

## Evaluation of the Cervical Spine in Head-injured Patients

a report by

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The evaluation of the cervical spine in head-injured patients is a problem that is frequently faced by emergency physicians. Five to 13% of patients who present with head injuries have concurrent cervical spine injuries.<sup>1-3</sup> There are multiple options for the evaluation of these patients for cervical spine injury, but currently no large randomized trial has been performed to outline the optimal strategy. The evaluation of these patients has been highly controversial and there is a variety of guidelines and opinions on the appropriate work-up of this patient population. These patients often remain immobilized for extended periods of time, awaiting spinal clearance. Prolonged immobilization is far from ideal, and clearance of the spine should be completed as soon as reasonably possible. This article will review the various imaging modalities available and highlight their particular strengths and weaknesses. Finally, a protocol will be suggested based on the most current literature available.

### Plain Films

Plain films of the cervical spine have been shown to accurately and reliably diagnose fractures in awake and alert patients.<sup>4</sup> Plain X-rays are easily obtained and relatively inexpensive and can be taken at the bedside for rapid screening purposes. Unfortunately, cervical plain radiographs have been shown to miss between 35 and 52% of fractures and 45% of dislocations compared with computed tomography (CT) scans.<sup>5,6</sup> Clearly, plain films alone will not be able to exclude cervical spine injuries in patients who have head injuries or altered mental status and are unable to give a reliable exam.

### Computed Tomography Scanning

CT has revolutionized the evaluation of trauma patients. It has the ability to rapidly and accurately diagnose a wide variety of injuries. CT scanning does have negative consequences: it is expensive and exposes the patient to high doses of radiation, and also is not always practical for critically ill patients who may not be stable enough to undergo scanning. However, patients with altered mental status cannot be cleared clinically or with plain X-rays;<sup>7</sup> these patients have been classified as high risk for cervical spine injury and CT is recommended for them.<sup>8</sup>

CT scanning has been shown to be accurate in diagnosing fractures and dislocations of the cervical spine.<sup>9,10</sup> In 2002, the American College of Radiology (ACR) recommended CT scanning of the cervical spine in patients with paresthesias or an altered level of consciousness, or in whom cranial CT will be ordered.<sup>11</sup> This approach has become standard in many trauma centers. Initially, it was felt that a lateral plain X-ray was also required to identify subluxations.<sup>12,13</sup> The ACR guidelines also recommend a lateral plain film to evaluate the dens and C2 in selected patients. With the current ability to sagittally reconstruct CT images, this practice is being questioned.<sup>14</sup> Patients who have indications for CT scanning of the brain should have concurrent cervical spine CT scanning, and no plain films are necessary for most patients. This approach is both time- and cost-efficient.<sup>11,15</sup>

### Magnetic Resonance Imaging

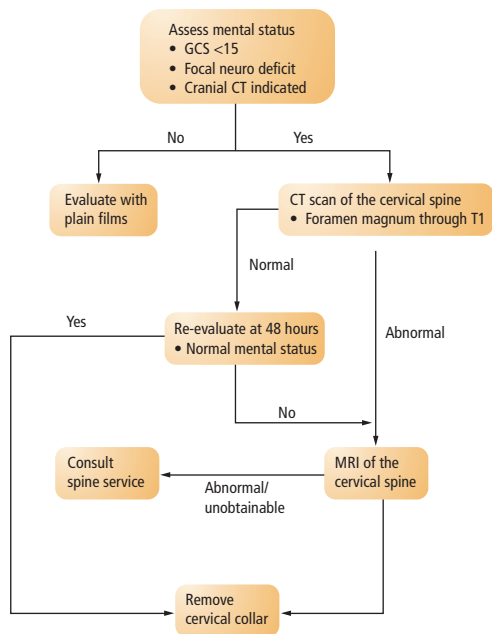
While CT scanning has drastically improved the ability to identify fractures and dislocations, its ability to diagnose ligamentous injuries is questionable. Ligamentous injuries can be missed on CT scans, with devastating results.<sup>12,16</sup> One option is to leave patients in cervical collars after the initial CT scan until they have a reliable neurological exam to exclude ligamentous injury. Leaving patients in cervical collars for extended periods of time has a variety of complications, including pressure sores, difficult access to the neck, and increased intracranial pressure.<sup>17,18</sup> Prolonged immobilization also makes caring for the patient very cumbersome. For these reasons, studies have evaluated the ability of magnetic resonance imaging (MRI) to rule out ligamentous injury. MRI performed in patients who remain obtunded at 48 hours has been shown to accurately identify ligamentous injuries.<sup>19</sup> MRI also has the ability to visualize soft-tissue structures and the spinal cord, and is indicated in all patients with neurological deficits or known fractures on CT scanning.<sup>20</sup> A combination of negative CT and MRI is felt to exclude cervical spine injury, after which spinal precautions can be terminated.<sup>19</sup> There have been some recent studies that have found CT scanning to have a negative predictive value of 99% for ligamentous injury and 100% for cervical instability.<sup>21,22</sup> If other studies can replicate these results, MRI eventually may not be needed in patients with a completely normal CT scan and no neurological deficits.

It is unlikely that MRI will be able to eliminate the need for CT scanning of the cervical spine. While MRI is ideal for imaging soft-tissue structures and the spinal cord, it is very poor at detecting spinal injuries. MRI has been shown to miss 45% of fractures and cannot be used alone to clear the cervical spine.<sup>3</sup> At this time, MRI should be performed in conjunction with CT scanning to rule out cervical injury. For patients with positive MRI findings, cervical collars should be maintained.<sup>19</sup>



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Figure 1: Cervical Spine Trauma Evaluation Protocol



GCS = Glasgow Coma Scale; CT = computed tomography; MRI = magnetic resonance imaging.

Dynamic Fluoroscopy

MRI is not available to all patients. Patients with pacemakers, metallic foreign bodies, or aneurysm clips cannot undergo MRI evaluation. Also, some patients are too unstable to leave the intensive care unit. Furthermore, MRI scans are typically very time-consuming and limit access to the patient. For these reasons, certain patients will not be candidates for the use of MRI to rule out ligamentous injury. Dynamic fluoroscopy has been considered as an option in this population. It has the advantage of being able to be performed at the bedside in unstable patients. However, no large studies have evaluated its sensitivity or specificity. Dynamic fluoroscopy does have the potential to cause

iatrogenic injury,<sup>24</sup> and the current ACR guidelines do not support dynamic fluoroscopy as a method to exclude ligamentous injury.<sup>11</sup> In patients who are not MRI candidates, there is no clear consensus at this time on the appropriate strategy. If future studies are able to confirm the sensitivity and reliability of CT scans to rule out ligamentous injury, the issue may be resolved by a single CT scan.

Protocol

Patients who have any indications for cranial CT scanning should receive a concurrent cervical CT scan (see Figure 1). Patients over the age of 65 or with evidence of upper cervical spine pathology should also have a single lateral plain film. Positive findings on the cervical CT or any neurological deficits mandate early MRI evaluation. Patients with a normal CT who are moving all extremities should be admitted in a cervical collar and spinal precautions should be maintained if their mental status precludes clinical clearance of the cervical spine. At 48 hours, the patient should be re-evaluated. If their neurological exam has improved, they can be cleared clinically. However, if the patient continues to have an unreliable neurological exam, an MRI should be obtained if feasible. The combination of a negative CT and MRI clears the cervical spine, and spinal precautions can then be terminated. Patients who are not candidates for MRI are problematic, and there is no clear consensus at this time. There is reasonable evidence that patients who are moving all extremities with a completely normal CT scan are at extremely low risk for unstable cervical spine injury.<sup>21,22</sup> Dynamic fluoroscopy is a possible option for patients who are not candidates for MRI, although its use is controversial. It cannot be recommended for routine use based on current literature.

Future Developments

It is likely that, in the near future, CT scanning alone will be the modality of choice for clearance of the cervical spine in obtunded patients who are moving all extremities. Early CT scanning will rule out spinal pathology and allow removal of the cervical collar immediately. MRI will be reserved for patients who have neurological deficits or abnormal findings on CT scanning. ■

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