

# Diagnostic Imaging Pathways - Cervical Spine Injury

## Population Covered By The Guidance

This pathway provides guidance on imaging patients at risk of a cervical spine injury following trauma. The guideline incorporates the validated Canadian C-spine Rules.

**Date reviewed: August 2013**

**Date of next review: 2017/2018**

**Published: October 2013**

## Quick User Guide

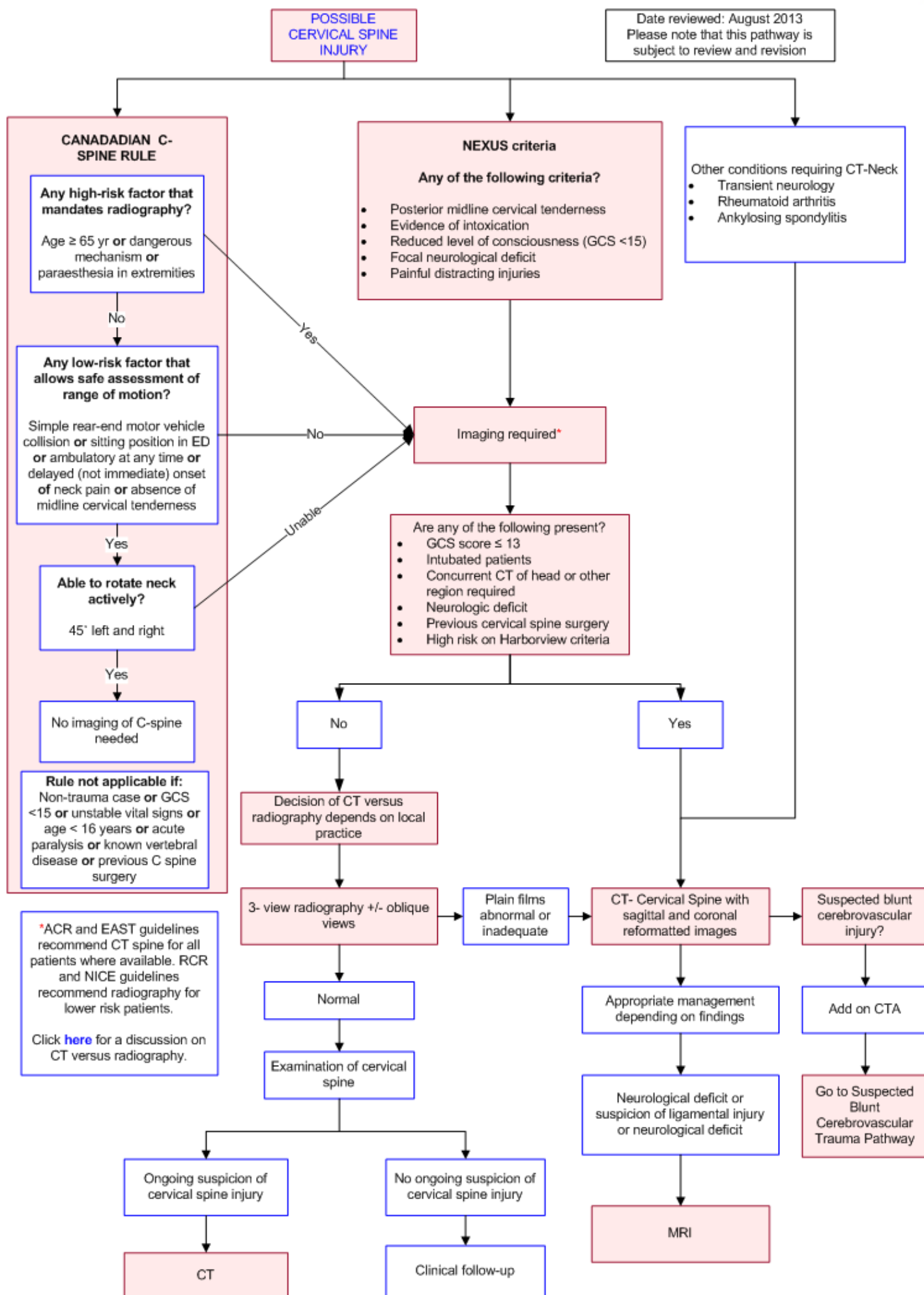
Move the mouse cursor over the **PINK** text boxes inside the flow chart to bring up a pop up box with salient points.

Clicking on the **PINK** text box will bring up the full text.

The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

## Pathway Diagram



## Image Gallery

*Note: These images open in a new page*



### Cervical Spine Fracture

Image 1a (Plain Radiograph): Burst fracture of the C5 vertebral body (arrow) with fragments travelling both anteriorly and posteriorly and fracture of the C6 pedicle (arrow).

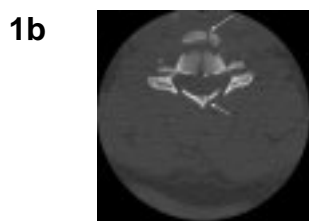


Image 1b and 1c (Computed Tomography): Axial and sagittal CT of the same patient demonstrating the burst fracture of the C5 vertebral body (arrow).

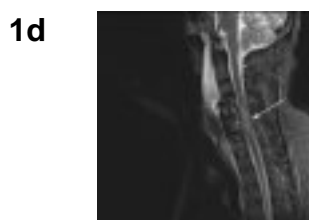


Image 1d (Magnetic Resonance Imaging): Post surgical MRI of the same patient showing plate and screw fixation of C4-C6 vertebral bodies. There is expansion and high signal of the cord from the mid-C4 to mid-C7 level (arrow). This most likely represents an intramedullary contusion injury.

## Teaching Points

- Canadian C-spine rules (CCR) or the NEXUS prediction rule can be used to identify trauma patients who can be safely clinically cleared without imaging
- Where imaging is indicated, cervical spine CT is superior to plain radiographs in cervical spine injury assessment and is preferred if available, feasible and safe. However, it is associated with radiation exposure, and there is little evidence in lower risk patients. Availability of CT for lower risk patients will depend on local resources and preference
- If early CT is unavailable, at least a three-view cervical spine radiograph series is recommended, which also has a high level of evidence in alert, symptomatic patients. Areas of suspicion or poor visualisation should be further defined with CT
- In the case of a normal CT in alert, symptomatic patients with persistent clinical suspicion of injury or in unevaluable, obtunded patients, the level of evidence regarding cervical spine clearance is lower. Current evidence based guidelines recommend either continuing cervical immobilisation until asymptomatic, discontinuing immobilisation following normal MRI within 48 hours of injury, or



- discontinuing immobilisation at the discretion of the treating physician [6](#)
- MRI can best evaluate suspected ligamentous, spinal cord and soft tissue injuries and should be considered if there are any neurological signs
- Flexion/extension radiography adds little diagnostic value to evaluation of blunt trauma patients compared to CT and MRI [5,7](#)
- In trauma patients with ankylosing spondylitis, routine CT and MR imaging is recommended, even after minor trauma [6](#)

## CT versus Plain Radiographs for Initial Evaluation of Cervical Spine Injury

- While CT is more accurate, there are conflicting recommendations from international evidence based guidelines, stemming from concerns over radiation exposure and the paucity of evidence of the clinical effectiveness and cost-effectiveness of CT over radiography in lower risk patients [19,20](#)
- The American College of Radiology (2012), the Eastern Association for the Surgery of Trauma (2009), the most recent ATLS Spine and Spinal Cord Trauma guideline (2012) and the recently published American Association of Neurological Surgeons (2013) evidence-based guidelines recommend that all patients who require radiological evaluation undergo cervical CT for cervical spine clearance if it is available. [6,21,22](#) If CT is unavailable, radiographs still have a substantial level of evidence in alert, symptomatic patients [6](#)
- The National Institute for Health and Care Excellence (2007) [23](#) and the Royal College of Radiologists (2012) [19](#) are not convinced of the clinical and cost-effectiveness of CT over radiography in alert, symptomatic low-risk patients who do not require concurrent CT head or other CT imaging
- The United States approach appears to be based on the existence of high acuity level I trauma centres that see a severely injured population with a high prevalence of C spine fracture. Studies comparing CT versus plain radiographs also tend to draw from this population. The United Kingdom recommendations reflect the population based structure of the National Health Service where demonstration of cost-effectiveness is required, and may be more appropriate for lower acuity centres with a lower prevalence of C spine injury [20](#)
- Risks would vary according to patient factors, clinical situation and local imaging facilities (availability and radiation doses) and C spine fracture prevalence
- One 2009 assessment based on a metaanalysis and systematic review of the literature and current organ-specific radiation risk concluded that the high diagnostic accuracy of CT outweighed the increase in dose compared to radiography or radiography followed by CT regardless of patient age, sex or, mechanism of injury or fracture risk [24](#)

## Computed Tomography (CT)

- Advantages:
  - Highly sensitive and specific and superior to radiography in the detection of cervical spine injury in both alert and obtunded or unevaluable patients. [6,26-29,31,32,36,37](#) In the obtunded patient, a negative CT has a negative predictive value of 92.9% for clinically significant cervical spine injury and 99.6% for cervical spine injury requiring operative intervention [38](#)
  - Useful in evaluation of bony displacement and in preoperative planning [39](#)
  - Faster scanning time
  - More cost effective than radiography if settlement costs from paralysis resulting from false negative imaging are considered particularly if concurrent CT head is being performed [24](#),

### [35,40](#)

- Limitations
  - Limited ability to show ligamentous injuries. Inferior to MRI in demonstrating soft tissue or spinal cord injury [41](#)
  - May miss fractures in the axial plane including base of odontoid and some subluxations [39](#)
  - Increased radiation exposure. CT is associated with an estimated skin dose of 27.6mGy compared with 2.8mGy for plain film radiography. The estimated thyroid dose is 26mGy for CT and 1.8mGy for plain film [42](#)
- Where CT imaging is available, routine 3-view cervical spine radiographs do not add diagnostic benefit [30](#)

## Magnetic Resonance Imaging (MRI)

- Not particularly effective at detecting cervical spine fractures, [41,43](#) but is the procedure of choice for evaluating ligamentous, spinal cord and soft tissue injuries. [41,43,44](#) Consider MRI where there are neurologic signs
- In alert, symptomatic patients where initial radiographs and CTs are normal
  - Where there is clinical suspicion of ligamentous injury, MRI is more sensitive than dynamic imaging [45](#) and changed management in 25% persistently symptomatic patients in one study [46](#)
  - If examination is normal, MRI is of minimal benefit in detecting additional injury in alert, symptomatic patients, [47](#) as is dynamic imaging [7,48,49](#)
- In obtunded or unevaluable patients where initial radiographs and CTs are normal
  - MRI can safely exclude cervical spine injury with a sensitivity of 97.2-100% and specificity of 98.5-94% [50,51](#)
  - Routine MRI in these patients is not cost-effective compared with empirical immobilisation, [52](#) but will detect a small number of additional clinically significant injuries [38,50](#)
  - In recent metaanalyses, approximately 10-12% of unevaluable patients with normal CTs had positive findings on MRI, around half of which altered management (0.4-0.8% surgical stabilisation, 5.4-6.7% extended immobilisation). [38,50](#) Both metaanalyses advocate the use of MRI in this population
  - One protocol suggests using additional MRI if the unevaluable patient was not moving all four extremities on arrival to the ED [37](#)
- In trauma patients with ankylosing spondylitis, routine CT and MR imaging is recommended, even after minor trauma [6](#)
- Indications [39](#)
  - Clinical evidence of spinal cord injury, especially incomplete injury
  - Neurological deficits not explained by plain film or CT findings
  - Patients with injuries requiring posterior stabilisation to exclude concomitant disc herniations that might alter the surgical approach
- Limitations
  - Longer imaging time
  - Inability to fully characterise vertebral fractures
  - Technical difficulties in clinically unstable patients and patient risk during transport

## C-Spine Rules (CCR) and the National Emergency X-Radiography Utilisation Study (NEXUS) Prediction Rule



- Use of either clinical decision rule is intended to identify patients whom can be safely cleared without radiological examination of the cervical spine
- Both the CCR and the NEXUS rules are highly sensitive and have been prospectively validated in large multicentre trials. [1,8-11](#) They have low false negative rates and are effective in reducing imaging rates without missing clinically important cervical spine injuries [9,12-14](#)
- Prospective studies set in ED reported sensitivities of 99-100% and 83-100% and specificities of 42-45% and 13-46% for CCR and NEXUS criteria respectively [13](#)
- The single prospective study (undertaken by the authors of the CCR) that has directly compared the two rules in the same cohort found that the CCR had better accuracy [1](#)
- Both distracting injury and intoxication do not appear to be predictive of fracture in recent large prospective studies using CT. [15,16](#) They are also not clearly defined in the published NEXUS criteria
- An alert, asymptomatic patient without a distracting injury or neurologic deficit who can perform a functional range-of-motion examination is able to be cleared clinically with a sensitivity of 98.1% and a negative predictive value of 99.8% [14](#)
- There is a relative paucity of reliable clinical predictors in older patients. Age  $\geq$ 65 years is an independent predictor of fracture. [16](#) Clinical predictors appear inadequate for the evaluation of the cervical spine in older patients after low energy trauma and these patients should have imaging [17,18](#)

## Plain Radiography

- Three view cervical spine radiography includes
  - Anteroposterior (AP)
  - True lateral (including all seven cervical vertebrae and C7-T1 junction)
  - Open-mouth odontoid views
- Oblique views are also performed although one study has suggested that oblique views do not improve detection of abnormalities over three view radiography [25](#)
- Limitations
  - Insensitive in detecting cervical spine injury compared to CT in prospective studies in alert, symptomatic patients (36-45%), [26-28](#) even when excluding technically inadequate scans (52-65%). [26, 29,30](#) This is supported by an earlier metaanalysis with methodologic limitations. [31](#) Radiographs perform similarly poorly in obtunded patients (39-53%) [28,32,33](#)
  - High rate of technical inadequacy necessitating further imaging, particularly in older, multi-trauma or non-compliant patients. The NEXUS study reported adequate radiographs could not be obtained in 29% of patients with cervical spine injury in their population of 34,069 patients [34](#)
- Advantages
  - Lower radiation dose than CT, important in younger patients [24](#)
  - Cheaper than CT, but cost-effectiveness must take into account the massive costs associated with even one missed fracture that results in spinal cord injury [24,35](#)
- These limitations and the potential morbidity associated with missed fractures have led to a change in recommendations in preference to CT [6,21,22](#)
- There is a paucity of evidence for 'low-risk' patients who would still undergo radiography under some guidelines. One prospective study reported a 25% sensitivity of plain radiographs compared to CT but there were only four patients with fractures in the low-risk cohort (0.25% of total cohort and 8% of those with clinically significant injury) [26](#)



## References

Date of literature search: May 2013

The search methodology is available on request. [Email](#)

References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. [Download the document](#)

1. Stiell IG, Clement CM, McKnight RD, Brison R, Schull MJ, Rowe BH, et al. **The Canadian C-spine rule versus the NEXUS low-risk criteria in patients with trauma.** N Engl J Med. 2003;349(26):2510-8. (Level I evidence)
2. Hanson JA, Blackmore CC, Mann FA, Wilson AJ. **Cervical spine injury: a clinical decision rule to identify high-risk patients for helical CT screening.** AJR Am J Roentgenol. 2000;174(3):713-7. (Level II evidence)
3. Burlew CC, Biffi WL, Moore EE, Barnett CC, Johnson JL, Bensard DD. **Blunt cerebrovascular injuries: redefining screening criteria in the era of noninvasive diagnosis.** J Trauma Acute Care Surg. 2012;72(2):330-5. (Level II evidence)
4. Franz RW, Willette PA, Wood MJ, Wright ML, Hartman JF. **A systematic review and meta-analysis of diagnostic screening criteria for blunt cerebrovascular injuries.** J Am Coll Surg. 2012;214(3):313-27. (Level II evidence)
5. Hennessy D, Widder S, Zygun D, Hurlbert RJ, Burrowes P, Kortbeek JB. **Cervical spine clearance in obtunded blunt trauma patients: a prospective study.** J Trauma. 2010;68(3):576-82. (Level II evidence)
6. Hadley MN, Walters BC, Aarabi B, Dhall SS, Gelb DE, Harrigan MR, et al. **Guidelines for the management of acute cervical spine and spinal cord injuries.** Neurosurgery. 2013;72(Supplement 2):1-259. (Evidence based guidelines)
7. Sierink JC, van Lieshout WA, Beenen LF, Schep NW, Vandertop WP, Goslings JC. **Systematic review of flexion/extension radiography of the cervical spine in trauma patients.** Eur J Radiol. 2013;82(6):974-81. (Level II evidence)
8. Stiell IG, Wells GA, Vandemheen KL, Clement CM, Lesiuk H, De Maio VJ, et al. **The Canadian C-spine rule for radiography in alert and stable trauma patients.** JAMA. 2001;286(15):1841-8. (Level II evidence)
9. Stiell IG, Clement CM, Grimshaw J, Brison RJ, Rowe BH, Schull MJ, et al. **Implementation of the Canadian C-Spine Rule: prospective 12 centre cluster randomised trial.** BMJ. 2009;339:b4146. (Level II evidence)
10. Hoffman JR, Mower WR, Wolfson AB, Todd KH, Zucker MI. **Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma. National Emergency X-Radiography Utilization Study Group.** N Engl J Med. 2000;343(2):94-9. (Level I evidence)
11. Coffey F, Hewitt S, Stiell I, Howarth N, Miller P, Clement C, et al. **Validation of the Canadian c-spine rule in the UK emergency department setting.** Emerg Med J. 2011;28(10):873-6. (Level I evidence)
12. Stiell IG, Clement CM, O'Connor A, Davies B, Leclair C, Sheehan P, et al. **Multicentre prospective validation of use of the Canadian C-Spine Rule by triage nurses in the emergency department.** CMAJ. 2010;182(11):1173-9. (Level I evidence)
13. Michaleff ZA, Maher CG, Verhagen AP, Rebbeck T, Lin CWC. **Accuracy of the Canadian C-spine rule and NEXUS to screen for clinically important cervical spine injury in patients following blunt trauma: a systematic review.** CMAJ. 2012;184(16):E867-E876. (Level I evidence)
14. Anderson PA, Muchow RD, Munoz A, Tontz WL, Resnick DK. **Clearance of the asymptomatic cervical spine: a meta-analysis.** J Orthop Trauma. 2010;24(2):100-6. (Level I evidence)



15. Rose MK, Rosal LM, Gonzalez RP, Rostas JW, Baker JA, Simmons JD, et al. **Clinical clearance of the cervical spine in patients with distracting injuries: It is time to dispel the myth.** J Trauma Acute Care Surg. 2012;73(2):498-502. (Level II evidence)
16. Duane TM, Young A, Mayglothling J, Wilson SP, Weber WF, Wolfe LG, et al. **CT for all or selective approach? Who really needs a cervical spine CT after blunt trauma.** J Trauma Acute Care Surg. 2013;74(4):1098-101. (Level II/III evidence)
17. Schrag SP, Toedter LJ, McQuay N, Jr. **Cervical spine fractures in geriatric blunt trauma patients with low-energy mechanism: are clinical predictors adequate?** Am J Surg. 2008;195(2):170-3. (Level IV evidence)
18. Bub LD, Blackmore CC, Mann FA, Lomoschitz FM. **Cervical spine fractures in patients 65 years and older: a clinical prediction rule for blunt trauma.** Radiology. 2005;234(1):143-9. (Level IV evidence)
19. The Royal College of Radiologists. **iRefer 7.0.1: Making the best use of clinical radiology.** 2012 [updated 2012 Jan; cited 2013 May 5]; 7. Available from: [www.irefer.org.uk](http://www.irefer.org.uk) (Evidence based guidelines)
20. The College of Emergency Medicine. **Guideline on the management of alert, adult patients with potential cervical spine injury in the Emergency Department.** London, United Kingdom; 2010 [updated 2010 November 1; cited 2013 May 1]. (Evidence based guidelines). [View the reference](#)
21. Expert Panel on Musculoskeletal and Neurologic Imaging; Daffner RH, Weissman BN, Wippold FJ, Angtuaco EJ, Appel M, et al. **American College of Radiology Appropriateness Criteria: Suspected spine trauma** [online publication]. Reston, VA; 2012 [cited 2013 May 4]. (Evidence based guidelines). [View the reference](#)
22. Como JJ, Diaz JJ, Dunham CM, Chiu WC, Duane TM, Capella JM, et al. **Practice management guidelines for identification of cervical spine injuries following trauma: update from the Eastern Association for the Surgery of Trauma practice management guidelines committee** . J Trauma. 2009;67(3):651-9. (Evidence based guidelines)
23. National Institute for Health and Care Excellence (NICE). **Head injury (CG56): Triage, assessment, investigation and early management of head injury in infants, children and adults.** 2007 [updated 2012 February 28; cited 2013 May 3rd]. (Evidence based guidelines). [View the reference](#)
24. Theocharopoulos N, Chatzakis G, Damilakis J. **Is radiography justified for the evaluation of patients presenting with cervical spine trauma?** Med Phys. 2009;36(10):4461-70. (Level III evidence)
25. Freemyer B, Knopp R, Piche J, Wales L, Williams J. **Comparison of five-view and three-view cervical spine series in the evaluation of patients with cervical trauma.** Ann Emerg Med. 1989;18(8):818-21. (Level III evidence)
26. Bailitz J, Starr F, Beecroft M, Bankoff J, Roberts R, Bokhari F, et al. **CT should replace three-view radiographs as the initial screening test in patients at high, moderate, and low risk for blunt cervical spine injury: a prospective comparison** . J Trauma. 2009;66(6):1605-1609. (Level II evidence)
27. Mathen R, Inaba K, Munera F, Teixeira PG, Rivas L, McKenney M, et al. **Prospective evaluation of multislice computed tomography versus plain radiographic cervical spine clearance in trauma patients** . J Trauma. 2007;62(6):1427-31. (Level III evidence)
28. Widder S, Doig C, Burrowes P, Larsen G, Hurlbert RJ, Kortbeek JB. **Prospective evaluation of computed tomographic scanning for the spinal clearance of obtunded trauma patients: preliminary results.** J Trauma. 2004;56(6):1179-84. (Level II evidence)
29. Griffen MM, Frykberg ER, Kerwin AJ, Schinco MA, Tepas JJ, Rowe K, et al. **Radiographic clearance of blunt cervical spine injury: plain radiograph or computed tomography scan?** J Trauma. 2003;55(2):222-6; discussion 226-7. (Level II evidence)
30. McCulloch PT, France J, Jones DL, Krantz W, Nguyen TP, Chambers C, et al. **Helical**



- computed tomography alone compared with plain radiographs with adjunct computed tomography to evaluate the cervical spine after high-energy trauma** . J Bone Joint Surg Am. 2005;87(11):2388-94. (Level II evidence)
31. Holmes J, Akkinepalli R. **Computed tomography versus plain radiography to screen for cervical spine injury: a meta-analysis**. J Trauma. 2005;58(5):902-905. (Level III evidence)
  32. Brohi K, Healy M, Fotheringham T, Chan O, Aylwin C, Whitley S, et al. **Helical computed tomographic scanning for the evaluation of the cervical spine in the unconscious, intubated trauma patient**. J Trauma. 2005;58(5):897-901. (Level II evidence)
  33. Diaz JJ, Jr., Gillman C, Morris JA, Jr., May AK, Carrillo YM, Guy J. **Are five-view plain films of the cervical spine unreliable? A prospective evaluation in blunt trauma patients with altered mental status** . J Trauma. 2003;55(4):658-63; discussion 663-4. (Level II evidence)
  34. Mower WR, Hoffman JR, Pollack CV, Jr., Zucker MI, Browne BJ, Wolfson AB. **Use of plain radiography to screen for cervical spine injuries**. Ann Emerg Med. 2001;38(1):1-7. (Level II evidence)
  35. Grogan EL, Morris JA, Jr., Dittus RS, Moore DE, Poulouse BK, Diaz JJ, et al. **Cervical spine evaluation in urban trauma centers: lowering institutional costs and complications through helical CT scan** . J Am Coll Surg. 2005;200(2):160-5. (Level III evidence)
  36. Panczykowski DM, Tomycz ND, Okonkwo DO. **Comparative effectiveness of using computed tomography alone to exclude cervical spine injuries in obtunded or intubated patients: meta-analysis of 14,327 patients with blunt trauma** . J Neurosurg. 2011;115(3):541-9. (Level III evidence)
  37. Sanchez B, Waxman K, Jones T, Conner S, Chung R, Becerra S. **Cervical spine clearance in blunt trauma: evaluation of a computed tomography-based protocol**. J Trauma. 2005;59(1):179-183. (Level II evidence)
  38. Russin JJ, Attenello FJ, Amar AP, Liu CY, Apuzzo ML, Hsieh PC. **Computed Tomography for Clearance of Cervical Spine Injury in the Unevaluable Patient**. World Neurosurg. 2013;80(3-4):405-13. (Level I/II evidence)
  39. Cornelius RS. **Imaging of acute cervical spine trauma**. Semin Ultrasound CT MR. 2001;22(2):108-24. (Review article)
  40. Blackmore CC, Mann FA, Wilson AJ. **Helical CT in the primary trauma evaluation of the cervical spine: an evidence-based approach** . Skeletal Radiol. 2000;29(11):632-9. (Level IV evidence)
  41. Holmes JF, Mirvis SE, Panacek EA, Hoffman JR, Mower WR, Velmahos GC. **Variability in computed tomography and magnetic resonance imaging in patients with cervical spine injuries**. J Trauma. 2002;53(3):524-9; discussion 530. (Level III evidence)
  42. Rybicki F, Nawfel RD, Judy PF, Ledbetter S, Dyson RL, Halt PS, et al. **Skin and thyroid dosimetry in cervical spine screening: two methods for evaluation and a comparison between a helical CT and radiographic trauma series** . AJR Am J Roentgenol. 2002;179(4):933-7. (Level II evidence)
  43. Katzberg RW, Benedetti PF, Drake CM, Ivanovic M, Levine RA, Beatty CS, et al. **Acute cervical spine injuries: prospective MR imaging assessment at a level 1 trauma center**. Radiology. 1999;213(1):203-12. (Level III evidence)
  44. Benzel EC, Hart BL, Ball PA, Baldwin NG, Orrison WW, Espinosa MC. **Magnetic resonance imaging for the evaluation of patients with occult cervical spine injury**. J Neurosurg. 1996;85(5):824-9. (Level III evidence)
  45. Duane TM, Cross J, Scarcella N, Wolfe LG, Mayglothling J, Aboutanos MB, et al. **Flexion-extension cervical spine plain films compared with MRI in the diagnosis of ligamentous injury**. Am Surg. 2010;76(6):595-8.
  46. Menaker J, Stein DM, Philp AS, Scalea TM. **40-slice multidetector CT: is MRI still necessary for cervical spine clearance after blunt trauma?** Am Surg. 2010;76(2):157-63. (Level III evidence)



47. Schuster R, Waxman K, Sanchez B, Becerra S, Chung R, Conner S, et al. **Magnetic resonance imaging is not needed to clear cervical spines in blunt trauma patients with normal computed tomographic results and no motor deficits** . Arch Surg. 2005;140(8):762-6. (Level II evidence)
48. Pollack CV, Jr., Hendey GW, Martin DR, Hoffman JR, Mower WR. **Use of flexion-extension radiographs of the cervical spine in blunt trauma**. Ann Emerg Med. 2001;38(1):8-11. (Level II evidence)
49. McCracken B, Klineberg E, Pickard B, Wisner DH. **Flexion and extension radiographic evaluation for the clearance of potential cervical spine injuries in trauma patients**. Eur Spine J. 2013 Feb 13. (Level III/IV evidence)
50. Schoenfeld AJ, Bono CM, McGuire KJ, Warholic N, Harris MB. **Computed tomography alone versus computed tomography and magnetic resonance imaging in the identification of occult injuries to the cervical spine: a meta-analysis** . J Trauma. 2010;68(1):109-13; discussion 113-4. (Level I/II evidence)
51. Muchow RD , Resnick DK, Abdel MP, Munoz A, Anderson PA. **Magnetic resonance imaging (MRI) in the clearance of the cervical spine in blunt trauma: a meta-analysis**. J Trauma. 2008;64(1):179-89. (Level I evidence)
52. Halpern CH, Milby AH, Guo W, Schuster JM, Gracias VH, Stein SC. **Clearance of the cervical spine in clinically unevaluable trauma patients**. Spine ( Phila Pa 1976). 2010;35(18):1721-8. (Level III evidence)

## Information for Consumers

Information from this website	Information from the Royal Australian and New Zealand College of Radiologists' website
<p><a href="#">Consent to Procedure or Treatment</a></p> <p><a href="#">Radiation Risks of X-rays and Scans</a></p> <p><a href="#">Computed Tomography (CT)</a></p> <p><a href="#">Computed Tomography (CT) Angiography</a></p> <p><a href="#">Magnetic Resonance Imaging (MRI)</a></p> <p><a href="#">Plain Radiography (X-ray)</a></p>	<p><a href="#">Computed Tomography (CT)</a></p> <p><a href="#">Contrast Medium (Gadolinium versus Iodine)</a></p> <p><a href="#">Gadolinium Contrast Medium</a></p> <p><a href="#">Iodine-Containing Contrast Medium</a></p> <p><a href="#">Magnetic Resonance Imaging (MRI)</a></p> <p><a href="#">Plain Radiography/X-rays</a></p> <p><a href="#">Radiation Risk of Medical Imaging During Pregnancy</a></p> <p><a href="#">Radiation Risk of Medical Imaging for Adults and Children</a></p>

## Copyright

© Copyright 2015, Department of Health Western Australia. All Rights Reserved. This web site and its content has been prepared by The Department of Health, Western Australia. The information contained on this web site is protected by copyright.

## Legal Notice

Please remember that this leaflet is intended as general information only. It is not definitive and The Department of Health, Western Australia can not accept any legal liability arising from its use. The information is kept as up to date and accurate as possible, but please be warned that it is always subject to change

## File Formats

Some documents for download on this website are in a Portable Document Format (PDF). To read these files you might need to download Adobe Acrobat Reader.



## [Legal Matters](#)