Cervical Spine Trauma

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Objectives

- Assess patient with suspected cervical spine injury
- Describe mechanisms of cervical spine injury
- Describe common types of injury and their management
- Discuss management of patients with cervical spine injury
- Discuss some of the pitfalls while managing these patients
- Describe rehabilitation and other long-term issues

Recognition

Immobilisation

Investigation

Reduction

Stabilisation

Mobilisation

Rehabilitation

Assessment

- Understanding biomechanics of the injury
- Awareness of the types of injuries
- Detailed and directed clinical examination
- Choosing the appropriate investigations
- Systematic approach to interpreting the images

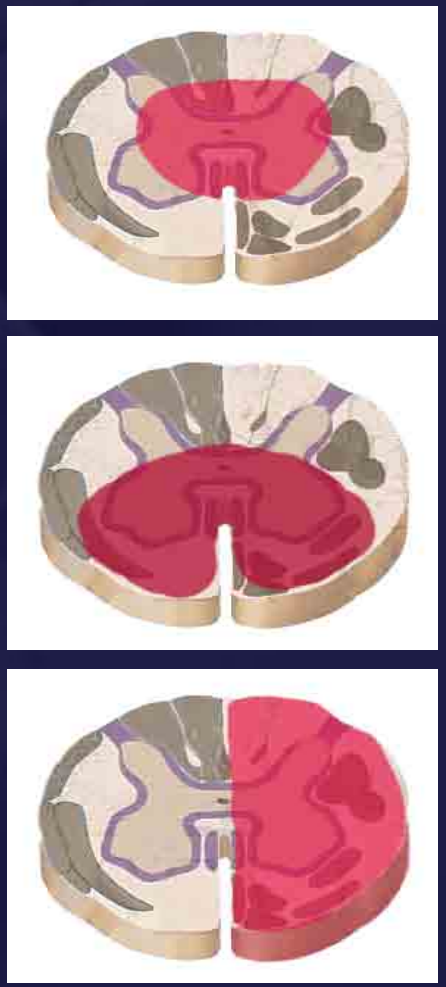
Mechanisms

- Hyperflexion
- Hyperextension
- Axial loading
- Rotational injuries
- Distraction
- Combination of any of the above

Neurological syndromes

It is important to recognize that a significant number of patients present also present with well-defined neurologic syndromes corresponding to specific incomplete neuroanatomic lesions

- Complete and Incomplete
- ASIA classification
- Central cord syndrome
- Anterior spinal cord syndrome
- Brown-Séquard syndrome



Neurological impairment

American Spinal Injury Association (ASIA) Impairment Scale is most widely used

A	Complete	No motor function or sacral sensation
B	Sensory incomplete	Sensation preserved below the level of injury including S4-5
C	Motor incomplete	Majority of key muscles have a power grade of less than 3
D	Motor incomplete	Majority of key muscles having a power grade ≥ 3
E	Normal	Normal motor and sensory function

Radiological Assessment

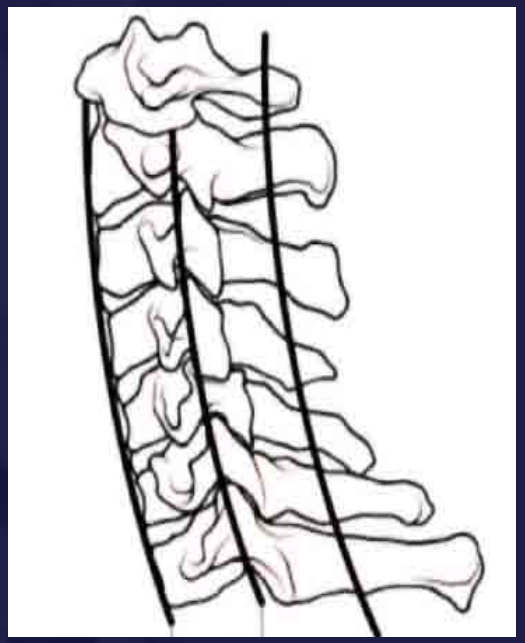
- Several guidelines are in use
- Not necessary in conscious patients with no symptoms or other distracting injuries
- If GCS <6 CT down to C2 when scanning head
- Lateral, AP and transoral X-rays can detect most (up to 95%) but not all injuries
- Use CT, MRI or dynamic images as necessary

Radiological Interpretation

Cervical radiographs are often the primary mode of investigation

Lateral view

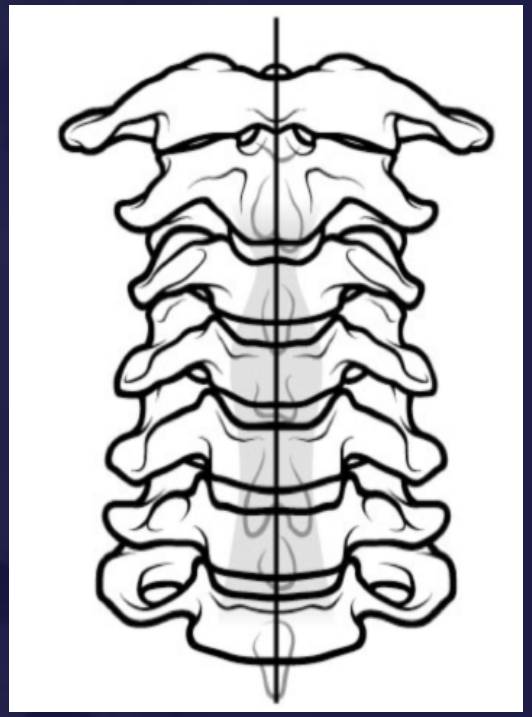
- Is it adequate?
- Alignment and lines
- Bones
- Cartilage
- Soft tissue



Radiological Interpretation

Antero-posterior view

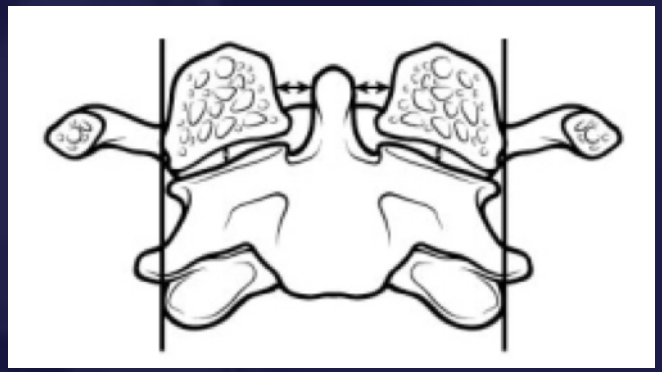
- Alignment
- Distance between spinous processes
- Uniformity
- Height of vertebrae



Radiological Interpretation

Open mouth odontoid view

- Spacing of dens
- Lateral masses
- Alignment of C1 and C2
- Uniformity



This view may not be always possible, CT scan is the investigation of choice in poly-trauma

Immobilisation

- Spinal board
- The unconscious patient
- Hard collar
- Sandbags
- Cranio-cervical traction
- Halo crown and vest

Extremely important to prevent secondary spinal cord injury. Appropriate method of spinal immobilization should be chosen according to the situation, be aware of the pitfalls – e.g. pressure sore, raised ICP with collar etc

Reduction

- Cranio-cervical traction
- Closed reduction under GA
- Open reduction

Controlled reduction of subluxation, dislocation or displacement should be attempted soon after initial resuscitation, but beware of the perils of cranio-cervical traction in the presence of gross ligament instability. Weights of up to 15kg may be required. Regular clinical and radiological monitoring is a must.

Stabilisation

External stabilisation

- Hard collar
- SOMI brace
- Halo vest

Internal Fixation

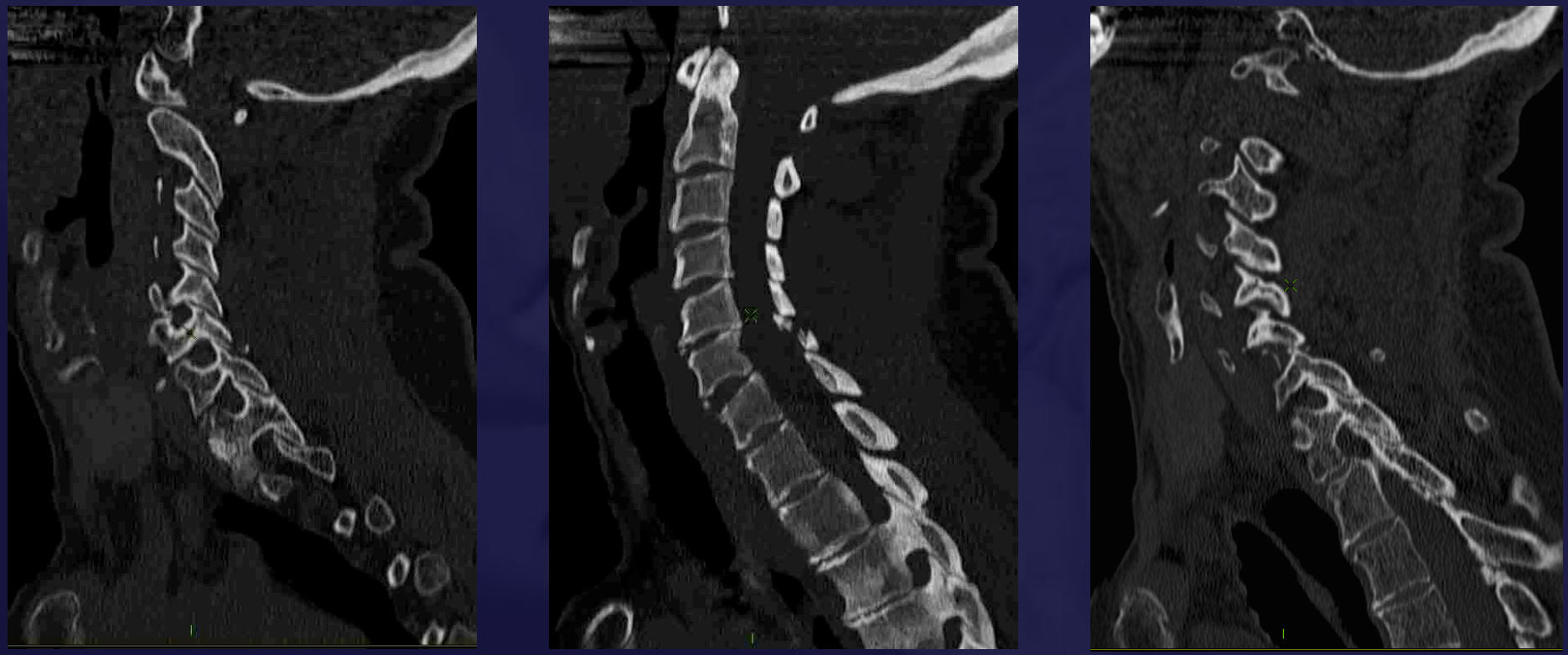
- Anterior
- Posterior
- Combined

Should be aimed at providing stability during repair of bone, soft tissue and neurological structures. A combination of techniques may be necessary.

Principles of surgical repair

- Single column injury – usually stable, generally heals with external immobilisation
- 2-column injury – often unstable, may need internal fixation
- 3-column injury – unstable, 3-column reconstruction or internal fixation supplement with halo
- Irreducible injuries – may need open reduction and fixation
- Discoligamentous injuries – watch out for delayed instability, often needs stabilisation
- Consider stabilisation for rehabilitation needs and pain even if complete cord lesion

Some common injuries and their management



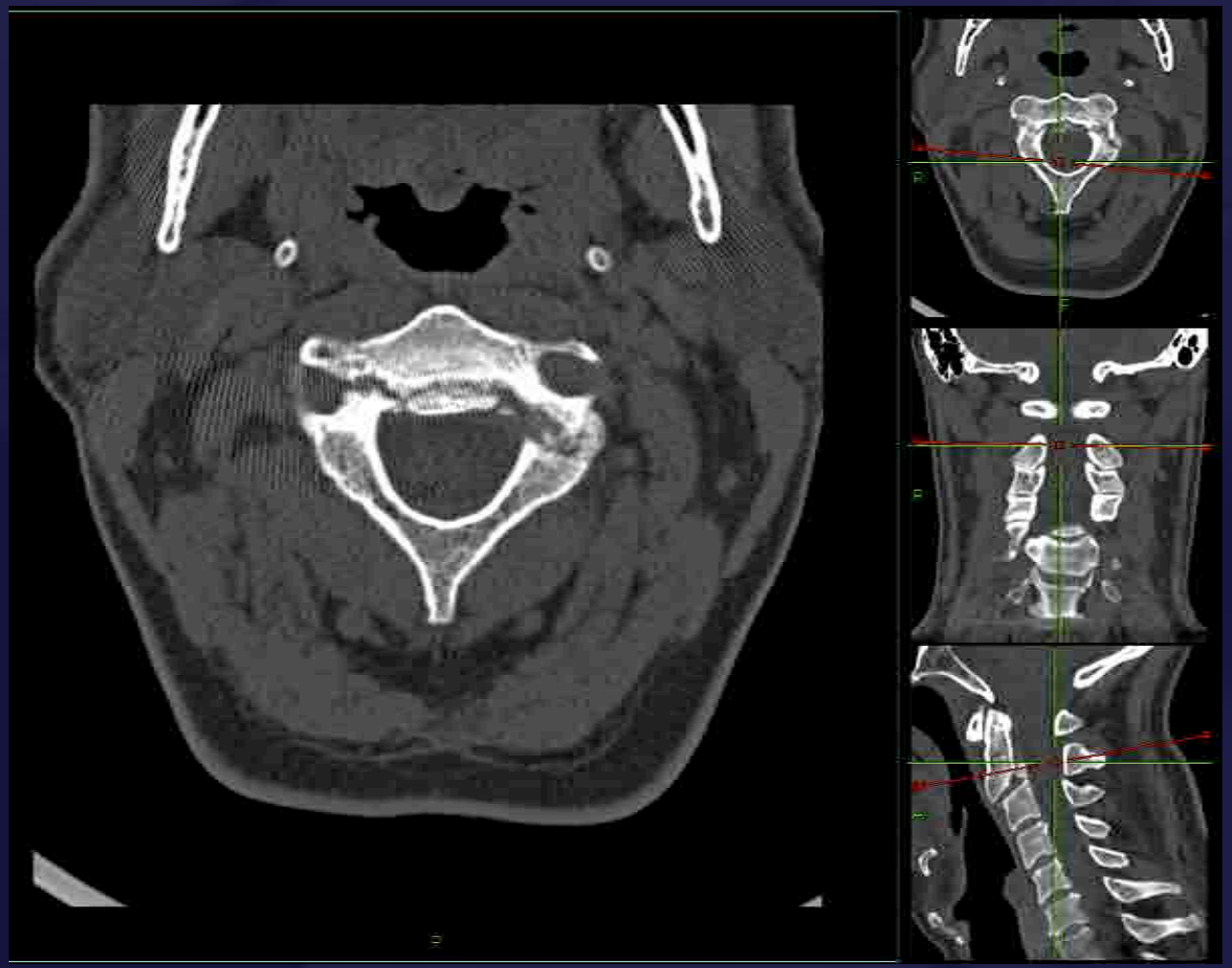
Flexion-extension injury: Unifacet subluxation with fractured lamina

360° Fixation – Anterior plate, interbody fusion & lateral mass screws

Facet Subluxation

- Hyperflexion injury
- Unifacet or bifacet
- Look out for nerve root lesions
- Attempt reduction by cervical traction
- Often has discoligamentous damage
- Optimum treatment 360 ° fixation

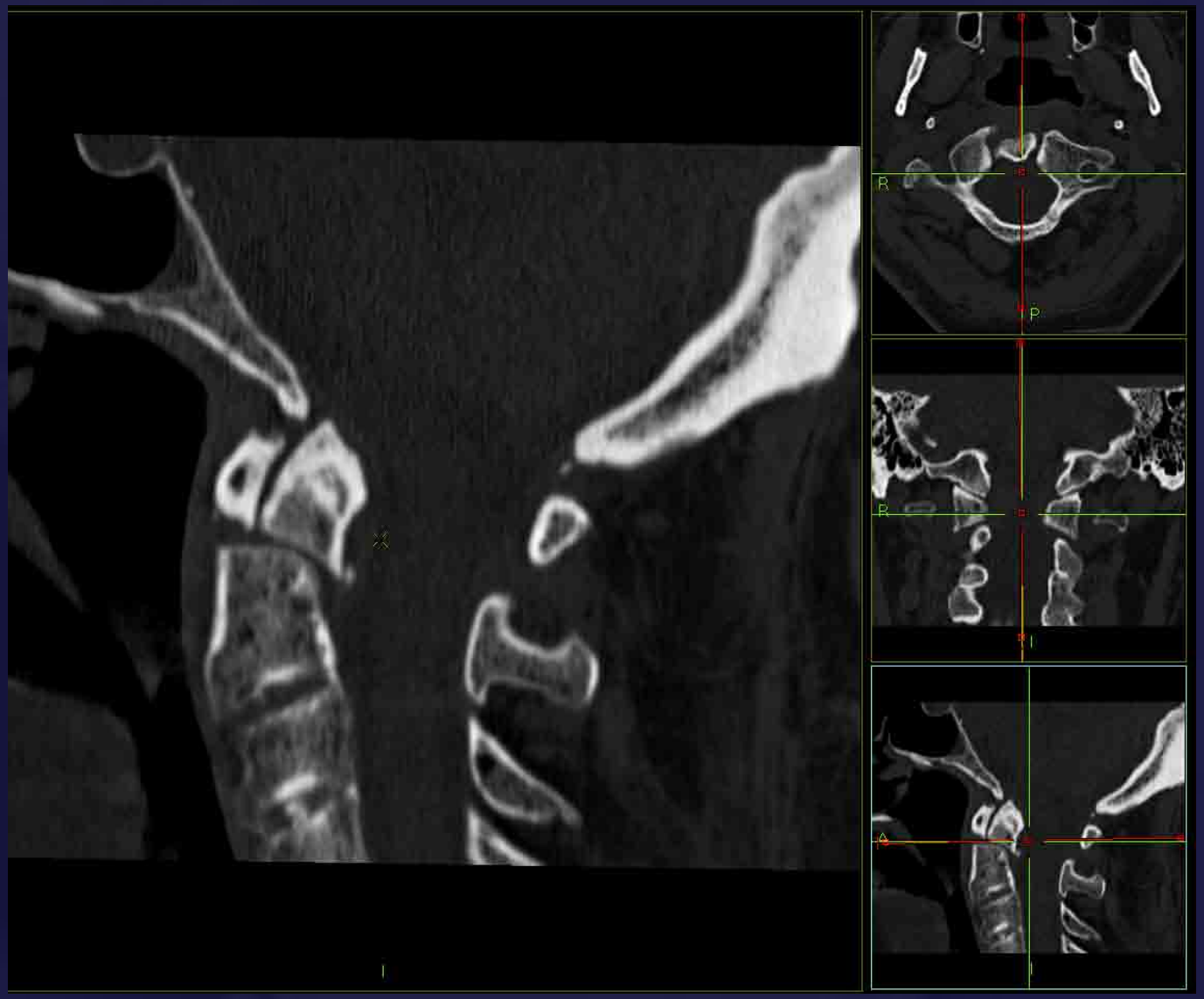
Hyperextension/Flexion distraction: Type I Traumatic axial spondylolisthesis



Type IA Traumatic axial spondylolisthesis– note the transverse foramen

Hangman's fracture

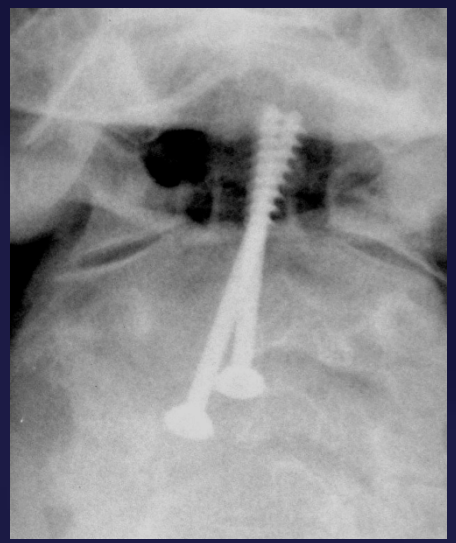
- C2 Traumatic spondylolisthesis
- Hyperextension injury
- Type I – stable, Halo immobilisation
- Type II – Unstable, may require posterior fixation +/- halo
- Craniocervical traction may be hazardous



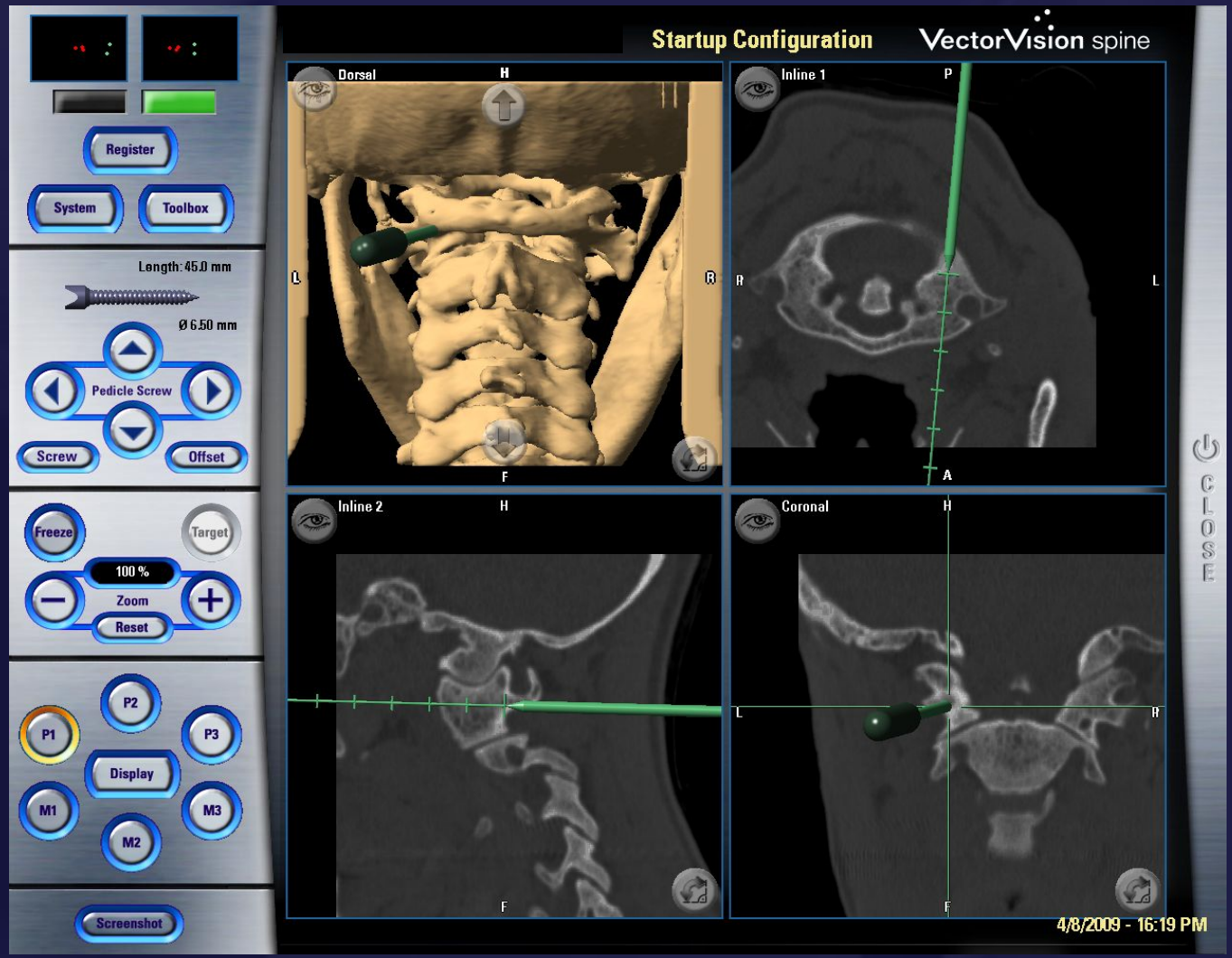
Hyperextension injury: Type II Odontoid peg fracture

C1 lateral mass and C2 pedicle

Axial view - C1 lateral mass screws



Type II odontoid peg fracture treated with C2 anterior odontoid screws



Intra-operative navigation can sometimes be useful in guiding difficult screw placements

Odontoid peg fracture

- Hyperextension injury
- Type I – rare, stable, collar
- Type II – Unstable, halo, high non-union rate, anterior or posterior fixation
- Type III – Unstable, good fusion with halo
- Os odontoideum
- Fibrous non-union may be acceptable

Vertebral compression fracture

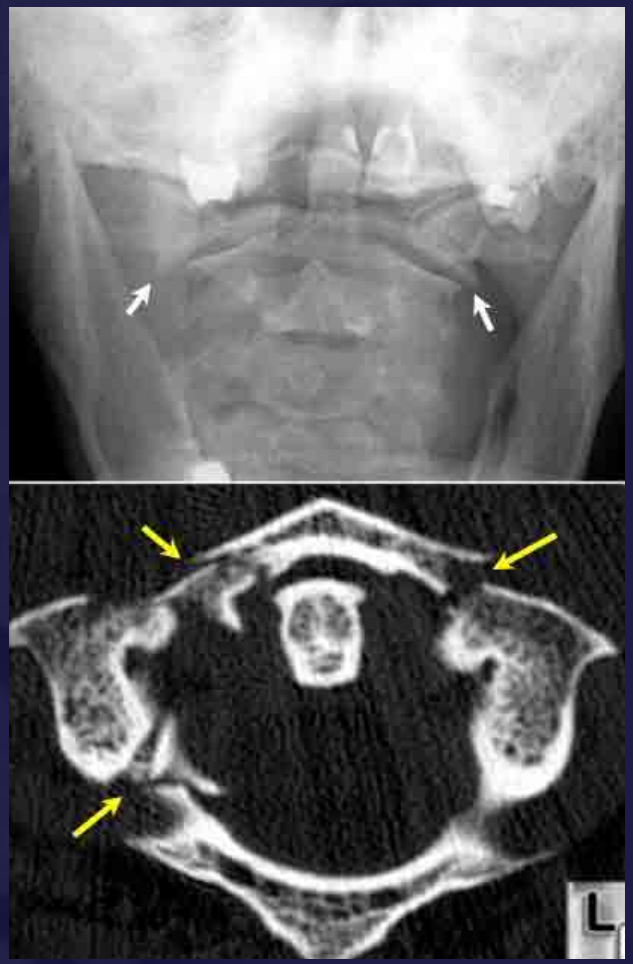
Surgery: Vertebrectomy, anterior cervical plate and screws

Compression fracture

- Axial loading injury
- Can be stable if no ligament injury
- Watch out for progressive kyphosis
- Stabilisation – vertebrectomy and anterior plating

Jefferson's fracture

- Axial loading injury
- Burst ring of C1
- Can be stable if Transverse ligament intact
- Often no neurological deficits
- Can be treated in a Halo
- Look out for delayed AAI

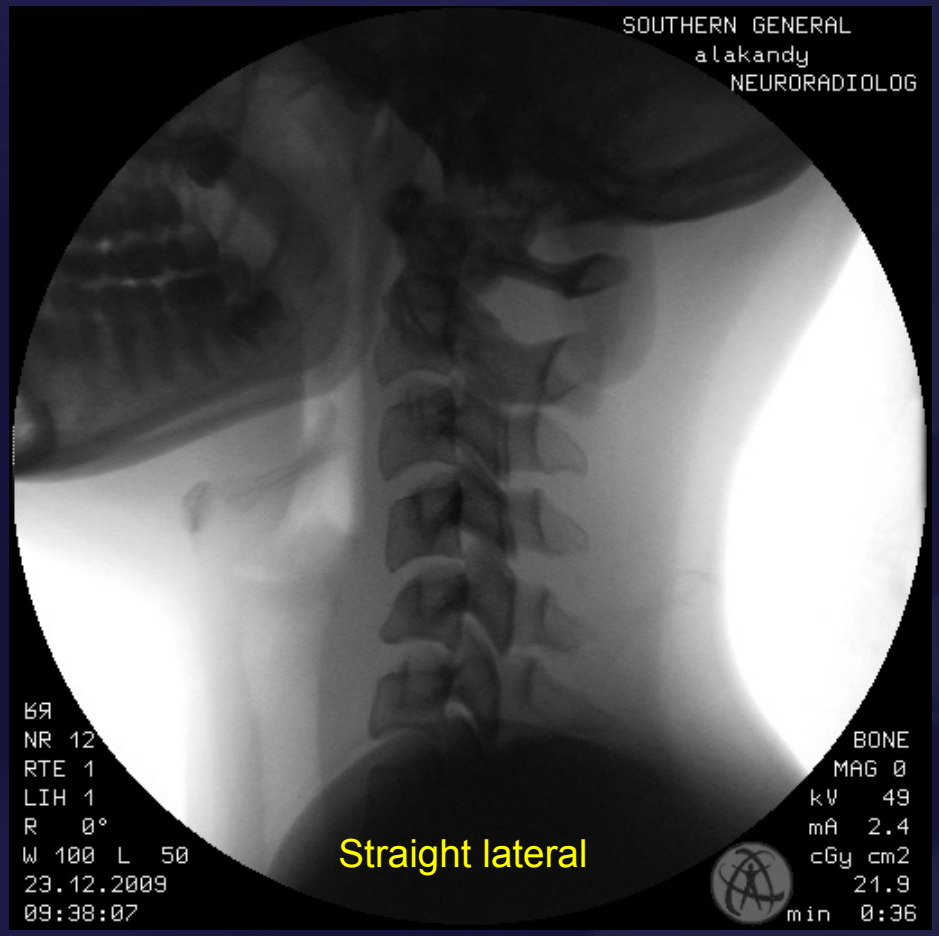


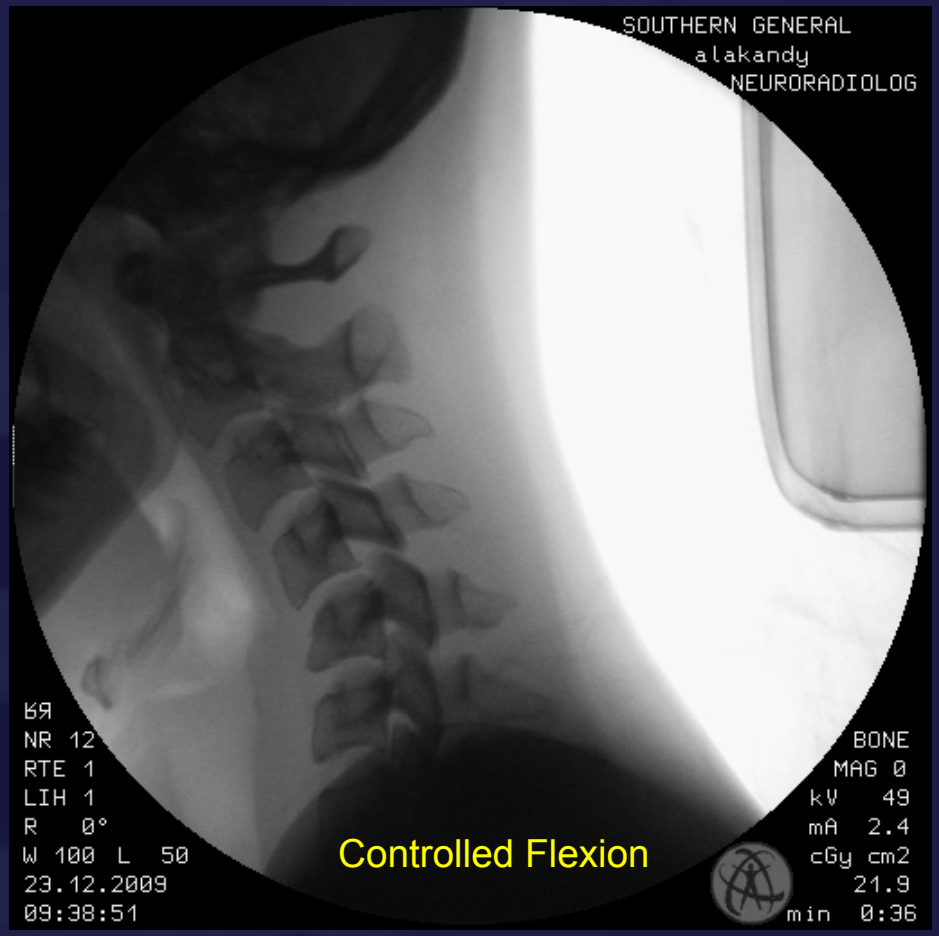
Traumatic Central Cord Syndrome

- Disproportionately greater weakness of the upper than the lower extremities
- Variable sensory loss and bladder dysfunction
- Often initial neurological improvement followed by plateau in recovery and then late deterioration
- Timing of surgery controversial; Early surgery not proven to be beneficial
- Improvement in ASIA score inversely correlates with age at Injury

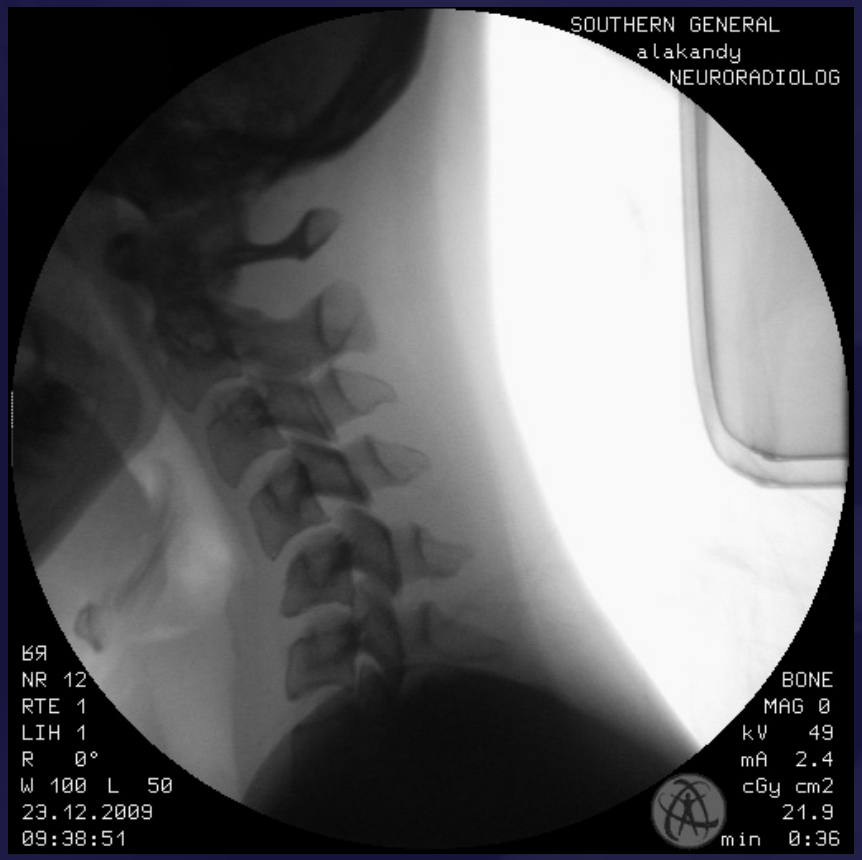
Common pitfalls

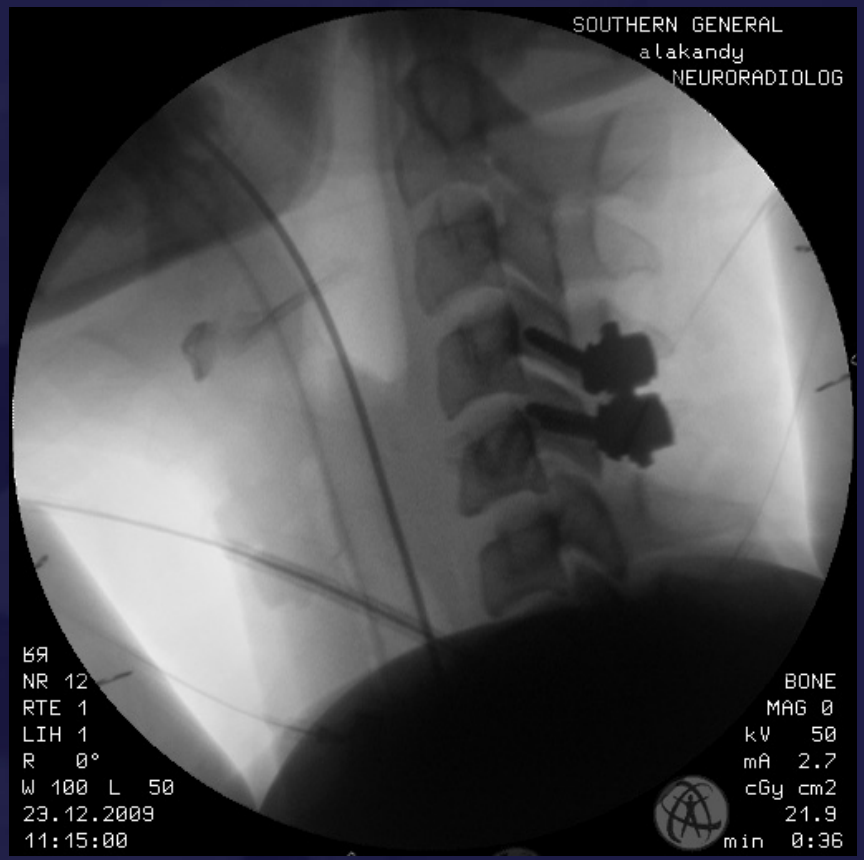
- Difficult to assess – the unconscious, inebriated
- In adequate x-rays – request CT scan if needed
- Normal looking x-rays – role of dynamic x-rays
- Multiple lesions
- Pre-existing conditions – Ank spond., Rh. arthritis etc
- Changing neurology – assess and reassess
- Remember SCIWORA
- Interpretation of paediatric x-rays





Straight lateral images may not always tell the whole story…





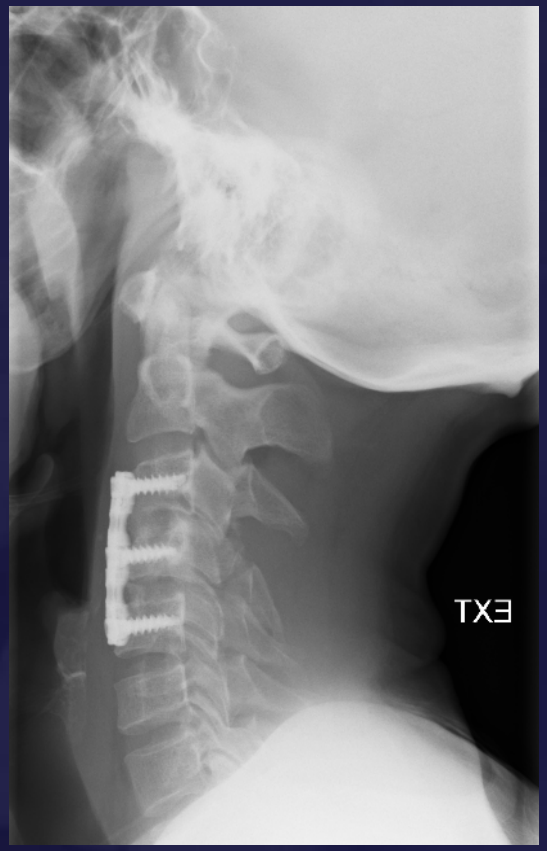
Posterior stabilisation alone can sometimes be adequate

A significant injury may not only distract the patient's focus…

Beware of a concomitant injury!

Note the Hangman's fracture in addition to the facet subluxation

Continued assessment is necessary even after adequate initial reduction and stabilisation

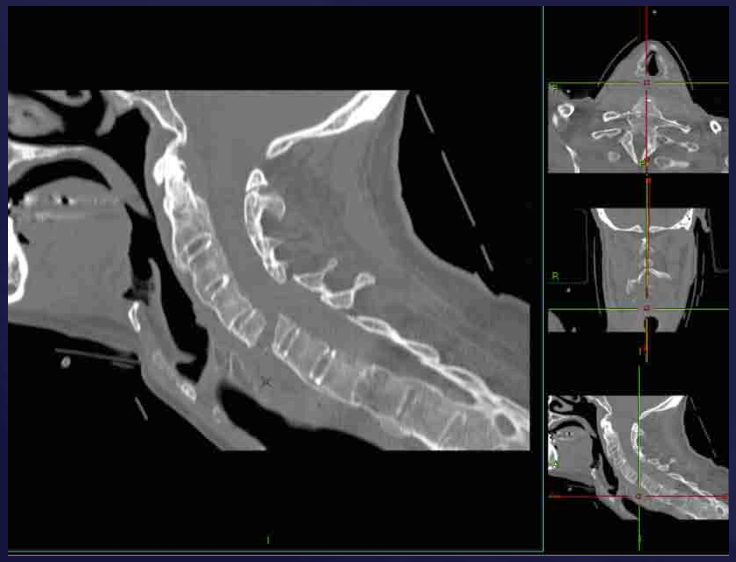


4 Weeks post halo – progressive kyphosis

Surgery: Anterior stabilisation with autologous graft and plate

Paediatric spine:

- Increased incidence at C0/C1/C2
- Remember ossifications centres
- Psuedosubluxation at C2/3 and C3/4
- Anterior wedging of vertebral bodies
- Increased pre-vertebral space
- SCIWORA is common



Ankylosing spondylitis: Fracture through vertebral body treated in Halo

Good fusion and remodelling at 6 months

Surgery only rarely necessary

Day3

6 weeks

6 months

Rehabilitation

- A dedicated multi-disciplinary team is vital during rehabilitation after SCI
- Occupational therapy plays an important role in the rehabilitation
- The therapeutic goal should be to maximize function
- The three prime aspects are self-care, productivity and leisure
- Community reintegration is another important aspect in maintaining quality of life

Machine Assisted therapies

FES arm cycle ▼

Lokomat® ▼

FES Tricycle ▼

- Functional Electrical Stimulation (FES) uses electric impulses to control peripheral nerves aimed at achieving function
- FES has been used to aid standing, grasp control, ambulation, bladder/bowel management and respiratory support
- Lokomat®: Robot assisted gait orthosis that automates locomotion therapy

Long term issues in SCI

- Rehabilitation
- Skin care
- Mobility
  Walking aids, wheel chair, Lokomat®, Brain-computer interface
- Pain and spasticity
  Medications, Baclofen pumps, Rhizotomy, tendon release
- Urological issues
  Autonomic dysreflexia, recurrent UTI, urinary calcluli
- Psychosocial issues
  adjusting to disability, depression, cultural adjustments
- Occupation
- Addressing sexual and reproductive needs
  Erectile dysfunction, Electro-ejaculation, psychological burden, relationships

Functional Outcome measures

Functional Independence Measure (FIM)

Scale 1-7; examples below:
7: Complete independence (timely and safely)
4: Minimal assistance (Subject contribution 75%)
1: Total assistance (Subject 0%)

Modified Barthel Index

Scale 0-15
To establish the degree of independence from any help, physical or verbal

Walking Index for Spinal Cord Injured (WISCI)

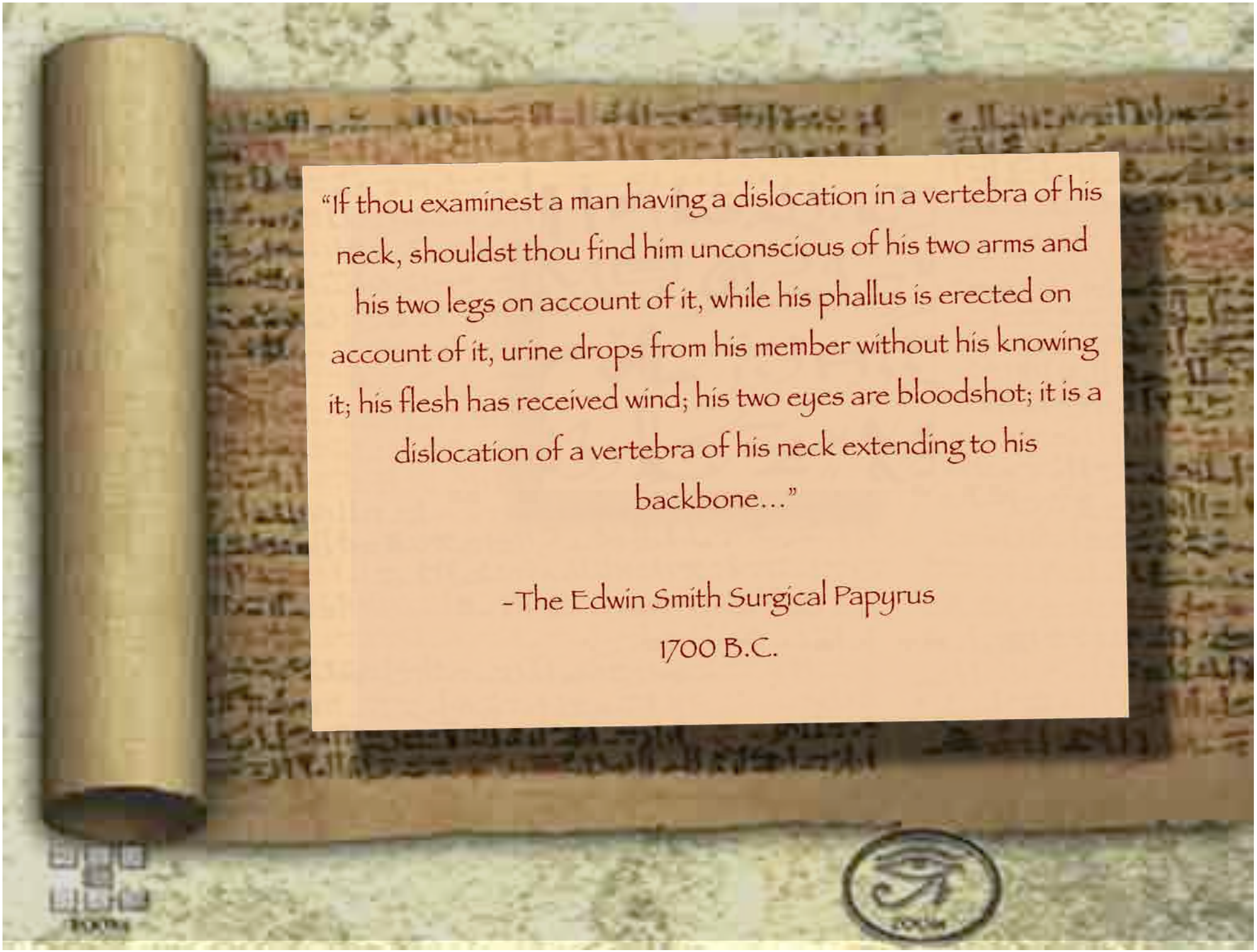
Scale from 0-20; Score examples below:
13: ambulates with walker, no braces or assistance
16: Ambulates with two crutches, no braces or assistance
20: Ambulates with no devices or assistance

The Spinal Cord Independence Measure (SCIM)

Scale from 0-100; Score examples below:
useful for assessing changes in performance in patients with SCI

Research areas

- Hyperacute management of Spinal trauma
  Pharmaceutical agents, cooling etc
- Role of early decompressive surgery
- Spinal cord regeneration
  The role of stem cell and induced pluripotent cells
- Brain-Computer Interface
- Intervention for management of spasticity and pain


"If thou examinest a man having a dislocation in a vertebra of his neck, shouldst thou find him unconscious of his two arms and his two legs on account of it, while his phallus is erected on account of it, urine drops from his member without his knowing it; his flesh has received wind; his two eyes are bloodshot; it is a dislocation of a vertebra of his neck extending to his backbone..."
-The Edwin Smith Surgical Papyrus
1700 B.C.

Thank you