

## Imaging Decision Making: Acute Cervical Spine Injury (in the Alert and Stable Adult Following Blunt Trauma)

This protocol is intended for acute cases of cervical spine trauma that present to the WSCC clinics. Blunt trauma is defined as any non-penetrating trauma, including whiplash injuries with and without impact to the head. Acute trauma is trauma within 48 hours of presentation to the clinic. Adults, as defined for this document, are patients over the age of 16. The following recommendations have a high degree of sensitivity for injuries such as clinical significant fractures\* or instability. They do not address the possible contribution of radiographs to establishing a prognosis in whiplash cases.

The following recommendations allow the practitioner the confidence to omit radiographs in a trauma case, knowing that missing a significant cervical injury is very unlikely. Also listed below are indications for when radiographs should be considered. Although these indicators have low specificity (i.e., most of the x-rays will be negative for serious trauma), research suggests that the serious ramifications of missing a fracture, cervical dislocation, or significant instability justify the use of x-ray imaging in these circumstances. Furthermore, if the suspicion of fracture is very high, negative x-rays should be followed up by appropriate advanced imaging, such as CT.

As always, clinicians should feel free to override this decision instrument if they have particular cause for concern.

### Recommendations for acute cervical trauma

- ✓ Consider plain film radiographs for 1) patients over 65, 2) patients with paresthesia in the extremities, or 3) patients who have sustained severe trauma. (See following table for more details.) NOTE: Radiographs should be taken before performing active range of motion (AROM) or any orthopedic loading tests.
- ✓ Consider x-rays for patients with known vertebral disease, such as fused cervical spinal segments, or underlying disease affecting the cervical spine, such as spinal stenosis, rheumatoid arthritis, ankylosing spondylitis, Down's syndrome, Marfan's syndrome, history of os odontoideum, Klippel-Feil syndrome and Morquio syndrome.

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\*The high sensitivity for detecting fractures may not include stable fractures in a neurologically intact patient: isolated fracture of an osteophyte, isolated fracture of the transverse process not involving a facet joint, isolated fracture of a spinous process not involving the lamina, or simple compression fracture involving less than 25% of the vertebral body height.

- ✓ Patients meeting all of the following criteria need NOT be radiographed for the purpose of excluding fractures or significant instability: no known underlying spinal disease or anomalies, under the age of 65, no paresthesia, mechanism of injury judged not to be high risk, and the ability to actively rotate their necks 45 degrees (even if painful). (This combination of findings has been reported to have a sensitivity of 100% and a specificity of 42%).<sup>9</sup>
- ✓ An alternative set of indicators for radiographs: Consider x-rays for patients who meet any of the following: focal neurological deficit, midline cervical tenderness,\* intoxicated, state of conscious is not alert, or suffering from another painful, distracting injury. (This combination of findings has a reported sensitivity ranging from 93-99% and a specificity of 12.9%).<sup>4</sup>

For further explanation, consult the following table.

### High Risk Factors for Cervical Spine Injury

If one or more of the following high risk factors are present, cervical spine radiography is recommended. Radiography should consist of a minimum of three views (AP lower cervical, AP open mouth and neutral lateral). Additional views or other diagnostic imaging modalities may be ordered at the discretion of the treating physician.

High-Risk Factors	Comments
<b>Age 65 and over</b>	A patient 65 years of age is considered to be at high-risk for cervical spine injury following blunt trauma.
<b>Dangerous mechanism of injury</b>	Dangerous mechanisms include 1) a fall from a height of more than 1 m, 2) an axial loading injury, such as diving injury, 3) high-speed (> 62 mph, 100 km/h) motor vehicle crash, rollover, or ejection, 4) motorized recreational vehicle or bicycle collision.
<b>Unable to actively rotate neck 45° to the left and to the right</b>	When evaluating a trauma patient, it is critical that palpation during the initial assessment is performed with the cervical spine properly immobilized without displacing or deforming the immobilized neck. Patients 65 years and over, dangerous mechanism of injury, or paresthesia must undergo cervical spine radiography prior to undergoing active range of motion testing.
<b>Presence of paresthesia in the extremities</b>	Paresthesia is defined as a sensation of numbness, prickling, or tingling. The patient may also experience a heightened sensitivity.

\* Midline tenderness is interpreted differently in the Canadian rules and the NEXUS rules. In the Canadian rules, the presence of midline tenderness not does necessitate radiographs if patients can rotate their heads and the other high-risk indicators are not present. In the NEXUS rules, presence of midline tenderness suggests the need for radiographs. See commentary section.

<b>Midline cervical spine tenderness</b> <sup>4,6</sup>	<p>If an alert trauma patient complains of midline cervical spine tenderness, plain film imaging should be considered.<sup>4,6,8</sup> Midline cervical spine tenderness is defined as pain on palpation at midline from the nuchal ridge to the prominence of the first thoracic vertebra or if the patient evinces pain with direct palpation of any cervical spinous process.<sup>4,6,8</sup></p>
<b>Painful, distracting injury</b> <sup>4,6</sup>	<p>It is important to consider cervical spine radiographs if the alert patient presents with severe associated injuries that may distract him/her from the focus of cervical spine discomfort. Some clinicians have found this to be poorly reproducible.</p>
<b>Altered level of alertness</b> <sup>4,6</sup>	<p>An altered level of alertness can include any of the following: a) Glasgow Coma Scale score of 14 or less; (<i>See Table 1 at the end of this protocol.</i>) b) disorientation to person, place, time, or events; c) inability to remember 3 objects at 5 minutes; d) delayed or inappropriate response to external stimuli.<sup>4,6</sup> Fracture or dislocation was found in 8.9% of patients with altered sensorium.<sup>5</sup> The probability of cervical spine fractures in patients who are unconscious at the time of initial evaluation is reported as 8.6%.<sup>2</sup></p>
<b>Focal neurologic deficit</b> <sup>4,6</sup>	<p>Focal deficit (defined as a deficit that could be in a spinal cord or spinal nerve distribution) may be elicited by history or finding on motor or sensory examination.<sup>4,6</sup> The prevalence of cervical spine fractures in patients with focal deficit has been reported as 19.7%.<sup>2</sup> 54.5% of patients presenting with motor deficits had an associated cervical spine fracture.<sup>5</sup></p>
<b>Evidence of intoxication</b> <sup>4,6</sup>	<p>Patients should be considered under the influence of intoxicants if they have either of the following: a) a recent history by the patient or an observer of intoxication or intoxicating ingestion; b) evidence of intoxication on physical examination such as odor of alcohol, slurred speech, ataxia, dysmetria or other cerebellar findings, or any behavior consistent with intoxication; c) tests of bodily secretions are positive for drugs (including but not limited to alcohol) that affect level of alertness.<sup>4,6</sup> Some clinicians have found determining evidence of intoxication to be poorly reproducible.</p>
<b>Patients with known vertebral disease</b>	<p>Patients with fused spinal segments or underlying disease affecting the cervical spine such as spinal stenosis, rheumatoid arthritis, ankylosing spondylitis, Down's syndrome, Marfan's syndrome, history of os odontoideum, Klippel-Feil syndrome and Morquio syndrome are at special risk and should be carefully evaluated.</p>

<b>Return for reassessment of the same injury</b>	Consider cervical spine radiography if patient's symptoms persist, neurological symptoms develop, patient's neck pain has prevented return to usual occupation, or use of a cervical collar is required.
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### **Commentary**

The practitioner is faced with an important clinical decision regarding radiographs in acute trauma cases. Taking radiographs in all trauma cases, regardless of circumstances, is not justifiable because of cost factors, exposing the patient needlessly to ionizing radiation, and the clinical dilemma of interpreting what often are incidental findings. However, it is critically important not to miss significant fractures or laxity, particularly for practitioners of manual therapy.

Physicians caring for patients with acute cervical spine trauma must always consider the potential for unstable injury since failure to diagnose these injuries may be devastating for the patient. A delay in diagnosis can have dire consequences, ranging from serious sensory deficit to paralysis. In a prospective study designed to document course and outcome of missed spine fractures, 253 patients with 274 spinal injuries seen in a tertiary care establishment and spinal injury referral center were reviewed.<sup>7</sup> Of these patients, 22.9% of cervical injuries had a delayed diagnosis ranging from less than 1 day to 36 days.<sup>7</sup> The causes for the delay in the majority of the cases were the physician who initially interpreted the radiographs misdiagnosed the study or the first physician to assess the patient did not order radiographs.<sup>7</sup> This prospective study reinforces the need for adequate assessment of the patient and the importance of understanding the significant risk factors associated factors leading to a missed diagnosis.

However, taking x-rays of all trauma cases is inappropriate. The recommendations in this document stem from three sources discussed below.

The American College of Radiology (ACR) on Appropriateness Criteria (1995) and its expert panel on musculoskeletal imaging conducted a literature review of studies that included an initial investigation of 5,719 patients with cervical spine trauma.<sup>1</sup> This panel of experts concluded that there is good evidence that following trauma if alert and stable patients are asymptomatic, without neck pain or tenderness and with normal neurologic findings, then cervical spine radiological examination is not necessary.<sup>1</sup> The alert patient is defined as having a Glasgow Coma Scale (GCS) of 15, and the stable patient defined as having normal vital signs (systolic blood pressure >90 mmHg and respiratory rate between 10 and 24/minute). This task force further stated that there is a significant likelihood of fracture in patients with neurological compromise, motor dysfunction, and altered sensorium.<sup>1</sup>

The National Emergency X-Radiography Utilization Study (NEXUS) (2000) investigated a set of clinical criteria that could be used to exclude the possibility of significant cervical spine injury in the presence of acute blunt cervical spine trauma. Clinically important cervical spine injury was defined as any fracture, dislocation, or ligamentous instability demonstrated by diagnostic imaging. Clinically unimportant cervical spine injuries generally do not require stabilization treatment or specialized follow-up. The five criteria for a low risk of injury are no midline cervical tenderness, no focal deficit, normal alertness, absence of intoxication, and no painful, distracting injury. In this study of 34,069 patients, they found the low-risk criteria 99.6% sensitive for clinically important injuries.

Another group of investigators established the Canadian C-Spine Rule (2001), a decision-making rule for use of C-spine radiography in alert and stable adult trauma patients. This clinical decision rule asks three basic questions and establishes the safety for evaluating active range of motion by identifying high-risk and low-risk factors. First, prior to performing active range of motion, patients at high risk due to age, dangerous mechanism of injury, or paresthesia, must undergo radiography. Second, patients who do not fall into the first category may proceed directly to active range of motion testing, if they fulfill even one of the following criteria: simple rear-end motor vehicle crashes (“fender benders”); patients who are in an emergency department but are able to sit up; patients who have been ambulatory at any time since the trauma (which would be virtually all patients in an ambulatory, chiropractic setting); patients with delayed onset of neck pain; or patients with absence of midline cervical tenderness. Third, if patients deemed safe for assessment of range of motion are able to actively rotate their necks 45 degrees to the left and to the right, regardless of pain, they do not require cervical spine radiography. This prospective cohort study involved 8924 adults who presented to the Emergency Department with blunt trauma to the head/neck, stable vital signs, and a Glasgow Coma Scale score of 15. Application of this rule had a 100% sensitivity and a 42.5% specificity for identifying 151 clinically important C-spine injuries<sup>9</sup>. This group also attempted a retrospective validation of the NEXUS criteria based upon their database of 8924 patients and found that the 5 low-risk criteria failed to predict 10 of 148 clinically important injuries, yielding a sensitivity of only 93%<sup>9</sup>. In addition, they found that two of the criteria, presence of intoxication and distracting painful injury, were poorly reproducible.

**Table 1: GLASGOW COMA SCALE (GCS SCALE RANGE, 3-15)**

<b>Eye opening</b>		<b>Verbal response</b>		<b>Motor response</b>	
Spontaneous	4	Oriented	5	Obeys commands	6
To voice	3	Confused	4	Localized pain	5
To pain	2	Inappropriate words	3	Withdraws	4
None	1	Incomprehensible words	2	Flexion	3
		None	1	Extension	2
				None	1

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**References**

- <sup>1</sup> American College of Radiology Appropriateness Criteria, copyright 1995.
- <sup>2</sup> Blackmore CC, Emerson SS, Mann FA, Koepsell TD. Cervical spine imaging in patients with trauma: determination of fracture risk to optimize use. *Radiology* 1999;211(3):759-65.
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