

# Cervical Spine Clearance in Australian Intensive Care Units

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## ABSTRACT

**Objective:** *Rigid or semi-rigid collar and spine board related complications may be causes of significant morbidity in intubated polytraumatised patients. As the process quantifying cervical spine injuries is controversial, exclusion of cervical spinal injuries (cervical spine clearance) can be delayed, thereby increasing complications associated with spinal cord immobilisation. We examined current practices in Australian ICU's by survey.*

**Methods:** *The intensive care unit or trauma services director and the senior nursing unit manager from 17 units within designated Australian trauma centres were surveyed separately by telephone. The presence of a written protocol for cervical spine clearance including radiological and clinical criteria, time goals for clearance, immobilisation methods and formal surveillance of collar related complications were assessed using a standardised questionnaire.*

**Results:** *All states and territories were represented. Of those services surveyed, only 50% had a written protocol, 50% had no specific time goal for cervical spinal clearance and the method of clearance ranged from plain cervical spine X-rays only to routine use of MRI. Immobilisation methods also varied, including use of rigid (hard) or soft collars with 71% having no formal surveillance of collar-related complications. Despite these results, 65% were satisfied with their approach to cervical spine clearance.*

**Conclusions:** *There is no standardised approach to the clearance of the cervical spine in intubated trauma patients in Australian intensive care units. In addition, morbidity from current practices and the true incidence of cervical spine injuries remains unknown. We recommend use of a written protocol and formal documentation of collar related complications. A standardised approach to radiological and clinical clearance of cervical spine injuries, which is practical, yet safe, remains a subject for future risk-benefit analysis. (Critical Care and Resuscitation 2003; 5: 91-96)*

**Key words:** Cervical spine, trauma, ligamentous, injury

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Cervical spine clearance in intubated, polytraumatised patients presents unique problems to the intensive care specialist. These patients are usually obtunded due to an associated head injury or drugs (recreational or medically administered) and haemodynamic instability or airway problems often confound the assessment. In addition, spinal immobilisation related complications of decubitus and pressure ulcers can occur within 30 minutes of spinal immobilisation.<sup>1</sup> Even when the cervical spine has been cleared of bony injury,

the possibility of ligamentous, soft tissue, or non-bony cervical spine injury is difficult to exclude. This may result in a further delay and an increase complications associated with collar and spinal board use.

The current practice of cervical spine clearance in Australian intensive care units was examined.

## METHODS

A standardised questionnaire was devised to investigate the following issues:

- the presence of written cervical spine 'clearance' protocols,
- radiological and clinical techniques used to assess cervical spine injury,
- established time goals for achieving cervical spine clearance,
- methods of immobilisation used in 'uncleared' patients and,
- surveillance and documentation of complications related to collar and board use.

The survey was undertaken over a 2 week period in 16 major hospitals throughout Australia using a standard questionnaire (appendix 1). The institutions were contacted by telephone and the director of the intensive care unit (ICU) was invited to answer each question. If the director was not readily available, the director of trauma was asked to participate. To provide insight into the nursing perspective, the senior nursing unit manager was also asked to complete the same questionnaire. Only intensive care units from hospitals with 'trauma centre status' were asked to participate. In the majority of cases both the medical and nursing participants from the same centre were taken through the questionnaire by the same investigator (either D. Lien or K. Powell). If one of the participants was not available, a follow-up call was made by either investigator. The responses of all participants were entered on separate questionnaire sheets and, for the purposes of analysis, were recorded on an Excel spreadsheet.

## RESULTS

A total of 16 centres participated. One hospital had a separate neurosurgical ICU, bringing the total to 17 intensive care units surveyed. All states and territories were represented (Table 1). The majority of participants were staff from an intensive care unit (i.e. 75% ICU directors, 25% directors of trauma and 94% ICU senior nursing unit managers).

**Table 1. State of origin and number of participating intensive care units**

State	NSW	VIC	QLD	SA	WA	ACT	NT	TAS
No ICU's	5	3	2	2	2	1	1	1

No ICU's = Number of intensive care units

There was a recurring difference between the responses from the directors and senior nursing unit managers (NUMs), suggesting that procedures or knowledge of agreed 'unit' procedures in many institutions were not clearly understood (Table 2). Many units did not have a written 'cervical spine clearance'

protocol and did not use time-goals in the clearance of cervical spine injuries (Table 2). While the ICU staff were usually involved in the management of cervical spine clearance in intubated trauma patients (e.g. from protocol development through to final arbitration on clearance of the cervical spine), the neurosurgical, orthopaedic and 'spinal' teams often had a significant input (Table 2). Table 3 shows that the most common initial films ordered in assessing cervical spine injury were static 3 view cervical vertebra series (e.g. antero-posterior, lateral and open-mouth or odontoid views), or a 3-view series plus a CT, either of the upper and lower cervical spine or of poorly visualised regions.

A significant number of units equated radiological clearance with clinical clearance, making no attempt to rule out ligamentous or soft-tissue injuries prior to removal of a cervical spine immobiliser. Some units managed patients as though radiological clearance equated to clinical clearance unless patients were likely to be assessable within 24 hours, in which case the cervical spine immobilisation was left in place. Some units used more than one technique for cervical spine clearance. Alternatively, a large number of units left the cervical spine immobilisation in place, in some cases for the full duration of intubation and ventilation, and then assessed patients either radiologically or clinically when the patient was more cooperative. A third of the intensive care units monitored patients for pressure sores from collar and board use, and of those that did not regularly monitor for decubitus or pressure sores, less than 25% felt that this practice was necessary (Table 2).

## DISCUSSION

After inconsistencies of cervical spine clearance were identified in our own practice we conducted a national audit in an attempt to review the current Australian practice and to standardise our own practice.

In our study, a major discrepancy often existed between the responses of the ICU or trauma directors and the senior nursing unit managers, indicating that clinical practice within many units was unclear. This lack of consistency has also been reported in a British study by Gupta and Clancy who found in a survey of 25 units, that cervical spine clearance was based on normal plain static radiology of the cervical spine in patients with no focal neurological signs in 19 units, and on the combined clinical examination (when the patients were awake) with a normal cervical spine X-ray, in 6 units. In only 4 of the 19 units lateral, anteroposterior and odontoid views of the cervical spine were required for 'clearance', and in 16 units a lateral cervical spine view only was required. Fifteen units had no guidelines in place.<sup>2</sup>

**Table 2. Cervical spine clearance protocols according to the directors and senior nursing unit managers of the intensive care units**

	% of directors	% of NUM
<i>Protocol for cervical spine clearance</i>		
Written protocol	37	60
'Verbal' protocol	25	7
Unknown	0	13
<i>Specialty involved in developing the protocol</i>		
Intensive care staff	31	30
'Joint effort'	69	60
Radiology	0	10
<i>Time goals and range in hours</i>		
Goals established	50	39
None or ASAP	50	61
Time goals in hours	4-48	4-48
<i>Specialist involved in final say on clearance</i>		
Intensivist	36	35
Neurosurgeon	44	53
Radiology	50	53
Orthopaedic surgeon	13	41
Spinal 'team'	6	11
Emergency medicine	6	0
<i>Immobilisation techniques used in uncleared patients</i>		
Hard collar	19	11
Soft collar	5	6
Philadelphia collar	14	28
Jordan frame	10	6
Log roll	19	22
Sedation	5	0
Paralysis	0	0
Sandbags	14	11
Modified log roll	5	0
Supine nursing	10	19
<i>Surveillance of complications related to collar and board use</i>		
Formal surveillance	31	29
Formal surveillance unnecessary	12	23
Satisfied with current practice	64	59

NUM = senior nursing unit manager, 'Verbal' protocol = an undocumented common clinical pathway or accepted practice agreed between the intensive care staff and other relevant specialties, 'Joint effort' = a cooperative effort between several specialties, usually neurosurgery and orthopaedics, ASAP = as soon as possible.

A common approach to cervical spine clearance in intubated or sedated polytraumatised patients involves radiological clearance after a normal three static film-series (e.g. lateral, anteroposterior and odontoid views) has been confirmed. A former ATLS chairman cites a 1990 study of 7500 trauma patients where 470 patients were identified with acute cervical spine injuries and claimed that "No obtunded patient with adequate three view screening examination correctly interpreted by the senior trauma surgeon and an experienced radiolo-

**Table 3. Initial radiological imaging ordered (in percent) by directors for cervical-spine clearance**

Anteroposterior/lateral/odontoid views	25
3-view series with CT	57
Anteroposterior/odontoid/oblique views	6
Anteroposterior/lateral views	6
Anteroposterior/lateral/oblique views	6

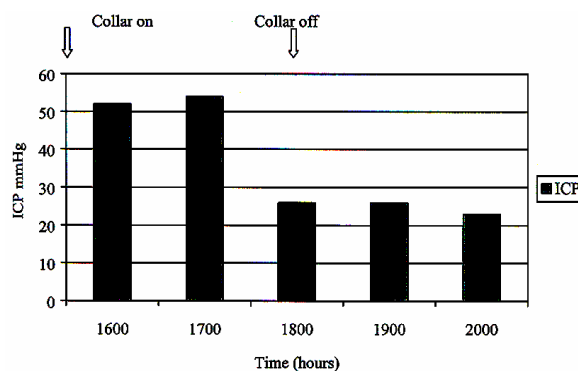
gist was subsequently identified as having an unstable cervical fracture” or if the three views are inadequate “a non-contrast CT of the relevant cervical spine portions is sufficient.”<sup>1</sup>

With the exclusion of a cervical spine bony injury, the concern of the possibility of cervical spine ligamentous injury, which usually has an incidence of < 1% of all major trauma patients, lingers.<sup>3</sup> Therefore, three questions remain: “should radiologically cleared patients have no collar, a soft collar, Philadelphia (semi-rigid) collar or hard collar applied?”, “Should strict log rolling still be enforced?” and “Should one attempt to clear the cervical spine of ligamentous injury as early as possible or wait until the patient is cooperative to assess the disorder either radiologically with flexion/extension films or clinically?”

Polytraumatised patients often emerge from sedation in an agitated state. In such cases strict immobilisation is usually unrealistic. It is our practice, where the clinical suspicion of a cervical spine injury is low, to place a radiologically cleared patient in a soft collar if an endotracheal tube is in situ, or a Philadelphia collar in the case of a tracheostomised patient. Flexion/extension views are then arranged when the patient is extubated and oriented, with the soft collar serving as a reminder to minimise extreme neck movements. To reduce the nursing load on these patients, we move these patients using a ‘modified log roll’ (appendix 2).

Limitations of both soft and hard collars have been described. A soft collar prevents about 30% of the cervical spine movement, compared with up to 70% for the hard collar.<sup>4</sup> It has been suggested that as the hard collar fails to immobilise the cervical spine completely<sup>5</sup> it may even worsen cervical spine instability for the mobile patient, especially to the upper and lower cervical spine junctions, where the majority of injuries are located. Moreover, some of the methods commonly used to immobilise the cervical spine may cause venous occlusion and hence raise intracranial pressure. Figure 1 illustrates the dramatic reduction of intracranial pressure with removal of a hard collar from a head injured patient managed in our ICU. Other adverse effects of prolonged hard collar application include pressure sores (a Philadelphia collar may reduce this risk), tracheostomy delay, hindrance of central line insertion, hypersensitivity and skin rashes.

It is recognised that it is impossible to clear the cervical spine of all injury despite normal radiographs. In one review of 29 studies, 16% of cervical spine fractures were missed in patients with normal cervical spine lateral, anteroposterior and odontoid views, in contrast with the classical teaching of 1 - 2%.<sup>6</sup> Adding two oblique views does not change this outcome and



**Figure 1.** Effect on the intracranial pressure in a polytrauma patient with the removal of a cervical spine hard collar.

the ‘swimmers’ view is considered by many to also be of minimal benefit.<sup>7</sup> Neck CT scans also fail to detect ligamentous injury,<sup>3</sup> unless there is a significant associated haematoma. An Australian study involving routine use of fine-cut helical CTs with reconstruction claimed to eliminate the need for dynamic functional X-rays to clear the cervical spine.<sup>8</sup> Two studies from United States of America claim that three static plain films with a cervical spine CT, as an adjunct, can ‘clear’ the cervical spine, although no mention of the risk of ligamentous injury was made, and the numbers in both these studies were 179 and 204 respectively.<sup>9,10</sup> The role of MRI is less well defined. It is thought to be sensitive for the detection of haemorrhage, contusion, cord or nerve root compression. Its disadvantages include difficulty in performing in the intubated patient, cost, poor definition of bony injury and need to be interpreted in the presence of a CT (thus mandating both in any trauma patient where one is suspicious of a cervical spine injury).<sup>11</sup>

Passive flexion and extension views may exclude significant cervical spine instability where MRI, CT and plain films cannot.<sup>3</sup> However, the safety of such a technique has been called into question.<sup>12</sup> Davis *et al*, performed a prospective study reviewing the safety of dynamic fluoroscopy, using 116 patients with normal plain X-rays. They used “full range of motion” and found there were no neurological complications. They also quoted a 44% decubitus ulcer rate in patients, with cervical collars that remained on for more than 5 days.<sup>5</sup> An Australian study found that only 1 in 48 patients had an unstable cervical spine injury which was detected on dynamic testing, with no deleterious effects from neck manipulation.

The guidelines in [www.trauma.org](http://www.trauma.org) for clearing the cervical spine in unconscious or intoxicated patients recommend anteroposterior, lateral and CT scan of the occiput to C<sub>3</sub> rather than odontoid views of the cervical spine and 2 mm axial CT scanning on specific bone windows with sagittal and coronal reconstruction

to evaluate abnormal or poorly visualised areas on plane radiology. However, to exclude ligamentous injury they recommend continuous cervical immobilisation until the patient is fully conscious in patients who are expected to regain consciousness within 24 - 48 hrs and then clinically exclude significant ligamentous injury (e.g. no neck pain and no abnormal neurological signs or symptoms). Otherwise, a CT scan, MRI of the whole of the cervical spine or dynamic flexion/extension under image intensifier control for patients unlikely to regain consciousness in less than 48 hours.<sup>13</sup>

In our study the three most common approaches in Australian intensive care units in patients who are radiologically 'clear' but not clinically 'clear' are:

- a) accept the risk and remove the hard-collar (around 30 - 45% of units surveyed),
- b) leave the collar (hard or Philadelphia) in place and perform clinical or radiological testing when conscious (5 - 23% of units surveyed); or,
- c) attempt to exclude ligamentous injury through flexion/extension films or use of fine-cut helical CT and sagittal and coronal reconstruction (up to 25% of units).

## CONCLUSION

Our survey revealed lack of a standardised approach to the clearance of the cervical spine in intubated and sedated polytraumatised patients in major Australian intensive care units. In addition, there was a lack of written protocols and no routine surveillance for spinal board or collar morbidity. Thus, the true incidence of spinal board and collar morbidity was unclear. A significant number of intensive care units make little or no attempt to exclude ligamentous injury in intubated polytraumatised patients.

We recommend formal written protocols to achieve consistency within and between units and surveillance for complications such as pressure area surveillance, collar related intracranial pressure changes, and missed neck injuries. Further studies should be undertaken to assess risk benefit analysis of clinical clearance techniques, which may also allow us to identify a specific group of head injured patients at risk of ligamentous cervical spine injury.

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## APPENDIX 1

### QUESTIONNAIRE

In your unit,

1. Do you have a protocol for cervical spine clearance in sedated, unconscious or intubated multi-trauma patients. If so, who developed and who ratified it?
2. Is there a specific time frame for cervical spine clearance, and if so what is it?
3. Who has final say on cervical spine clearance? (e.g. intensivist, neurosurgeon, orthopaedic surgeon).
4. How do you clear the cervical spine? (if no response, ask)

- a) How is radiological clearance undertaken? (e.g. plain anteroposterior, lateral and odontoid views, 'swimmers', oblique views, CT with or without 2mm axial cuts and sagittal and coronal reconstruction, MRI)
  - b) Clinical clearance (e.g. assessing dynamic flexion/extension, passive flexion/extension, awake flexion/extension)
  - c) What is the usual method of cervical spine immobilisation in the uncleared patient? (e.g. hard collar, soft collar, sandbags, none, Philadelphia collar, Halo and jacket). What other precautions are taken? (e.g. log roll, Jordan frame, sedation/paralysis, head straps)
  - d) Do you survey for collar related adverse events (eg pressure sores)? If not, do you think there needs to be?
5. Do you find cervical spine clearance a problem in your intensive care patients, or are you satisfied with the approach used in your unit?

Thank you for participating in this survey. We hope that the results may help contribute to a higher quality of care in intensive care units in Australia.

## APPENDIX 2

### ST GEORGE HOSPITAL INTENSIVE CARE UNIT SPINAL PROTECTION MOBILISATION PROTOCOL

#### 1. Log roll

To be used for all patents who have a suspected or definite spinal injury.

##### **Requires 4 people**

- 1 person - maintaining the axial alignment of head & neck
- 3 people - maintaining body alignment
  - one holding the shoulder and lower chest
  - one holding the lower chest and hip
  - one holding the upper thigh and ankle

A rigid cervical collar must be used.

#### 2. Modified log roll

To be used for patents who have had their spine cleared radiologically, but are awaiting soft tissue (e.g. ligamentous) clearance.

**Requires 2 people** (may require a 3<sup>rd</sup> person if patient tall or obese)

- 1 person - maintaining the axial alignment of the head and neck
- 1 person - maintaining body alignment (holding the shoulder and hip)

May use a soft collar or Philadelphia collar if the patient has a tracheostomy.