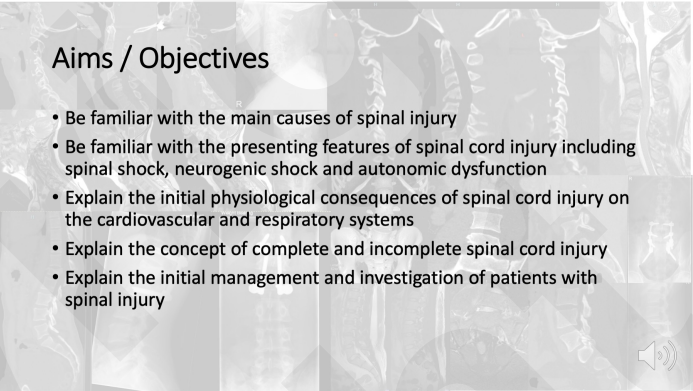


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BRITISH ORTHOPAEDIC ASSOCIATION STANDARDS FOR TRAUMA

The Management of Traumatic Spinal Cord Injury

Background and justification

Spinal cord injury (SCI) is a potentially devastating injury. Compromise to the spinal cord and risk to the patient's life can occur as a result of trauma. The management of SCI is a complex task requiring a multidisciplinary approach. The standards for the management of SCI are based on the best available evidence and clinical practice. The standards are intended to provide a framework for the management of SCI and to ensure that patients receive the best possible care.

Standards for Practice

1. All Major Trauma Centres and Trauma Units must have a named Spinal Cord Injury Centre.
2. All patients with a suspected SCI should have a named Spinal Cord Injury Consultant (SCIC) involved in their care from the point of presentation to the hospital.
3. All patients with a suspected SCI should have a named Spinal Cord Injury Nurse (SCIN) involved in their care from the point of presentation to the hospital.
4. All patients with a suspected SCI should have a named Spinal Cord Injury Physiotherapist (SCIP) involved in their care from the point of presentation to the hospital.
5. All patients with a suspected SCI should have a named Spinal Cord Injury Radiologist (SCIR) involved in their care from the point of presentation to the hospital.
6. All patients with a suspected SCI should have a named Spinal Cord Injury Surgeon (SCIS) involved in their care from the point of presentation to the hospital.
7. All patients with a suspected SCI should have a named Spinal Cord Injury Anaesthetist (SCIA) involved in their care from the point of presentation to the hospital.
8. All patients with a suspected SCI should have a named Spinal Cord Injury Pharmacist (SCIPH) involved in their care from the point of presentation to the hospital.
9. All patients with a suspected SCI should have a named Spinal Cord Injury Dietitian (SCID) involved in their care from the point of presentation to the hospital.
10. All patients with a suspected SCI should have a named Spinal Cord Injury Psychologist (SCIPSY) involved in their care from the point of presentation to the hospital.
11. All patients with a suspected SCI should have a named Spinal Cord Injury Social Worker (SCISW) involved in their care from the point of presentation to the hospital.
12. All patients with a suspected SCI should have a named Spinal Cord Injury Occupational Therapist (SCIO) involved in their care from the point of presentation to the hospital.
13. All patients with a suspected SCI should have a named Spinal Cord Injury Speech and Language Therapist (SCISLT) involved in their care from the point of presentation to the hospital.

Standards for Outcomes

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Management Spinal Injury

- ABCDE / ATLS / ETC Approach (not typical H&X)
- Protection - **THINK SPINAL CORD INJURY**
 - Maintain airway with spine control
 - Always aim to have a team of 6 for transfers (min 4 for log rolls)
- Detection
 - Level of injury
 - Complete or Incomplete cord injury
 - Spinal or Neurogenic shock
- Management
 - Conservative or Surgical treatment

Immobilise Entire Spine* - The Old School...

- *Caveats
- Pre existing spinal deformity – ank spond
- Head / Facial Injuries putting patient at risk
- Agitated / Combative patient

Prehospital Use of Cervical Collars in Trauma Patients: A Critical Review

Terje Sundstrom^{1,2}, Helge Asbjørnsen^{3,4}, Samer Habiba⁵, Geir Arne Sunds^{6,7}, and Knut Wæster^{8,9}

European Journal of Trauma and Emergency Surgery
https://doi.org/10.1007/s00508-020-01791-4

Evidence for the use of spinal collars in stabilising spinal injuries in the pre-hospital setting in trauma patients: a systematic review

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Abstract

The purpose of this systematic review was to evaluate the evidence for the use of cervical collars in the pre-hospital setting in trauma patients. The review included studies published between 1990 and 2020. The results of the review are summarized in the following table:

Question	Answer
Isolated penetrating trauma?	No
Critical ABC problem? and/or GCS < 10?	No
Obvious tenderness on spinal palpation? and/or neurological deficit?	No
No spinal classification	No
Spinal classification	Yes
Time critical spinal stabilization	Yes

Conclusion

The evidence for the use of cervical collars in the pre-hospital setting in trauma patients is weak. The use of cervical collars should be reserved for patients with a critical ABC problem, a GCS < 10, or obvious tenderness on spinal palpation and/or neurological deficit.

The Spinal Board

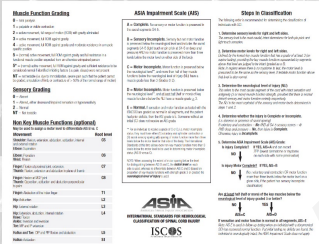
- Transport device
- Remove ASAP
- Regular log rolls
- Risk of pressure sores
 - Same goes for some collars...

Assessment - Spine

- History
 - Pain
 - Mechanism
 - Immediate post injury neurology
 - Associated injury
- Examination
 - Log roll
 - Tenderness / Gap / Step
 - Marked spasm
 - Spinal cord function incl PR / DRE
- Imaging

Examination - Spine

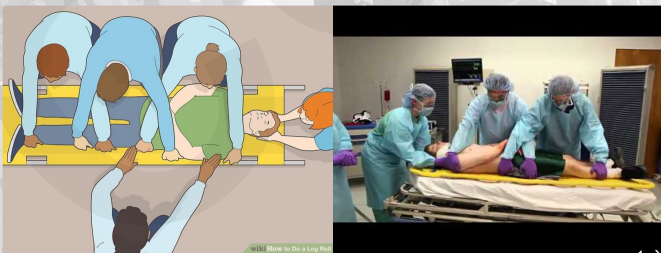
- Complete / Incomplete SCI
 - Sensory level
 - Sensory modality
 - Motor level
 - Sphincter tone
 - Bulbocavernosus reflex
- SCI in the Unconscious Patient**
 - Flaccid areflexia
 - Diaphragmatic breathing
 - Pain response above clavicle
 - Bradycardia / Hypotension
 - Priapism



Log Roll - "3 over 3 under" - No Arms Crossing



Log Roll - "5 vs 4" - Arms Crossing



"Shock"

- Refers to a state of inadequate organ perfusion and tissue oxygenation
- Hypovolaemic – Haemorrhagic or fluid loss
- Tension Pneumothorax
- Cardiac Tamponade
- Cardiogenic
- Neurogenic
- Septic
- Anaphylactic

Pump Failure (incl Obstructive)
Circulatory Failure

Spinal "Shock"

- Refers to the flaccid paralysis, areflexia and lack of sensation secondary to physiologic spinal cord "shut down" in response to injury
- Usually resolves within 24 hours when reflex arcs caudal to injury return
- Lowest that can be tested clinically
 - bulbocavernosus reflex
- Importance of spinal shock**
 - determining whether a patient has a complete or incomplete spinal cord injury

Neurogenic Shock

- State of inadequate tissue perfusion and oxygenation due to:
- Reduced sympathetic outflow (T1-L2) with resultant unopposed vagal tone
- **Hypotension** due to loss of blood vessel tone with resultant venous pooling
- **Bradycardia** due to reduced cardiac stimulation
 - distinguishes neurogenic shock from other types of shock (e.g. hypovolaemic, cardiac, anaphylactic) - caveat - end stage / catastrophic hypovolaemic shock

Spinal Cord Injury

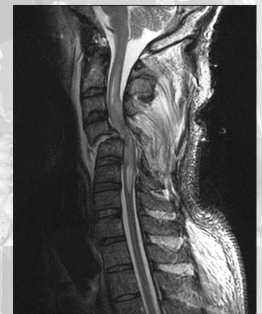
- Primary (at the time of injury)
- Secondary (occurring after the injury)
- **Complete spinal cord injury**
 - no sensation or voluntary motor function below the level of the injury
- It can only be confirmed after the resolution of spinal shock when reflex activity has returned
- The level of the injury is defined as the first with useful partial neurological function >3/5
- The overall prognosis for recovery of neurological function in complete lesions is poor

Spinal Cord Injury

- **Incomplete spinal cord injury means that there is some function caudal to the injury**
- In general, the greater the function the faster the recovery and better the prognosis
- Cord syndromes are forms of Incomplete SCI
 - Central Cord Syndrome, Anterior, Posterior and Brown Sequard
- Sacral sparing after spinal cord injury
 - the presence of sacral sensation, voluntary rectal tone and great toe movement
 - indicates intact long tract neurones and the potential for recovery
- Prognostic for predicting recovery except in lesions involving the conus medullaris or cauda equina

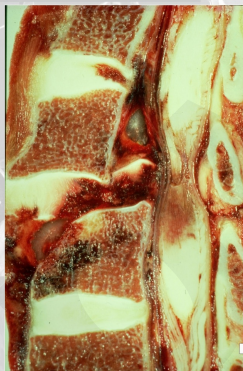
Pathophysiology SCI

- Primary injury:
 - Initial insult to cord
 - Local deformation
 - Energy transformation
 - Mainly COMPRESSION



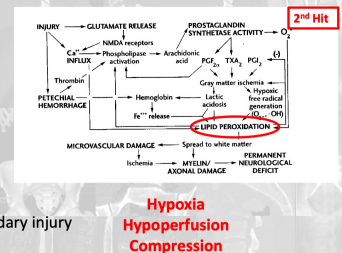
Pathophysiology SCI

- Transient Neurapraxia
- Oedema
- Haemorrhage
- Transection



Pathophysiology SCI

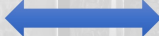
- Secondary injury
- Biochemical cascade
- Cellular processes
- Therapy aims to reduce the secondary injury



Clinical Instability

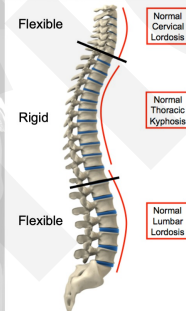
- The loss of the ability of the spine under **normal physiological loads** to maintain its pattern of displacement so that there is no initial or additional **neurological deficit**, no major **deformity** and no incapacitating **pain**

Stable



Unstable

Biomechanics

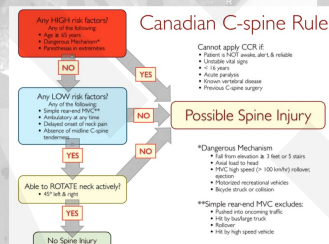


- Anterior Column**
 - Vertebral bodies
 - 80% Load
 - Compression
- Posterior Column**
 - Everything behind the vertebral bodies
 - 20% Load
 - Tension

Spinal Injury Screening

- Clinically**
 - Cooperative patient
 - Alert and orientated
 - Able to concentrate on spine
 - Normal neurological exam
 - No spinal pain or tenderness
 - No pain or tenderness with voluntary movement
- Altered consciousness or symptoms**
 - Radiological imaging required
 - Presume the spine is unstable
 - Protect

Spinal Injury Screening



National Emergency X-Radiography Utilization Study (NEXUS) Criteria

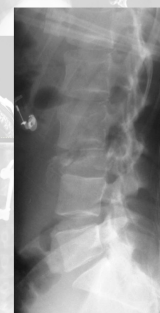
- Meets all low-risk criteria?**
- No posterior midline cervical-spine tenderness
 - No evidence of intoxication
 - A normal level of alertness
 - No focal neurologic deficit
 - No painful distracting injuries



Spinal Injury Screening

- Lateral Cervical X-Ray**
 - Detects 85% cervical fractures
- Image the entire spine**
 - 10% with one fracture have another non contiguous injury
- Reality – Polytrauma patients get a panCT**

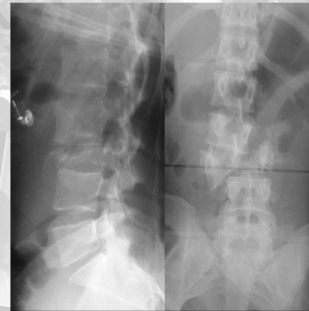
Orthopaedic Principles



Don't Forget This Slide...



Orthopaedic Principles



Get
Orthogonal
Views

CT Indications – “AB and CT”

- Poly trauma – CT Head to Hips
- Plain Radiographs have failed to visualise all the cervical spine
 - Cervico-thoracic junction
 - Intubated patient (no odontoid peg view) – continue brain CT down to C3
- Plain Radiographs show injury
 - Confirm and further categorise extent of injury



MRI in Spinal Trauma

- Overview for exclusion of injury in difficult cases (ankylosing spondylitis)
- Ligamentous injury
- Unexplained neurology
- Prognosis in neurological injury
 - Compression vs oedema vs haemorrhage vs transection
- Is surgical fixation safe?
 - Extruded disc may be made worse by surgical manipulation / Other discs ligaments may be injured

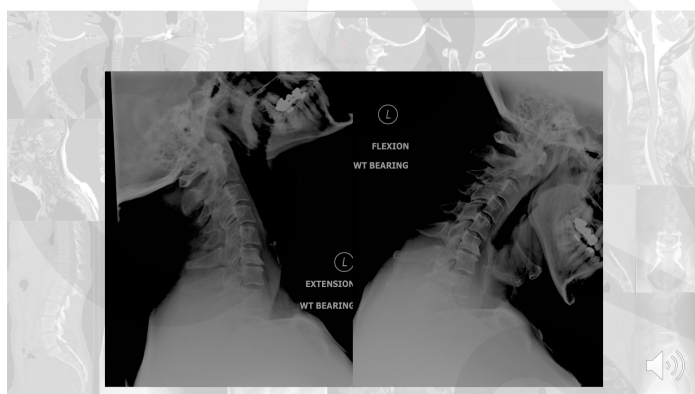
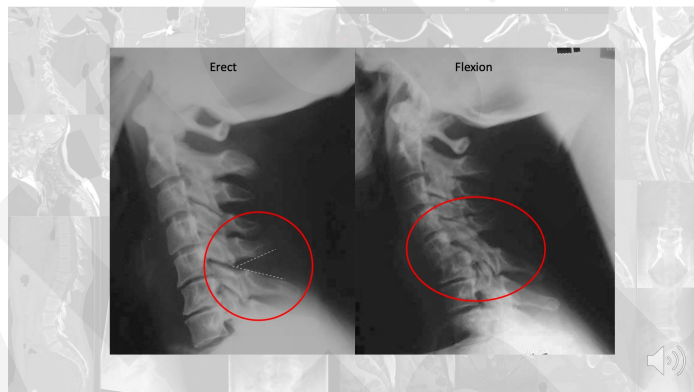


Erect XRs

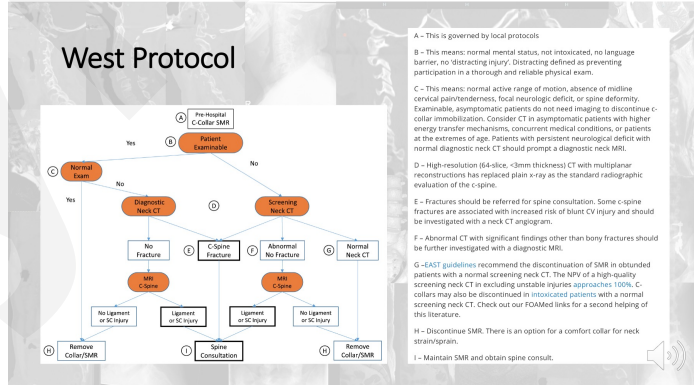
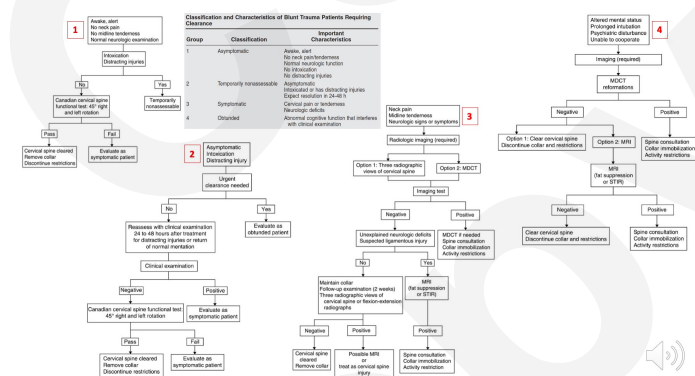
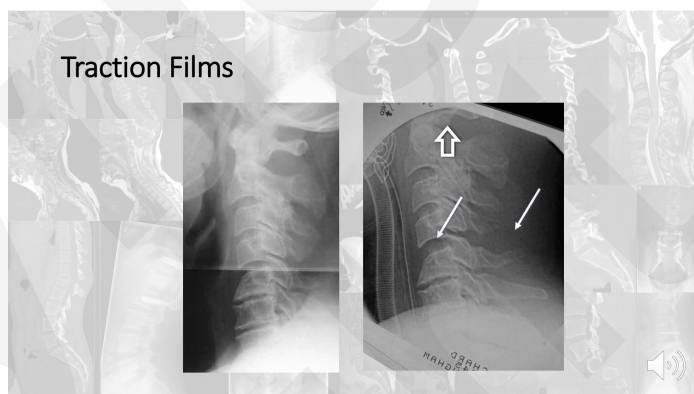
- Normally after discussion with specialist
- Load bearing - physiological
- Normally done in collar
- Useful adjunct after a CT showing a “stable injury” – checks for development of load bearing deformity and ligament injury (cf def of instability above)

Dynamic XRs

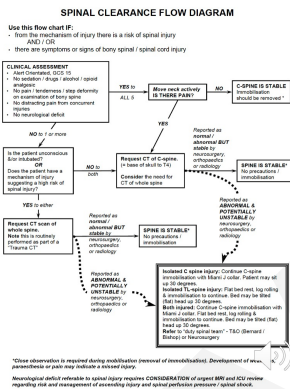
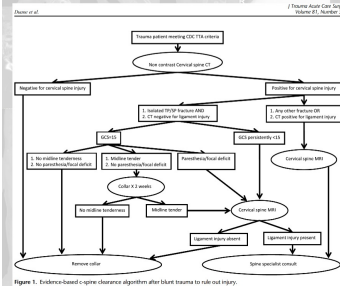
- Normally after discussion with specialist
- Physiological
- Normally done at 2 weeks post injury to check for stability or after treatment in a collar to ensure no latent instability
- Flexion and Extension X-Rays



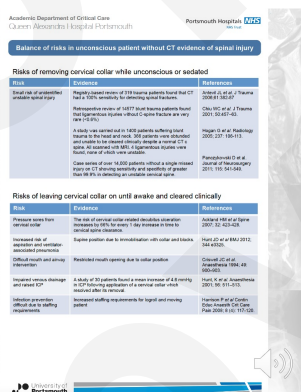
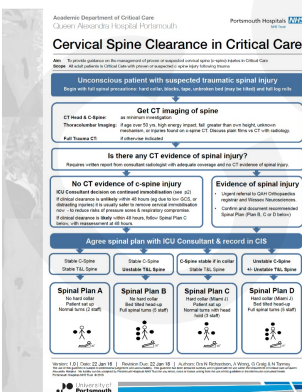
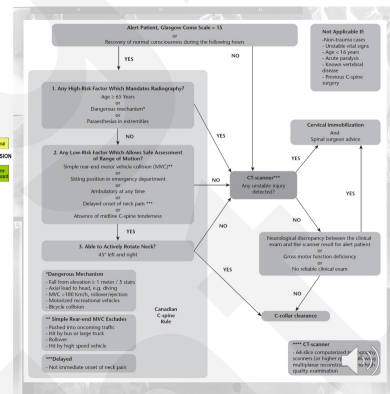
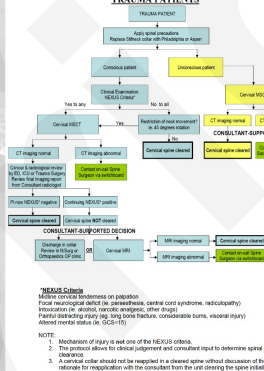
Traction Films



Other Protocols

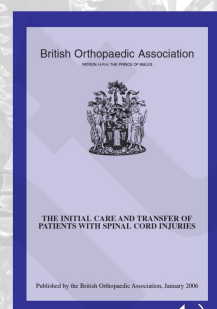


CERVICAL SPINE CLEARANCE PROTOCOL: TRAUMA PATIENTS



Spinal Cord Injury (SCI)

- Of 569 patients admitted to Spinal Cord Injuries Centre in UK:
 - 9% missed at presentation
 - 5% experienced further avoidable deterioration
 - 1% of those missed had significant head injury
- Multiple Fractures in 5%
- Use of Steroids
- NOT recommended



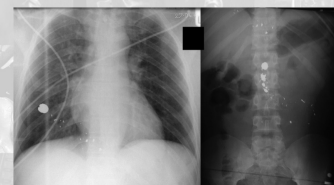
Acute Consequences SCI

- (Paralysed...)
- Inadequate ventilation
- Abdominal evaluation compromised
- Occult compartment syndrome



Management Spinal Injury

- Treat life threatening injuries first
- Ventilation and Oxygenation
- Maintain blood pressure
- Maintain spinal cord perfusion



Management Hypotension

- In Major Trauma:
- Haemorrhagic shock until proven otherwise
- Consider neurogenic shock
- Monitor urine output



Hypotensive Bradycardic...



Management Spinal Injury

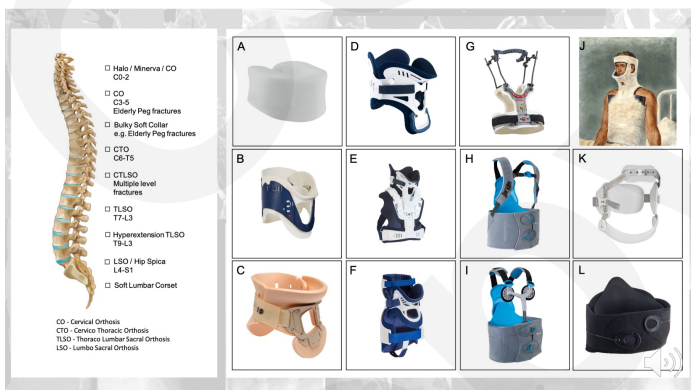
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- Protection - **THINK SPINAL CORD INJURY**
 - Maintain airway with spine control
 - Always aim to have a team of 6 for transfers (min 4 for log rolls)
- Detection
 - Level of injury
 - Complete or Incomplete cord injury
 - Spinal or Neurogenic shock
- Management
 - Conservative or Surgical treatment



Agree spinal plan with ICU Consultant & record in GIS			
Stable C-Spine Unstable T10-Spine	Stable C-Spine Unstable T10-Spine	C-Spine unstable if in contact Unstable T10-Spine	Unstable C-Spine Unstable T10-Spine
Spinal Plan A No hard collar Patient not to be moved Head immobilized in soft collar	Spinal Plan B No hard collar Patient not to be moved Head immobilized in soft collar	Spinal Plan C No hard collar Patient not to be moved Head immobilized in soft collar	Spinal Plan D No hard collar Patient not to be moved Head immobilized in soft collar

Conservative

- "Stable" Injuries
 - Radiological Parameters
 - Normal physiological load: No Neurological Deficit / Deformity / Pain
- Some Polytrauma patients
- Unfit for surgery
- Osteoporotic bones



Spinal Surgery



Indications for Surgery - DRS

- **Decompression**
 - Spinal cord / nerve roots
- **Realignment**
 - Correct deformity
- **Stabilisation**
 - Prevent / Treat
 - Neurological deficit / deformity / pain
 - (Non fusion technology form of "stabilisation")

All may require fusion

Require Instrumentation

Instrumentation increases fusion

Strong Indications Operation

- **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
- (Open fracture)

Relative Indications Operation

- **Decompression surgery (+ stabilisation)**
 - Dynamic neurology
 - Static incomplete neurology in presence of demonstrable neural compression
- **Stabilisation surgery**
 - Loss of anterior body height >50%
 - Kyphosis >20-30 degrees
 - Canal stenosis >50%
 - Disruption of posterior ligamentous complex

