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## Removal of Spinal Protection from Obtunded Trauma Patients

### Summary

Prolonged spinal immobilisation in trauma patients carries significant risks. Following a normal CT examination, the risks of continued immobilisation may exceed the risk associated with a spinal injury being present. Evidence suggests, that removal of spinal protection from trauma patients with normal CT scans is safe and reduces complications<sup>1</sup> Spinal protection should be removed from intubated and ventilated patients within 48 of admission to ICU, where there is no contraindication.

### Protocol

This protocol provides for the removal of spinal protection measures in selected trauma patients, with a normal cervical spine CT scan, as reported as by a consultant radiologist with a specialist interest in musculoskeletal radiology. Each trust radiology department will need to identify those consultants with a special interest that can provide the required report.

The protocol should be followed during normal working hours, under the direction of an ICU consultant. The protocol assumes that Orthopaedic Surgeons are responsible for the management of cervical spine injury. If other specialists are involved then the same considerations / criteria apply.

Patient selection is crucial. The following inclusion / exclusion criteria apply.

### Patient Selection

Inclusion Criteria	Exclusion Criteria
Intubated, sedated, and ventilated patients on ICU with spinal precautions and a trauma collar	Patients with motor / sensory deficits prior to intubation. (potential for SC injury - Urgent MRI advised).
Absence of overt clinical evidence of spinal cord injury prior to intubation	Patients with Ankylosing Spondylitis.
Patients who will be intubated for >24 hours	Patients with degenerative spinal disease where the CT scan suggests instability due to the pre-existing disease rather than trauma.
Completion of secondary survey	Patients requiring time critical transfer to another centre <sup>3</sup> .
Normal cervical spine anatomy on CT scan as reported by a consultant radiologist with an interest in musculoskeletal imaging. <sup>2</sup> ( CT slices must be less than 3mm thickness.)	Patients with severe traumatic brain injury i.e. significant haemorrhage or contusion on CT brain, base of skull fracture, or penetrating brain injury <sup>3</sup> .
	Radiological evidence of bony injuries to the thoracic and lumbar spines <sup>4</sup> .

Following reporting of the cervical spine CT scan by an MSK (or other agreed specialist radiologist) a report will be issued that states:

*There is no evidence for fracture or mal-alignment of the cervical spine. No paravertebral soft tissue abnormality. There is no radiological evidence of bony injuries to the thoracic and lumbar spines. Appearances of the cervical spine are consistent with the ICU protocol for the removal of spinal protection provided all the inclusion and exclusion criteria are met.*

If inclusion criteria are met, and there are no exclusion criteria, spinal protection should be removed and clearly documented in the notes. No further spine immobilisation, log rolling, or special positioning is required and the patient should be managed in the context of their remaining injuries<sup>5</sup>.

Immobilisation should be replaced immediately if the patient develops evidence of spinal cord instability and referred to the orthopaedic team promptly

Patients who do not meet the requirements of the protocol for removal of spinal protection, should remain immobilised and the appropriate specialists (orthopaedics / neurosurgery/ intensive care) determine when immobilisation can be safely removed. Very few patients outside the Major Trauma Centre will require prolonged spinal immobilisation<sup>5</sup>.

### **Audit**

All patients entered into this protocol should be followed up by orthopaedics and audited by ICU.

### **Notes**

1. See supporting literature below.
2. No intubated trauma patient should leave ED for ICU without a full trauma CT series including head, neck, chest, abdomen and pelvis. Patients requiring life-saving surgery are the exception; these patients should be transferred to theatre for definitive haemorrhage control. When circumstances allow they should have a full trauma CT and enter this protocol.

If the initial CT scan is not reported by one of the agreed specialist radiologists, immobilisation should be continued until such times as the scans can be reviewed by one of the agreed members of the panel.

The radiology report standardises the report to allow it to be included in this protocol and the responsibility for the removal of protection lies with the combined care between intensive care and orthopaedics. There may be occasions when there is a delay before a MSK radiologist can verify the reports. Under these circumstances spinal protection may be removed following agreement between a consultant orthopaedic surgeon and a consultant intensivist.

3. The management of patients with traumatic brain injury is complicated and unpredictable. Occasionally patients will be admitted to ICU inappropriately or they will deteriorate rapidly and will be re-referred to the neurosurgeons. If these patients require time critical transfer to a neurosciences centre they should not be entered into this protocol. Alternatively, patients may need referral to a tertiary centre during the course of the day but will not require a time critical transfer. These patients are still appropriate for inclusion in this protocol, indeed it is arguable that these patients will benefit most from prompt removal of spinal protection. If, after neurosurgical referral, the patient is not transfer, the neurosurgeons should be consulted on whether spinal protection can be removed. Their advice should be recorded in the notes and discussed with the intensive care and orthopaedic teams at the referring hospital. The aim should always be to remove protection within 48 hours.

4. Certain spinal injuries may be compatible with removal of protection despite meeting the exclusion criteria met.

- Facet joint fractures of the thoracic and lumbar spine
- Spinous process fractures
- Wedge compression fracture with loss of vertebral body height of less than 25%
- Type 1 odontoid fracture
- End-plate fracture
- Transverse process fracture
- Trabecular bone injury
- Osteophyte fracture, excluding corner or teardrop fractures
- Isolated avulsion fractures

If any of these injuries are present the decision to remove protection should be taken jointly by the intensive care and orthopaedic consultants within 48 hours of admission. In the interim, or if protection is to remain in place, a Philadelphia or Aspen collar should replace a hard collar and patients should be sat at 30 – 45° wherever practicable.

5. If the patient meets the protocol criteria it is not necessary to inform orthopaedics prior to removal of protection. If not reviewed by orthopaedics within 24 hours they should be informed. Patients may require immobilisation for other injuries, for example pelvic fractures. If this is the case the instructions should be documented in the notes.

### Supporting literature

Cervical spinal cord injury in unconscious trauma patients is uncommon yet devastating. These injuries may present as asymptomatic, unstable bony or ligamentous damage which may progress to a spinal cord lesion. Consequently, trauma patients are immobilised until the spine can be “cleared” and the current teaching dictates that this is done clinically by eliciting spinal tenderness or evidence of cord injury. Clinical clearance necessitates that the patients are awake and fully orientated and is, clearly, impossible with intubated, sedated and ventilated patients and therefore spinal protection is sometimes maintained in these patients until they are fully awake which may take many days or even weeks. Alternatively, clinical circumstances direct that spinal protection should be removed but it is currently an unsatisfactory ad hoc process.

The practice of precautionary spinal immobilisation originates from data published over 60 years ago demonstrating that 10 of patients who developed para or tetraplegia following trauma arrived at

hospital neurologically intact (reviewed in Blackham and Bengner 2011). Concern over the intervening years has shifted, however, to acknowledge the potential for spinal immobilisation to cause harm. This is particularly true of obtunded, intubated patients where prolonged immobilisation is associated with a range of serious complications which include pressure sores, increased intracranial hypertension, increased risk of airway complications, difficult central venous access, increased incidence of catheter related sepsis, increased incidence of ventilator associated pneumonia, and development of secondary spinal cord injury. Reviewed in Morris and McCoy 2004; Morris et al. 2004; Blackham and Bengner 2011; Traynelis and Kasliwal 2011; Panczykowski et al. 2011.

A broad consensus has now emerged that spines should be cleared radiologically where possible. There have been a variety of radiological investigations proposed; plain films, CT, CRI, and dynamic fluoroscopy, but over the last 10 years CT has become established as being sufficiently sensitive and specific to establish spinal stability. A series of large, multicentre studies have demonstrated that CT scans reported by a senior radiologist can serve to safely remove spinal protection.

The efficacy of this strategy is demonstrated by the absence of a single case of a patient developing a permanent neurological deficit from unrecognised ligamentous instability following a protocol based CT clearance of the c-spine. See, for example, Schuster et al. 2005; Hogan et al. 2005; Como et al. 2007; Tomycz et al. 2008; Hennessy et al. 2010; Como et al. 2011; Panczykowski et al. 2011). For example, the most recent of these case series describes over 14,000 patients without a single missed injury (Panczykowski et al. 2011) with sensitivity and specificity of greater than 99.9 in detecting an unstable cervical spine. Furthermore, a risk analysis suggests that the risks of complications due to spinal immobilisation exceed the risk of a unstable ligamentous injury following a normal CT scan (Dunham et al. 2008). Worldwide clinical experience also suggests that this approach is both clinically and medico-legally sound. A large number of centres in the US, UK, Europe and Australia use CT to remove spinal protection from obtunded trauma patients, effectively a large body of responsible medical opinion satisfying the Bolam test. CT cannot, however, adequately detect soft tissue injuries, in particular ligamentous injury in the absence of bony fracture. It is therefore argued that these injuries could cause instability if protection is removed and therefore MRI should be the investigation of choice. Studies in support of this approach come from the US and it is difficult to interpret these results, from a litigious medical environment, in the context of the UK trauma centre model of care where many of the MRIs would not be performed routinely. For example, Harris' group in Boston report the incidence of MRI detected injuries in these patients at around 20 K 30 but do not identify any patients who have gone on to develop permanent neurological injury (Harris et al. 2008; Schoenfeld et al. 2010; Simon et al. 2010), although a very small number of patients have been managed with longer term immobilisation and, occasionally, ORIF. Interestingly, in a recent review, despite the reservations of their clinical work they suggest a strategy similar to the BRI protocol (Anderson et al. 2010). This debate is usefully summarised in the editorials accompanying Panczykowski's study, Traynelis and Kasiwal (2011). Further, non US, perspectives are provided by Blackham and Bengner (2010) in the UK and by Cooper and Ackland (2005) in Australia.

In summary, a consultant reported normal CT scan of the spine is sufficient to remove spinal protection within a clearly defined protocol. The patients should be appropriately selected and

examined when awake for signs of neurological injury. The evidence also confirms that these patients may have soft tissue injuries demonstrated by MRI but these injuries of unclear significance and have never been demonstrated to be associated with c-spine instability causing permanent neurological deficit.

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## The Initial Spinal Management of Sedated and Ventilated Trauma Patients

Exclusion criteria: Ankylosing Spondylitis, motor/sensory deficit (prior to sedation), CT scan slice thickness >2mm  
If daytime imaging (8 am - 5 pm) – spine plan to be given by 6pm.  
If out of hours (5pm – 8am), spine plan to be given by 12 pm after consultation with reviewing consultant radiology report.

