

American College of Radiology ACR Appropriateness Criteria™

SUSPECTED CERVICAL SPINE TRAUMA

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Summary of Literature Review

Evaluation of patients with suspected cervical spine trauma is one of the most controversial topics in medicine today. The problem is not merely one of radiology, but touches all specialties—emergency medicine, trauma surgery, orthopedics, and neurosurgery. In the past decade, there have been a large number of reports in the medical literature dealing with this problem. The controversy swirls around several questions: 1) Which patients need imaging? 2) How much imaging is necessary? and 3) Exactly what sort of imaging is to be performed? Fueling the controversy is pressure from insurers and the federal government for cost containment. Conservative estimates in the literature indicate that more than one million blunt trauma patients, who have the potential for sustaining a cervical spine injury, are seen in emergency departments in the United States each year.

The original literature review for this ACR Appropriateness Criteria™ topic included the initial investigations of 5,719 patients with cervical trauma (1-17). The literature review for this revision included data on 13,534 patients (20-39). In addition, there are data from the National Emergency X-Radiography Utilization Study (NEXUS) of 34,069 patients (35) and from the Canadian Rule group of 8, 924 patients (39).

In recent years, there has been a profound change in the way in which patients suspected of having cervical spine injuries are evaluated. Foremost among this change has been a significant body of evidence within the radiologic literature supporting a more prominent role for helical computed tomography (CT) as a screening tool for these patients. Initial reports in the early 1990s, particularly by Nuñez et al (18,19), demonstrated how much more efficient helical CT was in identifying fractures. Their conclusions were supported by those of other investigators, who validated the initial observations in larger scale studies.

A function of the changing atmosphere has been a reversal on opinions on cervical trauma radiography by Daffner (36), long an advocate of the six-view series. In the first of two recent studies, times for examination in patients who underwent a six-view radiographic examination were recorded. The average time for that examination was 22 minutes; 79% of patients required repeat of one or more of the views. The most commonly repeated view was the open-mouth atlantoaxial view. In the second study recording the times for helical CT evaluation, the average time for the study was found to be 12 minutes — a significant time interval in the trauma setting. Daffner (38) now advocates helical CT be performed as the primary screening technique supplemented by anteroposterior (AP) and lateral radiographs. In no way should radiography be completely abandoned, in his opinion. The panel agrees that the three-view radiographic study be performed to serve as a guideline for interpreting the CT study.

At the same time, because of concerns of cost and radiation exposure, other investigators were studying methods of improving selection of those patients who truly were at risk and needed radiographs or other imaging. The first such paper to address these issues was by Vandemark in 1990 (8). He proposed a set of guidelines to identify patients at high risk for having a cervical spine injury. More recently is the study by Blackmore and colleagues (26) at the University of Washington, (32) who developed a new set of guidelines (decision rule) for the use of helical CT (32). In addition to this, they also performed a cost-effectiveness analysis of using helical CT in trauma patients (26). The most significant study in this respect

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was that by Stiell et al (39). Stiell was the lead investigator in formulating what is now accepted as the “Ottawa Rules” for selection of patients for ankle and knee radiography in the trauma setting. In a multi institution study, they present the “Canadian C-spine Rule” (see below) for selecting trauma patients for cervical radiography (39). The guidelines proposed by each of these studies are listed below under *Supplementary Recommendations*.

The use of any of the above guidelines must be done with the caveat that a thorough clinical evaluation of the patient should be performed before ordering imaging studies of the cervical spine. To use those guidelines blindly in a “protocol-driven” manner would result in the performance of many unnecessary studies. An example would be the patient who is alert, has no cervical tenderness, and who has a large bone (femur) fracture. By the Vandemark criteria (8) this patient would seemingly be at high risk because of a distracting injury. However, in such patients, who are not only alert, but in whom there was no evidence of sensorial impairment from injury, alcohol, and/or drugs, a clinical evaluation of the neck should be performed to determine whether there is any neck pain or tenderness. It is the consensus of the panel that clinical evaluation may lower the risk level and thus eliminate the need for cervical imaging.

Summary

There is agreement among most investigators and this expert panel that patients who are alert, have never lost consciousness, are not under the influence of alcohol and/or drugs, have no distracting injuries, have no cervical tenderness, and have no neurologic findings need no imaging. Patients who do not fall into this category should have as a minimum a three-view cervical radiographic series followed by helical CT (16,28,36). In instances the cervical CT examination will be performed immediately after a cranial CT, while the patient is still in the CT suite. This is both time-effective as well as cost-effective (38).

Although the literature still recommends flexion/extension radiographs, it is the opinion and experience of this expert panel that they are not very helpful except for ensuring that minor degrees of anterolisthesis or retrolisthesis in patients with cervical spondylosis are fixed deformities (25,34). Usually muscle spasm in acutely injured patients precludes an adequate examination in the acute setting. Flexion/extension radiography is best reserved for follow-up of symptomatic patients, usually in 7-10 days after muscle spasm has subsided. The real issue, however, with the use of flexion/extension radiography is whether or not the patient has ligamentous instability. In those settings, magnetic resonance imaging (MRI) is the procedure of choice.

Similarly, there is agreement among the panel members that the use of supine oblique views is no longer necessary in patients who are undergoing cervical CT examination. Oblique views, although useful in patients with unilateral facet lock, were most valuable in adding two more views of the cervicothoracic junction. Both of these functions can now be accomplished through the use of CT.

Finally, there is agreement in the literature that MRI be reserved for patients who have clearcut neurologic findings and those suspected of ligamentous instability (23). A recent review article by Saifuddin (37) goes further in recommending total spinal MRI to screen for multiple noncontiguous injuries (which occurs in about 20% of patients).

Supplementary Recommendations

Vandemark Criteria for High-Risk Patients

- High-velocity blunt trauma
- Multiple fractures
- Evidence of direct cervical injury (cervical pain, spasm, obvious deformity)
- Altered mental status (loss of consciousness, alcohol and/or drug use)
- Drowning or diving accident
- Fall of > 10 feet
- Significant head or facial injury
- Thoracic or lumbar fracture
- Rigid vertebral disease (AS, DISH)
- Paresthesias or burning in extremities

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University of Washington Criteria

Mechanism parameters

- High-speed (> 35 mph) MVA
- Crash with death at scene
- Fall from height > 10 ft

Clinical parameters

- Closed head injury
- Neurologic symptoms or signs referred to the cervical spine
- Pelvic or multiple extremity fractures

Canadian Rules – No Radiography

Absent high-risk factors

- Age > 65 years
- Dangerous mechanism (See Vandemark or University of Washington criteria)
- Paresthesias in extremities

Low-risk factors which allow safe assessment of range of motion

- Simple rear end MVC
- Sitting position in ED
- Ambulatory at any time
- Delayed onset of neck pain
- Absent midline cervical tenderness

Able to actively rotate neck 45° left & right

NEXUS Criteria (Low Risk)

- Absence of midline cervical tenderness
- Absence of focal neurologic deficits
- Absence of intoxication
- Absence of painful distracting injuries
- Normal alertness

Anticipated Exceptions

None.

Review Information

This guideline was originally developed in 1995. Complete reviews and revisions of this document were approved in 1999 and in 2002. All Appropriateness Criteria™ topics are reviewed annually and updated as appropriate.

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Clinical Condition:

Suspected Cervical Spine Trauma

Variant 1:

Adult: asymptomatic and alert, no cervical tenderness, no neurologic findings, no distracting injury, with or without cervical collar.

| Radiologic Exam Procedure | Appropriateness Rating | Comments |
|--|------------------------|----------|
| AP, lateral, and open mouth | 2 | |
| AP, lateral, open mouth, obliques | 2 | |
| AP, lateral, open mouth, obliques, flexion/extension | 2 | |
| CT | 2 | |
| MRI | 2 | |
| Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate | | |

Variant 2:

Adult: asymptomatic and alert now, history of unconsciousness, no neurologic findings, no distracting injury.

| Radiologic Exam Procedure | Appropriateness Rating | Comments |
|--|------------------------|----------|
| AP, lateral, and open mouth | 2 | |
| AP, lateral, open mouth, obliques | 2 | |
| AP, lateral, open mouth, obliques, flexion/extension | 2 | |
| CT | 2 | |
| MRI | 2 | |
| Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate | | |

Variant 3:

Adult: alert, cervical tenderness, no neurologic findings, no distracting injury.

| Radiologic Exam Procedure | Appropriateness Rating | Comments |
|--|------------------------|----------|
| AP, lateral, and open mouth | 9 | |
| AP, lateral, open mouth, obliques | 2 | |
| AP, lateral, open mouth, obliques, flexion/extension | 2 | |
| CT | 2 | |
| MRI | 2 | |
| Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate | | |

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Clinical Condition: Suspected Cervical Spine Trauma

Variant 4: Adult: alert, cervical tenderness, paresthesias in hands or feet.

| Radiologic Exam Procedure | Appropriateness Rating | Comments |
|--|------------------------|-------------------------|
| AP, lateral, and open mouth | 9 | |
| CT | 9 | |
| MRI | 8 | Depends on CT findings. |
| AP, lateral, open mouth, obliques | 2 | |
| AP, lateral, open mouth, obliques, flexion/extension | 2 | |
| Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate | | |

Variant 5: Adult: alert, no cervical tenderness, no neurologic findings, fractured femur.

| Radiologic Exam Procedure | Appropriateness Rating | Comments |
|--|------------------------|--|
| AP, lateral, and open mouth | 2 | Clinical evaluation to determine indication. |
| AP, lateral, open mouth, obliques | 2 | |
| AP, lateral, open mouth, obliques, flexion/extension | 2 | |
| CT | 2 | |
| MRI | 2 | |
| Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate | | |

Variant 6: Adult: unconscious.

| Radiologic Exam Procedure | Appropriateness Rating | Comments |
|--|------------------------|----------|
| AP, lateral, and open mouth | 9 | |
| CT | 9 | |
| AP, lateral, open mouth, obliques | 2 | |
| MRI | 2 | |
| Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate | | |

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Clinical Condition: Suspected Cervical Spine Trauma

Variant 7: Adult: impaired sensorium (including alcohol and/or drugs).

| Radiologic Exam Procedure | Appropriateness Rating | Comments |
|--|------------------------|----------|
| AP, lateral, and open mouth | 9 | |
| CT | 9 | |
| AP, lateral, open mouth, obliques | 2 | |
| MRI | 2 | |
| Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 | | |
| 1=Least appropriate 9=Most appropriate | | |

Variant 8: Adult: impaired sensorium (alcohol and/or drugs), neurologic findings.

| Radiologic Exam Procedure | Appropriateness Rating | Comments |
|--|------------------------|--|
| AP, lateral, and open mouth | 9 | |
| CT | 9 | |
| MRI | 8 | Depends on CT and neurological findings. |
| AP, lateral, open mouth, obliques | 2 | |
| CT myelogram | 2 | |
| Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 | | |
| 1=Least appropriate 9=Most appropriate | | |

Variant 9: Adult: neck pain, clinical findings suggest ligamentous injury, radiographs and/or CT “normal.”

| Radiologic Exam Procedure | Appropriateness Rating | Comments |
|--|------------------------|--|
| MRI | 6 | |
| Flexion/extension radiographs | 2 | May be of value in subsequent follow up. |
| CT myelogram | 2 | |
| Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 | | |
| 1=Least appropriate 9=Most appropriate | | |

Variant 10: Child: alert, no neck pain, neck supple, no distracting injury.

| Radiologic Exam Procedure | Appropriateness Rating | Comments |
|--|------------------------|----------|
| AP, lateral, and open mouth | 2 | |
| CT | 2 | |
| Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 | | |
| 1=Least appropriate 9=Most appropriate | | |

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Clinical Condition:**Suspected Cervical Spine Trauma****Variant 11:****Child: alert, no neck pain, neck supple, fractured femur.**

| Radiologic Exam Procedure | Appropriateness Rating | Comments |
|--|------------------------|----------|
| AP, lateral, and open mouth | 2 | |
| CT | 2 | |
| Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate | | |

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