

Spinal trauma – Imaging and management

Canadian C-spine rules

- Are any of the following **present** such that clinical clearance is inappropriate? Yes: radiography. No: proceed
 - Glasgow coma scale (GCS) <15
 - Presence of distracting injuries
 - Intoxication
- Are ≥ 1 high-risk factors **present** that mandate radiography? Yes: radiography. No: proceed
 - Age >65 years
 - Dangerous mechanism*
 - Paraesthesia in extremities
- Are ≥ 1 low-risk factors **present** which allow clinical clearance to be attempted? No: radiography. Yes: proceed
 - Simple rearend motor vehicle collision (MVC)**
 - Sitting in Emergency Department
 - Ambulatory at any time since
 - Delayed onset of neck pain
 - Absence of midline cervical spine tenderness
- Able to actively rotate neck 45 degrees left and right? No: radiograph. Yes: cervical spine cleared clinically
- *Dangerous mechanism includes:
 - Fall from height ≥ 1 metre or 5 stairs
 - Axial loading to head e.g. diving
 - MVC involving
 - High speed (≥ 60 mph)
 - Rollover
 - Ejection
 - Pedestrian or cyclist struck by a motor vehicle
- **Simple rearend motor vehicle collision excludes:
 - Pushed into oncoming traffic
 - Collision with bus or large truck
 - Rollover
 - High speed

National Emergency X-Radiography Utilization Study (NEXUS) criteria:

- Provided all of the following are **absent**, cervical spine can be cleared clinically; if ≥ 1 are **present** then radiography is required
 - Focal neurological deficit
 - Midline spinal tenderness
 - Reduced level of consciousness
 - Intoxication
 - Distracting injury

Which rules to use?

- Both have their advantages and disadvantages
- The Canadian C-spine rules are useful in the context of midline tenderness because clinical clearance can still be attempted provided ≥ 1 other low-risk factors are present
- The NEXUS criteria are useful in the context of age >65 and dangerous mechanism because these do not mandate radiography
- Ultimately, the decision of whether or not imaging is required is a clinical one; if in doubt, it is best to err on the side of caution and proceed to imaging
 - However, remember that imaging is not without its disadvantages such as radiation, discomfort and pressure sores from ongoing immobilisation, inconvenience to the patient, increased workload for radiographers

Primary imaging modality

- CT cervical spine should be used if any of the following are **present**
 - Elderly patients
 - Patients with known or presumed cervical spine degenerative disease
 - GCS <13
 - Intubated patients
 - Inadequate plain film series
 - Suspicion or certainty of abnormality on plain film series
 - Patients being scanned for head trauma and/or multi-region trauma as well
- In the absence of the above, 3-view plain radiographs (lateral, anteroposterior and odontoid peg) should be adequate

Cervical spine radiograph interpretation

- ABCD approach
 - Adequacy and alignment
 - Bones
 - Cartilage and other soft tissues
 - Dens and disc spaces
- Lateral view
 - Identify C1-7 and the superior border of T1
 - If the superior border of T1 cannot be identified, the film is inadequate and a swimmer's view should be requested
 - Check the alignment of the following three lines; each should be smooth and unbroken
 - Anterior vertebral line (along the anterior margins of the vertebral bodies)
 - Anterior spinal line (along posterior margins of the vertebral bodies)
 - Posterior spinal line (along the bases of the spinous processes); this may show a step at C2 but should not be >2 mm posterior to line
 - Check that Wackenheim's line drawn along the clivus passes posterior to the peg; if it intersects the peg, suspect atlanto-occipital dislocation
 - Check that the anterior cortex of the peg
 - Closely opposes the anterior arch of C1; this gap should be <3 mm in adults and <5 mm in children
 - Is continuous with the anterior cortex of the C2 body; displacement implies a fracture
 - Check that the posterior cortex of the peg is continuous with the posterior cortex of the C2 body; displacement implies a fracture

- Check that Harris' ring (white ring projected over the base of the peg and part of the C2 body) is normal; it is normal for this ring to appear incomplete over its superior and/or inferior borders but disruption of the anterior and/or posterior margins implies a fracture through the base of the peg or the body of C2
- Examine all vertebrae for preservation of height, width and integrity of the bony cortex; joints spaces should be uniform
- Check that the vertebral soft tissues are normal (C1-4 <7 mm and C5-7 <22 mm); any bulges indicate haemorrhage and suggest injury
- Anteroposterior (AP) view
 - Check that the spinous processes are in a straight line
 - Check that the space between adjacent spinous processes is approximately equal
- Odontoid peg view
 - Check that the lateral margins of C1 align vertically with those of C2; lateral displacement of the former compared to the latter implies a burst fracture, or Hangman's fracture
 - Check that the spaces on each side of the peg are approximately equal; if not, suspect C1 rotary subluxation
 - Check for a fracture line across the base of the peg; it is very common to see a thin black line (Mach band) across the top or base of the peg which is an optical illusion from superimposition; the gap between the two upper incisors can also cause an apparent vertical fracture

Thoracic and lumbar spine radiograph interpretation

- Lateral view
 - Identify three columns
 - Anterior
 - Anterior longitudinal ligament
 - Anterior annulus fibrosus
 - Anterior 2/3 vertebral body
 - Middle
 - Posterior longitudinal ligament
 - Posterior annulus fibrosus
 - Posterior 1/3 vertebral body
 - Posterior
 - Facet joints
 - Pedicles
 - Posterior ligaments
 - Ligamentum flavum
 - Interspinous ligament
 - Supraspinous ligament
 - Examine all vertebrae for preservation of height, width and integrity of the bony cortex; joints spaces should be uniform
 - Check for loss of height or wedging of the vertebral bodies which suggests a compression fracture
 - The posterior margin of each vertebral body should be slightly concave; loss of this concavity may be associated with a wedge fracture
- AP view
 - Examine all vertebrae for preservation of height, width and integrity of the bony cortex; joints spaces should be uniform
 - Check that the spinous processes are in a straight line
 - Check that the space between adjacent spinous processes is approximately equal

- Check the width between pedicles; normally pedicles gradually splay apart but sudden widening suggests a fracture
- Check the paraspinal lines on a thoracic spine radiograph
 - Right paraspinal line should not be visible
 - Left paraspinal line should be closely applied to vertebral bodies with the vertical shadow of the descending aorta lateral to it
 - Any displacement or bulging should be regarded as a haematoma from a vertebral body fracture

Initial management of spinal trauma:

- Manage patients with a dangerous mechanism of injury from an ABCDE perspective
- Patients with suspected or confirmed spinal trauma should have their spine immobilised in a neutral position
- This can be with manual inline stabilisation (MILS) initially followed by triple immobilisation (collar, blocks and tape) at the earliest opportunity
- If airway compromise is suspected, a jaw thrust can be applied simultaneously with MILS; head-tilt and chin-lift manoeuvres are contraindicated as these may exacerbate spinal trauma
- Patients requiring intubation and ventilation may have their triple immobilisation removed but this must be substituted with MILS applied by an assistant

Further management of spinal trauma

- Give analgesia for pain e.g. morphine 1-10 mg IV
- For agitated patients who are unable to cope with immobilisation, every effort should be made to relieve the cause of agitation e.g. analgesia for pain; sedation with or without intubation and ventilation may be necessary
- Patients should not be forcibly restrained by immobilisation as this is likely to exacerbate injury
- Spinal boards are for extrication and transport purposes only; on arrival to the Emergency Department, patients should be log-rolled for removal from the board and examination of the back with or without digital rectal examination
- During prolonged immobilisation consider IV maintenance fluid and toileting with bedpans