Clearing the Cervical Spine in the Emergency Department

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Conscious patient

- Aim: to detect serious injury
- Immobilised at scene
  - *Cervical collar*
- Clinical Assessment
  - *Neurological assessment*
  - *Physical assessment*
  - *NEXUS criteria & Canadian C-spine Rule*
- Radiology

Neurological Assessment

- Sensation
- Motor function
- Reflexes
- Rectal examination/perianal sensation

If abnormality present, do not clinically assess. Imaging required

Physical Assessment

Inspection & palpation from occiput to coccyx

- *Pain with movement*
- *Tenderness*
- *Gap or step*
- *Oedema and bruising*
- *Spasm of associated muscles*

NEXUS Group

Hoffman et al, NEJM, 2000
Panacek et al, Ann Emerg Med, 2001
Hendey et al, J Trauma, 2002

National X Radiography Utilisation Study

Purpose of study

- To whether a simple algorithm could determine need for plain cervical XR

Outcome of NEXUS Group

- 21 centers participated in the National X Radiography Utilisation Study
- 34,069 blunt trauma patients enrolled
- Radiographic studies included plain x-ray, CT, MRI
- Standard three XRs were obtained on all patients supplemented by other views and CT/MRI

Results of NEXUS Group

- Incidence of cervical spine injury > 2.4%
- 818 patients had one or more cervical spine injuries
- 570 (69.6%) of these had complete and adequate set of radiographs

Clinical Assessment: NEXUS criteria

- Midline cervical tenderness on palpation?
- Focal neurologic deficit?
- Evidence of intoxication?
- Painful distracting injury?
- Altered mental status?

If no to all, imaging not required

If yes to any, imaging required

Painful distracting injury

- NEXUS definition *(Panacek et al, Ann Emerg Med, 2001)*
  - *Any condition thought by the clinician to be causing enough pain to distract from neck injury eg. long bone #, large laceration, degloving, crush injury, burns etc*
  - *Non-specific definition*
- More recent view *(Heffernan et al, J Trauma, 2005)*
  - *NEXUS definition may be narrowed to upper torso injuries*

Canadian C-Spine Rule

Stiell et al, JAMA, 2001
Stiell et al, NEJM, 2004

- High risk factors which mandate radiography?
  - *Age ≥ 65 years?*
  - *Dangerous mechanism?*
    - Fall > 1 metre
    - Axial load eg diving
    - High speed MCA, rollover, ejection
    - Motorised recreational vehicles
    - Bicycle collision

Spinal Clearance Protocol: Aims

- To detect injury to the spine
  - Gross injury
  - Occult injury
- To prevent extension of injury to para/quadriplegia
- To prevent complications of immobilisation
- Most protocols don't exclude possibility of long term disability

Canadian C-Spine Rule

- Low risk factor allowing for safe assessment of range of motion?
  - *Simple rear end MCA?*
  - *Sitting upright in ED or ambulatory?*
  - *Delayed onset of neck pain?*
  - *No midline tenderness?*
- Then assess ability to rotate neck 45° to left & right

Alfred Hospital Protocol

Conscious patients

- NEXUS criteria
- Movement assessment component of Canadian C-spine Rule

Caution

- Degenerative cervical spine change
  - *Detected on CT*
  - *History of previous neck injury*

Conscious patient

Alert, sober, neurologically intact patient under 65 years with low risk mechanism

- *If no midline tenderness to palpation, remove collar*
- *If pt able to rotate head 45° to left & right, clear cervical spine – no radiology required*
- *Otherwise, imaging required*

Radiology

- Plain XR
- CT
- MRI

Plain X-rays – skeletal fractures, cervical alignment

12-16% fractures missed on plain film[1,2]

1. Widder et al, J Trauma, 2004
2. Ajani et al, Anaesth Intensive Care, 1998

CT-
skeletal fractures,
subluxation/dislocation injuries
disc spaces, alignment

No view of ligaments and cord

MRI-
ligamentous, disc and cord injuries

Poor view of fractures

Conscious patient

- Failed NEXUS or C-Spine Criteria, then

  → CT
- If CT NAD & symptoms resolved, clear spine
- If CT NAD & significant ongoing symptoms incl midline tenderness or neurologic deficit

  → MRI
- If MRI NAD, clear spine

Case Studies:

Conscious patient
No acute injury on CT
Continuing neck pain
MRI

Cervical Injury

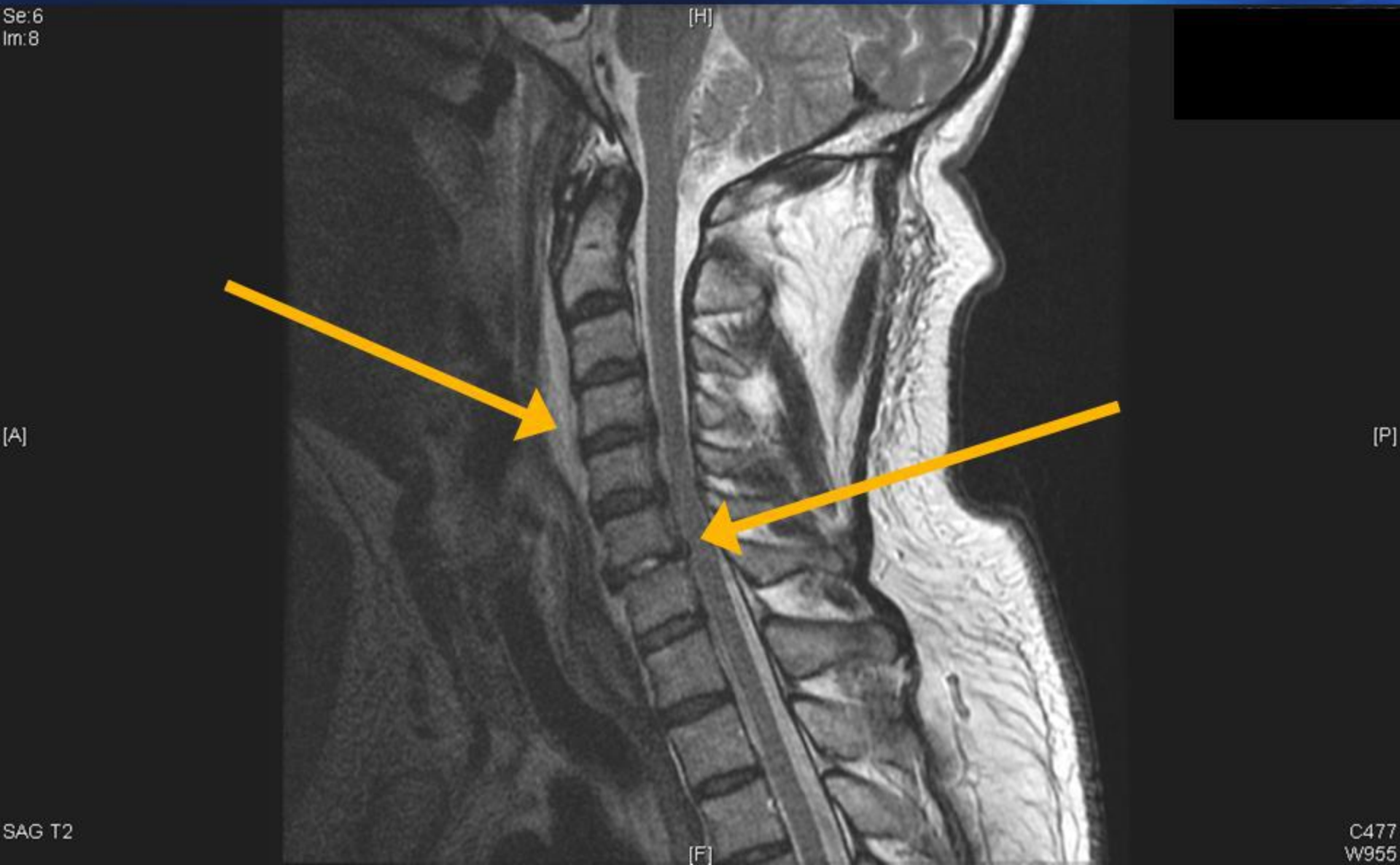
Trauma patients are suspected of having spinal injury until proven otherwise

Most spinal trauma results from 4 main mechanisms:

- Hyperflexion
- Hyperextension
- Axial loading (vertical compression)
- Lateral rotation

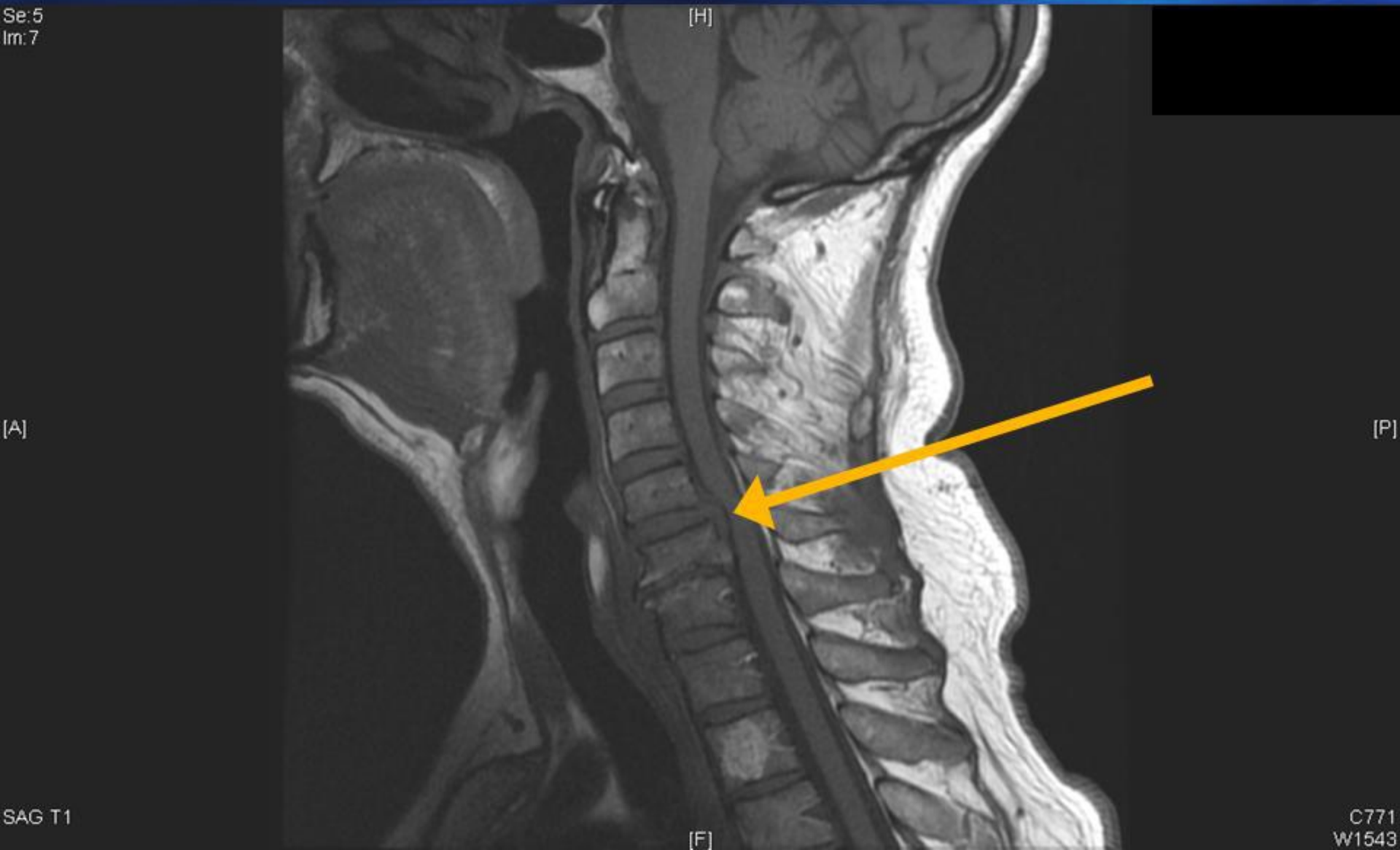
Pt 1: 54 year old male, truck vs tree, GCS 15, CT brain NAD, C spine degenerative changes only

Prevertebral haematoma C2-5, C5-6 disc protrusion with severe canal stenosis. Treatment: collar 4/52



Pt 2: 67 year old male, pt vs forklift, GCS 15, CT brain NAD, C spine non-acute loss of C6-7 disc height

C5-6 disc extrusion, with partial tear of ALL & high signal in PLL. Treatment: ACDF



- If the pt undergoes MRI, how do we interpret the results?
- Clinical significance of stable, single column injury?

Unconscious patient

- Aim: to detect unstable injury & prevent progression of potential injury to permanent neurologic deficit

- Neurological assessment not possible
- Clinical assessment not possible – patient unable to complain of neck pain

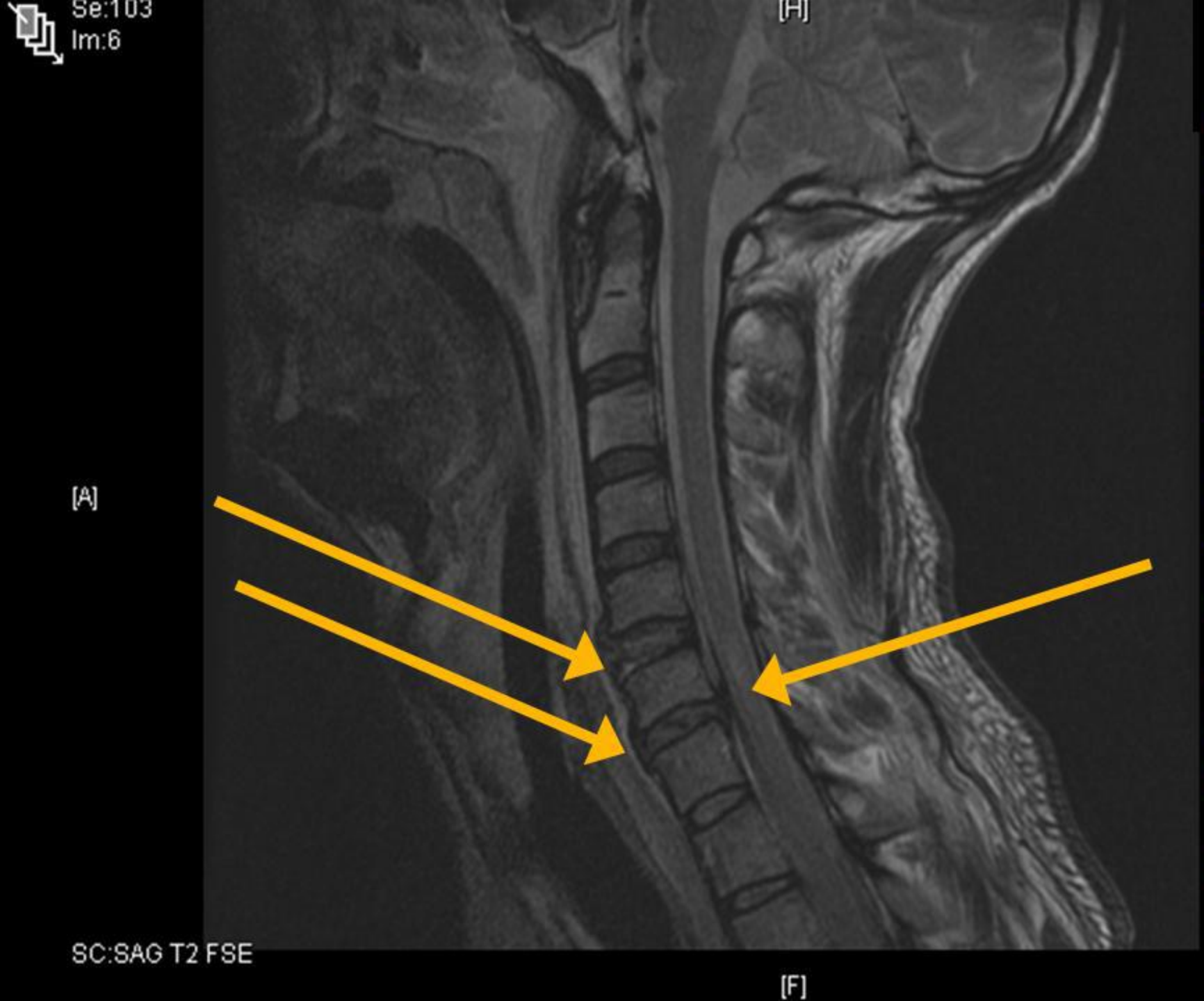
Unconscious patient

- Priority: imaging required
- If CT NAD, clear spine
- If abnormality on CT, MRI may be required to assess non-vertebral structures

Case Study:

Unconscious pt
Occult disc/ligamentous injury

- Motorcyclist vs stationary vehicle at 100kph
- GCS 3 at scene
- Fixed, dilated R) pupil
- CT no # (regional centre)
- Strong suspicion of hyperextension injury → MRI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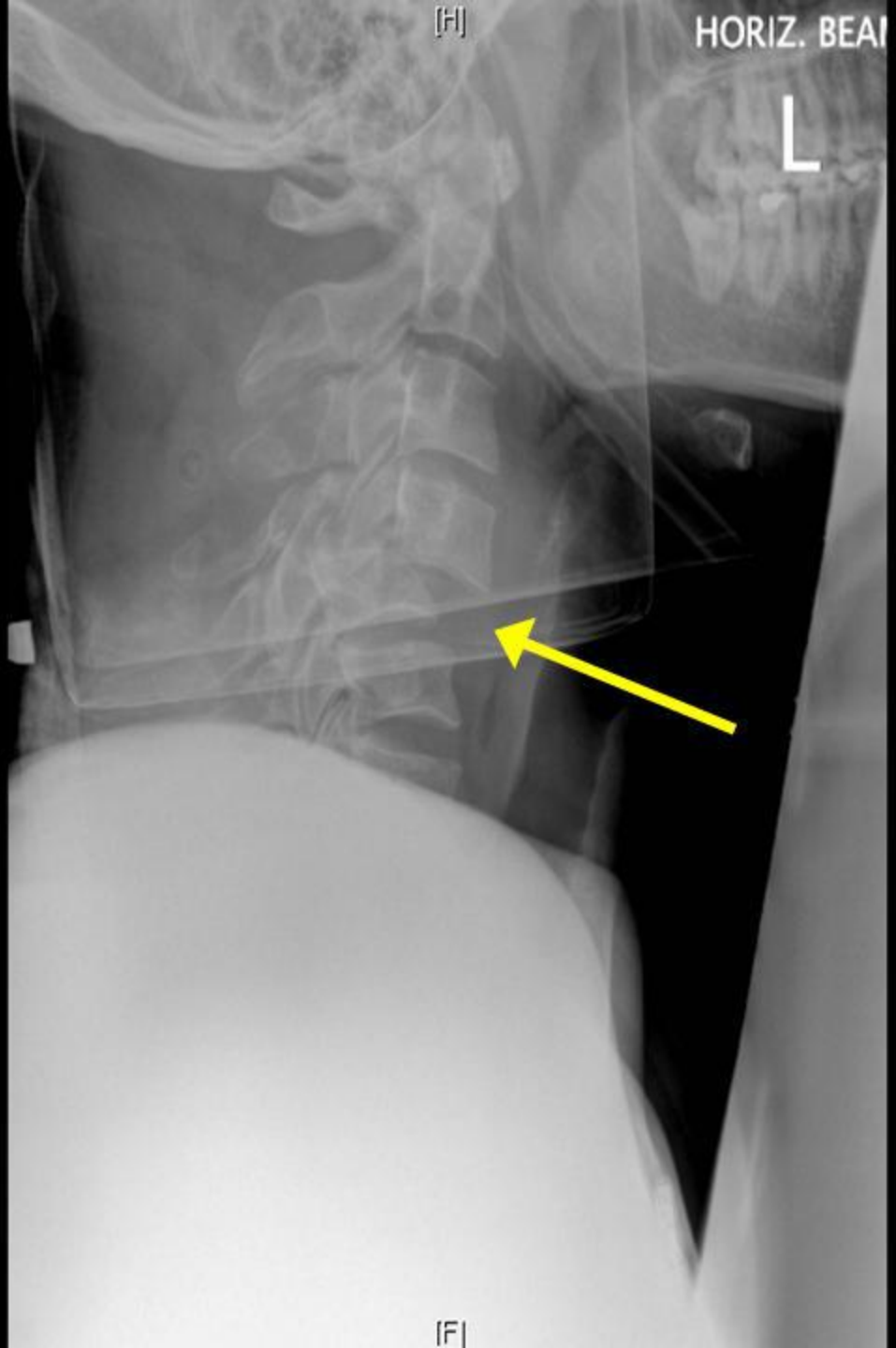
Hyperflexion

Case Study:

Cord Injury



27 year old male

[R]

MBA vs car

(car failed to give way from side street)

C4/5 fracture dislocation [L]

Grossly unstable

Cervical Lateral

C1-C5 fractures

ALL, PLL
C2-T1 cord
haemorrhage &
compression

Value of MRI: Questions

- No consensus on approach
- Should unconscious trauma patients have routine cervical MRI?
  (Ackland et al, Spine, 2007)
- Should conscious neck pain patients have MRI following normal CT?
- Should abnormal neurology be the only indication for cervical MRI in conscious patients with normal CT?
  (Labattaglia, Cameron et al, Emerg Med Aust 2007)

MRI vs long term outcomes

Very few studies comparing acute cervical MRI with long term outcomes

- Kaale et al *(J Neurotrauma, 2005)* compared functional outcome with late MRI (2-9 years post injury), inconclusive
- Davis et al *(Radiology, 1991)*, 14 pts, late MRI, found multi-level disc injury
- Borchgrevinck et al *(Injury, 1997)*, 40 pts, MRI within 48 hrs, no injuries
- Further research required

Alfred Hospital/Monash University Study

(Ackland, Cameron, Cooper et al)

- Commenced in December, 2006
- 250 patients
- Funded by TAC
- Emergency trauma patients with neck pain
- No cervical fracture on CT
- MRI within 72 hours of injury
- Follow-up at time points to 12 months post injury

Thank you

Hyperextension

Axial loading

Lateral rotation

Unstable cervical spine injury: Definition

3 spinal columns

(Denis, Clin Orthop Relat Res, 1983)

Anterior

ALL, anterior annulus fibrosis and anterior vertebral body

Middle

Posterior vertebral body, posterior annulus fibrosis & PLL

Posterior

All structures from ligamentum flavum to posterior bony and ligamentous complexes

2 or more columns affected = INSTABILITY