National Clinical Guideline Centre

Final

Spinal injury: assessment and initial management

Spinal injury assessment: assessment and imaging for spinal injury

NICE guideline NG41

Appendices G -I

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Appendix G: Clinical evidence tables

G.1 Protecting the spine

Table 1: Armstrong 2007[1]

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
Armstrong BP, Simpson HK, Crouch R, Deakin CD. Pre-hospital clearance of the cervical spine: does it need to be a pain in the neck? Implementation of clinical decision rules in the emergency department. Emergency Medicine Journal. 2007; 24(7):501-	Prospective observational study, UK	n=105 audit forms completed n=103 completed	None provided	Algorithm based on National Emergency X-Radiography Utilization Study criteria and NICE guidelines Neck pain and/or suspicion of C-spine injury Inspection: Significant intrusion of vehicle, significant distracting injury, age less than 16 or older than 65, dangerous mechanism of injury (fall from a height > 1 metre or 5 stairs, axial load	N/A	6 months Reports to the Emergency Department (ED) or ambulance service by patients, other EDs, GPs regional neurological centres or coroners offices	Missed C-spine injuries	None reported

Reference	Study type	Number of patients	Patient characteristics			Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding

503. (Guideline Ref ID ARMSTRONG 2007)						to head, vehicle roll-over ejection from a motor vehicle, high speed vehicle collision > 65 mph, accident involving motorised recreational vehicles, bicycle collision.
						If yes to any, then triple immobilisation
						If no then
						GCS < 15 at time of examination, intoxication with drugs or alcohol, immediate onset of neck pain, paraesthesia in the extremities, focal neurological deficit, presence of midline C-spine tenderness, patient unable to rotate neck through 45 degrees to left and right.
						If yes to any, then				

Reference	Study type	Number of patients	Patient characteristics			Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
						triple immobilisation. If no then C-spine cleared				
Results: 69/103 (67%) had no significant C-spine injury identified at scene. 60/103 (58%) were discharged at the scene, with no clinical adverse events reported; 34 did not have their C-spine cleared at scene. Of these 4 (4%) self-discharged at scene, all of whom would have required immobilisation. A total of 30 (39%) patients were conveyed to an ED. During the 6 months following the study period, no reports of missed C-spine injury were reported to the ED or ambulance service by patients, other EDs, GPs, regional neurological centres or coroners' offices. Limitations Paramedics taking part in the audit might not be representative. Patients may have presented to healthcare facilities other than the ones being monitored										

Table 2: Burton 2005[10]

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
Burton JH, Harmon NR, Dunn MG, Bradshaw JR. EMS provider findings and interventions with a state-wide EMS spine-assessment	Prospective observational study, USA	n=207,545 emergency medical services (EMS) runs n=31,885 trauma-related EMS encounters n=2,220 spine protocol data	July 2002-June 2003. Trauma related encounters: mean age 48.1 (SD 26.7 years) range 0-109 years. 45% male Spinal assessment forms: mean age 43.1 (SD 25.7 years) range 0-102 years. 46% male. Mechanism of injury – 0.1% diving, 47.8% motor vehicle, 1.3%	Revised emergency medical services spine assessment protocol Four step assessment sequence based on patient assessment findings: patient unreliability (intoxicated,	N/A	Not reported Hospital data from the state health data organisation (MHDO). All hospitals are mandated to report clinical and financial data to the	Number of patients immobilised Number of fractures not immobilised Number of patients not immobilised	None reported

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
protocol. Pre-hospital Emergency Care. 2005; 9(3):303-309. (Guideline Ref ID BURTON2005)		collection forms	bicycle vs. pedestrian, 25.8% falls from standing height, 4.2% fall greater than five feet, 0.1% penetrating traumas, 7.3% blunt traumas and 13.4% other	altered level of consciousness, not calm or uncooperative), presence of an abnormal motor or sensory neurologic examination, and presence of spine tenderness or complaint of spine pain. The protocol directed EMS providers to attempt spine immobilisation in the presence of any of the four considerations. A distracting injury was defined in the protocol as any injury that would produce clinically apparent pain that might distract the patient from pain of a spine injury Training provided		MHDO		
Results:								

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
n=1,301 decision to immobilise (59%). 5.4$ encounters in which patients refused immobilisation with no sign of altered level of consciousness or intoxication. For the immobilised patients, spine protocol findings included 416 (32%) patients deemed as unreliable, 358 (28%) with distracting injury, 80 (6%) with an abnormal neurologic examination and 709 (54%) with spine pain or tenderness. Of the 2,220 patients with spine forms there were seven patients with acute spine fractures all of whom were immobilised. All of these were stable spine injuries. Immobilisation was deemed not to be required in n=1,301 (59%) patients of which there were no cases of spine fractures. Limitations: No access to in-hospital patient records. Could have been selection bias (patient population) as participation voluntary								

Table 3: Domeier 2002[17]

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
Domeier RM, Swor RA, Evans RW, Hancock JB, Fales W, Krohmer J et al. Multicenter prospective validation of prehospital	Prospective observational study, USA	n=9,170 data sheets n=8,975 completed cases	April 1994 to October 1996 Patients of all ages with traumatic injury and spine immobilisation performed in the pre-hospital setting using a backboard or other spine immobilisation device. The decision to perform immobilisation was made of the basis of existing local protocols Population: 50.5% female, 1915 less than 18 years	Protocol Altered mental status, neurologic deficit, spine pain or tenderness, evidence of intoxication or suspected extremity	N/A	Not reported Medical records	Missed spine injuries	None reported

Reference	Study type	Number of patients	Patient characteristics			Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
clinical spinal clearance criteria. Journal of Trauma. 2002; 53(4):744-750. (Guideline Ref ID DOMEIER2002)						fracture – the absence of which identify pre-hospital trauma patients without a significant spine injury				
Results: 295/9170 (3.3%) patients with spine injuries (109 cervical, 86 thoracic and 100 lumbar). There were 15 false negatives. 13/15 had stable injuries, the majority of which were stable compression or vertebral process injuries. The remaining two would have been captured by more accurate pre-hospital evaluation. There were no additional cases identified by medical record registry. 15 missed cases: 1 C1, 2, odontoid fracture Halo, pain control 2 C 2/3 subluxation, 3-4 mm Philadelphia collar, outpatient 3 C3-5 spinous process, C6 laminar C7 compression Philadelphia collar 4 C6 anterior body fracture stiff neck collar 5 C6-7 facet fracture Cervical thoracic orthotic brace 6 T3 compression fracture < 25% Cervical thoracolumbosacral orthotic brace 77 T7 compression fracture pain control										

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
8 T6/7 subluxation Spine fusion 9 T11 compression fracture thoracolumbosacral orthotic brace 10 L1 transverse process fracture Pain control 11 L1 anterior body fracture Back brace 12 L1, 4 body fracture Lumbosacral orthotic brace 13 L2, 4, 5 compression fracture pain control 14 L2 pedicle fracture pain control 15 L4 transverse process fracture pain control								

Table 4: Domeier 2005[16]

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
Domeier RM, Frederiksen SM, Welch K. Prospective performance assessment	Prospective observational study, USA	n=13,483 patients with data collected n=13,357 patients with	October 1997 to September 2001. Consecutive trauma patients transported by advanced life support services. Only trauma patients with a documented spine injury assessment on the emergency	Protocol If any one positive: Altered mental status, evidence of	N/A	Not reported, hospital records	Number of patients not immobilised with a spinal cord injury	St Joseph Mercy Hospital Emergency Department Research

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
of an out-of-hospital protocol for selective spine immobilization using clinical spine clearance criteria Implementation of clinical decision rules in the emergency department. Annals of Emergency Medicine. 2005; 46(2):123-131. (Guideline Ref ID DOMEIER2005)		full data	medical services patient record were enrolled in the study. Population: < 1 to 104 years. 1,200 patients younger than 15 years and more than 2,700 patients 65 years and older.	intoxication, neurologic deficit, suspected extremity fracture, and spine pain or tenderness To be completed only on trauma patients with a mechanism of injury with potential for causing spine injury and omit the assessment for patients with insufficient mechanisms.				Fund and Clinical Research Funds
Results Spine injuries were present in 415/13.357 (3%). 50/415 had spinal cord injury. Positive assessments were documented for 8,132/13.357 (61%) patients, with								

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
immobilisation not performed in 594/8,132 (79%). Ten of these non-immobilised patients had a spine injury. All were treated conservatively, and none had a spinal cord injury. Negative assessments were documented in 5,225/13,357 (39%) patients, with immobilisation in 648/5,225 (12%) patients. 37 patients with negative assessments had spine injuries, and 14 of these had spine immobilisation. One patient with a negative assessment and immobilisation was a young football player with a partial spinal cord injury. Included among the 23 patients with negative assessments and withheld immobilisation were 2 patients with high cervical fractures. These were C1 to C" level injuries, without cord injury or morbidity, which were managed with halo immobilisation. Spine immobilisation was performed in 382 patients with a spine injury. 33 patients were missed with application of the selective immobilisation protocol. None of these missed patients were found to have a spinal cord injury. This group included the 2 patients with high cervical fractures, negative assessment results and non-immobilisation. All other patients were treated conservatively for their injuries. Missed spinal injuries: C1 ring, C2 odontoid Halo C1 ring, C2 odontoid Halo C2 lateral mass collar C3 body collar T7 comp TLSO T11 comp pain control T12 burst transv pro TLSO: refused back board T12 comp Pain control T12 comp Pain control T12 comp TLSO L1 body TSLO L1 comp TLSO L1 comp unknown L1 comp pain control L1 comp pain control, physical therapy L1 comp LS corset								

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check missed cases	Outcome measures	Source of funding
L1 comp LS corset L1, 2 Pain control L1, 2 transv pro Pain control L1, 3 comp Pain control L2 burst TLSO L2 comp TLSO L2, 3 comp TSLO L2, 3 trans pro LS corset L3 body chip Pain control L3 comp TLSO L3 comp No treatment L3 comp pain control L4 comp No treatment L4 comp Pain control L4 comp LS corset L5 ant/sup body Pain control								

Table 5: Muhr 1999[30]

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check misses cases	Outcome measures	Source of funding
Muhr MD,	Prospective	n=281	Inclusion: patients involved in	Protocol	N/A	Not	Missed	None

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check misses cases	Outcome measures	Source of funding
Seabrook DL, Wittwer LK. Paramedic use of a spinal injury clearance algorithm reduces spinal immobilizatio n in the out-of-hospital setting. Pre-hospital Emergency Care. 1999; 3(1):1-6. (Guideline Ref ID MUHR1999)	observational study, USA		traumatic incidents. Exclusion: Patients meeting trauma system criteria were not included for two reasons. First, the patients meeting the trauma system criteria would meet the spinal immobilisation algorithm criteria and the time would be better spent managing airway etc. Second, the primary purpose of this study was to examine the utility of the algorithm to reduce SI in patients with less severe injuries. In addition, patients were excluded if they were transported to any out-of-country medical facility	Patient mentation: (If yes immobilise) Decreased level of conscious, intoxication/drug impairment, loss of consciousness involved Subjective assessment: (if yes immobilise) spine pain, numbness/tinting/ weakness/burning sensation Objective assessment (if yes immobilise): Spine tenderness, other severe injury, pain with spine range of motion		reported Emergency Department chart	injuries	reported
Results:								

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow-up to check misses cases	Outcome measures	Source of funding
183/281 (65%) patients received spinal immobilisations. During the previous year 98% patients received spinal immobilisation. 6/281 were diagnosed as having a spinal fracture and one had acute neurologic deficit. In the non-immobilised group, one patient was diagnosed as having a lumbar fracture. There were 18 incidents where immobilisation was indicated but not done. 13/18 refused, none of the remaining 5 had spine injury. 33/281 (11.7%) were immobilised despite not meeting the criteria. None of these had spine injury Limitations: 50% of the survey forms turned in contained completed required information fields. The previous year's medical records were reviewed to compare spine immobilisation before and after the algorithm.								

Table 6: Vaillancourt 2009[39]

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow up for misses cases	Outcome measures	Source of funding
Vaillancourt C, Stiell IG, Beaudoin T, Maloney J, Anton AR, Bradford P et al. The out-of-hospital validation of the Canadian C-Spine Rule by paramedics Implementation of clinical	Prospective observational study, Canada	n=2,393 recruited n=1,949 number of patients with complete outcome assessment	2002-2006. Convenience sample of alert, stable and cooperative patients transported by ambulance to local hospitals after sustaining acute blunt trauma with potential injury to the neck. These are patients for whom standard EMS protocols require immobilisation. Alert was defined as a Glasgow Coma Scale score of 15. Stable refers to normal vital signs	Revised Canadian C-Spine Rule The low risk criteria pertaining to delayed onset of neck pain because paramedics were going to assess patients before such a delay would occur C-Spine	N/A	Not reported Radiography and telephone	Number of fractures immobilised Number of patients correctly not immobilised	Physicians' Services Incorporated Foundation and Ontario Ministry of Health and Long-Term Care

Reference	Study type	Number of patients	Patient characteristics			Intervention	Comparison	Length of follow-up, type of follow up for misses cases	Outcome measures	Source of funding
decision rules in the emergency department. Annals of Emergency Medicine. 2009; 54(5):663-671. (Guideline Ref ID VAILLANCOURT 2009)			as defined by the Revised Trauma Score. Cooperative indicates that the patient willingly follows commands and is not agitated. Acute refers to injury within the past 8 hours. Trauma with potential injury to the neck included patients with either posterior neck pain with any blunt mechanism of injury, or no neck pain but with some visible injury above the clavicles. Exclusions: Younger than 16 years, had penetrating trauma to the neck, were acutely paralysed or had known vertebral disease			immobilisation if: Any one of the high risk factors present: Age 65 years or over or dangerous mechanism or numbness or tingling in extremities. No to these questions then go one to: Any one low risk factor which allows safe assessment of range of motion: Simple rear-end motor vehicle collision, ambulatory at any time at scene, no neck pain at scene, absence of midline C-spine tenderness. Answer yes to any of these question then go on to: Patient				
			Age median (IQR)	39.0 (26-52)						
			Range	16 to 103						
			Female sex	50.8%						
			Motor vehicle accident	62.5%						

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow up for misses cases	Outcome measures	Source of funding
				voluntarily able to actively rotate neck 45 degrees left and right when requested, regardless of pain Answer yes then no C-spine immobilisation				
Results: 12 (0.6%) clinically important cervical spine injury all were immobilised by the paramedics. Paramedics conservatively misinterpreted the rule in 320 patients (16.4%) including 154 cases (7.9%) in which dangerous mechanism was overcalled and 166 cases (8.5%) in which paramedics did not evaluate neck rotation. There were no cases of an injury with a negative assessment.								

G.2 Spinal injury assessment risk tools

G.2.1 Adults

Table 7: Coffey 2011

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Coffey 2011 [12]	Prospective observational - Validation Setting:	n = 1420 Inclusion criteria: Neck pain following acute blunt trauma	Male: 716 Female: 704 Age: NR	Index test Canadian C-spine rule (CCR). Decision rule algorithm was appended to the recruited patient's notes by the triage	Diagnostic accuracy of CCR Sensitivity	100% (95% CI: 56 – 100)	Source of funding: This study was partially funded by the Special Trustees Fund of the University Hospital

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
	Emergency department of 2 hospitals Country: UK	to the head and/or neck. No neck pain, non-ambulatory and evidence of injury above the clavicle. Alert and stable (GCS >15) with normal vital signs). Ages over 16 and injury sustained within the previous 48 hours. <u>Exclusion criteria:</u> Patients < 16 years, no trauma to head and neck, ambulatory patients with no neck pain, minor head/facial injury and a low risk mechanism. Major trauma, GCS < 15. Injury occurred >48 hours previously, penetrating trauma, acute paralysis/ paresis. Vertebral disease, returned for assessment. Pregnancy.	GCS 15: all patients C-spine radiography performed in 987 patients. Telephone follow-up with 433. Unable to contact, refused or did not attend reassessment 178.	nurse. Doctors were instructed to record their findings and to order radiographs as they normally would, irrespective of the decision rule. <u>Reference standard</u> Radiography or follow up by telephone (14 days) by a study nurse using a validated proxy outcome tool. Patients were recalled for re-assessment if any of the following were present: moderate or severe neck pain, moderate or severe restriction of neck movement, on-going use of a neck collar, the neck injury had prevented a return to their usual pre-accident activity. If re-assessment suggested the possibility of a significant cervical injury, further imaging was performed.	Specificity PPV NVP TP FP FN TN <u>Injuries</u> Vertebral fractures Fracture dislocations	33% (95% CI: 31-36) 1% 100% 8 807 0 403 5 3	Nottingham. <u>Additional information:</u> There were 202 'indeterminate' cases, in which doctors did not evaluate the range of motion as required by the decision rule. Authors presented CCR sensitivity and specificity excluding indeterminates but by RevMan calculations they were in fact left in and counted as true negatives. Details presented here are excluding indeterminates. Aim of study was to investigate if the Canadian C-spine rule would reduce the number of radiographs ordered, rather than validating the diagnostic accuracy. Data on mechanism of injury available. Study size large but, due to small incidence of C-spine injuries, this study is not statistically powered to validate the rule in this setting.

Table 8: Dickinson 2004

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Dickinson 2004 [15] Population and methodology of Stiell 2001 [36]	Retrospective cohort – Retrospective application of NEXUS criteria to Canadian C-Spine Rule prospective cohort population. Setting: 10 large Canadian community and university hospital ED's between October 1996	n = 8924 <u>Inclusion criteria</u> Consecutive adult patients at risk of cervical spine injury after acute blunt trauma to the head or neck were considered for enrolment. <u>Exclusion criteria</u> Canadian C-Spine Rule: Age <16 years, minor injuries, GCS <15 years, abnormal	Age, mean (y (SD) [range]): 36.7 (16) [16-98] Male: 4,600 (51.5%) C-spine radiography performed on 6,145 (68.9%). Mechanism of Injury for patients with clinically significant C-spine injury	<u>Index test</u> Surrogates/approximations of the NEXUS criteria rather than the exact NEXUS criteria: Actual NEXUS 1. Posterior midline cervical tenderness → CCR-NEXUS interpretation: same. Actual NEXUS 2. Focal neurologic deficit → CCR-NEXUS interpretation: combination of 'motor deficit' and 'sensory deficit'. If either positive then considered a focal neurological deficit. Actual NEXUS 3. Normal	<u>NEXUS (CCR approximations)</u> for clinically significant cervical spine injury: Sensitivity Specificity PPV NPV TP FP FN TN	92.7% (87-96) 37.8% (37-39) 3% 100% 140 5461 11 3312	<u>Source of funding</u>: Supported by peer-review grants from the Medical Research Council of Canada and the Ontario Ministry of Health Emergency Health Services Committee. <u>Limitations</u>: Authors acknowledge that study would have been improved if the specific NEXUS criteria had been applied by Canadian emergency physicians, rather than approximations. However, these data were collected

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
	and April 1999. Country: Canada	vital signs, injury >48 hours previously, penetrating trauma, acute paralysis, known vertebral disease, reassessment of same injury, pregnancy. NEXUS: penetrating trauma, cervical spine imaging unrelated to trauma, no radiography.	with negative NEXUS (CCR-interpretation) criteria for radiology: Fall (down stairs) – 4 Fall (from height) – 1 Fall (from standing) – 2 MVC – 2 Skiing accident – 1 Trampled by horse – 1	level of alertness → CCR-NEXUS interpretation: this was an inclusion criterion for the CCR so inter-observer assessment of this element was not obtained. Actual NEXUS 4. No evidence of intoxication → CCR-NEXUS interpretation: captured as 'unreliable findings due to drugs or ethanol'. Actual NEXUS 5. Distracting painful injuries → CCR-NEXUS interpretation: same, was a specific data element in the CCR questionnaire. CCq; questionnaire. <u>Reference Test</u> Primary outcome was presence or absence of clinically important cervical spine injury, including fractures, dislocations, or ligamentous instability demonstrated by diagnostic imaging. Obtaining radiography (plain, flexion-extension views, and CT) was at the discretion of the treating physician and not a	Details of clinically important cervical spine injuries provided in Stiell 2001 Table 15.		before publication of the NEXUS trial. All subsequent studies have used the specifically defined NEXUS criteria [35].

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
				factor in eligibility for enrolment. All enrolled patients who did not have radiography were assessed with a structured telephone questionnaire administered 14 days after their ED visit by a trained registered nurse blinded to the results of the initially collected predictor variables. Tool classified patients as having no clinically important C-spine injury if they met all four of the following criteria: 1) neck pain rated as none or mild; 2) restriction of neck movement rated as none or mild; 3) use of cervical collar not required; and 4) return to usual occupational activities not prevented. Patients not fulfilling all criteria were recalled for clinical assessment and radiography. Patients who could not be contacted were excluded from the final analysis.			

Table 9: Duane 2011

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Duane 2011 [18]	Prospective validation Setting: Level 1 trauma centre Country: Virginia, USA	n = 2606 <u>Inclusion criteria:</u> All adults (>16 years) who suffered blunt trauma resulting in a trauma team activation. <u>Exclusion criteria:</u> None reported.	Patient characteristics reported by fracture/non-fracture Fracture Age: 43.4 ± 19.3 years GCS 13.7 ± 4.5 No fracture Age: 37.7 ± 17.5 years GCS 14.4 ± 3.6	<u>Index test</u> A data collection form was completed in the trauma bay in which all the answers to the Canadian cervical spine rule were documented on all patients. Only active rotation (45˚) of the neck was excluded as part of the evaluation because the trauma facility felt it was too much of a risk for C-spine injury. <u>Reference standard</u> All patients had a complete C-spine CT. CT was used to determine accuracy of clinical examination. A Siemens Sensation 16 multidetector CT was used in all patients. The scan extended from the base of the skull to the level of the third thoracic vertebra.	<u>Diagnostic accuracy of modified CCR criteria (minus neck rotation)</u> Sensitivity Specificity PPV NPV TP FP FN TN <u>Injuries</u> 157 patients had a total of 258 C-spine fractures. Transverse process Spinous process Vertebral body Facet	 82.8% 45.7% 8.9% 97.6% 130 1331 27 1118 56 32 79 50	<u>Source of funding:</u> None reported. <u>Additional information</u>: The authors conducted univariate analysis on the 30 clinical findings in the decision rule. Eight of these were identified as predictors of C-spine injury (tender to palpation midline, GCS <15, age <u>≥</u>65, paraesthesias, high speed motor vehicle collision (MVC), rollover MVC, patient ejection, never in sitting position in ED). Logistic regression determined that tenderness to midline palpitation of the C-spine (OR 3.8, CI 2.7-5.4), focal neurological deficits (OR 2.3, CI 1.4-3.7), and GCS <15 (OR 1.9, CI 1.3-2.8) were most predictive of the NEXUS for presence of fractures. Noted that the rule used was derived in a

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
					fracture Laminar fracture Other	39 2	population of haemodynamically stable patients with GCS 15.

Table 10: Duane 2013

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Duane 2013 [19]	Prospective validation study Setting: Level 1 trauma centre Country: Virginia, USA	n = 5182 <u>Inclusion criteria:</u> Adults (>16 years) who suffered blunt trauma resulting in a trauma team activation. Criteria included: i) Glasgow Coma Scale (GCS) <14. ii) Systolic Blood Pressure (SBP)<90mm Hg iii) Respiratory rate <10 or >20 per minute) iv)anatomic injury - flail chest - 2 or more long bone fracture - crushed, mangled, degloved extremity	Patient characteristics reported by fracture/non-fracture <u>Fracture</u> n=324 (6.25% of overall population) Sex (% Female) 33.3% Age, mean (SD) 43.89 (18.32) GCS 13.49 (3.49) SBP 133.7 (24.5) <u>Non-Fracture</u> n= 4858	<u>Index test</u> The sensitivity, specificity, positive predictive value, negative predictive value of the NEXUS criteria and CCR rule were calculated and compared to the Gold Standard of CT. Univariate analysis were conducted to determine which of these were associated with fracture. <u>Reference standard</u> All patients had a complete C-spine CT. CT was used to determine accuracy of clinical examination. A Siemens Sensation 16 multi-detector CT was used in all patients.	<u>NEXUS</u> Sensitivity Specificity PPV NPV TP FP FN TN <u>CCR</u> Sensitivity Specificity PPV NPV TP FP	 81.17% 45.8% 9.08% 97.33% 263 2633 61 2225 100% 1% 6% 100% 324 4828	<u>Source of funding:</u> Authors declare no interests or conflicts of interest <u>Additional information:</u> Univariate analysis produced seven independent predictors of cervical fracture including: i) Tender to palpitation ii) GCS Score >15 iii) Age >65 years iv) Paraesthesias v) Rollover Motor Vehicle Collision vi) Patient ejected vii) Failure to achieve sitting position in ED. Evaluation of these factors demonstrated a

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
		-pelvic fracture - open depressed skull fracture v) mechanism of injury (fall >20 feet, motor vehicle collision). <u>Exclusion criteria:</u> None specified	Sex (% Female) 36.7% Age, mean (SD) 38.42 (17.45) GCS 14.32 (2.34) SBP 139.8 (23.7)		FN TN <u>Injuries</u> 324 patients had a total of 518 fractures. Vertebral body Transverse process Facet Laminar Spinous process Other	0 30 154 120 90 82 65 7	sensitivity of 99.07%, specificity of 11.57%, PPV of 6.95% and NPV of 99.47%. The authors believe this is a more specific and sensitive approach for clearance of the C-Spine.

Table 11: Griffith 2011

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Griffith 2011 [21]	Retrospective validation Setting: Emergency department of a level 1 trauma centre Country: Detroit, USA	n = 1589 examination records (1552 patients, 30 patients had multiple scans) <u>Inclusion criteria:</u> Retrospective review of CT examinations in radiology info systems in patients older than 18 years and have search terms 'trauma, rule out fracture, motor vehicle accident or assault' <u>Exclusion criteria:</u> Patient had no documented trauma despite indication given on CT, patient presented as an outpatient or an inpatient (i.e. not in emergency department), trauma >48 hours before presentation,	Male: 921 Female: 631 Age, mean: 43.4 (range 18-100 years) Mechanism of injury: Fall: 381/1589 Assault 477/1589 Motor vehicle crash: 599/1589 Pedestrian vs. motor vehicle: 70/1589 Other: 62/1589 30 patients underwent multiple CT examinations for a repeat trauma during a separate examination: 24	<u>Index test</u> Historical and physical examination data from ED documentation were evaluated for the presence of the five NEXUS criteria. The patient was considered to have normal mental status if they were documented to be alert and oriented to person, place, and time or if there was no documentation of GCS. In addition, information regarding paravertebral cervical tenderness and painful or decreased cervical range of motion was also collected – not part of NEXUS criteria, but reported here as 'liberalized NEXUS criteria'. <u>Reference standard</u> Radiologist confirmed fracture of any type, a dislocation or subluxation based on CT findings. Intermediate injuries were those in which a radiologist suggested a finding	<u>Cervical spine injury – NEXUS criteria , n = 1589</u> Sensitivity Specificity PPV NPV TP FP FN TN <u>Cervical spine injury – liberalised NEXUS criteria (neck rotation addition), n = 1589</u> TP FP FN TN	 90% 24% 3% 99% 37 1180 4 368 37 1236 4 312	<u>Source of funding:</u> Not reported. <u>Limitations</u>: Descriptive information is provided based on the 1552 patients represented by the retrospective review of CT examination documentation. But Authors present results based on all 1589 examination records, therefore 30 people will be counted more than once in the 2 x 2 table. <u>Additional information</u>: Study not designed to test performance of NEXUS criteria (but to investigate if implementing NEXUS would lead to reduction in unnecessary CT scans). 24 documented examinations were

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
		penetrating injuries, follow up examinations of a known fracture.	patients twice, 5 patients three times and one patient four times.	may be related to trauma or other cause. In this case further imaging and medical records were reviewed to confirm findings.			indeterminate on initial CT but after follow up were found to be negative for cervical spine injury. Therefore they have been added to the 'negative' data.

Table 12: Griffith 2013

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Griffith 2013 [22]	Prospective validation study Setting: Level 1 trauma centre Country: Michigan, USA	n = 507 (1543 prior to exclusion criteria or clinician failure to complete survey). Inclusion criteria: Patients who underwent cervical spine CT in the ED following blunt trauma. Completion of Blunt Trauma Survey. Exclusion criteria: 152 on the basis of the following: Age <18 years	309 Male (69.9%) 198 Women (39.1%) Age, mean: 44 (range 18-100) Mechanism of Injury: i) Motor Vehicle Collision (40%) ii) Fall (29.6%) iii) Assault (19.6) iv) Pedestrian motor collision (9.1%)	Index test A clinical survey including 5 key NEXUS criteria were administered for all patients. In addition, information regarding paravertebral cervical tenderness and painful or decreased cervical range of motion was also collected – not part of NEXUS criteria. An abbreviated Canadian C-Spine criteria was applied to assess the C-spine. It included: i) >65 years old	Diagnostic accuracy of NEXUS criteria (n=507) TP FP TN FN Sensitivity Specificity Diagnostic accuracy of abbreviated CCR Criteria (n=416)	 5 421 81 0 100% 16%	Source of funding: None reported Additional information: Study not designed to test performance of NEXUS criteria (but to investigate if implementing NEXUS would lead to reduction in unnecessary CT scans). In each arm NEXUS, CCR Criteria and Combination a small % of patients were deemed to have intermediate findings. None of these progressed to clinical significant

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
		Penetrating trauma Known C-Spine fracture Transfer patient Remote injury (>48 hours) 884 did not have surveys completed.	v) Other (6.4%)	ii) dangerous mechanism iii) paraesthesia in extremities iv) inability to rotate neck Reference standard Radiologist confirmed fracture, dislocation or subluxation based on CT findings. Failure to find any of these resulted in negative result. Intermediate injuries were those in which a radiologist suggested a finding may be related to trauma or other cause and warranted further imaging to confirm findings	TP FP TN FN Sensitivity Specificity	4 293 119 0 100% 29%	disease when they were measured so patients were added to the negative group.
					Combined NEXUS and/or CCR Criteria (n= 507) TP FP TN FN Sensitivity Specificity PPV	 5 464 38 0 100% 8% 1% 100%	

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
					NPV		

Table 13: Hoffman 1992

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Hoffman 1992 [25]	Prospective observational cohort (derivation) Pilot NEXUS study Setting: UCLA emergency medicine centre for 19 months in 1987, 1988 and 1989. Country: USA	n = 974 (n = 1000 cases, 26 forms had incomplete data). <u>Inclusion criteria:</u> Consecutive patients. All patients with blunt trauma who underwent radiography of the cervical spine in a participating emergency department. <u>Exclusion criteria:</u> No exclusion criteria.	Male: 59.3% Median age (range): 25 (17 months - 98 years) 27 patients with C-spine fracture were admitted to the hospital during the entire study period.	<u>Index test</u> Prospective data collection forms were completed detailing history and physical examination, prehospital treatment, and estimated likelihood of cervical-spine injury. No specific attempt to modify physician use of cervical-spine radiography before, during, or after the study period. By combining data elements the authors identified most, and in some cases all, of the patients with fracture. 1. Midline neck tenderness 2. Altered level of alertness 3. Severely painful injury 4. Intoxication	<u>Pilot NEXUS diagnostic accuracy of C-spine injury</u> <u>1 or 2</u> Sensitivity Specificity NPV <u>Any of 1, 2 or 3</u> Sensitivity Specificity NPV	 93% (76 - 99) 50.6% (47.3 - 53.8) 99.6% (98.5 - 100) 96% (81 - 100) 41.8% (38.6 - 45.0) 99.7% (98.6 - 100)	<u>Source of funding:</u> Not reported <u>Additional information</u> Fracture n = 27 No fracture n = 947

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
				5. Midline neck pain <u>Reference standard</u> All patients received at least cross-table lateral, anteroposterior, and odontoid views, supplemented by oblique views, flexion-extension radiographs, and cervical CT as determined by emergency physicians. The presence of fracture was confirmed by review of the final radiographic diagnosis of the ED studies as well as any additional studies performed in the inpatient setting. Preliminary diagnoses of 'no fracture' were confirmed by: reviewing quality assurance logs and risk management records and searching the diagnoses of discharged patients up to 3 months.	<u>Any of 1, 2, 3 or 4</u> Sensitivity Specificity NPV	 100% (87 - 100) 37.3% (34.2 - 40.4) 100% (99.0 - 100)	
					<u>Any of 1, 2, 3, 4 or 5</u> Sensitivity Specificity NPV	 100% (87 - 100) 12.5% (10.4 - 14.7) 100% (96.9 - 100)	
					<u>Any of 1, 2, or 4 but exclude whiplash</u> Sensitivity Specificity NPV	 100% (87 - 100) 52.2% (48.9 - 55.4) 100% (99.3 - 100)	

Table 14: Hoffman 2000

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Hoffman 2000 [24] Methodology also Hoffman 1998 [26]	Prospective observational cohort (validation) Setting: 21 centres - university and community hospitals, varied in size and activity level in the emergency department. Country: USA	n = 34069 all patients children and adults <18 = 3065 (see Viccellio 2001) ≥ 18 = 31004 >65 = 2943 (see Touger 2002) Inclusion criteria: All patients with blunt trauma who underwent radiography of the cervical spine in a participating emergency department. Exclusion criteria: Patients with penetrating trauma and those who underwent cervical spine imaging for any other reason, unrelated to trauma, were not eligible for inclusion.	Male: 58.7% Mean age (range): 37 (1 - 101) C-spine injury: Mean age (range): 40 (2 - 100)	Index test NEXUS criteria: no tenderness at posterior midline of cervical spine; no focal neurological deficit; normal level of alertness; no evidence of intoxication; and no clinically apparent, painful injury that might distract them from the pain of cervical spine injury. Patients who met all 5 criteria were considered to have a low probability of injury and not require radiographic or other imaging. At each centre a physician in the emergency department served as a liaison to the study investigators and a dedicated radiologist ensured that data collection was complete and correct. Clinicians were trained in the NEXUS criteria and cautioned against using the set of criteria as the sole determinant of whether patients needed imaging. Reference standard	NEXUS diagnostic accuracy of clinically significant C-spine injury: All patients (n = 34069) Sensitivity Specificity NPV PPV TP FP FN TN Any injury Sensitivity Specificity NPV PPV TP FP FN	 100% (99-100) 13% (13 - 13) 99.5% 1.9% 576 29184 2 4307 99% 13% 100% 3% 810 28950 8	Source of funding: Grant from the Agency for Healthcare Research and Quality. Additional information: Details of the 8 missed injuries given (including 2 with clinically significant injury - 1. no symptoms, but plain films showed a fracture of an anteroinferior portion of the second cervical vertebra. 2. plain film showed fracture of the right lamina of the sixth cervical vertebra and fracture of the right clavicle). Noted that the decision instrument identified 2 patients with an odontoid fracture that was not initially diagnosed by the physicians.

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
				A standard set of three views of the spine was obtained in all patients (cross-table lateral, anteroposterior and open-mouth odontoid), unless CT or MRI imaging of the entire spine was performed because plain film radiography was impractical or impossible. Other imaging studies could be ordered at the discretion of the treating physician. Injuries were defined as not clinically significant if they typically require no specific treatment and, if not identified, would be expected to result in no harm. Radiographically documented cervical spine injuries were categorised as not clinically significant if they were isolated and there was no evidence of other bony injury or ligamentous or spinal cord injury.	TN	4301	
					NEXUS diagnostic accuracy of C-spine injury: All adults (n = 31004) Sensitivity Specificity NPV PPV TP FP FN TN	 99% 12% 99.7% 2.8% 780 26518 8 3698	
					Injuries (all adults) Occipital condyle C1 C2 non-odontoid C2 odontoid C3 C4	 19 90 192 90 50 79	

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
					C5 C6 C7 Cord injuries Atlanto-occipital C1 – C2 C2 – C3 C3 – C4 C4 – C5 C5 – C6 C6 – C7 C7 – T1	170 233 218 64 3 23 20 19 37 53 52 9	

Table 15: Stiell 2001

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Stiell 2001 [36]	Prospective observational cohort (derivation) Setting: 10 emergency departments in large community and university hospitals Country: Canada	n = 8924 <u>Inclusion criteria:</u> Convenience sample (stated in abstract) Consecutive (stated in methods) adult patients presenting to the ED after sustaining acute blunt trauma to the head or neck. Neck pain from any mechanism of injury or no neck pain but had all the following: some visible injury above the clavicles, had not been ambulatory, and had sustained a dangerous mechanism of injury. Alert (GCS 15), and stable (normal vital signs - systolic blood pressure >90 mmHg	Male: 4600 (51.5%) Mean age: 36.7 years (range 16 - 98) C-spine radiography performed: 6145 (68.9%) CT scan performed: 436 (4.9%) Cases followed up by telephone: 2779 (31.1%) 577 excluded as they did not have C-spine radiography and were unable to be followed up. Time from injury to	<u>Index test</u> Derivation of Canadian C-spine rule (CCR). Univariate analyses were used to determine the strength of association between each variable and the primary outcome to aid selection of the best variables for the multivariable analyses. Those variables found to be both reliable (κ >0.6) and strongly associated with the outcome measure (P<0.5) were combined using either recursive partitioning or logistic regression. <u>Clinical variables included in the proposed rule:</u> Dangerous mechanism, age ≥65, paraesthesia in extremities, ambulatory at any time after injury, sitting position in ED, delayed onset of neck pain, absence of midline neck tenderness, able to rotate neck 45˚ left and right and simple rear-end	<u>Diagnostic accuracy of CCR criteria</u> Sensitivity Specificity PPV NPV TP FP FN TN <u>Clinically important C-spine injury</u>* Fracture Dislocation Ligamentous injury *Some patients had >1 injury.	 100% (98 – 100) 42.5% (40.44) 3% 100% 151 5041 0 3732 151 (1.7%) 143 (1.6%) 23 (0.3%) 9 (0.1%)	<u>Source of funding:</u> Funded by peer-reviewed grants from the Medical Research Council of Canada and the Ontario Ministry of Health Emergency Health Services Committee. <u>Additional information:</u> 3281 eligible patients were examined, but not enrolled in this study by treating physicians. All C-spine injuries were considered clinically important unless the patient was neurologically intact and had one of the following: isolated avulsion fracture of an osteophyte, isolated fracture of a transverse process not involving body or facet joint, isolated fracture of a

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
		and a respiratory rate between (10 and 24/min). Exclusion criteria: Younger than 16, had minor injuries, GCS <15, grossly abnormal vital signs, injured >48 hours previously, had penetrating trauma, presented with acute paralysis, had known vertebral disease, had returned for reassessment or were pregnant.	assessment, mean (SD): 4.5h (7.4)	MVC Reference standard Patients were subject to clinical examination and then plain radiography (minimum 3 views) of the C-spine according to the judgment of the treating physician. Additional flexion-extension views and CT of the C-spine were at the discretion of the treating physician. Radiographs were interpreted by qualified staff radiologists who were blinded to the data collection sheet. All patients who did not have radiography had telephone follow up at 14 days. Patients were classified as having no clinically important C-spine injury if the met all criteria for 14 days: no or mild neck pain, no or mild restriction of head movement, use of cervical collar not required, neck injury has not prevented return to usual occupation activities.	Developed neurological deficit	11 (0.1%)	spinous process not involving the lamina, and isolated compression fracture less than 25% of the vertebral body height. Provide mechanism of injury details.

Table 16: Stiell 2003

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Stiell 2003 [35]	Prospective observational cohort (validation) Setting: 9 emergency department Country: Canada	n = 7438 (In 845 of 8283 patients, physicians couldn't evaluate range of motion as required by CCR algorithm). <u>Inclusion criteria:</u> Consecutive adults (≥ 16 years) with acute trauma to the head or neck who were both in a stable condition and alert and who had either neck pain or no neck pain, but met all of the following criteria: they had visible injury above the clavicles, were non-ambulatory, and who had a dangerous mechanism of injury. GCS 15, normal vital signs and injury within the previous 48 hours.	Male: 4328 (52.3%) Age, mean (range): 37.6 (16-100) CT scan performed: 5936 (71.7%) Cases followed up by telephone: 2338 (28.2%) Admitted to hospital: 430 (5.2%) Mean length of stay: 232.9 min(those who underwent radiography n = 4608) 123.2 min (did not undergo radiography n = 1997) Data reported excludes 845	<u>Index test</u> Canadian C-spine Rules (CCR) NEXUS low risk criteria Patients assessed by attending or resident emergency medicine physicians. Clinically important c-spine injury defined as: any fracture, dislocation, or ligamentous instability demonstrated by imaging. All injuries considered clinically important unless radiography showed; osteophyte avulsion, a transverse process not involving lamina, or a simple vertebral compression of less than 25% of body height. <u>Reference standard</u> Patients underwent standard plain radiography according to the judgement of the treating physicians. Additional	<u>CCR diagnostic accuracy of C-spine injury</u> Sensitivity Specificity PPV NPV TP FP FN TN <u>NEXUS - diagnostic accuracy of C-spine injury</u> Sensitivity Specificity PPV NPV	 99.4% (96 - 100) 45.1% (44 - 46) 4% 100% 161 3995 1 3281 90.7% (85 - 94) 36.8% (36 - 38) 3% 99%	<u>Source of funding:</u> Supported by peer-reviewed grants from the Canadian Institutes of Health Research and the Ontario Ministry of Health Emergency Health Services Committee. Additional information: Clinically important c-spine injury defined as any injury except avulsion of an osteophyte, an isolated fracture of a transverse process not involving a facet joint, an isolated fracture of a spinous process not involving lamina, and a simple compression fracture with less than 25% loss of vertebral body height. Provide mechanism of injury details.

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
		Exclusion criteria: Under 16; had penetrating neck trauma, acute paralysis, or known vertebral disease; had been evaluated previously for the same injury; or were pregnant. 3603 eligible patients were not enrolled by physicians. Another 635 had data forms but no outcome assessments	cases classified as indeterminate and (omitted from the analysis). Indeterminate defined as: physicians did not evaluate range of motion as required by the Canadian C-spine rule	views and investigations were ordered at the discretion of the treating physician. All patients with an identified injury had a CT scan. Patients who did not have radiography underwent telephone follow up at 14 days. Patients were recalled for radiography if they did not meet any of the following: mild neck pain or none, mild neck-movement restriction or none, neck collar not used, and a return to usual occupation activities.	TP FP FN TN	 147 4599 15 2677	
					Injuries: Clinically important C-spine injury Fracture Dislocation Ligamentous injury Developed neurologic deficit	 169 (2%) 209 (2.5%) 71 (0.9%) 8 (0.1%) 45 (0.5%)	

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
					When indeterminates (n = 845) assumed positive: CCR Sensitivity Specificity NEXUS Sensitivity Specificity When indeterminates (n = 845) assumed negative: CCR Sensitivity Specificity	 99.4% (96-100) 40.4% (39-42) 90.5% (85-94) 33.0% (33-35) 95.3% (91-97) 50.7% (50-52)	

Table 17: Touger 2002

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Touger 2002 [38] Sub-group of Hoffman 2000 [24] in geriatric patients ≥65 years.	Prospective observational cohort (validation) Setting: 21 centres - university and community hospitals, varied in size and activity level in the emergency department.	n = 2943 (8.6% of entire NEXUS sample, n = 34069) <u>Inclusion criteria:</u> All patients with blunt trauma who underwent radiography if the cervical spine in a participating emergency department and were >65 years.	Male: 47% (1383) Female: 53% (1560) Mean age not reported. Frequency of patients failing to meet NEXUS criteria: Intoxication 15.4%	<u>Index test</u> NEXUS criteria: Low-risk criteria for CSI included the absence of: 1) evidence of intoxication, 2) posterior midline neck tenderness, 3) distracting painful injury, 4) altered level of alertness, and 5) altered neurological function. The presence or absence of each of the five criteria was ascertained for each study patient before obtaining cervical spine imaging.	<u>NEXUS criteria in geriatric patients:</u> <u>Any injury</u> Sensitivity Specificity PPV NPV TP FP FN TN	 98.5% 14.6% 5.3% 99.5% 135 2395 2 411	<u>Source of funding:</u> Grant from the Agency for Healthcare Research and Quality. <u>Additional information</u>: Numbers for 'any injury' taken from Anderson 2010 meta-analysis. PPV for clinically significant injury reported by Hoffman 2000 to be 4.94%. NCGC calculated

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
	Country: USA	<u>Exclusion criteria:</u> Patients with penetrating trauma and those who underwent cervical spine imaging for any other reason, unrelated to trauma, were not eligible for inclusion, and patients <65 years.	Midline tenderness 53.1% Distracting injury 43.9% Altered alertness 36% Neurological findings 23.1%	<u>Reference standard</u> Minimum 3-view radiographic examination (cross-table lateral, anteroposterior, and open-mouth views). Additional imaging at physician discretion. All radiographic studies interpreted by study radiologist at each site without knowledge of the NEXUS data findings. Presence or absence of CSI was determined on the basis of the final interpretation of all cervical spine imaging studies.	<u>NEXUS criteria in geriatric patients: Clinically significant injury</u> Sensitivity Specificity PPV NPV TP FP FN TN *2 x 2 table calculated by NCGC using RevMan 5.1*	 100% 14.1% 0.32% 100% 8 2522 0 413	PPV listed here.
					<u>Injuries:</u> <u>Fractures</u> Occipital	 2	

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
					condyle C1 C2 non-odontoid C2 odontoid C3 C4 C5 C6 C7 <u>Cord injuries</u> <u>Dislocation-subluxation</u> Atlanto-occipital C1 – C2 C2 – C3 C3 – C4 C4 – C5 C5 – C6 C6 – C7 C7 – T1 SCIWORA	 26 52 40 6 6 17 23 27 8 0 9 3 3 5 6 9 0 5	

G.2.2 Children

Table 18: Ehrlich 2009

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Ehrlich 2009 [20]	Retrospective chart review to explore the validity of NEXUS and CCR on paediatric patients. Setting: American College of Surgeons-verified Level 1 paediatric	n (imaged children) = 125 <u>Inclusion criteria</u> Paediatric trauma patients ≤ 10 years. Cohort A all trauma patients 10 years or younger who underwent C-spine imaging as part of their initial workup in the ED. Cohort B (n=150) included those who did not	Cohort A characteristics Age, mean: 4.3 ± 3.1 Male: 72 Female: 53 GCS, mean: 13.1 ± 4.2 ISS, mean: 13.3 ± 11.1	<u>Index Test</u> NEXUS – five criteria: Posterior midline tenderness, intoxication, patient alertness, focal neurological deficit, painful distracting injuries. CCR – three criteria: Dangerous mechanism of injury, midline neck tenderness, (in)ability to rotate neck 45°. NEXUS and CCR criteria	<u>Retrospective NEXUS (n = 108)</u> Quoted by study authors: Sensitivity Specificity Calculated by NCGC: Sensitivity Specificity	 43% 96% 57% 35%	Additional information: NEXUS suggested that 70 cases required imaging compared to 93 by CCR. Clinically important spine injury was defined as any fracture, dislocation, or ligamentous instability demonstrated by imaging. Missed injury (false negatives): NEXUS – 3 (fractures of C3,

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
	trauma centre registry from 2005-2007. Country: USA	undergo imaging. This second cohort was randomly identified by the emergency registry. Only Cohort A results detailed here. <u>Exclusion criteria</u> Not stated.	Missed injuries NEXUS = 3 CCR = 1	retrospectively applied to paediatric registry charts from 2005-2007 by two blinded research assistants. n = 108 (86.4%) could have NEXUS applied. n = 109 (87.2%) could have CCR applied. <u>Reference Standard</u> Ultimate decision to image the cervical spine was at the discretion of the trauma team leader. Plain C-spine radiography, CT scan or both were used.	<u>Retrospective CCR (n=109)</u> Quoted by study authors: Sensitivity Specificity Calculated by NCGC: Sensitivity Specificity	 86% 94% 86% 15%	C5 and C7) CCR – 1 (spinous fracture of C5)

Table 19: Viccellio 2001

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
Viccellio 2001 [40]	Prospective, validation. Subgroup of NEXUS validation Hoffman et al 2000	n = 3065 (NEXUS cohort = 34069) <u>Inclusion criteria:</u> Patients who	Age: <2 = 88 2 - 8= 817 9 - 17= 2160 Intoxication =	<u>Index test</u> NEXUS low risk criteria: No tenderness at posterior midline of cervical spine; no neurologic abnormality; normal level of alertness; no	<u>NEXUS diagnostic accuracy of C-spine injury</u> Sensitivity	 100% (87.8 - 100) 19.9% (18.5 -	<u>Source of funding:</u> Funded by a grant from the Agency for Healthcare Research and Quality <u>Additional information</u>:

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
	Setting: Multicentre, mix of community hospitals, academic medical institutions, tertiary care facilities, trauma centres and children's hospitals. Country: USA	underwent radiographic evaluation. Subgroup = patients <18. <u>Exclusion criteria:</u> Patients with penetrating trauma and those who underwent cervical spine imaging for any other reason, unrelated to trauma, were not eligible for inclusion.	110 patients	evidence of intoxication; and no clinically apparent, painful distracting injury. Patients who met all 5 criteria were considered to have a low probability of injury and not require radiographic or other imaging. All patients underwent clinical evaluation prior to radiography, unless the patient was judged to be too unstable prior to radiography. The decision to radiograph was at the physicians discretion and nor driven by the NEXUS criteria. At each centre a physician in the emergency department served as a liaison to the study investigators and a dedicated radiologist ensured that data collection was complete and correct. Clinicians were trained in the NEXUS criteria and cautioned against using the set of criteria as the sole determinant of whether patients needed imaging. <u>Reference standard</u>	Specificity PPV NPV TP FP FN TN	21.3) 1.2% (0.8 - 1.8) 100% (99.2 - 100) 30 2432 0 603	Characteristics and prevalence of NEXUS criteria for patients who sustained cervical spine injury. 24/30 were clinically stable, 21/30 were male. No incidence of SCIWORA, >1 non-low-risk finding in 13/30 - full details for entire NEXUS cohort given, not just paediatric.
					<u>Injuries</u> Occipital condyle C1 C2 non-odontoid C2 odontoid C3 C4 C5 C6 C7 Cord injuries (documented) Atlanto-occipital C1 – C2 C2 – C3	 1 5 2 2 0 5 9 9 10 5 2 0 1	

Reference	Study type	Number of patients	Patient characteristics	Intervention and comparison (Index test and reference standard)	Outcome measures	Effect sizes	Comments
				Radiographic imaging used a minimum of 3-view examination, including cross-table lateral, anteroposterior, and open mouth odontoid views. Other imaging studies, including CT, were ordered at the discretion of the treating physician. Injuries were defined as clinically significant based on the final interpretation of all radiographic studies (including CT/MRI).	C3 – C4 C4 – C5 C5 – C6 C6 – C7 C7 – T1	4 1 5 2 0	

G.3 Immobilising the spine: pre-hospital strategies

Table 20: Black 1998[2]

Study (subsidiary papers)	Black 1998[2]
Study type	Prospective cohort study (patient randomised; parallel)
Funding	Equipment/drugs provided by industry
Number of studies (number of participants)	1 (n=20)
Countries and setting	Conducted in USA; setting: St Vincent Mercy Medical centre
Line of therapy	Not applicable
Duration of study	Intervention time: 30 minutes
Method of assessment of guideline condition	Adequate method of assessment/diagnosis ~ measured with the Talley Digital Skin Pressure Evaluator model SD500, and LCD digital hydrometer to measure humidity and temperature
Stratum	Healthy volunteers: none

Subgroup analysis within study	Not applicable: none
Inclusion criteria	Healthy volunteers
Exclusion criteria	Age less than 18 years, pregnancy, body temperature greater than 100F, skin rash, open wound, illness, infection, allergy to foam or plastic, previous cervical injury or collar usage, current use of NSAID, stimulants, steroids or analgesics. Subjects refrained from caffeine, nicotine and alcohol 48 hours prior to participation.
Recruitment/selection of patients	Volunteers, no further detail at this time
Age, gender and ethnicity	Age - mean (SD): 27 (9). Gender (M: F): 6 males (30%)/ 14 females (70%). Ethnicity: not reported
Further population details	1. Adults: 18-65 years 2. Children: not applicable/not stated/unclear
Interventions	Intervention 1: Philadelphia Collar. The collar was fitted by a single critical care nurse according to manufacturer's guidelines. Duration 30 minutes. Concurrent medication/care: none (n=20). Further details: Intervention 2: Aspen Collar. The collar was fitted by a single critical care nurse according to manufacturer's guidelines. Duration 30 minutes. Concurrent medication/care: none (n=20). Further details:

Table 21: Chan 1996[11]

Study (subsidiary papers)	**Chan 1996[11]**
Study type	Prospective cohort study (patient randomised; crossover ~ 2 weeks)
Funding	--
Number of studies (number of participants)	(n=37)
Countries and setting	Conducted in USA; setting: interventions applied by Los Angeles County paramedics
Line of therapy	Not applicable
Duration of study	Intervention time: 30 minutes
Method of assessment of guideline condition	Partially adequate method of assessment/diagnosis ~
Stratum	Healthy volunteers
Subgroup analysis within study	Not applicable
Inclusion criteria	Aged between 17- 49 years
Exclusion criteria	No history of back pain or spinal disease

Recruitment/selection of patients	Volunteers from a local community college
Age, gender and ethnicity	Age - mean (SD): 25.6 (8). Gender (M: F): 25 male (68%), 12 female (32%). Ethnicity: not reported
Further population details	1. Adults: 18-65 years 2. Children:
Interventions	Intervention 1: Collar and back board combination ~ any collar and back board combination. Subjects placed on a long spine board and a Stifneck cervical collar was applied. Sandbags were placed on either side of the neck, and the head, chest, neck, abdomen and upper extremities were taped to the board. Duration 30 minutes. Concurrent medication/care: none reported (n=37). Further details: Intervention 2: Vacuum mattress ~ any vacuum mattress. Subjects immobilised by paramedics in an Evac-U-Splint mattress according to manufacturer's instructions. Duration 30 minutes. Concurrent medication/care: none reported (n=37). Further details:

Table 22: Cordell 1995[13]

Study (subsidiary papers)	**Cordell 1995[13]**
Study type	Prospective cohort study (patient randomised; crossover ~ 60 minutes)
Funding	Funding not stated (not reported)
Number of studies (number of participants)	1 (n=20)
Countries and setting	Conducted in USA; setting: Emergency Department of Methodist Hospital of Indiana
Line of therapy	Not applicable
Duration of study	Intervention time: 80 minutes
Method of assessment of guideline condition	Unclear method of assessment/diagnosis ~ used 100mm VAS scale to assess pain; unclear how pressure assessed.
Stratum	Healthy volunteers
Subgroup analysis within study	Not applicable
Inclusion criteria	Healthy volunteers who had not taken analgesic drugs in the previous 24 hours, were not experiencing pain at the time of the study and did not have any history of chronic back pain.
Exclusion criteria	Analgesic use within 24 hours, history of back pain, pain at time of study
Recruitment/selection of patients	No details reported

Age, gender and ethnicity	Age - other: not reported. Gender (M: F): Not reported. Ethnicity: not reported
Further population details	1. Adults: not applicable/not stated/unclear (age not reported, assumed population adults). 2. Children: not applicable/not stated/unclear
Interventions	Intervention 1: Mattress splints ~ any mattress splints. Spinal board with mattress. Duration 80 minutes. Concurrent medication/care: all volunteers were immobilised with hard cervical collars and single buckle chest straps on wooden spine boards (n=20). Further details: Intervention 2: Mattress splints ~ any mattress splints. Spinal board without mattress. Duration 80 minutes. Concurrent medication/care: all patients were immobilised with hard cervical collars and single buckle chest straps on wooden spine board (n=20). Further details:

Table 23: Hauswald 2000[23]

Study (subsidiary papers)	**Hauswald 2000[23]**
Study type	Prospective cohort study (patient randomised; parallel)
Funding	Funding not stated
Number of studies (number of participants)	(n=22)
Countries and setting	Conducted in USA; setting: not reported
Line of therapy	Not applicable
Duration of study	Intervention time:
Method of assessment of guideline condition	Adequate method of assessment/diagnosis ~ comfort measured on a 10cm VAS scale (0 most uncomfortable, 10 most comfortable)
Stratum	Healthy volunteers
Subgroup analysis within study	Not applicable
Inclusion criteria	Volunteered for study, no further details
Exclusion criteria	Pre-existing injury that would make lying supine for 10 minutes potentially hazardous.
Recruitment/selection of patients	
Age, gender and ethnicity	Age: Not reported. Gender (M: F): not reported. Ethnicity: not reported

Further population details	1. Adults: 2. Children:
Interventions	Intervention 1: Spinal/back board ~ any spinal/back board. Backboard alone. Duration 10 minutes. Concurrent medication/care: lying supine on board without straps (n=22). Further details: Intervention 2: Spinal/back board ~ any spinal/back board. Backboard and 3cm gurney mattress. Duration 10 minutes. Concurrent medication/care: lying supine without straps (n=22). Further details: Intervention 3: Spinal/back board ~ any spinal/back board. Backboard and blanket. Duration 10 minutes. Concurrent medication/care: lying supine without straps (n=22). Further details: Intervention 4: Spinal/back board ~ any spinal/back board. Backboard and mattress and 6cm eggcrate foam. Duration 10 minutes. Concurrent medication/care: lying supine without straps (n=22). Further details:

Table 24: Lerner 1998[27]

Study (subsidiary papers)	**Lerner 1998[27]**
Study type	Prospective cohort study (patient randomised; crossover ~ 2 weeks)
Funding	Funding not stated
Number of studies (number of participants)	(n=39)
Countries and setting	
Line of therapy	Not applicable
Duration of study	Intervention + follow up: intervention lasted 45 minutes in total, then follow up 24 hours later
Method of assessment of guideline condition	Adequate method of assessment/diagnosis ~ pain assessed on a VAS scale
Stratum	Healthy volunteers
Subgroup analysis within study	Not applicable
Inclusion criteria	Between 18- 65 years
Exclusion criteria	Pregnancy, chronic back problems or previous back surgery, suffering from acute illness or injury at the time of

	participation
Recruitment/selection of patients	39 healthy volunteers
Age, gender and ethnicity	Age - --: Note reported. Gender (M: F): Not reported. Ethnicity: not reported
Further population details	1. Adults: 18-65 years 2. Children:
Interventions	Intervention 1: Head blocks ~ any head blocks. The natural void between the patients head and the board was filled with towels (padded) to achieve neutral head position. Duration 45 minutes. Concurrent medication/care: all patients had appropriate sized rigid cervical collar applied, then placed on a long wooden backboard according to New York State hospital practices. The patient was placed supine on the board using a rapid takedown technique and secured using 8 foot straps, head blocks and tape. The subject remained secured for 15 minutes. The straps, blocks and tape were then removed and the subjects remained supine on the backboard for an additional 45 minutes (n=47). Further details: Intervention 2: Head blocks ~ any head blocks. Rigid head support. Duration 45 minutes. Concurrent medication/care: all patients had appropriate sized rigid cervical collar applied, then placed on a long wooden backboard according to New York State hospital practices. The patient was placed supine on the board using a rapid takedown technique and secured using 8 foot straps, head blocks and tape. The subject remained secured for 15 minutes. The straps, blocks and tape were then removed and the subjects remained supine on the backboard for an additional 45 minutes (n=47). Further details:

Table 25: Totten 1999[37]

Study (subsidiary papers)	**Totten 1999[37]**
Study type	Prospective cohort study (patient randomised; crossover ~ not reported)
Funding	Equipment/drugs provided by industry (mattresses, collars and boards loaned by companies)
Number of studies (number of participants)	(n=39)
Countries and setting	Conducted in USA; setting:
Line of therapy	Not applicable
Duration of study	Other:
Method of assessment of guideline condition	Adequate method of assessment/diagnosis ~ comfort rated on Likert scale. Respiratory function assessed appropriately.
Stratum	Healthy volunteers

Subgroup analysis within study	Not applicable
Inclusion criteria	Volunteered to participate in study. No further detail.
Exclusion criteria	-Individual's inability to tolerate positions, request to terminate participation or apparent inability to understand instructions, history of dyspnoea at rest or respiratory compromise
Recruitment/selection of patients	Not reported
Age, gender and ethnicity	Age - mean (SD): 40.43 (26.65). Gender (M: F): male 51%/ female 49%. Ethnicity: not reported
Further population details	1. Adults: 18-65 years (divided into young adult and elderly). 2. Children: not applicable/not stated/unclear (7 to 17 years).
Interventions	Intervention 1: Spinal/back board ~ any spinal/back board. Wooden hardboard, standard full length board. Duration not reported. Concurrent medication/care: straps over subject's chest, pelvis and leg straps and a Velcro forehead pad strap attached to a 1cm thick occipital foam pad. Necks immobilised with disposable Stifneck collars in appropriate size (n=39). Further details: Intervention 2: Spinal/back board ~ any spinal/back board. Vacuum mattress. Duration not reported. Concurrent medication/care: vacuum mattress folded around the mattress and additionally secured by straps across the chest, pelvis and legs. The vacuum collar was a German cervicothoracic immobilisation device which is secured around the chest, throat and behind the head with additional forehead and throat straps (n=39). Further details:

Table 26: Walton 1995[41]

Study (subsidiary papers)	**Walton 1995[41]**
Study type	Prospective cohort study (patient randomised; crossover ~ minimum of 3 days (actual time not stated))
Funding	Funding not stated
Number of studies (number of participants)	(n=30)
Countries and setting	Conducted in USA; setting: study performed at Louisiana State University emergency medicine department
Line of therapy	Not applicable
Duration of study	Intervention time: 30 minutes
Method of assessment of guideline condition	Adequate method of assessment/diagnosis ~
Stratum	Healthy volunteers

Subgroup analysis within study	Not applicable
Inclusion criteria	Men and women aged 23- 60 years with no previous history of spinal injury or disease
Exclusion criteria	History of spinal injury, if they had prior spine board immobilisation or if they were pregnant or lactating
Recruitment/selection of patients	Selection by 1 of the authors of the study from a population of hospital employees and university residents
Age, gender and ethnicity	Age - Mean (SD): 32.5 (7.0). Gender (M: F): 26 male/ 4 female. Ethnicity: not reported
Further population details	1. Adults: 18-65 years (23- 60 years).
Interventions	Intervention 1: Spinal/back board ~ any spinal/back board. Half inch closed- cell foam padded long spine board. Duration 30 minutes. Concurrent medication/care: straps secured the chest, pelvis and legs to the board. Cervical immobilisation with Philadelphia collar with lateral support (sandbags) and regular adhesive tapes. Tapes were placed across forehead and chin (n=30). Further details: Intervention 2: Spinal/back board ~ any spinal/back board. Unpadded spine board. Duration 30 minutes. Concurrent medication/care: straps secured the chest, pelvis and legs to the board. Cervical immobilisation with Philadelphia collar with lateral support (sandbags) and regular adhesive tapes. Tapes were placed across forehead and chin (n=30). Further details:

G.4 Destination (immediate)

G.4.1 Spinal Cord

Table 27: Demetriades 2005[14]

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow up for misses cases	Outcome measures	Source of funding
Demetriades D, Martin M, Salim A, Rhee	Retrospective cohort study, USA	n=12,254 (all trauma patients)	Patients older than 14 years of age who were alive on	American College of Surgeons (ACS) level I centre	ACS level II centre n=244	Discharge	Mortality Incidence of severe	National trauma Data Bank of the

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow up for misses cases	Outcome measures	Source of funding
P, Brown C, Chan L. The effect of trauma center designation and trauma volume on outcome in specific severe injuries. Annals of Surgery. 2005; 242(4):512-517. (Guideline Ref ID DEMETRIADES2005)		n=892 (quadriplegia)	admission to the hospital and had at least one of the following severe injuries: aortic, vena cava, iliac vessels, grade IV/V liver injuries, penetrating cardiac injuries, quadriplegia, or complex pelvic fractures. 1996 to 2003	n=648 Essential characteristics: general surgery residency program, Advanced Trauma Life Support provide/participate, research, extramural educational presentation, cardiac surgery, microvascular/replant surgery, trauma admissions greater than or equal to 1200/year with greater than or equal to 240 patients with ISS > 15 or 35 patients/surgeon with ISS > 15, operating room and personnel immediately available 24 hours/day, surgical ICU physician in-house 24 hours/day, surgically directed and staffed ICU service, in-house CT technician,	Characteristics as for level 1 except these are desirable rather than essential		disability	Committee on Trauma of the American College of Surgeons

Reference	Study type	Number of patients	Patient characteristics	Intervention	Comparison	Length of follow-up, type of follow up for misses cases	Outcome measures	Source of funding
				MRI, acute haemodialysis				

Results:

For quadriplegia injury type

Mortality unadjusted mortality level I 161/648 (24.8%) versus 64/244 (26.2%) Adjusted OR 0.85 (0.59 to 1.2) adjusted p value 0.360

Adjusted for age (≤ 65 > 65), gender, mechanism of injury, hypotension on admission and injury severity score > 25 or ≤ 25

Incidence of severe disability (functional independence measure total < 9) unadjusted level 1 79.9% (151/189) versus level II 82.4% (108/131) adjusted OR 0.69 (0.38 to 1.27) p value 0.236

Adjusted for age, gender, mechanism, admission hypotension, head injury and injury severity score

Functional independence measure:

Evaluates the degree of functional disability in 3 areas: feeding, locomotion and expression. Patients are given a score in each score ranging from 1 (requires total assistance) to 4 (able to perform activity independently). The total FIM score is the sum of the scores for the 3 areas with a maximum possible score of 12 indicating complete functional independence at discharge.

G.5 Diagnostic imaging

Table 28: Adams et al. 2006

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Adams JM et al. Spinal clearance in the difficult trauma patient: a	Retrospective review	97	Patients at high risk for axial trauma due to pain, neurologic symptoms or	CT of cervical spine, with collimation of 5mm, from base skull to T1	MRI, without contrast. Sagittal T1- and T2- weighted images from C2 to T1.	Not reported	**Cervical fractures (whole group of patients)**		Not reported	No attempts made to blind, and unclear time between tests
							Sens	0.94		
							Spec	0.88		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
role for screening MRI of the spine. The American Surgeon 2006; 72: 101-105			obtundation after significant blunt trauma. Had to have had both MRI and CT scanning. Mean age 40 (21); 69 males; ISS 15(11); all blunt injury; 45% MVCs, 44% falls				+PV	0.80		
							-PV	0.97		
							Cervical fractures (pain group of patients) n=39			
							Sens	0.87		
							Spec	0.75		
							+PV	0.68		
							-PV	0.90		
							Cervical fractures (obtunded group of patients) n=29			
							Sens	1		
							Spec	0.91		
							+PV	0.78		
							-PV	1		
							Cervical fractures (neurologic group of patients) n=29			
							Sens	1		
							Spec	1		
							+PV	1		
							-PV	1		

Table 29: Antevil 2006

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Antevil JL. et al. Spiral Computed Tomography for the initial evaluation of spine trauma: a new standard of care. J Trauma 2006; 61:382-387	Retrospective	319 in CT group	Trauma centre patients undergoing either X-ray or CT	CT – 4 array helical CT scanning of the symptomatic region	Composite findings, including final diagnosis	Unclear	**Spinal fractures for CT** sensitivity	 1	Not reported	Gold standard poorly reported. Blinding unclear. There was also a group primarily given X-ray, and sensitivity was reported for this as well, but this has not been included as a large number (>65%) of these had adjunctive CT. A small

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
										section of those with CT had adjunctive X-ray, but this was acceptable as <10%.

Table 30: Awan 2011

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Awan et al. Detection of cervical spine fracture on computed radiography images: a monitor resolution study. Acad Radiol 2011; 18: 353-358	Retrospective	200	People with suspected traumatic injury; 132 male; mean age 46 (range 18-97)	X-rays, taken at same resolution, that were later (at time of current study) presented on LCD displays at the following resolutions: 1, 2, 3 or 5MP, and interpreted by 9 radiologists of varying experience.	CT, interpreted by a MSK radiologist otherwise uninvolved in the study (thus blinded)	Not reported	**X-ray 1MP for cervical fractures**		Not reported	Blinding clear; time between test unclear
							Sens	0.7		
							spec	0.84		
							X-ray 2MP for cervical fractures			
							Sens	0.73		
							spec	0.87		
							X-ray 3MP for cervical fractures			
							Sens	0.69		
							spec	0.86		
							X-ray 5MP for			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							cervical fractures			
							Sens	0.74		
							spec	0.79		

Table 31: Bailitz 2008

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Bailitz2009	Prospective observational	50	Patients who met one or more of the NEXUS criteria requiring spinal imaging for bony cervical injury	i) X-Ray ii) CT	Final diagnosis at discharge	Not reported	**Cervical injury for X-ray**		Not reported	Unclear blinding or time between test
							TP	18		
							FN	32		
							Sensitivity	36%		
							Cervical injury for CT			
							TP	50		
							FN	0		
							Sensitivity	100%		

Table 32: Ballock 1992

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Ballock RT et al. 1992. Can burst	Retrospective	25. Data from 67 patients	Patients retrospectively selected from a	Radiographs – AP and lateral. Reviewed	CT – reviewed by an	Unclear	**Radiographs /CT: orthopaedic**		None	No raw data given (that is,

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
fractures be predicted from plain radiographs? JBJS, 74-B: 147-50		were eligible (see column on right) but data from 42 were excluded because it was felt the 2 radiologists and 2 orthopaedic surgeons may have seen the radiographs before.	database of a trauma unit, if diagnosed with a wedge compression or burst fracture (at levels T2 to L4, with most at T12 and L1). They had to have a CT scan of the region and both AP and lateral radiographs. Fracture dislocations, flexion-distraction injuries, chance fractures, sagittal split fractures or gunshot wounds were excluded. It appears as though patients were selected on the basis of whether their radiographs	independently by 2 radiologists and 2 orthopaedic surgeons. Unlikely, but not clear, that these readers had seen the gold standard CT results.	independent observer		**surgeons**			TP, TN, etc.). It is not clearly reported but it seems as though all patients had either a bust fracture or a wedge compression factor, and not anything else (including no pathology). Hence instead of the 'no disease' group having no disease, they had wedge compression fractures in this study. In other words, a true negative was the correct interpretation of a wedge fracture,
							Sens	0.82		
							Spec	0.50		
							+ve pred	0.68 (unclear it is +ve)		
								0.82		
							Radiographs /CT: radiologists			
							Sens	0.79		
							Spec	0.87		
							+ve pred	0.89 (unclear it is +ve)		
								0.82		
							Radiographs /CT: all observers			
							Sens	0.80		
							Spec	0.68		
							+ve pred	0.78 (unclear it is +ve)		
								0.82		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
			showed either type of fracture, rather than whether their CT scans showed either type of fracture. The latter would seem more sensible given that the latter represents the 'true' diagnosis.							which is the same as the correct interpretation of it NOT being a compression fracture. Since it may have been easier to spot the difference between 2 alternate diagnoses than a diagnosis and no diagnosis, this may have introduced results that lack external validity. Unclearly reported how the 2 readers (in each category of orthopaedic surgeons and radiologists) were combined

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
										(consensus?)

Table 33: Berry 2005

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Berry GE (2005) Are plain radiographs of the spine necessary during evaluation after blunt trauma? Accuracy of screening torso computed tomography in thoracic/lumbar spine fracture diagnosis. The journal of trauma 29: 1410-1413	Retrospective review of records	103	All blunt trauma victims admitted over a 2 month period who underwent chest/abdomen /pelvis (CAP) CT and plain radiograph evaluation of the thoracolumbar spine. Average age 38; ISS: 15; 73 lae, 30 female; 26 with gold standard diagnosis of TLS fractures.	X-ray OR CAP CT Readings by attending radiologist unfamiliar with the patients and blinded to gold standard decision.	Combination of all information – X-ray, CT, discharge summary, consult notes. Unclear who did this. Dependence on index tests may have introduced bias (desire to agree with index tests to improve accuracy).	Not reported	CT/composite gold standard		Not reported	Gold standard appears weak for CT. However it is more useful for X-ray.
							TP	26		
							FN	0		
							FP	2		
							TN	75		
							Sens	1.00		
							Spec	0.97		
							+ve pred	0.93		
							-ve pred	1.00		
							+LR	33.33		
							-LR	0		
							Diagnostic OR	infinite		
							X-ray/composite gold standard			
							TP	19		
							FN	7		
							FP	0		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							TN	77		
							Sens	0.73		
							Spec	1.00		
							+ve pred	1.00		
							-ve pred	0.92		
							+LR	inf		
							-LR	0.27		
							Diagnostic OR	inf		

Table 34: Brockmeyer 2012

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Brockmeyer 2012	Prospective cohort analysis	24	i) Glasgow Coma Scale <8 ii) Admitted to ICU iii) Aged between 2 week and 17 years iv) suspected CSI	i) X-Ray ii)Flexion/Extension film +Fluoro	Clinical assessment and final diagnosis of CSI	Reported per patient in between diagnostic test	**Cervical instability – X-ray**		None Disclosed	Only 1 patient had a diagnosis of cervical instability.
							TP FP TN FN	1 1 22 0		
							Sensitivity	100%		
							Specificity	95.65%		
							NPV	100%		
							Cervical instability – X-ray/flouro			Single unstable patient did not undergo Fluoro
							TN	0		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							FN	21		Diagnosis.
							Specificity	100%		
				iii)CT			**Cervical instability – CT**			
							TP FP TN FN	1 0 23 0		
							Sensitivity Specificity	100% 100%		
							NPV	100%		
				iv) MRI			**Cervical instability – MRI**			
							TP FP TN FN	1 0 17 6		
							Sensitivity	14.3%		
							Specificity	100%		
							NPV	74%		

Table 35: Brown 2010

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Brown CVR et al. Computed tomography versus magnetic resonance imaging for evaluation of the cervical spine: how many slices do you need? The American Surgeon 2010; 76: 365-368	Retrospective review	106	Patients sustaining blunt trauma having both 4/64 slice CT of the cervical spine and MRI. Exclusion: cord deficits. Mean age 37(16); 60% male; 54% MVC, 30% fall, 5% motorcycle crash, 4% sports injury.	4 slice CT scan (n=43) OR 64 slice CT scan (n=63) That is, people received ONE of the CTs together with the MRI. Non-contrast with 1 mm collimation.	MRI. 1.5T obtaining continuous 3mm axial, coronal and parasagittal scans through whole cervical spine.	Not reported	**Cervical spine injury (including fracture, dislocation, ligament injury, spinal stenosis or SCI) – BOTH FORMS OF CT (n=106)**		Not reported	All images were interpreted real time (that is, the interpretations were gathered from the notes) and not re-interpreted for the purposes of this study. Unclear blinding or time between test
							FN	3		
							TN	72		
							NPV	0.96		
							Missed injury rate (FN/whole sample)	3/106 =0.028		
							Cervical spine injury (including fracture, dislocation, ligament injury, spinal stenosis or SCI) – 4 slice CT (n=43)			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							FN	3		
							TN	33		
							NPV	0.916		
							Missed injury rate (FN/whole sample)	3/43= 0.069 0.028		
							Cervical spine injury (including fracture, dislocation, ligament injury, spinal stenosis or SCI) – 64 slice CT (n=63)			
							FN	0		
							TN	39		
							NPV	1		
							Missed injury rate (FN/whole sample)	0/39= 0		

Table 36: Brohi 2005

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Brohi et al. Helical computed tomographic scanning for the evaluation of the cervical spine in the unconscious, intubated trauma patient. J Trauma 2005;58:897-901	Prospective	442 included, but for CT scanning only 381 had both CT and MRI/clinical outcome; Only 421 had both lateral X-ray and CT	All unconscious and intubated trauma patients included in a protocol for spinal evaluation. All had lateral X-rays and CT scans and a subset (n=24) with 'abnormal neurology prior to intubation' or 'plain film or CT scan suspicion of ligamentous injury' were given MRI too. Median (IQR) age: 34 (25-50); M:F=2.6:1; 14.3% eventually died of injuries	CT Lateral X-ray	MRI and/or clinical outcome. Clinical outcome was used for the vast majority who didn't have an MRI. CT	Not reported	**Cervical spine injuries CT/MRI or clinical diagnosis**		Not reported	Why was CT used as gold standard for X-ray, when MRI/clinical diagnosis was the available gold standard (and used for CT)? Unclear blinding or time between test
							TP	51		
							FP	4		
							TN	325		
							FN	1		
							sens	0.981		
							spec	0.988		
							NPV	0.997		
							Unstable cervical spine injuries CT/MRI or clinical diagnosis			
							TP	29		
							FP	4		
							TN	348		
							FN	0		
							sens	1		
							spec	0.99		
							NPV	1		
							Cervical spine injuries X-			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							ray/CT			
							TP	44		
							FP	21		
							TN	339		
							FN	17		
							sens	0.721		
							spec	0.942		
							NPV	0.952		

Table 37: Brown 2005A

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Brown CVR (2005A), Spiral computed tomography for the diagnosis of cervical, thoracic and lumbar spine fractures: its time has come. The journal of trauma, injury,	Retrospective review of records	236 with 278 cervical, thoracic or lumbar fractures. Only those with lumbar (n=112) and thoracic (n=66) injuries are reported here.	167 males and 69 females; age range 16-94 (mean; 42); ISS: 17; 59% of injuries were from a motor vehicle accident and 28% were due to a fall.	CT of spine using standard protocol, using high speed helical scanner with a collimation of 5mm and 3mm reconstructions in the sagittal and coronal planes. Plain X-rays were also taken	Diagnosis at discharge, as well as further MRI/X-ray testing for those with any persistent neck pain or spine tenderness. If completely asymptomatic then this was taken as indicating no spinal	Not reported	**CT/later clinical findings - THORACIC**		Not reported	Was the reference test truly a gold standard? The use of previous scan results to determine this may have led to bias through a desire to agree with index testing
							sens	98.5%		
							TP	65		
							FN	1		
							CT/later clinical findings - LUMBAR			
							sens	100%		
							TP	112		
							FN	0		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
infection and critical care; 58: 890-896				in 8 patients with thoracic fracture and 16 with lumbar fracture. All readings done by attending radiologist. Unclear if blinded from gold standard decision.	fracture. Unclear if the definitive diagnosis was made completely independently of the previous scanning.					(to make the diagnostic accuracy appear better).
							X-ray/later clinical findings - THORACIC			
							sens	64%		
							TP	7		
							FN	4		
							X-ray/later clinical findings - LUMBAR			
							sens	69%		
							TP	11		
							FN	5		

Table 38: Campbell 1995

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Campbell et al. (1995). The value of CT in determining potential instability of	Retrospective diagnostic accuracy study.	53	Consecutive patients with lumbar spine fractures and both CT and X-ray. Patients with previous	Plain film X-rays of the chest evaluated by 6 readers blinded to the identity	CT scans evaluated by separate 3 readers (2 neuroradiologists and one neuroradiology	Not reported	**X-ray/CT for unstable fractures**		Not stated	No reporting of the X-ray reader's expertise.
							Sens	0.83(0.78-0.87)		
							Spec	0.80(0		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
simple wedge-compression fractures of the lumbar spine. American Journal of Neuroradiology 16: 1385-13921			spine surgery, as well as people with CT scans degraded by metal or other artefacts, were excluded. The aim of the study was to evaluate the diagnostic accuracy of X-rays in diagnosing <u>unstable</u> lumbar fractures. Instability was graded on a graded response scale to allow for uncertainty.	of the patients. They were told that all images were of fractures but they had to assess if they were unstable or not on a 5 point graded response scale. A score of 1 or 2 (definite or probable stability) was taken as no instability and 3-5 (possible, probably or definite instability) was taken as unstable. The values from the 6 readers were pooled. A training	fellow). A training session was provided and consensus was reached on the gold standard. No reporting of blinding, but the readers looking at index and reference tests were independent and so detection bias unlikely.			.70-0.87) +ve pred 0.62(0.53-0.70) -ve pred 0.92(0.87-0.95)		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
				session was given to the readers to assist them with X-ray diagnosis, using 5 signs of instability.						

Table 39: Cohn 1991

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Cohn SM et al. Exclusion of cervical spine injury: a prospective study. The Journal of Trauma 1991; 31: 570-574	Prospective	60	Adults with blunt trauma. GCS <15 in 29/60; Coma 9/60; 1/60 cord injury; 2/60 SBP<80 mmHg)	Lateral X-ray	Composite, including other imaging	unclear	**Cervical injury – X-ray**		Not reported	Unclear blinding or time between tests
							TP	4		
							FN	7		
							Sensitivity	0.57		

Table 40: Dai 2008

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Dai LY et al. Plain radiography versus computed tomography scans in the diagnosis and management of thoracolumbar burst fractures. Spine 2008; 33:E548-552	Retrospective diagnostic study	73	Patients with a diagnosis of acute thoracolumbar spine, AND had to have either a compression or burst fracture. The burst fracture was the target for diagnosis.	X-rays – anteroposterior and lateral. Reviewed by 3 residents and 3 spine surgeons. Blinding clear.	CT scan. Assessed by a separate surgeon. Blinding clear.	Not reported	**X-ray/CT for residents**		Not reported	All patients had either a burst fracture or a wedge compression factor, and not anything else (including no pathology). Hence instead of the 'no disease' group having no disease, they had wedge compression fractures in this study. In other words, a true negative was the correct interpretation of a wedge fracture, which is the same as the correct interpretation of it NOT being a
							sens	0.80		
							spec	0.89		
							PPV	0.90		
							NPV	0.73		
							X-ray/CT for spine surgeons			
							sens	0.93		
							spec	0.88		
							PPV	0.93		
							NPV	0.88		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
										compression fracture. Since it may have been easier (or perhaps harder) to spot the difference between 2 alternate diagnoses than a diagnosis and no diagnosis, this may have introduced results that lack external validity.

Table 41: Duane 2008

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Duane TM et al. Is the lateral cervical spine plain film	Prospective review	1004	All blunt trauma patients aged >16 who had received both X-ray and CT.	Lateral cervical spine X-ray	Cervical CT	Not reported	**Cervical spine fracture**		Not reported	Unclear blinding or time between test
							TP	16		
							FN	68		
							TN	913		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
obsolete? Journal of surgical research 2008; 147: 267-269			41.3 years and c60% male. c75% MVC.				FP	7		
							sens	0.19		
							spec	0.99		
							+PV	0.696		
							-PV	0.931		

Table 42: Duane et al. 2010

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Duane et al. 2010. Flexion-extension cervical spine plain films compared with MRI in the diagnosis of ligamentous injury. The American Surgeon 2010; 76: 595-598	Retrospective review	49 patients	Adult patients sustaining blunt trauma, who had FE X-rays and subsequent MRI. Age 37.9 (17.7); 34/49 male; 34/49 MVC; 8/49 falls; ISS 15.6 (10.2); GCS 13.8 (3.5); hospital stay of 8 (11.2) days.	Flexion-extension X-rays. Considered complete if it visualised from C1 to base T1 and there was >30 degrees excursion in both F and E.	MRI, suing 1.5T, without contrast	Not given	**Cervical ligamentous injury**		None reported	No indication of blinding, nor time between index and reference test
							TP	0		
							TN	40		
							FN	8		
							FP	1		
							sens	0		
							spec	0.98		
							+PV	0		
							-PV	0.83		

Table 43: Garton et al. 2008

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Garton et al. Detection of paediatric cervical spine injury. Neurosurgery 2008; 62:700-708	Retrospective	187	All paediatric trauma patients on institutional databases with ICDs consistent with cervical cord and/or column injury. Inclusion: <19 years, and radiologically proven spinal column injury or clinical examination compatible with SCI. Exclusion: SCIWORA Sub-grouping to <8 years (n=32) and >8 years (n=155), based on age-related changes in	Plain film Plain film and O-C3 CT Plain film and flex/ext	CT/MRI or F/E MRI MRI and/or CT	Not reported	**Plain film spinal injury <8 years**		Not reported	Only included those with radiological abnormality (so not a typical sample of trauma patients) and this only allowed sensitivity to be calculated. Unclear blinding or time between test
							TP	24		
							FN	8		
							sens	0.75		
							Plain film spinal injury >8 years			
							TP	144		
							FN	11		
							sens	0.929		
							Plain film + CT spinal injury <8 years			
							TP	30		
							FN	2		
							sens	0.938		
							Plain film + CT spinal injury >8 years			
							TP	150		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
			cervical physiology. Most trauma were MVC and falls in <8 sub-group. MVC, sports and falls were the most common forms of trauma in >8 years Younger sub-group tended to have higher cervical (O-C2) injuries, and older sub-group were mostly C5-T1 62% spine fracture only, 21% ligamentous injury only, and 17% had both				FN	5		
							sens	0.968		
							Plain film +F/E spinal injury <8 years			
							TP	26		
							FN	6		
							sens	0.813		
							Plain film + F/E spinal injury >8 years			
							TP	146		
							FN	9		
							sens	0.942		

Table 44: Griffen 2003

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Griffen2003	Retrospective cohort Review	116	Blunt trauma patients evaluated	i) X-Ray ii) CT	Clinical assessment and final diagnosis of CSI	Not reported	**Cervical injury for X-ray**		Not reported	Unclear blinding or time between test
							TP	75		
							FN	47		
							Sensitivity	65%		
							Cervical injury for CT			
							TP	116		
							FN	0		
							Sensitivity	100%		

Table 45: Goodnight et al. 2008

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Goodnight TJ et al. A comparison of flexion and extension radiographs with computed tomography of the cervical spine in blunt trauma.	Retrospective review	379	Patients sustaining blunt trauma having both F/E X-rays and CT of the cervical spine. Exclusion: neurologic deficits consistent with cervical cord injury,	Flexion-extension X-rays OR CT (1.5mm collimation helical scanning from occiput to T1	MRI, plus all other available evidence	Unclear	**Cervical ligamentous injury for CT**		Not reported	Unclear blinding or time between test
							sens	1		
							spec	0.965		
							+PV	0.316		
							-PV	1		
							Cervical ligamentous injury for F/E X-rays			
							sens	1		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
American surgeon 2008			being obtunded, penetrating injuries and age<18 years. Mean age 39(19), ISS median 5; 63% male; 53% MVC				spec	0.973		
							+PV	0.375		
							-PV	1		

Table 46: Harris 2008

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Harris TJ et al. Clearing the cervical spine in obtunded patients. Spine 2008; 33: 1547-1553	Retrospective		Consecutive obtunded blunt trauma patients. Only records of those who were originally cleared on CT were	CT	Composite of imaging or clinical diagnosis	Unclear	**Cervical injuries**		Not reported	Only NPV calculable as only people with negative index test were included. Blinding unclear.
							FN	1		
							TN	366		
							NPV	0.9973		
							False negative rate (FN/FN+TN)	0.00272		

Table 47: Hashem 2009

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Hashem2009	Retrospective cohort Review	121	Patients with a positive diagnosis of cervical spine injury	i) X-Ray ii) CT	Clinical assessment and final diagnosis of CSI	Not reported	**Cervical spine injury – X-ray**		Not reported	Unclear blinding or time between test
							TP	74		
							FN	47		
							Sensitivity	61%		
							Cervical spine injury - CT			
							TP	121		
							FN	0		
							Sensitivity	100%		

Table 48: Hauser 2003

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Hauser CJ (2003). Prospective validation of computed tomographic screening of the thoracolumbar spine in trauma. The journal of trauma, injury, infection and critical care; 55:	Prospective diagnostic	215. Originally 222, but 15 excluded because of a lack of both tests.	Consecutive trauma patients deemed to be at high risk of thoracolumbar spine (TLS) injury because of clinical findings or mechanism of injury. Mean age 38.8; 78% men; Mean	Plain X-rays of the TLS (AP and lateral) using standard protocols and using a PACS digital radiology system. X-rays read by attending radiologist on call. No report	Dedicated thin-cut (1-2mm) spine CT scans through any area of suspicion on any screening study AND/OR any subsequent clinical examination of the patients	Not reported	**X-ray/CT**		None	No attempt was made to blind the evaluating radiologists to any imaging study that had been performed. Was clinical examination
							Sens	0.58(0.41-0.75)		
							Spec	0.93(0.89-0.97)		
							+ve pred	0.64(0.45 – 0.80)		
							-ve pred	0.92 (0.87-		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
228-235			Injury Severity score (MISS): 12.4; GCS: 13.9; 3% penetrating and 97% blunt.	that blinded to gold standard result. Although blinding to the final definitive gold standard result is almost certain by virtue of the fact that the index reading was done prior to discharge, which is when the final definitive decision was made, there is possible bias from the readers knowing the CT scan results. This study also used helical scanning CT as an index test but this has not been included here as the reference test	when fully alert. Not stated who read the CT scan.			0.95)		adequate to serve as a gold standard alone? [It was stated that a) thin cut CT was the gold standard accompanied by clinical examination OR b) that the gold standard could be clinical examination alone].

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
				is too similar.						

Table 49: Henry et al. 2013

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Henry et al. Utility of STIR MRI in paediatric cervical spine clearance after trauma. J Neurosurg Pediatrics 2013; 12: 30-36	Retrospective	73	Database containing Paediatric patients who received a traumatic injury warranting radiographic imaging, had a STIR-MRI sequence of the cervical spine, and were available for mean 8 month follow up (4 days to 7.6 years). Inclusion: 18 years or less; could not be cleared by clinical criteria;	STIR MRI – this is MRI with short term T1 inversion recovery (STIR) sequencing	Clinical outcome at 8 month follow up	unclear	**MRI for cervical instability**		Not reported	Unclear blinding
							TP	1		
							FP	2		
							TN	70		
							FN	0		
							sens	1		
							spec	0.97		
							PPV	0.33		
							NPV	1		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
			underwent MRI STIR within 48 hours of injury. Mean age 8.3(5.8) years; 65% male; majority in MVC;							

Table 50: Inaoka et al. 2012

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Inaoka et al. 2012. Clinical role of radiography for thoracic spine fractures in daily practice in the MDCT era: a retrospective review of 255 trauma	Retrospective diagnostic accuracy study	255	Patients with a history of trauma, except for gunshot or penetrating injuries, who came to hospital < 1 week after the trauma, who were imaged by both X-rays	AP and lateral radiographs (an additional swimmer's view was obtained in 109 patients. Carried out by 2 experienced musculoskeletal radiologists.	Multi-detector row CT. Four types of scanners were used: 4, 6, 16 and 64 detector row CTs. Carried out by 2 experienced musculoskeletal radiologists (inferred from the fact that	Actual tests separated by 48 hours, but readings separated by 6 weeks to avoid recall bias (implies the same 2 radiologists did both the index and gold	**X-ray/CT for vertebral body fractures**			1887 thoracic vertebrae were studied in 255 patients. No raw data provided. Same radiologists for both index and
							Sens (all patients)	0.55 (0.51-0.58)		
							Sens (<65)	0.56 (0.52-0.60)		
							Sens (≥65)	0.44 (0.33-0.55)		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
patients. Jpn J Radiol; 30:617-623			(AP and lateral) and multi-detector row CT with an interval of 48 hours.		recall bias was regarded as an issue – see column on right).	standard readings).	Spec (all patients)	0.94 (0.93-0.95)		gold standard tests. Was 6 weeks long enough to prevent recall bias? Likely as the X-rays and MRI scans were anonymised and there were a sufficiently large number of patients for recall to have been a realistic problem.
							Spec (<65)	0.94 (0.93-0.95)		
							Spec (≥65)	0.95 (0.93-0.97)		
							X-ray/CT for unstable fractures			
							Sens (all patients)	0.41 (0.35-0.48)		
							Sens (<65)	0.47 (0.40-0.54)		
							Sens (≥65)	0.09 (0.19-0.24)		
							Spec (all patients)	0.99 (0.99-1.0)		
							Spec (<65)	0.99 (0.99-100)		
							Spec (≥65)	0.99 (0.98-100)		

Table 51: Ito 2006

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Ito Z et al. 2006. Can you diagnose for vertebral fracture correctly by plain X-ray? Osteoporosis Int. 17: 1584-1591.	Cross-sectional diagnostic study	120.	112 women and 8 men; Age mean 75.6 years (range 50-96); a group of 67 with incident vertebral fragility thoracolumbar fractures caused by a weak external force (that is, fall from standing). A group of 53 without any incident fractures. Exclusion: History of primary or metastatic tumour, infectious disease, haematological disorders or compression fracture within past year.	AP and lateral thoracolumbar radiographs assessed by 5 orthopaedists and 2 radiologists. Not reported how the interpretations from the different assessors were pooled, or how (if any) consensus was reached. However the assessors were reported as having good inter-rater reliability (ICC=0.739). No questioning of patients or access to physiological findings (assumedly this means the gold standard MRI results as well)	MRI by 2 radiologists, using 1.5T, T1 weighted images (SE: TR/TE = 400/15 ms); T2 weighted images (SE: TR/TE = 2500/120 ms)	Within 4 weeks	**X-rays/MRI**		None	Very long time between X-rays and MRI – possibly enough time for the fracture to have healed? Raw data (that is, TP, TN etc.) given as % of all rather than a raw count – but this is valid for calculation of diagnostic accuracy data.
							TP	31%		
							FN	24.8%		
							FP	6.49%		
							TN	37.7%		
							Sens	0.55		
							Spec	0.85		
							+ve pred	0.83		
							-ve pred	0.60		
							+LR	3.78		
							-LR	0.52		
							Diagnostic OR	7.26		
							Sens	0.58(0.41-0.75)		
							Spec	0.93(0.89-0.97)		
							+ve pred	0.64(0.45 – 0.80)		
							-ve pred	0.92 (0.87-0.95)		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
				and the images were arranged by 3rd party with patients ID concealed.						

Table 52: Karul 2013

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Karul M et al. Fractures of the thoracic spine in patients with minor trauma: comparison of diagnostic accuracy and dose of biplane radiography and MDCT. European Journal of radiology 82: 1273-1277	Diagnostic accuracy study	107	Consecutive minor-trauma patients with suspected fractures of the thoracic spine. All had palpable deformity or step-off of the thoracic spine on physical examination, low to moderate back pain made worse on movement, and none had neurological signs. Mean age was 67 (20); 54 male and 52 female. There were later found (see ref test) to be	Biplane (AP/lateral) X-ray	Multi detector CT – 256 detector row.	<10 days	**X-ray/CT**			The two experienced Radiologists reviewing X-rays were blinded to results of CT. However these seem to be the same radiologists who later assessed the CT – could they have been tempted to ensure their gold
							TP	32		
							FN	33		
							FP	19		
							TN	23		
							Sens	0.49		
							Spec	0.55		
							+ve pred	0.63		
							-ve pred	0.41		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
			77 thoracic vertebral fractures							standards agreed with their index tests?

Table 53: Klein et al. 1999

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Klein et al. Efficacy of magnetic resonance imaging in the evaluation of posterior cervical spine fractures. Spine 1999A; 24: 771-774	Retrospective	42	All patients admitted to a level I spinal cord injury centre that had both CT and MRI scans. MRI had to be within 24 hours of injury Exclusion: gunshot victims Mean age: 46.3 (range 15-86); MVA in 18, falls in 7, diving accidents in 5.	MRI	CT	Not reported	**Cervical spine anterior element fractures**		Not reported	Clear blinding. Time between tests unclear.
							sens	0.367		
							spec	0.98		
							PPV	0.912		
							NPV	0.64		
							Cervical spine posterior element fractures			
							sens	0.115		
							spec	0.97		
							PPV	0.83		
							NPV	0.46		

Table 54: Krueger 1996

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Krueger MA et al. Overlooked spine injuries associated with lumbar transverse process fractures. Clinical orthopaedics and related research 1996; 327: 191-195	Retrospective diagnostic accuracy study	28	Consecutive patients with trauma to lumbar spine transverse processes. Patients excluded from analysis if they had injuries other than a transverse process injury. Inclusion criteria were CT and X-ray done, and a transverse process fracture noted on initial X-ray.	X-ray (for ANY lumbar fracture)	CT scan (for ANY lumbar fracture)	Not reported	**X-ray/CT for ANY lumbar fractures**		Not reported	Gold standard not defined, but for purposes of this review we have designated CT findings as the gold standard. Although the sample for this study was restricted to those with a transverse process fracture seen on X- ray, the diagnostic accuracy was for ANY lumbar fracture in these people. This is an artificial sample – those observed to have lumbar transverse fractures by X-
							TP	21		
							FN	7		
							Sens	0.75		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
										ray are probably only a proportion of all those with transverse fractures (because X-ray is not very sensitive, as shown by other studies). And these people with visible transverse process fractures on X-ray are also a special case – the patients who have transverse process fractures visible on X-ray may also tend to have more visibility of OTHER fractures on X-ray than the general population of those with

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
										transverse process fractures. Hence sensitivity may be overestimated.

Table 55: Lee et al. 2001

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Lee et al. The role of spiral CT versus plain films in acute cervical spine trauma: a comparative study. Emergency Radiology 2001; 8: 311-314	Retrospective review	604	Trauma patients presenting to ED undergoing both forms of imaging	Conventional radiographs – AP, lateral, swimmers and open-mouth	Helical computed tomography. 1mm collimation to C3 and then 3mm collimation to T1.	Not reported	**Cervical fracture**		Not reported	Unclear blinding or time between test
							TP	12		
							FN	24		
							sens	0.33		

Table 56: Macdonald 1990

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Macdonald et al. Diagnosis of cervical spine injury in motor vehicle crash victims: how many x-rays are enough? The Journal of trauma 1990; 30: 392-397	Prospective	775	Adults with trauma from MVC; 50% had GCS <15 on admission; mean ISS 25.9(14); 63/775 subsequently died	X-ray – lateral radiographs (including swimmers view if required)	Blinded review of X-rays by experts with/without CT scans, plain tomograms and F/E views	Not reported	**Cervical spine injury – lateral view only**		Not reported	Review of radiology was blinded. Time between tests unclear.
							TP	76		
							FP	18		
							TN	665		
							FN	16		
							sens	0.826		
							spec	0.974		
							PPV	0.809		
							NPV	0.977		

Table 57: Mathen 2007

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Mathen et al. Prospective evaluation of multislice computed tomography versus plain radiographic cervical spine clearance in trauma	Prospective	667	Trauma patients requiring C-spine evaluation; mean age 35.4; 70% male; blunt injury in 99%; 48.7 due to MVC	X-ray: 3-view plain films Multislice CT	Composite of all imaging and clinical data	Not reported	**X-ray cervical spine injury**		Not reported	Unclear blinding or time between test
							TP	27		
							FP	16		
							TN	591		
							FN	33		
							sens	0.45		
							spec	0.974		
							PPV	0.628		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
patients. J Trauma 2007; 62: 1427-1431							NPV	0.947		
							CT cervical spine injury			
							TP	60		
							FP	3		
							TN	604		
							FN	0		
							sens	1.0		
							spec	0.995		
							PPV	0.952		
							NPV	1.00		

Table 58: Mower et al. 2001

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Mower WR et al. Use of plain radiography to screen for cervical spine injuries. Annals of Emergency Medicine	Prospective, multi-centre	34069 (but diagnostic data only available for the 818 with cervical injury according to gold	All patients with blunt trauma who underwent cervical spine radiography in the participating EDs. Exclusion:	X-ray – 3 view, plain film	Final diagnosis-reviewing of neurosurgical and risk management logs of all patients 3 months post-study	Not reported	**Cervical spine injuries (X-ray/final diagnosis**		Not reported	Unclear blinding or time between tests. Only TP and FN data available – hence only sensitivity
							TP	498		
							TN	320		
							sens	0.609		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
2001; 38: 1-7		standard)	patients without trauma, and those undergoing cervical spine imaging for any other reason. Ages 1 month to 101 years (mean 37 years); 58.7% male.							calculable

Table 59: Pizones 2013

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Pizones J et al. Prospective analysis of magnetic resonance imaging accuracy in diagnosing traumatic injuries of the	Prospective cohort study	58	Consecutive patients with suspected acute traumatic thoracolumbar fracture. Pathological fractures were excluded.	MRI	Surgery (wherein the injured PLC could be visualised on dynamic testing). Some were evaluated	Not reported	**MRI/Surgery for supraspinous ligament**		Not reported	Blinding reported. Time between tests unreported.
							Sens	0.93		
							Spec	1		
							PPV	1		
							NPV	0.96		
							MRI/Surgery			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
posterior ligamentous complex of the thoracolumbar spine. Spine 2013; 38: 745-751					with a non-surgical test but the results were not clearly reported for this gold standard (and neither was the test itself) so this has not been included.		**for ligamentum flavum**			
							Sens	1		
							Spec	1		
							PPV	1		
							NPV	1		
							MRI/Surgery for facet capsules			
							Sens	1		
							Spec	0.52		
							PPV	0.57		
							NPV	1		
							MRI/Surgery for interspinous ligament			
							Sens	0.92		
							Spec	1		
							PPV	1		
							NPV	0.92		

Table 60: Ptak et al. 2001

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Ptak et al.	Retrospective	676	Multitrauma	Helical scanning	Clinical	Not given	**Cervical**		Not	Unclear to

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Screening for cervical spine trauma with helical CT: experience with 676 cases. Emergency Radiology 2001; 8: 315-319	review		patients. Only records from patients who had been initially imaged with CT using the standard protocol were included. 66% men; ages 1-104 years (mean 47.2 (24.1) years	CT on HiSpeed Advantage CT scanner using helical technique.	diagnosis and outcome		**fracture**		reported	what extent the final diagnosis depended on the imaging. However the final diagnosis made by 3 consultants on clinical as well as imaging grounds.
							TP	59		
							TN	616		
							FN	1		
							FP	0		
							sens	0.983		
							spec	1		
							+PV	1		
							-PV	0.998		

Table 61: Rana et al. 2009

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Rana et al. Traumatic cervical spine injuries: characteristic of missed injuries. Journal of paediatric	Retrospective	345. 200 with CT only 64 with plain films only 54 both	All paediatric (<18 years old) trauma patients identified on a trauma registry. Exclusion: patients	X-ray CT	CT Further clinical and radiological review	Not reported	**X-ray for cervical spine injury**		Not reported	Unclear blinding or time between tests. Unclear reporting of raw data – thus not
							sens	0.615		
							spec	0.016		
							PPV	0.615		
							NPV			
							CT for cervical			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
surgery 2009; 44: 151-155			without imaging for CSI or without a CSI. Mean age 10.2-12.6; male 64-78%; ISS 14.2-17.5; GCS 13; 245-30% intubated				**spine injury**			possible to verify the very low specify figure reported for X-ray
							sens	1		
							spec	0.976		
							NPV	0.794		

Table 62: Resnick et al. 2014

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Resnick et al. Clinical relevance of magnetic resonance imaging in cervical spine clearance – a prospective study. JAMA Surg 2014; 149:934-939	Prospective	830.	Consecutive adult patients who had sustained blunt trauma, underwent CT evaluation of the cervical spine and were admitted to a level I trauma centre between 2010 and 2011. Patients had	MRI – obtained with a 1.5T system (GE Signa). This was reviewed at a 3 megapixel resolution by a board-certified radiologist Multidetector -row helical	Final diagnosis at time of discharge, including results of all imaging and operative findings	Not reported	**CT for cervical spine injury (all)**		Not reported	Unclear blinding or time between tests. No analysis of diagnostic accuracy of MRI was performed, despite the article's apparently
							TP	149		
							FN	15		
							FP	0		
							TN	666		
							Sens	0.91		
							Spec	1.0		
							CT for clinically important (needing surgical			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
			to have a GCS of 15 or over, not be intoxicated and not have a distracting injury. They also had to be awake and alert, with persistent midline cervical spine pain, tenderness to palpation and a focal neurological deficit.	CT			**stabilisation or halo placement) cervical spine injury**			contradictory title.
							TP	164		
							FN	0		
							FP	0		
							TN	666		
							Sens	1.0		
							Spec	1.0		

Table 63: Rhea 2001

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Rhea JT et al. Can chest	Prospective	125 (38 with chest	Consecutive multiple	X-ray of thoracic (AP	Where CT and X-ray findings	Not	**CT/composite for all thoracic**			Reference standard not

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
and abdominal trauma CT eliminate the need for plain films of the spine? – experience with 329 multiple trauma patients. Emergency Radiology 8: 99-104	study	CT and thoracic spine X-ray and 87 with abdominal CT and lumbar spine X-ray)	trauma patients examined with chest trauma CT and thoracic spine X-ray OR abdominal trauma CT and lumbar spine X-ray	and lateral) or lumbar spine (AP, lateral and coned lateral) on plain films – interpreted by a resident and staff radiologist or staff radiologist alone. CT of abdomen or chest using a helical scanner. This was not targeted on the spine. Viewed on a CT workstation – interpreted by a resident and staff radiologist or staff radiologist alone.	disagreed then all images were reviewed and the reports of any other imaging studies were obtained. Further spinal CTs were taken if needed. However if X-ray and CT scans agreed then this was taken as the reference test result. (Thus both could be wrong but this error would be undetected).	reported	**fractures**			rigorous as if X-ray and CT agreed this was taken as gold standard. Only if they disagreed were further information used to get a composite decision. The limitation of this approach is that both X- ray and CT could simultaneously miss a fracture, and this would not be known. Reliance on index tests for reference tests opens findings to bias.
							Sens	1.0(0.75-1.0)		
							X-ray/composite for all thoracic fractures			
							Sens	0.62(0.32-0.86)		
							CT/composite for all lumbar fractures			
							Sens	0.94(0.73-0.99)		
							X-ray/composite for all lumbar fractures			
							Sens	0.67(0.41-0.87)		
							CT/composite for thoracic transverse process			
							Sens	1		
							X-ray/composite for thoracic transverse			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							process			
							Sens	0.86		
							CT/composite for thoracic burst fracture			
							Sens	1		
							X-ray/composite for thoracic burst fracture			
							Sens	0.5		
							CT/composite for thoracic compression fracture			
							Sens	1		
							X-ray/composite for thoracic compression fracture			
							Sens	0		
							CT/composite for thoracic spinous process fracture			
							Sens	1		
							X-ray/composite for thoracic spinous process fracture			
							Sens	0		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							CT/composite for lumbar transverse process fracture			
							Sens	1		
							X-ray/composite for lumbar transverse process fracture			
							Sens	0.67		
							CT/composite for sacral fracture			
							Sens	1		
							X-ray/composite for sacral fracture			
							Sens	1		
							CT/composite for lumbar compression fracture			
							Sens	1		
							X-ray/composite for lumbar compression fracture			
							Sens	0		
							CT/composite for lumbar body/pedicle			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							fracture			
							Sens	1		
							X-ray/composite for lumbar body/pedicle fracture			
							Sens	1		
							CT/composite for lumbar articular process fracture			
							Sens	0		
							X-ray/composite for lumbar articular process fracture			
							Sens	1		

Table 64: Rhee 2002

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Rhee PM et al. Lumbar fractures in adult blunt trauma: axial and single	Retrospective diagnostic accuracy study	All patients with a diagnosis of lumbar fracture secondary to	Blunt trauma patients with a final diagnosis of a lumbar	X-ray (2 view), using a portable X-ray machine.	Composite findings, including history and physical examination,	Not stated	**X-ray/composite**		Not reported	This was only in those with a diagnosis of lumbar fracture so
							TP	96		
							FN	14		
							Sens	0.87		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
slice helical abdominal and pelvic computed tomographic scans versus portable plain films. J Trauma 2002; 53: 663-667		trauma n=115; n=5 had CT data only, 58 had X-rays only and 52 had both)	fracture	OR Abdominal and pelvic CT scanning (AP-CT). In 1st 2 years, it was a HiLight scanner and thereafter it was a helical single-slice scanner.	physician progress notes, radiology reports, operative reports and discharge summary. The definitive piece of evidence, if unclear from the composite evidence, was the radiology report.		**CT/composite**			no specificity data available.
							TP	43		
							FN	13		
							Sens	0.77		

Table 65: Sheridan 2003

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Sheridan R et al. Reformatted visceral protocol helical computed tomographic scanning allows	Prospective diagnostic accuracy study	78	People with trauma having lumbar or thoracic fractures. Aged 39(21) years; 77% male; ISS of 21.3; 44% car crash, 13% pedestrian hit	Reformatted CT (CT scanning aimed at the thoracic/abdominal viscera reformatted to target the lumbothoracic spine). Helical	Discharge diagnosis. To the authors knowledge follow up of patients indicates that no thoracic or lumbar fractures were	Not reported	**CT/discharge outcome for thoracic fractures**		Not reported	CT scans tended to be done first and it was stated that therefore the reviewing of them was done
							TP	18		
							FN	1		
							Sens	0.95		
							CT/discharge outcome for			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
conventional radiographs of the thoracic and lumbar spine to be eliminated in the evaluation of blunt trauma patients. J Trauma 2003; 55:665-669			by vehicle, 2.7% motorcycle crash.	scanning done with a single-detector helical scanner or a multi-detector helical scanner. OR Conventional AP and lateral thoracic and lumbosacral X-rays	missed in the discharge diagnoses.		**lumbar fractures**			without Knowledge of the X-ray results. However it was stated by the authors that on some occasions the X-rays were interpreted in the knowledge of the CT scan results. All had fractures so specificity data not available. Sensitivity figures in paper appear inaccurate so they have been recalculated from raw data.
							TP	25		
							FN	2		
							Sens	0.93		
							X-ray/discharge outcome for thoracic fractures			
							TP	11		
							FN	8		
							Sens	0.58		
							X-ray/discharge outcome for lumbar fractures			
							TP	23		
							FN	4		
							Sens	0.85		

Table 66: Silberstein 1992B

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Silberstein M et al. (1992B). A comparison between MRI and CT in acute spinal trauma. Australasian Radiology 36: 192-197	Retrospective review	34	Trauma patients admitted to a Spinal Injuries Unit over 3 years. 22males, 12 females; age 12-70 (mean 34); Most injuries due to MVA or falls; 22 with cervical injuries and 12 with thoracic injuries.	MRI (for bony fractures) – using a 0.3 Tesla MR unit on 31 patients and 1.5 Tesla superconducting MR unit on 3 patients. Slice thickness was 4mm with 1mm interslice gap. CT (for cord injury), using contiguous 4mm slices.	CT (for bony fractures) MRI (for cord injury)	Average time from injury to MR was 11 days, but CT was obtained on admission	**CT/MRI for prevertebral swelling**		Not reported	Independent retrospective examination of imaging data, which seems to imply that those analysing CT did not see MRI results and vice versa. However details of expertise not reported.
							TP	15		
							FN	2		
							FP	1		
							TN	16		
							Sens	0.88		
							Spec	0.94		
							+ve pred	0.94		
							-ve pred	0.89		
							+LR			
							-LR			
							Diagnostic OR			
							CT/MRI for ligament injury			
							TP	3		
							FN	8		
							FP	0		
							TN	23		
							Sens	0.27		
							Spec	1.0		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							+ve pred	1.0		
							-ve pred	0.74		
							+LR			
							-LR			
							Diagnostic OR			
							CT/MRI for disc herniation			
							TP	0		
							FN	7		
							FP	0		
							TN	27		
							Sens	0		
							Spec	1.0		
							+ve pred	0		
							-ve pred	0.77		
							+LR			
							-LR			
							Diagnostic OR			
							CT/MRI for extramedullary haematoma			
							TP	0		
							FN	14		
							FP	0		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							TN	20		
							Sens	0		
							Spec	1.0		
							+ve pred	0		
							-ve pred	0.53		
							+LR			
							-LR			
							Diagnostic OR			
							CT/MRI for cord compression			
							TP	0		
							FN	12		
							FP	0		
							TN	22		
							Sens	0		
							Spec	1.0		
							+ve pred	0		
							-ve pred	0.60		
							+LR			
							-LR			
							Diagnostic OR			
							MRI/CT for vertebral body fracture			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							TP	9		
							FN	1		
							FP	1		
							TN	23		
							Sens	0.91		
							Spec	0.96		
							+ve pred	0.91		
							-ve pred	0.96		
							+LR			
							-LR			
							Diagnostic OR			
							MRI/CT for posterior element fracture			
							TP	3		
							FN	10		
							FP	0		
							TN	21		
							Sens	0.23		
							Spec	1.0		
							+ve pred	1.0		
							-ve pred	0.68		
							+LR			
							-LR			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							Diagnostic OR			
							MRI/CT for subluxation			
							TP	8		
							FN	0		
							FP	0		
							TN	26		
							Sens	1.0		
							Spec	1.0		
							+ve pred	1.0		
							-ve pred	1.0		
							+LR			
							-LR			
							Diagnostic OR			
							MRI/CT for spondylosis			
							TP	10		
							FN	0		
							FP	0		
							TN	24		
							Sens	1.0		
							Spec	1.0		
							+ve pred	1.0		
							-ve pred	1.0		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							+LR			
							-LR			
							Diagnostic OR			

Table 67: Tarr et al. 1987

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Tarr RW et al. MR imaging of recent spinal trauma. Journal of Computer assisted tomography 1987; 11: 412-417	Retrospective study	14	Suspected recent spinal trauma	MRI for bony injuries CT for soft tissue injuries	CT for bony injuries MRI for soft tissue injuries	Up to 2.5 weeks, with MRI later	**MRI (bony)/CT (bony) for posterior element fractures**		Not reported	Mostly lumbar and thoracic but some cervical included as well. This was not intended as a diagnostic accuracy study. The diagnostic accuracy data has been calculated by imposing our own choice of gold
							TP	4		
							FN	3		
							sens	0.57		
							MRI (bony)/CT (bony) for vertebral body fractures			
							TP	14		
							FN	0		
							sens	1		
							CT (soft tissue)/MRI (soft tissue) for cord or thecal			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							sac impingement			standard upon the paper's raw data.
							TP	2		
							FN	2		
							sens	0.5		
							CT (soft tissue)/MRI (soft tissue) for disc herniations			
							TP	2		
							FN	3		
							sens	0.4		
							CT (soft tissue)/MRI (soft tissue) for epidural heamatomas			
							TP	0		
							FN	3		
							sens	0		
							CT (soft tissue)/MRI (soft tissue) for spinal cord oedema/heamatomas			
							TP	0		
							FN	4		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							sens	0		

Table 68: Tracy 1989

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Tracy PT. Magnetic resonance imaging of spinal injury. Spine 1989; 14: 292-301	Retrospective study	13. 27 others were included in the study but not relevant to this review so their results have not been included	Patients with acute spinal injury who had received both CT and MRI	MRI for bony injuries CT for soft tissue injuries	CT for bony injuries MRI for soft tissue injuries	<5 days	**MRI bony/CT bony for vertebral fractures - body**		Not reported	This was not intended as a diagnostic accuracy study. The diagnostic accuracy data has been calculated by imposing our own choice of gold standard upon the paper's raw data.
							TP	10		
							FN	0		
							Sens	1.0		
							MRI bony/CT bony for vertebral fractures – posterior elements			
							TP	6		
							FN	3		
							Sens	0.67		
							CT soft tissue/MRI			

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							soft tissue disc herniations			
							TP	0		
							FN	3		
							Sens	0		
							CT soft tissue/MRI soft tissue ligament disruptions			
							TP	0		
							FN	6		
							Sens	0		
							CT soft tissue/MRI soft tissue epidural haematomas			
							TP	0		
							FN	2		
							Sens	0		
							CT soft tissue/MRI soft tissue spinal cord oedema and/or haemorrhage			
							TP	0		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							FN	3		
							Sens	0		
							CT soft tissue/MRI soft tissue transected spinal cord			
							TP	0		
							FN	3		
							Sens	0		

Table 69: Wintermark et al. 2003

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Wintermark M et al. Thoracolumbar spine fractures in patients who have sustained severe trauma: depiction with multi-detector row CT. Emergency	Prospective diagnostic study	100 (1700 thoracolumbar vertebrae assessed)	Consecutive adult patients sustaining severe blunt trauma. 76 men and 24 women (IQR 25-52) who had undergone both conventional radiography of TLS and thoracoabdominal multi-detector row CT as part of their normal management. 69	X-rays – AP and lateral views of TLS, with swimmers view used as appropriate. Reviewed by 3 radiologists and 2 orthopaedic surgeons.	A full composite assessment made in consensus by one radiologist and 1 orthopaedic surgeon (each had been involved in the X-ray reviews and	Not reported by reference test would have been done after discharge.	X-rays/composite for ALL thoracolumbar fractures		Not reported	Diagnostic accuracy data based on 1700 vertebrae examined). Patient data anonymised to prevent knowledge of X-ray result influencing CT result (and vice
							Sens	0.32(0.27-0.37)		
							Spec	1.0		
							CT/composite for ALL thoracolumbar fractures			
							Sens	0.78(		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
radiology 227: 681-689			RTAs, 12 motorcycle accidents, 26 falls and 5 crush accidents. 26 later found (see reference test criteria) to have 67 thoracolumbar spine fractures.	CT-Thoracoabdominal multi-detector row CT included series of thoracic and abdominopelvic images, acquired in helical mode. Reviewed by the same 3 radiologists at CT workstations (not the orthopaedic surgeons as this would be outside their area of expertise).	one of them also in the CT reviews, and it is not stated how blinding of index test results was ensured). This was made on the basis of clinical evolution, any repeated imaging, MRI, final diagnosis, orthopaedic intervention and autopsy.			0.72-0.84)		versa). Also one month between reviewing of X-rays and CT for same reason. However, the degree of blinding between each of the 2 index tests and the reference test was less rigorously reported. The index tests were performed by >1 reviewer. The variability of their reviews was accounted for by a weighting system
							Spec	1.0		
							X-rays/composite for UNSTABLE thoracolumbar fractures			
							Sens	0.33(0.22-0.47)		
							Spec	1.0		
							CT/composite for UNSTABLE thoracolumbar fractures			
							Sens	0.97(0.86-0.99)		
							Spec	1.0		
							X-ray/composite for thoracolumbar fractures on anterior column			
							Sens	0.74		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							X-ray/composite for thoracolumbar fractures on middle column			taking into account the consensus or divergent opinion of the 5 or 3 reviewers.
							Sens	0.35		
							X-ray/composite for thoracolumbar fractures on posterior column			
							Sens	0.40		
							CT/composite for thoracolumbar fractures on anterior column			
							Sens	0.96		
							CT/composite for thoracolumbar fractures on middle column			
							Sens	0.89		

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
							CT/composite for thoracolumbar fractures on posterior column			
							Sens	0.94		
							X-ray/composite for transverse and spinous process fractures of thoracolumbar region			
							Sens	0.09		
							CT/composite for transverse and spinous process fractures of thoracolumbar region			
							Sens	0.71		

Table 70: Takami 2014

Reference	Study type	Number of patients	Patient characteristics	Index test	Reference test	Time between tests	Outcomes (Index/Ref)	Effect sizes	Source of funding	Comments
Takami M et al. Usefulness of full spine computed tomography in cases of high-energy trauma: a prospective study. Eur J Orthop Surg Traumatol 2014; 24: (suppl 1): S167-S171	Diagnostic accuracy	179	Patients sustaining high-energy trauma – 134 male and 45 female.	Plain X-rays	Full spine CT scan (Asteion, Toshiba medical systems Corp. Otawara, Japan)	Not stated	**Plain X-ray/CT – Cervical fractures**		Not stated	This did not set out to determine diagnostic accuracy – simply aimed at evaluating whole spine CT in this population. The sensitivity values yielded for X-rays are fortuitous.
							TP	10		
							FN	6		
							sens	0.625		
							Plain X-ray/CT – thoracolumbar fractures			
							TP	37		
							FN	6		
							sens	0.86		

G.6 Radiation risk

Table 71: RONCKERS 2010[33]

Reference	Study type and analysis	Number of participants and characteristics	Prognostic variable(s)	Confounders OR stratification strategy	Outcome measures	Effect sizes	Comments
Ronckers CM,	Prospective	N = 5,573	Continuous risk	Stratification by:	Breast Cancer	3.9 (1.0-9.3) Excess	Low risk of bias.

Reference	Study type and analysis	Number of participants and characteristics	Prognostic variable(s)	Confounders OR stratification strategy	Outcome measures	Effect sizes	Comments
Land CE, Miller JS, Stovall M, Lonstein JE, Doody MM. Cancer mortality among women frequently exposed to radiographic examinations for spinal disorders. Radiation Research. 2010; 174(1):83-90 [33]	cohort Cox regression	Lag time – 10 years USA. Follow-up of US Scoliosis Cohort Study which recruited women with confirmed diagnosis of scoliosis, kyphosis, lordosis or kyphoscoliosis before 20 years of age in one of 14 orthopaedic centres in the USA. Diagnosed between 1912 and 1965.	factor: Cumulative breast dose (Gy) due to diagnostic radiography.	Age at diagnosis Type of curvature Aetiology of curvature Maximum curve magnitude Number of surgeries Number of examinations	Mortality	relative risk per gray (ERR/Gy)	Indirect population of patients with curvature of spine.
					10-19 cGy versus <10 cGy breast dose (10 year lag)	Events in high-dose exposed 23/1239 Events in low-dose group 63/3388	
					20-29 cGy versus <10 cGy breast dose	Events in exposed 14/540 Events in low-dose group 63/3388	
					≥30 cGy versus <10 cGy breast dose (10 year lag)	Events in exposed 12/345 Events in low-dose group 63/3388	

Table 72: MATHEWS 2013

Reference	Study type and analysis	Number of participants and characteristics	Prognostic variable(s)	Confounders OR stratification strategy	Outcome measures	Effect sizes	Comments
Mathews, J. D., Forsythe, A. V., Brady, Z., Butler, M. W., Goergen, S. K., Byrnes, G. B., Giles, G. G., Wallace, A. B., Anderson, P. R., Guiver, T. A., McGale, P., Cain, T. M., Dowty, J. G., Bickerstaffe, A. C., and Darby, S. C. Cancer risk in 680 000 people exposed to computed tomography scans in childhood or	Retrospective cohort Poisson regression	N = 10,939,680 Exposed n= 680,211 Unexposed n= 10,259,469 Lag time: 1 year Mean F/U: Exposed 9.5 Unexposed17.3 Australia. 10 million people aged 0-19 years during the period 1st January 1985 to 31st December 2005. Data sourced from electronic Medicare database.	Dichotomous risk factor: Exposed/unexposed to CT scan	Poisson regression analysis. Stratification by: Age Sex Year of birth	All malignancy	10 year lag IRR 1.18 (1.11-1.24) Absolute excess incidence rate (EIR) per 10 000 person years (95%CIs and p value)	High risk of bias. Exposure measured through electronic database – possibly missing studies carried out outside of Medicare. Poisson regression used with only age, sex and year of birth adjusted for and a low ratio of events to covariates.
						Events in exposed 3,150/680,211 Events in unexposed 57,524/10,259,469	

Reference	Study type and analysis	Number of participants and characteristics	Prognostic variable(s)	Confounders OR stratification strategy	Outcome measures	Effect sizes	Comments
adolescence: Data linkage study of 11 million Australians. BMJ 346(7910). 2013.[28]							

Table 73: Yuan 2013

Reference	Study type and analysis	Number of participants and characteristics	Prognostic variable(s)	Confounders OR stratification strategy	Outcome measures	Effect sizes	Comments
Yuan et al. The risk of cataract associated with repeated head and neck CT studies: a nationwide population-based study. American Journal of	Retrospective cohort Cox regression analysis	N = 30,537 Exposed n= 2776 Unexposed n= 27761 Mean age 40 in both groups; male 72.4% in both groups; DM 5.9% in both groups; CAD 2.5%/3.4% Mean F/U: 10 years	Dichotomous risk factor: Exposed/unexposed to CT scan	Time to event analysis, adjusted for age, sex, hypertension, DM and history of coronary heart disease. Two analyses done: 1) For any CT	Effect of any CT exposure on risk of development of cataract	Raw results: 27/2776 (0.97%) in exposed group and 201/27761 (0.72%) in non-exposed group; raw RR: 1.35	High risk of bias – retrospective and so all plausible confounders may not have been measured.

Reference	Study type and analysis	Number of participants and characteristics	Prognostic variable(s)	Confounders OR stratification strategy	Outcome measures	Effect sizes	Comments
Radiology 2013; 201: 626-630		Exposed : not stated Unexposed: not stated Taiwan 2 million people from 2 longitudinal health insurance databases from the Taiwan National health Insurance Research Database.		2) exposure Stratification of results according to the number of CTs received	Effect of any number of CT exposures on hazard of development of cataract	Unadjusted HR: 1.67 (1.12-2.5) Adjusted* HR: 1.76 (1.18-2.63) *see confounders column	
					Effect of 1-2 CT exposures on hazard of development of cataract (n=1512)	Unadjusted HR: 1.40 (0.78-2.5) Adjusted* HR: 1.61 (0.9-2.88) *see confounders column	
					Effect of 3-4 CT exposures on hazard of development of cataract (n=645)	Unadjusted HR: 1.71 (0.76-3.85) Adjusted* HR: 1.64 (0.73-3.69)	

Reference	Study type and analysis	Number of participants and characteristics	Prognostic variable(s)	Confounders OR stratification strategy	Outcome measures	Effect sizes	Comments
						*see confounders column	
					Effect of >5 CT exposures on hazard of development of cataract (n=619)	Unadjusted HR: 2.23 (1.14-4.35) Adjusted* HR: 2.12 (1.09-4.14) *see confounders column	

G.7 Neuroprotective pharmacological Interventions

Table 74: Bracken 1984

Study (subsidiary papers)	Bracken 1984[3] (Bracken 1985[7])
Study type	RCT (patient randomised; parallel)
Funding	Academic or government funding (National Institute of Neurological and Communicative Disorders and Stroke grant)
Number of studies (number of participants)	1 (n=306)
Countries and setting	Conducted in USA; setting: 9 hospitals, 6 of which were specialised spinal cord centres
Line of therapy	1st line
Duration of study	Intervention + follow up: 1 year
Method of assessment of guideline condition	Adequate method of assessment/diagnosis ~
Stratum	Overall

Study (subsidiary papers)	Bracken 1984[3] (Bracken 1985[7])
Subgroup analysis within study	Not applicable
Inclusion criteria	Diagnosed as acute spinal cord injury by an attending neuro-surgeon
Exclusion criteria	Patients with only root involvement or cauda equina alone, admittance to the participating centre >48 hours after injury, dosage of > 100mg of methylprednisolone (or equivalent steroid) before admission, severe comorbidity (such as head trauma) or other life-threatening conditions, patients <13 years, and patients whom participating physicians at their discretion wished to exclude for specific reasons including history of diabetes mellitus, severe vascular disease, concurrent infection, GI bleeding or pregnancy.
Recruitment/selection of patients	Recruitment between February 1979 and November 1981
Age, gender and ethnicity	Age - other: age reported categorically as frequencies of ranges. Gender (M:F): 267/39. Ethnicity: Black 27% White 52% Hispanic 20% Oriental 1%
Further population details	1. Age: not applicable/not stated/unclear 2. Comorbidities: not applicable/not stated/unclear (life-threatening trauma excluded only). 3. Location (spinal level) of spinal cord injury: mixed
Interventions	Intervention 1: Steroids ~ Methylprednisolone. Methylprednisolone 1000 mg bolus and 250 mg four times daily thereafter for ten days. Duration 10 days. Concurrent medication/care: not reported (n=165). Further details: 1. Dose: high-dose 2. Duration: > 24 hours 3. Timing of intervention: not applicable/not stated/unclear (mixed). Intervention 2: Steroids ~ Methylprednisolone. Methylprednisolone 100 mg bolus and 25 mg four times daily thereafter for ten days. Duration 10 days. Concurrent medication/care: not reported (n=165). Further details: 1. Dose: low-dose 2. Duration: > 24 hours 3. Timing of intervention: not applicable/not stated/unclear (mixed).

Table 75: Bracken 1990

Study (subsidiary papers)	Bracken 1990[5] (Bracken 1993[4], Bracken 1992[6])
Study type	RCT (patient randomised; parallel)
Funding	Supported by a grant from NINDS, drugs provided by Upjohn Corporation and DuPont Corporation)
Number of studies (number of participants)	1 (n=487)
Countries and setting	Conducted in USA; setting: 10 medical centres in 8 states

Study (subsidiary papers)	Bracken 1990[5] (Bracken 1993[4], Bracken 1992[6])
Line of therapy	1st line
Duration of study	Intervention + follow up: 1 year
Method of assessment of guideline condition	Adequate method of assessment/diagnosis ~
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Aged 13 years or over, spinal cord injury diagnosed by a physician associated with the study, randomised within 12 hours of their injury.
Exclusion criteria	Involvement of nerve root or cauda equina only, gunshot wounds, life-threatening morbidity, pregnancy, addiction to narcotics, receiving maintenance steroids for other reasons, received 100 mg of methylprednisolone or its equivalent or 1mg of naloxone before admission to the centre, those in whom follow-up would be difficult.
Recruitment/selection of patients	Recruitment from May 1985 to December 1988
Age, gender and ethnicity	Age - other: age reported categorically as frequencies of ranges. Gender (M:F): 409/78. Ethnicity: Black 12%, Non-Hispanic White 76%, Hispanic 7%, Other 5%
Further population details	1. Age : 2. Comorbidities: 3. Location (spinal level) of spinal cord injury:
Interventions	Intervention 1: Steroids ~ Methylprednisolone. Methylprednisolone 30 mg/kg bolus followed by 5.4 mg/kg/hour for 23 hours. Duration 24 hours. Concurrent medication/care: not reported (n=162). Further details: 1. Dose: high-dose 2. Duration: up to 24 hours 3. Timing of intervention: not applicable/not stated/unclear (mixed). Intervention 2: Opioid antagonist ~ Naloxone. Naloxone 5.4 mg/kg bolus followed by 4 mg/kg/hour for 23 hours. Duration 24 hours. Concurrent medication/care: not reported (n=154). Further details: 1. Dose: high-dose 2. Duration: up to 24 hours 3. Timing of intervention: not applicable/not stated/unclear (mixed). Intervention 3: Placebo/no treatment ~ Placebo. Placebo. Duration 24 hours. Concurrent medication/care: not reported (n=171). Further details: 1. Dose: not applicable/not stated/unclear 2. Duration: up to 24 hours 3. Timing of intervention: not applicable/not stated/unclear

Table 76: Bracken 1997

Study (subsidiary papers)	Bracken 1997[8] (Bracken 1998[9])

Study (subsidiary papers)	Bracken 1997[8] (Bracken 1998[9])
Study type	RCT (patient randomised; parallel)
Funding	Equipment/drugs provided by industry (Grant from National Institute of Neurological Disorders and Stroke. Drugs supplied by Pharmacia and Upjohn)
Number of studies (number of participants)	1 (n=499)
Countries and setting	Conducted in USA; setting: hospitals in USA and Canada
Line of therapy	1st line
Duration of study	Follow up (post intervention): 1 year
Method of assessment of guideline condition	Adequate method of assessment/diagnosis ~
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Aged 14 years or over, spinal cord injury diagnosed by a physician associated with the study, randomised within 6 hours of their injury
Exclusion criteria	Pregnancy, illegal immigrant status, indicted criminals, patients with serious comorbidity or specific health conditions that might affect treatment assessment, patients weighing >109 kg because of concern regarding volume overload, patients with gunshot wounds, those with previous spinal injury or those started earlier on maintenance methylprednisolone.
Recruitment/selection of patients	Recruitment from December 1991 to September 1995
Age, gender and ethnicity	Age - other: age reported categorically as frequencies of ranges. Gender (M:F): 423/76. Ethnicity: African American 12%, Non-Hispanic White 75%, Hispanic 8%, Other 5%
Further population details	1. Age: adults 18-65 (adults 14 years or over). 2. Comorbidities: not applicable/not stated/unclear 3. Location (spinal level) of spinal cord injury: mixed
Extra comments	Patients all given an open label bolus of 20-40 mg/kg at injury site or ED prior to randomisation.
Interventions	Intervention 1: Steroids ~ Methylprednisolone. Methylprednisolone 5.4 mg/kg/hour for 48 hours. Duration 48 hours. Concurrent medication/care: all patients given Methylprednisolone 20-40 mg/kg bolus dose prior to randomisation (n=166). Further details: 1. Dose: not applicable/not stated/unclear 2. Duration: > 24 hours 3. Timing of intervention: < 6 (bolus given within 6 hours, infusion started within 8 hours). Intervention 2: Steroids ~ Methylprednisolone. Methylprednisolone 5.4 mg/kg/hour for 24 hours. Duration 24 hours. Concurrent medication/care: all patients given Methylprednisolone 20-40 mg/kg bolus dose prior to randomisation

Study (subsidiary papers)	Bracken 1997[8] (Bracken 1998[9])
	(n=166). Further details: 1. Dose: not applicable/not stated/unclear 2. Duration: up to 24 hours 3. Timing of intervention: < 6 (bolus given within 6 hours, infusion started within 8 hours).

Table 77: Matsumoto 2001

Study (subsidiary papers)	Matsumoto 2001[29]
Study type	RCT (patient randomised; parallel)
Funding	Funding not stated
Number of studies (number of participants)	1 (n=46)
Countries and setting	Conducted in Japan; setting: single centre
Line of therapy	1st line
Duration of study	Follow up (post intervention): 2 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Cervical spinal cord injury diagnosed by physicians associated with the study, randomised within 8 hours of injury
Exclusion criteria	Involvement of 1 or more nerve roots only, gun-shot wounds, life-threatening morbidity, pregnancy, addiction to narcotics, receiving maintenance steroids for other reasons, those given operative treatment, patients with ankylosing spondylitis
Recruitment/selection of patients	April 1993 to August 1999
Age, gender and ethnicity	Age - mean (range): 60.6 (20-84). Gender (M:F): 42/4. Ethnicity: not reported
Further population details	1. Age: adults 18-65 2. Comorbidities: not applicable/not stated/unclear 3. Location (spinal level) of spinal cord injury: mixed
Interventions	Intervention 1: Steroids ~ Methylprednisolone. Methylprednisolone 30 mg/kg bolus followed by 5.4 mg/kg/hour for 23 hours. Duration 24 hours. Concurrent medication/care: broad spectrum antibiotics and gastric protection given to all participants (n=23). Further details: 1. Dose: not applicable/not stated/unclear 2. Duration: up to 24 hours 3. Timing of intervention: 6-12

Study (subsidiary papers)	Matsumoto 2001[29]
	Intervention 2: Placebo/no treatment ~ Placebo. Placebo. Duration 24 hours. Concurrent medication/care: broad spectrum antibiotics and gastric protection given to all participants (n=23). Further details: 1. Dose: not applicable/not stated/unclear 2. Duration: not applicable/not stated/unclear 3. Timing of intervention: not applicable/not stated/unclear

Table 78: Otani 1994

Study (subsidiary papers)	Otani 1994[31]
Study type	RCT (patient randomised; parallel)
Funding	Funding not stated
Number of studies (number of participants)	1 (n=117)
Countries and setting	Conducted in Japan; setting: multicentre
Line of therapy	1st line
Duration of study	Follow up (post intervention): 6 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Age 16-65 years inclusive, diagnosed as having loss of motor or sensory function caused by spinal cord injury, patients who could start receiving treatment within 8 hours of injury, patients who would be available for 6 month follow-up after start of treatment
Exclusion criteria	Spinal root involvement and/or cauda equina lesions only, serious co-morbidity, receiving corticosteroid dose equivalent to 100 mg methylprednisolone or more between the time of injury and the start of treatment, receiving maintenance therapy with corticosteroids, congenital or previously acquired spinal cord illness, severe comorbidity (including hepatic disorder, cardiac failure, renal failure, peptic ulcer disease, diabetes mellitus, hypertension, psychosis, glaucoma, infectious diseases), pregnancy or breast feeding, history of corticosteroids hypersensitivity, judged inappropriate for enrolment by attending physician
Recruitment/selection of patients	Recruitment from January 1992 to March 1993
Age, gender and ethnicity	Age - other: age reported categorically as frequencies of ranges. Gender (M:F): 89/28. Ethnicity: not reported
Further population details	1. Age: adults 18-65 2. Comorbidities: not applicable/not stated/unclear 3. Location (spinal level) of spinal cord injury:

Study (subsidiary papers)	Otani 1994[31]
	mixed
Interventions	Intervention 1: Steroids ~ Methylprednisolone. Methylprednisolone 30 mg/kg bolus followed by 5.4 mg/kg/hour for. Duration 24 hours. Concurrent medication/care: use of other corticoids in the 6 month period prohibited (n=82). Further details: 1. Dose: not applicable/not stated/unclear (moderate dose). 2. Duration: up to 24 hours 3. Timing of intervention: 6-12 (<8 hours). Intervention 2: Placebo/no treatment ~ Placebo. Placebo. Duration 24 hours. Concurrent medication/care: concomitant use of a corticosteroid other than Methylprednisolone permitted up to a dose equivalent of MP 100 mg per day (n=76). Further details: 1. Dose: not applicable/not stated/unclear 2. Duration: up to 24 hours 3. Timing of intervention: 6-12 (< 8 hours).

Table 79: Pointillart 2000

Study (subsidiary papers)	Pointillart 2000[32]
Study type	RCT (patient randomised; parallel)
Funding	Funding not stated
Number of studies (number of participants)	1 (n=106)
Countries and setting	France
Line of therapy	1st line
Duration of study	Intervention + follow up: 1 year
Method of assessment of guideline condition	Adequate method of assessment/diagnosis ~
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Age >15 and <65 years, hospitalisation within 8 hours of vertebral trauma with spinal cord involvement
Exclusion criteria	Pattern of nerve root involvement, cauda equina syndrome, open spinal lesions, pregnancy, multiple trauma, head injury with GCS <13, pulmonary contusion, haemodynamic instability that persisted despite volume expansion, MAP <60mmHg, previous treatments by corticosteroids or calcium channel blockers or history of diabetes mellitus, cardiovascular disorders, stomach ulcer, liver failure
Recruitment/selection of patients	Recruitment between November 1990 and March 1995

Study (subsidiary papers)	Pointillart 2000[32]
Age, gender and ethnicity	Age - Range: 20- 47. Gender (M:F): 9:1. Ethnicity:
Further population details	1. Age: 2. Comorbidities: major trauma absent (exclusion criterion - multiple trauma). 3. Location (spinal level) of spinal cord injury: mixed
Interventions	Intervention 1: Steroids ~ Methylprednisolone. Methylprednisolone 30 mg/kg over 1 hour, followed by 5.4 mg/kg for 23 hours. Duration 24 hours. Concurrent medication/care: not reported (n=27). Further details: Intervention 2: Calcium channel blockers ~ Nimodipine. Nimodipine 0.015 mg/kg for 2 hours, followed by 0.03 mg/kg for 7 days. Duration 7 days. Concurrent medication/care: not reported (n=27). Further details: Intervention 3: Placebo/no treatment ~ No treatment. No treatment. Duration 24 hours. Concurrent medication/care: not reported (n=25). Further details: 1. Dose: not applicable/not stated/unclear 2. Duration: not applicable/not stated/unclear 3. Timing of intervention: < 6 Intervention 4: Steroids + Calcium channel blockers ~ Methylprednisolone + Nimodipine. Methylprednisolone 30 mg/kg over 1 hour, followed by 5.4 mg/kg for 23 hours with Nimodipine 0.015 mg/kg for 2 hours, followed by 0.03 mg/kg for 7 days. Duration 7 days. Concurrent medication/care: not reported (n=27). Further details: 1. Dose: not applicable/not stated/unclear 2. Duration: > 24 hours 3. Timing of intervention: < 6 (mean time to medication 4 hours (range 3-6)).

G.8 Neuropathic pain

Table 80: Salinas 2012

Study (subsidiary papers)	Salinas 2012[34]
Study type	RCT (patient randomised; parallel)
Funding	Academic or government funding (Colciencias and the Universidad de Antioquia)
Number of studies (number of participants)	1 (n=46)
Countries and setting	Conducted in Colombia; setting: university hospital

Study (subsidiary papers)	Salinas 2012[34]
Line of therapy	1st line
Duration of study	Intervention + follow up: 6 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis ~
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Age 18-70 years, spinal cord injury at any level and any degree of completeness, the spinal cord injury occurred no more than 2 weeks before entering the study, living within the metropolitan area.
Exclusion criteria	Evidence of neuropathic pain, anticonvulsants consumption, inability to give an informed consent, evidence of previous allergic reaction to carbamazepine.
Recruitment/selection of patients	Patients recruited between May 2005 and September 2008
Age, gender and ethnicity	Age - other: age reported as frequencies of categories. Gender (M:F): 42/4. Ethnicity: not reported
Further population details	1. Comorbidities:
Interventions	Intervention 1: Carboxamide ~ Carbamazepine. Tegretol 200 mg once daily for 3 days, then 400 mg for the next 3 days, then 600 mg until the fourth week, in which the dose is reduced and then discontinued. Duration 1 month. Concurrent medication/care: reported that "consumption of analgesics or antineuropathic medications was similar during the follow up for both groups"(n=24). Further details: 1. Dose: not applicable/not stated/unclear 2. Timing of intervention: commenced within 2 weeks of spinal cord injury. Intervention 2: Placebo/no treatment ~ Placebo. Dose/quantity, brand name, extra details. Duration 6 months. Concurrent medication/care: reported that "consumption of analgesics or antineuropathic medications was similar during the follow up for both groups" (n=22). Further details: 1. Dose: not applicable/not stated/unclear 2. Timing of intervention: not applicable/not stated/unclear

Appendix H: GRADE tables

H.1 Immobilising the spine: pre-hospital strategies

Table 81: Clinical evidence profile: Philadelphia collar versus Aspen collar

Quality assessment							No of patients		Effect			
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	Phil	Aspen	Relative (95% CI)	Absolute	Quality	Importance
Mortality at 1, 6 and 12 months												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Health related quality of life												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Rates of spinal cord injury (SCI)												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Missed spinal cord neurological function												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Spinal cord neurological function at 1, 6 and 12 months (ASIA and Frankel)												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Temperature (adverse effects) - Philadelphia versus Aspen (better indicated by lower values)												
1	Randomised trials	Very serious[a]	No serious inconsistency	Serious[b]	Serious[d]	None	20	20	-	MD 2 higher (0.23 lower to 4.23 higher)	Very low	Critical
% relative skin humidity (adverse effects) - Philadelphia versus Aspen (better indicated by lower values)												
1	Randomised	Very	No serious	Serious[b]	No serious	None	20	20	-	MD 30	Very	Critical

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	Phil	Aspen	Relative (95% CI)	Absolute		
	trials	serious[a]	inconsistency		imprecision					higher (21.23 to 38.77 higher)	low	
Occipital pain (adverse effects) - Philadelphia versus Aspen (better indicated by lower values)												
1	Randomised trials	Very serious[a]	No serious inconsistency	Serious[b]	Very serious[c]	None	20	20	-	MD 4 higher (5.32 lower to 13.32 higher)	Very low	Critical

(a) Very small study (n=20), randomisation not described, missing data not reported
(b) Population was comprised of healthy volunteers
(c) Confidence Interval crosses MID in both directions making the results very uncertain
(d) Confidence interval crosses MID in one direction making results uncertain

Table 82: Clinical evidence profile: board versus board or vacuum

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	Control	Exp	Relative (95% CI)	Absolute		
Mortality at 1, 6 and 12 months												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Health related quality of life												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Rates of spinal cord injury (SCI)												
0	-	-	-	-	-	-	-	-	-	-	-	Critical

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Control**	**Exp**	**Relative (95% CI)**	**Absolute**		
Missed spinal cord neurological function												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Spinal cord neurological function at 1, 6 and 12 months (ASIA and Frankel)												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Board versus vacuum- Respiratory (Adverse effects)- FVC (Better indicated by higher values)												
1	Randomised trials	Very serious [c]	No serious inconsistency	Serious[b]	No serious imprecision	None	39	39	-	MD 0.01 higher (0.42 lower to 0.44 higher)	Very low	Critical
Board versus vacuum- Respiratory (Adverse effects)- FEV (Better indicated by higher values)												
1	Randomised trials	Very serious [c]	No serious inconsistency	Serious[b]	No serious imprecision	None	39	39	-	MD 0.11 higher (0.25 lower to 0.47 higher)	Very low	Critical
Board versus vacuum- Respiratory (Adverse effects)- PEF (Better indicated by higher values)												
1	Randomised trials	Very serious [c]	No serious inconsistency	Serious[b]	No serious imprecision	None	39	39	-	MD 0.01 lower (0.88 lower to 0.86 higher)	Very low	Critical
Board versus vacuum- Respiratory (Adverse effects)- FEF (25-75%) (Better indicated by higher values)												
1	Randomised trials	Very serious [c]	No serious inconsistency	Serious[b]	Serious[f]	None	39	39	-	MD 0.17 higher (0.37 lower to 0.71 higher)	Very low	Critical
Board versus vacuum- Comfort (Likert scale 1 (very uncomfortable) to 6 (very comfortable) (Better indicated by higher values)												
1	Randomised trials	Very serious [c]	No serious inconsistency	Serious[b]	No serious imprecision	None	39	39	-	MD 2 lower (2.49 to 1.51 lower)	Very low	Important
Padded board versus unpadded board- Pain (VAS 10cm scale) (Better indicated by higher values)												
1	Randomised	Serious	No serious	Serious[b]	No serious	None	30	30	-	MD 2.9 lower	Low	Important

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	Control	Exp	Relative (95% CI)	Absolute		
	trials	[d]	inconsistency		imprecision					(4.71 to 1.09 lower)		
Board versus vacuum- Pain - Occipital pain- first exposure												
1	Randomised trials	Serious [e]	No serious inconsistency	Serious[b]	No serious imprecision	None	16/18 (88.9%)	3/19 (15.8%)	RR 5.63 (1.97 to 16.11)	731 more per 1000 (from 153 more to 1000 more)	Low	Important
Board versus vacuum -Pain - Lumbosacral pain- second exposure												
1	Randomised trials	Serious [e]	No serious inconsistency	Serious[b]	Very serious[g]	None	3/19 (15.8%)	2/16 (12.5%)	RR 1.26 (0.24 to 6.65)	32 more per 1000 (from 95 fewer to 706 more)	Very low	Important
Board versus vacuum - Pain - Any symptom- first exposure												
1	Randomised trials	Serious [e]	No serious inconsistency	Serious[b]	Serious[f]	None	18/18 (100%)	7/12 (58.3%)	RR 1.69 (1.05 to 2.7)	402 more per 1000 (from 29 more to 992 more)	Very low	Important
Board versus vacuum - Pain - Any symptom- second exposure												
1	Randomised trials	Serious [e]	No serious inconsistency	Serious[b]	Serious[f]	None	10/19 (52.6%)	2/16 (12.5%)	RR 4.21 (1.08 to 16.48)	401 more per 1000 (from 10 more to 1000 more)	Very low	Important
Board versus vacuum - Pain - Occipital pain- second exposure												
1	Randomised trials	Serious [e]	No serious inconsistency	Serious[b]	No serious imprecision	None	9/19 (47.4%)	0/16 (0%)	Peto OR 11.12 (2.48 to 49.83)	470 more per 1000 (from 240 more to 710 more)	Very low	Important

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Control**	**Exp**	**Relative (95% CI)**	**Absolute**		
Board versus vacuum - Pain - Cervical pain- first exposure												
1	Randomised trials	Serious[e]	No serious inconsistency	Serious[b]	Very serious[g]	None	1/17 (5.9%)	5/19 (26.3%)	Peto OR 0.24 (0.04 to 1.35)	200 fewer per 1000 (from 430 fewer to 20 more)	Very low	Important
Board versus vacuum - Pain - Cervical pain- second exposure												
1	Randomised trials	Serious[e]	No serious inconsistency	Serious[b]	No serious imprecision[h]	None	0/19 (0%)	0/16 (0%)	Peto OR not estimable	0 fewer per 1000(from 110 fewer to 110 more)	Low	Important
Board versus vacuum - Pain - Scapular pain- first exposure												
1	Randomised trials	Serious[e]	No serious inconsistency	Serious[b]	Very serious[g]	None	1/17 (5.9%)	1/19 (5.3%)	Peto OR 1.12 (0.07 to 18.75)	10 more per 1000 (from 140 fewer to 160 more)	Very low	Important
Board versus vacuum - Pain - Scapular pain- second exposure												
1	Randomised trials	Serious[e]	No serious inconsistency	Serious[b]	Very serious[g]	None	1/19 (5.3%)	0/16 (0%)	Peto OR 6.31 (0.12 to 322.65)	50 more per 1000(from 90 fewer to 190 more)	Very low	Important
Board versus vacuum - Pain - Lumbosacral pain- first exposure												
1	Randomised trials	Serious[e]	No serious inconsistency	Serious[b]	No serious imprecision[hf]	None	10/17 (58.8%)	1/19 (5.3%)	Peto OR 11.64 (2.87 to 47.21)	540 more per 1000(from 280 more to 790 more)	Low	Important
Backboard versus backboard + blanket- Comfort (VAS 10cm) (Better indicated by higher values)												
1	Randomised	Very	No serious	Serious[b]	No serious	None	22	22	-	MD 2.50 lower	Very	Important

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Control**	**Exp**	**Relative (95% CI)**	**Absolute**		
	trials	serious [a]	inconsistency		imprecision					(3.17 lower to 1.83 lower)	low	
backboard versus backboard + mattress - Comfort (VAS 10cm) (Better indicated by higher values)												
1	Randomised trials	Very serious [a]	No serious inconsistency	Serious [b]	No serious imprecision	None	22	22	-	MD 6.2 lower (6.77 to 5.63 lower)	Very low	Important
backboard versus backboard + mattress + eggcrate foam- Comfort - (VAS 10cm) (Better indicated by higher values)												
1	Randomised trials	Very serious [a]	No serious inconsistency	Serious [b]	No serious imprecision	None	22	22	-	MD 8.8 lower (9.47 to 8.13 lower)	Very low	Important
backboard + mattress versus backboard + blanket - Comfort - (VAS 10cm) (Better indicated by higher values)												
1	Randomised trials	Very serious [a]	No serious inconsistency	Serious [b]	No serious imprecision	None	22	22	-	MD 3.7 higher (2.83 to 4.57 higher)	Very low	Important
backboard + mattress versus backboard + mattress + eggcrate foam - Comfort - (VAS 10cm) (Better indicated by higher values)												
1	Randomised trials	Very serious [a]	No serious inconsistency	Serious [b]	No serious imprecision	None	22	22	-	MD 2.6 lower (3.47 to 1.73 lower)	Very low	Important
backboard + blanket versus backboard + mattress + eggcrate foam - Comfort - (VAS 10cm) (Better indicated by higher values)												
1	Randomised trials	Very serious [a]	No serious inconsistency	Serious [b]	No serious imprecision	None	22	22	-	MD 6.3 lower (7.23 to 5.37 lower)	Very low	Important

(a) Very small study (n=22), unclear randomisation,, missing data not reported, washout period not reported
(b) Population of healthy volunteers
(c) Small study (n=48), randomisation not clear, missing data not reported, duration of intervention and washout not reported
(d) Small study (n=30), randomisation unclear, duration of washout not reported
(e) Small study (n=37), randomisation unclear, missing data not reported
(f) Confidence interval crosses the MID in one direction making the result uncertain

(g) Confidence interval crosses the MID in both directions making the result very uncertain
(h) Imprecision could not be calculated

Table 83: Clinical evidence profile: Unpadded versus padded head supports

Quality assessment							No of patients		Effect			
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Unpadded**	**Padded head blocks**	**Relative (95% CI)**	**Absolute**	**Quality**	**Importance**
Mortality at 1, 6 and 12 months												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Health related quality of life												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Rates of spinal cord injury (SCI)												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Missed spinal column/ cord injury												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Spinal cord neurological function at 1, 6 and 12 months (ASIA and Frankel)												
0	-	-	-	-	-	-	-	-	-	-	-	Critical
Pain (number of people reporting)- immediately following intervention - Head (rear)												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	14/39 (35.9%)	10/39 (25.6%)	RR 1.4 (0.71 to 2.76)	103 more per 1000 (from 74 fewer to 451 more)	Very low	Important
Pain (number of people reporting)- immediately following intervention – Neck												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Serious[d]	None	9/39 (23.1%)	15/39 (38.5%)	RR 0.6 (0.3 to 1.2)	154 fewer per 1000	Very low	Important

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	Unpadded	Padded head blocks	Relative (95% CI)	Absolute		
										(from 269 fewer to 77 more)		
Pain (number of people reporting)- immediately following intervention - Shoulder												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	2/39 (5.1%)	3/39 (7.7%)	RR 0.67 (0.12 to 3.77)	25 fewer per 1000 (from 68 fewer to 213 more)	Very low	Important
Pain (number of people reporting)- immediately following intervention - Lumbar												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Serious[d]	None	19/39 (48.7%)	13/39 (33.3%)	RR 1.46 (0.84 to 2.53)	153 more per 1000 (from 53 fewer to 510 more)	Very low	Important
Pain (number of people reporting)- immediately following intervention – Buttock												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Serious[d]	None	4/39 (10.3%)	10/39 (25.6%)	RR 0.4 (0.14 to 1.17)	154 fewer per 1000 (from 221 fewer to 44 more)	Very low	Important
Pain (number of people reporting)- immediately following intervention - Ankle												

Quality assessment							No of patients		Effect			
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Unpadded**	**Padded head blocks**	**Relative (95% CI)**	**Absolute**	**Quality**	**Importance**
1	Randomised trials	Serious [a]	No serious inconsistency	Serious [b]	Very serious [c]	None	3/39 (7.7%)	6/39 (15.4%)	RR 0.5 (0.13 to 1.86)	77 fewer per 1000 (from 134 fewer to 132 more)	Very low	Important
Pain (number of people reporting)- immediately following intervention - Head (front)												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious [b]	Very serious [c]	None	1/39 (2.6%)	1/39 (2.6%)	Peto OR 1.00 (0.06 to 16.28)	0 fewer per 1000 (from 70 fewer to 70 more)	Very low	Important
Pain (number of people reporting)- immediately following intervention - Arm												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious [b]	Very serious [c]	None	1/39 (2.6%)	1/39 (2.6%)	Peto OR 1.00 (0.06 to 16.28)	0 fewer per 1000 (from 70 fewer to 70 more)	Very low	Important
Pain (number of people reporting)- immediately following intervention – Thoracic												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious [b]	Very serious [c]	None	2/39 (5.1%)	1/39 (2.6%)	Peto OR 1.98 (0.20 to 19.64)	30 more per 1000 (from 60 fewer to 110 more)	Very low	Important
Pain (number of people reporting)- immediately following intervention – Thigh												

Quality assessment							No of patients		Effect			
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Unpadded**	**Padded head blocks**	**Relative (95% CI)**	**Absolute**	**Quality**	**Importance**
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	2/39 (5.1%)	1/39 (2.6%)	Peto OR 1.98 (0.20 to 19.64	30 more per 1000 (from 60 fewer to 110 more)	Very low	Important
Pain (number of people reporting)- immediately following intervention - Knee												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	3/39 (7.7%)	1/39 (2.6%)	Peto OR 2.83 (0.38 to 20.90)	50 more per 1000 (from 50 fewer to 150 more)	Very low	Important
Pain (number of people reporting)- immediately following intervention - Calf												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	3/39 (7.7%)	1/39 (2.6%)	Peto OR 2.83 (0.38 to 20.90)	50 more per 1000 (from 50 fewer to 150 more)	Very low	Important
Pain (number of people reporting)- immediately following intervention - Feet												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	No serious imprecision[e]	None	0/39 (0%)	0/39 (0%)	Peto OR not estimable	0 more per 1000 (from 50 fewer to 50 more)	Low	Important
Pain (number of people reporting)- 24 hours following intervention – Neck												

Quality assessment							No of patients		Effect			
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Unpadded**	**Padded head blocks**	**Relative (95% CI)**	**Absolute**	**Quality**	**Importance**
1	Randomised trials	serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	3/39 (7.7%)	5/39 (12.8%)	RR 0.6 (0.15 to 2.34)	51 fewer per 1000 (from 109 fewer to 172 more)	Very low	Important
Pain (number of people reporting)- 24 hours following intervention - Thoracic												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	2/39 (5.1%)	2/39 (5.1%)	RR 1 (0.15 to 6.75)	0 fewer per 1000 (from 44 fewer to 295 more)	Very low	Important
Pain (number of people reporting)- 24 hours following intervention - Lumbar												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	No serious imprecision	None	4/399 (1%)	6/39 (15.4%)	RR 0.07 (0.02 to 0.22)	143 fewer per 1000 (from 120 fewer to 151 fewer)	Low	Important
Pain (number of people reporting)- 24 hours following intervention - Head (front)												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	0/39 (0%)	1/39 (2.6%)	Peto OR 0.14 (0.00 to	30 fewer per 1000 (from 90 fewer to	Very low	Important

Quality assessment							No of patients		Effect			
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	Unpadded	Padded head blocks	Relative (95% CI)	Absolute	Quality	Importance
									6.82)	49 more		
Pain (number of people reporting)- 24 hours following intervention - Head (rear)												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	3/39 (7.7%)	1/39 (2.6%)	Peto OR 2.83 (0.38 to 20.90)	50 more per 1000 (from 50 fewer to 150 more)	Very low	Important
Pain (number of people reporting)- 24 hours following intervention – Shoulder												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	0/39 (0%)	1/39 (2.6%)	Peto OR 0.14 (0.00 to 6.82)	30 fewer per 1000 (from 90 fewer to 40 more)	Very low	Important
Pain (number of people reporting)- 24 hours following intervention – Arm												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	0/39 (0%)	1/39 (2.6%)	Peto OR 0.14 (0.00 to 6.82)	30 fewer per 1000 (from 90 fewer to 40 more)	Very low	Important
Pain (number of people reporting)- 24 hours following intervention – Buttock												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	0/39 (0%)	2/39 (5.1%)	Peto OR 0.13 (0.01 to 2.15)	50 fewer per 1000 (from 130 fewer to 30 more)	Very low	Important

Quality assessment							No of patients		Effect			
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Unpadded**	**Padded head blocks**	**Relative (95% CI)**	**Absolute**	**Quality**	**Importance**
Pain (number of people reporting)- 24 hours following intervention – Thigh												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	3/39 (7.7%)	0/39 (0%)	Peto OR 7.79 (0.79 to 77.21)	80 more per 1000 (from 20 fewer to 170 more)	Very low	Important
Pain (number of people reporting)- 24 hours following intervention – Knee												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	1/39 (2.6%)	2/39 (5.1%)	Peto OR 0.5 (0.05 to 5.00)	30 fewer per 1000 (from 110 fewer to 60 more)	Very low	Important
Pain (number of people reporting)- 24 hours following intervention – Calf												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	1/39 (2.6%)	0/39 (0%)	Peto OR 7.39 (0.15 to 372.38)	30 more per 1000 (from 40 fewer to 90 more)	Very low	Important
Pain (number of people reporting)- 24 hours following intervention – Ankle												
1	Randomised trials	Serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	0/ 39 (0%)	0/39 (0%)	Peto OR not estimable	0 more per 1000 (from 50 fewer to 50 more)	Very low	Important
Pain (number of people reporting)- 24 hours following intervention – Feet												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	Unpadded	Padded head blocks	Relative (95% CI)	Absolute		
1	Randomised trials	serious [a]	No serious inconsistency	Serious[b]	Very serious[c]	None	1/39 (2.6%)	1/39 (2.6%)	Peto OR 1.00 (0.06 to 16.28)	0 more per 1000 (from 70 fewer to 70 more)	Very low	Important

(a) Small study (n=39), randomisation not reported, washout time unclear
(b) Population of healthy volunteers
(c) Confidence interval crosses MID in both directions making the result very uncertain
(d) Confidence interval crosses the MID in one direction making the result uncertain
(e) Imprecision could not be assessed

H.2 Destination (immediate)

H.2.1 Spinal Cord

Table 84: Clinical evidence profile: Level I versus level II ACS trauma centre

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	ACS level I	ACS level II	Relative (95% CI)	Absolute		
Health related quality of life – no data												
Missed diagnosis – no data												
Length of hospital stay – no data												
Discharge destination – no data												
Patient reported outcomes – no data												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	ACS level I	ACS level II	Relative (95% CI)	Absolute		
Mortality1												
1	Observational studies	Serious [a]	No serious inconsistency	No serious indirectness	Serious [b]	None	161/648 (24.8%) [c]	64/244 (26.2%) [c]	OR 0.85 (0.59 to 1.2) [d]	30 fewer per 1000 (from 89 fewer to 37 more)	Very low	Critical
Incidence of severe disability (assessed with: Functional independence measure total < 9)1												
1	Observational studies	Serious [a]	No serious inconsistency	No serious indirectness	Very serious [e]	None	151/189 (79.9%) [c]	108/131 (82.4%) [c]	OR 0.69 (0.38 to 1.27) [f]	60 fewer per 1000 (from 184 fewer to 32 more)	Very low	Critical

(a) Retrospective
(b) The 95%CI crosses upper or lower minimally important difference (MID)
(c) Unadjusted
(d) Adjusted for age, gender, mechanism of injury, hypotension on admission and injury severity score
(e) The 95%CI crosses both MIDs
(f) Adjusted for age, gender, mechanism, admission hypotension, head injury and injury severity score

H.3 Neuroprotective pharmacological interventions

Table 85: Clinical evidence profile: High-dose methylprednisolone versus placebo/no treatment

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	High-dose Methylprednisolone (24 hours)	None	Relative (95% CI)	Absolute		

Quality of life												
No evidence found												
All-cause mortality at six months												
3	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[c]	None	8/266 (3%)	15/264 (5.7%)	RR 0.54 (0.24 to 1.25)	26 fewer per 1000 (from 43 fewer to 14 more)	LOW	CRITICAL
Motor function at six weeks - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
2	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	216	203	-	MD 1.53 higher (0.53 lower to 3.59 higher)	HIGH	CRITICAL
Motor function at six months - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
2	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	214	200	-	MD 0.85 higher (1.79 lower to 3.49 higher)	HIGH	CRITICAL
Motor function at one year - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	138	147	-	MD 0.86 lower (4.62 lower to 2.9 higher)	HIGH	CRITICAL
Motor function at six weeks <8 hours to treatment (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
2	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Serious[b]	None	134	115	-	MD 3.19 higher (0.44 to 5.94 higher)	LOW	CRITICAL
Motor function at six months <8 hours to treatment (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
2	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Serious[b]	None	135	115	-	MD 4.44 higher (0.96 to 7.93 higher)	LOW	CRITICAL

Motor function at one year <8 hours to treatment (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Serious[b]	None	62	65	-	MD 5.2 higher (0.53 to 9.87 higher)	LOW	CRITICAL
Motor function at one year <8 hours to treatment (ASIA score) (Range of scores: 0-100; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[b]	None	27	23	-	MD 5.7 lower (20.12 lower to 8.72 higher)	MODERATE	CRITICAL
Pinprick sensation at six weeks – all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
2	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	214	200	-	MD 1.55 higher (0.27 lower to 3.36 higher)	HIGH	CRITICAL
Pinprick sensation at six months – all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
2	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[b]	None	213	199	-	MD 3.31 higher (1.17 to 5.46 higher)	MODERATE	CRITICAL
Pinprick sensation at one year – all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	138	146	-	MD 0.18 higher (2.69 lower to 3.05 higher)	HIGH	CRITICAL
Pinprick sensation at Six Weeks <8 hours to treatment (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
2	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	No serious imprecision	None	134	115	-	MD 1.95 higher (0.41 lower to 4.32 higher)	MODERATE	CRITICAL
Pinprick sensation at Six Months <8 hours to treatment (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												

2	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Serious[b]	None	135	115	-	MD 3.97 higher (1.27 to 6.66 higher)	LOW	CRITICAL
Pinprick sensation at One Year <8 hours to treatment (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Serious[b]	None	62	65	-	MD 2.41 higher (1.72 lower to 6.54 higher)	LOW	CRITICAL
Pinprick sensation at one year <8 hours to treatment (ASIA score) (Range of scores: 0-100; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[c]	None	27	23	-	MD 0 higher (20.72 lower to 20.72 higher)	LOW	CRITICAL
Touch Sensation at Six Weeks - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
2	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	214	199	-	MD 1.9 higher (0.04 lower to 3.85 higher)	HIGH	CRITICAL
Touch Sensation at Six Months – all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
2	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[b]	None	212	199	-	MD 3.04 higher (0.84 to 5.24 higher)	MODERATE	CRITICAL
Touch Sensation at One Year – all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	137	145	-	MD 0.69 higher (2.21 lower to 3.59 higher)	HIGH	CRITICAL
Touch Sensation at Six Weeks <8 weeks to treatment (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
2	Randomise	Serious[a]	No serious	No serious	Serious[b]	None	134	115	-	MD 2.55 higher (0.07 to	LOW	CRITICAL

	d trials		inconsistency	indirectness						5.04 higher)		
Touch Sensation at Six Months <8 weeks to treatment (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
2	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Serious[b]	None	135	115	-	MD 3.85 higher (1.13 to 6.57 higher)	LOW	CRITICAL
Touch Sensation at One Year <8 weeks to treatment (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Serious[b]	None	62	65	-	MD 3.38 higher (0.91 lower to 7.67 higher)	LOW	CRITICAL
Touch sensation at one year <8 weeks to treatment (ASIA score) (Range of scores: 0-100; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[b]	None	27	23	-	MD 2.9 higher (15.36 lower to 21.16 higher)	MODERATE	CRITICAL
Adverse effects - Pneumonia at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[c]	None	44/156 (28.2%)	46/167 (27.5%)	RR 1.02 (0.72 to 1.45)	6 more per 1000 (from 77 fewer to 124 more)	LOW	CRITICAL
Adverse effects - Hyperglycaemia at six weeks												
1	Randomised trials	Very serious[d]	No serious inconsistency	No serious indirectness	No serious imprecision	None	16/35 (45.7%)	1/30 (3.3%)	RR 13.71 (1.93 to 97.42)	424 more per 1000 (from 31 more to 1000 more)	MODERATE	CRITICAL
Adverse effects - GI haemorrhage at six weeks												
3	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[b]	None	12/214 (5.6%)	5/220 (2.3%)	RR 2.22 (0.85 to 5.8)	28 more per 1000 (from 3 fewer to 109 more)	MODERATE	CRITICAL

Adverse effects - Pulmonary embolus at six weeks											
2	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	13/179 (7.3%)	3/190 (1.6%)	RR 4.5 (1.32 to 15.4)	55 more per 1000 (from 5 more to 227 more)	HIGH	CRITICAL
Adverse effects - Wound infection at six weeks											
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[c]	None	11/156 (7.1%)	6/167 (3.6%)	RR 1.96 (0.74 to 5.18)	34 more per 1000 (from 9 fewer to 150 more)	LOW	CRITICAL
Adverse effects - UTI at six weeks											
2	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[b]	None	79/191 (41.4%)	81/201 (40.3%)	RR 1.05 (0.83 to 1.33)	20 more per 1000 (from 69 fewer to 133 more)	MODERATE	CRITICAL
Adverse effects - Sepsis at six weeks											
3	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[c]	None	14/220 (6.4%)	12/224 (5.4%)	RR 1.18 (0.56 to 2.47)	10 more per 1000 (from 24 fewer to 79 more)	LOW	CRITICAL

(a) The majority of evidence was from studies at high risk of bias
(b) Confidence interval crossed one MID
(c) Confidence interval crossed both MIDs

Table 86: Clinical evidence profile: Moderate dose methylprednisolone versus low-dose methylprednisolone

Quality assessment							No of patients		Effect			
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Moderate**	**Control**	**Relative (95% CI)**	**Absolute**	**Quality**	**Importance**
Quality of life												

No evidence found												
All-cause mortality at one year												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[a]	None	19/165 (11.5%)	13/165 (7.9%)	RR 1.46 (0.75 to 2.86)	36 more per 1000 (from 20 fewer to 147 more)	MODERATE	CRITICAL
Motor function at six weeks - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	125	133	-	MD 0.6 lower (4.44 lower to 3.24 higher)	HIGH	CRITICAL
Motor function at six months - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	91	88	-	MD 0.9 lower (5.38 lower to 3.58 higher)	HIGH	CRITICAL
Motor function at one year - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	115	108	-	MD 0.46 higher (3.11 lower to 4.03 higher)	HIGH	CRITICAL
Pinprick sensation at six weeks - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	125	133	-	MD 0.9 higher (3.28 lower to 5.08 higher)	HIGH	CRITICAL
Pinprick sensation at six months - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	91	88	-	MD 0.5 lower (4.79 lower to 3.79 higher)	HIGH	CRITICAL
Pinprick sensation at one year - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	115	108	-	MD 1.67 lower (4.76	HIGH	CRITICAL

										lower to 1.42 higher)		
Touch sensation at six weeks - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	125	133	-	SMD 0.4 higher (3.43 lower to 4.23 higher)	HIGH	CRITICAL
Touch sensation at six months - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	91	88	-	MD 0 higher (4.26 lower to 4.26 higher)	HIGH	CRITICAL
Touch sensation at one year - all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	115	108	-	MD 0.25 higher (2.68 lower to 3.18 higher)	HIGH	CRITICAL
Adverse effects - Pneumonia at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[b]	None	27/151 (17.9%)	29/153 (19%)	RR 0.94 (0.59 to 1.51)	11 fewer per 1000 (from 78 fewer to 97 more)	LOW	CRITICAL
Adverse effects - GI haemorrhage at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[b]	None	15/151 (9.9%)	13/153 (8.5%)	RR 1.17 (0.58 to 2.37)	14 more per 1000 (from 36 fewer to 116 more)	LOW	CRITICAL
Adverse effects - Pulmonary embolus at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[b]	None	7/151 (4.6%)	4/153 (2.6%)	RR 1.77 (0.53 to 5.93)	20 more per 1000 (from 12 fewer to 129 more)	LOW	CRITICAL

Adverse effects - Wound infection at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[a]	None	14/151 (9.3%)	4/153 (2.6%)	RR 3.55 (1.19 to 10.53)	67 more per 1000 (from 5 more to 249 more)	MODERATE	CRITICAL
Adverse effects - UTI at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[a]	None	53/151 (35.1%)	46/153 (30.1%)	RR 1.17 (0.84 to 1.62)	51 more per 1000 (from 48 fewer to 186 more)	MODERATE	CRITICAL
Adverse effects - Sepsis at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[b]	None	13/151 (8.6%)	8/153 (5.2%)	RR 1.65 (0.7 to 3.86)	34 more per 1000 (from 16 fewer to 150 more)	LOW	CRITICAL

(a) The majority of evidence was from studies at high risk of bias
(b) Confidence interval crossed one MID
(c) Confidence interval crossed both MIDs

Table 87: Clinical evidence profile: High-dose methylprednisolone (48 hours) versus high-dose methylprednisolone (24 hours)

Quality assessment							No of patients		Effect			
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**High-dose Methylprednisolone for 48 hours**	**24 hours**	**Relative (95% CI)**	**Absolute**	**Quality**	**Importance**
Quality of life												
No evidence found												
All-cause mortality at one year												
1	Randomised trials	No serious	No serious inconsistency	No serious indirectness	Very serious[a]	None	10/166 (6%)	9/166 (5.4%)	RR 1.11 (0.46 to	6 more per 1000 (from	LOW	CRITICAL

		risk of bias							2.66)	29 fewer to 90 more)		
Motor function at six weeks, <8hours to treatment(NASCIS score) (range of scores: 0-70; better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	154	151	-	MD 2.81 higher (0.62 lower to 6.24 higher)	HIGH	CRITICAL
Motor function at six months, <8hours to treatment (NASCIS score) (range of scores: 0-70; better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	149	142	-	MD 3.37 higher (0.54 lower to 7.28 higher)	HIGH	CRITICAL
Motor function at one year, <8hours to treatment (NASCIS score) (range of scores: 0-70; better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	141	145	-	MD 2.35 higher (1.75 lower to 6.45 higher)	HIGH	CRITICAL
Pinprick sensation at six weeks, <8hours to treatment (NASCIS score) (range of scores: 0-70; better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	154	151	-	MD 1.39 higher (1.55 lower to 4.33 higher)	HIGH	CRITICAL
Pinprick sensation at six months, <8hours to treatment (NASCIS score) (range of scores: 0-70; better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	149	142	-	MD 0.42 higher (2.57 lower to 3.41 higher)	HIGH	CRITICAL
Pinprick sensation at one year, <8hours to treatment (NASCIS score) (range of scores: 0-70; better indicated by higher values)												
1	Randomised trials	No serious risk of	No serious inconsistency	No serious indirectness	No serious imprecision	None	141	145	-	MD 0.4 higher (2.7 lower to 3.5	HIGH	CRITICAL

		bias								higher)		
Touch sensation at six weeks, <8hours to treatment (NASCIS score) (range of scores: 0-70; better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	154	151	-	MD 1.72 higher (1.26 lower to 4.7 higher)	HIGH	CRITICAL
Touch sensation at six months, <8hours to treatment (NASCIS score) (range of scores: 0-70; better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	149	142	-	MD 0.89 higher (2.23 lower to 4.01 higher)	HIGH	CRITICAL
Touch sensation at one year, <8hours to treatment (NASCIS score) (range of scores: 0-70; better indicated by higher values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	No serious imprecision	None	141	145	-	MD 1 higher (2.1 lower to 4.1 higher)	HIGH	CRITICAL
Adverse effects - pneumonia at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[a]	None	26/154 (16.9%)	23/154 (14.9%)	RR 1.13 (0.68 to 1.89)	19 more per 1000 (from 48 fewer to 133 more)	LOW	CRITICAL
Adverse effects - haemorrhage at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[a]	None	3/154 (1.9%)	0/154 (0%)	RR 7.0 (0.36 to 134.39)	-	LOW	CRITICAL
Adverse effects - pulmonary embolus at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[a]	None	2/154 (1.3%)	2/154 (1.3%)	RR 1 (0.14 to 7.01)	0 fewer per 1000 (from 11 fewer to 78 more)	LOW	CRITICAL

Adverse effects - wound infection at six weeks											
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[a]	None	7/154 (4.5%)	4/154 (2.6%)	RR 1.75 (0.52 to 5.86)	19 more per 1000 (from 12 fewer to 126 more)	LOW	CRITICAL
Adverse effects - UTI at six weeks											
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[b]	None	59/154 (38.3%)	53/154 (34.4%)	RR 1.11 (0.83 to 1.5)	38 more per 1000 (from 59 fewer to 172 more)	MODERATE	CRITICAL
Adverse effects - sepsis at six weeks											
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[a]	None	11/154 (7.1%)	7/154 (4.5%)	RR 1.57 (0.63 to 3.95)	26 more per 1000 (from 17 fewer to 134 more)	LOW	CRITICAL

(a) Confidence interval crossed both MIDs
(b) Confidence interval crossed one MID

Table 88: Clinical evidence profile: High-dose methylprednisolone plus nimodipine versus no treatment/placebo

Quality assessment							No of patients		Effect			
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**High-dose Methylprednisolone (24 hours) plus nimodipine**	**None**	**Relative (95% CI)**	**Absolute**	**Quality**	**Importance**
Mortality												
No evidence found												
Quality of life												
No evidence found												
Motor function at one year: all patients (ASIA score) (Range of scores: 0-100; Better indicated by higher values)												

1	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Serious[b]	None	26	23	-	MD 8.1 lower (23.28 lower to 7.08 higher)	LOW	CRITICAL
Pinprick sensation at one year: all patients (ASIA score) (Range of scores: 0-100; Better indicated by higher values)												
1	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Very serious[c]	None	26	23	-	MD 1 lower (21.98 lower to 19.98 higher)	VERY LOW	CRITICAL
Touch sensation at one year: all patients (ASIA score) (Range of scores: 0-100; Better indicated by higher values)												
1	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Very serious[c]	None	26	23	-	MD 1.8 lower (21.04 lower to 17.44 higher)	VERY LOW	CRITICAL

(a) The majority of evidence was from studies at high risk of bias
(b) Confidence interval crossed one MID
(c) Confidence interval crossed both MIDs

Table 89: Clinical evidence profile: Naloxone versus no treatment/placebo

Quality assessment							No of patients		Effect			
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Naloxone**	**None**	**Relative (95% CI)**	**Absolute**	**Quality**	**Importance**
Mortality												
No evidence found												
Quality of life												
No evidence found												
Neurological function												
No evidence found												
Motor function at one year: all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised	Serious[a]	Unable to	No serious	Unable to				Reported only as		Unable to	CRITICAL

	trials		assess	indirectness	assess				"not statistically significant"		assess	
Pinprick sensation at one year: all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	Serious[a]	Unable to assess	No serious indirectness	Unable to assess				Reported only as "not statistically significant"		Unable to assess	CRITICAL
Touch sensation at one year: all patients (NASCIS score) (Range of scores: 0-70; Better indicated by higher values)												
1	Randomised trials	Serious[a]	Unable to assess	No serious indirectness	Unable to assess				Reported only as "not statistically significant"		Unable to assess	CRITICAL
Adverse effects - Pneumonia at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[b]	None	46/154 (29.9%)	41/167 (24.6%)	RR 1.22 (0.85 to 1.74)	54 more per 1000 (from 37 fewer to 182 more)	MODERATE	CRITICAL
Adverse effects - GI haemorrhage at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[c]	None	3/154 (1.9%)	5/167 (3%)	RR 0.65 (0.16 to 2.68)	10 fewer per 1000 (from 25 fewer to 50 more)	LOW	CRITICAL
Adverse effects - Pulmonary embolus at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[b]	None	8/154 (5.2%)	2/167 (1.2%)	RR 4.34 (0.94 to 20.11)	40 more per 1000 (from 1 fewer to 229 more)	MODERATE	CRITICAL
Adverse effects - Wound infection at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious[b]	None	5/154 (3.2%)	6/167 (3.6%)	RR 0.9 (0.28 to 2.9)	4 fewer per 1000 (from 26 fewer to 68 more)	LOW	CRITICAL

Adverse effects - UTI at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[b]	None	76/154 (49.4%)	77/167 (46.1%)	RR 1.07 (0.85 to 1.35)	32 more per 1000 (from 69 fewer to 161 more)	MODERATE	CRITICAL
Adverse effects - Sepsis at six weeks												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[b]	None	10/154 (6.5%)	11/167 (6.6%)	RR 0.99 (0.43 to 2.26)	1 fewer per 1000 (from 38 fewer to 83 more)	MODERATE	CRITICAL

(a) The majority of evidence was from studies at high risk of bias
(b) Confidence interval crossed one MID
(c) Confidence interval crossed both MIDs

Table 90: Clinical evidence profile: Nimodipine versus no treatment/placebo

Quality assessment							No of patients		Effect Median score (IQ range)			
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Nimodipine**	**None**	**Nimodipine**	**None**	**Quality**	**Importance**
Mortality												
No evidence found												
Quality of life												
No evidence found												
Adverse events												
No evidence found												
Motor function at one year: all patients (ASIA score) (Range of scores: 0-100; Better indicated by higher values)												
1	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Very serious[b]	None	24	23	-	MD 1.7 lower (15.83 lower	VERY LOW	CRITICAL

										to 12.43 higher)		
Pinprick sensation at one year: all patients (ASIA score) (Range of scores: 0-100; Better indicated by higher values)												
1	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Very serious[b]	None	24	23	-	MD 0.4 lower (20.49 lower to 19.69 higher)	VERY LOW	CRITICAL
Touch sensation at one year: all patients (ASIA score) (Range of scores: 0-100; Better indicated by higher values)												
1	Randomised trials	Serious[a]	No serious inconsistency	No serious indirectness	Serious[c]	None	24	23	-	MD 4.2 lower (19.64 lower to 11.24 higher)	LOW	CRITICAL

(a) The majority of evidence was from studies at high risk of bias
(b) Confidence interval crossed both MIDs
(c) Confidence interval crossed one MID

H.4 Neuropathic pain

Table 91: Clinical evidence profile: Carbamazepine versus placebo

Quality assessment							No of patients		Effect			
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Carbamazepine**	**Placebo**	**Relative (95% CI)**	**Absolute**	**Quality**	**Importance**
Mortality at 6 months												
Not reported												Critical
Neuropathic pain absent or mild (VAS 0-39 mm) at 1 month												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious[a]	None	21/23 (91.3%)	13/21 (61.9%)	RR 1.47 (1.03 to 2.11)	291 more per 1000 (from 19	Moderate	Critical

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	Carbamazepine	Placebo	Relative (95% CI)	Absolute		
										more to 687 more)		
Neuropathic pain absent or mild (VAS 0-39 mm) at 6 months												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious [a]	None	17/23 (73.9%)	13/21 (61.9%)	RR 1.19 (0.79 to 1.81)	118 more per 1000 (from 130 fewer to 501 more)	Moderate	Critical
Neuropathic pain moderate to intense (VAS 40-100 mm) 1 month												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious [a]	None	2/23 (8.7%)	8/21 (38.1%)	RR 0.23 (0.05 to 0.96)	293 fewer per 1000 (from 15 fewer to 362 fewer)	Moderate	Critical
Neuropathic pain moderate to intense (VAS 40-100 mm) at 6 months												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious [b]	None	6/23 (26.1%)	8/21 (38.1%)	RR 0.68 (0.28 to 1.65)	122 fewer per 1000 (from 274 fewer to 248 more)	Low	Critical

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Carbamazepine**	**Placebo**	**Relative (95% CI)**	**Absolute**		
Quality of life at 6 months - bodily pain (better indicated by lower values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious [a]	None	23	21	-	MD 7.9 higher (9.03 lower to 24.83 higher)	Moderate	Critical
Quality of life at 6 months - emotional performance (better indicated by lower values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious [b]	None	23	21	-	MD 4.1 higher (21.52 lower to 29.72 higher)	Low	Critical
Quality of life at 6 months - physical performance (better indicated by lower values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious [b]	None	23	21	-	MD 1.3 higher (12.18 lower to 14.78 higher)	Low	Critical
Quality of life at 6 months - physical function (better indicated by lower values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious [a]	None	23	21	-	MD 7.4 higher (5.47 lower to 20.27 higher)	Moderate	Critical

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Carbamazepine**	**Placebo**	**Relative (95% CI)**	**Absolute**		
Quality of life at 6 months - social function (better indicated by lower values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious [a]	None	23	21	-	MD 6.4 higher (9.49 lower to 22.29 higher)	Moderate	Critical
Quality of life at 6 months - general health state (better indicated by lower values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious [b]	None	23	21	-	MD 1.8 higher (12.47 lower to 16.07 higher)	Low	Critical
Quality of life at 6 months - mental health (better indicated by lower values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious [b]	None	23	21	-	MD 1.3 lower (18.18 lower to 15.58 higher)	Low	Critical
Quality of life at 6 months - vitality (better indicated by lower values)												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious [a]	None	23	21	-	MD 5 higher (6.89 lower to 16.89 higher)	Moderate	Critical

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other**	**Carbamazepine**	**Placebo**	**Relative (95% CI)**	**Absolute**		
Adverse events – nausea												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious [b]	None	2/23 (8.7%)	1/21 (4.8%)	RR 1.83 (0.18 to 18.7)	40 more per 1000 (from 39 fewer to 843 more)	Low	Critical
Adverse events – vomiting												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious [b]	None	1/23 (4.3%)	0/21 (0%)	Peto OR 6.77 (0.13 to 342.4)	40 more per 1000 (from 70 fewer to 160 more)	Low	Critical
Adverse events - visual disturbance												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious [b]	None	0/23 (0%)	1/21 (4.8%)	Peto OR 0.12 (0 to 6.24)	42 fewer per 1000 (from 48 fewer to 190 more)	Low	Critical
Absence of depression at 6 months												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Serious [a]	None	13/23 (56.5%)	8/21 (38.1%)	RR 1.48 (0.77 to 2.85)	183 more per 1000 (from 88 fewer to 705	Moderate	Important

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	Carbama-zepine	Placebo	Relative (95% CI)	Absolute		
										more)		
Mild depression at 6 months												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious	None	3/23 (13%)	6/21 (28.6%)	RR 0.46 (0.13 to 1.6)	154 fewer per 1000 (from 249 fewer to 171 more)	Low	Important
Moderate depression at 6 months												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious [b]	None	3/23 (13%)	3/21 (14.3%)	RR 0.91 (0.21 to 4.04)	13 fewer per 1000 (from 113 fewer to 434 more)	Low	Important
Severe depression at 6 months												
1	Randomised trials	No serious risk of bias	No serious inconsistency	No serious indirectness	Very serious [b]	None	3/23 (13%)	4/21 (19%)	RR 0.68 (0.17 to 2.71)	61 fewer per 1000 (from 158 fewer to 326 more)	Low	Important

(a) 1 Confidence interval crossed one MID
(b) Confidence interval crossed both MIDs

Appendix I: Forest plots

I.1 Spinal injury assessment risk tools

I.1.1 Sensitivity and specificity for NEXUS decision tool

Figure 1: NEXUS decision tool in all adults with 95% confidence intervals

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
DUANE 2013	263	2633	61	2225	0.81 [0.76, 0.85]	0.46 [0.44, 0.47]
GRIFFITH 2011	37	1180	4	368	0.90 [0.77, 0.97]	0.24 [0.22, 0.26]
GRIFFITH 2013	5	421	0	81	1.00 [0.48, 1.00]	0.16 [0.13, 0.20]
HOFFMAN 2000	780	26518	8	3698	0.99 [0.98, 1.00]	0.12 [0.12, 0.13]
STIELL 2003	147	4599	15	2677	0.91 [0.85, 0.95]	0.37 [0.36, 0.38]

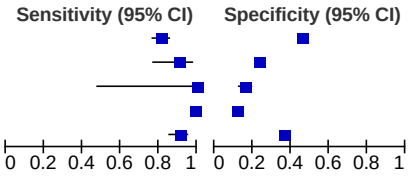


Figure 2: Summary sensitivity/1-specificity plot for NEXUS decision tool in all adults

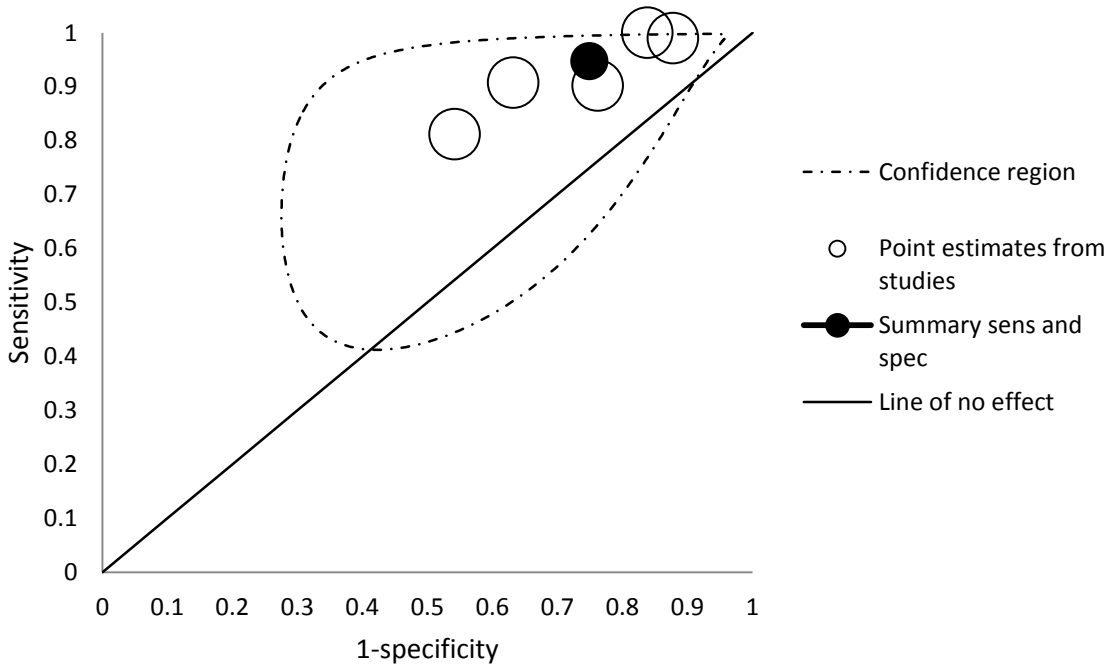


Figure 3: NEXUS decision tool in children with 95% confidence intervals

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
EHRLICH 2009	4	66	3	35	0.57 [0.18, 0.90]	0.35 [0.25, 0.45]
VICCELLIO 2001	30	2432	0	603	1.00 [0.88, 1.00]	0.20 [0.18, 0.21]

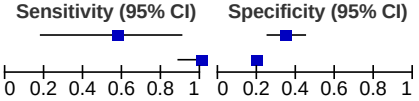


Figure 4: NEXUS decision tool in adults and children with 95% confidence intervals

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
HOFFMAN 1992	27	0	0	0	1.00 [0.87, 1.00]	Not estimable

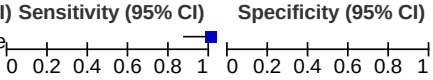


Figure 5: NEXUS decision tool in older adults (≥ 65) with 95% confidence intervals

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
TOUGER 2002	8	2522	0	413	1.00 [0.63, 1.00]	0.14 [0.13, 0.15]

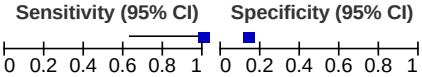


Figure 6: Pilot NEXUS decision tool in adults and children with 95% confidence intervals

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
HOFFMAN 1992	27	0	0	0	1.00 [0.87, 1.00]	Not estimable

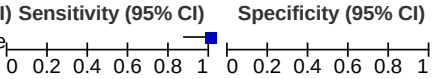
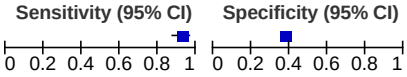


Figure 7: NEXUS approximations decision tool in adults with 95% confidence intervals

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
DICKINSON 2004	140	5461	11	3312	0.93 [0.87, 0.96]	0.38 [0.37, 0.39]



I.1.2 Sensitivity and specificity for CCR decision tool

Figure 8: Canadian C-spine Rule in all adults with 95% confidence intervals

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
COFFEY 2011	8	807	0	403	1.00 [0.63, 1.00]	0.33 [0.31, 0.36]
DUANE 2013	324	4828	0	30	1.00 [0.99, 1.00]	0.01 [0.00, 0.01]
STIELL 2001	151	5041	0	3732	1.00 [0.98, 1.00]	0.43 [0.42, 0.44]
STIELL 2003	161	3995	1	3281	0.99 [0.97, 1.00]	0.45 [0.44, 0.46]

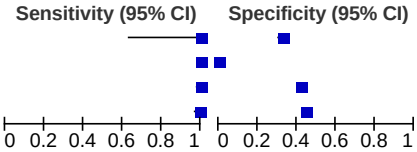


Figure 9: Canadian C-spine Rule in children with 95% confidence intervals

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
EHRLICH 2009	6	87	1	15	0.86 [0.42, 1.00]	0.15 [0.08, 0.23]

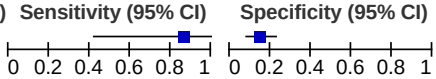


Figure 10: Modified Canadian C-spine Rule (minus neck rotation) in adults with 95% confidence intervals

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
DUANE 2011	130	1331	27	1118	0.83 [0.76, 0.88]	0.46 [0.44, 0.48]

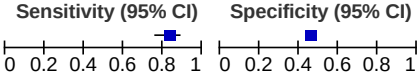
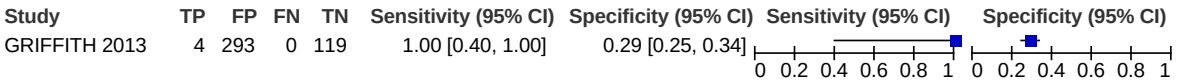


Figure 11: Modified Canadian C-spine Rule (minus low-risk factors) in adults with 95% confidence intervals



I.2 Immobilising the spine: pre-hospital strategies

I.2.1 Collar versus collar

Figure 12: Philadelphia versus Aspen collars in healthy volunteers: temperature (^{0}F)

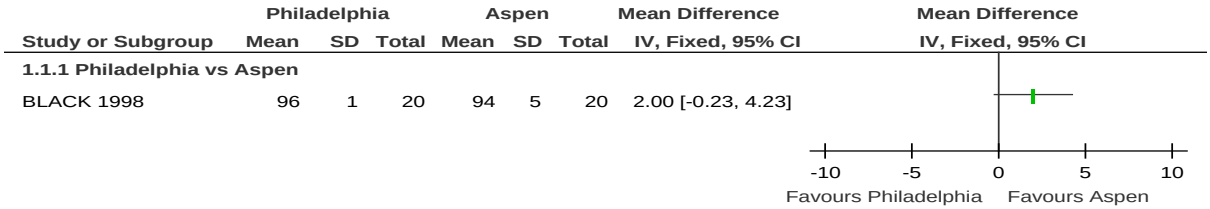


Figure 13: Philadelphia versus Aspen collars in healthy volunteers: % relative skin humidity

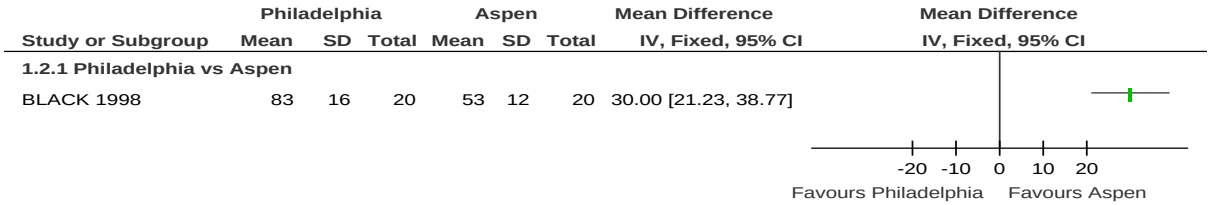
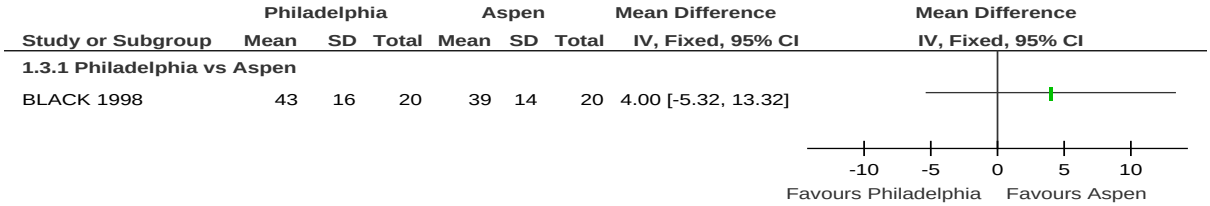


Figure 14: Philadelphia versus Aspen collars in healthy volunteers: Occipital pain (mmHg)



I.2.2 Board versus Board/vacuum mattress

Figure 15: Board versus vacuum in healthy populations: respiratory outcomes

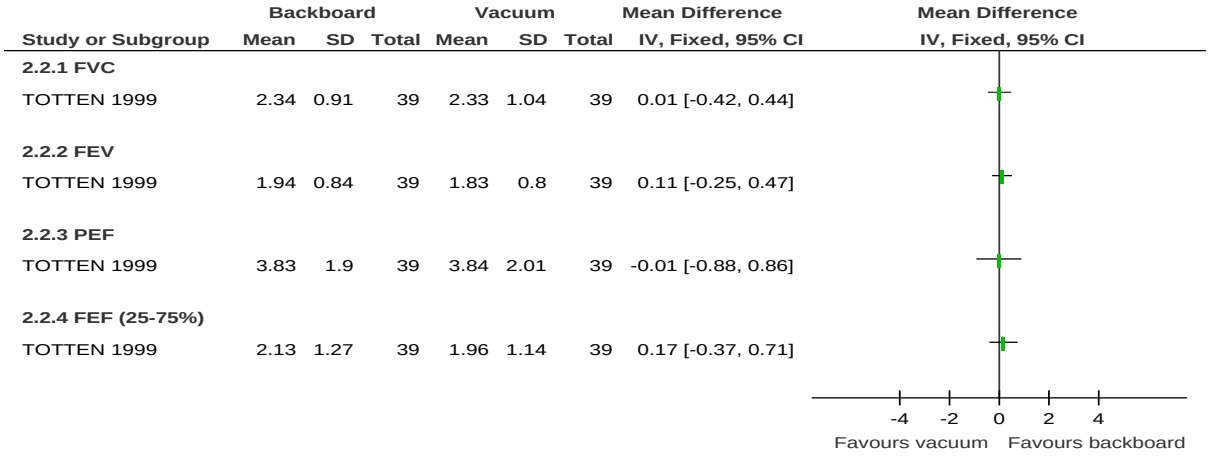


Figure 16: Board versus vacuum in healthy volunteers: comfort

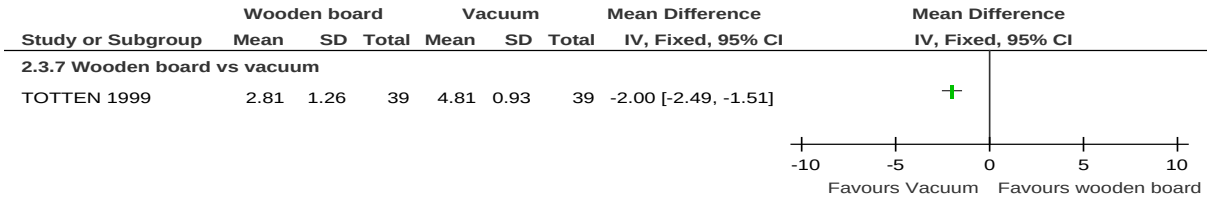


Figure 17: Padded board versus unpadded board in healthy population: pain (VAS)

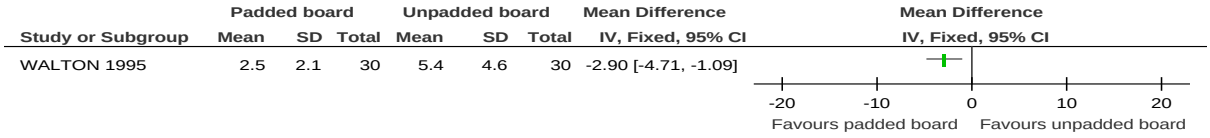


Figure 18: Backboard versus vacuum mattress in healthy population: pain (number of people reporting), (Risk Ratio)

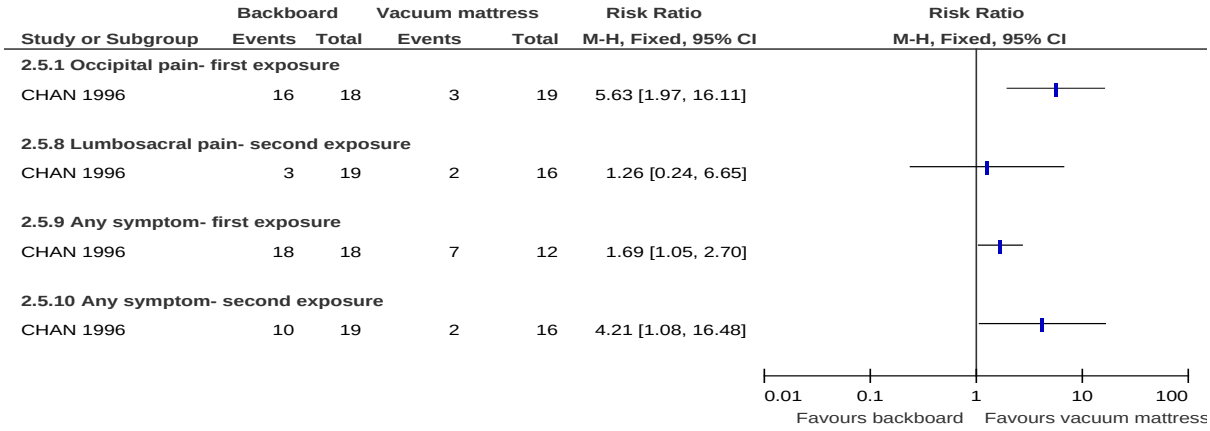


Figure 19: Backboard versus vacuum mattress in healthy population: pain (number of people reporting), (Peto Odds Ratio)

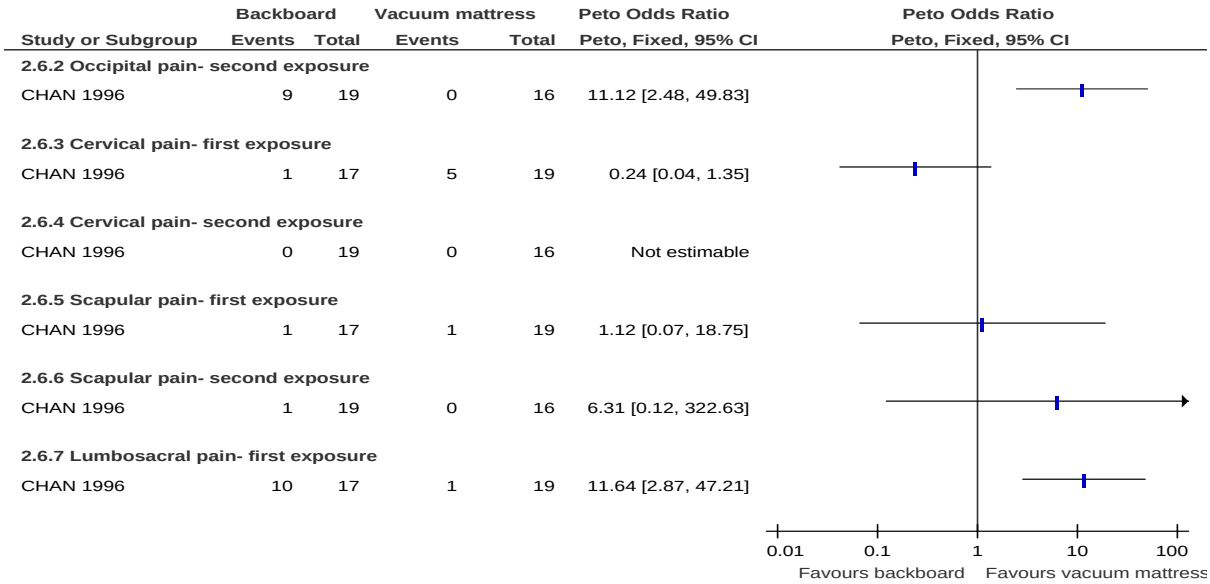


Figure 20: Backboard versus backboard + blanket: comfort (10cm VAS)

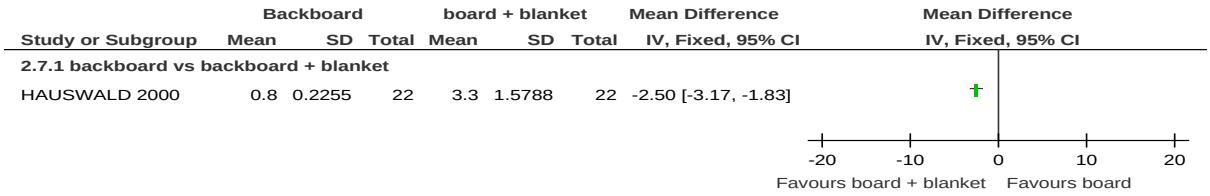


Figure 21: Backboard versus backboard + mattress: Comfort (10cm VAS)

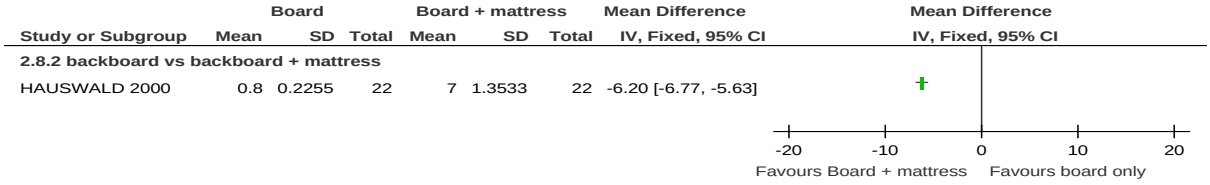


Figure 22: Backboard versus backboard + mattress + eggcrate foam: Comfort (10cm VAS)

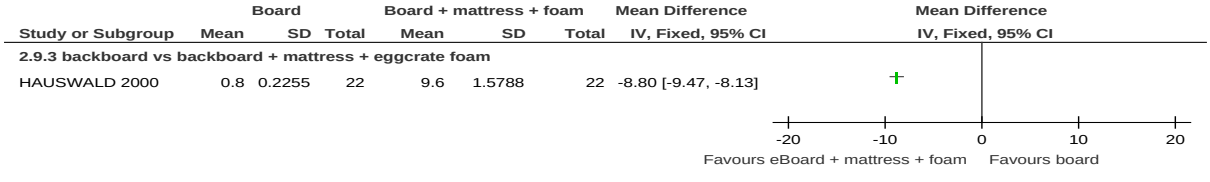


Figure 23: Backboard + mattress versus backboard + blanket: Comfort (10cm VAS)

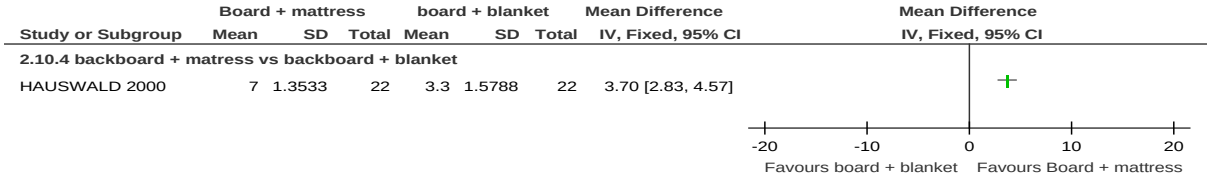


Figure 24: backboard + mattress versus backboard + mattress + eggcrate foam: Comfort (10cm VAS)

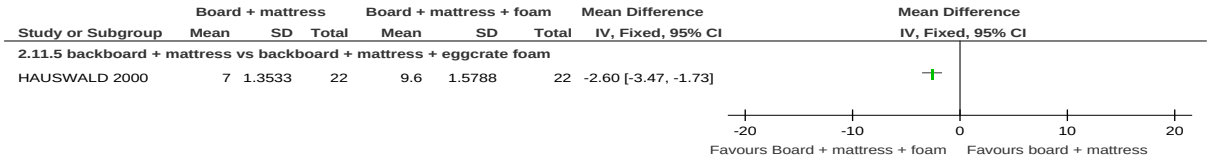
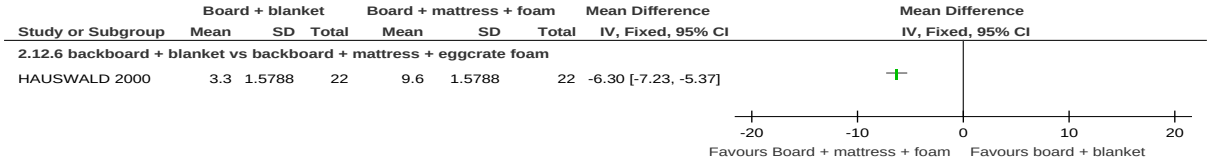


Figure 25: backboard + blanket versus backboard + mattress + eggcrate foam: Comfort (10cm VAS)



I.2.3 Head support

Figure 26: Unpadded versus padded head blocks in healthy populations: Pain (number of people reporting pain) immediately after intervention, (Risk Ratio)

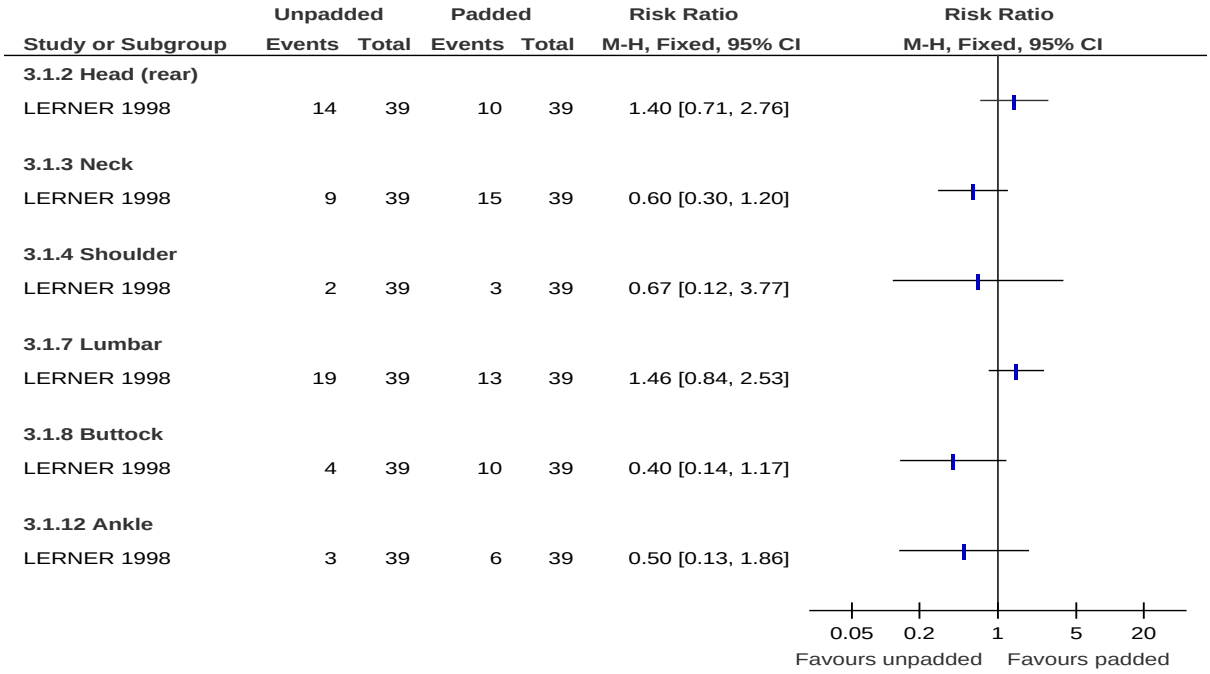


Figure 27: Unpadded versus padded head blocks in healthy populations: Pain (number of people reporting pain) immediately after intervention, (Peto Odds Ratio)

Study or Subgroup	Unpadded Events	Unpadded Total	Padded Events	Padded Total	Peto Odds Ratio Peto, Fixed, 95% CI
3.2.1 Head (front)					
LERNER 1998	1	39	1	39	1.00 [0.06, 16.28]
3.2.5 Arm					
LERNER 1998	1	39	1	39	1.00 [0.06, 16.28]
3.2.6 Thoracic					
LERNER 1998	2	39	1	39	1.98 [0.20, 19.64]
3.2.9 Thigh					
LERNER 1998	2	39	1	39	1.98 [0.20, 19.64]
3.2.10 Knee					
LERNER 1998	3	39	1	39	2.83 [0.38, 20.90]
3.2.11 Calf					
LERNER 1998	3	39	1	39	2.83 [0.38, 20.90]
3.2.13 Feet					
LERNER 1998	0	39	0	39	Not estimable

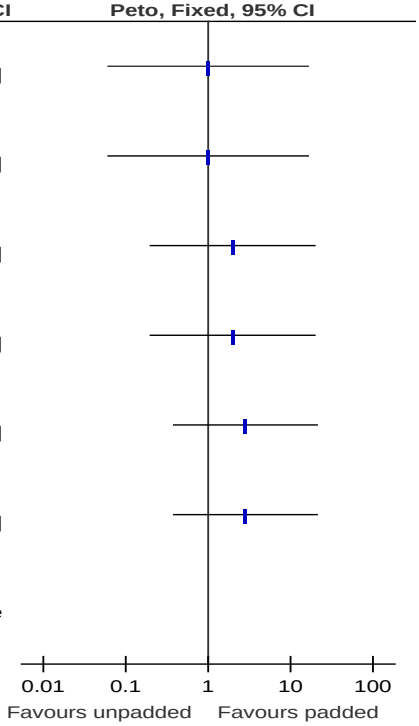


Figure 28: Unpadded versus padded head blocks in healthy populations: Pain (number of people reporting pain) immediately after intervention, (Risk Ratio)

Study or Subgroup	Unpadded Events	Unpadded Total	Padded Events	Padded Total	Risk Ratio M-H, Fixed, 95% CI
3.3.3 Neck					
LERNER 1998	3	39	5	39	0.60 [0.15, 2.34]
3.3.6 Thoracic					
LERNER 1998	2	39	2	39	1.00 [0.15, 6.75]
3.3.7 Lumbar					
LERNER 1998	4	399	6	39	0.07 [0.02, 0.22]

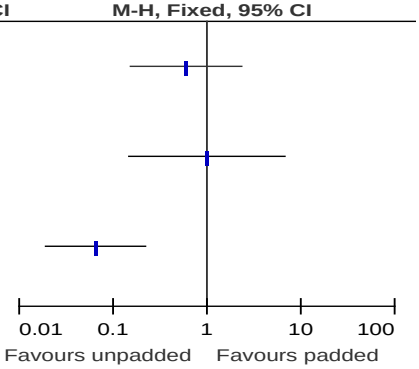
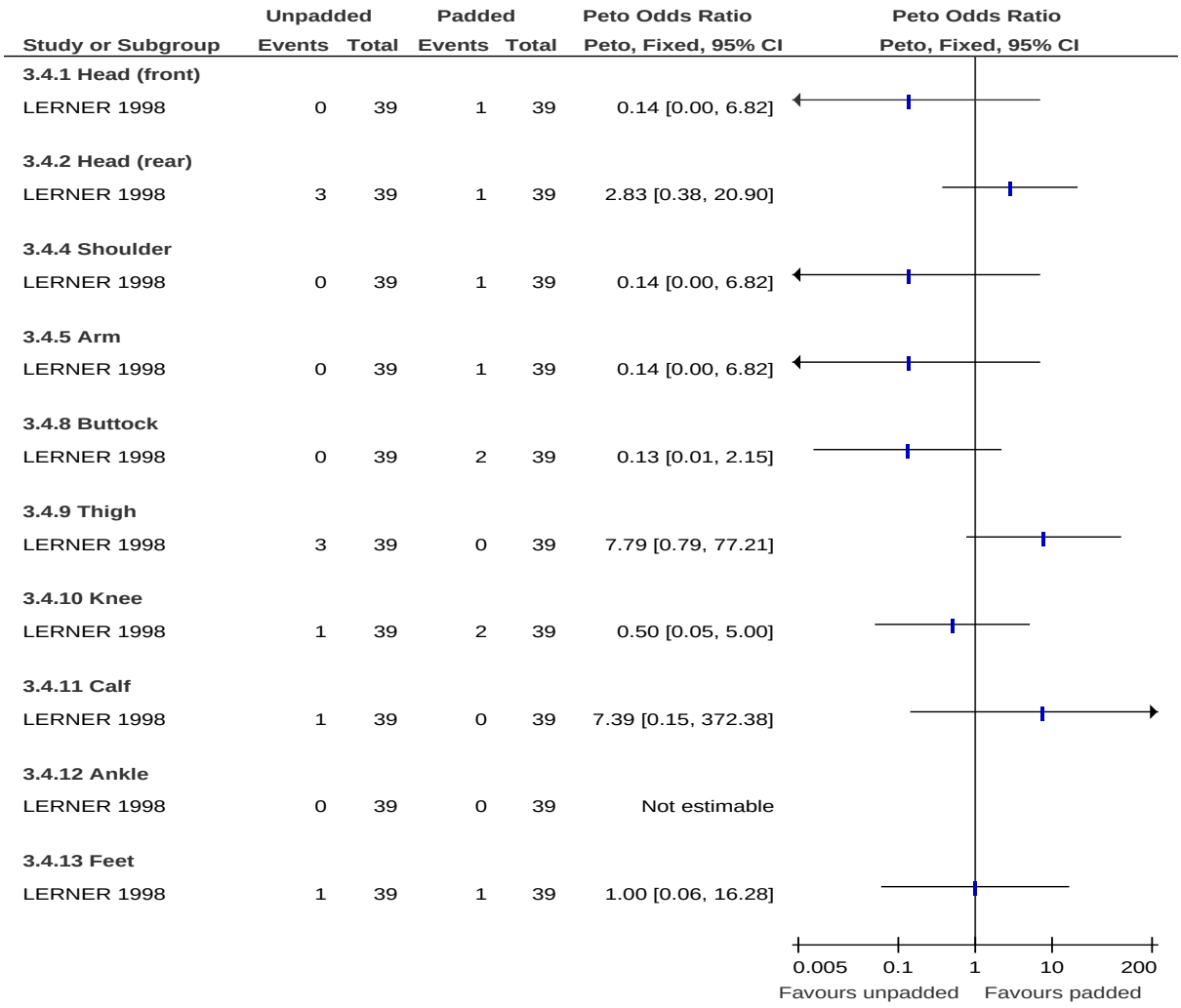


Figure 29: Unpadded versus padded head blocks in healthy populations: Pain (number of people reporting pain) immediately after intervention, (Peto Odds Ratio)



I.3 Destination (immediate)

I.3.1 Spinal Cord

I.3.1.1 Destination

Figure 30: ACS level I versus ACS level II, outcome: 1.1 Mortality.

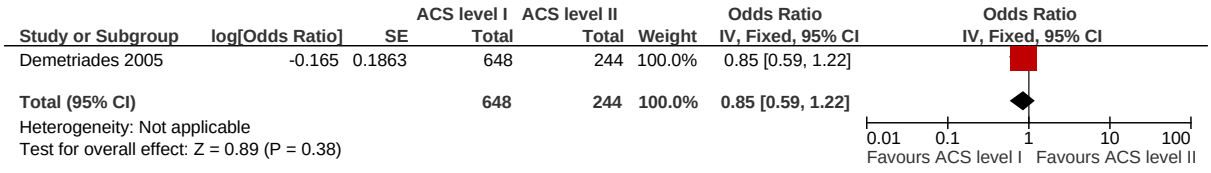
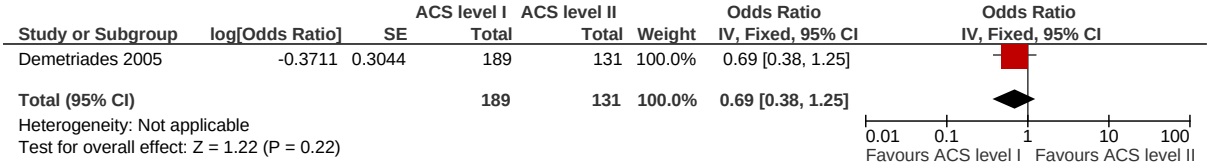


Figure 31: ACS level I versus ACS level II, outcome: 1.2 Incidence of severe disability.



I.4 Diagnostic imaging

The following forest plots are from studies that provided enough raw data; raw data was not available from all studies so some forest plots may not be present here.

Figure 32: Diagnostic accuracy of CT (ref standard MRI) for disc herniation in adults

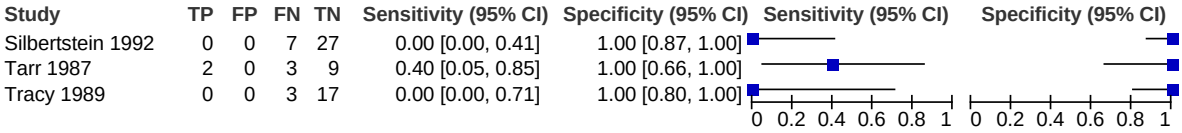


Figure 33: Diagnostic accuracy of CT (ref standard MRI) for extramedullary haematoma in adults

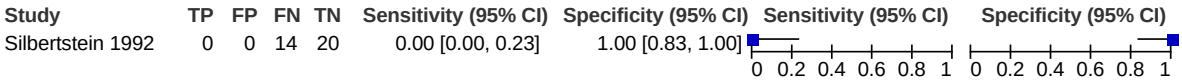


Figure 34: Diagnostic accuracy of CT (ref standard MRI) for epidural haematoma in adults

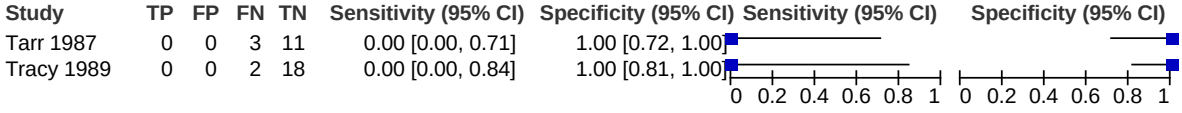


Figure 35: Diagnostic accuracy of CT (ref standard MRI) for spinal cord oedema/haemorrhage or haematoma in adults

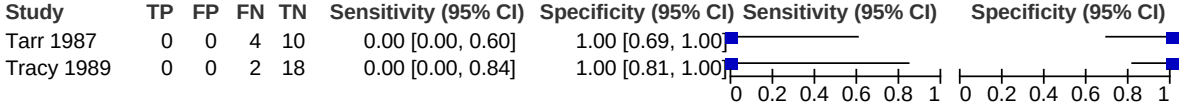


Figure 36: Diagnostic accuracy of CT (ref standard MRI) for cord transection in adults

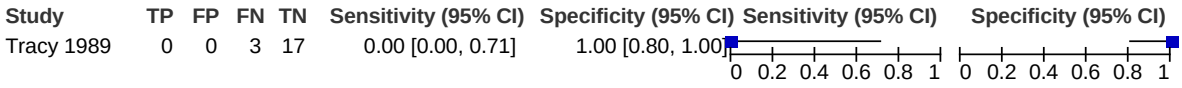


Figure 37: Diagnostic accuracy of CT (ref standard MRI) for cord compression / cord or thecal sac impingement in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Silbertstein 1992	0	0	12	12	0.00 [0.00, 0.26]	1.00 [0.74, 1.00]
Tarr 1987	2	0	2	10	0.50 [0.07, 0.93]	1.00 [0.69, 1.00]

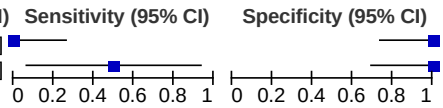


Figure 38: Diagnostic accuracy of X ray (ref standard CT) for cervical fractures in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Duane 2008	16	7	68	913	0.19 [0.11, 0.29]	0.99 [0.98, 1.00]
Lee 2001	12	0	24	0	0.33 [0.19, 0.51]	Not estimable
Takami 2014	10	0	6	0	0.63 [0.35, 0.85]	Not estimable

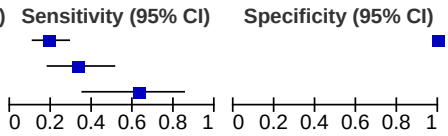


Figure 39: Diagnostic accuracy of X ray (ref standard CT) for cervical injuries in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Brohi 2005	44	21	17	339	0.72 [0.59, 0.83]	0.94 [0.91, 0.96]

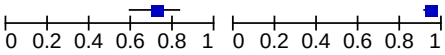


Figure 40: Diagnostic accuracy of X ray (ref standard MRI) for cervical ligament injuries in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Duane 2010	0	1	8	40	0.00 [0.00, 0.37]	0.98 [0.87, 1.00]

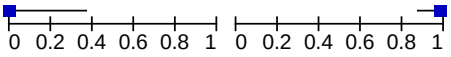


Figure 41: Diagnostic accuracy of X ray (ref standard discharge diagnosis) for cervical injuries in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Bailitz 2009	18	0	32	0	0.36 [0.23, 0.51]	Not estimable
Griffen 2003	75	0	41	0	0.65 [0.55, 0.73]	Not estimable
Hashem 2009	74	0	47	0	0.61 [0.52, 0.70]	Not estimable
Macdonald 1990	76	18	16	665	0.83 [0.73, 0.90]	0.97 [0.96, 0.98]
Mower 2001	498	0	320	0	0.61 [0.57, 0.64]	Not estimable

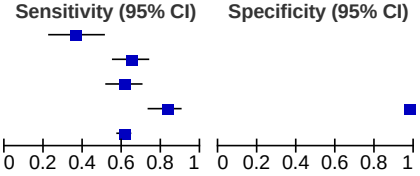


Figure 42: Diagnostic accuracy of X ray (ref standard composite outcomes) for cervical injuries in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Cohn 1991	5	0	3	67	0.63 [0.24, 0.91]	1.00 [0.95, 1.00]
Goodnight 2008	6	10	0	363	1.00 [0.54, 1.00]	0.97 [0.95, 0.99]
Mathen 2007	27	16	33	591	0.45 [0.32, 0.58]	0.97 [0.96, 0.98]

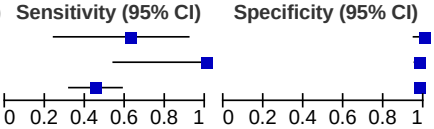


Figure 43: Diagnostic accuracy of CT (ref standard discharge diagnosis) for cervical fractures in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Antevil 2006	34	0	0	0	1.00 [0.90, 1.00]	Not estimable
Ptak 2001	59	0	1	616	0.98 [0.91, 1.00]	1.00 [0.99, 1.00]

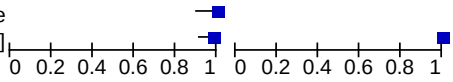


Figure 44: Diagnostic accuracy of CT (ref standard later clinical outcomes) for cervical injury in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Bailitz 2009	50	0	0	0	1.00 [0.93, 1.00]	Not estimable
Griffen 2003	116	0	0	0	1.00 [0.97, 1.00]	Not estimable
Hashem 2009	121	0	0	0	1.00 [0.97, 1.00]	Not estimable
Resnick 2014	149	0	15	666	0.91 [0.85, 0.95]	1.00 [0.99, 1.00]

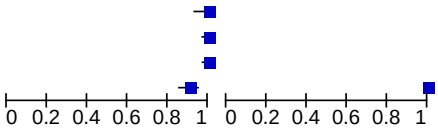


Figure 45: Diagnostic accuracy of CT (ref standard later clinical outcomes) for clinically important cervical injury in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Resnick 2014	164	0	0	666	1.00 [0.98, 1.00]	1.00 [0.99, 1.00]

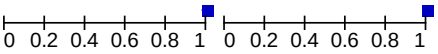


Figure 46: Diagnostic accuracy of CT (ref standard composite outcomes) for cervical ligamentous injuries in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Goodnight 2008	6	13	0	360	1.00 [0.54, 1.00]	0.97 [0.94, 0.98]

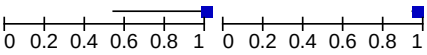


Figure 47: Diagnostic accuracy of CT (ref standard composite outcomes) for cervical injuries in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Brohi 2005	51	4	1	325	0.98 [0.90, 1.00]	0.99 [0.97, 1.00]

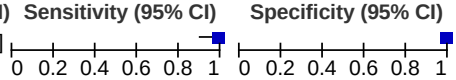


Figure 48: Diagnostic accuracy of MRI (ref standard CT) for anterior element cervical fracture in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Klein 1999	22	2	38	88	0.37 [0.25, 0.50]	0.98 [0.92, 1.00]

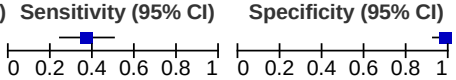


Figure 49: Diagnostic accuracy of MRI (ref standard CT) for posterior element cervical fracture in adults

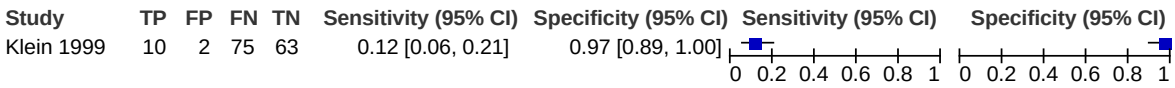


Figure 50: Diagnostic accuracy of X ray (ref standard CT) for thoracolumbar fractures in adults (restricted to those with either burst or wedge compression fractures)

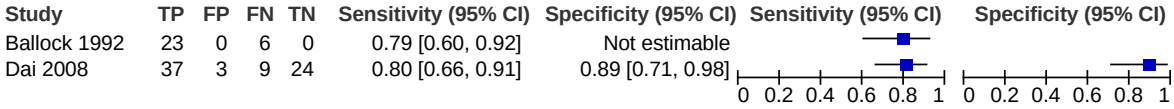


Figure 51: Diagnostic accuracy of X ray (ref standard CT) for thoracolumbar fractures in adults

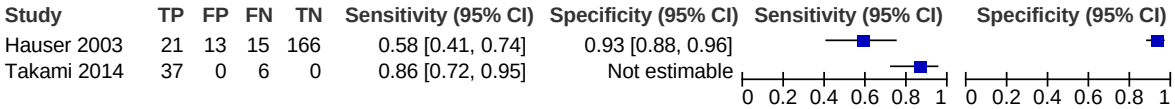


Figure 52: Diagnostic accuracy of X ray (ref standard CT) for thoracic fractures in adults

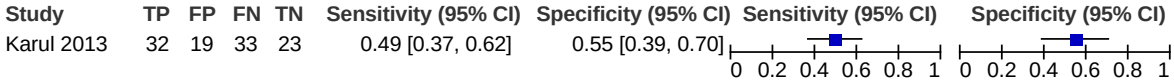


Figure 53: Diagnostic accuracy of X ray (ref standard CT) for unstable lumbar fractures in adults

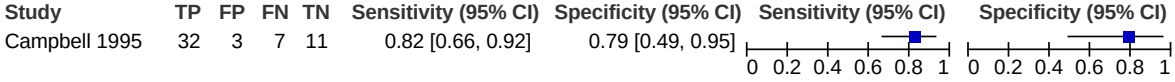


Figure 54: Diagnostic accuracy of X ray (ref standard CT) for any lumbar fractures in adults with a transverse lumbar fracture

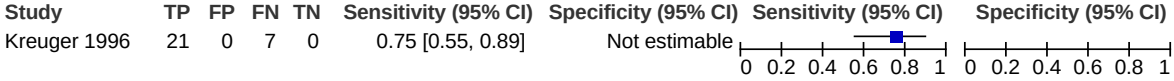


Figure 55: Diagnostic accuracy of X ray (ref standard MRI) for thoracolumbar fractures in adults

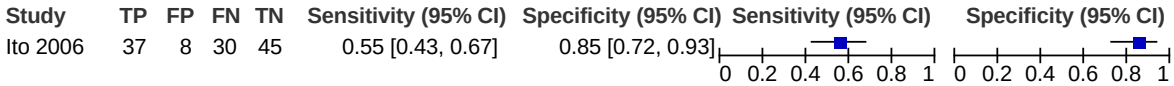


Figure 56: Diagnostic accuracy of X ray (ref standard discharge diagnosis) for thoracic fractures in adults

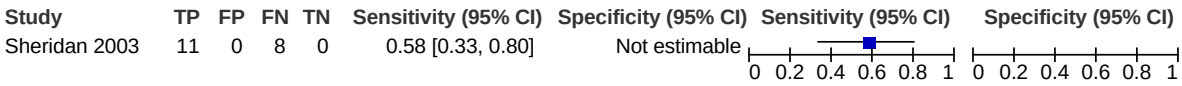


Figure 57: Diagnostic accuracy of X ray (ref standard discharge diagnosis) for lumbar fractures

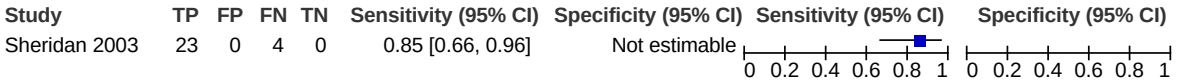


Figure 58: Diagnostic accuracy of X ray (ref standard composite outcomes) for all thoracolumbar fractures in adults

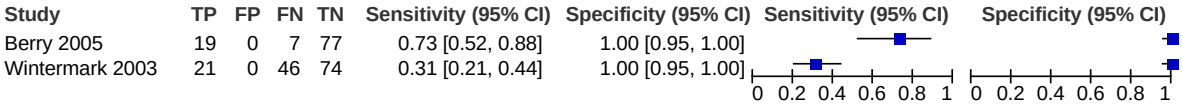


Figure 59: Diagnostic accuracy of X ray (ref standard composite outcomes) for all thoracic fractures in adults

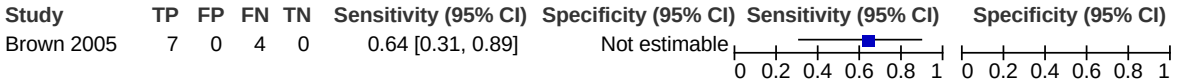


Figure 60: Diagnostic accuracy of X ray (ref standard composite outcomes) for all lumbar fractures in adults

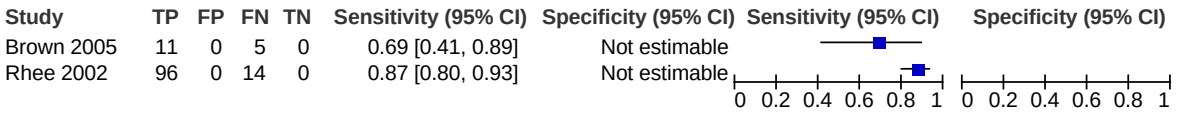


Figure 61: Diagnostic accuracy of CT (ref standard later outcomes) for thoracic fractures in adults

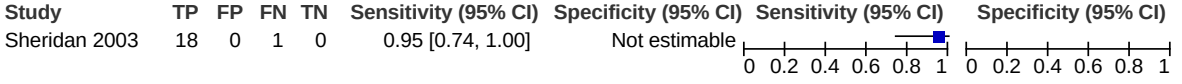


Figure 62: Diagnostic accuracy of CT (ref standard later outcomes) for lumbar fractures in adults

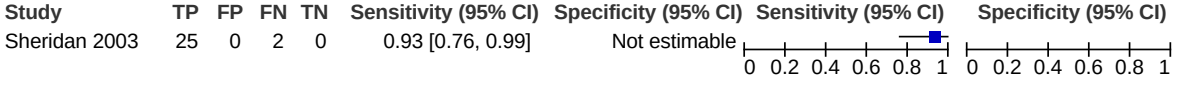


Figure 63: Diagnostic accuracy of CT (ref standard composite outcomes) for all thoracolumbar fractures in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Berry 2005	26	2	0	75	1.00 [0.87, 1.00]	0.97 [0.91, 1.00]
Wintermark 2003	41	0	26	74	0.61 [0.49, 0.73]	1.00 [0.95, 1.00]

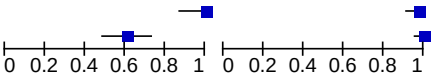


Figure 64: Diagnostic accuracy of CT (ref standard composite outcomes) for all thoracic fractures in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Brown 2005	65	0	1	0	0.98 [0.92, 1.00]	Not estimable

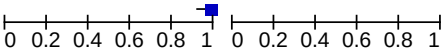


Figure 65: Diagnostic accuracy of CT (ref standard composite outcomes) for all lumbar fractures in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Brown 2005	112	0	0	0	1.00 [0.97, 1.00]	Not estimable
Rhee 2002	43	0	13	0	0.77 [0.64, 0.87]	Not estimable

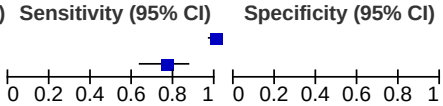


Figure 66: Diagnostic accuracy of CT (ref standard MRI) for pre-vertebral swelling in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Silbertstein 1992	15	1	2	16	0.88 [0.64, 0.99]	0.94 [0.71, 1.00]

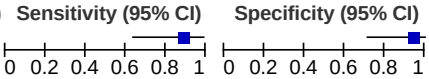


Figure 67: Diagnostic accuracy of CT (ref standard MRI) for ligament injury in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Silbertstein 1992	3	0	8	23	0.27 [0.06, 0.61]	1.00 [0.85, 1.00]
Tracy 1989	0	0	6	0	0.00 [0.00, 0.46]	Not estimable

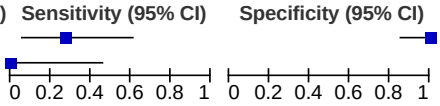


Figure 68: Diagnostic accuracy of MRI (ref standard CT) for vertebral body fractures in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Silbertstein 1992	9	1	1	23	0.90 [0.55, 1.00]	0.96 [0.79, 1.00]
Tarr 1987	14	0	0	0	1.00 [0.77, 1.00]	Not estimable
Tracy 1989	10	0	0	0	1.00 [0.69, 1.00]	Not estimable

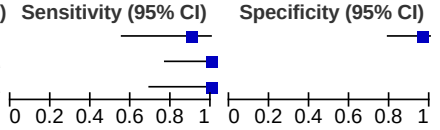


Figure 69: Diagnostic accuracy of MRI (ref standard CT) for posterior element fractures in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Silbertstein 1992	3	0	10	21	0.23 [0.05, 0.54]	1.00 [0.84, 1.00]
Tarr 1987	4	0	3	0	0.57 [0.18, 0.90]	Not estimable
Tracy 1989	6	0	3	0	0.67 [0.30, 0.93]	Not estimable

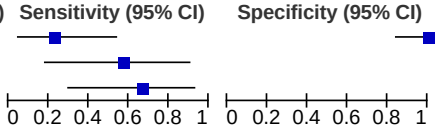


Figure 70: Diagnostic accuracy of MRI (ref standard CT) for subluxation in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Silbertstein 1992	8	0	0	26	1.00 [0.63, 1.00]	1.00 [0.87, 1.00]

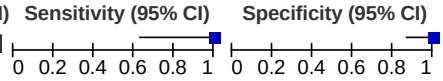


Figure 71: Diagnostic accuracy of MRI (ref standard CT) for spondylosis in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Silbertstein 1992	10	0	0	24	1.00 [0.69, 1.00]	1.00 [0.86, 1.00]

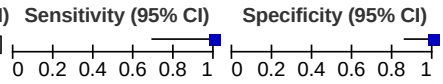


Figure 72: Diagnostic accuracy of X rays (ref standard later outcomes) for cervical instability in children

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Brockmeyer 2012	1	1	0	22	1.00 [0.03, 1.00]	0.96 [0.78, 1.00]

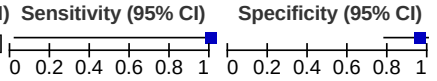


Figure 73: Diagnostic accuracy of X rays (ref standard later outcomes) for cervical injuries in children

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Garton 2008	24	0	8	0	0.75 [0.57, 0.89]	Not estimable

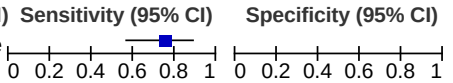


Figure 74: Diagnostic accuracy of CT (ref standard later outcomes) for cervical instability in children

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Brockmeyer 2012	1	0	0	23	1.00 [0.03, 1.00]	1.00 [0.85, 1.00]

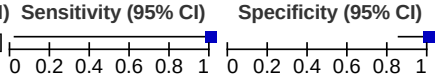
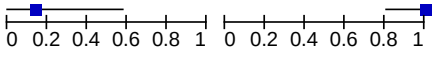


Figure 75: Diagnostic accuracy of MRI (ref standard surgery) for cervical instability in children

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Brockmeyer 2012	1	0	6	17	0.14 [0.00, 0.58]	1.00 [0.80, 1.00]



I.5 Radiation risk

Figure 76: All malignancy

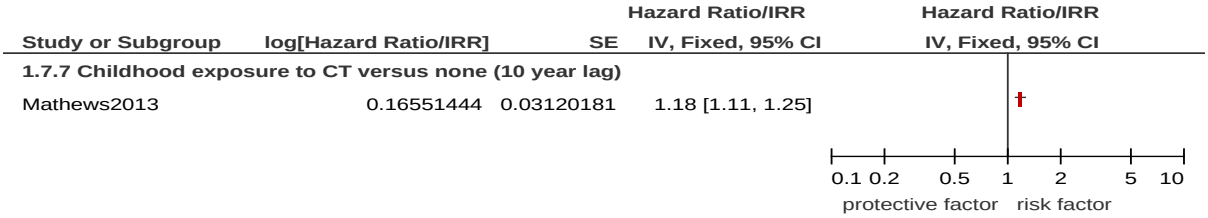


Figure 77: Breast cancer mortality

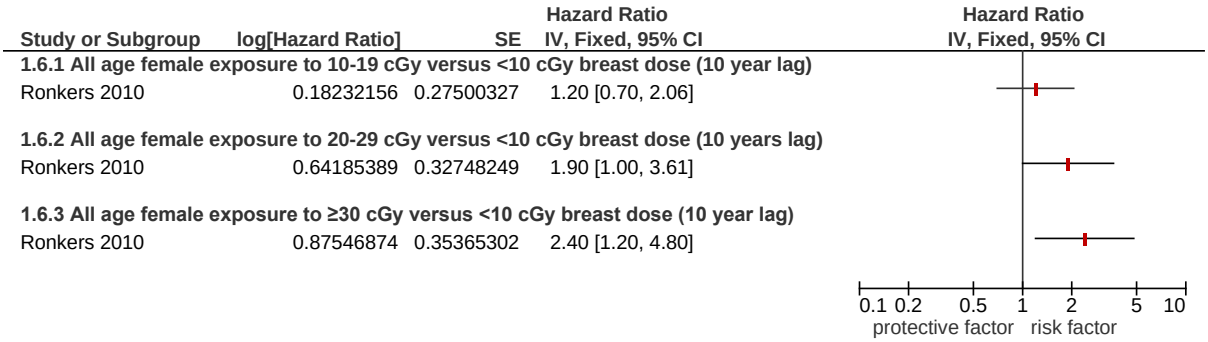
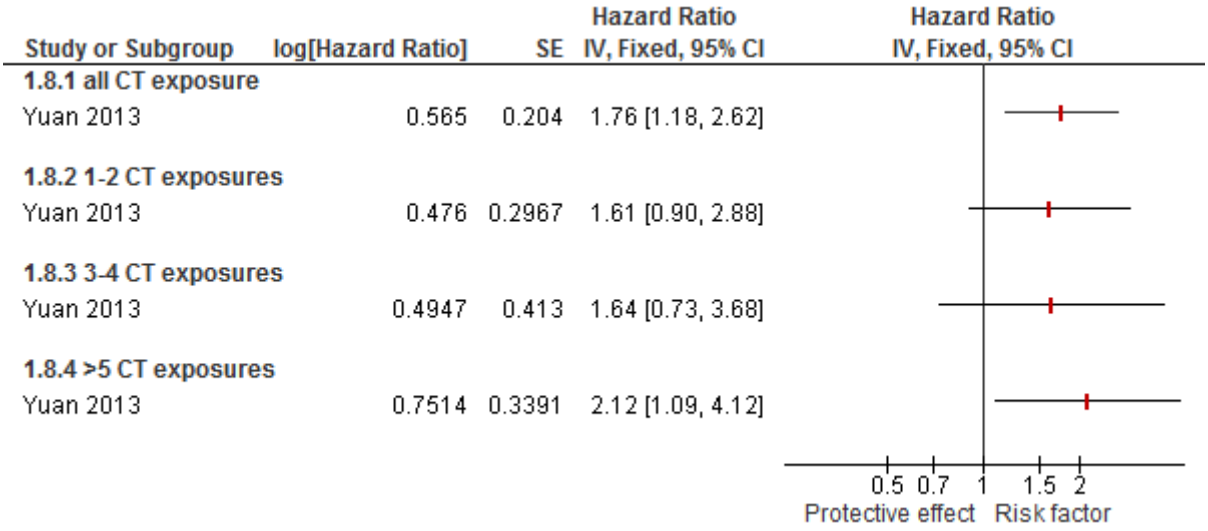


Figure 78: Cataract formation



I.6 Neuroprotective pharmacological interventions

I.6.1 High-dose methylprednisolone versus placebo/no treatment

Figure 79: Mortality (all-cause mortality)

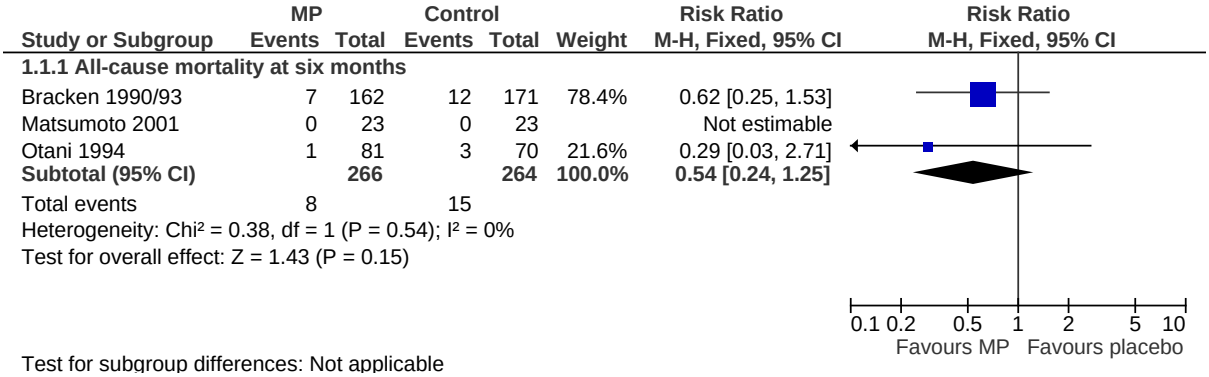


Figure 80: Motor sensation (NASCIS score) all patients

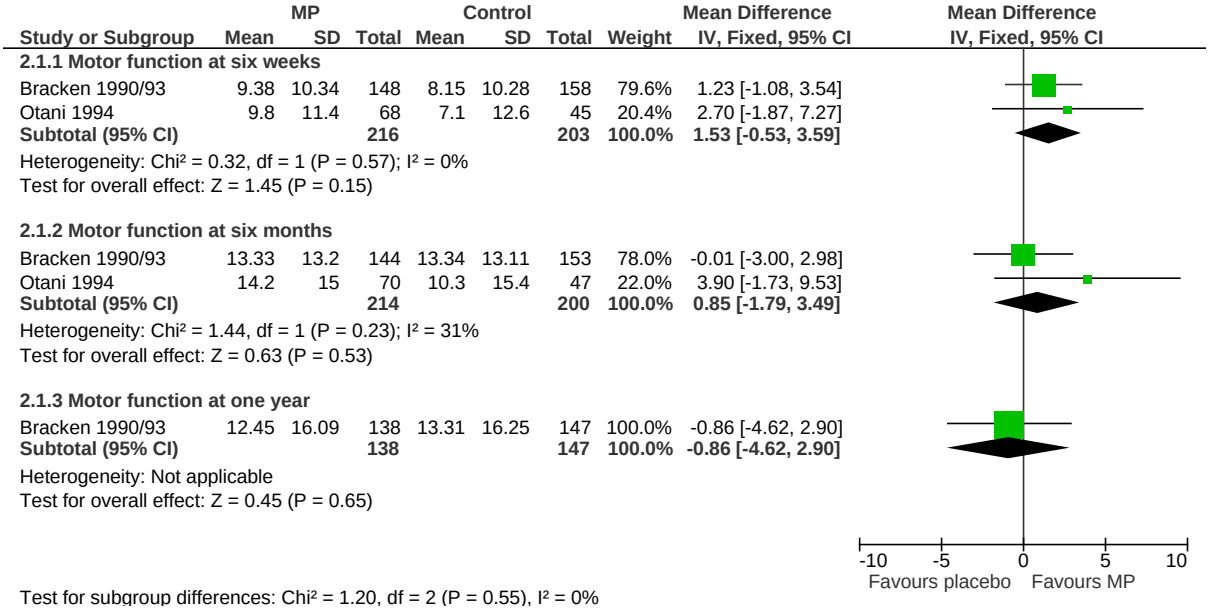
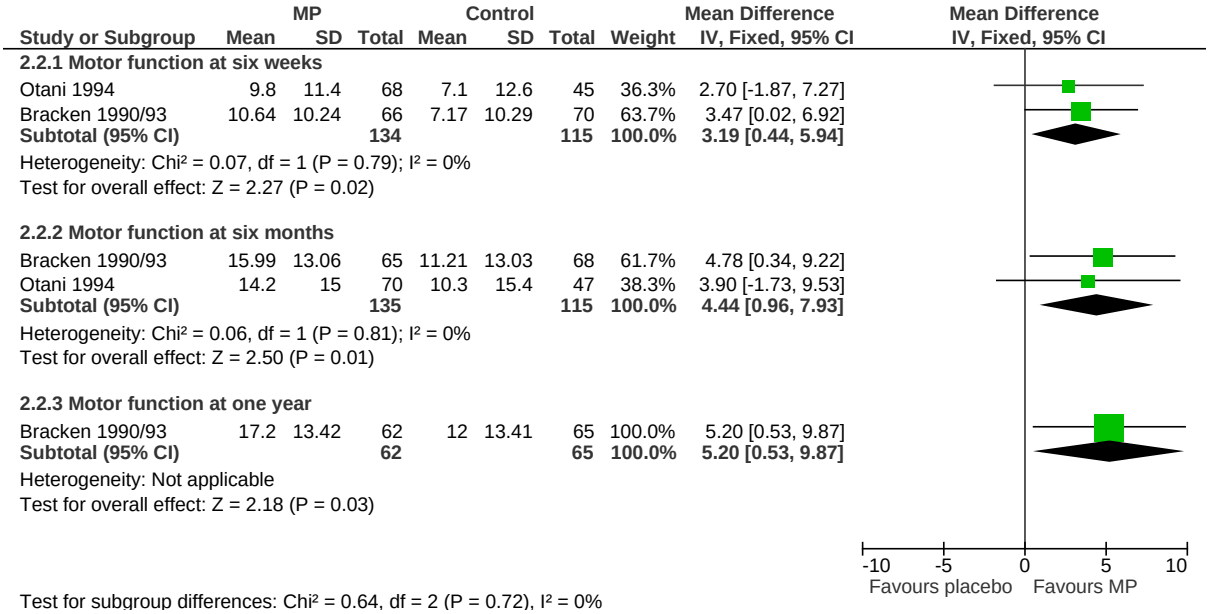


Figure 81: Motor function (NASCIS score) <8 hours to treatment



Test for subgroup differences: Chi² = 0.64, df = 2 (P = 0.72), I² = 0%

Figure 82: Motor function (ASIA score) <8 hours to treatment

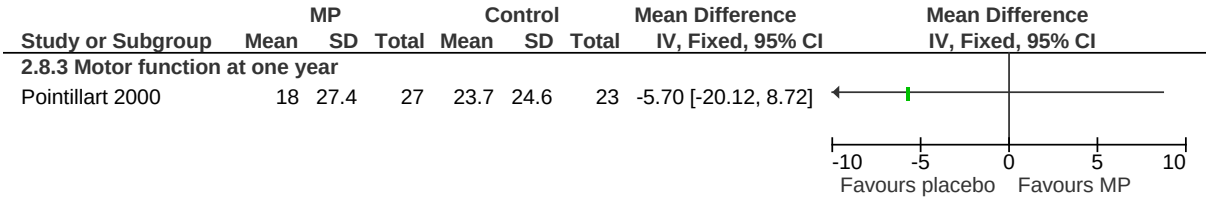
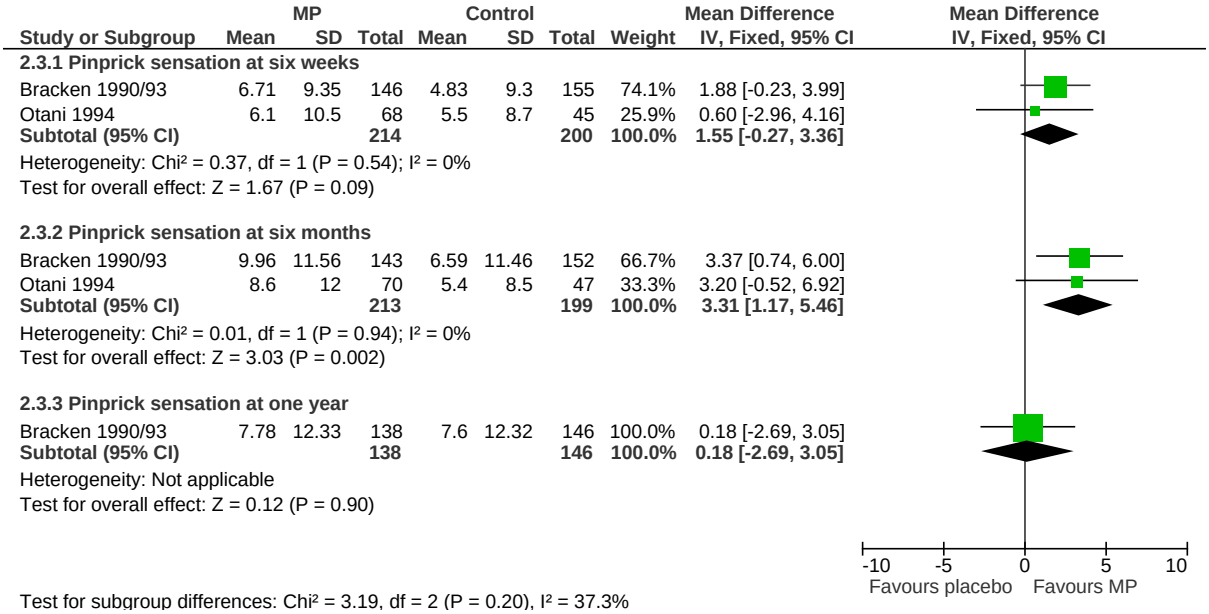


Figure 83: Pinprick sensation (NASCIS score) all patients



Test for subgroup differences: Chi² = 3.19, df = 2 (P = 0.20), I² = 37.3%

Figure 84: Pinprick sensation (NASCIS score) <8 hours to treatment

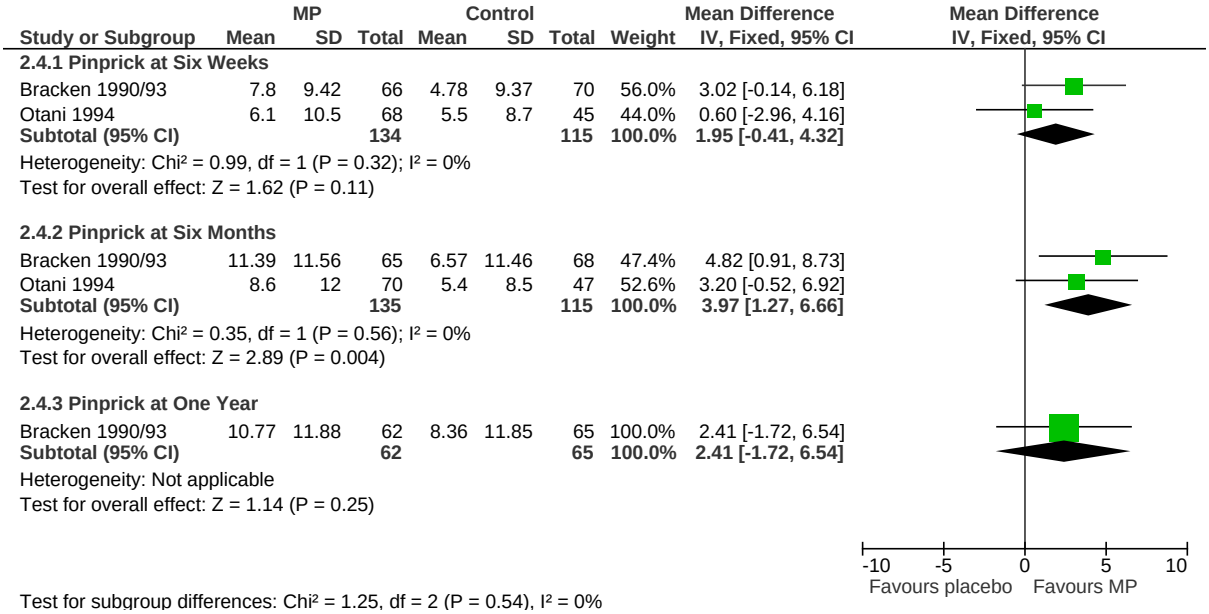


Figure 85: Pinprick sensation (ASIA score) <8 hours to treatment

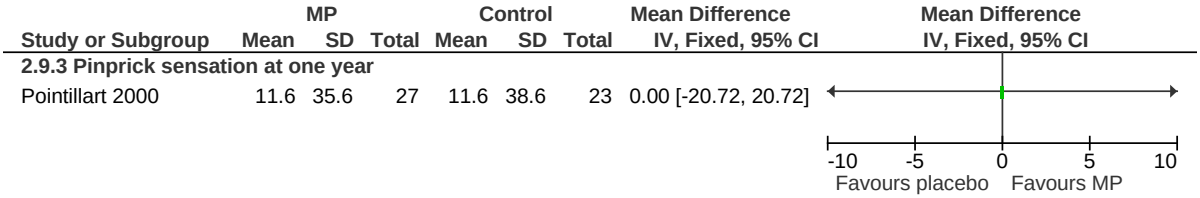


Figure 86: Touch sensation (NASCIS score) all patients

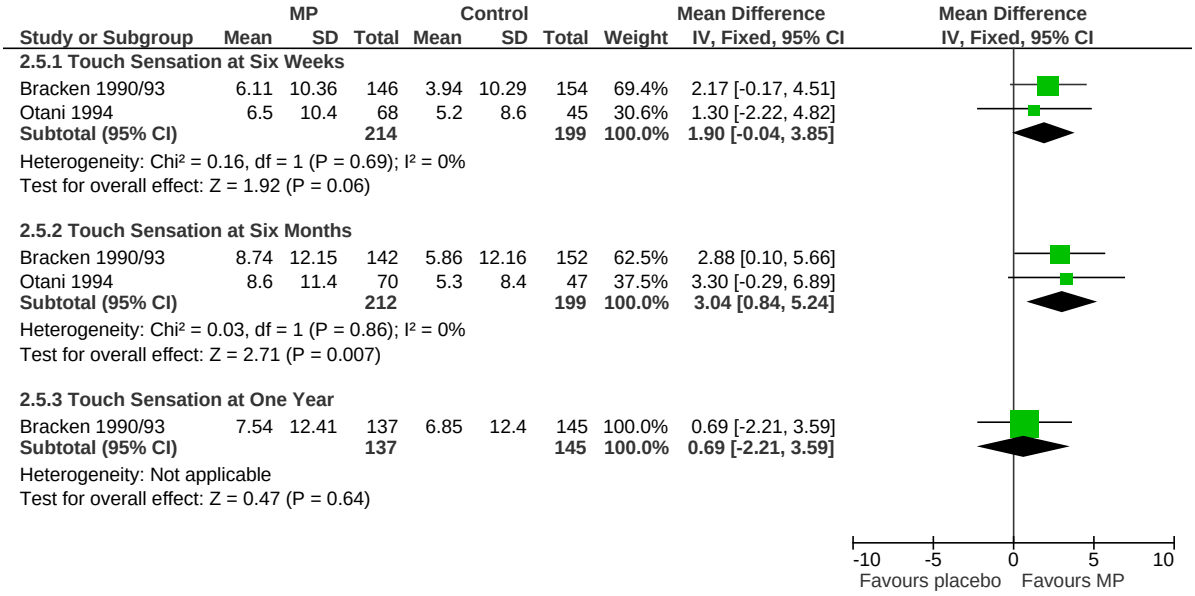


Figure 87: ouch sensation (NASCIS score) <8 hours to treatment

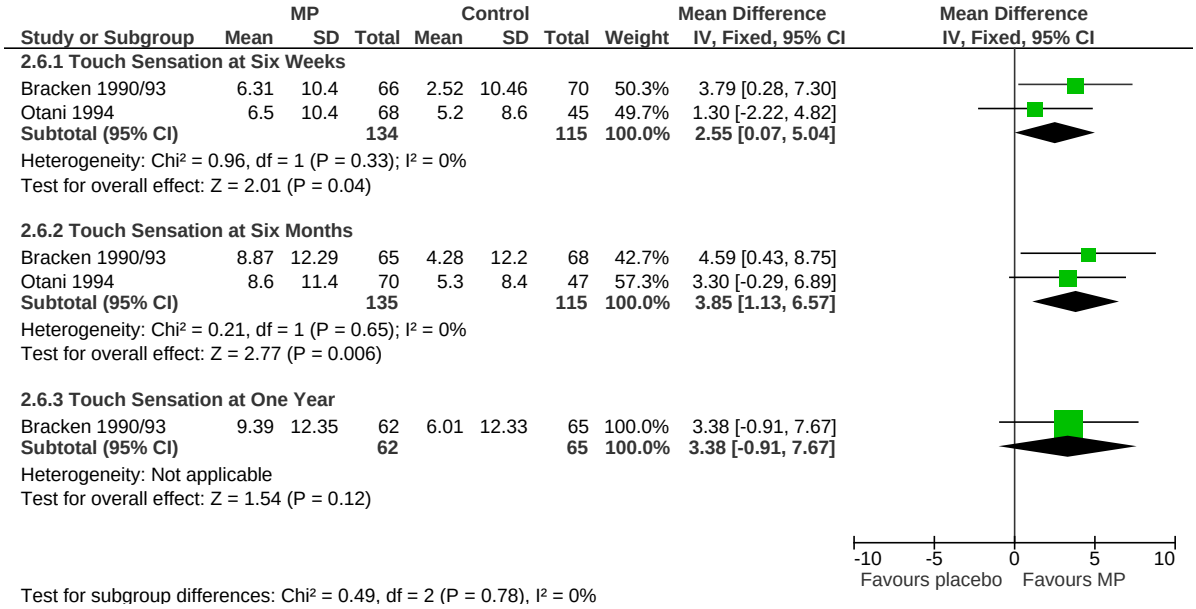


Figure 88: Touch sensation (ASIA score) <8 hours to treatment

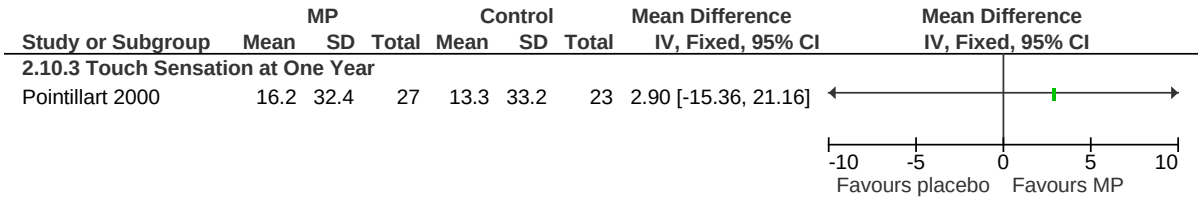
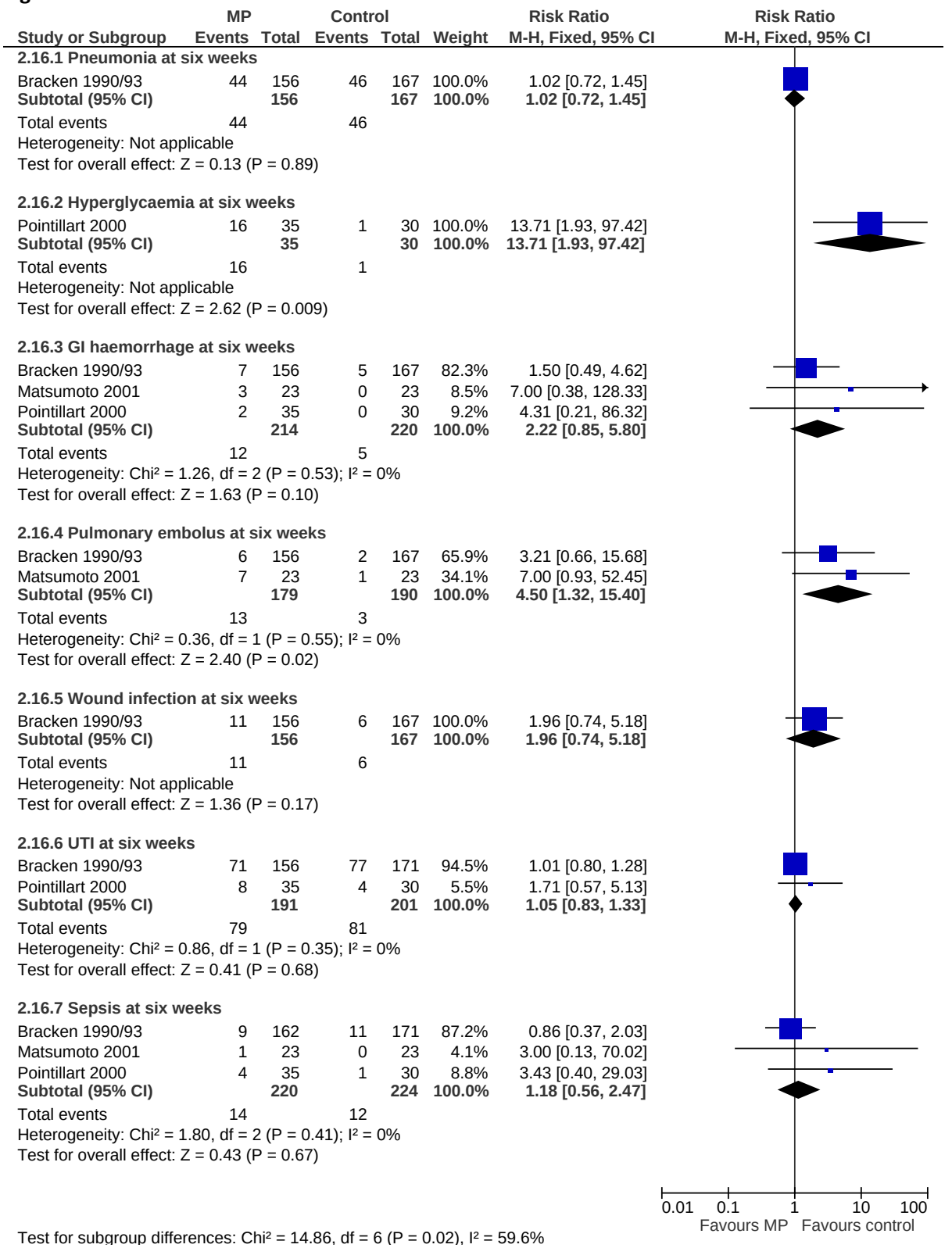


Figure 89: Adverse events



I.6.2 Moderate dose methylprednisolone versus low-dose methylprednisolone

Figure 90: All-cause mortality at one year

Study or Subgroup	MP (moderate dose) Events	Total	MP (low dose) Events	Total	Risk Ratio M-H, Fixed, 95% CI
Bracken 1984/85	19	165	13	165	1.46 [0.75, 2.86]

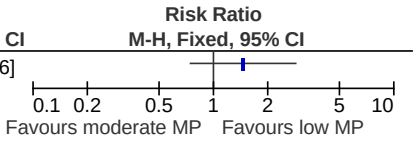


Figure 91: Motor function: all patients

Study or Subgroup	MP (moderate dose) Mean	SD	Total	MP (low dose) Mean	SD	Total	Mean Difference IV, Fixed, 95% CI
1.1.1 Motor function at six weeks							
Bracken 1984/85	8.2	15.17	125	8.8	16.28	133	-0.60 [-4.44, 3.24]
1.1.2 Motor function at six months							
Bracken 1984/85	13.2	14.78	91	14.1	15.79	88	-0.90 [-5.38, 3.58]
1.1.3 Motor function at one year							
Bracken 1984/85	11.95	13.42	115	11.49	13.74	108	0.46 [-3.11, 4.03]

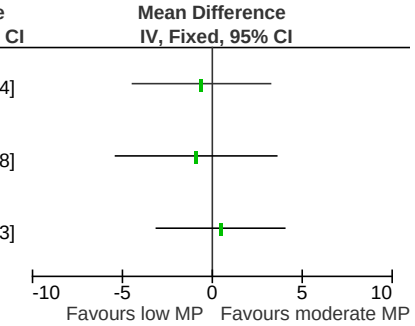


Figure 92: Pinprick sensation: all patients

Study or Subgroup	MP (moderate dose) Mean	SD	Total	MP (low dose) Mean	SD	Total	Mean Difference IV, Fixed, 95% CI
1.3.1 Pinprick sensation at six weeks							
Bracken 1984/85	7.1	18.18	125	6.2	15.87	133	0.90 [-3.28, 5.08]
1.3.2 Pinprick sensation at six months							
Bracken 1984/85	9.4	14.25	91	9.9	15	88	-0.50 [-4.79, 3.79]
1.3.3 Pinprick sensation at one year							
Bracken 1984/85	6.76	11.65	115	8.43	11.87	108	-1.67 [-4.76, 1.42]

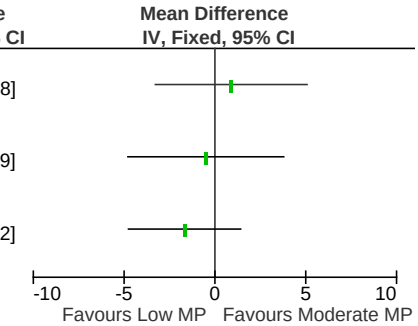


Figure 93: Touch sensation: all patients

Study or Subgroup	MP (moderate dose) Mean	SD	Total	MP (low dose) Mean	SD	Total	Mean Difference IV, Fixed, 95% CI
1.5.1 Touch sensation at six weeks							
Bracken 1984/85	7.4	16.12	125	7	15.25	133	0.40 [-3.43, 4.23]
1.5.2 Touch sensation at six months							
Bracken 1984/85	10.4	14.53	91	10.4	14.53	88	0.00 [-4.26, 4.26]
1.5.3 Touch sensation at one year							
Bracken 1984/85	7.56	10.94	114	7.31	11.29	107	0.25 [-2.68, 3.18]

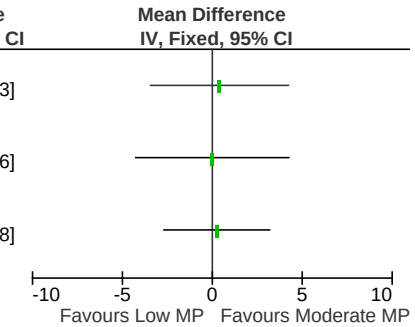
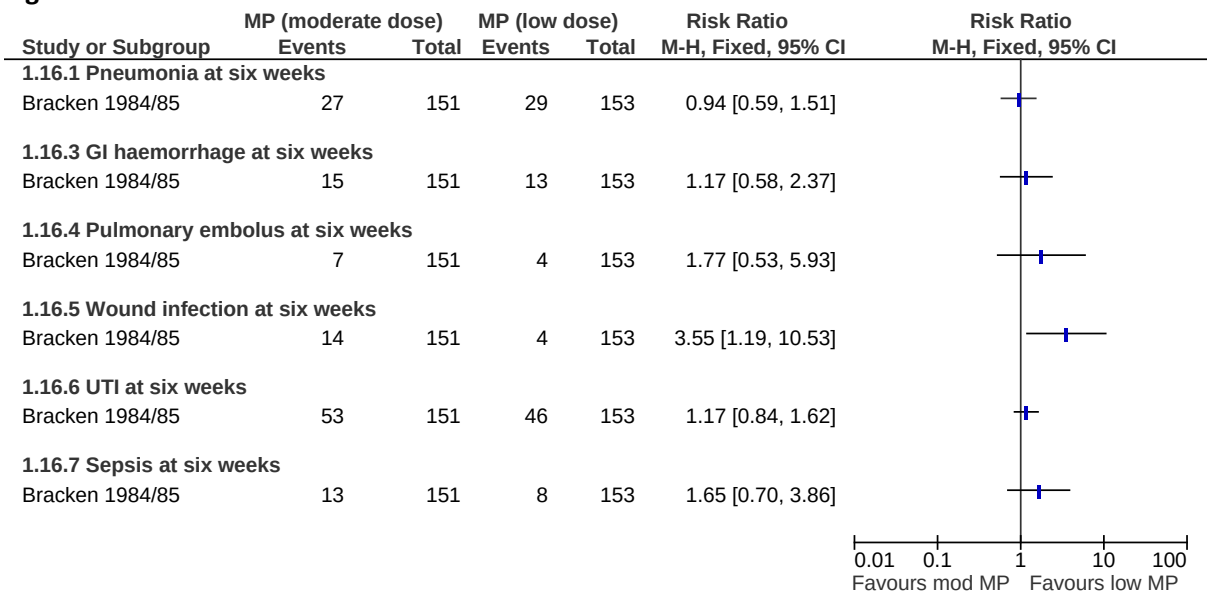


Figure 94: Adverse events



I.6.3 High-dose Methylprednisolone (48 hours) versus high-dose Methylprednisolone (24 hours)

Figure 95: All-cause mortality at one year

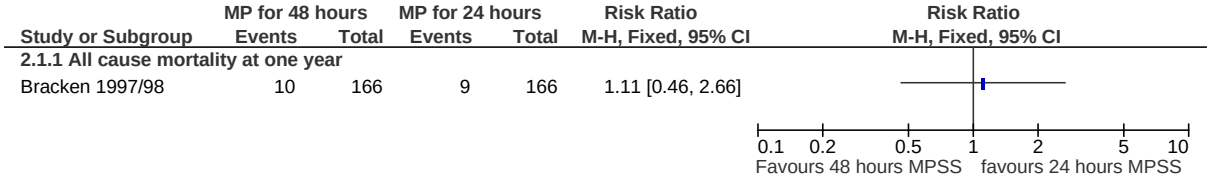


Figure 96: Motor function (NASCIS score) <8 hours to treatment

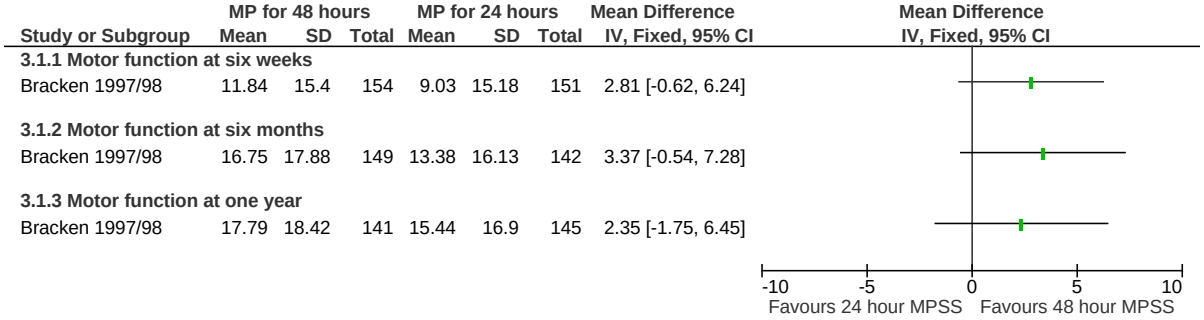


Figure 97: Pinprick sensation (NASCIS score) <8 hours to treatment

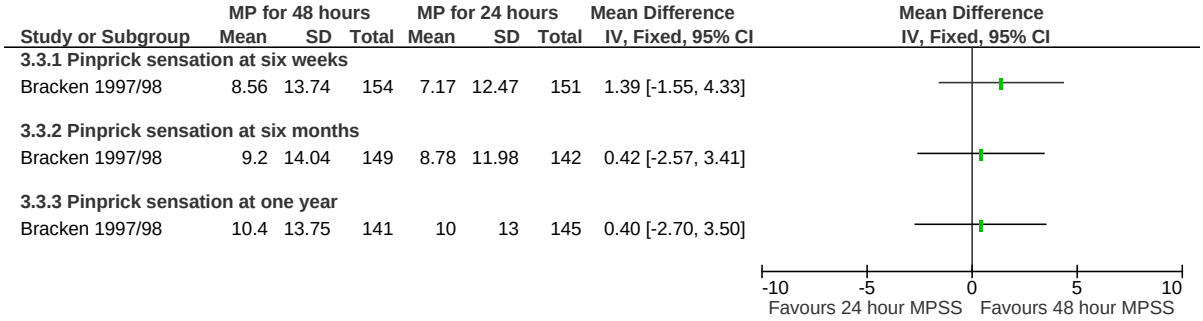


Figure 98: Touch sensation (NASCIS score) <8 hours to treatment

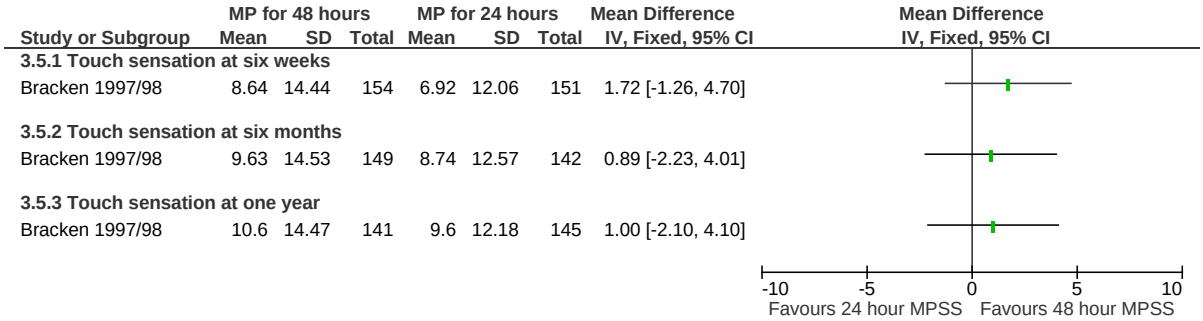
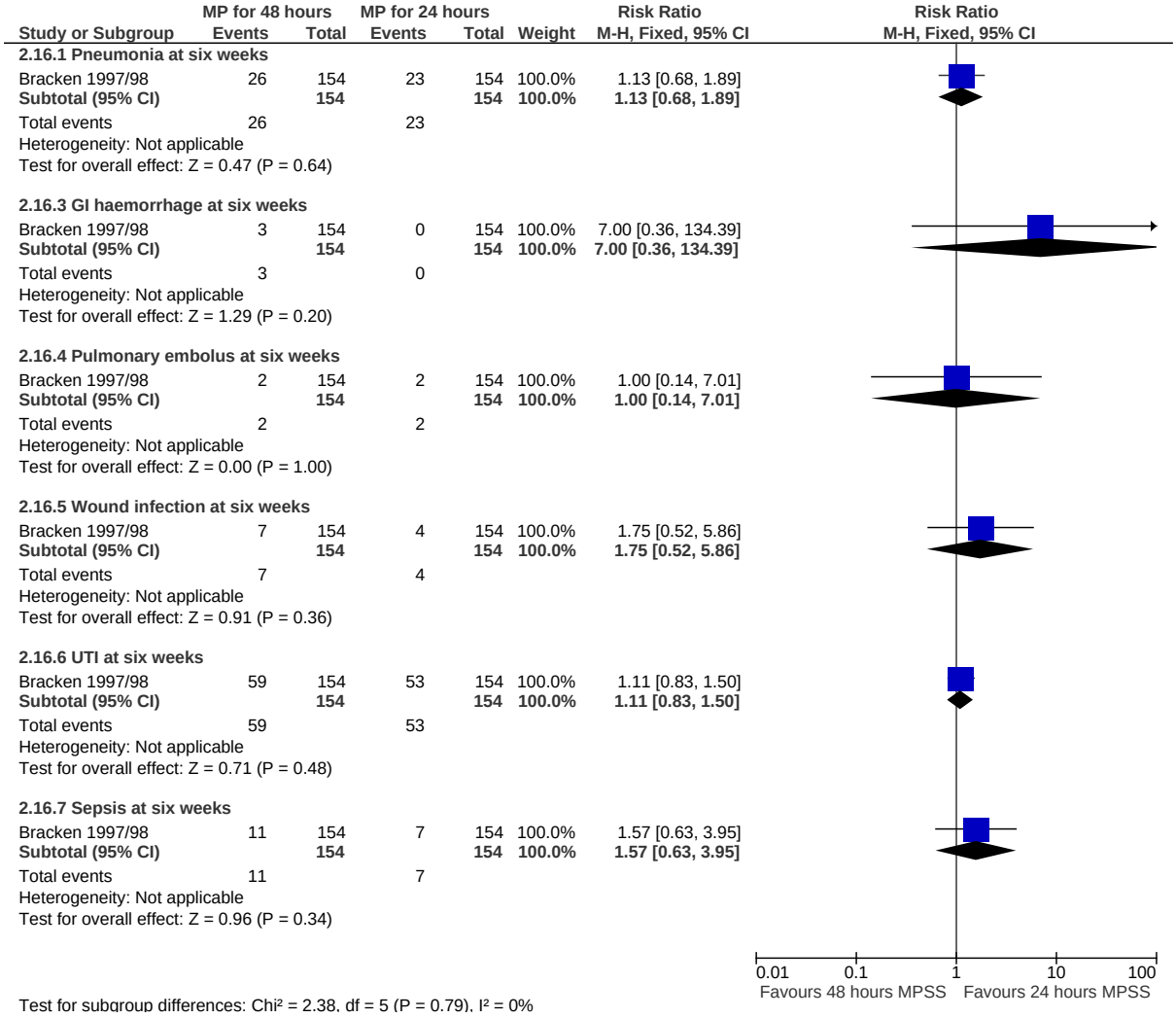


Figure 99: Adverse events



I.6.4 High-dose Methylprednisolone plus Nimodipine versus placebo/no treatment

Figure 100: Motor function: all patients

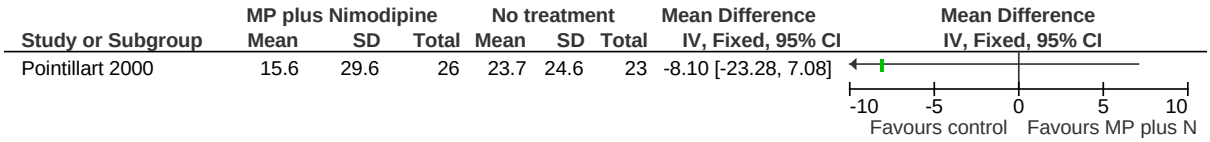


Figure 101: Pinprick sensation: all patients

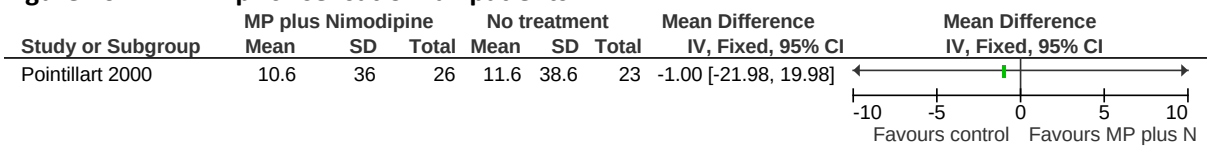
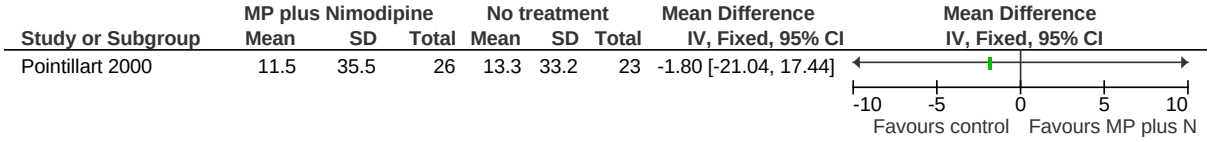
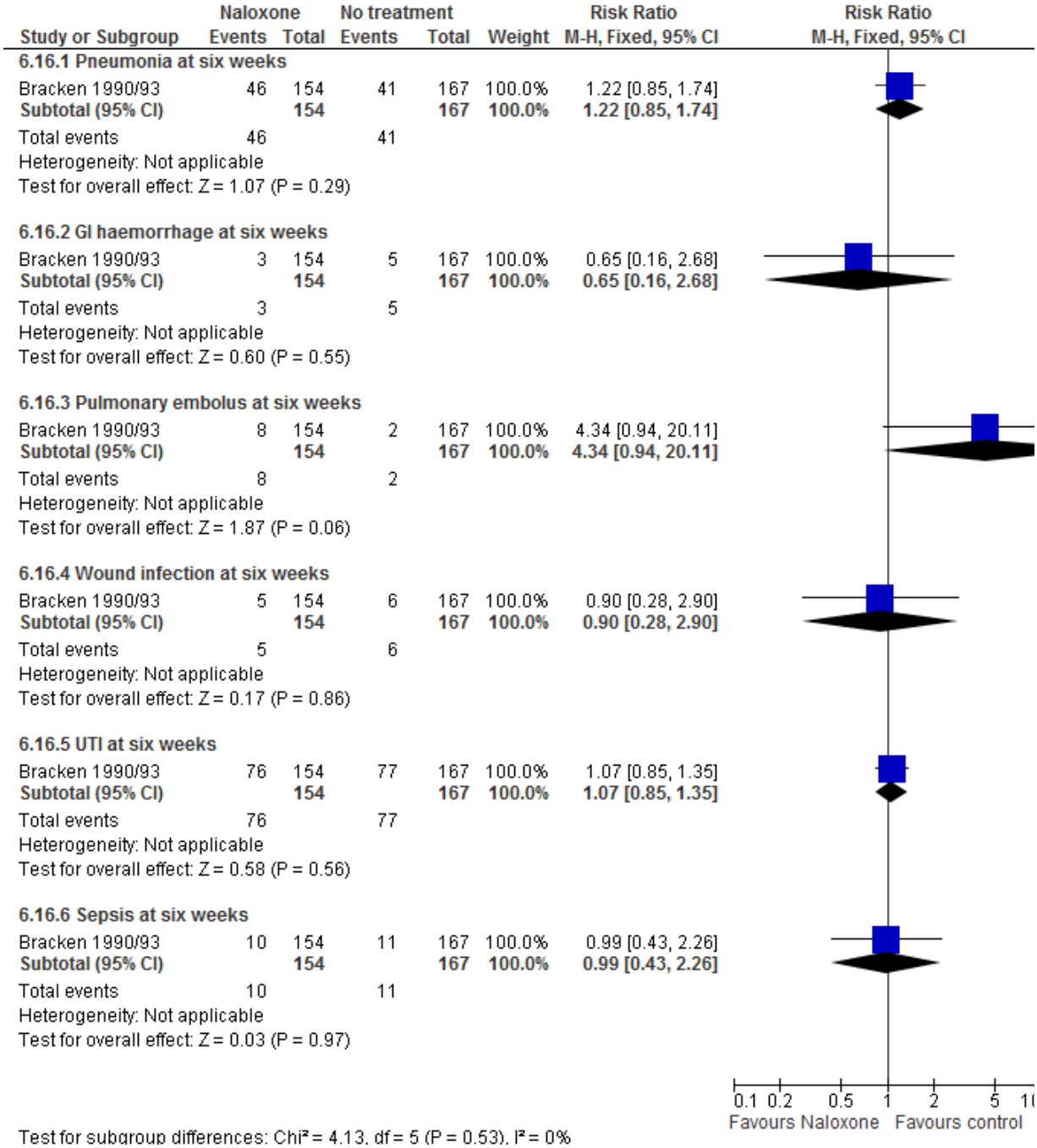


Figure 102: Touch sensation: all patients



I.6.5 Naloxone versus placebo/no treatment

Figure 103: Adverse events



I.6.6 Nimodipine versus no treatment

Figure 104: Motor function: all patients

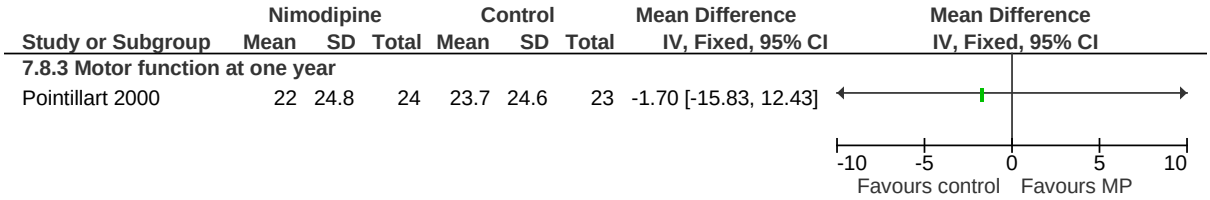


Figure 105: Pinprick sensation: all patients

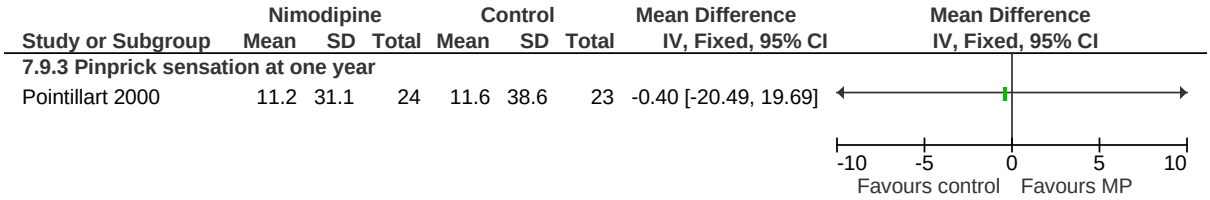
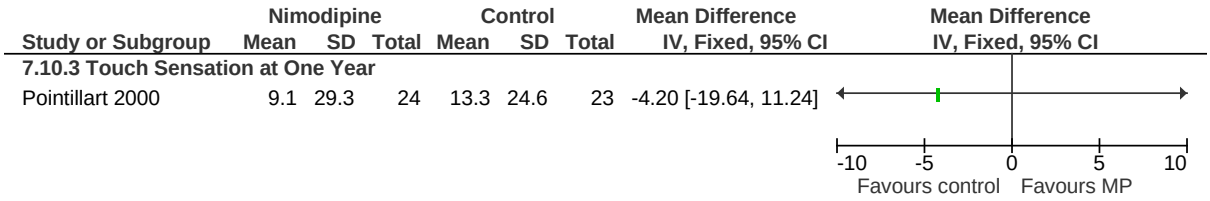


Figure 106: Motor function: all patients



I.7 Neuropathic pain

I.7.1 Carbamazepine versus placebo

Figure 107: Absent or mild neuropathic pain

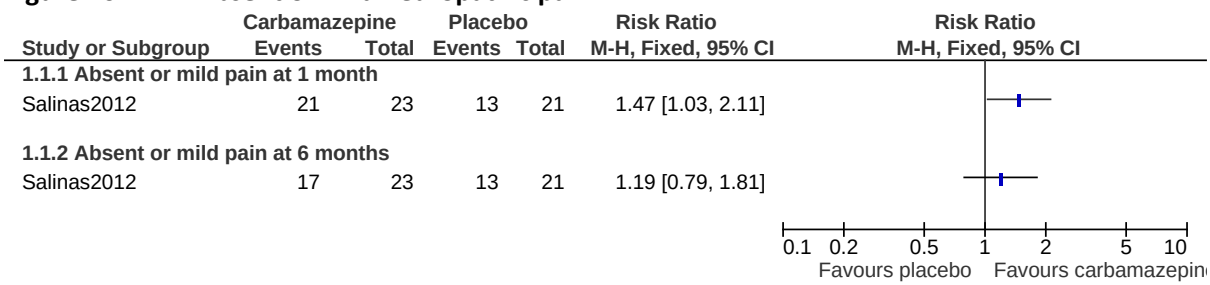


Figure 108: Moderate to intense neuropathic pain

Study or Subgroup	Carbamazepine Events	Carbamazepine Total	Placebo Events	Placebo Total	Risk Ratio M-H, Fixed, 95% CI
1.2.1 Moderate to intense pain at 1 month					
Salinas2012	2	23	8	21	0.23 [0.05, 0.96]
1.2.2 Moderate to intense pain at 6 months					
Salinas2012	6	23	8	21	0.68 [0.28, 1.65]

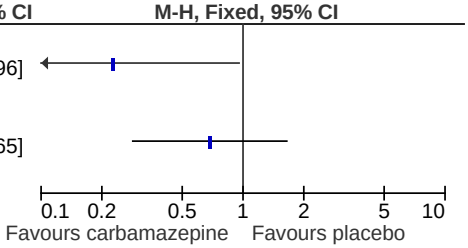


Figure 109: Quality of life at 6 months (SF-36)

Study or Subgroup	Carbamazepine Mean	Carbamazepine SD	Carbamazepine Total	Placebo Mean	Placebo SD	Placebo Total	Mean Difference IV, Fixed, 95% CI
1.7.1 Bodily pain							
Salinas2012	58.7	31.6	23	50.8	25.6	21	7.90 [-9.03, 24.83]
1.7.2 Emotional performance							
Salinas2012	40.4	44.8	23	36.3	41.9	21	4.10 [-21.52, 29.72]
1.7.3 Physical performance							
Salinas2012	10.8	21	23	9.5	24.3	21	1.30 [-12.18, 14.78]
1.7.4 Physical function							
Salinas2012	20	24.6	23	12.6	18.8	21	7.40 [-5.47, 20.27]
1.7.5 Social function							
Salinas2012	51.4	26.7	23	45	27	21	6.40 [-9.49, 22.29]
1.7.7 General health state							
Salinas2012	53.4	23.6	23	51.6	24.6	21	1.80 [-12.47, 16.07]
1.7.8 Mental health							
Salinas2012	57.9	29.1	23	59.2	28	21	-1.30 [-18.18, 15.58]
1.7.9 Vitality							
Salinas2012	63.7	20	23	58.7	20.2	21	5.00 [-6.89, 16.89]

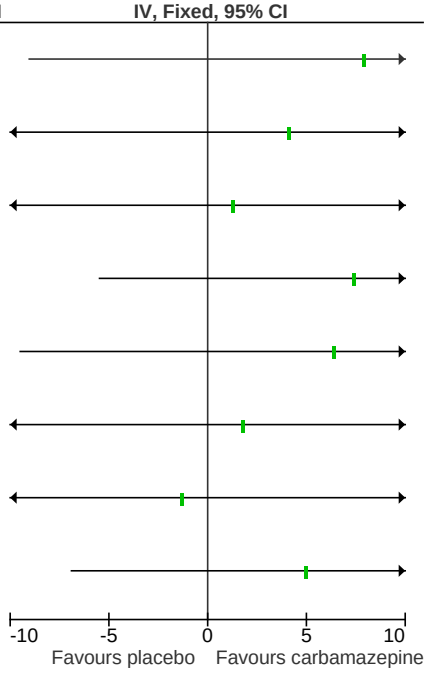


Figure 110: Adverse events - nausea

Study or Subgroup	Carbamazepine Events	Carbamazepine Total	Placebo Events	Placebo Total	Risk Ratio M-H, Fixed, 95% CI
1.8.1 Nausea					
Salinas2012	2	23	1	21	1.83 [0.18, 18.70]

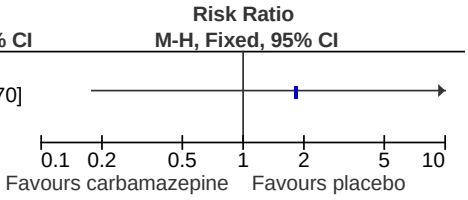


Figure 111: Adverse events - vomiting

Study or Subgroup	Carbamazepine Events	Carbamazepine Total	Placebo Events	Placebo Total	O-E	Variance	Peto Odds Ratio Exp[(O-E) / V], Fixed, 95% CI
1.9.2 Vomiting							
Salinas2012	1	23	0	21	0.477	0.24948	6.77 [0.13, 342.40]

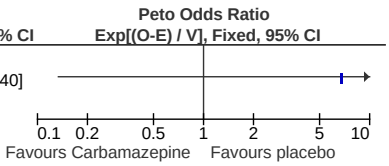


Figure 112: Adverse events – visual disturbance

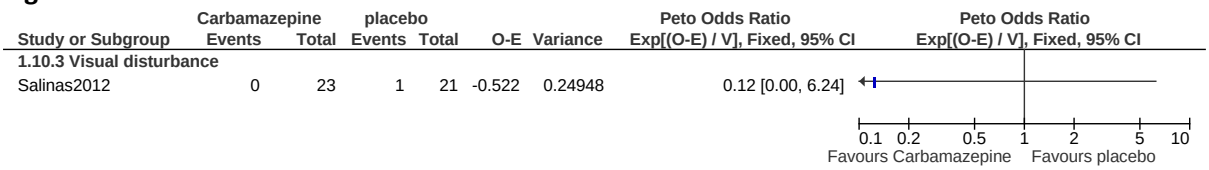


Figure 113: Absence of depression at 6 months

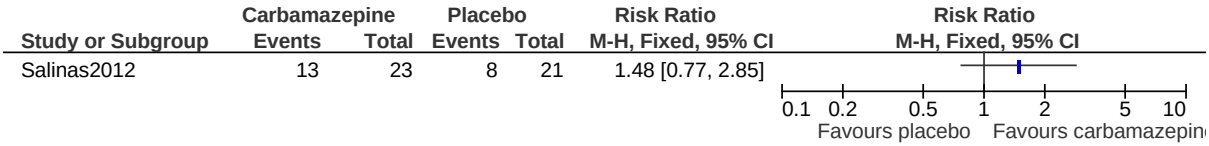


Figure 114: Mild depression at 6 months

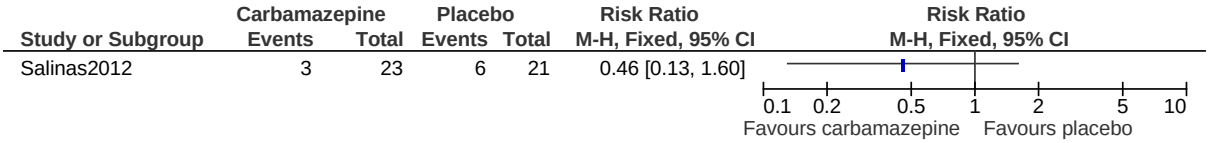


Figure 115: Moderate depression at 6 months

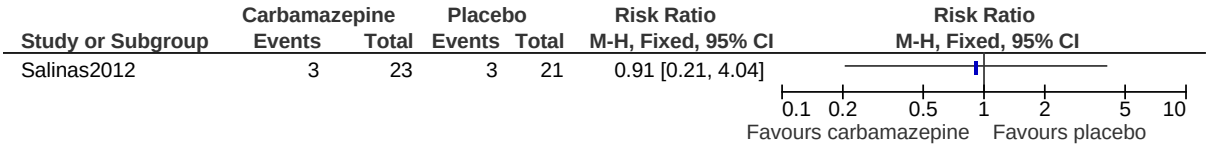
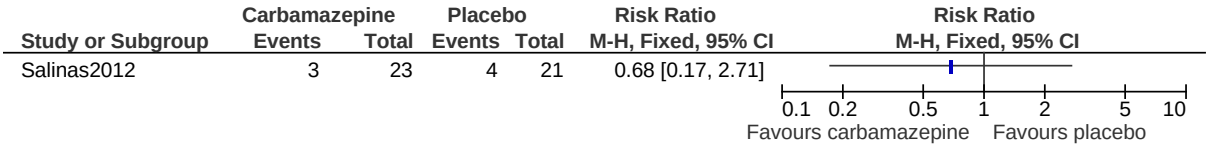


Figure 116: Severe depression at 6 months



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