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The (f)utility of flexion-extension C-spine films in the setting of trauma

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Abstract

BACKGROUND: Flexion-extension radiographs are often used to assess for removal of the cervical collar in the setting of trauma. The objective of this study was to evaluate their adequacy. We hypothesized that a significant proportion is inadequate.

METHODS: This was a retrospective review of C-spine clearance at a level 1 trauma center. A trauma-trained radiologist interpreted all flexion-extension radiographs for adequacy. Studies performed within 7 days of injury were considered acute.

RESULTS: Three hundred fifty-five flexion-extension radiographs were examined. Ninety-five percent% of these studies were inadequate (51% because of the inability to visualize the top of T1, whereas 44% had less than 30° of angulation from neutral). Two hundred ten studies were performed acutely; of these, 97% were inadequate. When performed 7 days or longer from injury, 91% were inadequate.

CONCLUSIONS: Injury to the C-spine may harbor significant consequences; therefore, its proper evaluation is critical. The majority of flexion-extension films are inadequate. As such, they should not be included in the algorithm for removal of the cervical collar. If used, adequacy must be verified and supplemental radiographic studies obtained as indicated.

Injury to the cervical spine is relatively common after major trauma. Its initial evaluation and diagnosis have changed significantly over the past decade. Numerous studies have documented the inability of 3-view cervical spine radiographs to identify both vertebral fractures and ligamentous injuries reliably. The reported sensitivities of such films range from 30% to 60%.[1–3] Thus, when patients are unable to be cleared clinically via the National Emergency X-Radiography Utilization Study or Canadian C-Spine Rule criteria, computed tomographic (CT) imaging of the cervical spine is the diagnostic tool of choice.[4,5] In alert and oriented patients with negative findings on CT imaging, a normal physical examination, and no neck pain, the cervical spine may be cleared clinically.[6,7]

The presence of midline neck pain or tenderness prevents the clearance of the cervical spine because of potential

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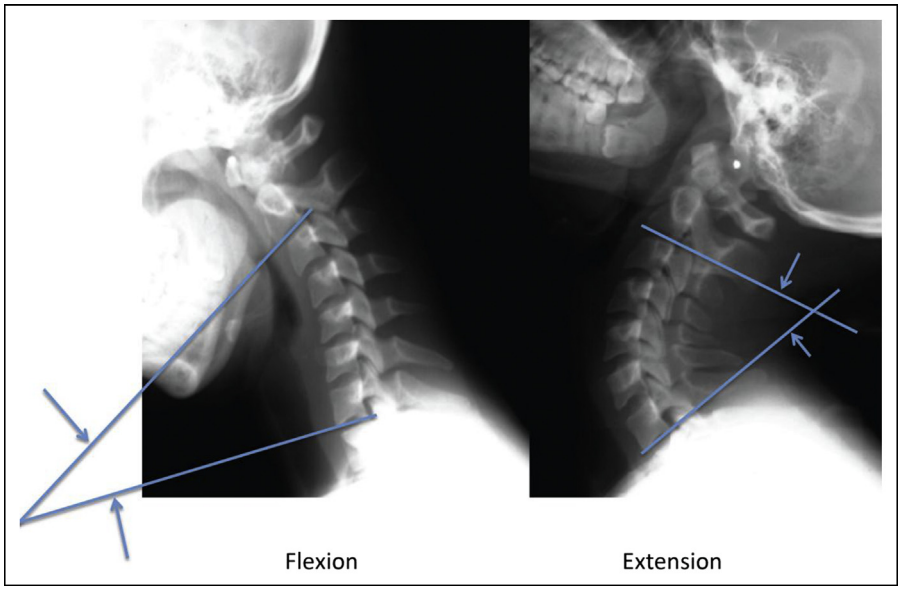

Figure 1 Measurement of adequacy for greater than or equal to 30° of angulation in both flexion and extension.

ligamentous injuries missed by the CT scan. In the past, flexion-extension radiographs of the cervical spine were used as an adjunct in hopes of better characterizing ligamentous injuries (and vertebral fractures); however, the usefulness of such films performed acutely has been questioned because 30% are deemed inadequate.[8,9] With CT imaging of the cervical spine now the preferred diagnostic tool for vertebral fractures, flexion-extension series are now used primarily for the identification of ligamentous injuries rather than vertebral fractures. More recent series document the adequacy of acute flexion-extension films at 30% to 60% depending on the stringency of adequacy criteria applied.[9,10]

The 2009 Eastern Association for the Surgery of Trauma "Practice Management Guideline for Cervical Spine Injuries following Trauma" includes flexion-extension films as an option for clearing the cervical spine "in the neurologically-intact awake and alert patient complaining of neck pain with a negative CT scan." The objective of this study was to evaluate the adequacy of flexion-extension radiographs obtained for the removal of the cervical collar after trauma. We hypothesized that a significant proportion of these films are inadequate.

Methods

This was a retrospective review of cervical spine clearance after trauma at Bellevue Hospital Center in New York City. Bellevue is a New York State–designated level I trauma center primarily serving the lower half of Manhattan and Western Brooklyn. A trauma radiology database was queried for those patients with both a cervical spine CT scan and flexion-extension radiography from 2002 through 2012. Inclusion criteria included patients suffering blunt trauma who had a negative CT scan, were alert and oriented without neurologic deficits, and had persistent neck pain. The medical record and trauma radiology database were then used to evaluate patient demographics, radiographic imaging, and clinical outcomes.

A single radiologist with a fellowship in trauma and critical care radiology examined all of the cervical spine flexion-extension radiographs for adequacy. Adequacy was defined as visualization of the cervical spine from the base of the occiput to the top of the first thoracic vertebrae (T1) and greater than or equal to 30° of angulation in both flexion and extension. For the measurement of this angulation, 2 straight lines are drawn: one parallel to the bottom of the second cervical vertebrae and a second one parallel to the lowest cervical vertebrae endplate. With flexion, these lines intersect anteriorly, whereas upon extension, they intersect posteriorly (Fig. 1). If any of these criteria were not met, the flexion-extension series was deemed inadequate.

Parameters to diagnose ligamentous instability (a positive flexion-extension series) were extrapolated from cadaver and healthy volunteer studies.[11–13] The 2 parameters used most frequently are horizontal and angular displacement. Although some groups use 3.5 mm of horizontal displacement as one of the criteria for injury, we chose a more conservative value based on studies cited in the 2009 Eastern Association for the Surgery of Trauma guideline.[9,10] Ligamentous instability was defined as greater than or equal to 2 mm of horizontal displacement or greater than or equal to 11° of angular displacement. For the purposes of this study, flexion-extension radiographs performed within 7 days of injury were considered acute.

Standard descriptive statistical tests were used. Numeric data are presented as mean ± standard deviation and median where appropriate. In comparing potential study groups, the Student *t* test was used for continuous data. Chi-square analysis was used for categorical data. When appropriate, this was substituted with the Fisher exact