

Critical Review Form

Meta-analysis

CT versus Plain Radiograph to Screen for Cervical Spine Injury: A Meta-analysis, *J Trauma* 2005; 58: 902-905

Objective: “To compare the test performance of plain radiography and CT for identifying patients with cervical spine injuries after blunt events.” (p 902)

Methods: MEDLINE search of English language article from Jan 1995 to June 2004 with two search terms (cervical spine trauma and computed tomography). The authors also hand-searched of bibliographies of articles found by the electronic search and four journals (*J Trauma, Spine, Annals EM, Academic EM*). Study inclusion criteria included randomized controlled trials comparing CT to x-ray compared with a blinded Gold standard OR cohort studies where patients obtained both CT and x-rays. Studies were excluded if: plain x-rays studies did not include at least traditional 3 views c spine series; CT did not include entire c spine; or CT cuts were > 5 mm. The authors graded the evidence as follows:

- a. Level I : RCT
- b. Level II : Sample size > 50 with minimal selection bias and an independent Gold standard
- c. Level III: Sample size > 50 with moderate selection bias or lacking an independent Gold standard
- d. Level IV: < 50 subjects or severe selection bias

The authors defined significant inter-study heterogeneity as $p < 0.10$. When significant heterogeneity was identified, a sensitivity analysis was conducted by excluding heterogeneous trials and re-analyzing the data. The authors reported pooled sensitivity for plain radiography and CT using a random-effects model.

Guide	Question	Comments
I	<i>Are the results valid?</i>	
1.	Did the review explicitly address a sensible question?	Yes, whether CT can replace XR as the primary screening tool in blunt neck trauma because of its speed and superior sensitivity. This review does not address questions like financial feasibility, turn around times, consequences of missed x-ray fractures, or other patient important end points.



2.	Was the search for relevant studies details and exhaustive?	Not really. The authors neglected to search EMBASE (European), LILACS (Latin American), CINAHL (nursing), or Cochrane nor did they contact researchers or industry experts for on-going unpublished grey literature. Also, limiting the search to studies since 1995 may have neglected some early CT research, however it is likely that prior to that date there were relatively few relevant CT related studies since CT's underwent a major technologic change around this time from single slice to helical scans.
3.	Were the primary studies of high methodological quality?	No. Of the 712 studies reviewed only 7 made it into the meta-analysis. Of the 7, five were level III and 2 were level IV (< 50 subjects or a severe selection bias)
4.	Were the assessments of the included studies reproducible?	Unknown because no Kappa analysis was reported.
II.	<i>What are the results?</i>	
1.	What are the overall results of the study?	<ul style="list-style-type: none"> • 712 MEDLINE citations were identified but only seven met inclusion criteria • No RCT's or Level II studies • X-ray pooled sensitivity 52% (95% CI 47-56%) [Fig 1 pg 903] • CT pooled sensitivity 98% (95% CI 96-99%) [Fig 2 pg 904] • Since all of the data included CT of the c-spine as part of the Gold standard (as opposed to MRI or necropsy or some other diagnostic test), the authors could not assess specificity , false positives, or likelihood ratios. • The authors did not assess possibility of <i>publication bias</i> with a funnel plot • <i>Spectrum bias</i> may have been present since most of these studied selected only the most severely injured subjects (altered MS, ICU admits, GCS < 9). This <i>selection bias</i> is reflected in the prevalence of c-spine injuries in the present meta-analysis cohort (5-23%) versus the generally accepted rate of 2-5 % among all patients undergoing imaging after blunt trauma.

2.	How precise are the results?	Fairly narrow sensitivity confidence intervals for x-ray 52% (95% CI 56%) and CT 98% (95% CI 96-99%)
3.	Were the results similar from study to study?	No, study heterogeneity existed but the sensitivity analysis only increased x-ray sensitivity from 52% to 54% when the heterogeneous trials were excluded. Table 1 (p 903) demonstrates that several studies are not very ED relevant (Berne – ICU admissions or Widder – GCS < 9 or intubated!) for the low to moderate risk ED C-spine patient who cannot be cleared by low-risk clinical scores. No study heterogeneity existed but sensitivity analysis only increased x-ray sensitivity to 54% when these trials were excluded.
III.	<i>Will the results help me in caring for my patients?</i>	
1.	How can I best interpret the results to apply them to the care of my patients?	Among severely injured blunt trauma patients, c-spine CT is superior to x-ray imaging to diagnose injury. It appears that the take home message here is that CT is probably the gold standard for bony traumatic c-spine imaging which is really already established. The limited study selection and poor study make up that generated the 7 studies used in the meta-analysis coupled with poor application to low-mod risk ED patients, makes this review of limited utility for our purposes. <u>This study essentially states that CT is the criterion standard, not whether it should or could easily be used as a screening tool.</u>
2.	Were all patient important outcomes considered?	No. Patients not care about the diagnosis of fractures. (Plaintiff attorneys do!) Instead, patients care about paralysis, pain, surgical management, and long-term disability none of which were addressed in this study.
3.	Are the benefits worth the costs and potential risks?	The current study was not a cost-effectiveness analysis and the authors do not hypothesize about potential benefits (see PGY IV paper). Again, if you only want to make sure you miss no cervical spine fractures, than CT is the way to go.

Limitations

- 1) Incomplete search strategy**
- 2) No Kappa analysis of article selection or quality grading**
- 3) Definite spectrum bias**
- 4) Moderate to poor quality, heterogeneous trials limiting confidence in meta-analysis**
- 5) Inability to calculate specificity or LR's**
- 6) No definition of severe trauma injury except change in MS or ICU admission. Why didn't the authors use NEXUS, the Canadian cervical spine rule, and ISS scores (see below) to help readers understand how severely subjects were injured?**

Bottom Line

Based upon seven studies of overall poor quality, for severely injured blunt trauma patients with altered mental status or ICU admission, cervical spine CT has superior sensitivity (98%) to 3-view x-rays (52%). Future research should assess CT as a first line imaging study among low, moderate, or high-risk cervical spine injured patients in a randomized, controlled fashion assessing for both injury and patient-important outcomes (paralysis, operative management, disability).



Injury Severity Score - ISS

ISS defined as the sum of the squares of the single highest abbreviated injury score (AIS) to each of the three *most* severely injured body regions. The six regions include: head/neck, chest, abdomen, extremities/pelvis, general external structures. Of particular note, the use of only the single most severe AIS injury **per body region** is used:

Minor	1 point
Moderate	2 points
Serious	3 points
Severe	4 points
Critical	5 points
Not survivable	6 points

ISS ranges from 1 to 75. An ISS of 75 is assigned to anyone with AIS of 6.

ISS Limitations:

- ISS limits total number of contributing injuries to three regions.
- Considers at most one injury per body region.
- In patients with injuries in several body regions, the ISS is often constrained to consider a second, perhaps less severe injury in a second body region rather than a second, more severe injury in the first body region. In response to this the NISS was developed.
- Takes no account of physiological variables
- Gives equal weight to each body region