

## Critical Review Form

PGY-1

### Meta-analysis

VandenBerg J, Cullison K, Fowler SA, Parsons MS, McAndrew CM, Carpenter CR. Blunt Thoracolumbar-Spine Trauma Evaluation in the Emergency Department: A Meta-Analysis of Diagnostic Accuracy for History, Physical Examination, and Imaging. J Emerg Med. 2018 Dec 28.

**Objectives:** "to quantify parameters of diagnostic accuracy of commonly used imaging modalities for blunt TL spine trauma in patients aged 14 years or older, with a focus on the mechanism of injury, physical examination findings, and commonly employed imaging modalities." (p. 2)

**Methods:** This systematic review was conducted with assistance of a medical librarian. Studies including patients aged 14 years or older presenting to the ED following blunt trauma, in whom an evaluation of the TL spine was reported "in sufficient detail to construct 2X2 tables" were eligible for inclusion. A detailed literature search, limited to the English language, was conducted on January 30, 2017. In addition, the abstracts of several scientific assemblies were searched, as were society presentations from Orthopedic Trauma Association meetings and American Association of Neurological Surgeons meetings.

Two authors independently reviewed titles and abstracts for inclusion and evaluated each study's risk of bias using the revised Quality Assessment Tool for Diagnostic Accuracy Studies ([QUADAS-2](#)). When possible, authors distinguished "all fractures" from "clinically significant fractures," which includes those fractures requiring surgery or orthosis, and those deemed "unstable."

Out of 6420 articles identified, 224 were selected for review and 48 were included in the review. The mean age of patients in the included studies ranged from 35 to 44 years and the prevalence of TL spine fractures ranged from 4% to 72%.

Guide	Question	Comments
I	<i>Are the results valid?</i>	
1.	Did the review explicitly address a sensible question?	Yes. The evaluation of the thoracic and lumbar spines in the setting of trauma has long been a contentious issue. Some studies have suggested that the clinical examination alone is insufficient to rule out injuries to this area ( <a href="#">Inaba 2011</a> ) and others have suggested that plain radiography has too high a rate of missed fracture to be used routinely ( <a href="#">Parizel 2010</a> ), at least in cases of "severe" trauma ( <a href="#">Wintermark 2003</a> ). This systematic

		review attempts to quantify the clinical utility of history, physical exam findings, and radiologic modalities in assessing for thoracolumbar injury in blunt trauma.
2.	Was the search for relevant studies detailed and exhaustive?	Yes. <a href="#">PubMed</a> and <a href="#">EMBase</a> were searched using an extensive strategy devised with the assistance of a medical librarian. In addition, several conference abstracts and major society presentations were searched. It does not appear that <a href="#">CINAHL</a> , <a href="#">the Cochrane Database</a> , or the <a href="#">gray literature</a> were searched, but there appears to be a low risk of <a href="#">publication bias</a> .
3.	Were the primary studies of high methodological quality?	No. Per the authors, the studies were of "variable quality." Only two of the studies involved a case-control design. Eight studies were at high risk of <a href="#">spectrum bias</a> due to inclusion of only "sicker" trauma patients who were admitted or intubated. Most of these studies were retrospective, which would make blinding of the interpretation of index tests and gold standard tests very unlikely. The studies were also at high risk of <a href="#">incorporation bias</a> .
4.	Were the assessments of the included studies reproducible?	Yes. The authors used the <a href="#">QUADAS-2</a> tool to assess the quality of the included studies. This is a well validated tools used to assess for sources of bias in studies of diagnostic accuracy.
<b>II.</b>	<b><i>What are the results?</i></b>	
1.	What are the overall results of the study?	<ul style="list-style-type: none"> <li>• Mechanism of injury had a pooled LR+ ranging from 0.5 to 1.7 and LR- of 0.63 to 1.25, making this a poor tool to aid decision-making. <ul style="list-style-type: none"> <li>○ The pooled LR+ and LR- for "high risk mechanism" were 1.5 (95% CI 1.3-1.8) and 0.63 (95% CI 0.55-0.71), respectively.</li> </ul> </li> <li>• The most useful aspect of the history and physical exam was a palpable spine deformity, which had a LR+ of 15.3 (95% CI 7.1-33.0). <ul style="list-style-type: none"> <li>○ There was no negative finding on physical examination that significantly reduced the probability of finding a TL-spine fracture.</li> <li>○ Physician gestalt for a "greater than low pre-test probability" of fracture, based on history and physical exam findings, had a LR+ of 1.8 (95% CI 1.4-2.3) and LR- of 0.50 (95% CI 0.29-0.84).</li> </ul> </li> <li>• Five studies evaluated the accuracy of plain films of T and L-spine, with a pooled LR+ of 25.0 (95% CI 4.1-152.2) and LR- of 0.43 (95% CI 0.32-0.59) for diagnosis of injury. <ul style="list-style-type: none"> <li>○ Three studies evaluated the accuracy of plain</li> </ul> </li> </ul>

		<p>films of the thoracic spine, with a pooled LR+ of 2.2 (95% CI 0.7-7.2) and LR- of 0.62 (95% CI 0.30-1.27).</p> <ul style="list-style-type: none"> <li>○ Two studies evaluated the accuracy of plain films of the lumbar spine, with a pooled LR+ of 15.7 (95% CI 7.6-32.4) and LR- of 0.60 (95% CI 0.35-1.03).</li> <li>● Six studies evaluated the accuracy of chest, abdomen, and pelvis (CAP) CT scan, with a pooled LR+ of 81.1 (95% CI 14.1-467.9) and LR- of 0.04 (95% CI 0.02-0.08) for diagnosis of injury.</li> <li>● A single study evaluated the accuracy of reformatted TL-spine CT, revealing a LR+ of 40.2 (95% CI 16.8-95.8) and LR- of 0.05 (95% CI 0.01-0.21).</li> <li>● A single study evaluated the accuracy of plain films for diagnosing a "clinically significant" fracture of the TL-spine, with LR+ of 61.6 (95% CI 3.5-1079.4) and LR- of 0.66 (95% CI 0.44-0.98). Plain films missed 66.7% of clinically significant fractures.</li> </ul>
2.	How precise are the results?	See above. Overall, the 95% confidence intervals were sufficiently narrow to draw conclusions regarding the utility of various findings in the evaluation of thoracolumbar injury.
3.	Were the results similar from study to study?	Mostly yes. For the most part, reported <a href="#">I<sup>2</sup> values</a> were low (mostly 0%). For diagnostic accuracy of plain films for TL-spine injury, T-spine injury, and L-spine injury, these values were very high (ranging from 84% to 94%) suggesting a great deal of heterogeneity. The I <sup>2</sup> value for the +LR of CAP CT was also high (87%).
<b>III.</b>	<b><i>Will the results help me in caring for my patients?</i></b>	
1.	How can I best interpret the results to apply them to the care of my patients?	<ul style="list-style-type: none"> <li>● This systematic review and meta-analysis suggests that there is little in the history and physical exam of the blunt trauma patient to assist in determining who does and does not have a TL-spine fracture, including mechanism of injury. While it is not surprising that individual findings on history and physical are insufficient in the evaluation of these patients, this study was not designed to evaluate the accuracy of multiple aspects of the history and physical when considered together.</li> <li>● Plain radiography fared rather poorly in this review, doing a poor job of ruling out T and L spine injuries. When considering only "clinically significant" injuries plain films did no better. Based on these results, imaging of the thoracic and lumbar spine in</li> </ul>

		blunt trauma patients, when warranted, should consist of CT scanning. CAP CT appeared to do well in this review, and specific reformatting of the T and L spine may not be entirely necessary (though given lack of downsides, it may be prudent in most patients to include reformatted images).
2.	Were all patient important outcomes considered?	No. This review was limited by the data available in the individual studies, and the definitions of "disease" and "no disease," as well as the definition of "clinically significant" injuries, was based on the standard devised by the individual studies. This makes it difficult to know if the outcomes being evaluated were truly <a href="#">patient-centered</a> or not.
3.	Are the benefits worth the costs and potential risks?	Uncertain, but likely yes. This review suggests that individual aspects of the history and physical examination alone are insufficient to rule-out thoracic and lumbar spine injury. While this does not mean that history and physical examination, taken as a whole, are inadequate in this regard, but suggests that the clinician maintain a low threshold to order imaging in patients at any risk of thoracic or lumbar injury. In addition, when imaging is undertaken, it would seem that plain radiography alone is insufficient to rule out fracture, and CT scanning should be undertaken for most patients.

### **Limitations:**

1. It does not appear that [CINAHL](#), [the Cochrane Database](#), or the [gray literature](#) were searched. Despite this limitation, there appears to be a low risk of [publication bias](#).
2. The included studies were of "variable quality," with a high risk of [spectrum bias](#) and [incorporation bias](#) in many of the studies.
3. While this review suggests that individual aspects of the history and physical examination alone are insufficient to rule-out thoracic and lumbar spine injury, this does not mean that history and physical examination, taken as a whole, are inadequate in this regard.
4. This review was limited by the data available in the individual studies, and the definitions of "disease" and "no disease," as well as the definition of "clinically significant" injuries, was based on the standard devised by the individual studies.

This makes it difficult to know if the outcomes being evaluated were truly [patient-centered](#) or not.

**Bottom Line:**

**This systematic review and meta-analysis suggests that history and physical exam findings, taken individually, are inadequate to rule out TL spine injury following blunt trauma, but was not able to assess the history and physical when taken as a whole. In addition, plain films appear to be inadequate to rule out injury, and it may be prudent to perform CT scanning when imaging is being pursued. Further studies validating the handful of clinical decision rules is necessary to identify a means of foregoing CT scanning in select patients at low risk of injury.**