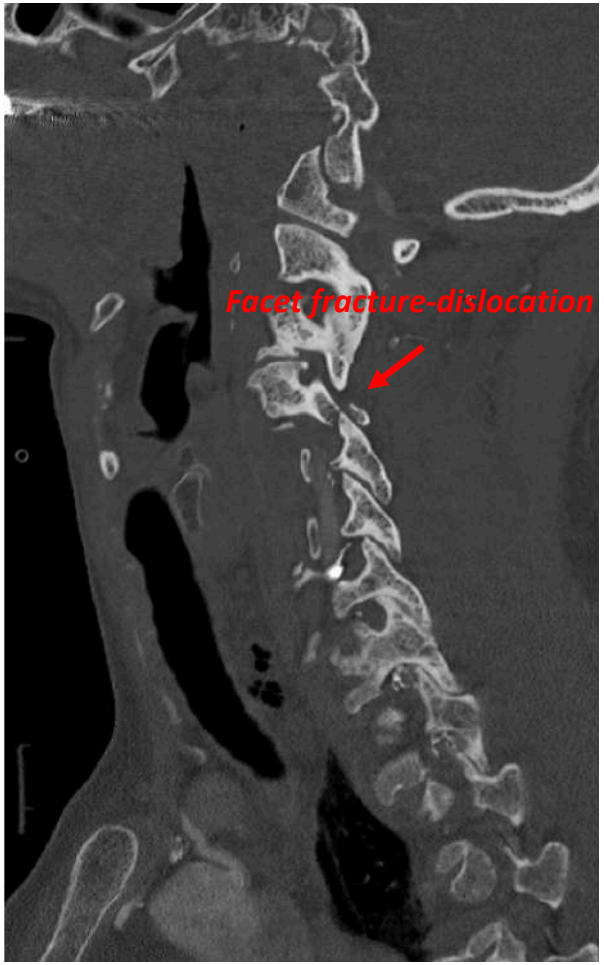
Bilateral facet fracture-dislocation



Left



Midline



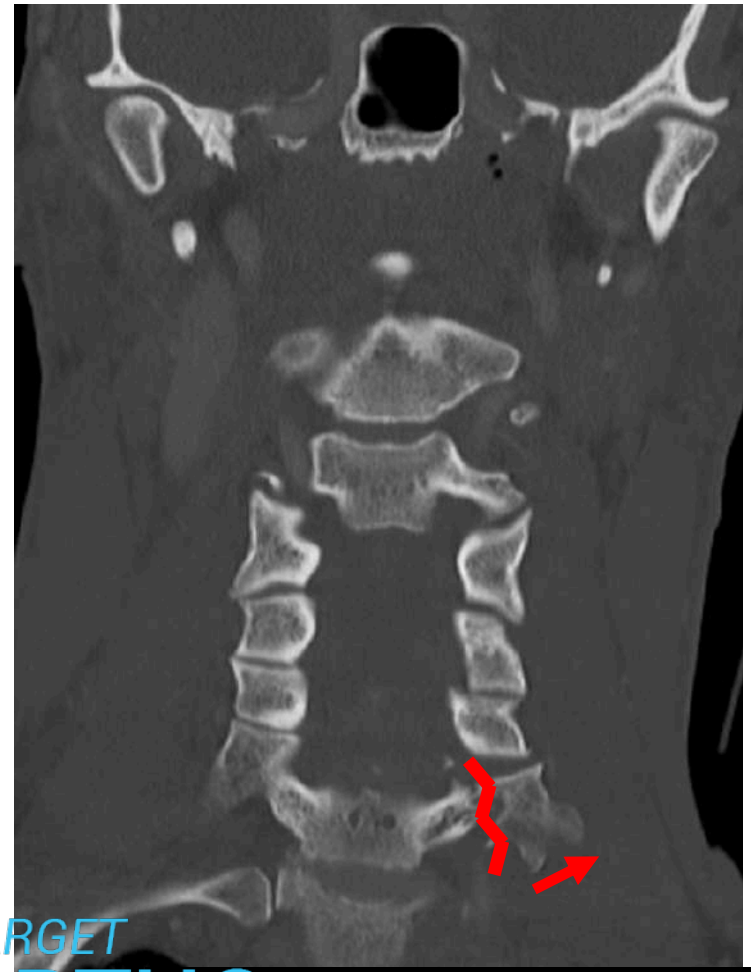
Right

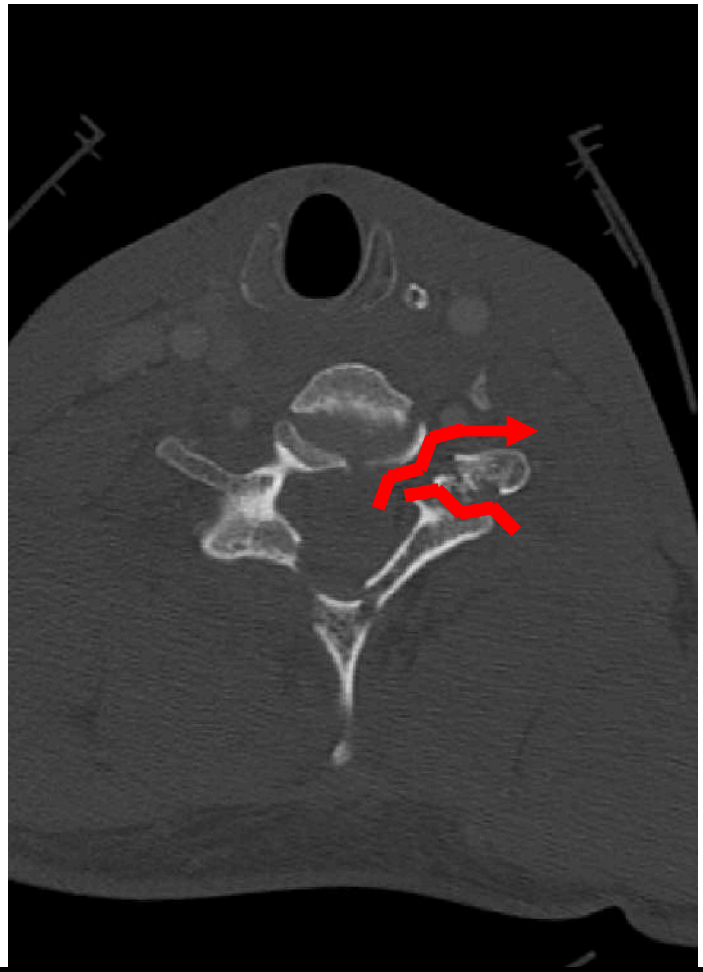
Translation/rotation

+ 4 POINTS

Lateral mass fracture-dislocation

(AKA isolated articular pillar fracture)



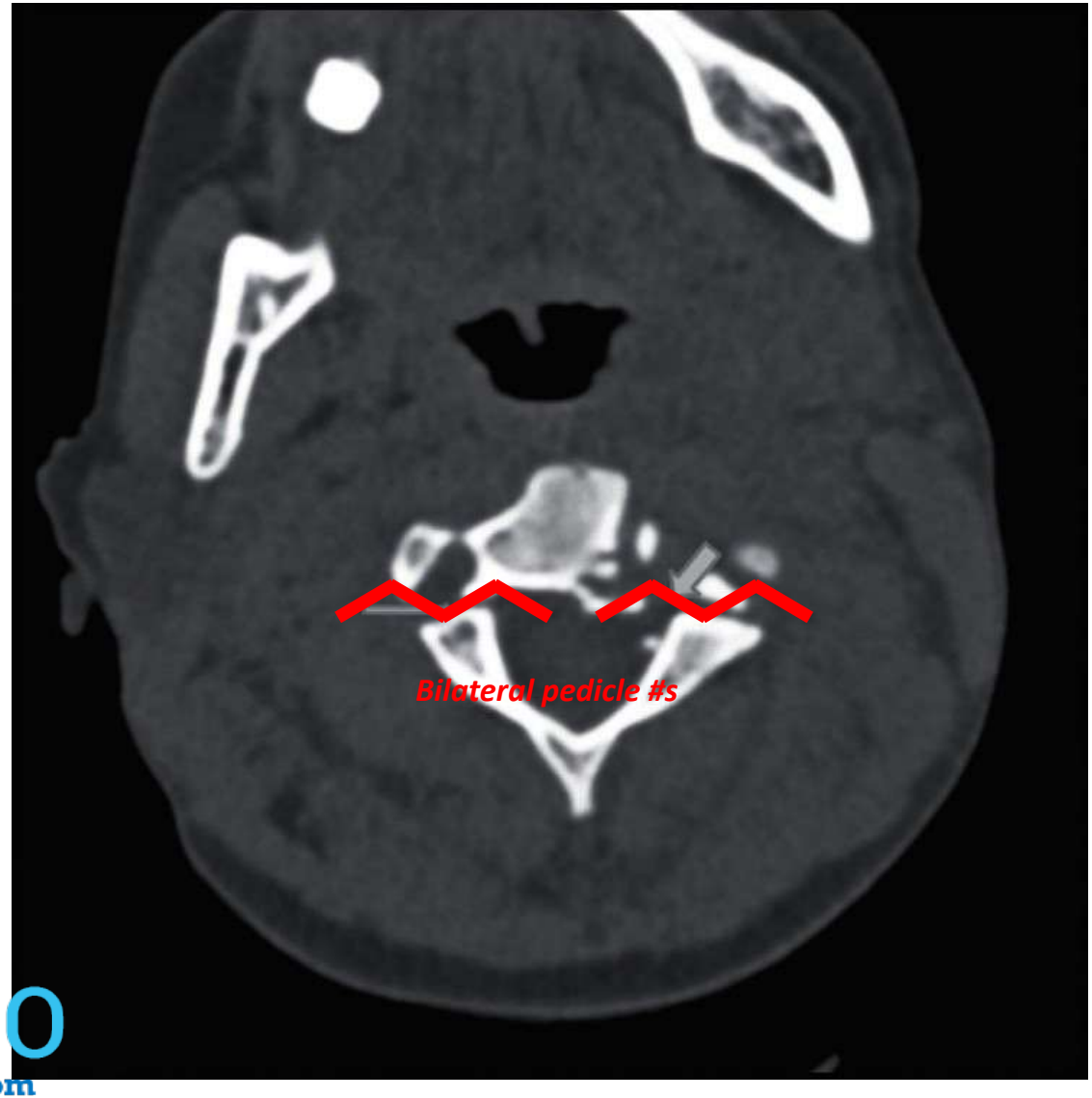


Fracture pattern results in isolation and lateral subluxation of the articular pillar

Translation/rotation

+ 4 POINTS

Bilateral pedicle fractures

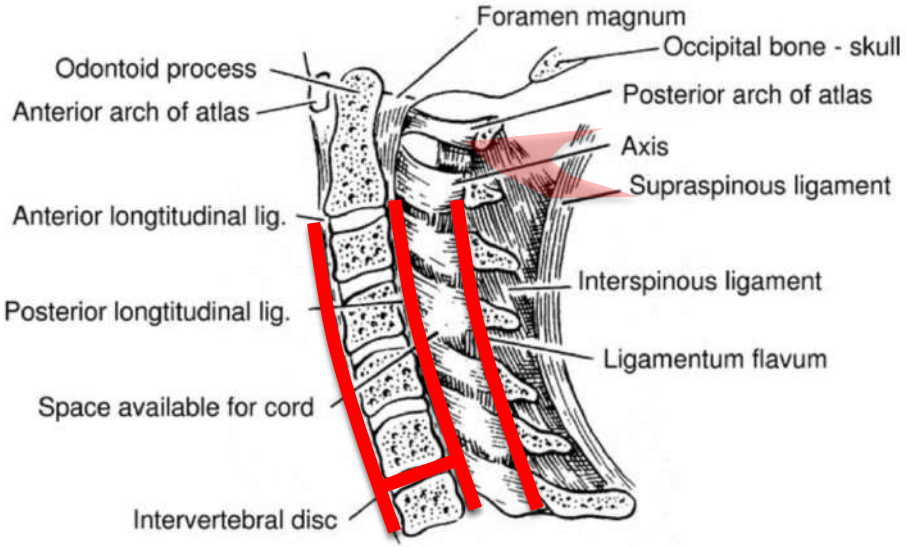


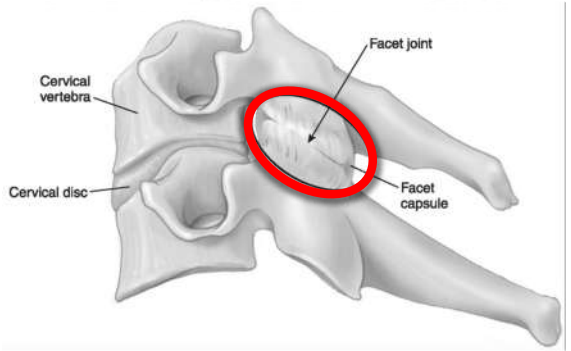
Translation-4

Discoligamentous Integrity

- The discoligamentous complex (DLC) provides significant restraint against motion, making its integrity key to spinal stability
- Anatomically, the DLC consists of the:
  - Intervertebral disc
  - Anterior longitudinal ligament
  - Posterior longitudinal ligament
  - Ligamentum flavum
  - Interspinous and supraspinous ligaments
  - Facet capsules

*(**strongest component of posterior tension band**)*





Discoligamentous Integrity

- Evaluation of DLC integrity is either indirect (radiographs, CT or MRI) or direct (MRI only)
- DLC injury can be:
  - ***Indirectly*** diagnosed when normal relationships between bony structures are compromised
  - ***Directly*** diagnosed by the presence of abnormal T2 signal
- The SLIC scoring system divides findings of DLC injuries into two categories according to level of diagnostic confidence:

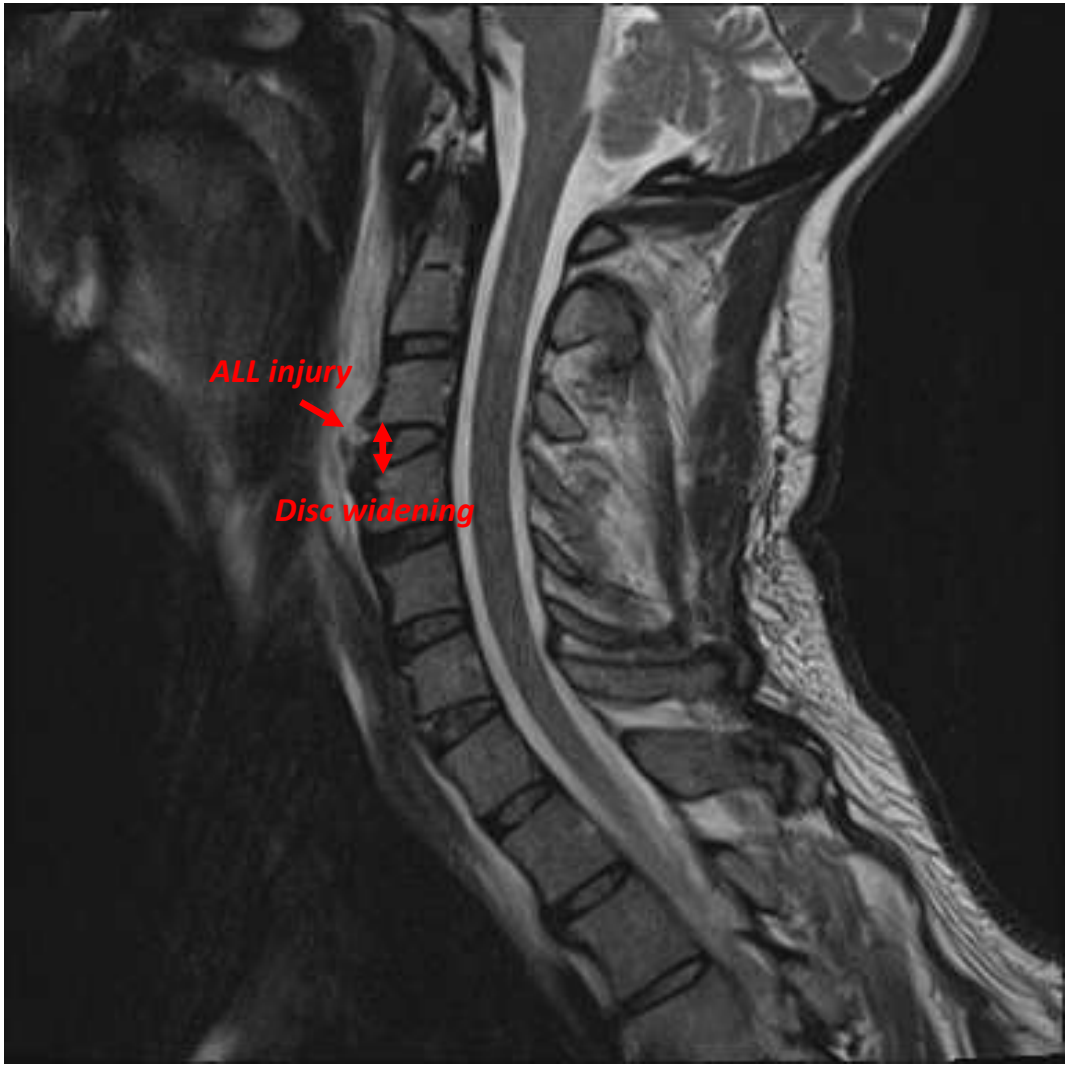
Definite DLC Injury *(2 points toward SLIC score)*	**Indeterminate DLC Injury** *(1 point toward SLIC score)*
Definite ALL Injury	Indeterminate Disc Injury
Definite Facet Capsule Injury	Indeterminate Facet Capsule Injury
Definite Interspinous Ligament Injury	Indeterminate Ligamentous Injury

Discoligamentous Integrity

+ 2 POINTS

Definite ALL Injury

- Requires abnormal widening of the intervertebral disc space
- May be seen on:
  - Neutrally-positioned radiographs, CT or MRI
  - Extension radiographs

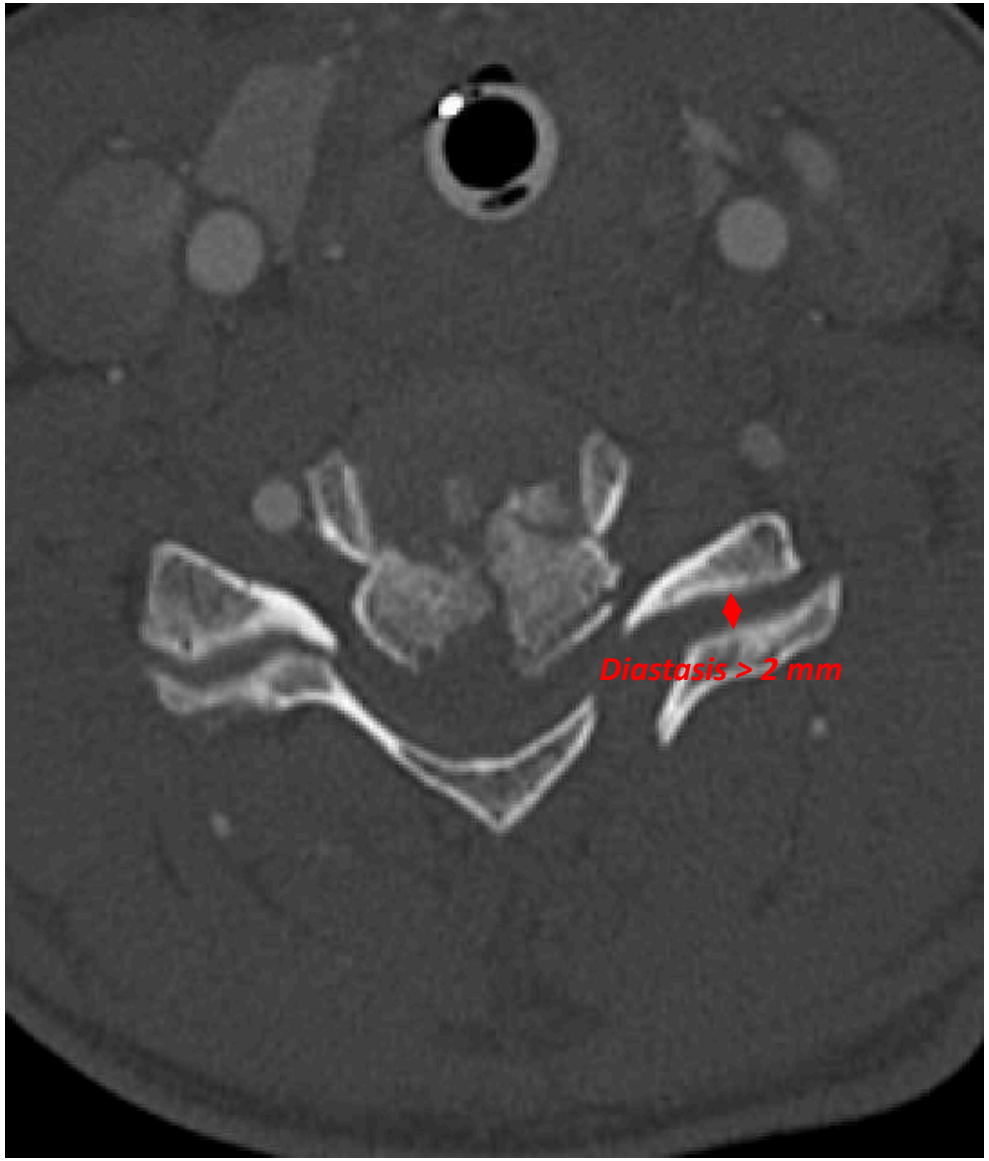


Discoligamentous Integrity

+ 2 POINTS

Definite Facet Capsule Injury

- Requires abnormal facet alignment
- Defined as:
  - Articular apposition < 50%, or
  - > 2 mm diastasis



Discoligamentous Integrity

+ 2 POINTS

Definite Interspinous Ligament Injury

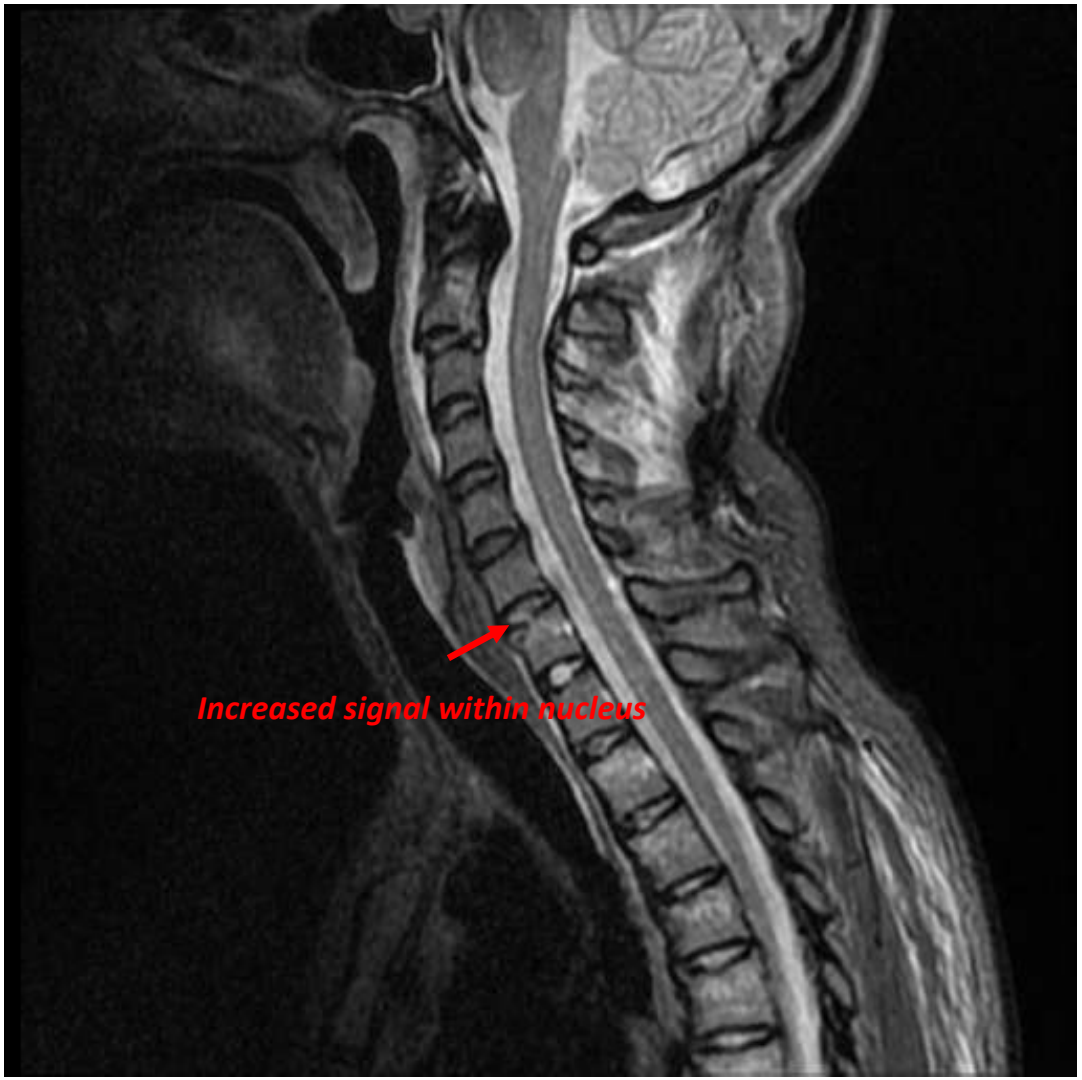
- Requires evidence of incompetence on flexion radiographs
- Defined as:
  - Abnormal facet alignment
  - Relative angulation > 11 degrees

Disco-ligamentous Integrity

+ 1 POINT

Indeterminate Disc Injury

- Increased T2 signal within disc, involving annulus and nucleus
- Even in isolation, this finding is highly suspicious for disc injury

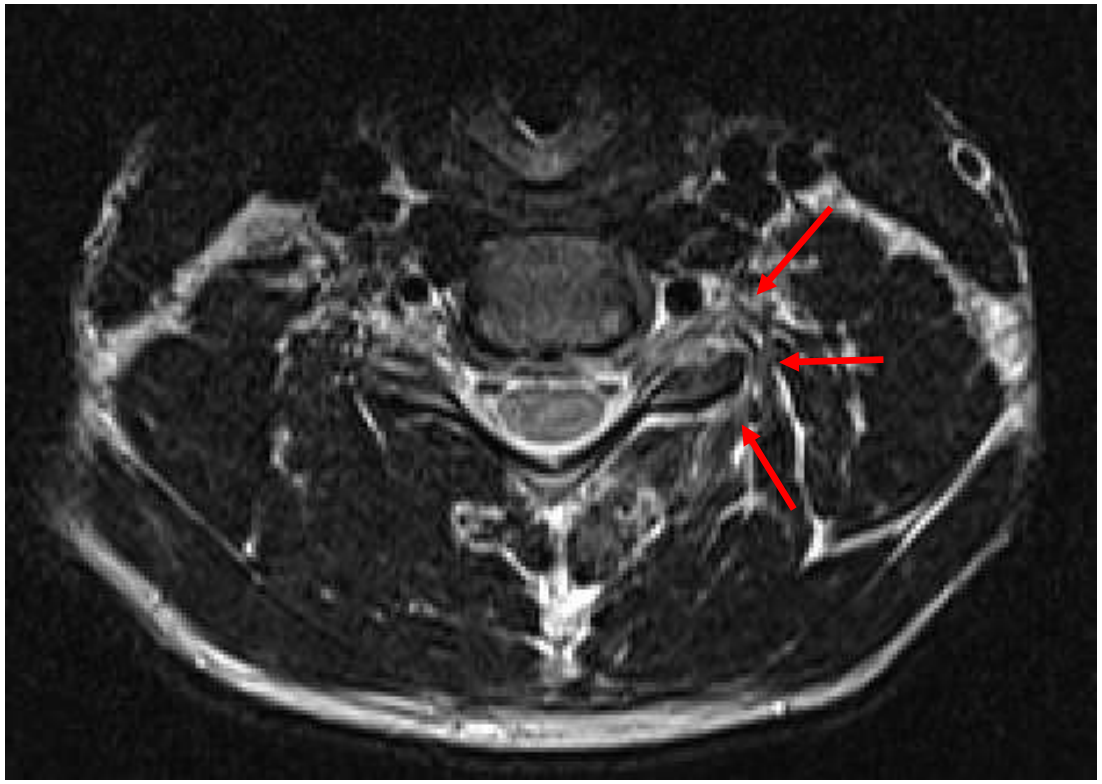


Disco-ligamentous Integrity

+ 1 POINT

Indeterminate Facet Capsule Injury

- Increased T2 signal within facets
- No definite facet injury
- *Remember, definite facet injury requires:*
  - Articular apposition > 50%
  - Diastasis > 2 mm

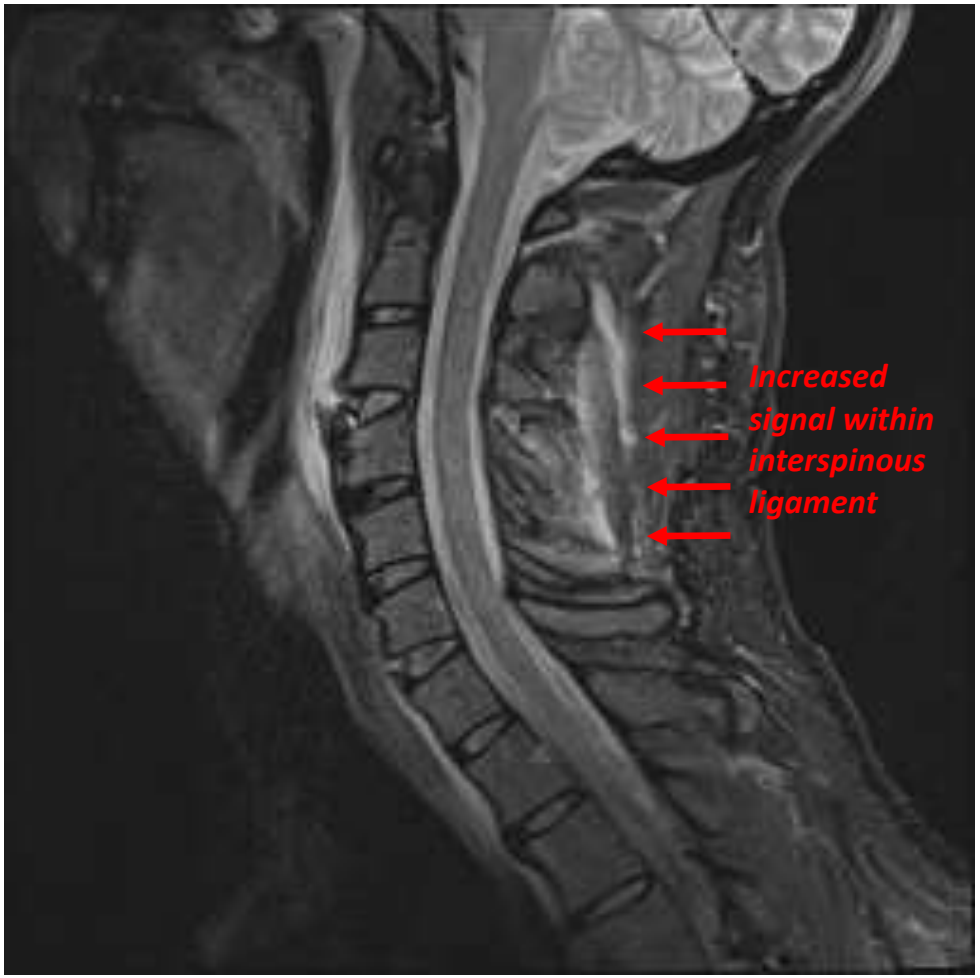


Disco-ligamentous Integrity

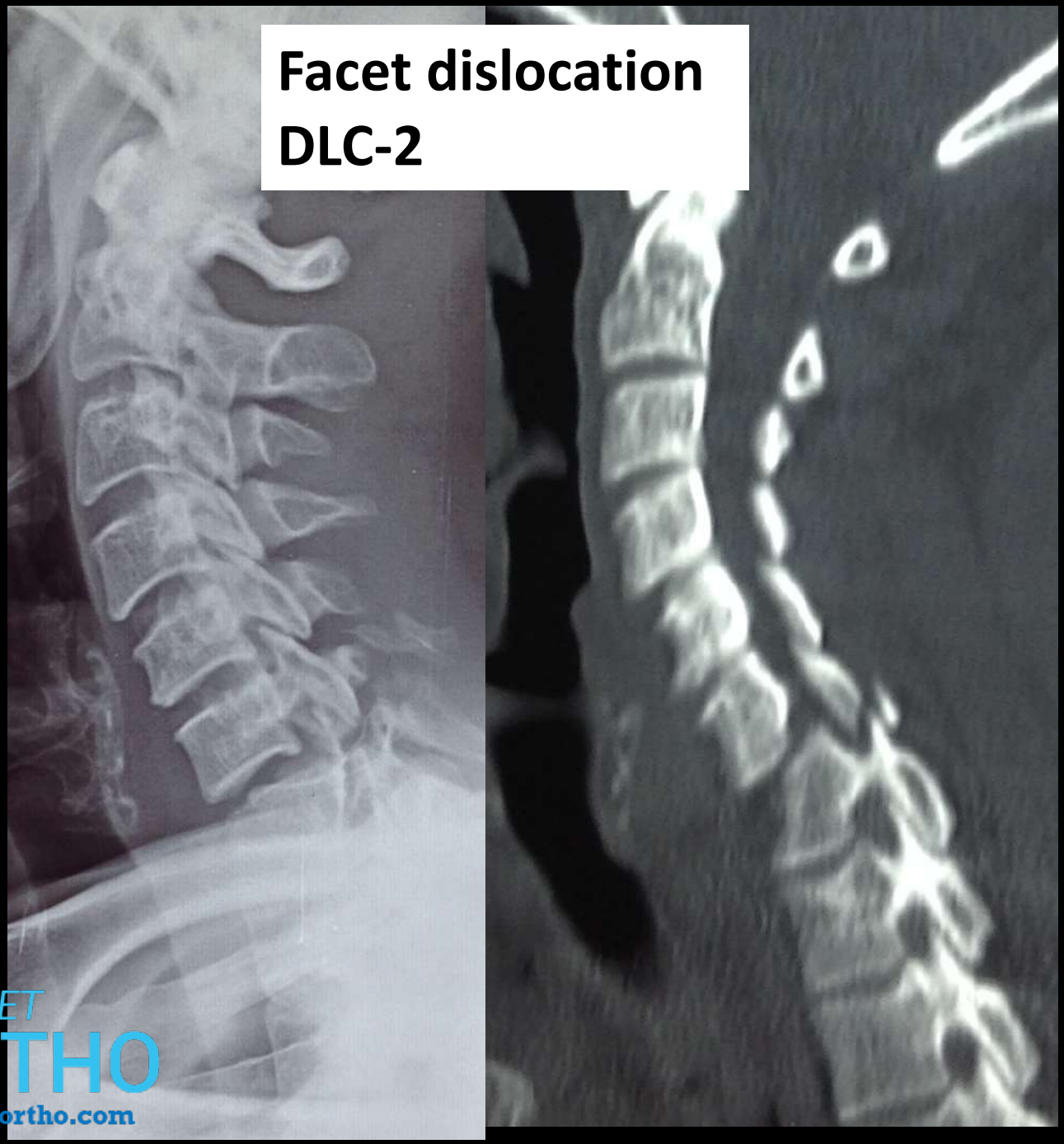
+ 1 POINT

Indeterminate Ligamentous Injury

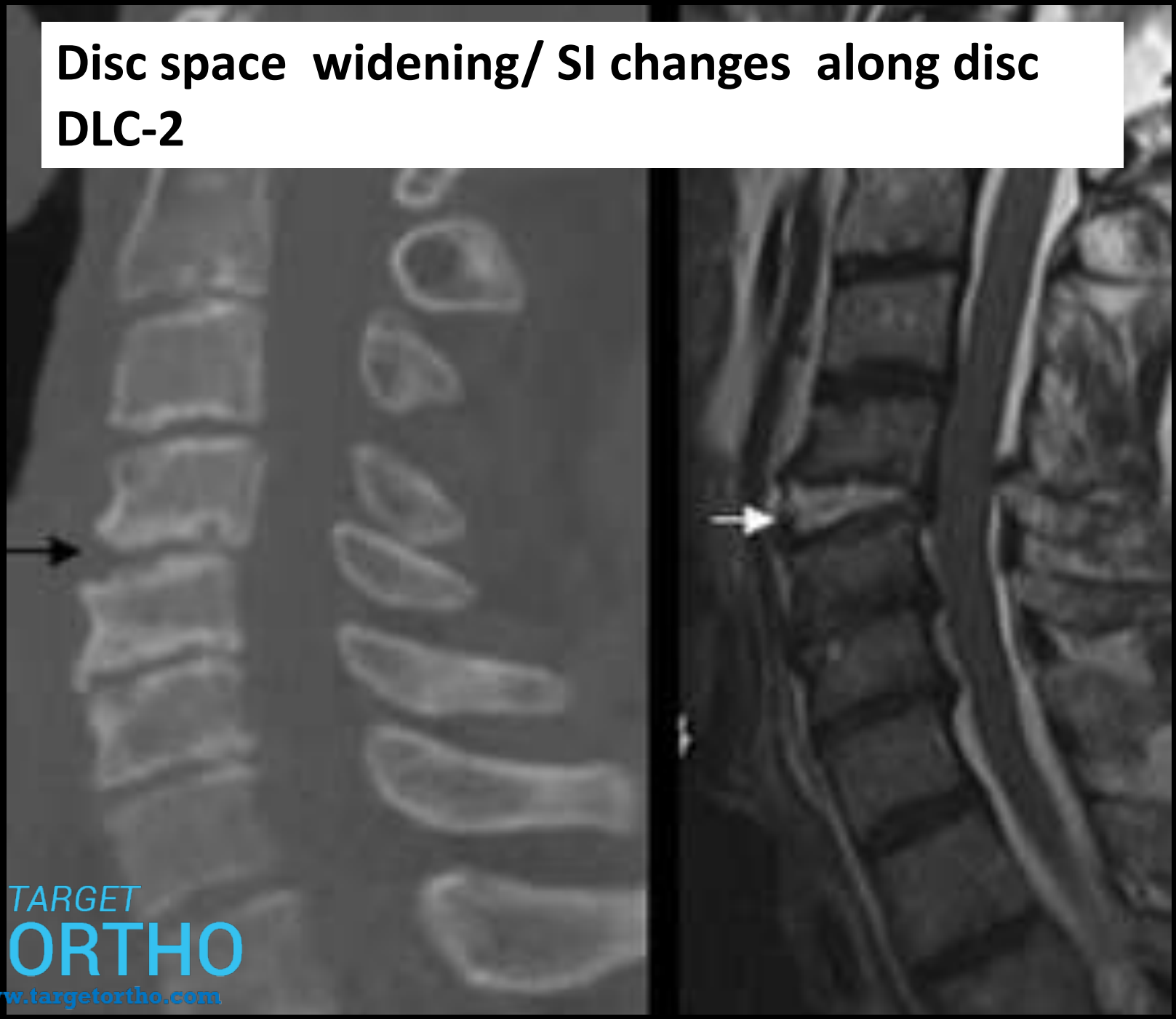
- Increased T2 signal within spinal ligaments
- No definite ligamentous injury
  - Without abnormal widening of intervertebral disc space
  - without abnormal facet alignment



Facet dislocation
DLC-2



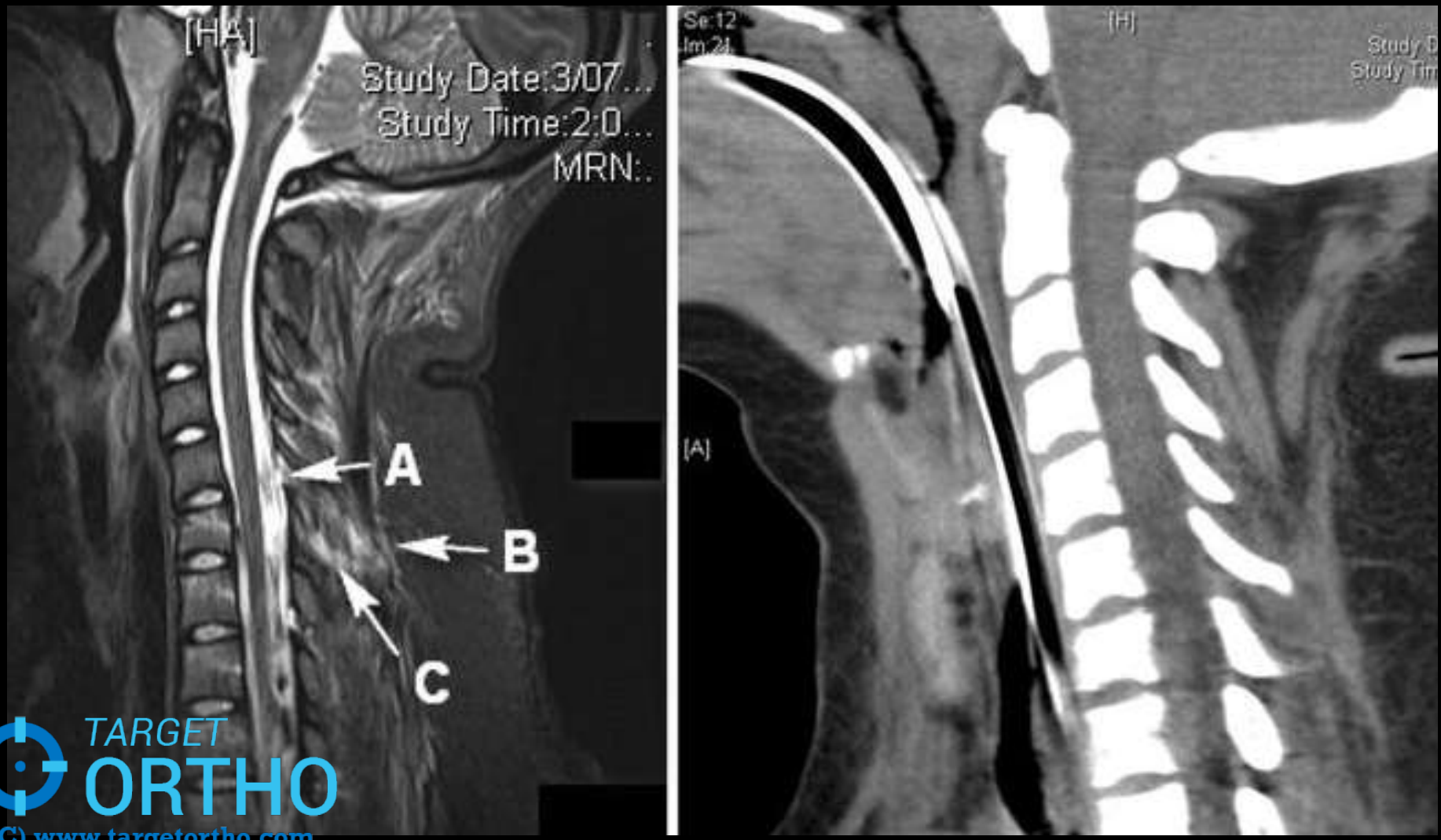
Disc space widening/ SI changes along disc DLC-2



Translation/rotation
DLC-2

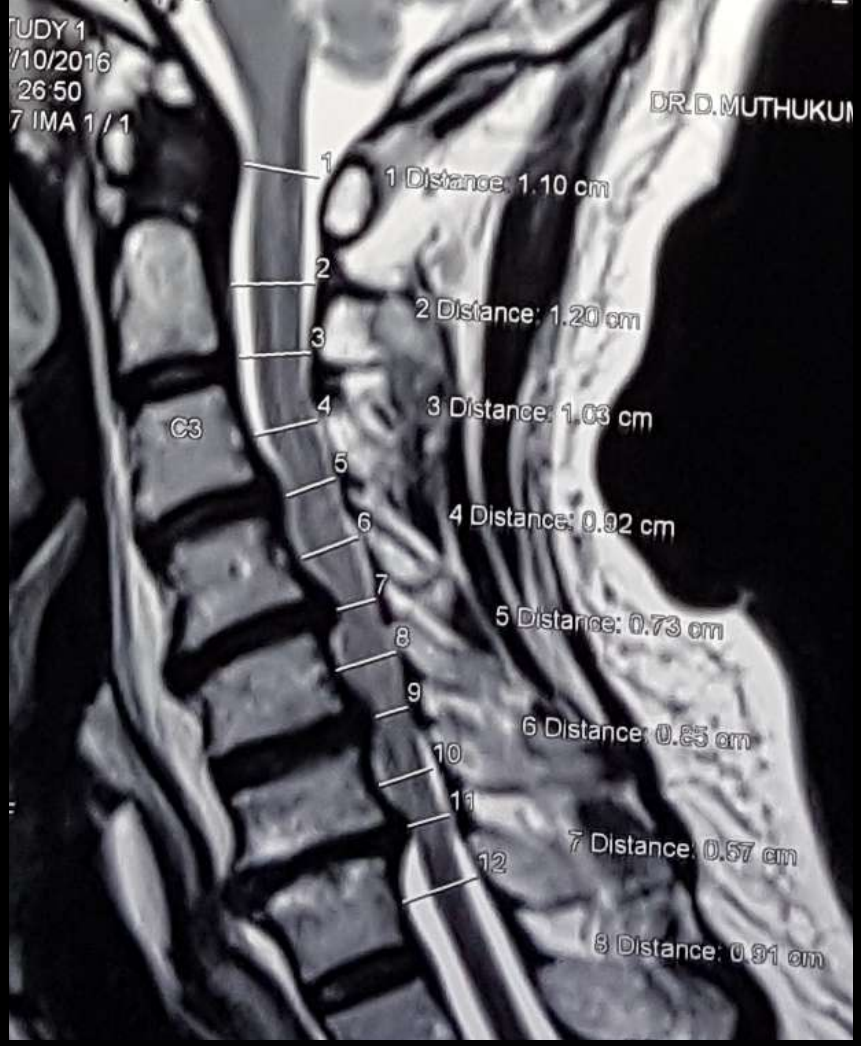
Interspinous widening
DLC-1

MRI signal intensity change only
DLC-1



Neurological involvement

- Important indicator of the severity of spinal column injury.
- Not a component in many other classifications
- Single most influential predictor of treatment



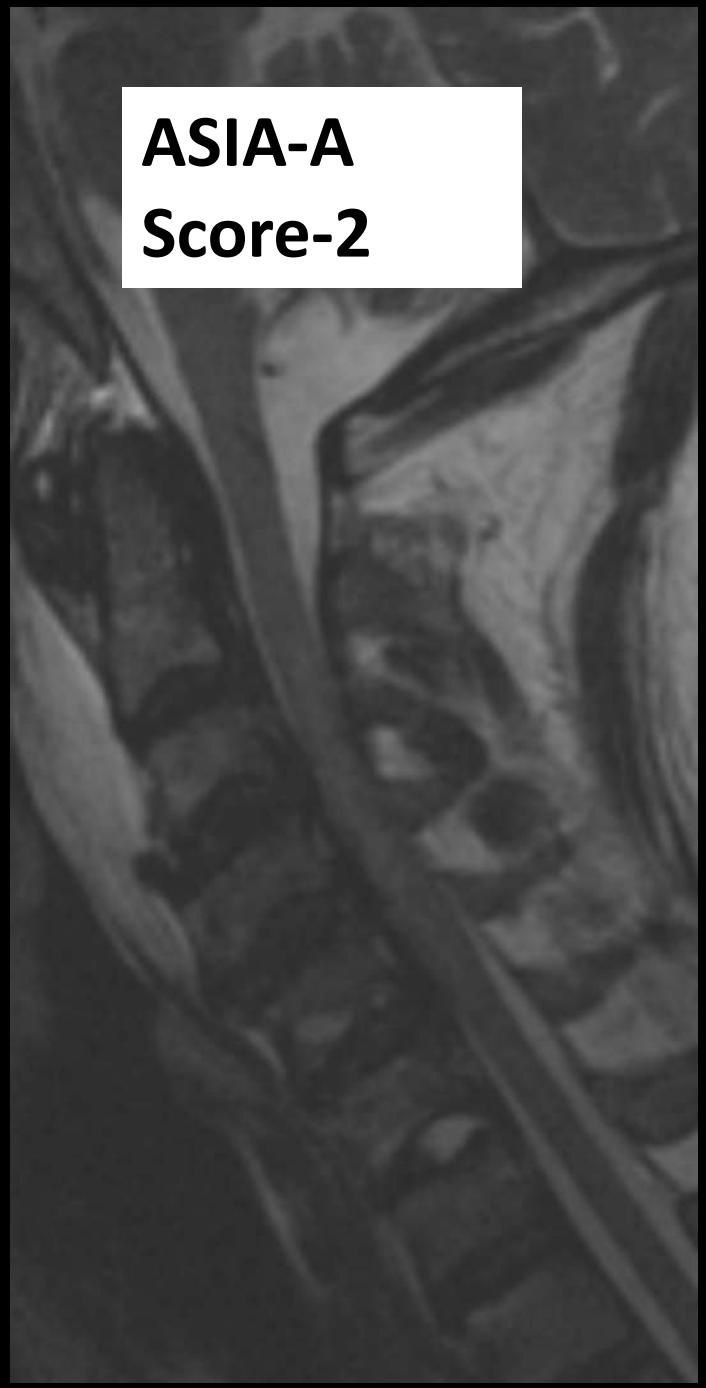
Significant neurologic injury in the setting of spondylotic stenosis may occur without overt fracture/ soft-tissue disruption.

Neurological Status

SLIC Scoring

Neurologic Status	SLIC Score*
Intact	0
Root injury	1
Complete level *(ASIA A)*	2
Incomplete level *(ASIA B, C, D)*	3

+1 is added for cord compression in setting of **any deficit*



Characteristics	Points
Injury morphology	
No abnormality	0
Compression	1
Burst	2
Distraction	3
Translation	4
Integrity of the disco-ligamentous complex	
Intact	0
Indeterminate	1
Disrupted	2
Neurological status	
Intact	0
Nerve root injury	1
Complete	2
Incomplete	3
Persistent cord compression	+1

Total SLIC Score

Determining Patient Management

- The individual score of each domain is then added to make the *total SLIC score*
- The *total SLIC score* is then used to determine optimal management:

< 4: non-surgical management

= 4: equivocal

> 4: surgical management

SLIC scoring demonstration

Case-1

- 38 yr old male
- h/o fall from height
- c/o pain in neck
- Normal neurology

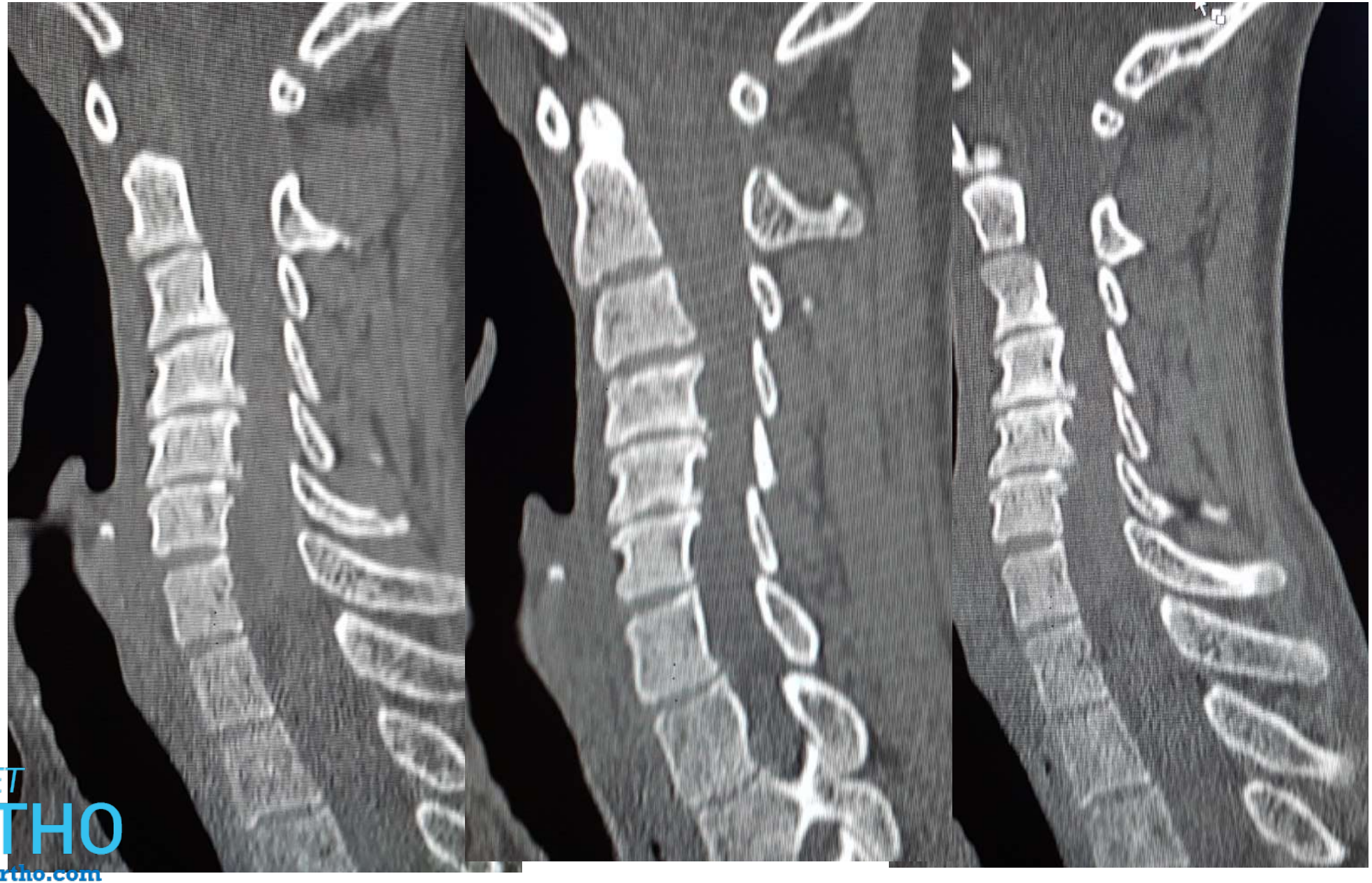


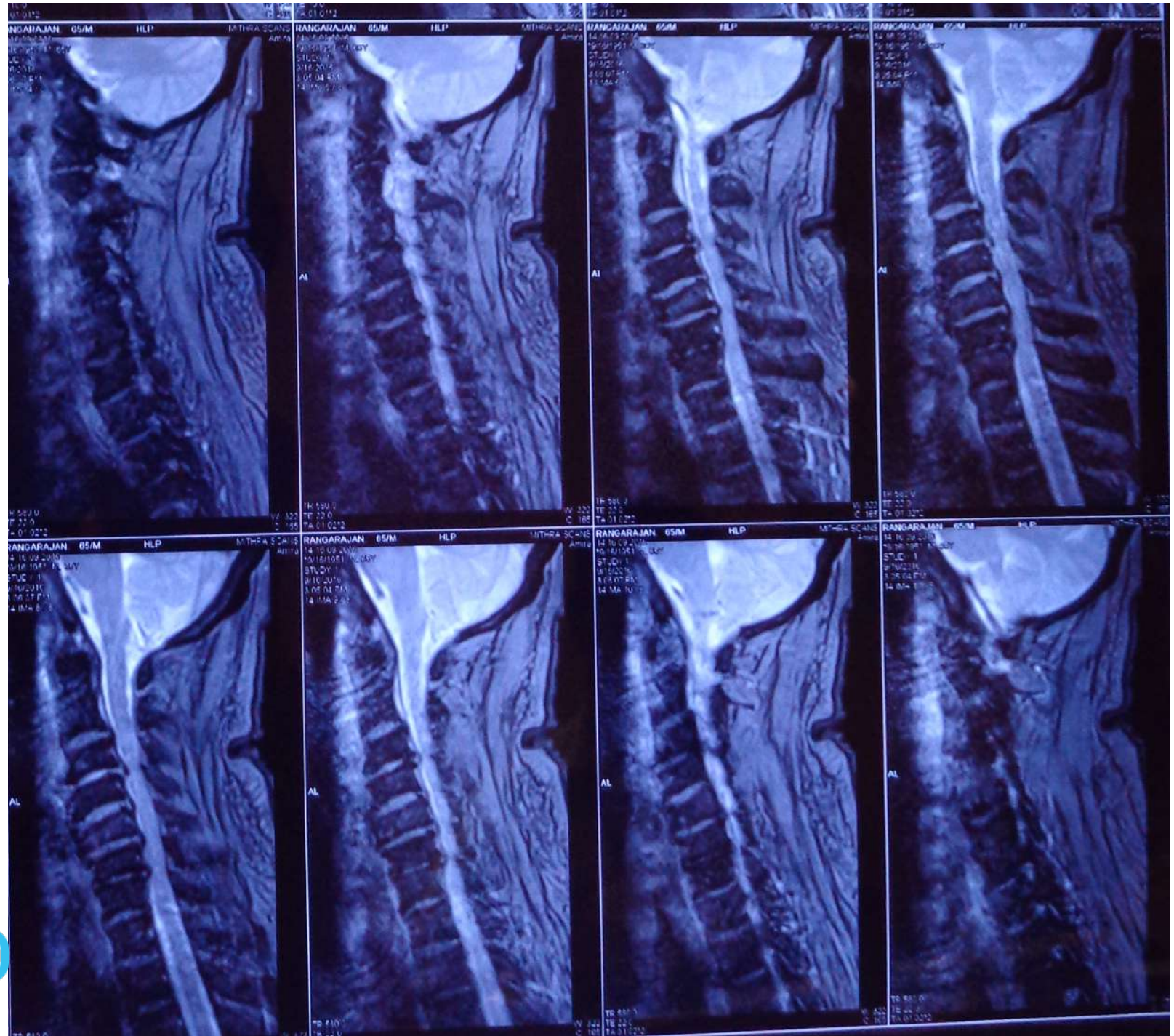
Characteristics	Points
Injury morphology	
No abnormality	0
Compression	1
Burst	2
Distraction	3
Translation	4
Integrity of the disco-ligamentous complex	
Intact	0
Indeterminate	1
Disrupted	2
Neurological status	
Intact	0
Nerve root injury	1
Complete	2
Incomplete	3
Persistent cord compression	+1

4 + 2 + 0 = 6

Case-2

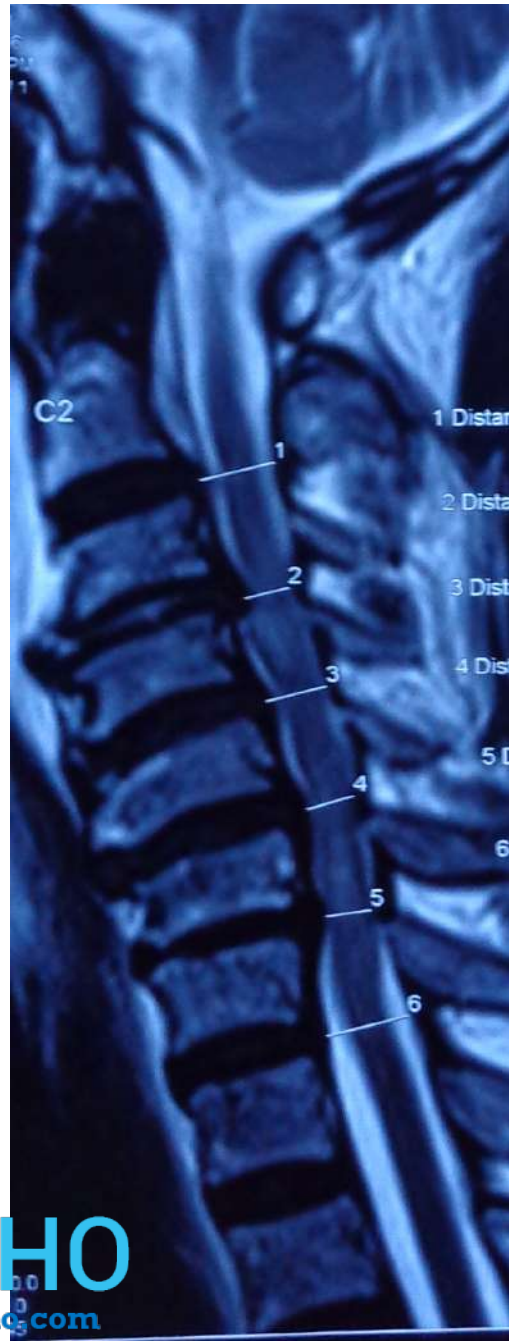
- 65 yr old male
- h/o fall while riding cycle 2 days back
- c/o weakness of both upper and lower limbs
- Neurology- upper limb- 2/5
  lower limb- 3/5





Characteristics	Points
Injury morphology	
No abnormality	0
Compression	1
Burst	2
Distraction	3
Translation	4
Integrity of the disco-ligamentous complex	
Intact	0
Indeterminate	1
Disrupted	2
Neurological status	
Intact	0
Nerve root injury	1
Complete	2
Incomplete	3
Persistent cord compression	+1

0+0+4 = 4

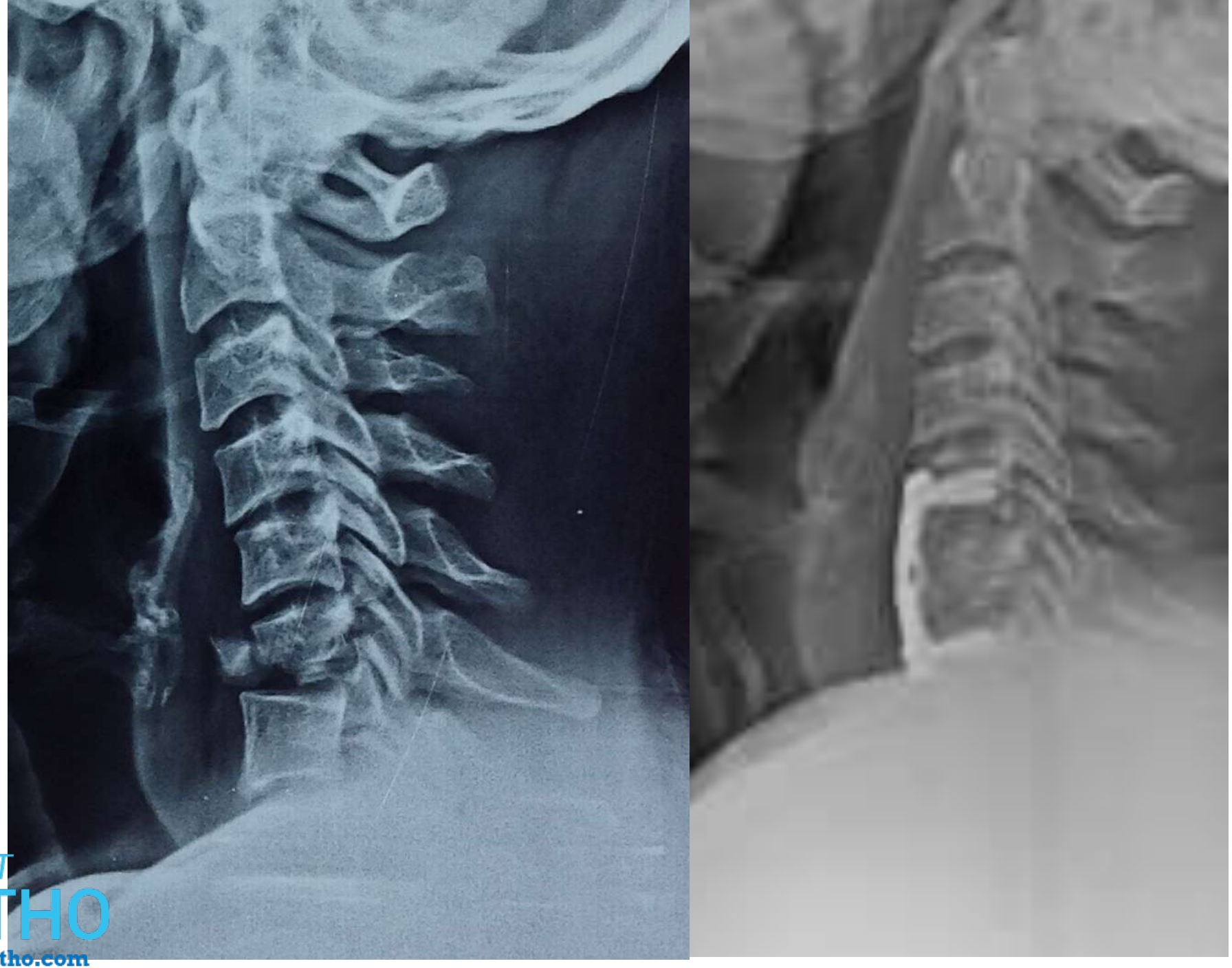


Case-3

- 36 yr old male
- Fall from tree
- c/o pain in neck with Rt upper limb pain
- Neurology- Rt C7-triceps-3/5

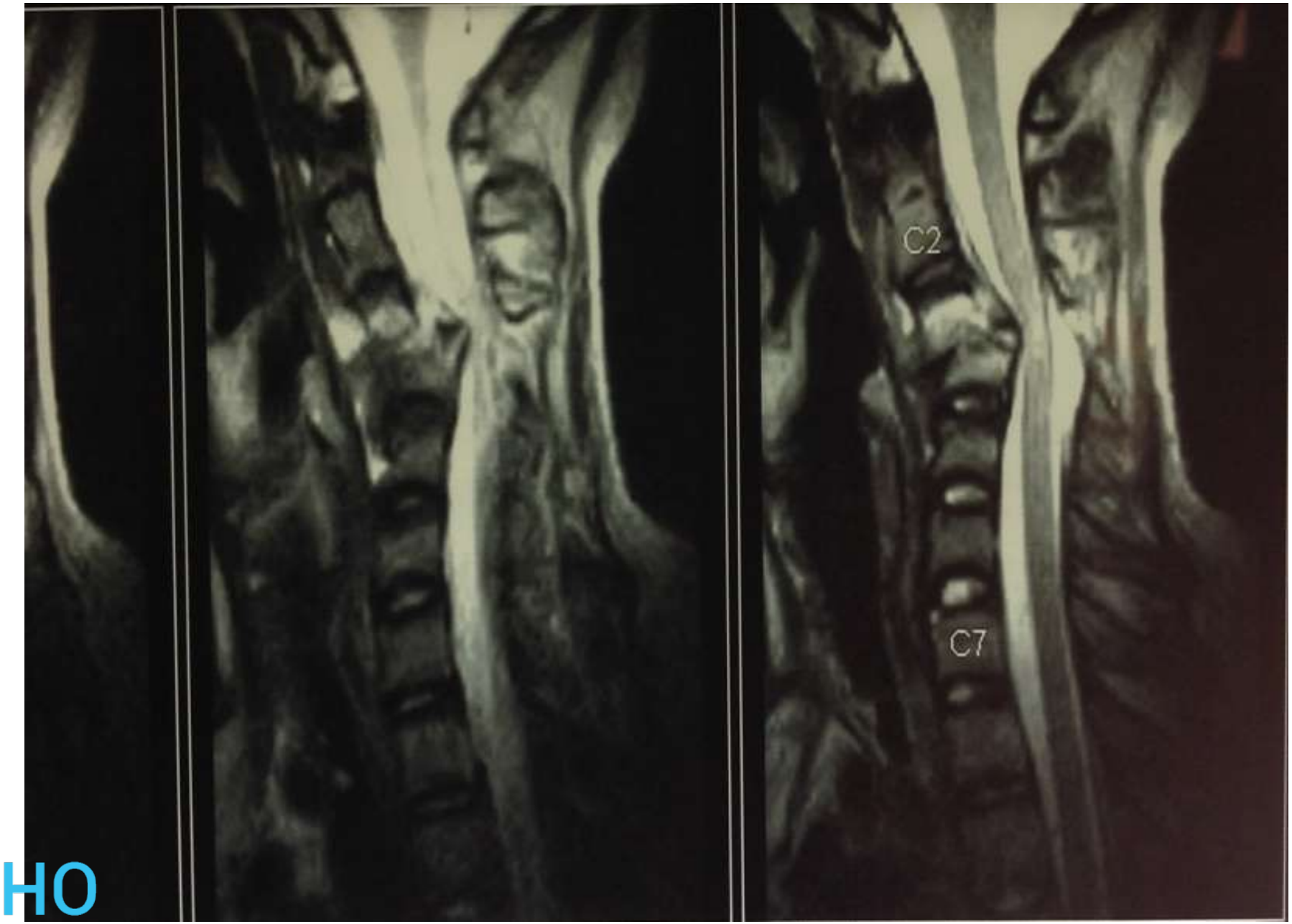
Characteristics	Points
Injury morphology	
No abnormality	0
Compression	1
Burst	2
Distraction	3
Translation	4
Integrity of the disco-ligamentous complex	
Intact	0
Indeterminate	1
Disrupted	2
Neurological status	
Intact	0
Nerve root injury	1
Complete	2
Incomplete	3
Persistent cord compression	+1

2+1+1 = 4



Case-4

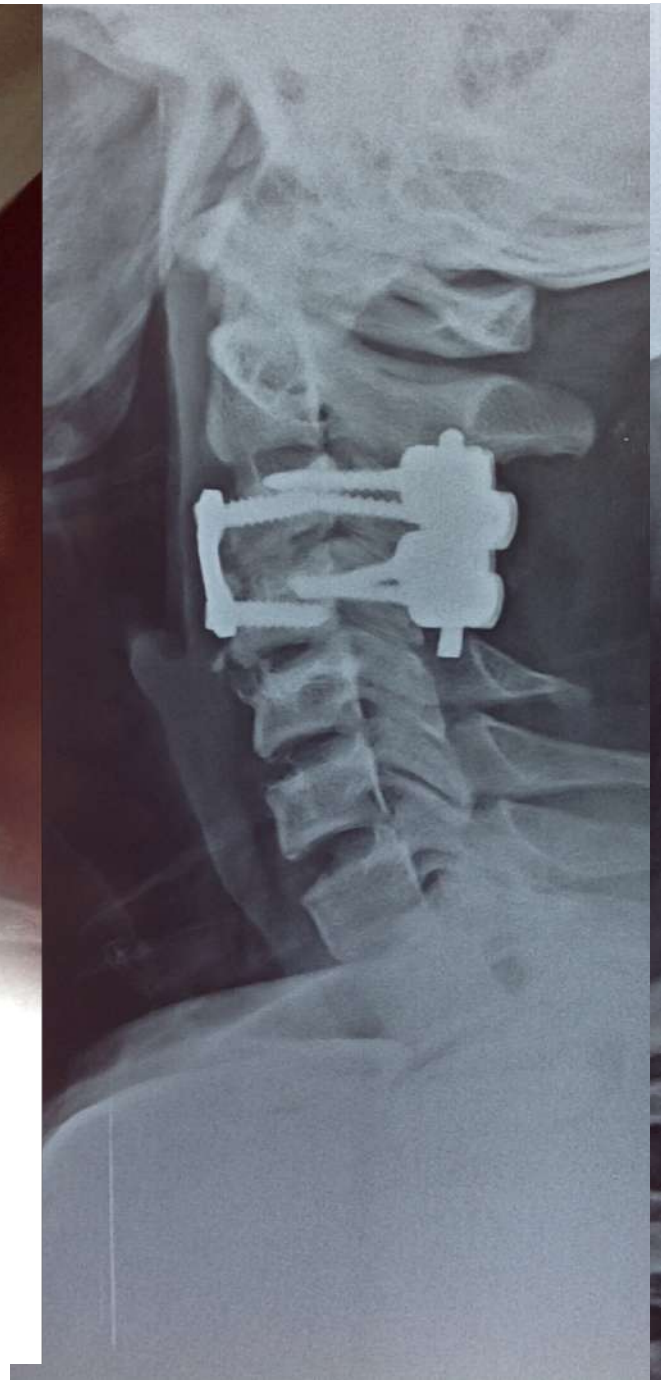
- 16 yr old boy
- RTA
- Head injury – unconscious for 3 weeks
- Upper and lower limb weakness when he regained consciousness
- Neurology- upper limb and lower limb-3/5



Characteristics	Points
Injury morphology	
No abnormality	0
Compression	1
Burst	2
Distraction	3
Translation	4
Integrity of the disco-ligamentous complex	
Intact	0
Indeterminate	1
Disrupted	2
Neurological status	
Intact	0
Nerve root injury	1
Complete	2
Incomplete	3
Persistent cord compression	+1

4+2+4 = 10

`



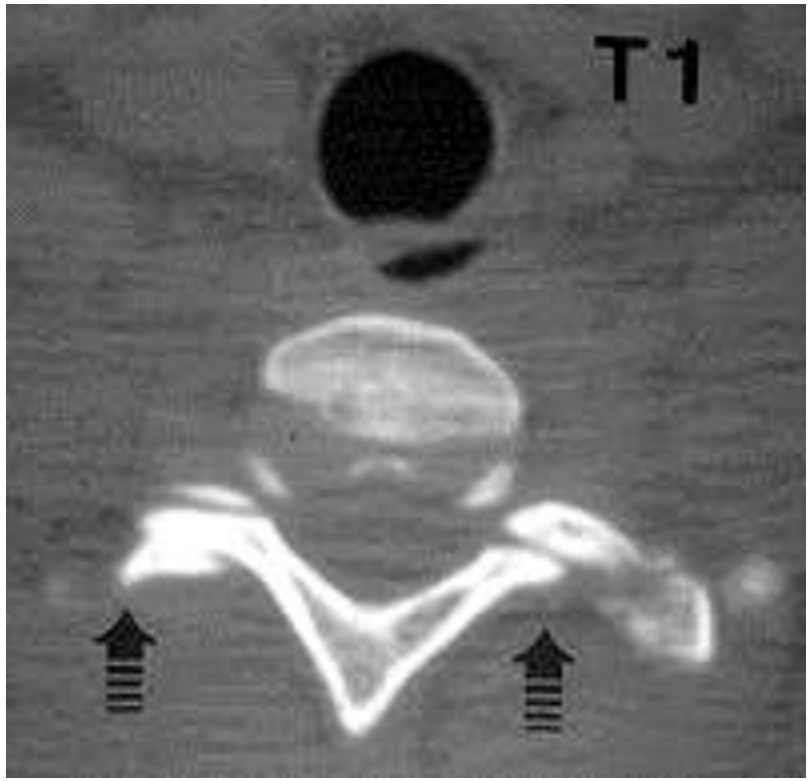
TARGET ORTHO

Unilateral Facet Dislocation

- Flexion/rotation injury
- 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

- Reduce to minimize late pain, instability
- Flex, rotate to unlock; extend
- 50% successful reduction
- OR vs. halo



Unilateral Facet Dislocation

Note C7 fracture also!

Unilateral Facet Dislocation
Treatment

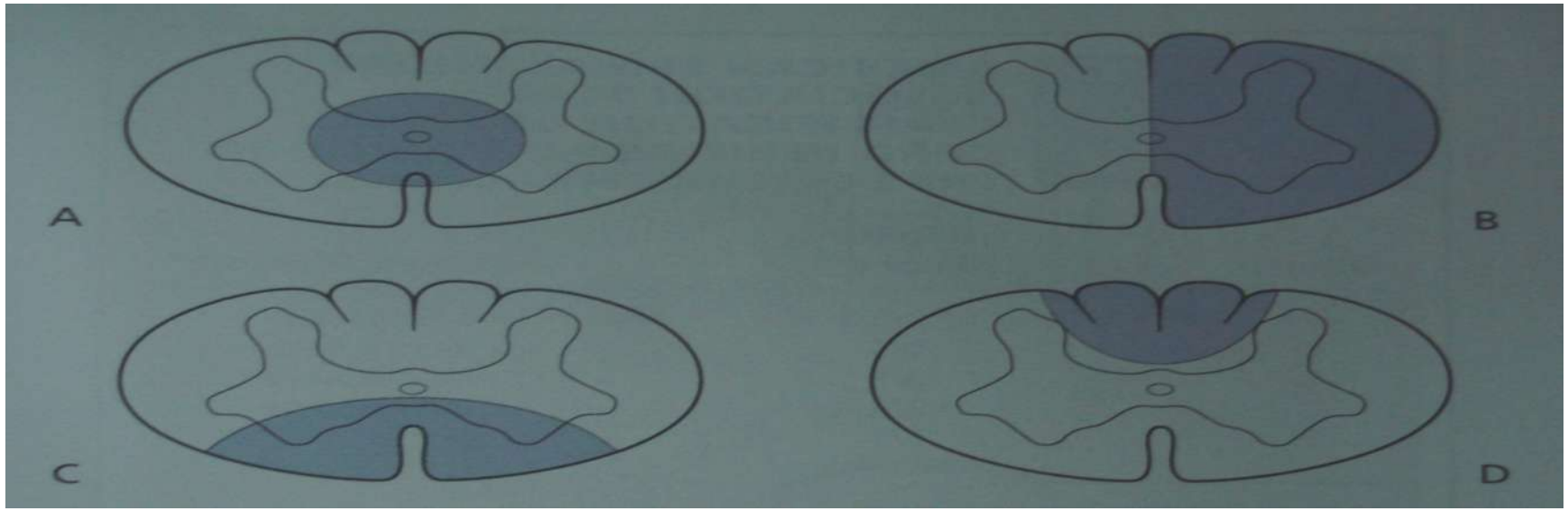
- ***Nonoperative***
  - Cervicithoracic brace or halo x 12 weeks
- ***OR approach and treatment depends on pathology***
  - Anterior discectomy and fusion with plate
  - Posterior foraminotomy and fusion with segmental stabilization

SPINAL CORD SYNDROMES

- **Complete SCI:** total motor and sensory loss distal to injury

- **Incomplete SCI:** partial motor or sensory loss distal to injury

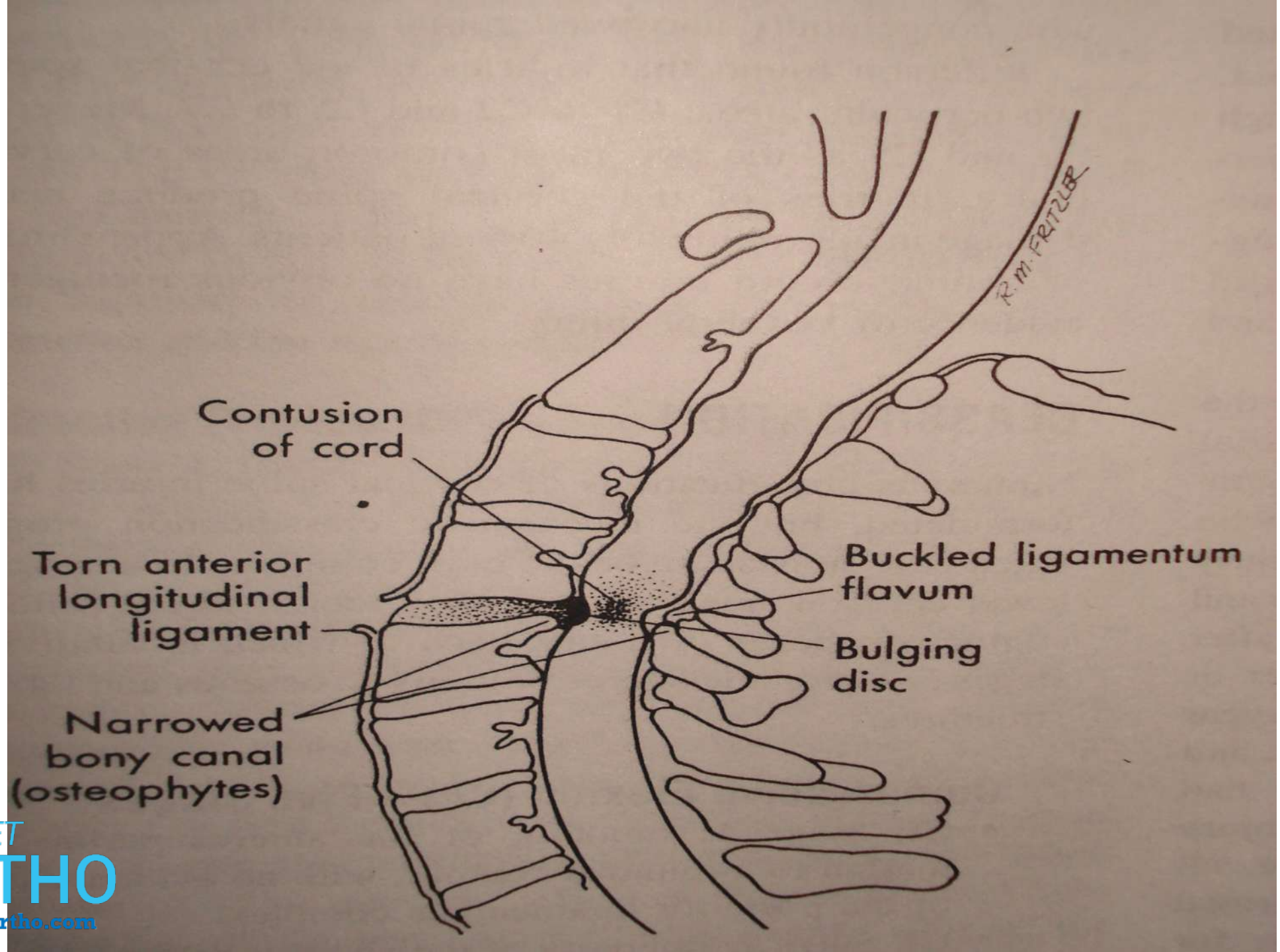
INCOMPLETE SPINAL CORD SYNDROMES

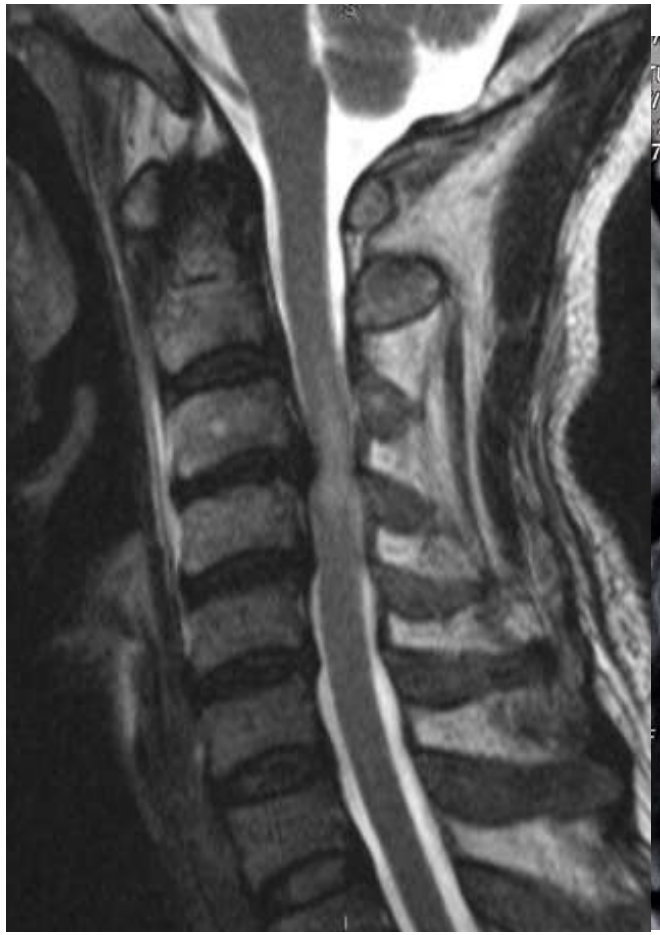


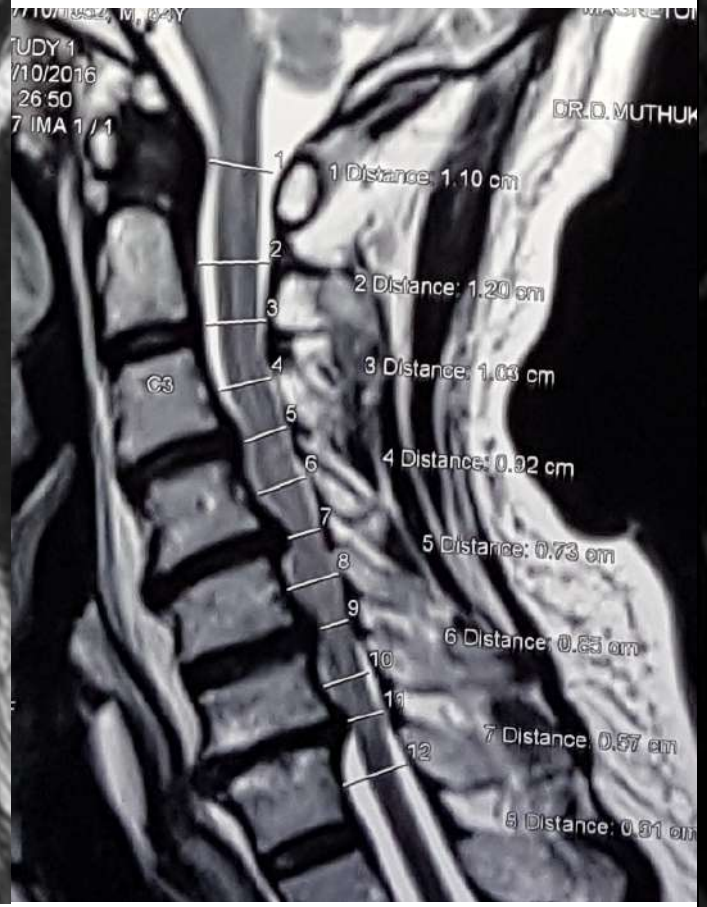
A. Central cord syndrome B. Brown- sequard syndrome C. Anterior cord syndrome D. posterior cord syndrome

CENTRAL CORD SYNDROME

- M/C Incomplete SCI
- Quadriparesis UL > LL
- Hyperextension injury – preexisting cervical spondylosis .
- Prognosis- good .
- > 50% pts recovering BB function , ambulation

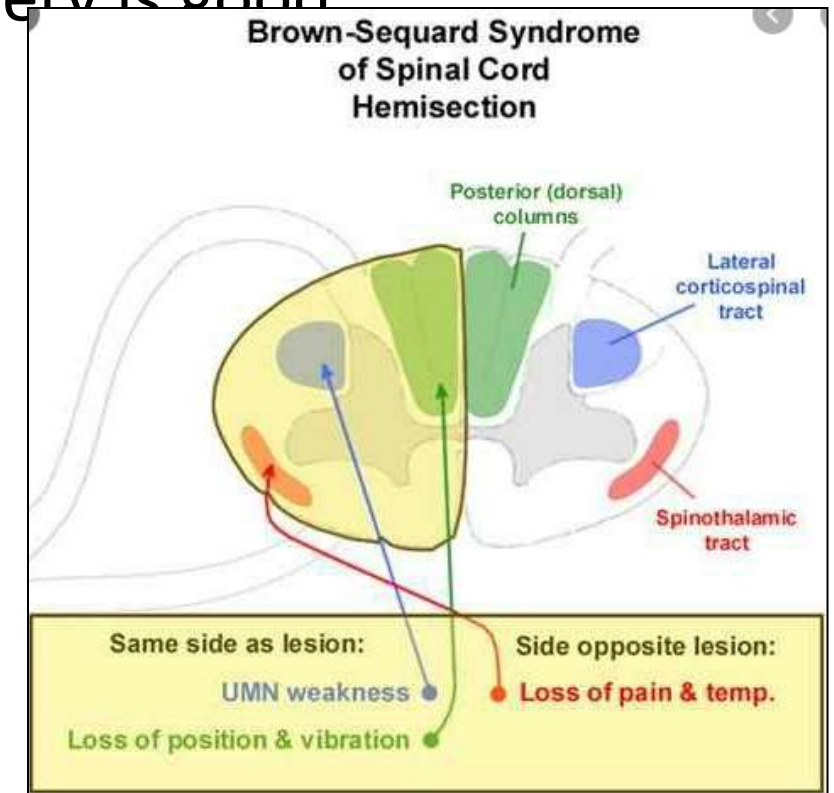






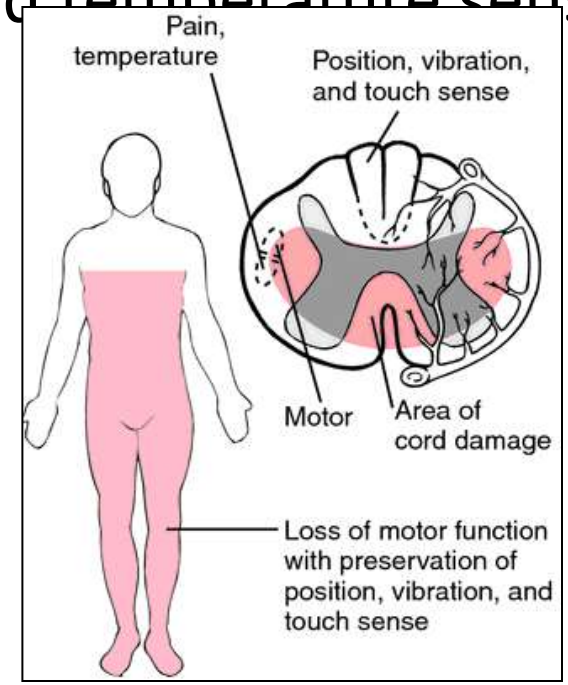
BROWN-SEQUARD SYNDROME

- Hemitransection of cord .
- Laminar / pedicle fracture/penetrating injury.
- Prognosis for recovery is good



ANTERIOR CORD SYNDROME

- **Hyperflexion injury** - disc or bone fragments compress the ant spinal artery and cord
- Complete motor loss and loss of pain and temperature sensation
- Posterior column spared
- Prognosis poor

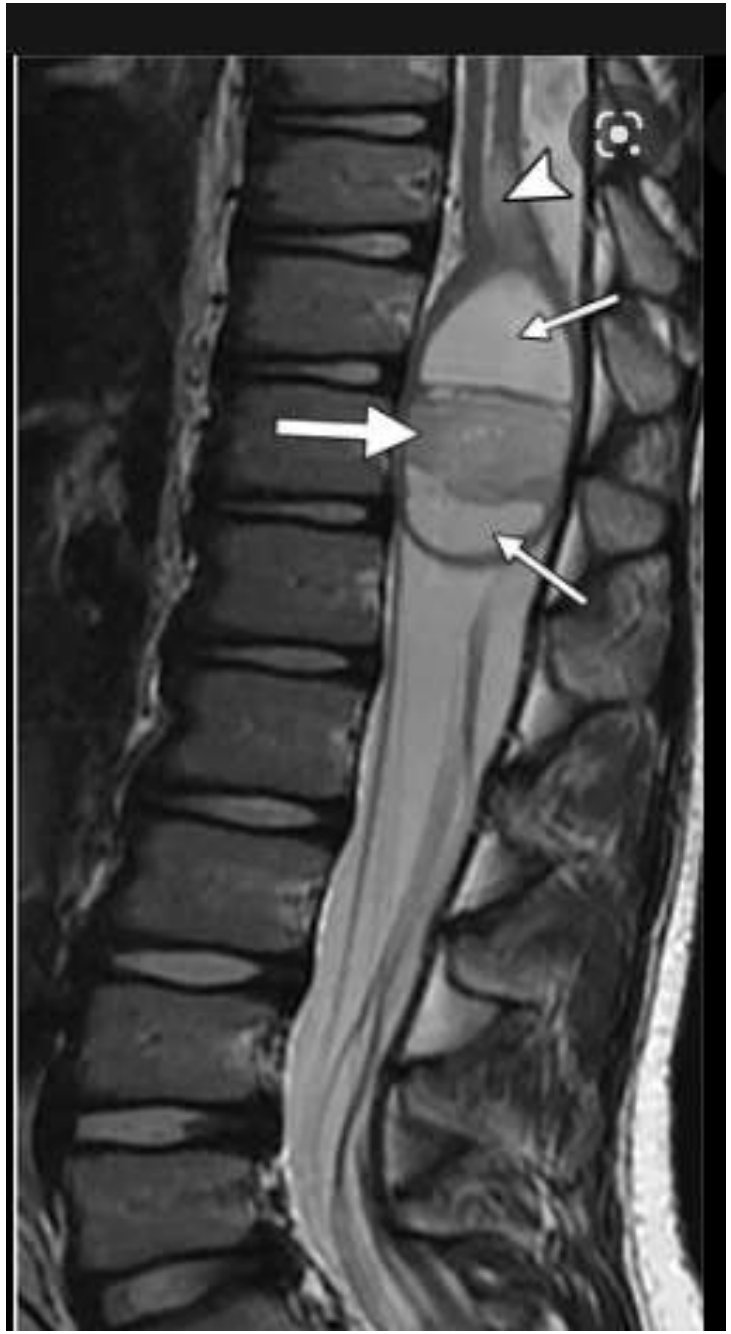


POSTERIOR CORD SYNDROME

- Caused by **extension injury**
- Involves the **dorsal column**
- Motor and other sensory functions are spared

CONUS MEDULLARIS SYNDROME

- Injury of conus medullaris and lumbar nerve roots
- Results in areflexic bowel , bladder , lower extremities weakness.
- Irreversible injury



Which of the following imcomplete spinal cord injuries has the worst prognosis?

A)The posterior cord syndrome

B) The anterior cord syndrome

C) The central cord syndrone

D) Brown –sequard syndrome

Spinal Cord Injury
pathophysiology

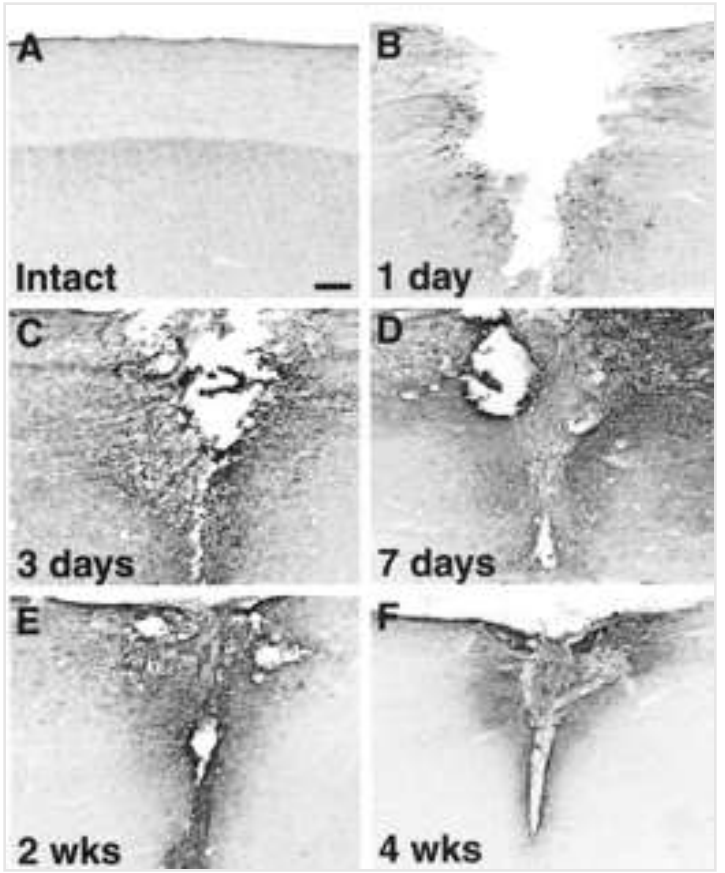
Primary injury

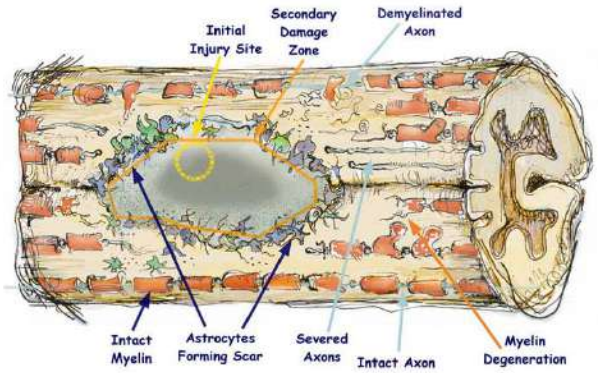
- **Initial insult to cord**
- **Local deformation**
- **Energy transformation**

Spinal Cord Injury
pathophysiology

Secondary injury

- **Biochemical cascade**
- **Cellular processes**





Injury-Hypoperfusion/ischemia

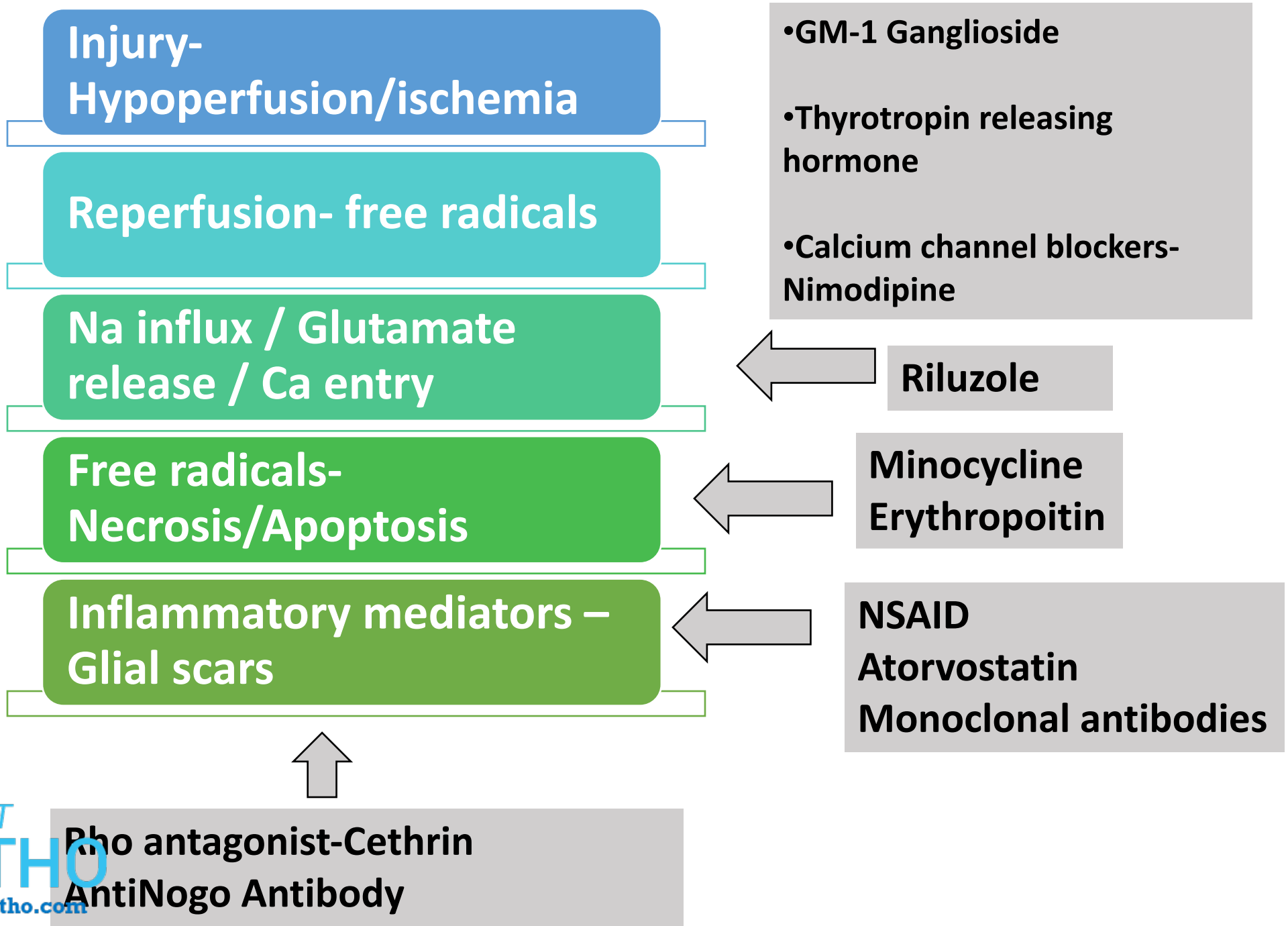
Reperfusion- free radicals

Na influx / Glutamate release / Ca entry

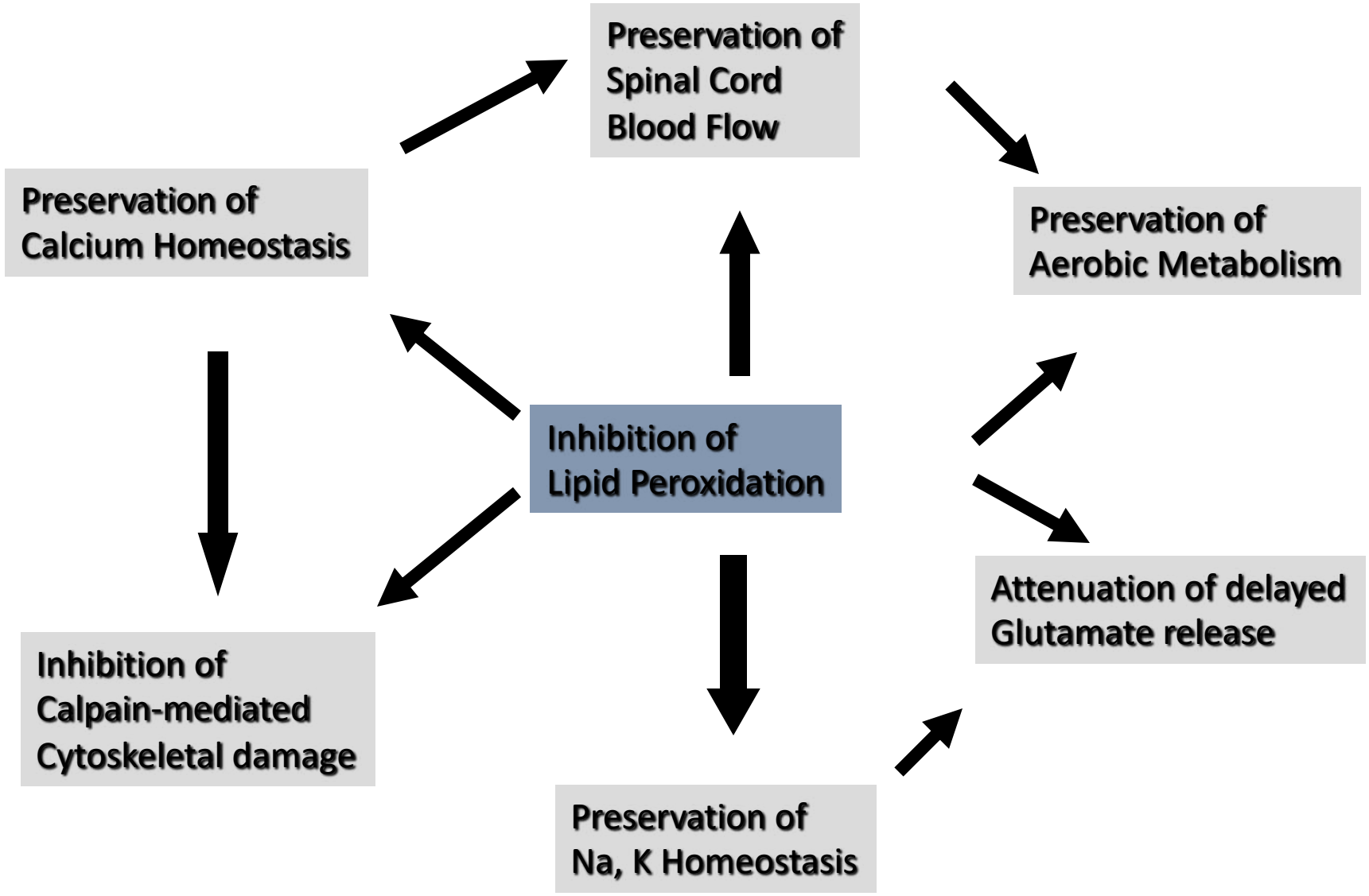
Free radicals- Necrosis/Apoptosis

Inflammatory mediators – Glial scars

Most acute therapies aim to limit secondary injury cascade



Steroids



National acute spinal cord injury study NASCIS 1 (1984)

- 330 pts of SCI
- 2 groups- Low dose group/ High dose group.
- No difference between 2 groups
- Complications- Wound infection/ Fatality in high dose group.

NASCIS 2

- Placebo group

- 10 hospitals, 487 patients

- Compared:

1. MPSS (30 mg/kg bolus + 5.4 mg/kg x 23°)
2. Naloxone (5.4 mg/kg bolus + 4.5mg/kg x 23°)
3. Placebo

Criticism of NASCIS III

- **Primary outcomes negative**

(no diff in treatment among groups)

- **All positive findings in post hoc analyses**

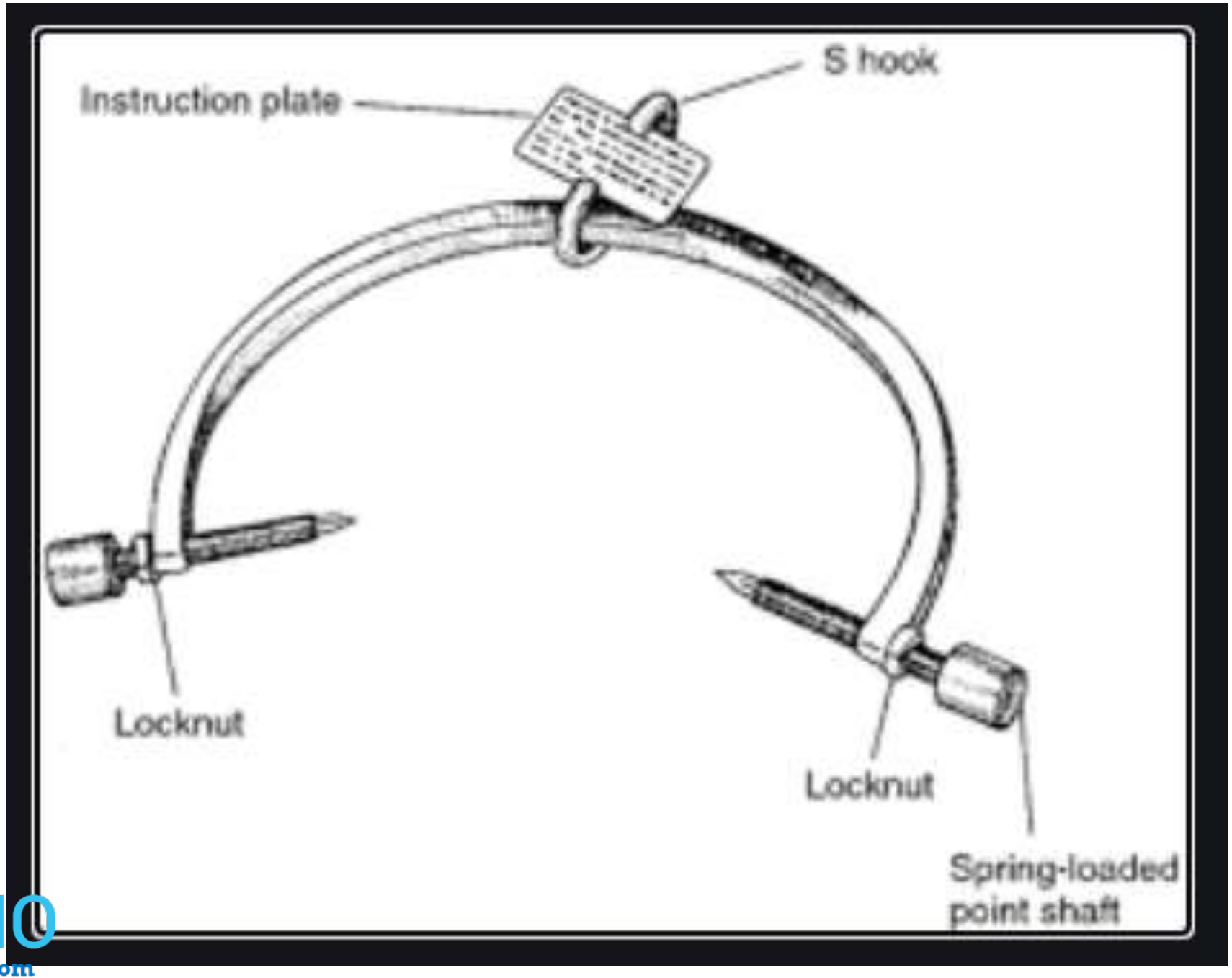
(when arbitrarily divided into <3hr/ >3 hr)

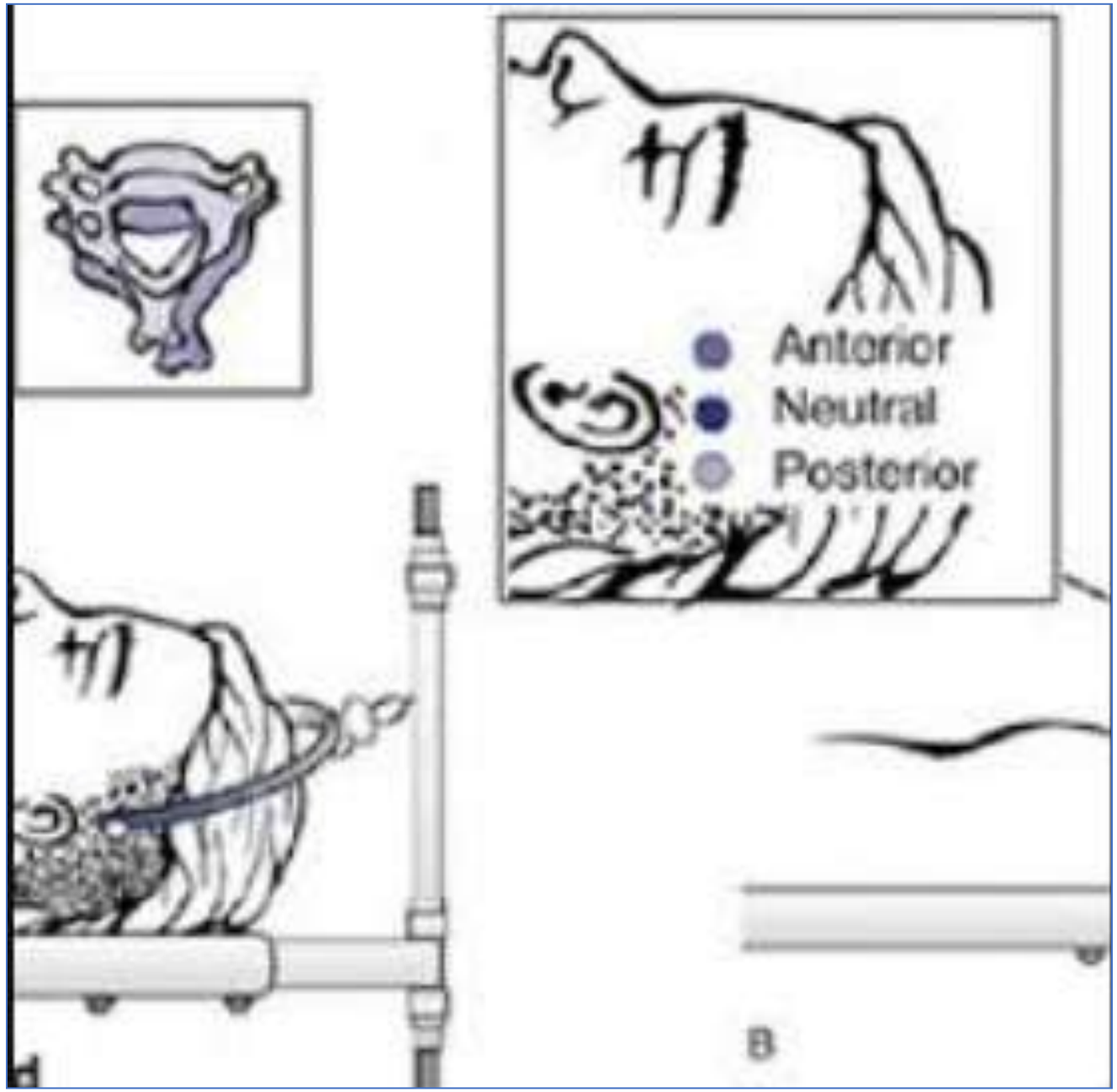
Methylprednisolone

- Routine use currently not uniformly accepted
- Several professional associations have issued position statements that MPSS should not be considered “standard of care”
- Concerns- Acute corticosteroid myopathy.
  Pneumonia
  SSI

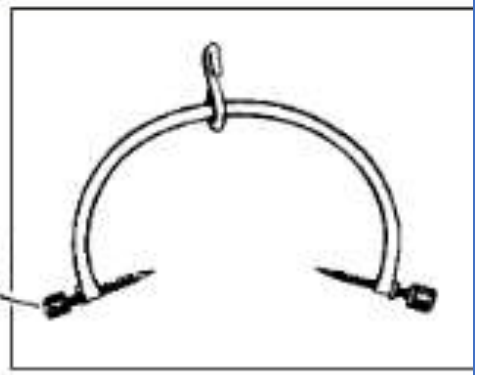
- **Fehlings** -*MP administration remains justified for acute SCI (within 8 hours) in nondiabetic and nonimmunocompromised patients given the severity of SCI deficits and current lack of alternatives.*

The 24-hour infusion of MP within 8 hours of acute SCI is not a standard treatment but rather a treatment option ***(very weak level II and III evidence)***

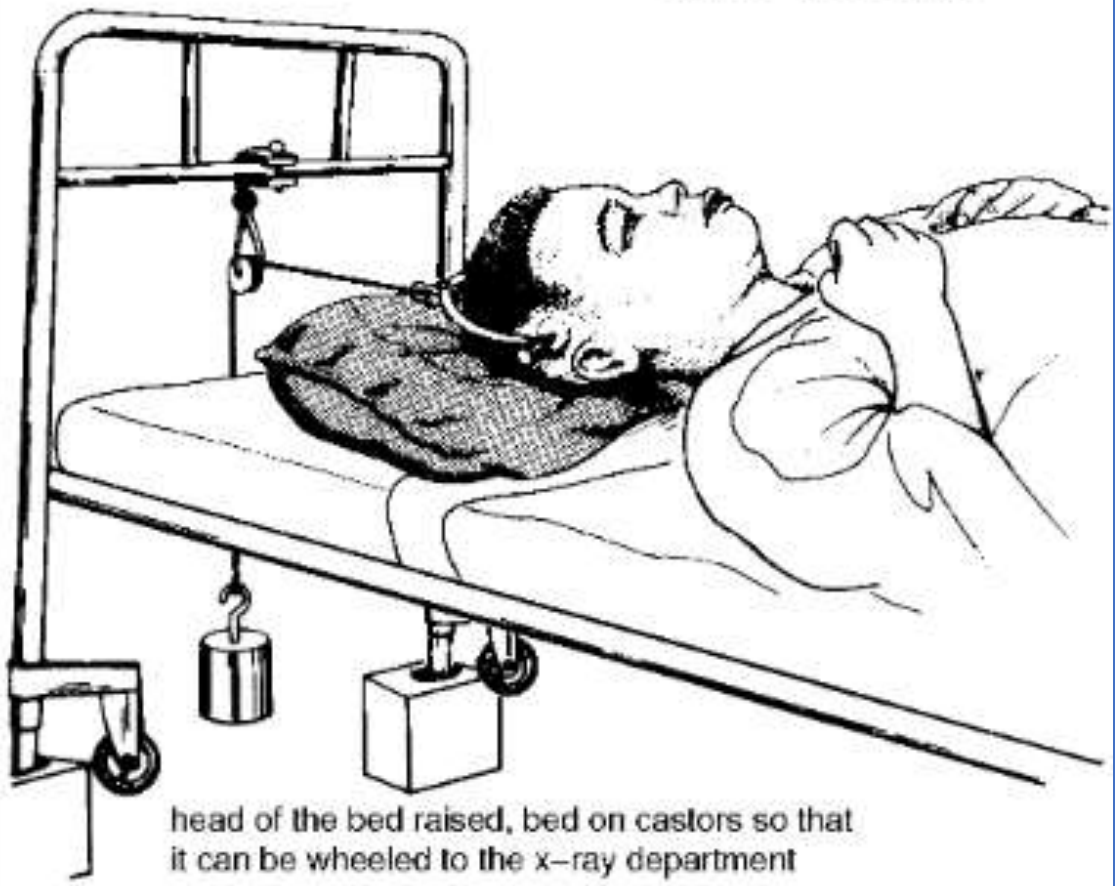




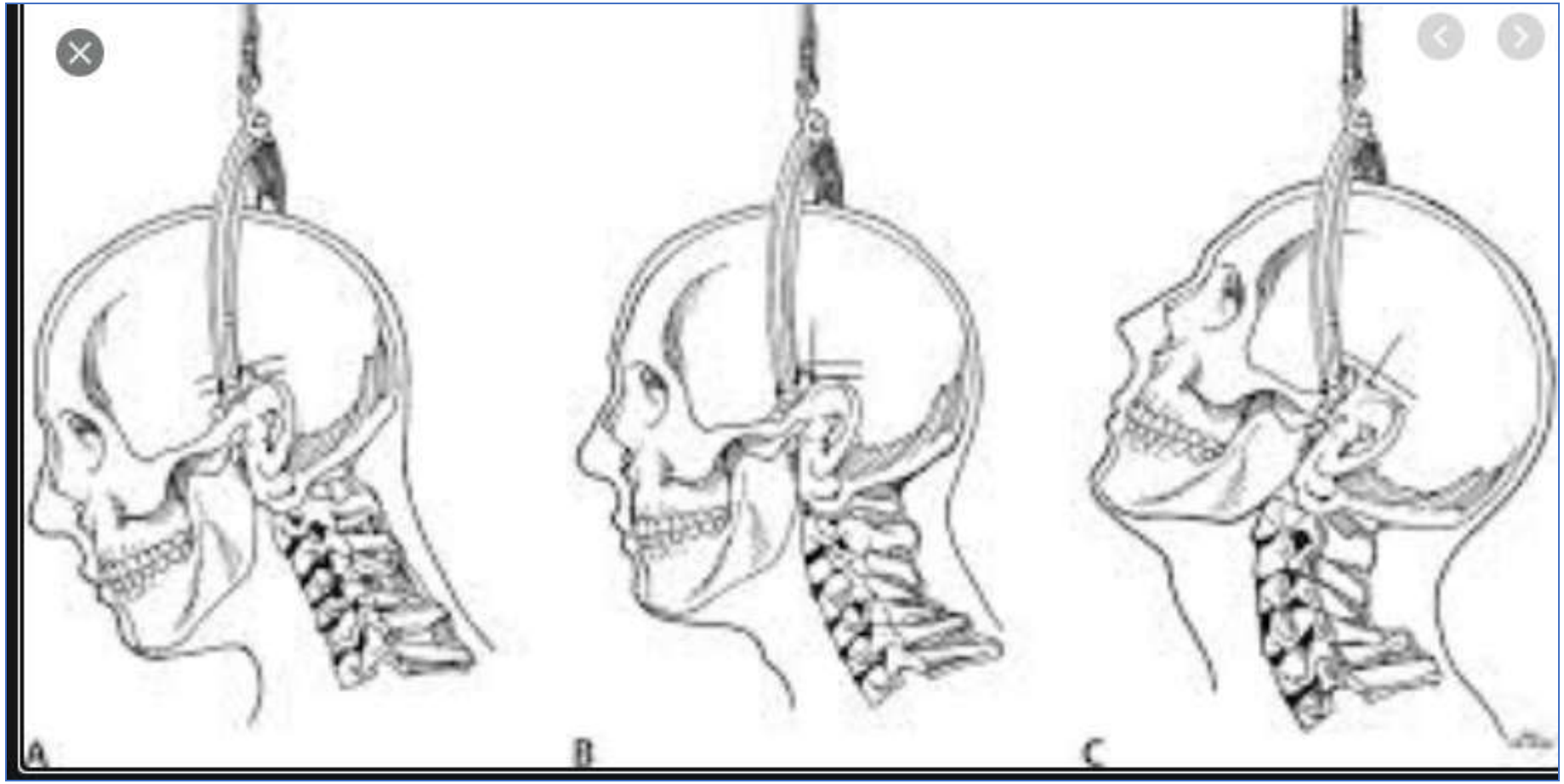
CERVICAL TRACTION WITH GARDNER WELLS TONGS



Gardner–Wells Tongs



head of the bed raised, bed on castors so that it can be wheeled to the x–ray department



Thank you