Imaging suspected cervical spine injury: plain radiography or computed tomography?  
Systematic review
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CRD summary
The review found computed tomography (CT) superior to plain radiography for detecting cervical spine injury following blunt trauma. Significant methodological weaknesses in the included studies and limitations in the review process make the reliability of this conclusion uncertain. The authors’ qualification (that evidence was insufficient to require CT in all trauma patients at risk of cervical spine injury) is reasonable.

Authors’ objectives
To compare the diagnostic accuracy of plain radiography and computed tomography (CT), as the initial test in patients with suspected cervical spine injury following blunt trauma.

Searching
MEDLINE, EMBASE, CINAHL and Science Direct were searched from January 1991 to January 2008. Search terms were reported. The ASLIB index to theses database was queried to identify any relevant unpublished papers. Bibliographies of identified studies were screened and an internet search was performed to identify further articles. No language restrictions were applied.

Study selection
Studies that compared the results of plain radiography and CT (helical or multi-slice CT) with a reference standard, in patients suspected of having sustained a cervical spine injury following blunt trauma, were eligible for inclusion. Included studies were required to report sensitivity and specificity, or data to calculate these measures. Studies that did not include a minimum of three views (lateral, anteroposterior and odontoid process), for plain radiography, or those that did not perform a CT scan of the entire cervical spine, were excluded.

Study participants varied (inclusion criteria for each study reported); three of the ten included studies included only patients with cervical spine injury who had both plain radiography and CT. The reference standard varied across studies but, in most cases, was based upon the radiologist’s final review of all imaging studies (with or without clinical information).

The authors did not state how many reviewers assessed studies for inclusion.

Assessment of study quality
The methodological quality of included studies was assessed by one reviewer, using the QUADAS (Quality Assessment of Diagnostic Accuracy Studies) tool.

Data extraction
The sensitivity and specificity, or data to calculate these, of each imaging test, reported by each study, were extracted.

Data were extracted by one reviewer, using pre-designed forms.

Methods of synthesis
Studies were combined in a narrative synthesis (with sensitivity and specificity data were presented in graphs) for comparison between imaging tests.

Results of the review
Ten studies were included in the review, with a total of 4,106 participants (range 58 to 1,199). Seven of the ten studies included in the review were judged to be susceptible selection bias and did not include a representative spectrum of
patients. All ten studies used either CT or a composite of radiographic studies and clinical records as the reference standard to verify injury status, so were open to incorporation bias. Two studies failed to report sufficient details of the CT technique used to allow replication of the study. Only three studies clearly stated that imaging studies were interpreted blind to the results of the other test; one study reported partial blinding.

The sensitivity estimates for CT ranged from 90 to 100% (ten studies) and the sensitivity estimates for plain radiography ranged from 38.9 to 93.3% (nine studies); only one study reported sensitivity for plain radiography approaching that of CT.

The specificity estimates for CT ranged from 98 to 100% (seven studies) and the specificity estimates for plain radiography ranged from 95 to 100% (seven studies); three studies selected only patients with cervical spine injury, so no specificities could be calculated for these studies. Specificity estimates, where calculated, were similar across tests and studies.

**Authors' conclusions**

CT was superior to plain radiography for the detection of cervical spine injury. However there was insufficient evidence to suggest that CT was required for all trauma patients at risk of cervical spine injury.

**CRD commentary**

The review addressed a clearly stated research question, defined by appropriate inclusion criteria. The search strategy interrogated a number of sources, without language restrictions, and included attempts to identify unpublished studies. The review was conducted by a single investigator, so it was open to the risk of errors and/or bias at all stages of the review process.

The methodological quality of included studies was assessed and the implications of methodological weaknesses were discussed in detail. However, full results of the quality assessment were not reported. The narrative synthesis used was appropriate; the authors discussed the limitations of the data set extensively and listed a number of caveats in their conclusions.

Although results indicated a higher sensitivity for CT than for plain radiographs, the reported data were not adequate to support the firm conclusion that CT was superior to plain radiography in the detection of cervical spine injury; i.e. included studies were methodologically weak, sensitivity results were heterogeneous, results of individual studies only presented graphically, and there were no confidence intervals around estimates. In addition, the conclusion (that plain radiography was reliable for the vast majority of trauma patients due to the relatively low incidence of cervical spine injury together with the effectiveness good-quality radiographs) appears to have been drawn from sources other than the results of the review.

**Implications of the review for practice and research**

**Practice:** The authors stated that the optimal imaging strategy requires a differentiated approach dependent on the patients’ relative risk of cervical spine injury. For high-risk patients, cervical CT is indicated. In minor trauma patients at low-risk of cervical spine injury good-quality plain radiographs are sufficient.

**Research:** The authors did not state any implications for future research.

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