UHL policy for the initial clinical management and radiological evaluation of suspected cervical spine injuries in adults

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2. Abbreviations

CDR  Clinical decision rule
CSI  Cervical spine injury
CT  Computed tomography
CTJ  Cervicothoracic junction
ED  Emergency Department
HCA  Healthcare assistant
LRI  Leicester Royal Infirmary
SCIWORA  Spinal cord injury without radiological abnormality
UHL  University Hospitals of Leicester NHS Trust

3. Introduction

This policy describes effective clinical management and investigation of suspected blunt cervical spine injuries (CSI) based on guidance from the National Institute for Health and Care Excellence (NICE) published in January 2014. [1]

Following blunt trauma, CSI should be suspected in any of the scenarios below:

- Alert patient complaining of posterolateral neck pain
- Alert patient with the following triad of features (see box 2 of the proforma shown in Appendix A) even if not complaining of neck pain [2]:
  - Evidence of trauma above the clavicles
  - Not ambulatory since injury
  - A mechanism of injury from a clearly defined list (see box 3 of the proforma)
- Altered level of consciousness and any evidence of trauma above clavicles
- New limb weakness
- Patient brought to Emergency Department (ED) with cervical spine precautions in situ

Effective management of patients with suspected CSI starts with the early and consistent application of a clinical decision rule (CDR) that allows injuries to be safely ruled out clinically wherever possible - without unnecessary exposure to ionising radiation. Where imaging is required, the choice between plain film radiographs and computed tomography (CT) should reflect the pre-test probability of CSI. In addition, the need for patients to undergo both investigations sequentially, with the associated risks of increased exposure to radiation and unacceptable processing delays, has to be minimised.

4. Scope

The policy covers trust procedures for the clinical management and, where indicated, radiological investigation of adult patients from the moment an acute CSI is suspected to the point at which clinically important CSI has either been ruled out or confirmed. It applies to trauma patients brought to the ED as well as those who sustain injuries while cared for elsewhere within UHL.
5. **Step-by-step clinical management and radiological evaluation**

### A. Initial clinical assessment and selection for imaging

ED clinicians will use the proforma ‘Suspected cervical spine injury – ED assessment’ (see Appendix A and Appendix B) to help decision-making and guideline compliance (NB: Other departments may also choose to follow the ED proforma):

- In alert and stable trauma patients, the decision regarding ‘clinical clearance’ of the c-spine or need for radiological evaluation is taken according to the Canadian c-spine rules (on which guidance contained in NICE CG176 is based) [3]
- In unstable patients and those with altered level of consciousness, imaging decision is taken as per NICE CG176

For a full list of indications for imaging see Section 6.

### B. Preparation for imaging

1. All jewellery will be removed from affected body parts in ED / by the referring team
2. Immobilisation
   - Standard immobilisation requires hard cervical collar, head blocks and tape but can be provided manually during initial assessment
   - Spinal boards help extrication but cause pressure damage, do not add value once patient is placed on ED trolley and must therefore be removed ASAP.
   - In alert and stable patients without neurological signs, **senior clinicians** may rarely relax or forgo immobilisation to promote both comfort and safety (e.g. if pre-existing fixed c-spine deformity or immobilisation refused). Under those circumstances, the clinician will pre-alert the imaging department and clearly state the clinical rationale on the request form.
   - Walking, alert and stable patients do not require immobilisation unless peripheral neurological deficit or paraesthesia (pins & needles) present. [4]
   - NB: All immobilisation decisions must be clearly documented in patient’s notes

### C. Escorting arrangements – safety during transfer to imaging department

- A nurse trained and competent in safe transfer techniques (including log-rolling) of patients with cervical spine precautions will escort all patients
  - With cervical spine immobilisation in situ OR
  - Requiring cervical spine CT (regardless of whether they are immobilised or not)
- Ambulatory patients requiring plain film imaging only do not usually require an escort

### D. Plain film imaging process and escalation to CT

A flowchart depicting the entire process described below can be found in Appendix C.

1. The standard 3-view plain film trauma series of the cervical spine consists of a lateral, anteroposterior and odontoid peg view. Radiological ‘clearance’ of the cervical spine hinges on the adequacy of the obtained views; in particular of the cervicothoracic junction (CTJ; visibility of the upper part of T1 vertebral body)
2. The lateral view is taken first. The following will ensure the best chance of adequacy:
   a. In ambulatory patients, the radiograph may be taken in an upright position and ideally with the patient bearing weights to draw down their shoulders
   b. In trolley patients, appropriately trained radiographers will provide gentle downward axial traction of both arms unless there is clinical evidence of
shoulder or elbow dislocations or fractures of the clavicle or arm that have not been appropriately splinted or other major tissue damage (e.g. degloving). [5]  

NB: If no appropriately trained radiographer or other radiographer is available (as may occur at night etc) the responsible clinician will be notified as soon as patient has been positioned for imaging to provide the necessary traction.

3. The radiographer will review the lateral view on screen before it is saved on PACS
   a. If radiographer deems lateral view to be both adequate and grossly normal:
      i. Three-view series is completed and saved on PACS
      ii. Responsible clinician will review study on return to clinical area and
         1. Request CT if inadequate, suspicious or abnormal
         2. Clear c-spine if normal
   b. If the radiographer deems the lateral view to be inadequate:
      i. Three-view series is completed and saved on PACS
      ii. Radiographer notifies the duty ER radiologist of the issue
      iii. Duty ER radiologist will access the study on PACS and request a limited CT of the inadequately visualised areas or complete cervical spine CT as indicated [6]
      iv. Patient is taken for CT directly from plain film area
   c. If the radiographer deems the lateral view to be grossly abnormal:
      i. No further plain film views are taken
      ii. Lateral view is saved on PACS
      iii. Radiographer notifies responsible clinician of the findings by telephone (for ED, see ED phone map on Sharepoint)
      iv. Clinician will access the study on PACS and request a complete CT of the cervical spine (together with CT of other body areas if clinically indicated)
      v. Patient is taken for CT directly from plain film area

E. CT time scales and abnormal results communication

All CTs will be performed within 1h of the request.

For all CTs, a provisional report will be made available on the UHL Picture Archiving and Communication System (PACS) within 1h from the start of imaging.

The reporting radiologist will inform a senior clinician (middle grade or above in ED or responsible ward team) of any CT demonstrating an acute abnormality by telephone (for ED, see ED phone map on Sharepoint).

F. Clinical management post-imaging

- Patients with immobilised c-spines awaiting 'clearance' must not be admitted to EDU
- Patients with c-spine injury confirmed by CT should be / remain immobilised and reviewed by the orthopaedic middle grade to determine further management. NB: In ED, patients MAY be transferred to the orthopaedic ward prior to orthopaedic review in order to comply with the 4-hour ED time frame if ALL of the following apply
  o Orthopaedic middle grade informed of transfer
  o Patient alert
  o Vital signs stable
  o No significant other acute medical conditions or injuries (e.g. CT-positive head injury)
  o Cervical spine injury not reported as 'unstable' by radiologist
  o Spine assessment (ASIA) chart completed if any focal neurological deficit had been found (see Appendix D)
  o The following statement recorded in patient’s ED notes: ‘Spinal stability uncertain - follow spine protection protocol on ward’
• Patients with new focal neurological deficit despite normal CT should be / remain immobilised and reviewed by the orthopaedic middle grade to determine further management including need for MR.
• Intubated patients should remain immobilised. If clinical reassessment is not possible after 24h the options are
  o Radiological clearance using MR
  o Signed statement by consultant intensivist and consultant orthopaedic surgeon that occult cervical spine injury / SCIWORA is deemed to be unlikely given that CT has been reported as normal, and that cervical spine precautions can be removed. [7]
• For all other patients, the c-spine can be declared 'radiologically cleared'. Cervical spine precautions can be removed and this must be documented in the patients’ record.

6. Indications for imaging

A. Indications for CT

- GCS less than 13 on initial assessment in ED (or ward if injury occurred there)
- Intubated
- Definitive diagnosis of cervical spine injury is needed urgently (for example, before emergent surgery)
- Other body areas scanned for head injury or multi-region trauma
- age 65 years or older
- dangerous mechanism of injury (as defined in box 4 of the proforma shown in Appendix A)
- focal peripheral neurological deficit
- limb paraesthesia (pins & needles)
- Plain X-rays are technically inadequate
- Plain X-rays are suspicious or definitely abnormal

NB: The following additional indications, although not covered by NICE CG176, represent an important area of clinical practice:

- Patients with GCS 13-14 within 2h of injury. Senior clinical judgement will determine need for CT if prolonged immobilisation is not tolerated or a period of observation followed by reassessment (see proforma).
- Patients with known significant c-spine pathology (see box 5 on proforma)

B. Indications for plain film series

Plain films are only appropriate in alert and stable patients requiring imaging who do not meet any of the CT indications listed above.

C. Indications for CT or MR neck vessel angiography

Consider CT or MR angiography of the neck vessels if injuries seen on CT (fractures involving foramina transversaria or lateral processes, or vertebral malalignment) raises suspicion of vascular injury or if patient has features of a posterior circulation stroke.

D. Indications for MR

Consider MR to look for ‘spinal cord injury without radiological abnormality’ (SCIWORA) if focal peripheral neurological deficit despite normal CT, or for radiological clearance of the c-spine in intubated patients in whom clinical reassessment is not possible after 24h.
7. Training

Radiographers and ED nursing staff will, where required, receive appropriate brief training in the provision of safe and effective arm traction to facilitate optimal lateral plain film views of the cervical spine.

8. References

6. RethnamU, YesupalanRSU and BastawrousSS. The Swimmer’s view: does it really show what it is supposed to show? A retrospective study. BMC Med Imaging 2008;8:2.
Appendix A. Suspected cervical spine injury – ED assessment proforma (p1)
Appendix B. Suspected cervical spine injury – ED assessment proforma (p2)

- **Mechanism of injury**
  - **Fall**
  - down stairs
distance in steps:
  - from height
distance in feet:
  - on level ground
  - riding incident

- **Motor vehicle collision (MVC)**
  - Seatbelt worn: Yes No
  - Did vehicle roll over: Yes No
  - Was patient ejected: Yes No
  - Patient vehicle type (please circle):
    - Other

- **Object of collision (please circle)**
  - Other vehicle type or object
  - None

- **Collision schematic**
  - Mark patient’s position in vehicle
  - Tick direction of travel
  - Draw an arrow to indicate point & direction of impact with object

- **C-spine assessment in unstable patients**
  - Arrange CT if:
    - GCS less than 13 on arrival in ED
    - Intubated
    - Meets criteria for CT head
    - Other body areas require CT
    - Focal peripheral neurological deficit
    - Presence or absence of cervical spine integrity needs to be established urgently (e.g., before surgery)
  - If none of the above AND alert but abnormal vital signs
    - Reassess patient after aggressive resuscitation
    - Stabilized patients - continue down flowchart on reverse
    - Persistent instability – CT body regions of concern AND c-spine
    - If none of the above AND stable vital signs but GCS 13 or 14
      - Use clinical judgment; select from the following options
        - Immobilization and reassessment at 2h from injury
          (If GCS then 15 continue down flowchart on reverse; CT if not)
        - Early CT c-spine (AND head) if immobilization poorly tolerated

- **C-spine immobilisation needs**
  - Standard immobilisation requires hard cervical collar, head blocks and tape but can be provided manually during initial assessment
  - Spinal boards help extrication but can cause pressure damage and do not add value once patient is placed on ED trolley. Remove ASAP.
  - In alert and stable patients without neurological signs, senior clinicians may rarely relax or forget immobilisation (e.g., if pre-existing fixed c-spine deformity or immobilisation refused). Document rationale on request form and inform radiographers.
  - Walking, alert and stable patients do not need to be immobilised unless peripheral neurological deficit or paraplegia are present
  - Immobilisation is mandatory if patient altered or unstable, or new peripheral neurological deficit or radiological abnormality found

- **C-spine imaging results**
  - Plain films
    - Normal
    - Abnormal
    - Inadequate
  - NB: Request CT if films are suspicious or abnormal (radiographers will arrange CT themselves if films merely technically inadequate)
  - CT
    - Normal
    - Abnormal
  - NB: Consider CT or MR angiography of the neck vessels if injuries seen on CT (fractures involving foramina transversaria or lateral processes, or vertebral misalignment) raises suspicion of vascular injury or if patient has features of a posterior circulation stroke.

- **Post-imaging care guidance**
  - Acute CT abnormality or new focal neurological deficit
    - Keep immobilised and refer to orthopaedic team. NB: If focal peripheral neurological deficit despite normal CT, MRI can show spinal cord injury without radiological abnormality ("SCIWORA").
  - Neither of the above but patient intubated and ventilated
    - Keep immobilised. If reassessment possible after 24h the options are MRI or mobilisation, signed off by two consultants.
  - All other patients can be declared ‘radiologically cleared’
    - Remove c-spine precautions and record outcome in the notes.
Appendix C. Plain film imaging in suspected CSI – operational process

Plain film imaging in suspected cervical spine injury (CSI)
Operational process including escalation to CT

- Patient ambulatory? (Y/N)
  - Lateral view on trolley with radiographer providing arm traction
  - Lateral view in upright position with patient holding weights

- Radiographer to inspect lateral view

- Film normal and adequate? (Y/N)
  - Inadequate only? (Y/N)
    - Complete 3-view series
    - Save on PACS
    - Send patient back to ED
  - No further films
  - Save on PACS
  - Patient remains in X-ray
  - Phone ED clinician

- Radiologist interprets film(s)

- Film(s) inadequate, suspicious or abnormal? (Y/N)
  - ED clinician to discuss CT with radiologist and request on ICE
  - Radiologist arranges limited CT (or complete, at their discretion)

- ED clinician ‘clears’ c-spine

- CT c-spine

\[\text{NB:} \text{ May also be done by ED staff if no suitable radiographer available}\]
**Muscle Grading**

0  total paralysis
1  palpable or visible contraction
2  active movement, full range of motion, gravity eliminated
3  active movement, full range of motion, against gravity
4  active movement, full range of motion, against gravity and provides some resistance
5  active movement, full range of motion, against gravity and provides normal resistance
5* muscle able to exert, in examiner's judgement, sufficient resistance to be considered normal if identifiable inhibiting factors were not present
NT not testable. Patient unable to reliably exert effort or muscle unavailable for testing due to factors such as immobilization, pain or effort or contracture.

**ASIA Impairment Scale**

- **A = Complete:** No motor or sensory function is preserved in the sacral segments S4-S5.
- **B = Incomplete:** Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.
- **C = Incomplete:** Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.
- **D = Incomplete:** Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
- **E = Normal:** Motor and sensory function are normal.

**Clinical Syndromes (Optional)**

- Central Cord
- Brown-Séquard
- Anterior Cord
- Conus Medullaris
- Cauda Equina

**Steps in Classification**

The following order is recommended in determining the classification of individuals with SCI:

1. Determine sensory levels for right and left sides.
2. Determine motor levels for right and left sides. **Note:** In regions where there is no nyctoe to test, the motor level is presumed to be the same as the sensory level.
3. Determine the single neurological level.
   - *This is the lowest segment where motor and sensory function is normal on both sides, and is the most cephalad of the sensory and motor levels determined in steps 1 and 2.*
4. Determine whether the injury is Complete or Incomplete (sacral sparing).
   - If voluntary anal contraction = No and all S4-S5 sensory scores = 0 and any anal sensation = No, then injury is COMPLETE.
   - Otherwise injury is incomplete.
5. Determine ASIA Impairment Scale (AIS) Grade:
   - **Is injury Complete?**
     - NO
       - Is injury motor incomplete? (Yes=sensory and motor function more than three levels below the motor level on a given side.)
       - YES
         - Are at least half of the key muscles below the (single) neurological level graded 3 or better?
           - NO
             - AIS = C
           - YES
             - AIS = D
   - If sensation and motor function is normal in all segments, AIS = E
   - **Note:** AIS E is used in follow up testing when an individual with a documented SCI has recovered normal function. If at initial testing no deficits are found, the individual is neurologically intact; the ASIA Impairment Scale does not apply.