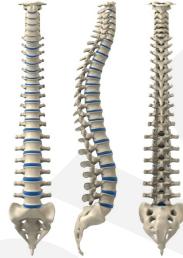


## Cervical Spine Injuries, Classification and Management



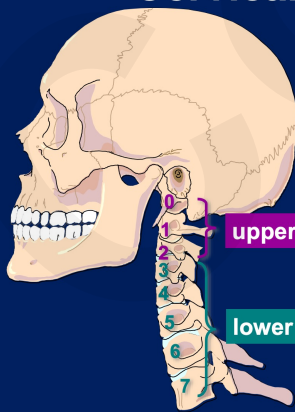
Mr M J H McCarthy  
Consultant Spinal Surgeon



## Aims / Objectives

- Aka Cervical Spine Fractures
- Classification Systems
- Stability
- Conservative Management
- Operative Management
- Upper Cervical Injuries
- Lower Cervical Injuries
- VA injury
- Ank Spond / DISH

## Cervical Fractures



- 'atypical' vertebrae
- distinct injury patterns
- 'typical' vertebrae
- complex injury patterns
- classified together

upper cervical spine

lower cervical spine – Sub-Axial

*Why have  
a classification ?*

Communication  
• clinicians

Treatment  
guidelines

Standardisation  
• research

Prediction  
• outcome

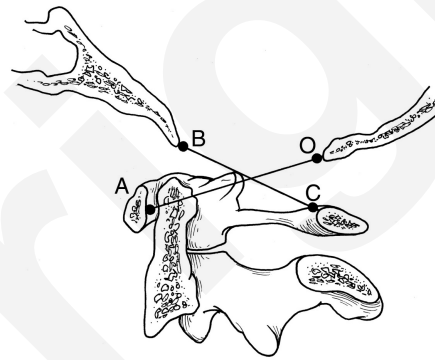
## Clinical Instability

## 3 Rules of 3

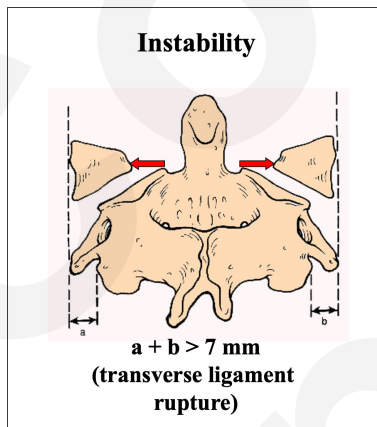
- The loss of the ability of the spine under **normal physiological loads** to maintain its pattern of displacement so that there is no initial or additional **neurological deficit**, no major **deformity** and no incapacitating **pain**
- Predentate space <3mm
- Prevertebral soft tissue at C3 < 3mm
- Anterior wedging > 3mm suggests fracture

# Upper Cervical Instability

- $>8^\circ$  axial rotation C0-1 to one side
- Powers ratio distance BC / OA  $> 1$  (occipito - cervical dislocation)
- Increased odontoid basion distance - the tip of the odontoid should be in line with basion, with the odontoid basion distance 4-5mm adults and up to 10mm in children
- $>1$ mm C0-1 translation in flexion / extension (this is a specialist investigation, not in the acute trauma setting)
- $>7$ mm overhang C1-2 (total left and right)
- $>45^\circ$  axial rotation C1-2 to one side
- Atlantodens interval  $>5$ mm (should be  $<3$ mm)



| Ratio | BC / OA Signifies                                                |
|-------|------------------------------------------------------------------|
| 1     | Normal                                                           |
| $>1$  | Anterior Dislocation (of Head)                                   |
| $<1$  | Posterior dislocation, odontoid fracture, ring of atlas fracture |



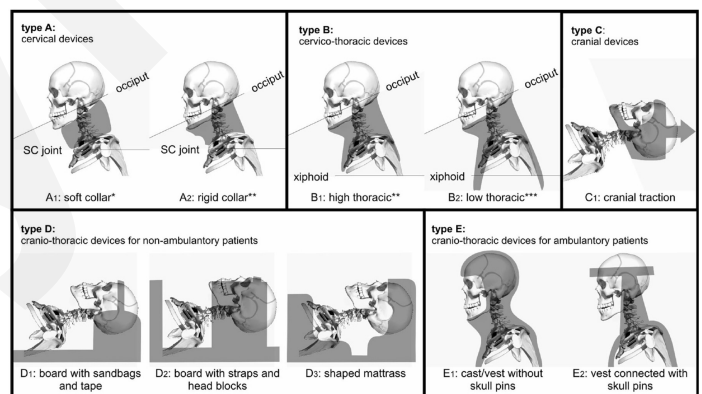
# Lower Cervical Instability

- Horizontal vertebral body translation  $>3.5$ mm or 20%
- Difference in intervertebral angulation between adjacent levels  $>11^\circ$
- Vertebral body height loss
- Disc space  $>1.7$ mm
- Facet fracture, subluxation or widening
- Flexion teardrop – small antero-inferior body fracture

# Conservative Indications

- Personalities
  - Pathology / Patient / Practitioner
- “Stable” Injuries
  - Normal physiological load
  - Neurological Deficit / Deformity / Pain

# Orthoses





## Operative Indications

- Personalities
  - Pathology / Patient / Practitioner
- “Unstable” Injuries
  - Normal physiological load
  - Neurological Deficit / Deformity / Pain



## Strong Indications Op

- Indications for decompression
  - Worsening neurological deficit in the presence of demonstrable neural compression
- Indications for stabilisation
  - All cases requiring decompression
  - Unstable fractures +/- malalignment
  - Complete ligamentous disruption associated with dislocation
- Patient with complete neurological deficit and neurological compression +/- malalignment
- +/- Multiply injured patient

## Relative Indications Op

- Decompression surgery (+ stabilisation)
  - Dynamic neurology
  - Static incomplete neurology in presence of demonstrable neural compression
- Stabilisation surgery
  - Loss of anterior body height >25%
  - Canal stenosis >50%
  - Disruption of posterior ligamentous complex

## Upper Cervical Spine Injuries

## Occipitocervical Injuries

- High energy injury
- Often multiple injuries
- Often missed (head injury)
- High mortality
- Often spinal cord injury
- Early stabilisation best

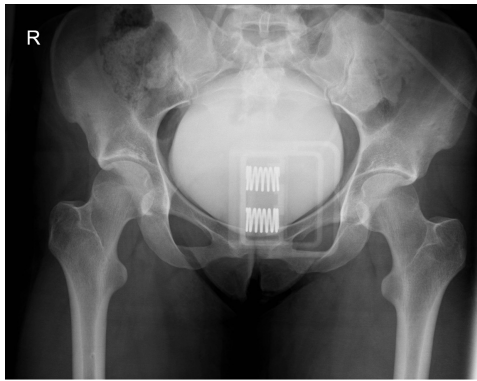


| Type | Characteristic                                              |
|------|-------------------------------------------------------------|
| I    | Anterior displacement of the occiput relative to atlas      |
| II   | Distraction of the occiput from the atlas                   |
| III  | Posterior displacement of the occiput relative to the atlas |

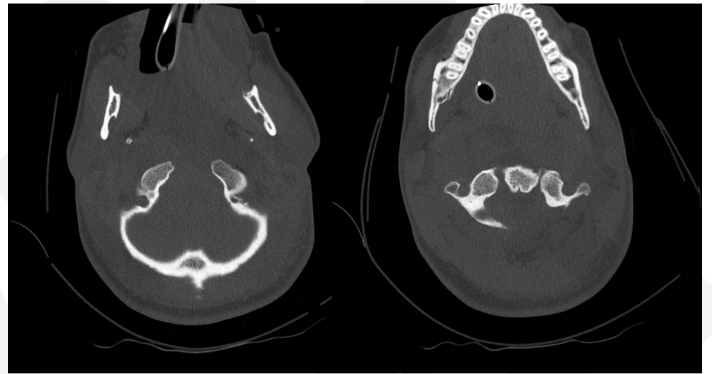
Traynelis et al. 1986

## Case 1

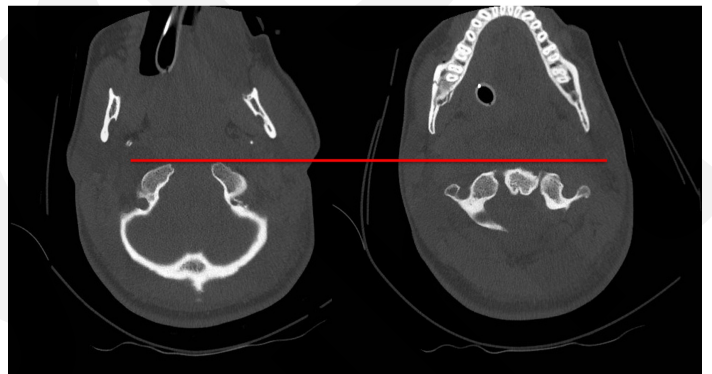
- 22 year old female
- Trauma call
- Motorcross – collided with barrier
- Significant HI noted at scene
- Arrest and CPR – intubated at scene
- Ventilated since – no resp effort
- Occ arrhythmias – vasopressor support



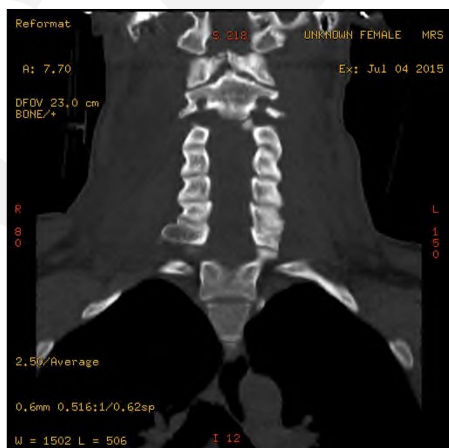
- CTH – SAH and...

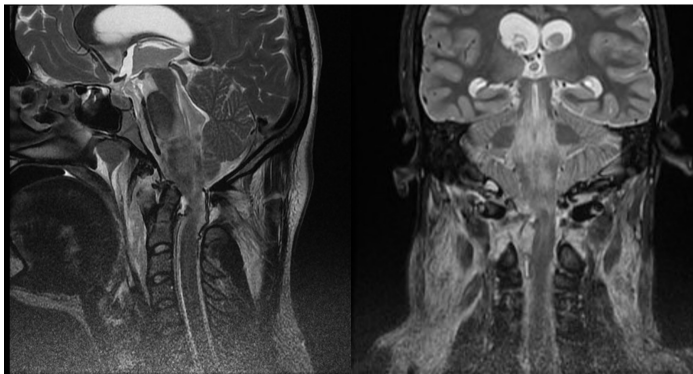


- CTH and neck - axials only – SAH and..



- Pt Intubated in ED – “stable” on the drugs
- ICU bed and theatres available and waiting
- Neurosurgical Reg – needs ICP monitoring
- Ortho Reg – needs a nail
- What next?...





## Learning Points – Case 1

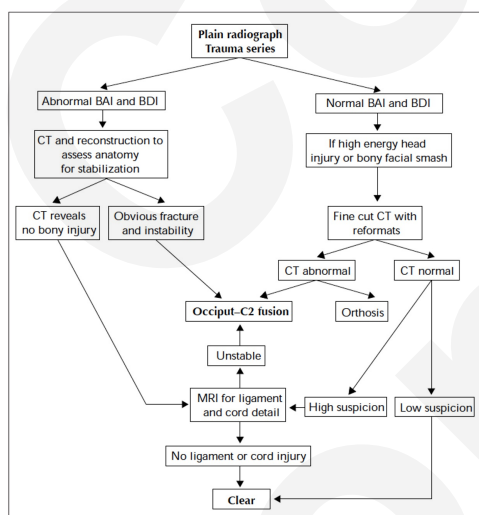
- Ensure review of reformatted images
- Identify
  - Mechanism – high energy distraction with flex / ext
  - Clinical findings
  - Imaging
- Reduce / relocate
- Assess likelihood recovery
- Stabilize
- Rehabilitate

## OC Dislocation

- Early autopsy studies
  - Found in 6-8% of trauma fatalities
- Currently
  - 8-35% MVC fatalities
  - 10% fatal cervical spine injuries
- Death
  - Acute neurogenic shock + neuro respiratory dysfunction
  - Pontomedullary brainstem and mid-brain laceration
- Mainly a ligamentous injury
  - anterior / posterior / vertical types – highly unstable

## OC Dislocation

- >100 reported survivors in literature
- Only 20% neurologically normal
- Only ¼ evidence closed head injury
- Diagnosis often delayed or missed
  - approx 1/3 neurologically deteriorate

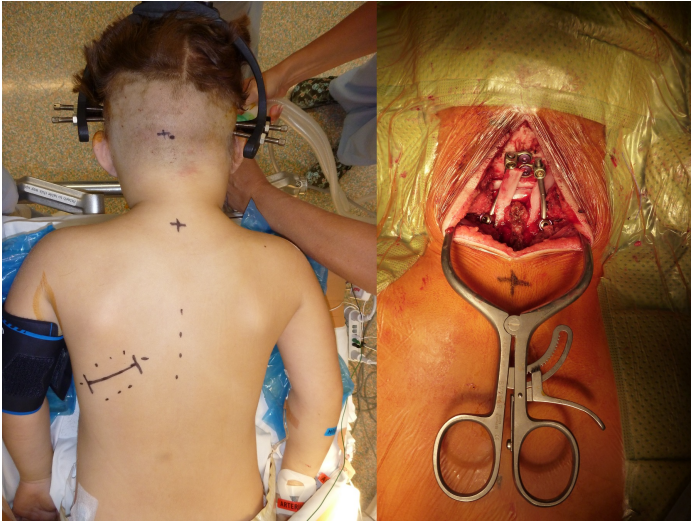


- Doesn't take into account MRI for assessing survivability of injury

## Example of Survival



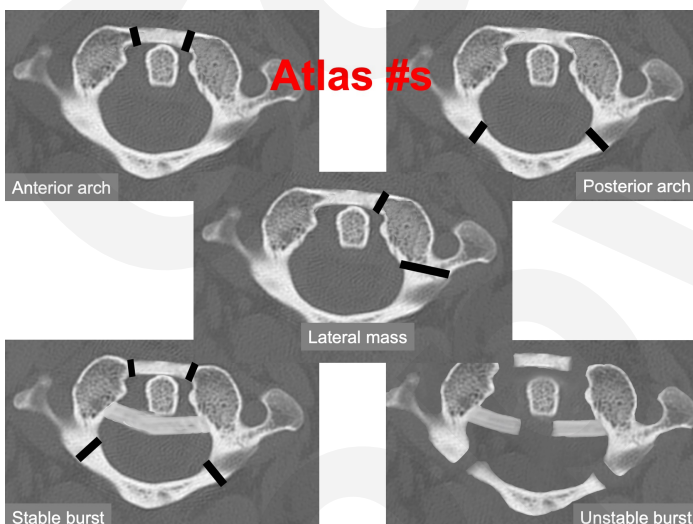




## Occipital Condyle #s

- Tuli:
  - 1 Nondisplaced – stable
  - 2a Displaced – stable (2mm)
  - 2b Displaced – unstable – evidence instability
- Comminution / bilateral fractures / ligament injury = unstable
- Risk OC dissociation / cranium may settle on to the axis
- Stable fractures collar
- Minimal displacement halo-vest
- Displaced fractures C0-C2 fusion

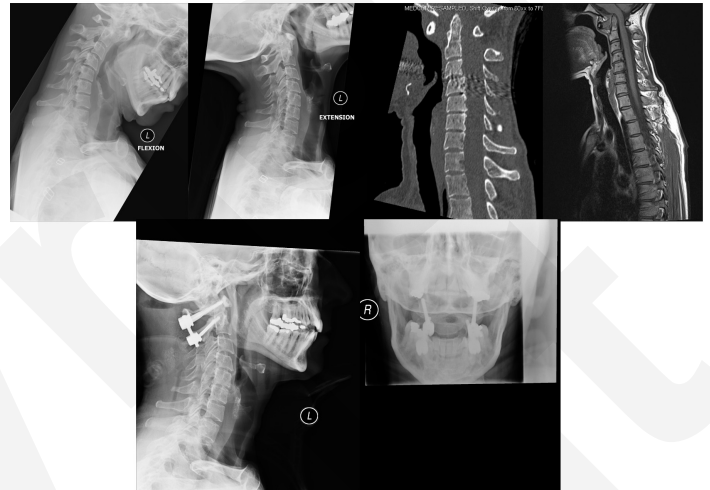
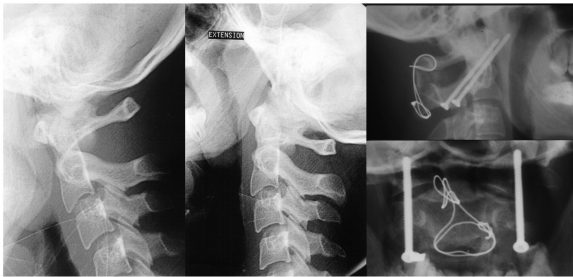
Tuli S, Tator CH, Fehlings MG, Mackay M. Occipital condyle fractures. *Neurosurgery* 1997; 41: 368–377



## Management of Atlas #s

| Fracture type           | Displacement | Transverse Ligament          | Management                            |
|-------------------------|--------------|------------------------------|---------------------------------------|
| Anterior/posterior arch | No           | Intact                       | Collar                                |
| Lateral mass            | No<br>Yes    | Intact<br>Intact<br>Ruptured | Collar / Halo<br>Halo<br>C0-C2 fusion |
| Comminuted              | No<br>Yes    | Intact<br>Ruptured           | Collar / Halo<br>C1/C2 fusion         |

## Atlantoaxial Instability



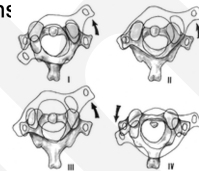
## Atlantoaxial Instability

- Trauma / Infection / Tumour
- Paediatric
  - Juvenile RA, OI, Morquio's, Congenital scoliosis
- Adult
  - RA, Downs, Infection, Os Odontoidem



## Atlantoaxial Rotatory Instability

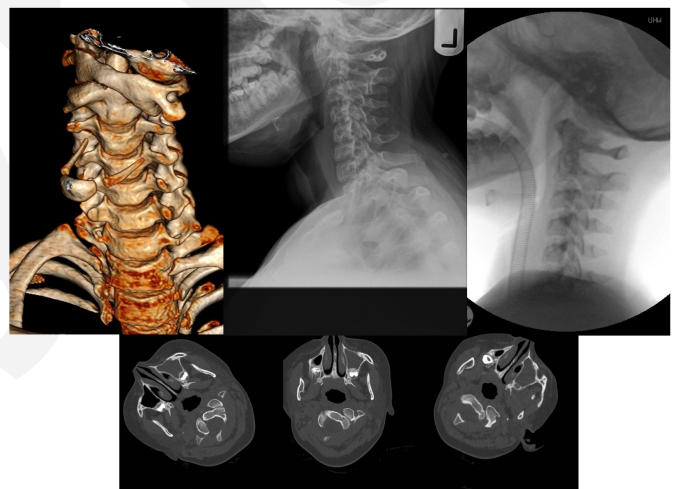
- Type 1 - rotatory subluxation around the dens with intact transverse ligament
- Type 2 - associated with transverse ligament injury with ADI from 3-5 mm
- Type 3 - similar to Type II with greater than 5 mm ADI
- Type 4 - rare posterior dislocation where the atlantal arch is posterior to the dens
- Mostly Children
- Remodelling



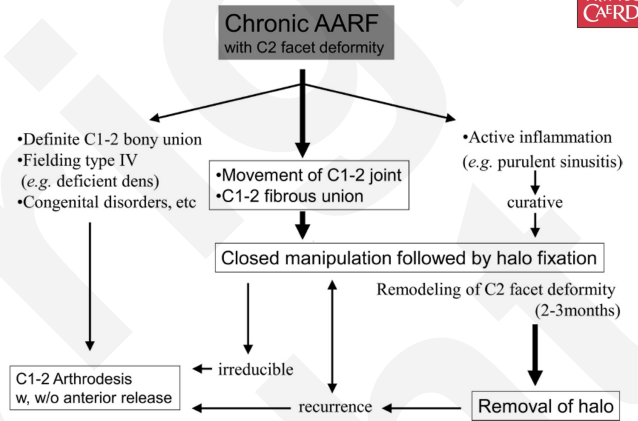
Fielding, Hawkins RJ. Atlanto-axial rotatory fixation. (Fixed rotatory subluxation of the atlanto-axial joint). *Journal of Bone & Joint Surgery - American Volume*. 1977; 59:37-44

## Management of AARI

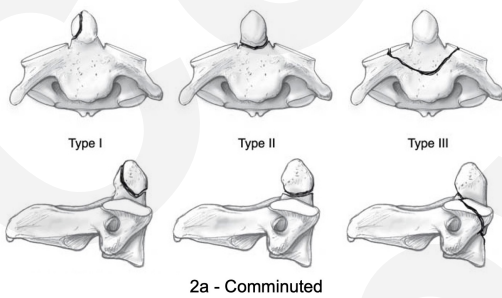
| Type  | Displacement | Transverse Ligament | Management                             |
|-------|--------------|---------------------|----------------------------------------|
| 1     | No           | Intact              | Traction and / or collar / Halo        |
| 2 / 3 | Yes          | Ruptured            | Halo-vest 12/52, may need C0-C2 fusion |
| 4     | Yes          | Ruptured            | C1/C2 fusion                           |







## Odontoid Peg #s



Anderson, D'Alonzo RT. Fractures of the odontoid process of the axis. *Journal of Bone & Joint Surgery - American Volume*. 1974; 56: 1663-1674

## Odontoid Fractures

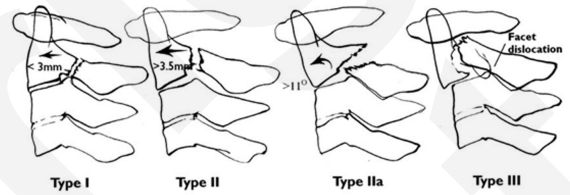
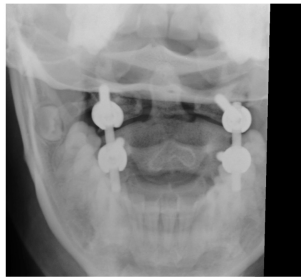
- Majority treated non-operatively
  - Type III
  - Undisplaced Type II
  - Elderly without instability
- Indications for surgery
  - Displaced / Comminuted Type II
  - Ass #s – unstable C1 fracture
  - Multiple injuries
  - Delayed / non-union

## Management Peg #s

| Type | Displacement                          | Stable?              | Management                                                                                                     |
|------|---------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------|
| 1    | No<br>Yes                             | Yes<br>No            | Collar<br>C0-C2 fusion                                                                                         |
| 2    | <5mm<br>>5mm<br>Elderly<br>Paediatric | No<br>No<br>No<br>No | Collar / Halo / Fixation / C1/2<br>Halo / Fixation / C1/2<br>Collar / Halo / Fixation / C1/2<br>Halo / Minerva |
| 3    | No<br>Yes                             | No<br>No             | Collar / Halo<br>Halo / Fixation / C1/2 (+/-3)                                                                 |



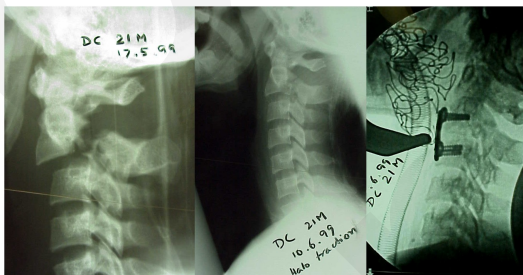
## Hangman's #s



Effendi, Roy D, Cornish B, Dussault RG, Laurin CA. Fractures of the ring of the axis. A classification based on the analysis of 131 cases. *Journal of Bone and Joint Surgery, British Volume* 1981; 63-B:319-327

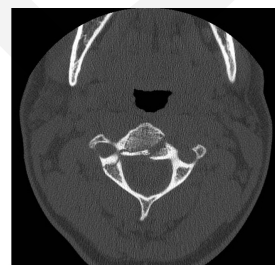
## Hangman's #s

- Indications Surgery:
  - Irreducible
  - Type II/III
  - Multiple injuries
  - Delayed/non-union

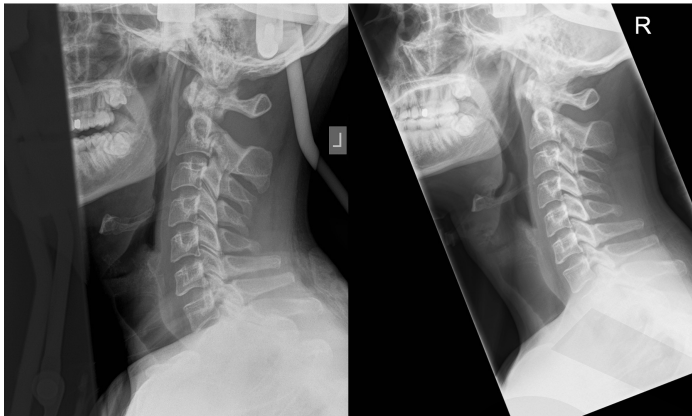


## Management Hangman's #s

| Type | Stable? | Disc / Facet Intact? | Management                           |
|------|---------|----------------------|--------------------------------------|
| 1    | Yes     | Intact               | Collar or halo vest                  |
| 2    | No      | ? Disc Injured       | Halo or Fusion C2/3 or Direct repair |
| 2a   | No      | Disc Injured         | As above – avoid traction            |
| 3    | No      | Both injured         | C2/3 fusion                          |



## C2 Variant Hangman



## C1 GSW

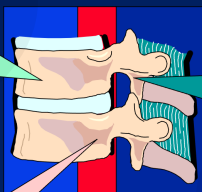


## Lower Cervical Spine Injuries

### The column theory THREE COLUMNS

**ANTERIOR COLUMN**

- anterior longitudinal ligament
- anterior half of vertebral body
- anterior part of annulus fibrosis



**POSTERIOR COLUMN**

- neural arch
- ligamentum flavum
- facet joint capsules
- interspinous ligament

**MIDDLE COLUMN**

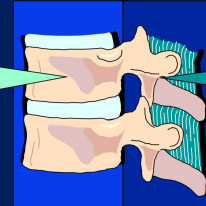
- posterior longitudinal ligament
- posterior half of vertebral body
- posterior part of annulus fibrosis

- Denis 1983
- conceptual rather than anatomical
- based on biomechanical studies

### The column theory TWO COLUMNS

**ANTERIOR COLUMN**

- solid column of vertebral bodies
- compression-resistant

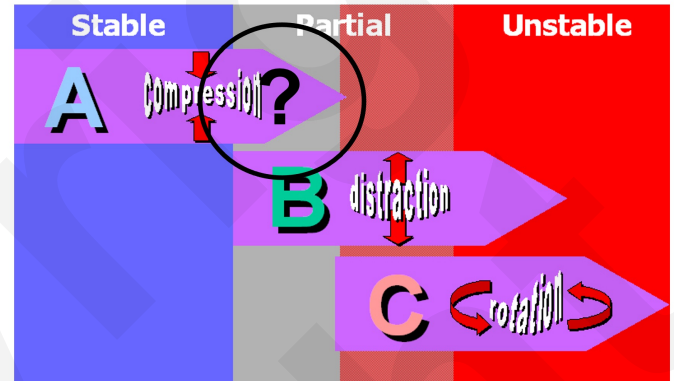
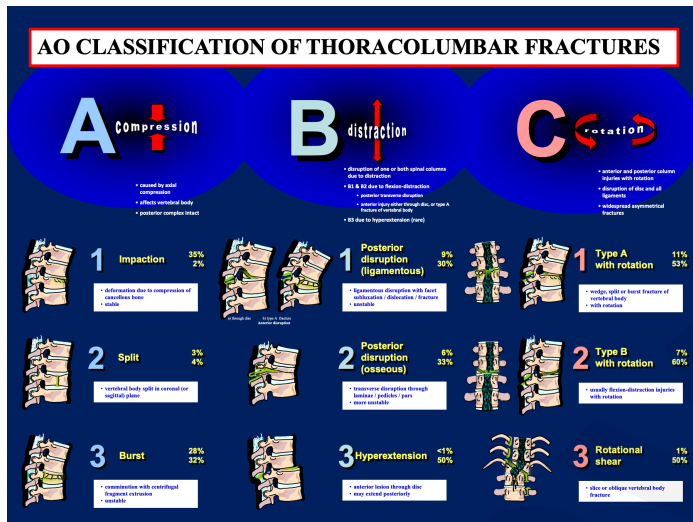


**POSTERIOR COLUMN**

- hollow column of neural canal
- tension-resistant

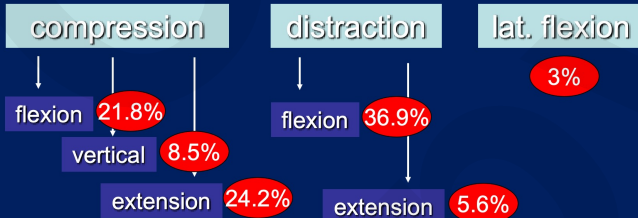
- AO Magerl 1993
- anatomically based concept



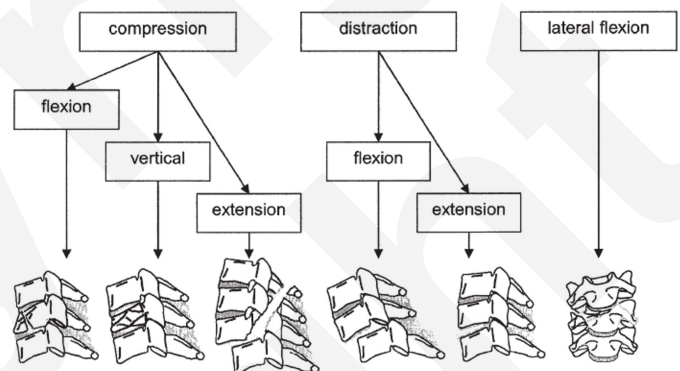


## Allen and Ferguson

- Injuries divided into families or phylogenies
- Named according to:
  - Initial dominant force vector
  - Position of head at time of failure



## Allen and Ferguson



## Allen and Ferguson

- #### Allen Classification
- Compressive flexion (shear mechanism resulting in "teardrop" fractures)
    - Stage I: Blunting of anterior body; posterior element intact.
    - Stage II: "Beaking" of the anterior body; loss of anterior vertebral height.
    - Stage III: Fracture line passing from anterior body through the inferior subchondral plate.
    - Stage IV: Inferoposterior margin displaced <3mm into the spinal canal.
    - Stage V: Teardrop fracture: inferoposterior margin >3mm into the spinal canal; posterior ligaments and the posterior longitudinal ligament have failed.
  - Vertical compression (burst fractures)
    - Stage I: Fracture through superior or inferior endplate with no displacement.
    - Stage II: Fracture through both endplates with minimal displacement.
    - Stage III: Burst fracture: displacement of fragments peripherally and into the neural canal.
  - Distraction flexion (dislocations)
    - Stage I: Failure of the posterior ligaments, divergence of spinous processes, and facet subluxation.
    - Stage II: Unilateral facet dislocation; displacement is always <50%.
    - Stage III: Bilateral facet dislocation; displacement >50%.
    - Stage IV: Bilateral facet dislocation with 100% translation.
  - Compressive extension
    - Stage I: Unilateral vertebral arch fracture.
    - Stage II: Bilaminar fracture without other tissue failure.
    - Stage III: Bilateral vertebral arch fracture with fracture of the articular processes, pedicles, and lamina without vertebral body displacement.
    - Stage IV: Bilateral vertebral arch fracture with full vertebral body displacement anteriorly; ligamentous failure at the posterolateral and anteroinferior margins.
  - Distraction extension
    - Stage I: Failure of anterior ligamentous complex or transverse fracture of the body; widening of the disc space and no posterior displacement.
    - Stage II: Failure of posterior ligament complex with displacement of the vertebral body into the canal.
  - Lateral flexion
    - Stage I: Asymmetric unilateral compression fracture of the vertebral body plus a vertebral arch fracture on the ipsilateral side without displacement.
    - Stage II: Displacement of the arch on the anteroposterior view or failure of the ligaments on the contralateral side with articular process separation.

TABLE 1: SLIC Scale

| Morphology                                                                                                       | Points |
|------------------------------------------------------------------------------------------------------------------|--------|
| No Abnormality                                                                                                   | 0      |
| Compression                                                                                                      | 1      |
| Burst                                                                                                            | +1 = 2 |
| Distraction (e.g. facet perch, hyperextension)                                                                   | 3      |
| Rotation / Translation (e.g. facet dislocation, unstable teardrop or advanced staged flexion compression injury) | 4      |
| Disco-ligamentous complex (DLC)                                                                                  |        |
| Intact                                                                                                           | 0      |
| Indeterminate (e.g. isolated interspinous widening, MRI signal change only)                                      | 1      |
| Disrupted (e.g. widening of disc space, facet perch or dislocation)                                              | 2      |
| Neurological Status                                                                                              |        |
| Intact                                                                                                           | 0      |
| Root Injury                                                                                                      | 1      |
| Complete Cord Injury                                                                                             | 2      |
| Incomplete Cord Injury                                                                                           | 3      |
| Continuous Cord Compression in setting of neuro deficit (Neuro Modifier)                                         | +1     |

≤ 3 = non op  
4 = grey  
≥ 5 = op

**Load-sharing classification** McCormack, Gaines et al (Spine 1994) **28 pts**

| COMMINUTION                                                                                                                                          | APPOSITION                                                                                                                                       | KYPHOSIS                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p><b>1. Little</b><br/>&lt; 30% comminution</p>                   |  <p><b>1. Minimal</b><br/>minimal spread</p>                    |  <p><b>1. Little</b><br/>&lt; 4° correction</p>                                     |
|  <p><b>2. More</b><br/>30-60% comminution</p>                       |  <p><b>2. Spread</b><br/>&lt; 2mm of &lt; 50%</p>               |  <p><b>2. More</b><br/>4-9° correction</p>                                          |
|  <p><b>3. Gross</b><br/>&gt; 60% comminution<br/>on sagittal CT</p> |  <p><b>3. Wide</b><br/>&gt; 2mm of &gt; 50%<br/>on axial CT</p> |  <p><b>3. Most</b><br/>&gt; 9° correction<br/>on lateral x-ray - <b>POST OP</b></p> |

score from 3 to 9

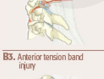
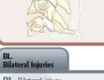
≤ 6 = posterior surgery

> 6 = anterior surgery

**Old Instrumentation Not Externally Validated**

Lying vs standing  
Prediction of correction

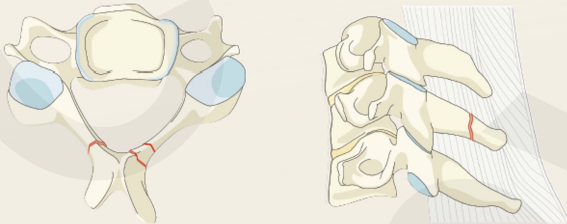
## AOSpine Subaxial Classification System

| Type A: Compression injuries                                                                                                    | Type B: Distraction injuries                                                                                                                                             | Type C: Translation injuries                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A0. Minor, nonstructural fractures</b><br> | <b>B1. Posterior tension band injury (bony)</b><br>                                   | <b>C. Translational injury in any axis</b><br>                              |
| <b>A1. Wedge-compression</b><br>              | <b>B2. Posterior tension band injury (bony capsule, ligamentous, ligamentous)</b><br> | <b>Type F: Facet injuries</b><br><b>F1. Nondisplaced facet fracture</b><br> |
| <b>A2. Split</b><br>                          | <b>B3. Anterior tension band injury</b><br>                                           | <b>F2. Facet fracture with potential for instability</b><br>                |
| <b>A3. Incomplete burst</b><br>               | <b>BL. Bilateral injury</b><br>                                                       | <b>F3. Rotating lateral mass</b><br>                                        |
| <b>A4. Complete burst</b><br>                 |                                                                                                                                                                          | <b>F4. Pathologic subluxation or perched/dislocated facet</b><br>           |

2016

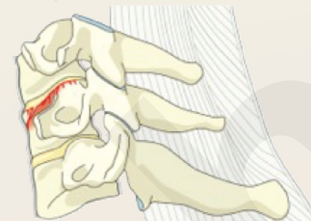
### A0. Minor, nonstructural fractures

No bony injury or minor injury such as an isolated lamina fracture or spinous process fracture.



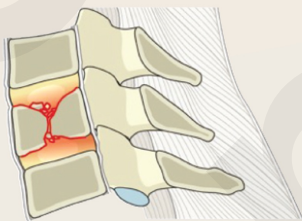
### A1. Wedge-compression

Compression fracture involving a single endplate without involvement of the posterior wall of the vertebral body.



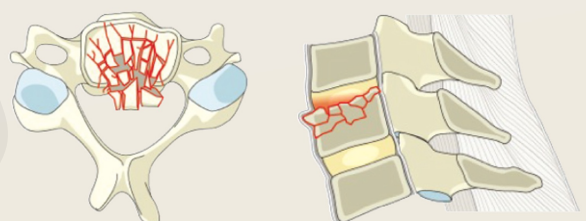
### A2. Split

Coronal split or pincer fracture involving both endplates without involvement of the posterior wall of the vertebral body.



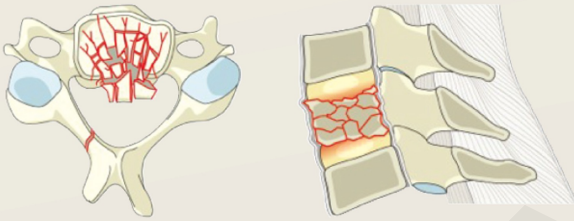
### A3. Incomplete burst

Burst fracture involving a single endplate with involvement of the posterior vertebral wall.



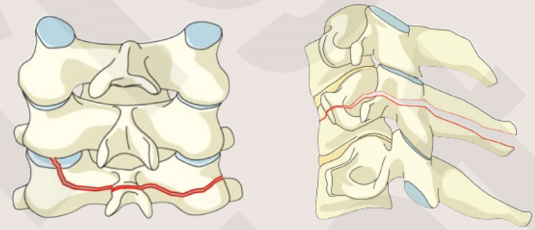
## A4. Complete burst

Burst fracture or sagittal split involving both endplates.



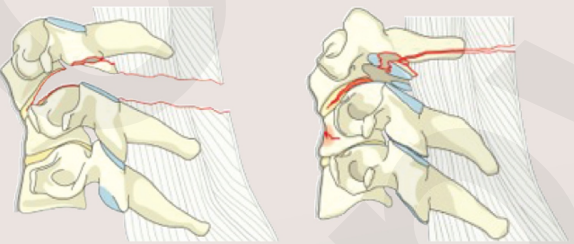
## B1. Posterior tension band injury (bony)

Physical separation through fractured bony structures only.



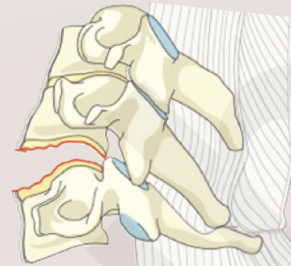
## B2. Posterior tension band injury (bony capsuloligamentous, ligamentous)

Complete disruption of the posterior capsuloligamentous or bony capsuloligamentous structures together with a vertebral body, disk, and/or facet injury.

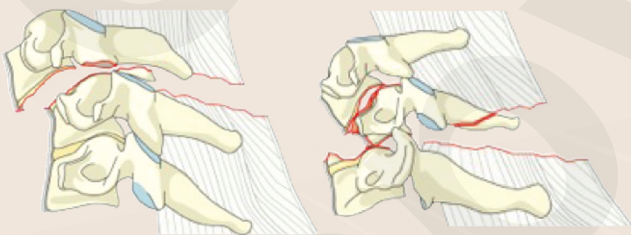


## B3. Anterior tension band injury

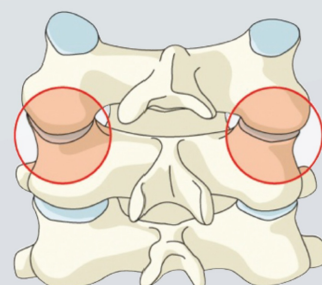
Physical disruption or separation of the anterior structures (bone/disk) with tethering of the posterior elements.



## C. Translational injury in any axis-displacement or translation of one vertebral body relative to another in any direction



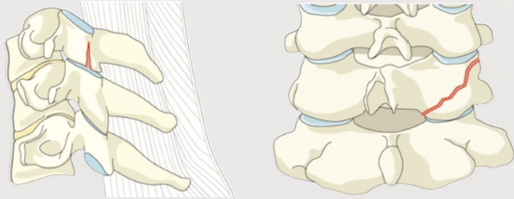
## BL. Bilateral injury





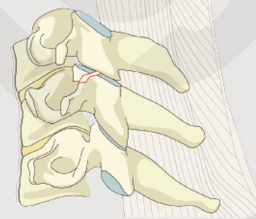
## F1. Nondisplaced facet fracture

With fragment <1cm in height, <40% of lateral mass.

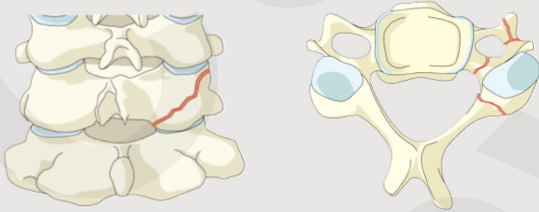


## F2. Facet fracture with potential for instability

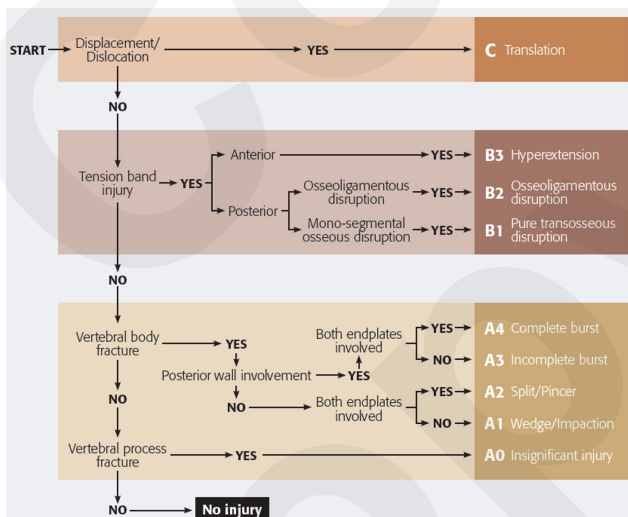
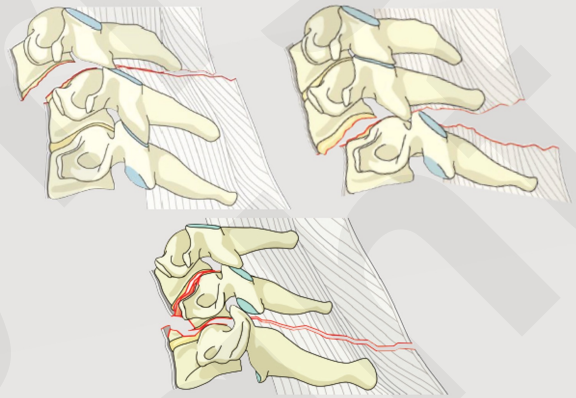
With fragment >1cm, > than 40% lateral mass, or displaced.



## F3. Floating lateral mass



## F4. Pathologic subluxation or perched/dislocated facet



## Neurological status modifier

Neurologic status at the moment of admission should be scored according to the following scheme:

| Type | Description                            |
|------|----------------------------------------|
| N0   | Neurologically intact                  |
| N1   | Transient neurologic deficit, resolved |
| N2   | Radiculopathy                          |
| N3   | Incomplete spinal cord injury          |
| N4   | Complete spinal cord injury            |
| NX   | Cannot be examined                     |

## Case-specific modifiers

There are four modifiers, which can be used in addition to ad 1 and 2:

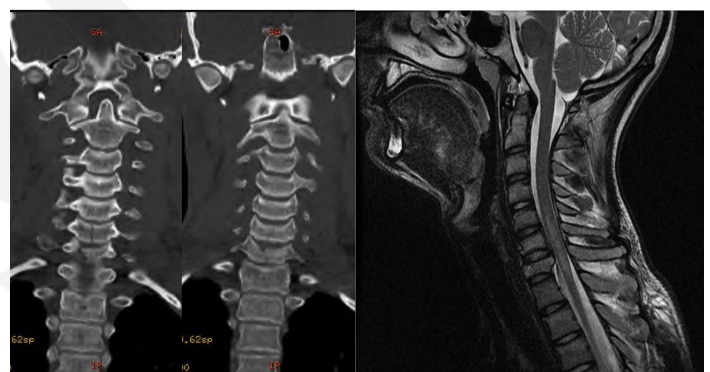
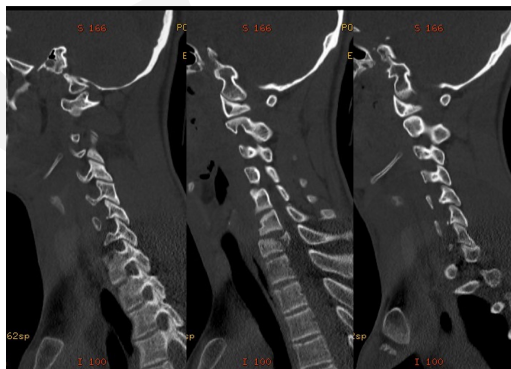
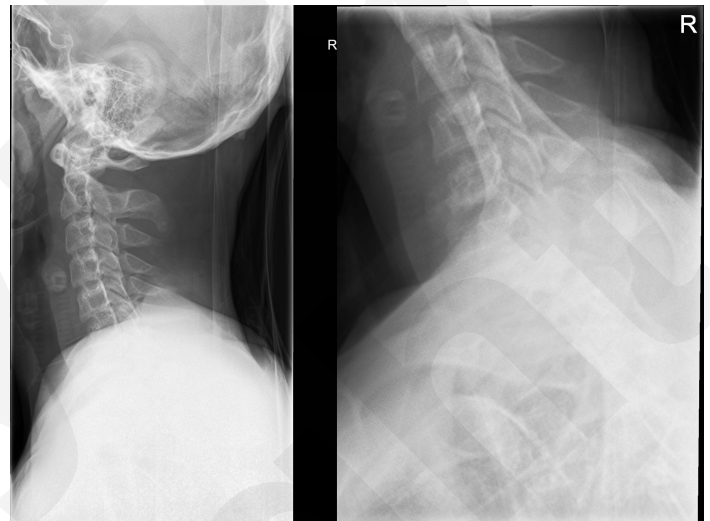
| Type | Description                                                              |
|------|--------------------------------------------------------------------------|
| M1   | Posterior Capsuloligamentous Complex injury without complete disruption. |
| M2   | Critical disk herniation.                                                |
| M3   | Stiffening/metabolic bone disease (ie DISH, AS, OPLL, OLF).              |
| M4   | Vertebral artery abnormality.                                            |

## Compression Fractures

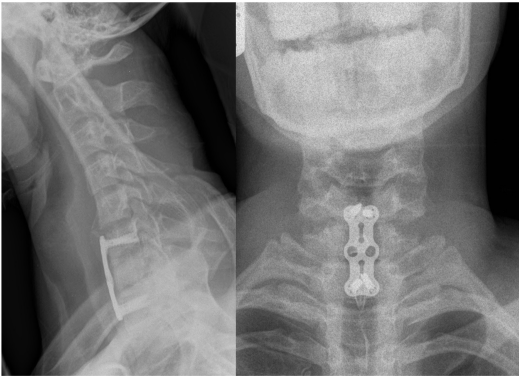
- Anterior VB
  - >3mm anterior wedging usually sup endplate
- NO disruption posterior VB wall
- +/- PLC injury
- Unlikely SCI
- Can be unstable

## Burst Fractures

- Involves posterior VB
- +/- PLC injury
- +/- SCI
- Usually unstable

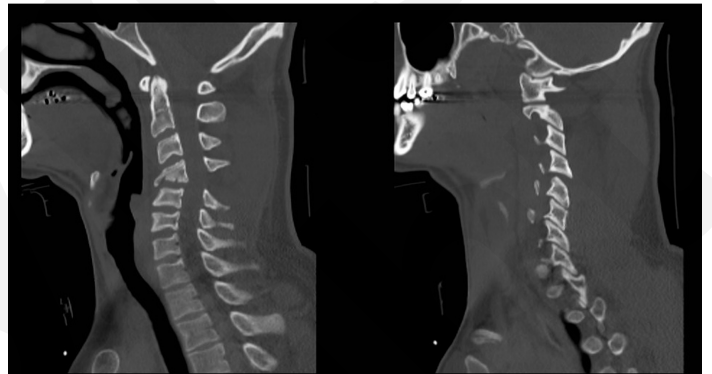
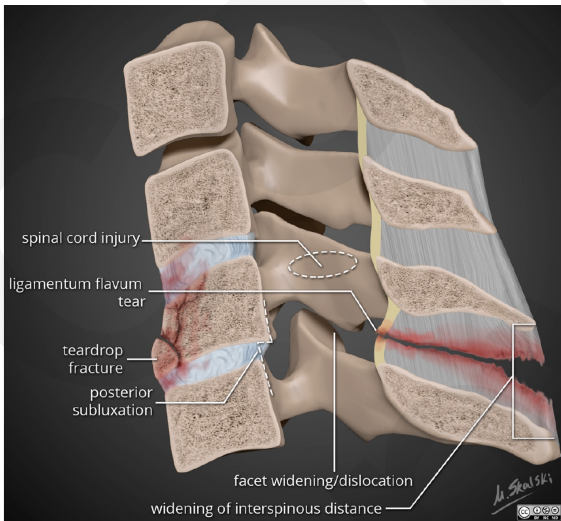


## C7 Burst C6 Split

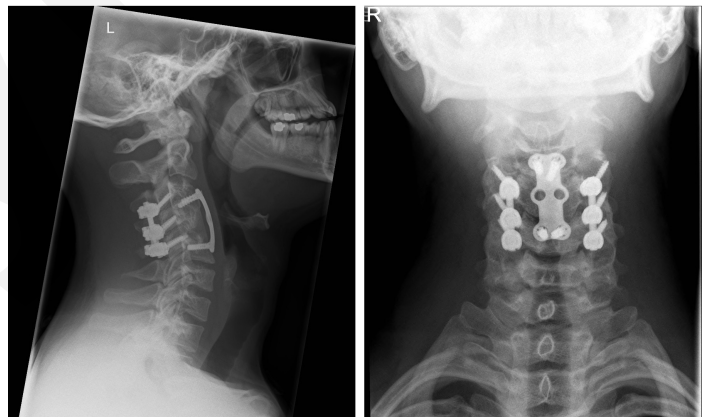
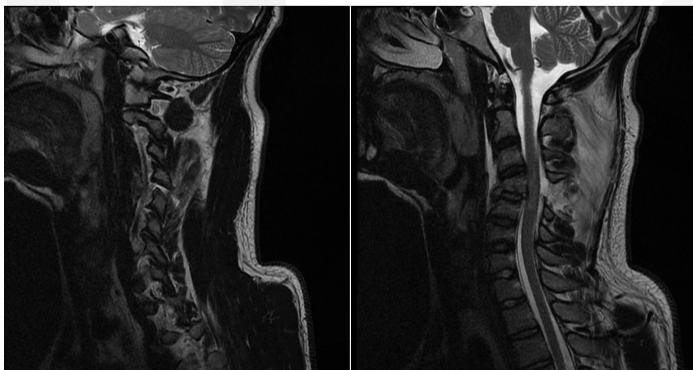


## Flexion Teardrop

- Flexion compression
- Anteroinferior VB teardrop
  - quadrangular fragment
- Posterior retropulsion VB
- PLC injury
- SCI frequent (70%)
- Unstable



## C4 Teardrop AP





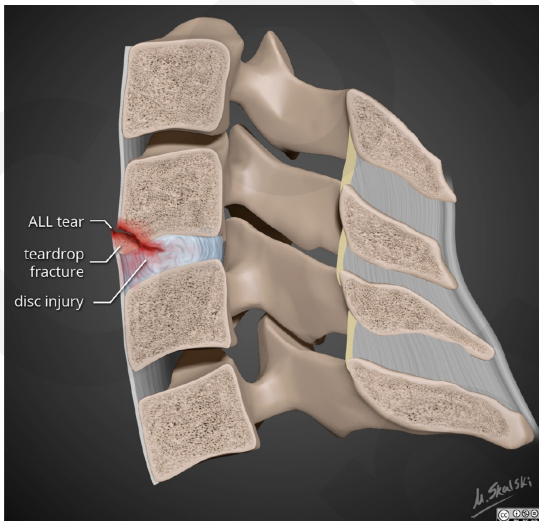
### Comparison of Outcomes for Unstable Lower Cervical Flexion Teardrop Fractures Managed With Halo Thoracic Vest *Versus* Anterior Corpectomy and Plating

**24 Halo vs 21 Op**

Charles G. Fisher, MD, MHSc, FRCSC, Marcel F. S. Dvorak, MD, FRCSC,  
Jordan Leith, MD, FRCSC, and Peter C. Wing, MB, MSc, FRCSC

**Conclusions.** The results of this study indicate that anterior cervical plating is a safe and effective treatment for cervical teardrop fractures, and that it is superior to the halo thoracic vest for restoring and maintaining sagittal alignment and for minimizing treatment failures.

**No Failures Fixation**



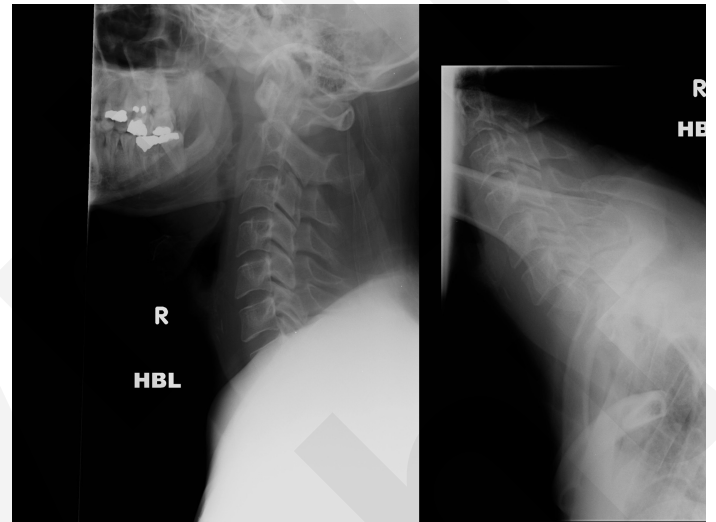
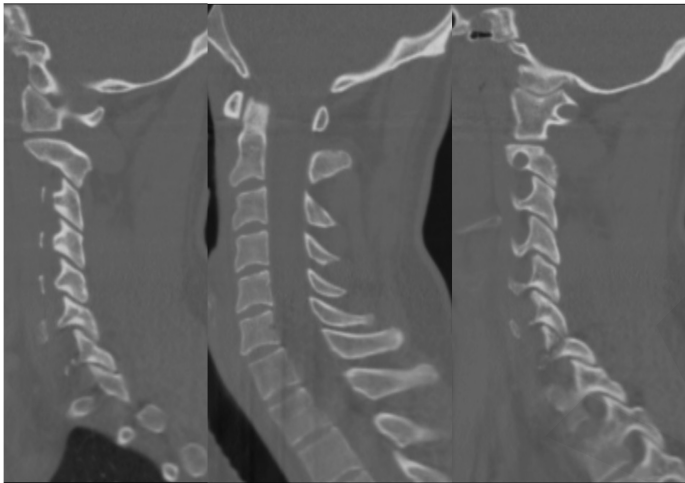
## Extension Teardrop

- Avulsion anteroinferior corner VB
- ALL extension injury
- Often at C2
- Uncommon SCI (elderly may get CCS)
- Stable in flexion
- Must differentiate from flexion type



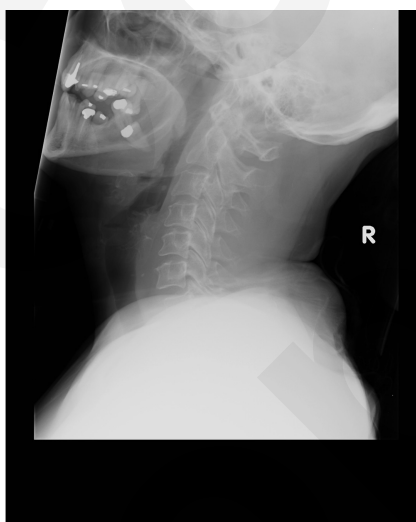
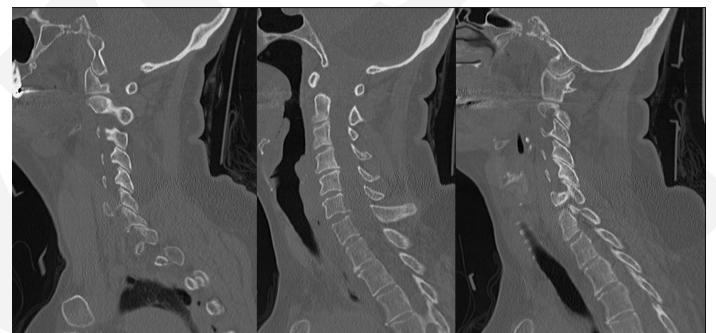
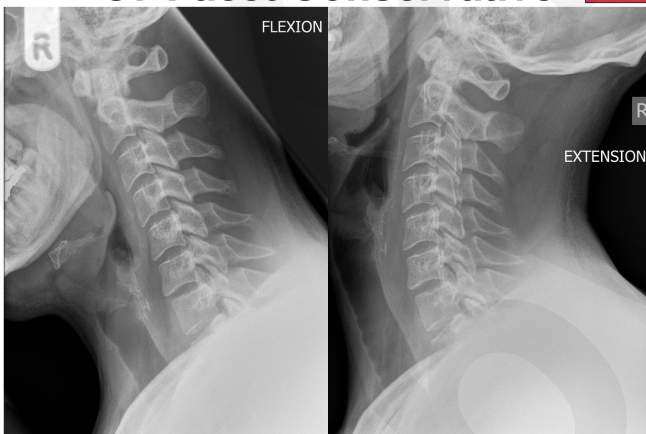
## Unilateral Facet Fractures

- Often superior facet articular process
- Monoradiculopathy
- Think!
  - Displaced or undisplaced
  - Integrity of disc / PLC



## C7 Facet Conservative

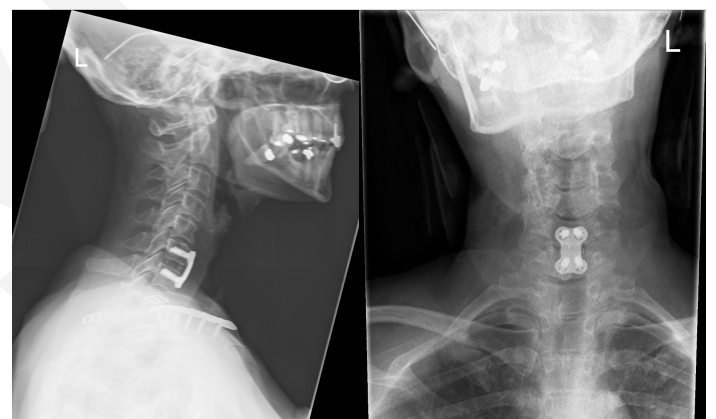
CARDIFF  
UNIVERSITY  
PRIFYSGOL  
CAERDYDD



CARDIFF  
UNIVERSITY  
PRIFYSGOL  
CAERDYDD

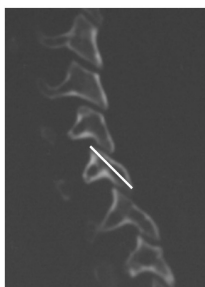
## C7 Facet Fracture Sublux

CARDIFF  
UNIVERSITY  
PRIFYSGOL  
CAERDYDD



## ■ Use of Computed Tomography to Predict Failure of Nonoperative Treatment of Unilateral Facet Fractures of the Cervical Spine

- **Involves > 40% absolute height of LM or >1cm absolute height of fracture fragment**



## Facet Dislocations

- 85% neurological deficit with bifacets dislo
  - SCI
  - Flexion
- 30% neurological deficit with unifacet dislo
  - Root injury +/- SCI
  - Rotational element

### Facet Dislocation 1

- After CT Dx d/w t/f to Spinal Surgeon ASAP
- No Neurological Deficit
  - MRI
  - No Disc Lesion
    - Closed reduction by sequential traction then urgent op
    - Urgent / Emergent op if evolving neurological deficit
  - Disc Lesion
    - Urgent / Emergent op
- Recovery  $\propto$  duration

Realign  
Stabilize  
Decompress – Direct / Indirect  
Prevent Late Pain / Deformity

### Facet Dislocation 2

- After CT Dx d/w t/f to Spinal Surgeon ASAP
- Partial Neurological Deficit / Obtunded
  - MRI
  - No Disc Lesion
    - Closed reduction by sequential traction then urgent / emergent operation
  - Disc Lesion
    - Urgent / emergent operation
- Recovery  $\propto$  duration

Realign  
Stabilize  
Decompress – Direct / Indirect  
Prevent Late Pain / Deformity

### Facet Dislocation 3

- After CT Dx d/w t/f to Spinal Surgeon ASAP
- Complete Neurological Deficit
  - Is there any need for MRI?
    - Prognostic / surgical planning
  - Attempt at closed reduction?
    - Surgical facilities not immediately available
  - Emergency Operation
- Recovery  $\propto$  duration

Realign  
Stabilize  
Decompress – Direct / Indirect  
Prevent Late Pain / Deformity

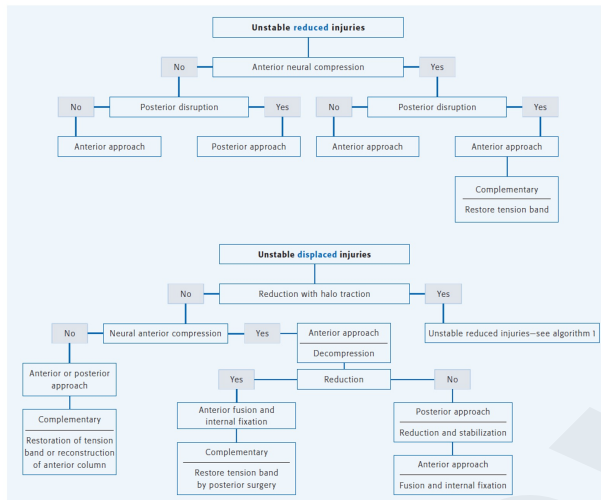
Eur Spine J (2017) 26:1272–1276  
DOI 10.1007/s00586-017-5004-z

ORIGINAL ARTICLE

Early versus delayed reduction of cervical spine dislocation with complete motor paralysis: a multicenter study

**Reduce it ASAP**  
**Ideally < 6 hours**





## Treatment of Cervical Spine Injuries with Anterior Plating 86 pts

### Indications, Techniques, and Results

W. S. Yoo, K. Zuber, MD, and D. Marchesi, MD

## Series of Nine Cervical Traumatic Cervical Spine Injuries Stabilized with Anterior ASIF Plate Fusion Technique

Daniel R. Rifa, MD, Mark G. Kowall, MD, J. Allen Cooper, Jr., MD, and Joseph J. Rubin, MD

## Anterior Reduction for Cervical Spine Dislocation 41 pts

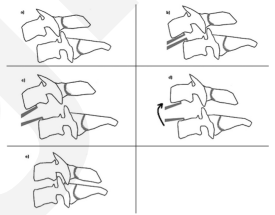
Rudy Reinold, MD, Jean Ouellet, MD, Edward J. Harney, MD, Greg Berry, MD, and Vincent Astar, MD

## The Radiographic Failure of Single Segment Anterior Cervical Plate Fixation in Traumatic Cervical Flexion Distraction Injuries 87 pts

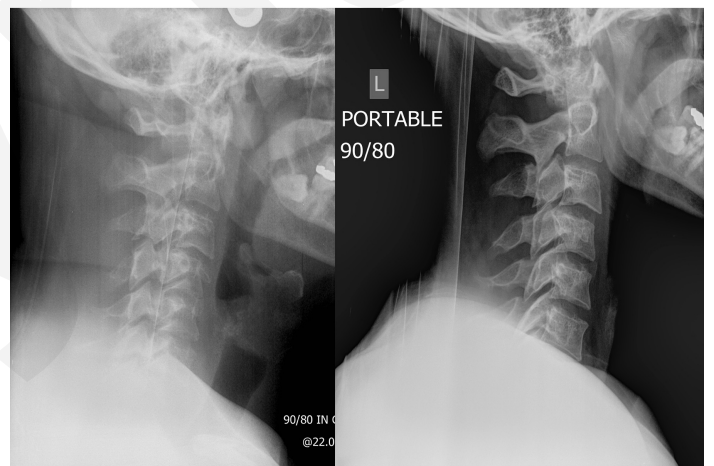
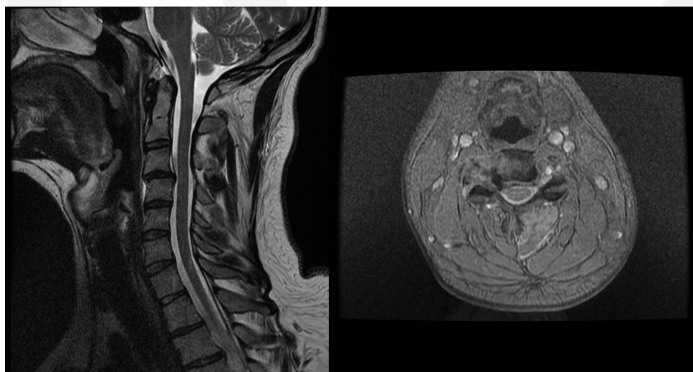
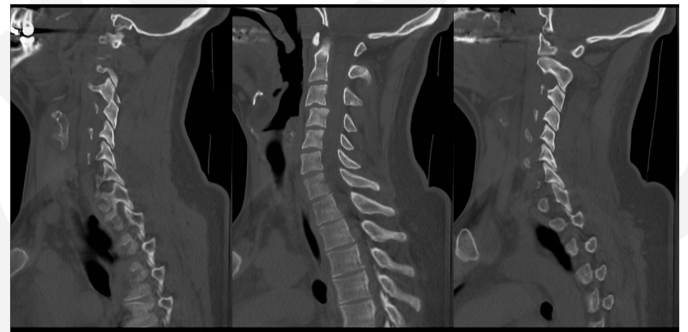
Michael G. Johnson, MD,\* Charles S. Fisher, MD,† Michael Boyd, MD,† Tobias Pizon, MD,‡ Thomas R. Gdard, PhD,§ and Marcel F. Doran, MD†

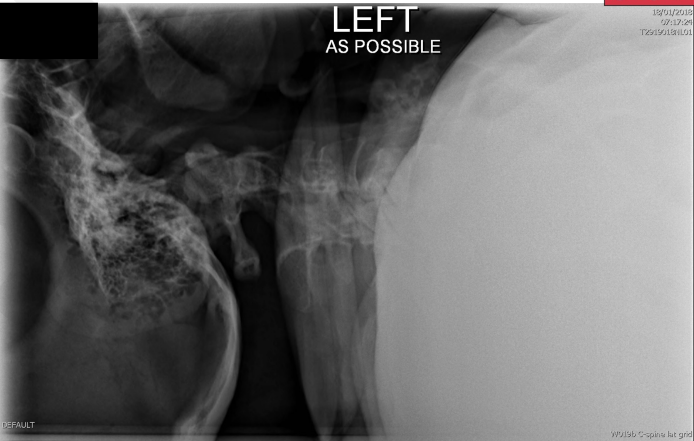
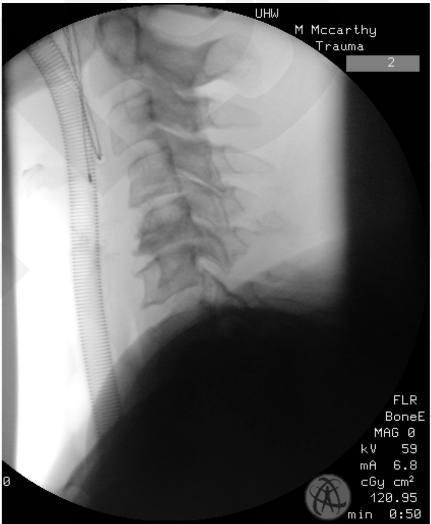
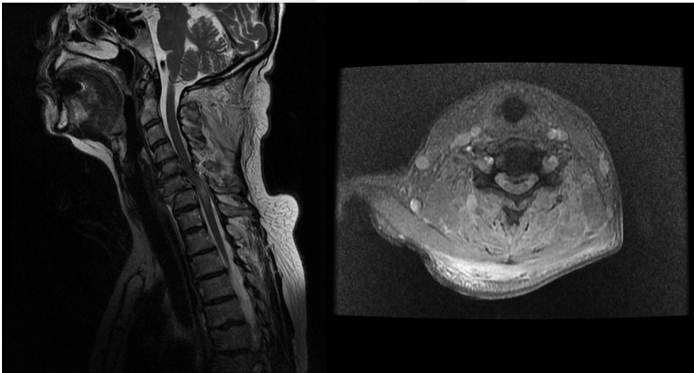
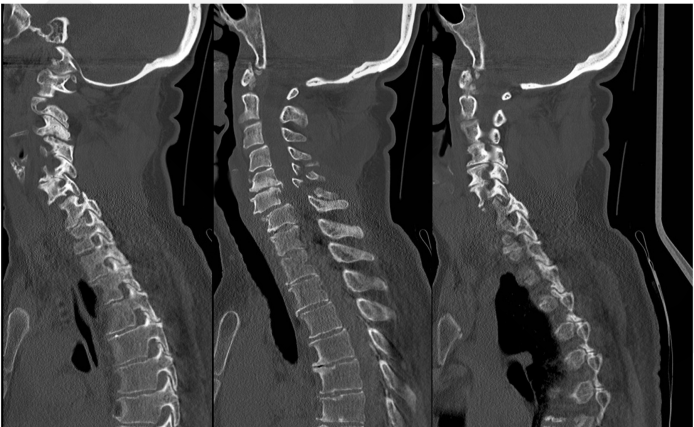
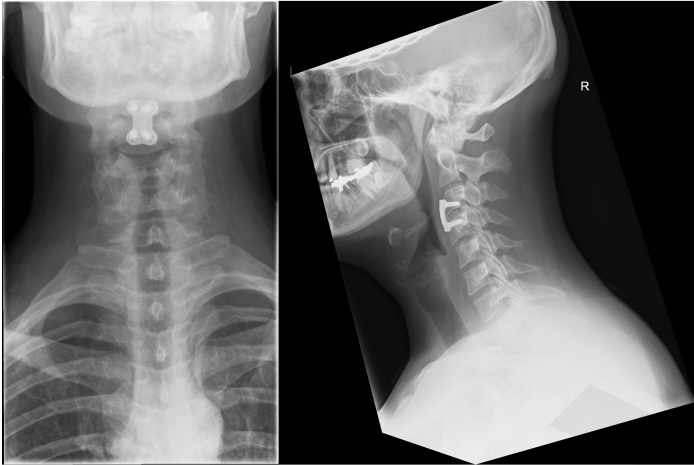
### Key Points

- A 13% radiographic failure rate is reported for anterior plate fixation of distractive flexion injuries of the subaxial cervical spine where 75% of the subjects had bilateral facet injuries.

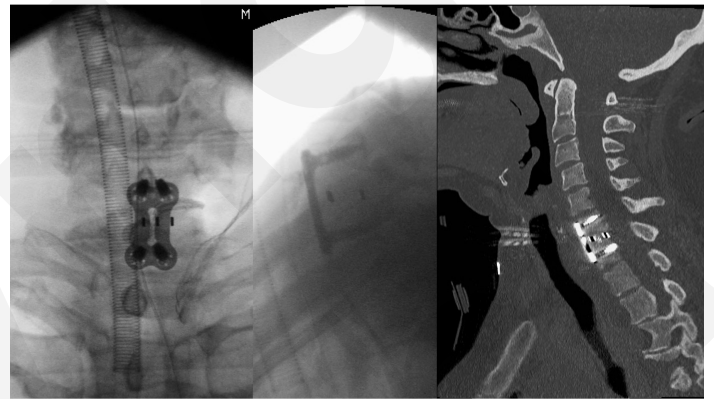
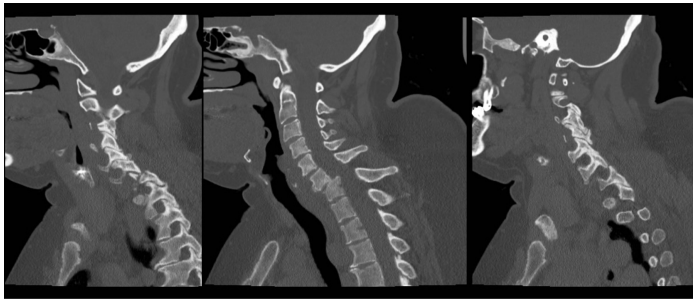


|                   | Radiographic Failure |          |                                     |
|-------------------|----------------------|----------|-------------------------------------|
|                   | Yes                  | No       |                                     |
| Facet fracture    | Yes 10 (26%)         | 28 (74%) | $P = 0.004$ , Pearson $\chi^2$ test |
|                   | No 1 (3%)            | 25 (97%) |                                     |
| Endplate fracture | Yes 9 (64%)          | 5 (36%)  | $P < 0.001$ , Fisher exact test     |
|                   | No 2 (3%)            | 58 (97%) |                                     |



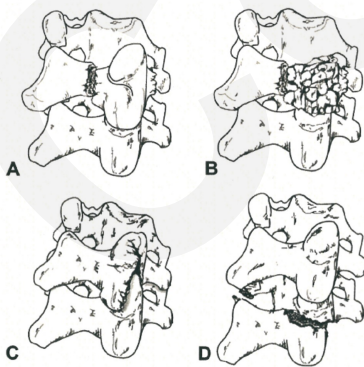






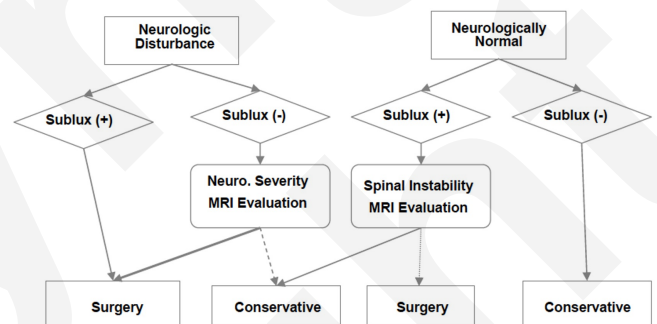
## Lateral Mass Fractures

## Lateral Mass Fractures



- A. Separation
- B. Comminution
- C. Split
- D. Dislocation

Kotani et al. 2005

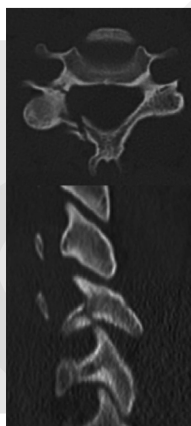


## Floating Lateral Mass

## Vertebral Artery Injury

### > Key Points

- ❑ A FLM fracture requires a high injury mechanism that leads to a high rate of associated other injuries, which include vertebral artery injuries and neurological injuries.
- ❑ Frequently observed radiographic findings on CT and MRI were rotational subluxation, "horizontalization" of the facet, and disc injury.
- ❑ The floating lateral mass injury is a two level injury and both levels ought to be addressed operatively to allow for optimal maintenance of physiological alignment.
- ❑ In our series, a two level ACDF or posterior fusion of spanning both levels was sufficient for stabilization of the injury.



1. Dissection <25% lumen narrowing
2. Dissection >25% lumen narrowing
3. Pseudo aneurysm
4. Occlusion
5. Transection

- Diagnosis - CTA
- Treatment
  - Reduce the fracture! (dislocation)
  - No treatment
  - Antiplatelet therapy
  - Rarely – interventional – stent / coil / surgery

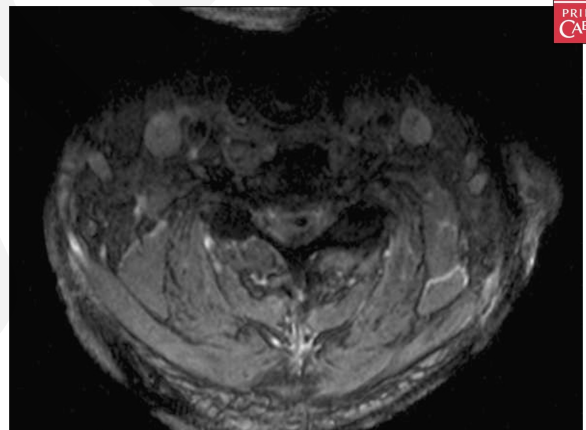
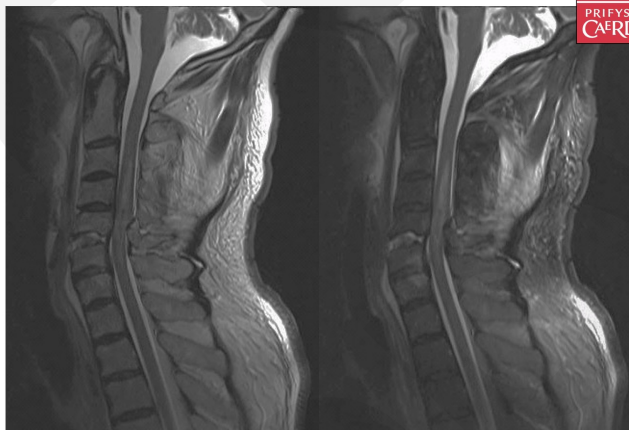
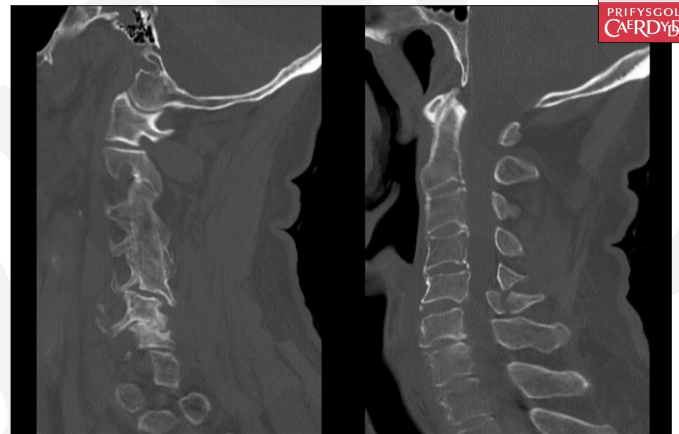


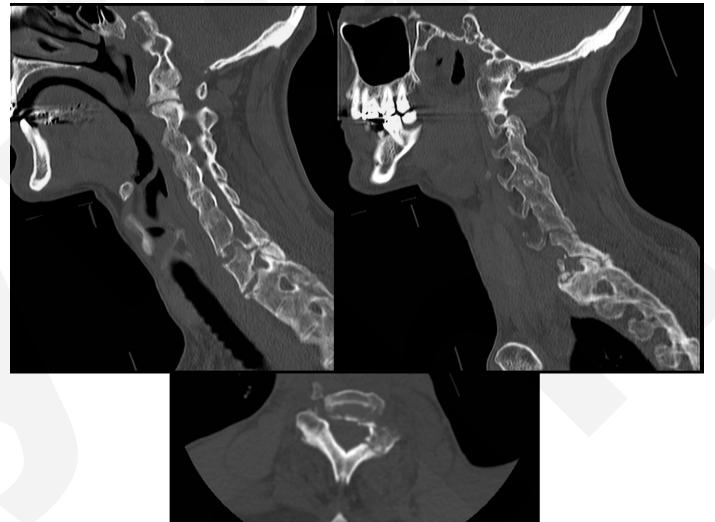
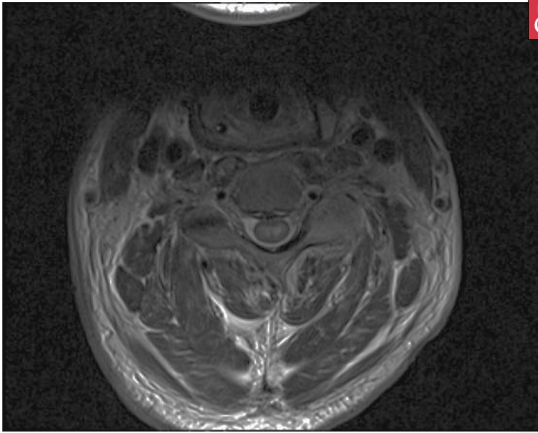
## Clinical Indications for Arterial Imaging in Cervical Trauma

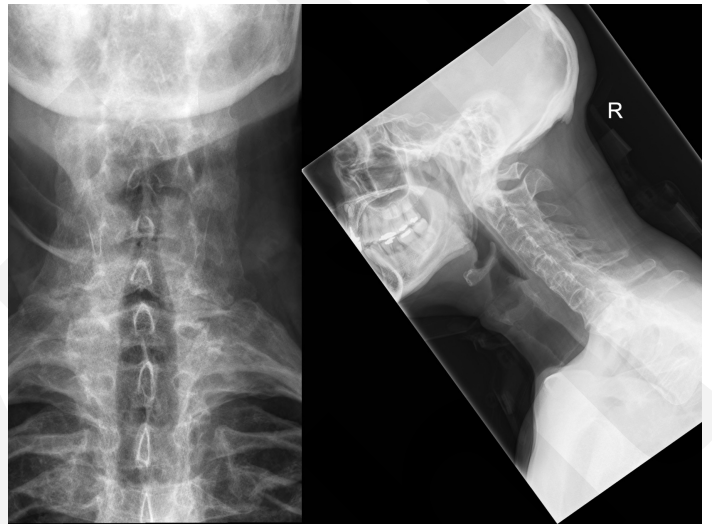
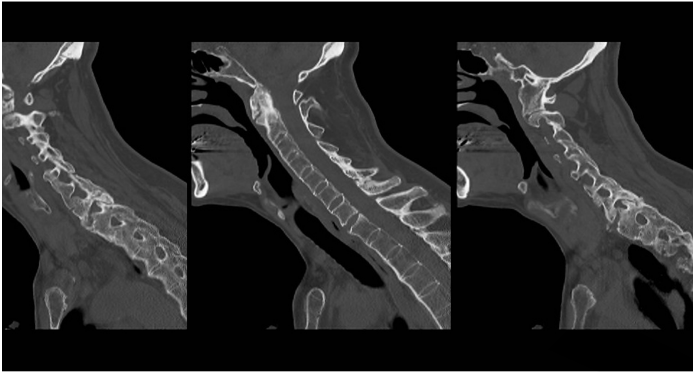
- Any cervical fractures with displacement:
  - Cervical fracture / dislocations
  - Jumped facets
  - Atlanto-occipital / Atlanto-axial dislocations
  - Neurological deficits
    - Esp suggesting posterior stroke
- **Isolated** transverse foramen fractures unlikely to cause significant VA injury

## Ank Spond / DISH

- Ankylosis
- Relative osteoporosis
- Long lever arm
- Low energy injuries
- Often hyperextension
- Unstable 3 column injuries
  - Chalkstick fractures
- Risk delayed haematoma







## Don't Forget The Disc

